INTERIM REPORT OF THE
DEPARTMENT OF ENVIRONMENTAL QUALITY ON

SOLID WASTE MANAGEMENT IN VIRGINIA

TO THE GOVERNOR AND
THE GENERAL ASSEMBLY OF VIRGINIA

SENATE DOCUMENT NO. 32

COMMONWEALTH OF VIRGINIA
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Partners and Other Contributors to this Study

This study and Interim Report on Solid Waste Management in Virginia was created through a partnership of VDEQ with the U.S. Army Corps of Engineers (ACOE), Norfolk District under the authority of Section 22 of the federal Water Resources Development Act of 1974 (Public Law 93-251), as amended. The above Act provides the ACOE with the federal authority, cost sharing structure, and financing to assist the states in the preparation of comprehensive plans for the development, utilization, and conservation of water and related land resources.

The VDEQ's mandate for this study is provided under the second enactment of Chapters 584, 613, and 947 of The Acts of the Assembly of 1999.

Significant contributions to this report were also made by the Virginia Economic Development Partnership, private industry and municipal organizations, other states, and each of the public and private landfill owners/operators who responded to the survey questionnaires utilized in this study.

VDEQ Interim Report
Comprehensive Study of Solid Waste Management In Virginia

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EXECUTIVE SUMMARY

This interim report provides information for the DEQ's comprehensive study of solid waste management in Virginia as requested by the 1999 General Assembly.

The scope of the report, study issues, and findings include the following:

1. Background information on the solid waste management program in Virginia and municipal solid waste (MSW) landfills in Virginia. An overview of the permitting, compliance and enforcement programs is provided, as well as a history of the solid waste management regulations in Virginia.

2. Projections on future landfill capacity and landfill capacity needs in Virginia. The report indicates that based on the projected rate of filling, the permitted capacity available in 1998 will be used up by 2014. In addition, the Non-Subtitle D capacity is approximately 5% of the total available capacity permitted at this time.

3. Comparison of costs and benefits for all active Non-Subtitle D (HB 1205) landfills is provided under two scenarios: 1) the continued operation of Non-Subtitle D landfills and possible corrective action; and 2) the early closure of Non-Subtitle D landfills (with alternative disposal at a Subtitle D landfill) and possible corrective action. Scenario two may present a potentially lower level of corrective action versus scenario one; however, the benefit /cost analysis needs to be made on a site-specific basis for each Non-Subtitle D landfill. A site-specific analysis is recommended in order to make accurate comparisons of costs and benefits for this category of landfills.

4. An analysis of solid waste disposal practices and the status of Non-Subtitle D landfills in Virginia as compared with 16 other states is summarized in the following table.

5. A review of waste reduction and recycling practices of 16 states, Virginia and other sources. Information was compiled which could be used to enhance waste reduction and recycling efforts in Virginia. The study found that all states surveyed have instituted a suite of initiatives promoting and requiring recycling, such as local solid waste management plans, recycled newsprint requirements, procurement preferences for recycled paper, tax credits for recycling equipment and facilities, landfill bans on waste tires, and outreach programs. States that have made recycling mandatory have the highest recycling rates.

6. Review of alternatives to landfills and a cost/benefit comparison of alternatives versus landfills reveals that:

An incineration or a Waste-to-Energy (WTE) facility is usually not competitive with landfilling in less densely populated areas. A WTE facility typically requires a minimum municipal solid waste (MSW) flow rate of at least 500 tons/day (tpd), which is above the flow of most communities with Non-Subtitle D facilities. The economic feasibility of a WTE facility also depends on revenues from the sale of electricity or steam. Prices received for energy produced by a WTE may be insufficient to cost-justify a WTE facility when fuel prices are low. A WTE facility has limited flexibility to handle waste flow rates below or above the facility's design capacity due to the high capital and operation and maintenance costs, which dictate that the design capacity of a WTE facility be optimized. The design capacity of the largest WTE are between 2,000 to 3,000 tpd; this capacity is much less than a large regional landfill which may be capable of accepting up to 10,000 tpd. Additionally, the option of constructing a WTE facility does not preclude the need to operate a landfill, since the any noncombustible waste and the incinerator ash must be disposed of properly.

Recycling and composting can reduce the inflow of waste to landfills and save landfill capacity. Recycling and composting operations that are managed with attention to cost effectiveness can also reduce the total MSW disposal costs for a community. Programs that have documented their recycling and composting success stories, with a full accounting of costs and revenues, provide the best models for other communities looking for ways to improve their waste diversion and recycling rates.

The information presented in this report may be refined as the study progresses toward completion. The DEQ will use the information contained in this interim report to develop any recommendations that may be appropriate.

Table 1 Executive Summary

State	Number of Landfills	Landfill Capacity (years)	Disposal Rate (% by weight)	Recycling Rate (% by weight)	Combustion Rate (% by weight)	Permanent HHW Programs	Yard Waste Ban (yes/no)	Pay-As-You-Throw Programs*
Virginia	80	>10	47	35	30	11	N	1-25
California	289	>10	83	26	2	40	N	26-100
Connecticut	3	5-10	17	23	60	2	Y	1-25
Georgia	101	5-10	66	33	1	0	Y	1-25
Indiana	51	>10	69	23	8	10	Y	101-200
Kentucky	24	19#	85	18	0	0	N	0
Maryland	26	5-10	54	27	19	1	Y	1-25
New Jersey	12	<5	34	43	23	3	Y	101-200
New York	33	<5	34	32	16	13	N	1-25
North Carolina	65	5-10	76	22	2	7	Y	101-200
Ohio	51	5-10	83	15	2	1	Y	101-200
Oregon	54	>10	60	29	11	2	N	101-200
Pennsylvania	47	>10	66	20	20	3	Y	101-200
South Carolina	30	>10	71	27	2	0	Y	1-25
Tennessee	77	5-10	59	40	1	0	N	0
West Virginia	22	>10	87	13	0	0	Y	1-25
Wisconsin	51	5-10	56	40	4	4	Y	200+

Source: MSW Factbook, Ver. 4.0, Office of Solid Waste, USEPA, Washington, DC, 1997.
*: Source: Waste Age Magazine, May 1999
#: 1999 VADEQ survey information

Table 1 (cont.) Executive Summary

STATE	Goal (%) / year	Tax Credit/ Incentive	Procurement Preference	Recycled Newsprint	Tire Recycl./ LF Ban	Bottle Deposit
Virginia	25 / 1995	Yes	Yes	Yes	Yes/Whole	No
California	50 / 2000	Yes	Yes	Yes	Yes/Whole	No
Connecticut	40 / 2000	Yes	Yes	Yes	Yes/No	Yes
Georgia	25 / 1996	Yes	Yes	No	Yes/Whole	No
Indiana	50 / 2001	Yes	Yes	No	Yes/Whole	No
Kentucky	25 / 1997	Yes	Yes	No	Yes/Whole	No
Maryland	20 / 1994[2]	Yes	Yes	Yes	Yes/Yes	No
New Jersey	50 / 1996	Yes	Yes	No	No/No	No
New York	50 / 1997	No	Yes	No	Yes/No	Yes
North Carolina	40 / 2001	Yes	No	Yes	Yes/Whole	No
Ohio	25 / 2000[1]	Yes	Yes	No	Yes/Yes	No
Oregon	50 / 2000	Yes	Yes	Yes	Yes/Whole	Yes
Pennsylvania	25 / 1997	Yes	Yes	No	Yes/No	No
South Carolina	30 / 1997	Yes	Yes	No	Yes/Whole	No
Tennessee	25 / 1996	No	No	No	Yes/Whole	No
West Virginia	25 / 1995	No	Yes	Yes	Yes/Yes	No
Wisconsin	Not Available	Yes	Yes	Yes	Yes/Whole	No

Source: USEPA, 1997

1. For residential/commercial only. Ohio has alternatively assessed target options.
2. Maryland Recycling Advisory Group recommended 50% by 2005 goal.

1.0 INTRODUCTION

1.1 PURPOSE OF INTERIM REPORT

The purpose of this report is to provide the Honorable James S. Gilmore, III, Governor of Virginia, and General Assembly with the "interim findings" of a comprehensive study of solid waste management in Virginia. This report is in accordance with the requirements of the second enactment of Chapters 584, 613, and 947 of The Acts of the Assembly of 1999, which specifies the following:

> *The Department of Environmental Quality shall undertake a comprehensive study of solid waste management in Virginia, including an analysis of and recommendations regarding solid waste disposal practices, projections on future landfill capacity needs, mechanisms to enhance waste reduction and recycling, and needed State and federal legislation to protect human health and the environment. The Department shall report its interim findings to the Governor and the General Assembly by December 1, 1999, and shall submit its final report to the Governor and the General Assembly by July 1, 2000.*

1.2 VDEQ/ACOE SOLID WASTE STUDY PARTNERSHIP & AUTHORITY

In order to complete this study and report, the VDEQ partnered with the U.S. Army Corps of Engineers (ACOE), Norfolk District, by entering into a Letter Agreement, effective June 16, 1999. The above Letter Agreement included a scope of work which provided the overview and detail of the study issues and work required of the ACOE. (See Appendix A.)

The above Letter Agreement was signed under the authority of Section 22 of the federal Water Resources Development Act of 1974 (Public Law 93-251), as amended. The above Act provides the ACOE with the federal authority, cost sharing structure, and financing to assist the states in the preparation of comprehensive plans for the development, utilization, and conservation of water and related land resources. The above Letter Agreement specified a fifty (50) percent cost share of the study by both the ACOE and the VDEQ.

The VDEQ's mandate for this study is provided under the second enactment of Chapters 584, 613, and 947 of The Acts of the Assembly of 1999.

Completion of this study and report required close coordination and partnering between the staff of the ACOE and the VDEQ. Significant contributions to this report were also made by the Virginia Economic Development Partnership, private industry and municipal organizations, other states, and each of the public and private landfill owners/operators who responded to the survey questionnaires utilized in this study.

1.3 OVERVIEW OF STUDY - SCOPE OF WORK

The items addressed within this study's scope of work fall under four main issues. A listing of these issues along with an overview of the nature of related work and analyses is provided below. To assist the reader, a glossary of key terms is provided in the back of this report.

1. **MSW Landfill Capacity in Virginia** - Determine the available capacity of all active municipal solid waste (MSW) landfills in Virginia (Non-Subtitle D and Subtitle D) and project the needed future capacity of MSW landfills based upon 1998 disposal rates.

2. **Analysis of Non-Subtitle D (HB 1205) versus Subtitle D MSW Landfills in Virginia** - Provide an analysis of active Non-Subtitle D landfills and, where appropriate, provide a comparison with active Subtitle D landfill facilities. For Non-Subtitle D landfills, evaluate the threat to human health and the environment, establish the average and range of costs associated with closure and corrective action, and determine the short term benefits of continued operation versus the long term costs and liabilities related with closure and corrective action. (See the definition of HB 1205 in the glossary at the end of the report.)

3. **Waste Disposal Reduction Practices in Virginia and Other States**- Review and summarize the waste disposal reduction practices in Virginia and other states. Identify and analyze options to reduce municipal solid waste which includes source reduction and recycling. Summarize the most widely used and apparently effective technologies and options to enhance waste reduction and recycling.

4. **Alternatives To Landfills** - Evaluate alternatives to landfilling wastes and compare the alternatives to landfills on a cost/benefit or economic standpoint.

In order to obtain information needed in this study, two questionnaires were jointly developed by the ACOE and the VDEQ. (See Appendix B) The first, a "Municipal Solid Waste Landfill Facilities Survey Questionnaire," was developed to supplement the VDEQ database, as needed, and to provide information for numerous study items delineated within the scope of work. The second, a "States Survey Questionnaire," was developed to determine information regarding the operation and regulatory status of MSW landfills in other states and, in particular, the status of Non-Subtitle D landfills. In addition, the states survey questionnaire was used to provide information associated with waste reduction and recycling, and alternatives to landfilling.

The ACOE implemented the two surveys. The owner or operator of each active municipal solid waste landfill facility in Virginia was contacted to complete the MSW Landfill Survey Questionnaire, while the following states were contacted to complete the States Survey Questionnaire: New York, Connecticut, Pennsylvania, New Jersey, West Virginia, Maryland, North Carolina, South Carolina, , Georgia, Tennessee, Kentucky, Ohio, Indiana, Wisconsin, California, and Oregon.

In addition, the ACOE performed literature searches of EPA publications, reports, and journals to provide information for the following areas: landfill closure, landfill corrective action, new landfill cell construction, MSW transportation, landfill disposal, waste reduction and recycling, and alternatives to landfilling.

1.3.1 Inventory, Categories, and Distribution of MSW Landfills in Virginia

The VDEQ and the ACOE initiated this study by verifying and updating the VDEQ database which provides an inventory of all active municipal solid waste (MSW) landfills in Virginia. Figure 1.1 is a map showing the location and type of these active landfills. Existing information in the VDEQ database was supplemented with information from file searches and the landfill survey questionnaires to establish three categories of active MSW landfills in Virginia as follows:

1. **Subtitle D Landfills.**

2. **Non-Subtitle D (HB 1205) Landfills.**

3. **Combination (Subtitle D and Non-Subtitle D) Landfills.**

For each category above, the average size (area) and volume, the range of sizes and volumes, and the total sizes and volumes were established.

1.3.2 MSW Landfill Capacity in Virginia

One of the objectives of this study is to determine the available capacity of all active MSW landfill facilities in Virginia and to project the needed future capacity for MSW landfills in Virginia based upon 1998 disposal rates. In addition, this part of the study includes an analysis of the various capacity issues of Non-Subtitle D landfill facilities in relation to Subtitle D landfill facilities.

In order to determine the available capacity of all active MSW landfills and make the projections of needed future capacity, the study needed to determine the current capacity (yd^3) that exists and the potential capacity (yd^3) that may exist for each currently active MSW landfill in Virginia. In addition, the study needed to establish the used capacity for each currently active MSW landfill.

The ACOE and the VDEQ established the current capacity and used capacity for all active MSW landfills by the collective analyses of information from the following:

1. The VDEQ database of MSW landfills.

2. The review of the solid waste permits for MSW landfills in the VDEQ's central office files.

3. The review of 1998 report information submitted by each MSW landfill in accordance with 10.1-1413.1, Solid Waste Information and Assessment Program.

4. The MSW Landfill Survey Questionnaires performed as a component part of this study.

The projected rate of use of MSW landfill capacity is established based upon the 1998 disposal rates reported by the permitted MSW landfills and the projected population growth rates for the Commonwealth of Virginia, while the out-of-state disposal rates were held constant at the levels reported in 1998.

Landfill capacity information is summarized in this report in one graph which shows the total current MSW landfill capacity in Virginia along with the projected rates of use attributed to in-State and out-of-State waste. The above graph projects the estimated year when the current landfill capacity should be used up based upon waste received from both in-State and out-of-State sources, under the assumptions described in Section 3.0.

1.3.3 Analysis of Non-Subtitle D (HB 1205) MSW Landfills Versus Subtitle D MSW Landfills in Virginia

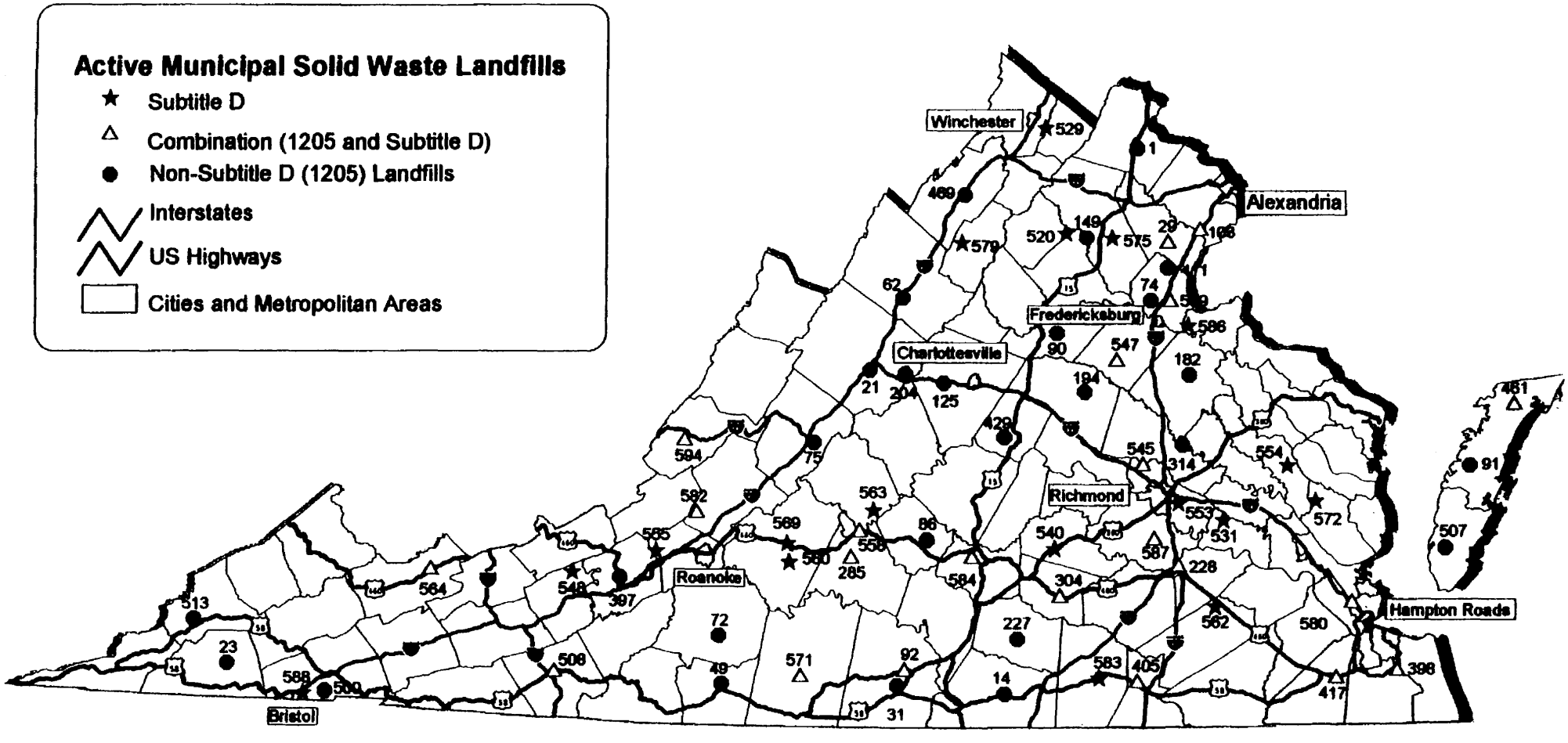
Another study issue for this report is to provide an analysis of active Non-Subtitle D landfill facilities in Virginia and, where appropriate, provide a comparison with active Subtitle D landfill facilities. The general nature of this study issue required the segregation of the analysis in the scope of work into four main parts which are summarized below:

1. **Potential Threat to Human Health and the Environment** - The analysis in this part includes a comparison of the groundwater status of Non-Subtitle D landfill facilities in Virginia versus Subtitle D landfill facilities. Information from the States Survey Questionnaire and literature searches of EPA publications, reports, journals, etc., were utilized to establish the potential threat to human health and the environment posed by Non-Subtitle D facilities in comparison with Subtitle D facilities. This analysis does not provide a site by site evaluation or assessment of individual MSW landfills in Virginia.

2. **Projected Closure Dates of Non-Subtitle D MSW Landfills** - This analysis provides a comparison of the most recent expected dates of closure of the Non-Subtitle D landfill facilities with the stated dates of closure provided with MSW landfill's certifications in 1993.

3. **Average and Range of Costs Associated With Closure and Corrective Action of Non-Subtitle D MSW Landfills** - This analysis and evaluation establishes the average and range of costs associated with closure and corrective action of Non-Subtitle D landfills, and the transportation of MSW to alternate Subtitle D landfill facilities. In addition, a comparison of the above transportation costs were made with the costs of constructing a new Subtitle D landfill cell on-site at an existing landfill.

Figure 1-1 Virginia Solid Waste Management Study



Developed through a collaberation of VDEQ through the Virginia Economic Development Partnership

DATE CREATED: 1 November 1999

Norfolk District
U.S. Army Corps of Engineers

Commonwealth of Virginia
Department of Environmental Quality

4. **Cost/Benefit Analysis Associated With Closure and Corrective Action of An Average Non-Subtitle D MSW Landfill in Virginia** - This analysis evaluates the short term potential benefits associated with the continued operation of an average Non-Subtitle D landfill facility versus the potential long term costs and liabilities associated with closure and corrective action for such a facility.

The analysis in the above four parts utilized information from the following: the VDEQ database, literature searches, the States Survey Questionnaire, the MSW Landfill Facilities Survey Questionnaire, this study scope of work, and requirements specified within the Virginia Solid Waste Management Regulations, 9 VAC 20-80-10, et seq.

1.3.4 Status of Non-Subtitle D MSW Landfills In Other States

A component part of this study was for the ACOE to establish information regarding the operational and regulatory status of Non-Subtitle D and Subtitle D landfills in 16 other states.

The information under this part of the study was obtained by developing and implementing the States Survey Questionnaire. Information from other states is summarized in this report by state and in an overall summary of findings. The above survey results provide information under the following areas:

1. General information and capacity of Non-Subtitle D And Subtitle D landfills.
2. Active Non-Subtitle D landfills.
3. Corrective action for Non-Subtitle D landfills.
4. Closure for Non-Subtitle D landfills.
5. Health and environmental effects related with Non-Subtitle D and Subtitle D landfills.
6. Monitoring of Non-Subtitle D And Subtitle D landfills.

1.3.5 Waste Disposal Reduction Practices Of Virginia and Other States

In accordance with the scope of work, the ACOE obtained information regarding the waste disposal reduction and recycling practices of Virginia and other states.
The information under this part of the study was obtained from the States Survey Questionnaire and is summarized in this report by state and in an overall summary of findings under the following areas:

1. Statewide waste management plans.

2. State legislation that requires or encourages recycling and/or waste reduction.
3. Effects of state legislation that requires or encourages recycling and/or waste reduction.
4. Costs of waste reduction and recycling versus landfilling.
5. Waste reduction and recycling technologies or processes.
6. Recycling markets.
7. Waste separation and recycling facilities in conjunction with MSW landfills or MSW incinerators.
8. Resource recovery facilities such as MSW incinerators for the generation of steam and electric power.

In addition, this part also identifies states with successful waste reduction and recycling programs and identifies key program elements and legislation that supports successful waste reduction and recycling practices.

1.3.6 Alternatives To MSW Landfills

The final component part of this study is to evaluate and compare the alternatives to landfilling wastes based upon a cost/benefit or economic standpoint.

The information for this part of the report was obtained from survey information from Virginia and other states, and literature searches of EPA publications, reports, journals, etc. This part of the report evaluates and summarizes findings on a technological and a cost/benefit basis. The analysis includes the evaluation of the various alternative standard technologies and new or innovative technologies associated with disposal or recycling of municipal solid waste.

2.0 BACKGROUND OF SOLID WASTE MANAGEMENT AND MSW LANDFILLS IN VIRGINIA

2.1 OVERVIEW OF REGULATORY AUTHORITY -- REGULATIONS, REGULATORY OVERSIGHT, AND MSW PROGRAM MANAGEMENT AND STRUCTURE AT VDEQ

The purpose of this section is to provide background information related to the history and development of the solid waste management regulatory scheme in Virginia, an overview of the solid waste management oversight functions that are performed by the Department of Environmental Quality (DEQ) and the associated agency resources.

2.1.1 Background/History

The regulatory requirements for the management of solid wastes in Virginia were established in April 1971 pursuant to Title 32 of the Code of Virginia (1950) (as amended). The regulations promulgated at that time by the Virginia Department of Health prohibited construction and operation of any solid waste management facility without a permit issued by the Health Commissioner. The 1986 session of the Virginia General Assembly enacted legislation creating the Department of Waste Management (DWM) under the new Cabinet-level Secretary of Natural Resources. The same action made the new Department the successor in interest to the Department of Health and Virginia Hazardous Waste Facility Siting Council in regards to any authority, duty and responsibility for solid, hazardous, or radioactive waste. The Assembly also retained in force all the regulations which the Board of Health or the Council had issued in these areas.[1] In 1993, the Department of Environmental Quality (DEQ) replaced the DWM.

The general nature of the performance regulations promulgated in 1971 allowed the program to update the solid waste management facility design and operation requirements and to upgrade the quality of the permits issued to these facilities in a gradual, evolutionary manner. With the passage of the Hazardous and Solid Waste Amendments of 1984 and the projected increase in the federal role in the nonhazardous waste management, however, it became obvious that the 1971 regulations were becoming obsolete. Late in 1987, the Department of Waste Management developed its new regulations consistent with one of the early versions of the draft federal Solid Waste Disposal Facility Criteria. These new regulations were adopted by the Virginia Waste Management Board on October 18, 1988, with an effective date of December 22, 1988.

The 1988 Solid Waste Management Regulations were a mixture of specific design and operation standards and general performance requirements. They established regulatory deadlines for upgrading of all existing solid waste management facilities, prescribed contemporary design, operation, closure and post-closure standards, groundwater monitoring requirements, and

[1] *Acts of General Assembly 1986*, c.492.

required corrective action at the sites that evidenced actual or potential environmental damage. The regulations also contained detailed procedural requirements for the issuance, amendment, and revocation of permits. These regulations mirrored most of the requirements established by the Solid Waste Disposal Facility Criteria promulgated on October 9, 1991.

On February 3, 1993, the Virginia Department of Waste Management received a partial approval from the Environmental Protection Agency for its solid waste management permit issuance program. That approval responded to an early application by the Department based on the 1988 Solid Waste Management Regulations.

Recognizing the advantages of the programmatic flexibility that came with federal program approval, the Department of Waste Management took active steps to revise its 1988 Solid Waste Management Regulations to conform them to the federal Solid Waste Disposal Facility Criteria. On January 8, 1993, the Virginia Waste Management Board adopted Amendment 1 to the Virginia Solid Waste Management Regulations with an effective date of March 15, 1993. This amendment addressed the changes that would ensure compliance with of the federal Criteria (40 CFR 258).

The Financial Assurance Regulations for Solid Waste Management Facilities were promulgated by the Virginia Waste Management Board on May 19, 1987, with an effective date of July 22, 1987. Based on the statutory mandate at that time, these regulations only applied to privately-owned facilities. In order to obtain full EPA approval of the Virginia solid waste program, the statute, as well as the regulations, required changes, including applicability to both private and public facilities. The necessary legislative changes were made during the 1993 session of the General Assembly, while the regulatory changes were put into effect with the adoption of Amendment 1 of the Financial Assurance Regulations, effective January 7, 1998.

2.1.2. Program Responsibility

Based on the authority contained in Chapter 14, Title 10.1, Code of Virginia (1950), as amended, the Department of Environmental Quality has the sole responsibility for the administration of laws and regulations concerning solid wastes. The technical and regulatory functions are discharged by the Waste Program Coordination Division, the Office of Enforcement, the Office of Pollution Prevention and Compliance Assistance, the Office of Environmental Enhancement, all of which are in the DEQ central office in Richmond, and the six Regional Compliance Monitoring Offices. The regional offices, which have primary responsibility for compliance, inspection and enforcement activities are located in Woodbridge, Glen Allen, Virginia Beach, Abingdon, Roanoke, and Harrisonburg. The alignment of these offices within the DEQ organizational structure is shown in Appendix C.

2.1.3. Size of the Regulated Community

In the area of solid waste management, the Department regulates the number of solid waste management facilities as shown in Table 2-1 below. For all landfills, the numbers include active

facilities, inactive facilities, and closed facilities that remain subject to post-closure care requirements.

Table 2-1 Solid Waste Management Facilities in Virginia

TYPE OF FACILITY	PUBLIC	PRIVATE	TOTAL
Sanitary Landfills	148	14	162
Construction/Demolition/Debris Landfills	13	32	45
Industrial Landfills	3	46	49
Incinerators	4	3	7
Permits by Rule	54	56	110
TOTAL	222	151	373

NOTE: The Virginia definition of "sanitary landfill" is equivalent to the federal definition of municipal solid waste disposal facility. (See the "Glossary of Terms" provided in the back of this report.)

2.1.4. Resources of the Department

The day-to-day operation of the solid waste management program resides primarily in the Waste Program Coordination Division and the Offices of Compliance Monitoring within the six regional offices. In the Central Office, the majority of personnel active in the solid waste program are assigned to two offices of the Waste Program Coordination Division: the Office of Waste Permitting, whose primary function deals with the permitting of solid waste management facilities, and the Office of Waste Programs which is concerned with inspection coordination, compliance assistance, regulation and guidance development, and database management activities. The six regional offices are primarily involved in the compliance, inspection and enforcement aspects of the program. The Office of Enforcement in the Central Office provides enforcement support to the Regional Offices. Recycling and waste minimization programs reside in the Office of Pollution Prevention and Compliance Assistance and the Office of Environmental Enhancement, respectively. Other Divisions/Offices of the Department furnish administrative, planning, and supervisory support to the solid waste management program as well as to other programs of the Department.

The current staffing level of the Department is 805 full time equivalents (FTE) positions. Of the presently authorized positions, approximately 51 FTEs (including the 19 additional positions that were approved for this fiscal year) are devoted to various aspects of the solid waste management program as shown below:

Table 2-2 Staffing Levels for the Solid Waste Management Program in Virginia

Elements of Solid Waste Management Program	Current Full-Time Positions
Program Administration	2.5
Permitting, Closures and Corrective Action	15.0
Inspections, Compliance and Enforcement	25.5
Program Development	4.0
Recycling and Waste Minimization	4.0
TOTAL	51.0

Note: The above table does not include the support offered to the Department by the Office of the Attorney General. The legal staff represents the Department on all civil matters, including enforcement and litigation. Criminal cases are prosecuted by local Commonwealth's attorneys.

The budget for the solid waste management program for fiscal year 1999 - 2000 includes approximately $1.2 million for permitting, $2.6 million for inspection and compliance and $390,000 for enforcement. Detail of the budget for the solid waste management program is available from the Office of Budget and Grants, DEQ.

2.1.5 Permitting of Existing and New Units

Permitting of all solid waste management facilities was the cornerstone of the Virginia solid waste management program since its inception in 1971. Therefore, all MSW facilities operate under a currently valid permit issued by the Department of Environmental Quality or one of its predecessors, the Department of Waste Management or the Department of Health.

The design and operational standards that formed the basis for older permits evolved over time, so that the less prescriptive requirements of the older permits became unacceptable. In recognition of the inadequacies of the older permits, the Virginia Waste Management Board adopted Amendment 1 to the Virginia Solid Waste Management Regulations with an effective date of March 15, 1993. The Amendment 1 regulations required that all existing MSW facilities comply with the regulatory requirements as follows:

1. All new facilities established after the effective date of regulations (March 15, 1993) must be in full compliance with the regulations.

2. Existing privately-owned facilities must meet all the requirements of the regulations by the effective date of regulations with the exception of those for liner design and leachate control. Facilities that met certain notification requirements or had shown good faith effort to comply with the regulations were allowed to operate under the conditions of the original permit until October 9, 1993.

3. Existing facilities owned by the local governing bodies must meet all the requirements of the regulations by the effective date of the regulations with the exception of those for liner design and leachate control. The compliance date for the liner design and leachate control requirements was extended to January 1, 1994, provided no lateral expansion of the landfill unit took place after October 9, 1993.

The regulations allowed vertical expansion of an existing landfill unit up to its original design capacity (and continued operation past the regulatory deadlines described above) provided that the Director approved a variance petition submitted by the owner or operator of the facility. In case of the sanitary landfills, vertical expansion could only occur over the landfill area that had received waste prior to October 9, 1993. Additionally, the petitioner had to furnish certifications that the facility was in full compliance with the existing permit, that the facility was not an open dump or did not pose a substantial threat to human health and the environment, that the permittee was in compliance with the financial assurance requirements and that the site had been operated in accordance with the operating plan (i.e., landfill units were not prematurely expanded to avoid regulation). The 1993 General Assembly effectively removed the requirement that the Director approve the variance petition for vertical expansion, but continued the notification and certification requirements of the regulations (outlined above) as the precondition for relief under the statute.[2]

2.1.6 Permitting Procedures

Both the enabling legislation (Chapter 14, Title 10.1, Code of Virginia (1950), as amended) and the regulations (9 VAC 20-80-10 *et seq*) require a permit for the treatment, storage, or disposal of nonhazardous solid wastes. Additionally, the regulations prohibit the construction, operation, or modification of a solid waste management facility without a permit issued by the Director. The regulations provide for public participation in the permit issuance process. Availability of the draft permit is advertised in the local newspaper. In addition, the Department is required to conduct a public hearing prior to the issuance of any permit for a new solid waste management facility permit. Notice of the public hearing is published in a newspaper in the community where the MSW facility is located and in the Virginia Register. A 45-day public comment period is provided to receive comments related to the proposed permitting action. All comments relating

[2] § 10.1-1408.1.N. of the Virginia Waste Management Act.

to the technical and regulatory conditions of the draft permit, written or oral, are addressed by the Department. Each commenter receives a written response setting out the resolution to the comment. Final permit decisions are to be rendered within 30 days of the close of the public comment period. Final permits are a matter of public record and are available under the Virginia Freedom of Information Act to all requestors. The Department follows the same public notice procedures for any major amendment of an existing MSW facility permit.

In June 1993, the Department published the Solid Waste Permitting Manual which describes in detail the administrative procedures and requirements that lead to an issuance, an amendment or a denial of a solid waste facility permit. This manual is available to the regulated community and to the public-at-large from the Office of Waste Permitting, Waste Program Coordination Division, DEQ.

2.1.7 Compliance Monitoring

Section 10.1-1402(6) specifies that the Department is authorized to collect data and information as necessary to conduct the state solid waste program. Based on this statutory authorization, Virginia Solid Waste Management Regulations require, at a minimum, the same level of reporting and recordkeeping as the federal criteria (40 CFR 258). All reports and monitoring records are to be kept for at least three years, unless the facility is required by the Director to maintain them for a longer period of time, and are to be available for inspection by the Department The reporting requirements are also listed in the permit. The permittee is obligated to correct any incomplete or incorrect information submitted to the Department. Because the Virginia program, unlike the federal program, is not designed to be self-executing, the documents that may be required by the criteria to be kept at the facility are normally also available in the Department's files, either as the result of the permit issuance process or as the result of the on-going compliance inspection reports and records. Prior to the inspection of a MSW facility, the entire pertinent record of the permittee is reviewed by the inspector.

In addition to the review of records and information, the Department maintains a program of prioritized periodic inspections and surveillance. Reinspection of facilities with unresolved non-compliance histories and reported cases of management of solid wastes without permit are placed among the highest priority. Periodic inspection visits and record reviews of sanitary landfills are also a priority and are performed at least monthly, while inspections of all other types of solid waste management facilities (see Table 2-1) are performed quarterly. Surveillance of inactive facilities are performed semi-annually, while inspections at closed landfills are conducted on an annual basis. Inspectors are required to perform complete and comprehensive surveys of the regulated solid waste management facilities. To ensure that all the program requirements have been met, inspection records are compiled to indicate the degree of compliance with each and every requirement contained in the regulations or the conditions of the permit. The surveillance extends to review of records received by the Department prior to the visit and to the documents kept at the facility. When necessary, copies of the latter documents are brought back for further evaluation. Completeness of sampling and monitoring performed by the facility is one of the items evaluated by the inspectors.

Section 10.1-1456 provides authority to the Director or his designee to enter at any reasonable time onto any property to inspect, investigate, evaluate, conduct tests or take samples for testing in order to determine compliance with any law, regulation, order, or condition of a permit. Additionally, the regulations state that, by accepting a permit, the owner or operator agrees to the specified periodic inspections. Should the inspector be denied entry, he may apply to an appropriate Circuit Court for an inspection warrant. Sections 19.2-393 *et seq*, provide conditions for issuance, duration, conduct of inspection and penalties for refusal to permit authorized inspection.

2.1.8 Enforcement

Section 10.1-1402(11), provides in part that the Virginia Waste Management Board (Board) is authorized to enforce its regulations as may be necessary to carry out its powers and duties and the intent of the Virginia Waste Management Act and the federal acts. Section10.1-1405(B) vests the Director of the Department of Environmental Quality (DEQ) with all the authority of the Board when the latter body is not in session. The six DEQ Regional Offices have primary responsibility for the enforcement program.

The types of enforcement tools available to the Agency as well as the criteria for violation classification are outlined below.

2.1.8.1 Enforcement Tools.

Emergency Orders. The Board is authorized to make separate orders and regulations to meet any emergency to protect public health, natural resources, and the environment from the release or imminent threat of release of waste pursuant to Section 10.1-1402(18). Alternatively, the violation may be referred to the Office of the Attorney General to seek a temporary injunction or other appropriate remedies from the civil court. When such an emergency situation arises, Department staff will immediately contact both the Office of the Attorney General and the Director for instruction and an authorization to proceed with all the necessary and appropriate actions.

Criminal Enforcement. Various provisions of the Waste Management Act (Act) provide for criminal penalties for violations caused by negligence or refusal to comply with the Act and regulations or orders of the Board or the Director. In general, knowing and willful violations can lead to prosecution as a felony while willful or negligent acts can lead to prosecution as a misdemeanor. When the Director obtains information concerning a potential criminal violation, the case is referred to the appropriate law enforcement authorities. Criminal prosecutions under the Act must be commenced within three years of the discovery of the offense (Section 10.1-1455(J)).

Civil Enforcement.
With the consent of any person who has violated any regulation or order of the Board or the Director, any condition of a permit, or any provision of the Act, the Board may provide, in an

order issued by the Board against such person, for the payment of civil charges for past violations in specific sums, not to exceed the limits specified in the Act. Such civil charges shall be instead of any appropriate civil penalty which could be otherwise imposed (Section 10.1-1455(F)).

In the case of violations that do not require immediate action under an emergency order, the Board or the Director may issue orders to require any person to comply with the provisions of the Act, any condition of the permit or certification, or any regulations, or to comply with any case decision of the Board or the Director after a hearing (Section 10.1-1455(C)).

Pursuant to Section 10.1-1186, the Director may issue unilateral special orders to any person to comply with: (i) the provision of any law administered by the Board, the Director or the Department, (ii) any condition of any permit or certification, (iii) any regulations of the Board, or (iv) any case decision of the Board or the Director. Such orders may not have a duration of more than twelve months, but may include a civil penalty of up to $10,000 total.

The Board may also issue unilateral administrative orders for the violation of (i) any law or regulation administered by the Board, (ii) any condition of any a permit or certification, (iii) any case decision or order of the Board. Orders issued may include penalties of up to $25,000 per violation and may compel the taking of corrective actions or the cessation of any activity upon which the order is based. (Code Section 10.1-1455(G)).

Any person violating or failing, neglecting, or refusing to obey any lawful regulation or order of the Board or the Director, any condition of a permit or certification or any provision of the Act, may be compelled in a proceeding instituted in an appropriate court by the Board or the Director to obey such regulation, permit, certification, order or provision of the Act and to comply therewith by injunction, mandamus, or other appropriate remedy (Section 10.1-1455 (D)).

In addition to the above general authority, Section 10.1-1455(A) provides that such persons that violate any provision of the Act, any condition of the permit or certification, or any regulation or order of the Board or the Director may be assessed by an appropriate court a civil penalty of not more than $25,000 for each day of such violation.

Any person violating or failing, neglecting or refusing to obey any injunction, mandamus or other remedy obtained pursuant to Section10.1-1455 shall be subject, in the discretion of the court, to a civil penalty not to exceed $25,000 for each violation. Each day of violation shall constitute a separate offense (Section 10.1-1455(E)).

The burden of proof in civil cases is "a preponderance of evidence." The burden of proof in criminal cases is "beyond a reasonable doubt."

2.1.8.2 Violation Classification

The Department's enforcement mission is to take fair and consistent enforcement actions to ensure compliance with the Act and the regulations and orders issued by the Board in a manner

that promotes the health and well being of the Commonwealth's citizens and protects its environment. All statutory and regulatory violations are subject to enforcement. This principle applies to all facilities (major or minor, permitted or unpermitted) and to all violations of the Act and regulations administered by the Department.

Violations are classified based upon the seriousness of the alleged violations (i.e., duration, gravity, magnitude, willfulness) and their impact or threat of impact on human health and the environment. The classification of violations are used to prioritize enforcement actions. The violation classification and prioritization system does not imply that lower priority violations will not be subject to enforcement. It merely indicates that the level of attention given to enforcement matters is based upon their environmental and programmatic significance. The solid waste program uses this general violation classification system to guide compliance and enforcement actions.

In general, appropriate enforcement action means that the mechanism used by DEQ to achieve compliance is proportional to the alleged violation, responsive to the facility's compliance history, and protective of human health and the environment. In addition, an appropriate enforcement action, which may include a civil charge and recovery of economic benefit, sends a message of deterrence to the regulated community. Further, in order for the enforcement program to maintain credibility with the regulated community and the public in general, DEQ must take consistent and fair enforcement actions. This means that the regulated community should expect a similar response to a comparable violation - given its impact on human health and the environment - regardless of the region in which it occurs. While it is important to recognize that each case is fact-specific and must be managed accordingly, consistency is always a factor in determining the enforcement action.

DEQ's fundamental principle in choosing a course of enforcement action is to use the least adversarial method appropriate to the situation that will achieve DEQ's goals of compliance, correction, and deterrence. It is DEQ's intent, however, to use the full range of enforcement tools available to it as necessary to achieve its goals.

2.2 MSW LANDFILL PERMITTING

The Waste Management Act requires all facilities that treat, store, or dispose waste to have a permit. In order to construct a landfill in Virginia, a permit application is required to be submitted to, and approved by VDEQ. The permit application is divided into two parts, Part A and Part B.

The Part A application addresses site suitability and considers such issues as local government approval, site geology, including seismic conditions, and groundwater hydrology, as well as site location and proximity to such features as airports, floodplains, and wetlands. The Part B permit application is a detailed engineering design which includes design plans, a design report with engineering calculations, an operations plan, an emergency (contingency) plan, a groundwater monitoring plan, a closure plan, a post-closure plan, and financial assurance. The application is reviewed by DEQ and, when all elements required by regulation have been provided and are

technically adequate, a draft permit is assembled from the information in the application. The draft permit is made available for public review and comment, and a public hearing is held by DEQ to allow public participation. Once the permit is issued, the facility can begin construction, and operation.

2.2.1 Design Criteria

Landfills receiving municipal solid waste are required to have a specific type of liner. The liner functions to contain the wastes and any liquid that is released from the waste mass. The liner required by regulation consists of two elements, a low permeability compacted clay and a flexible synthetic membrane, that work together to minimize leakage from the landfill. A liner that has a clay and a synthetic component is called a composite liner, and the Virginia Solid Waste Management Regulations specify design criteria that the liner must meet. Other liners are allowed if they meet applicable performance criteria. A composite liner consisting of two feet of compacted clay overlain by a synthetic membrane is generally called a Subtitle D liner. This is the standard municipal solid waste landfill liner design in Virginia.

The permit issued by DEQ specifies where the liner will be placed, how it will be sloped for adequate drainage, and the quality control testing that will be done to ensure that the liner meets the performance criteria specified in the permit. The design must also provide for the collection and treatment of all liquids (leachate) originating from the waste.

2.2.2 Operating Criteria

MSW landfills must comply with certain operating requirements that relate to the routine operation, management, and environmental monitoring at the landfill. These operating requirements have been developed to ensure the safe daily operation and management of the landfill. The operating requirements include:

1. The requirement for a program to detect and prevent the disposal of regulated hazardous waste in the landfill to include random inspections of incoming loads or other prevention methods.

2. Daily cover to control disease vectors (i.e., birds, flies and other insects and rodents), prevent fires and odors, and to control blowing litter and scavenging at the landfill. Either soil or an approved alternate may be used as daily cover.

3. Explosive gases control to include quarterly methane monitoring and, if necessary, corrective action to ensure that the methane levels do not exceed specified limits.

4. Air criteria that prohibit the open burning of solid waste.

5. Facility access control such as the use of natural or artificial barriers to prevent access to the landfill site and protect human health and the environment.

6. The prevention of run-on onto the landfill site and the control of run-off from the active portion of the landfill, including the a requirement to comply with the Clean Water Act for any discharges.

7. Restrictions on the placement of bulk or noncontainerized liquids in the landfill.

8. Recordkeeping requirements to include the maintenance of inspection records, training records, gas monitoring results, testing or analytical data, cost estimates for financial assurance and closure and post-closure plans.

2.2.3 Groundwater Monitoring

Landfills are required to have a groundwater monitoring system to assess any effects on the uppermost aquifer underlying the landfill. Monitoring wells must be located upgradient and downgradient of the landfill. The groundwater monitoring system must insure early detection of any statistically significant increases in hazardous constituents; therefore, the downgradient wells are to be installed at the edge of the waste disposal area. The groundwater monitoring program is part of the facility permit and must include consistent sampling and analysis procedures which include procedures for sample collection, preservation and shipment, analytical methods and chain-of-custody control.

Groundwater monitoring is conducted in a phased manner. The phases are detection monitoring, assessment monitoring, groundwater corrective action. The flow chart in Figure 2-1 is provided as a visual representation of the process. The initial phase of groundwater monitoring is detection monitoring, which consists of analyzing for approximately 60 inorganic and organic hazardous constituents. At a minimum, the wells must be sampled twice a year throughout the active life of a facility and the post-closure period. The analytical data must be statistically evaluated annually, and the analytical data results must be submitted to DEQ every year.

If it is determined that statistically significant increases have been detected as the result of detection monitoring, the landfill must initiate an assessment monitoring program. Assessment monitoring is to evaluate the rate and the extent of migration of the solid waste constituents and their concentrations in the groundwater. The constituents that are to be sampled for and analyzed initially consist of over 250 chemical materials. The frequency of sampling is specified in the facility permit. The results of the assessment monitoring are used to establish the background for all constituents found and to determine the groundwater protection standards. Groundwater protection standards are site-specific limits developed for specific constituents that are protective of human health and the environment. The facility is required to evaluate the results of the assessment monitoring and, depending on the results, return to the detection monitoring, continue with the assessment monitoring, or initiate an assessment of corrective measures.

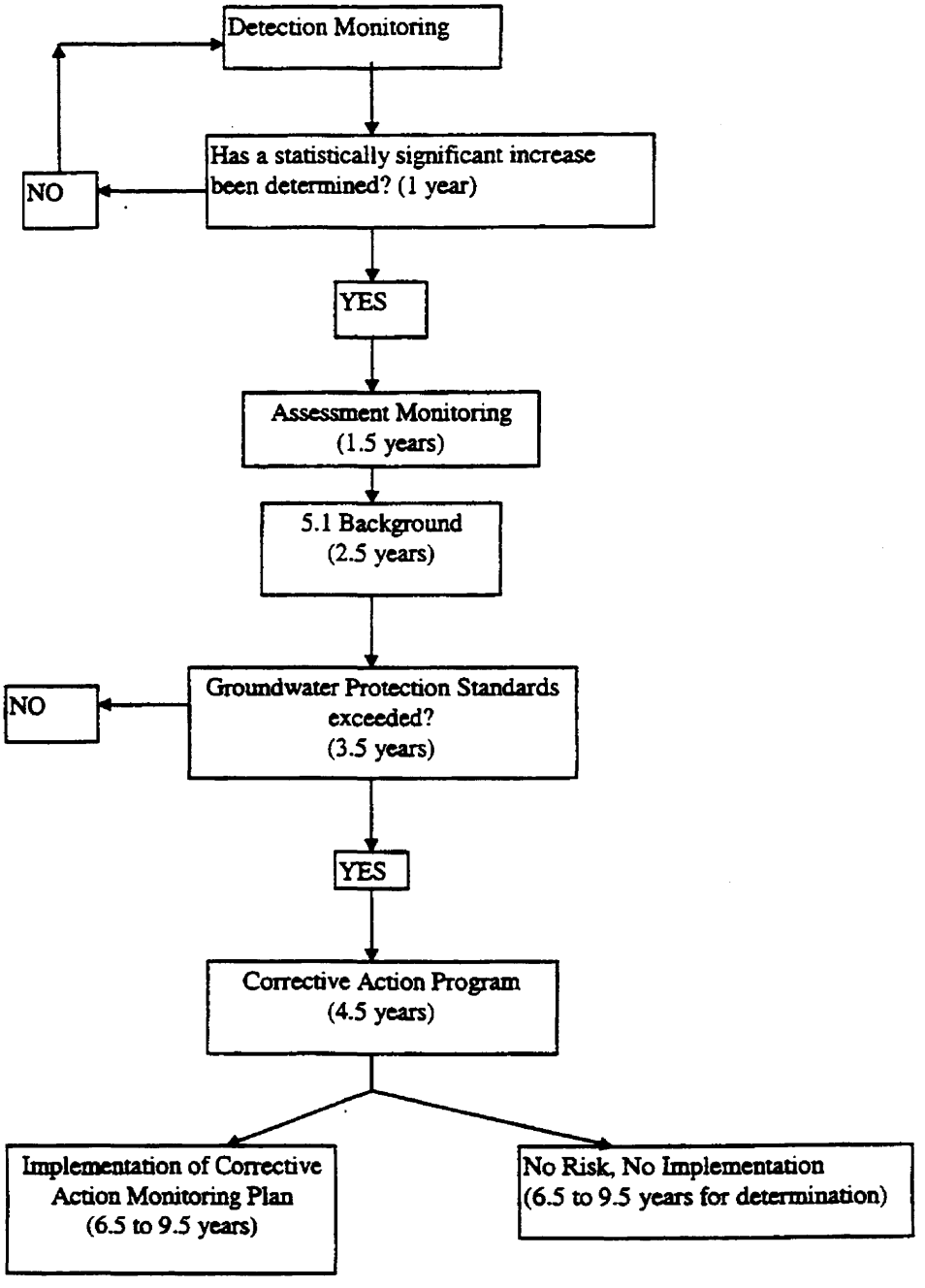
2.2.4 Corrective Measures

For the purpose of this report, corrective measures will consist of either groundwater corrective action, or gas remediation.

2.2.4.1 Groundwater

Groundwater corrective action is required if contamination is demonstrated above a site specific groundwater protection standard (GPS) developed for the landfill. If the groundwater protection standard is exceeded, the facility is required to perform a corrective measures assessment, and a remedy or remedies are selected based on the requirements of the Virginia Solid Waste Management Regulations.

Figure 2-1 Groundwater Monitoring Program for MSW Landfills in Virginia



The facility is then required to develop a corrective action plan based on the corrective measures assessment, and it is submitted to DEQ for approval. Once a corrective action plan is approved, it is implemented and, under the provisions of the plan, the Department determines if the selected remedy is working. When compliance with the groundwater protection standard is achieved corrective action is considered complete. There are specific timeframes outlined in the VSWMR for submission of the various plans required under this process.

One of the facts that is pointed out in this report is that at the present time, no MSW landfills in Virginia are performing corrective action. In order to understand why this is so, it is necessary to provide some historical and background information on the groundwater monitoring requirements for MSW landfills in Virginia.

The first comprehensive Virginia Solid Waste Management Regulations (VSWMR) became effective in 1988. These regulations required facilities to initiate groundwater monitoring by July 1, 1991, if there were no groundwater monitoring wells in place at the facility, or by July 1, 1992, if there were wells located at the facility. Until Amendment 1 of the Virginia Solid Waste Management Regulations (VSWMR) was promulgated in March, 1993, there was no assessment monitoring program. Prior to that time, if a facility experienced an statistically significant increase (SSI) for any indicator parameter, then the facility entered into was what was termed a "Phase II monitoring program."

VSWMR, Amendment 1 required MSW landfills to enter into the final detection monitoring program and then implement assessment monitoring if there was a SSI for any one of the 62 constituents that were part of the detection monitoring program. The regulations contained a phased compliance schedule for entering the detection monitoring program that was based on the facility's distance from surface or subsurface drinking water intakes. The earliest compliance date was October 9, 1994, while the last date was October 9, 1996. Therefore, the earliest that a MSW landfill could have entered assessment monitoring would have ranged from between October, 1995 and October, 1997 (i.e., after generating one year's worth of background data, conducting the first semiannual sampling event, and performing the required statistical tests). However, because of a petition that was submitted to the Department from the Virginia Municipal Group, assessment monitoring was delayed for most MSW landfills.

The Virginia Municipal Group represented the assessment monitoring program as being excessively expensive as compared to the Phase I monitoring program and that any SSI indicated in the Phase I program would have been for indicator parameters and not any specific constituent(s). A Compliance Agreement between the Department and specific MSW landfill facilities allowed those facilities that had determined a SSI under the Phase I program to enter the detection monitoring program and not go directly to assessment monitoring. The process of negotiating the Compliance Agreement and the additional time required for facilities to determine background for the 62 detection monitoring constituents and perform the required statistical tests delayed assessment monitoring at many MSW landfill facilities for approximately two (2) years.

In addition, any facility has the opportunity to demonstrate that a SSI was caused by a sampling error, temporal or spatial variation, or that some other source was the cause of the increase. The facility may propose and conduct demonstrations that may delay implementation of the assessment monitoring program.

When a facility triggers a SSI under the assessment monitoring program, the facility's permit must be amended to establish groundwater protection standards (GPS). This is a major permit amendment that can take one year or more for the Department to process. This further delays the process. Once the GPSs are in place, the facility will stay in the assessment monitoring program until a GPS is statistically exceeded. If that occurs, the facility must characterize the nature of the release by adding additional wells and initiate an assessment of the corrective measures that should be undertaken to remediate the plume of contamination. This process can take several years or even longer depending on the site-specific situation. All these activities can cause the elapse of a substantial amount of time before a facility actually undertakes a corrective action (such as pump and treat, insitu remediation, natural attenuation, etc.).

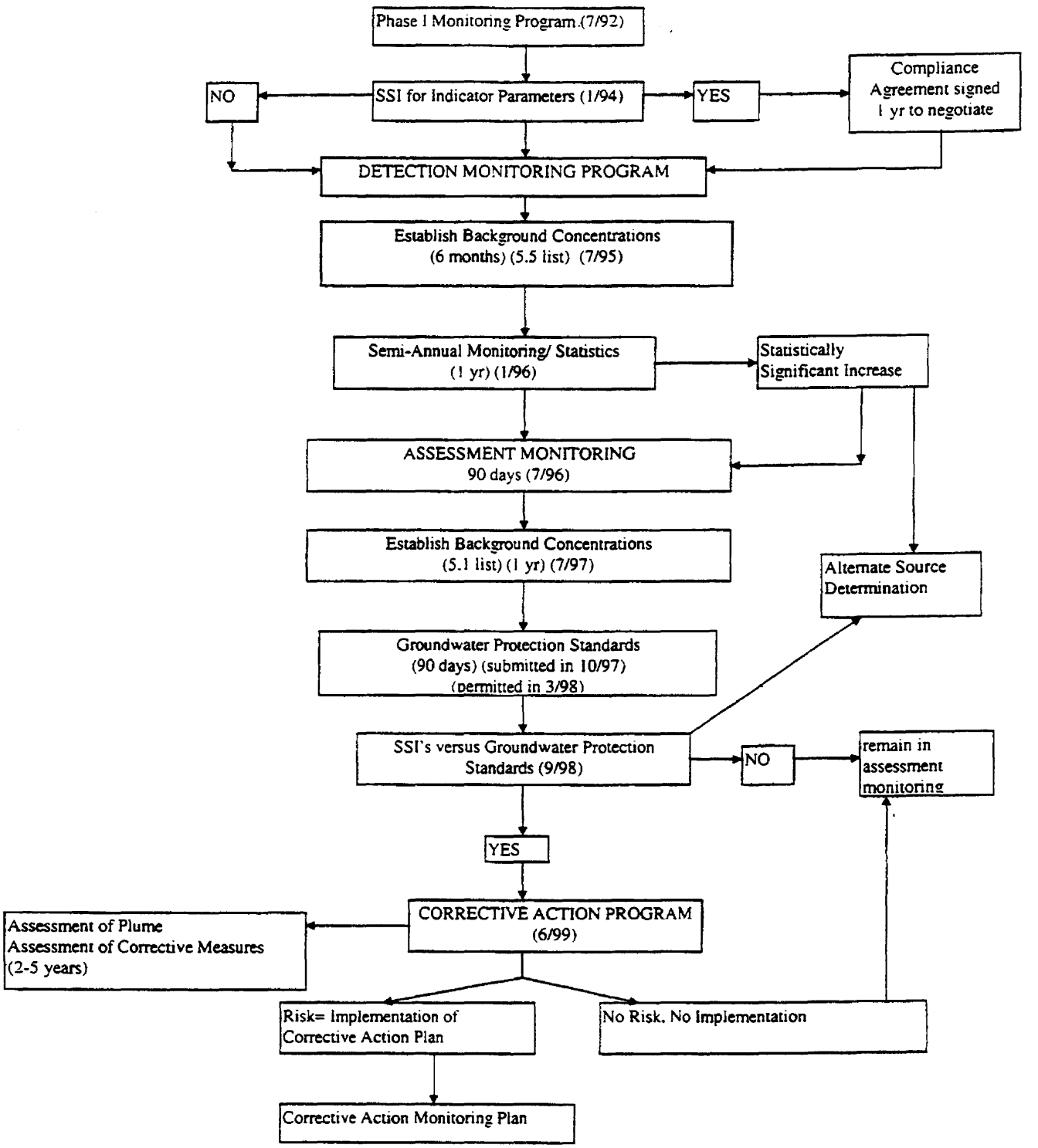
Another factor that needs to be pointed out is that under the VSWMR, even if groundwater may be contaminated, if there is no risk to human health or the environment due to the level of contamination, then no corrective action may be required.

Figures 2-2 and 2-3 depict the groundwater monitoring process and provide the earliest estimated date by which a MSW in Virginia could conceivably enter corrective action. Figure 2-2 would be for those MSW facilities that were covered under the Compliance Agreement described above. Figure 2-3 is based on the timeframes outlined in the VSWMR.

2.2.4.2 Gas

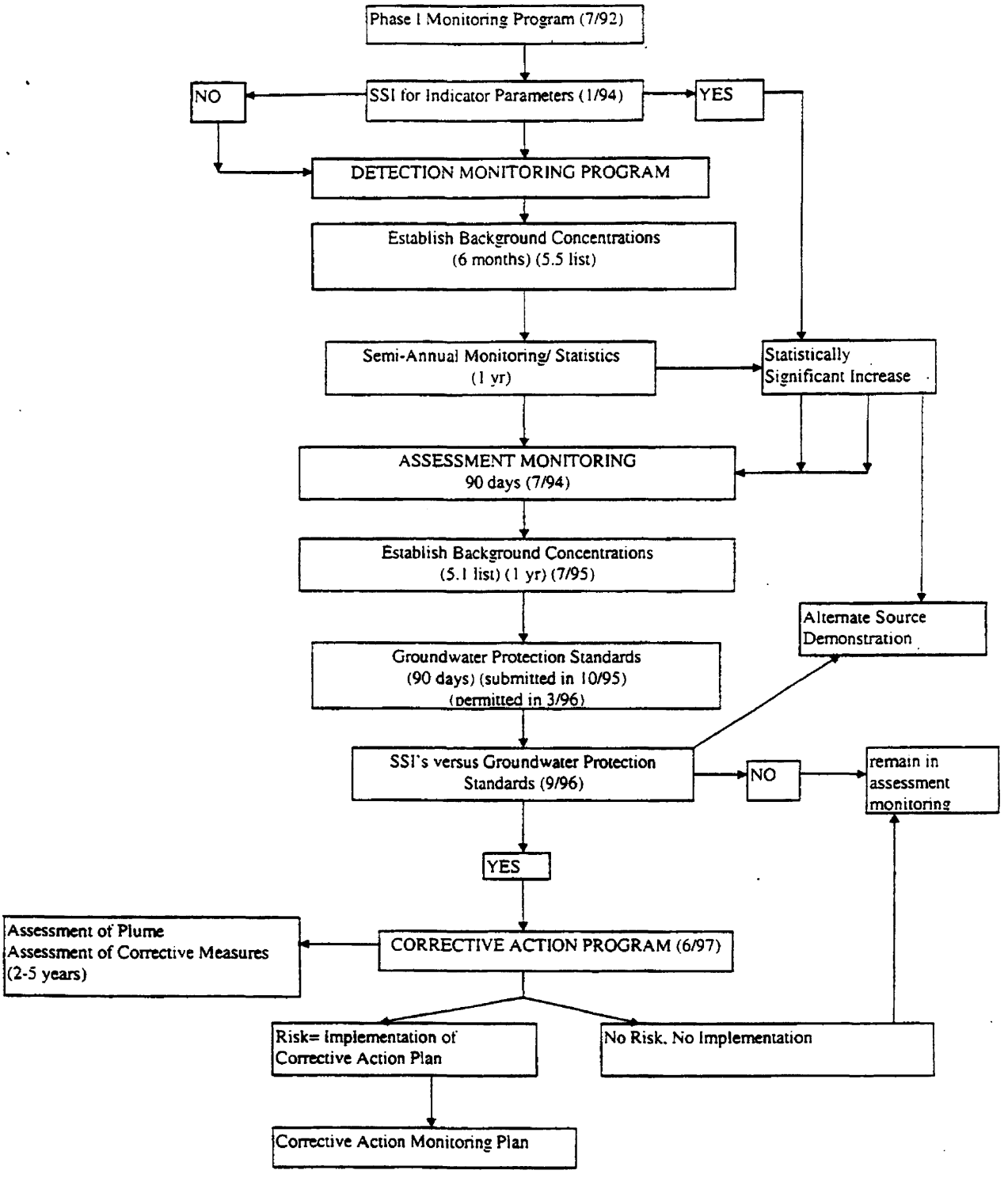
Gas remediation is required if methane gas is detected above the lower explosive limit (LEL) at the facility boundary, or above 25% of the LEL in a facility structure. Methane is the most prevalent gas produced by the biological degradation of municipal solid waste, and is an explosion hazard. Gas remediation can consist of passively venting the methane to the atmosphere though a number of different mechanisms, or the installation of a system of gas wells and actively drawing gas though a system of pipes to a flare where it is burned. There are specific timeframes outlined in regulation for submission of the various plans required under this process.

Figure 2-2 VSWMR Amendment 1
March 15, 1993 (Slow Track)



At any time the Director can revoke the permit after a substantial threat has been determined.

Figure 2-3 VSWMR Amendment 1
March 15, 1993 (Fast Track)



At any time the Director can revoke the permit after a substantial threat has been determined.

2.2.5 Closure and Post-Closure Care

All currently operating MSW landfills are required to properly secure the waste after the active life of the facility and to maintain and monitor the landfill for 30 years after waste disposal has ceased. The manner in which the facility is closed and the post-closure activities to be undertaken must be approved by DEQ.

Closure of a facility must begin when a landfill has been filled to capacity, or when no additional waste has been received for one (1) year. When a facility is closed, access to the facility is restricted and appropriate signs are posted to prohibit the disposal of any additional waste. The location of the waste disposal areas and other notations are recorded on the deed for the property.

Closure activities include the grading of the landfill to assure proper drainage and the installation of a final cover system, or cap. The purposes of the cap are to prevent the continued introduction of water into the waste mass and to isolate the waste from the environment. The design of the cap must be included in the closure plan. Design criteria are set forth in the state regulations; the cap may consist of compacted clay, a synthetic material alone, or a composite of clay and synthetic material. A soil layer is placed above the cap material to protect the cap from damage by the elements and erosion effects, and to provide a base for vegetative cover.

Once the cap has been installed and the vegetative cover has been established, the facility begins the post-closure period. Post-closure care must be conducted for 30 years after the active life for a sanitary landfill that operated after October 9, 1993; all other landfills have a post-closure period of 10 years. Post-closure activities include regular inspections of the landfill, maintenance of the facility, and monitoring of the groundwater and landfill gases. At the end of the post-closure period, the facility must submit a certification to DEQ that the post-closure care has been completed in accordance with the post-closure plan, after which the facility may be released from the post-closure responsibilities. The post-closure period may also be extended if the additional time is needed for corrective measures or to ensure proper protection of human health and the environment.

2.2.6 Financial Assurance

Financial assurance is required for waste disposal facilities. Money is set aside through a number of possible mechanisms to provide assurance that if the facility is abandoned, or is not properly closed, DEQ has sufficient funds to properly cap the facility, and maintain the facility during the post-closure care period. A closure and post closure care cost estimate is submitted to the Department during the permitting process; the estimate must provide the cost for a third party, other than the owner or operator, to properly close the facility and to maintain the facility during post closure care, as required by the facility's permit. DEQ reviews the closure and post-closure cost estimate as well as the mechanism chosen to provide financial assurance in order to determine if funds will be available for the point in the facility's operating life when closure will be most expensive, as well as at the end of the facility's operating life. The amount of financial

responsibility is reviewed and adjusted for inflation annually by DEQ. The owner or operator must provide the financial assurance prior to receiving any waste.

Facility owner/operators must maintain continuous financial assurance for closure, post-closure care, and if applicable, corrective action. The amount of financial assurance must equal the amount of the current cost estimate. The regulations specify nine (9) mechanisms that can be used to demonstrate financial assurance. The regulations also provide some discretion to accept other types of mechanisms. One or a combination of the following mechanisms can be used to demonstrate financial assurance, however, mechanisms that guarantee payment cannot be combined with mechanisms that guarantee performance (i.e., performance bonds cannot be combined with a letter of credit):

1. Trust agreement
2. Performance bond with standby trust agreement
3. Irrevocable standby letter of credit
4. Deposit of acceptable credit
5. Insurance policy
6. Corporate financial test
7. Corporate guarantee
8. Local government financial test
9. Local government guarantee

During the 1999 legislative session, a joint legislative study committee was established (HJ 585) to evaluate the reliability of each of the various mechanisms that owners or operators of solid waste management facilities may use in Virginia to demonstrate financial assurance for the costs of closure, post-closure care and corrective action. Particular attention is to be given to the use of "self-assurance" mechanisms, including insurance coverage provided by captive insurance companies, and to financial tests and corporate guarantees. The joint legislative study committee is to make recommendations and provide options for regulatory or legislative actions that would improve the reliability of financial assurance mechanisms.

2.3 BACKGROUND OF NON-SUBTITLE D (1205) AND SUBTITLE D MSW LANDFILLS IN VIRGINIA

With the promulgation of the Virginia Solid Waste Management Regulations (VSWMR) in 1988, solid waste management facilities in Virginia became subject to extensive new requirements. These new requirements addressed such things as landfill siting, liner and leachate collection systems, operational requirements, groundwater monitoring, financial responsibility and closure and post closure care requirements. Under the 1988 regulations, owners and operators of permitted solid waste management facilities were required to comply with the new requirements by July 1, 1992. The regulations required that after July 1, 1992, existing landfills (including sanitary, industrial and construction, demolition and debris (CDD) landfills) could only place waste over areas that met the liner and leachate collection requirements of the regulations. This included operation both vertically (i.e., increases in the

height of the landfill) and horizontally (i.e., increases in the lateral extent of the landfill). In 1991, new legislation was enacted which allowed local governments that owned or operated a permitted solid waste landfill an extension until January 1, 1994 to comply with the liner and leachate collection system requirements of the VSWMR. The following year, state legislation gave the Department of Waste Management the ability to extend this compliance date beyond January 1, 1994, provided that the landfill posed no threat to public health or the environment. Additional legislation that passed the same year allowed private landfills to continue to operate in accordance with the liner and leachate collection systems required by their permit until October 9, 1993, provided certain conditions were met. The Department also had the ability to extend this compliance date for private landfills.

In the meantime, the Environmental Protection Agency (EPA) promulgated new standards for municipal solid waste landfills on October 9, 1991. These new standards, contained in 40 CFR 258, were authorized by Subtitle D of the Resource Conservation and Recovery Act (RCRA), and became effective on October 9, 1993. These standards affected all new and existing landfills, however the liner and leachate collection system requirements only applied to new municipal landfills or lateral expansions of municipal solid waste landfills. Under the Federal criteria, existing municipal solid waste landfills could continue to operate vertically within the landfill footprint as of October 9, 1993 without meeting the new design criteria for liners and leachate collection.

On March 15, 1993 Amendment 1 of the VSWMR was enacted aligning Virginia's regulatory requirements with the Federal requirements for design of new and expanded facilities. During the 1993 legislative session, Va. Code Section 10.1-1408.1.N. was enacted (also commonly referred to as House Bill 1205). The above legislation allowed landfills that were permitted prior to March 15, 1993 (the effective date of Amendment 1 of the VSWMR) to continue to operate vertically within the landfill footprint as of October 9, 1993 as long as certain information was submitted to the Director. This information included:

1. Acknowledgment that the owner/operator is familiar with state and Federal laws and regulations pertaining to solid waste facilities

2. Statement from a professional engineer that:

    1. The facility is not an open dump.
    2. The facility does not pose a threat to human health or the environment.
    3. Leachate or residues from the facility do not pose a threat of contamination which would create an open dump or do not pose a substantial current or potential threat to human health or the environment.

3. Statement from the owner or operator:

    1. That the facility complies with applicable financial assurance regulations.
    2. An estimate of when the facility will reach vertical design capacity.

Numerous landfills in Virginia met the above requirements and continue to operate under the provisions of Section 10.1-1408.1.N. (HB 1205). After October 9, 1993, all new facilities, and lateral expansions of existing facilities are required to comply with the requirements of Subtitle D.

As a result of this regulatory and legislative history, landfills either continued operating, became inactive, or closed. The active MSW landfills in Virginia are categorized into one of the following three categories:

Subtitle D landfill - This means a landfill that is underlain by a composite liner consisting of two feet of clay, combined with a flexible membrane liner, or an approved alternate liner (i. e., the liner meets EPA's Subtitle D criteria). Landfills of this type were typically constructed after October, 1993.

Non-Subtitle D landfill - This means a landfill that may be unlined, or may have a liner, but the liner has not been demonstrated to meet the regulation in effect after 1993. Landfills of this type were typically constructed prior to October, 1993.

Combination landfills - This means landfills of which some portions have a Subtitle D composite liner, while other portions either have no liner or a Non-Subtitle D liner. Combination landfills typically monitor groundwater over the entire combined area. If groundwater contamination is detected, it is not possible to differentiate which area (Subtitle D or Non-Subtitle D) has impacted the groundwater.

2.3.1 Closed and Inactive Non-Subtitle D Landfills in Virginia

There are a number of older landfill sites in Virginia that were built prior to regulation of solid waste disposal. Approximately 800 of these sites stopped operation in the late 1960's and early 1970's. There are approximately 291 closed and 45 inactive landfill sites that opened before the effective date of the current regulatory program, but were in operation when the regulations went into effect and therefore fall under the current closure/post-closure care requirements. A number of these sites were in existence well before the Federal or state regulations were in place and well before a permit was required.

2.4 INVENTORY, CATEGORIES, AND DISTRIBUTION OF ACTIVE MSW LANDFILLS IN VIRGINIA

Data from VDEQ's 1998 inventory of active MSW landfills is present in the following two tables. Table 2-3 is sorted by permit number and indicates the type of facility, its groundwater monitoring status and the 1998 tons of MSW disposed at the facility. A summary of the number of facilities in groundwater detection or assessment by type can be found in Section 4. Table 2-4 shows the data by type of landfill, either Subtitle D, Combination, or Non-Subtitle D. This table also includes an estimate of current available capacity in cubic yards for each facility and facity type. This estimate was derived from several sources, described in Section 3.3.

Table 2-3 Inventory, Categories, and Distribution of Active MSW Landfills in Virginia
Sorted by Permit Number

Permit Number	Facility Name	Type of Landfill	Groundwater Monitoring Status	1998 Tons of Waste
1	Loudoun	Non-Sub D	A	10,054.00
14	Mecklenburg	Non-Sub D	A	37,686.00
21	Augusta	Non-Sub D	D	82,087.78
23	Scott	Non-Sub D	A	7,028.00
29	Independent Hill PR William	Combo	A	324,016.00
31	South Boston	Non-Sub D	A	65,983.65
49	Martinsville	Non-Sub D	A	122,408.00
62	Rockingham	Non-Sub D	A	95,494.73
72	Franklin	Non-Sub D	D	44,304.25
74	Stafford (Rapp Reg)	Non-Sub D	A	69,282.00
75	Rockbridge - Buena Vista	Non-Sub D	D	42,582.00
86	Appomattox	Non-Sub D	A	4,006.00
90	Orange	Non-Sub D	A	21,790.68
91	Accomack - South (Bobtown)	Non-Sub D	A	15,989.87
92	Halifax	Combo	A	21,667.13
103	I-95	Combo	A	356,880.99
125	Ivy Sanitary	Non-Sub D	A	63,348.16
149	Fauquier	Non-Sub D	A	2,175.00
178	Covington-Peters Mtn	Combo	D	10,462.88
182	Caroline	Non-Sub D	A	11,076.51
194	Louisa Co	Non-Sub D	A	18,386.50
204	Waynesboro MSW Balefill	Non-Sub D	A	27,269.65
227	Lunenburg	Non-Sub D	D	9,085.00
228	Petersburg	Combo	A	25,389.50
285	Campbell	Combo	A	52,835.71
304	Nottoway	Combo	A	16,205.31
314	Hanover - 301	Non-Sub D	A	37,052.00
397	Montgomery (Mid-County)	Non-Sub D	D	55,011.91
398	Virginia Beach #2 Mt Trash	Combo	A	98,010.00
405	Greensville	Combo	A	22,342.52
411	Quantico	Non-Sub D	D	313.98
417	SPSA	Combo	D	372,865.86
429	Fluvanna	Non-Sub D	A	7,292.34
461	Accomack, North (Site #2)	Combo	A	17,386.13
469	Shenandoah	Non-Sub D	A	38,111.00
500	Bristol Debris (back up capacity)	Non-Sub D	D	0.00
507	Northampton - Oyster	Non-Sub D	A	13,718.00
508	Carroll-Grayson-Galax-Reg	Combo	D	51,224.00
513	Wise	Non-Sub D	D	51,930.70

Table 2-3 Inventory, Categories, and Distribution of Active MSW Landfills in Virginia
Sorted by Permit Number

Permit Number	Facility Name	Type of Landfill	Groundwater Monitoring Status	1998 Tons of Waste
520	Rappahannock	SUB D	D	1,477.00
529	Frederick Co	SUB D	D	106,535.37
531	USA Waste Charles City	SUB D	D	692,867.97
540	Maplewood Recyc & Waste Dis	SUB D	D	553,143.56
545	Springfield Road	Combo	A	72,538.00
547	Livingston	Combo	A	37,213.09
548	New River Resource Authority	SUB D	D	89,552.48
553	Old Dominion SLF & Res Mgmt	SUB D	D	373,538.18
554	King & Queen	SUB D	D	478,090.58
555	Smith Gap	SUB D	D	136,278.82
558	Lynchburg	Combo	A	1,007,753.69
560	Bedford County	SUB D	D	36,179.00
562	Atlantic Waste	SUB D	D	1,271,987.00
563	Amherst	SUB D	D	23,014.04
564	Tazewell	Combo	D	27,352.93
569	City of Bedford (Hylton Site)	SUB D	D	23,297.25
571	Pittsylvania	Combo	A	42,040.00
572	Middle Peninsula Landfill & Recycl	SUB D	D	508,009.28
575	Corral Farm	SUB D	D	41,164.00
579	Page County (tons based on #89)	SUB D	D	140.00
580	Big Bethel	Combo	D	698,368.00
582	Botetourt	Combo	A	20,886.68
583	Brunswick	SUB D	D	675,988.37
584	Prince Edward	Combo	A	22,319.24
586	King George	SUB D	D	1,098,711.00
587	Shoosmith	Combo	A	928,653.95
588	Bristol Balefill	SUB D	D	109,739.25
589	Rappahanock Regional	Combo	D	6,932.00
			Total =	11,389,129.00

Table 2-4 Inventory, Categories, and Distribution of Active MSW Landfills in Virginia (1998)

Permit Number	Facility Name	Type of Landfill	1998 Tons of Waste	Groundwater Monitoring Status	Acres Permited for Disposal	Current Available Landfill Capacity in Cubic Yards
	Subtitle D Facilities					
520	Rappahannock	SUB D	1,477.0	D	35.0	386,760
529	Frederick Co	SUB D	106,535.4	D	79.0	5,081,490
531	USA Waste Charles City	SUB D	692,868.0	D	289.0	39,000,000
540	Maplewood Recyc & Waste Dis	SUB D	553,143.6	D	404.0	42,000,000
548	New River Resource Authority	SUB D	89,552.5	D	350.0	1,920,039
553	Old Dominion SLF & Res Mgmt	SUB D	373,538.2	D	70.0	5,390,909
554	King & Queen	SUB D	478,090.6	D	269.0	41,587,273
555	Smith Gap	SUB D	136,278.8	D	100.0	9,679,444
560	Bedford County	SUB D	36,179.0	D	16.2	722,415
562	Atlantic Waste	SUB D	1,271,987.0	D	65.0	3,300,000
563	Amherst	SUB D	23,014.0	D	38.0	1,000,000
569	City of Bedford (Hylton Site)	SUB D	23,297.3	D	9.0	250,000
572	Middle Peninsula Landfill & Recycl	SUB D	508,009.3	D	240.0	44,000,000
575	Corral Farm	SUB D	41,164.0	D	28.0	2,370,603
579	Page County (tons based on #89)	SUB D	140.0	D	67.2	3,775,000
583	Brunswick	SUB D	675,988.4	D	198.0	24,500,000
586	King George	SUB D	1,098,711.0	D	290.2	42,536,364
588	Bristol Balefill	SUB D	109,739.3	D	16.6	7,584,500
	Number of sites/permits	18	**6,219,713.2**		**2,564.22**	**275,084,797**
	AVERAGE for 18 sites		345,539.62		142.5	

Table 2-4 Inventory, Categories, and Distributio.. of Active MSW Landfills in Virginia (1998)

Permit Number	Facility Name	Type of Landfill	1998 Tons of Waste	Groundwater Monitoring Status	Acres Permited for Disposal	Current Available Landfill Capacity in Cubic Yards
	Combination Facilities					
29	Independent Hill PR William	Combo	324,016.0	A	115.6	9,543,074
92	Halifax	Combo	21,667.1	A	56.0	1,500,000
103	I-95	Combo	356,881.0	A	250.0	10,703,200
178	Covington-Peters Mtn	Combo	10,462.9	D	16.8	700,000
228	Petersburg	Combo	25,389.5	A	36.0	3,400,000
285	Campbell	Combo	52,835.7	A	51.0	858,000
304	Nottoway	Combo	16,205.3	A	20.1	11,767,000
398	Virginia Beach #2 Mt Trash	Combo	98,010.0	A	10.0	936,000
405	Greensville	Combo	22,342.5	A	18.0	0
417	SPSA	Combo	372,865.9	D	146.6	655,460
461	Accomack, North (Site #2)	Combo	17,386.1	A	24.4	641,105
508	Carroll-Grayson-Galax-Reg	Combo	51,224.0	D	14.7	1,700,000
545	Springfield Road	Combo	72,538.0	A	34.0	3,000,000
547	Livingston	Combo	37,213.1	A	38.6	2,200,000
558	Lynchburg	Combo	1,007,753.7	A	36.2	3,466,667
564	Tazewell	Combo	27,352.9	D	34.0	490,000
571	Pittsylvania	Combo	42,040.0	A	8.8	49,000,000
580	Big Bethel	Combo	698,368.0	D	208.0	317,096
582	Botetourt	Combo	20,886.7	A	25.0	881,500
584	Prince Edward	Combo	22,319.2	A	18.7	9,100,000
587	Shoosmith	Combo	928,654.0	A	158.0	1,200,000
589	Rappahanock Regional	Combo	6,932.0	D	21.3	451,857
	Number of sites/permits	**22**	**4,215,948.7**		**1,303.70**	**112,510,958.7**
	AVERAGE for 22 sites		191,634.03		59.26	

Table 2-4 Inventory, Categories, and Distribution of Active MSW Landfills in Virginia (1998)

Permit Number	Facility Name	Type of Landfill	1998 Tons of Waste	Groundwater Monitoring Status	Acres Permited for Disposal	Current Available Landfill Capacity in Cubic Yards
	Non-Subtitle D Facilities					
1	Loudoun	Non-Sub D	10,054.0	A	56.1	2,700,000
14	Mecklenburg	Non-Sub D	37,686.0	A	52.0	750,000
21	Augusta	Non-Sub D	82,087.8	D	63.0	56,018
23	Scott	Non-Sub D	7,028.0	A	32.0	202,870
31	South Boston	Non-Sub D	65,983.7	A	22.0	2,375,424
49	Martinsville	Non-Sub D	122,408.0	A	36.0	1,057,181
62	Rockingham	Non-Sub D	95,494.7	A	25.0	648,160
72	Franklin	Non-Sub D	44,304.3	D	21.0	443,040
74	Stafford (Rapp Reg)	Non-Sub D	69,282.0	A	33.0	810,000
75	Rockbridge - Buena Vista	Non-Sub D	42,582.0	D	35.0	389,250
86	Appomattox	Non-Sub D	4,006.0	A	40.0	32,048
90	Orange	Non-Sub D	21,790.7	A	26.0	740,883
91	Accomack - South (Bobtown)	Non-Sub D	15,989.9	A	113.0	655,460
125	Ivy Sanitary	Non-Sub D	63,348.2	A	86.0	89,062
149	Fauquier	Non-Sub D	2,175.0	A	38.0	200,000
182	Caroline	Non-Sub D	11,076.5	A	38.0	1,176,000
194	Louisa Co	Non-Sub D	18,386.5	A	16.0	719,660
204	Waynesboro MSW Balefill	Non-Sub D	27,269.7	A	20.0	32,852
227	Lunenburg	Non-Sub D	9,085.0	D	40.0	833,333
314	Hanover - 301	Non-Sub D	37,052.0	A	35.0	1,300,000
397	Montgomery (Mid-County)	Non-Sub D	55,011.9	D	56.0	0
411	Quantico	Non-Sub D	314.0	D	10.0	0
429	Fluvanna	Non-Sub D	7,292.3	A	23.0	475,000
469	Shenandoah	Non-Sub D	38,111.0	A	20.0	73,266
500	Bristol Debris (back up capacity)	Non-Sub D		D	18.0	122,204
507	Northampton - Oyster	Non-Sub D	13,718.0	A	70.0	1,169,319
513	Wise	Non-Sub D	51,930.7	D	16.0	378,668
	Number of sites/permits	**27**	**953,467.7**	**8**	**1,040.1**	**17,429,698.1**
	AVERAGE for 27sites			35,313.62	38.5	

3.0 MSW LANDFILL CAPACITY IN VIRGINIA

3.1 OVERVIEW OF CURRENT AND FUTURE LANDFILL CAPACITY ESTIMATION

The purpose of this section of the report is to determine the available landfill capacity in Virginia and to project the need for future capacity. An estimate is made of the total landfill space, in cubic yards, that will be needed to accommodate the total waste stream over the next 30 years. The cubic yards of landfill space available as of 1998 and the future tonnage projected to be disposed in Virginia landfills are used to estimate the years of landfill life remaining. Section 3.2 presents information from VDEQ databases on total current permitted capacity and factors that affect the potential future capacity of MSW landfills already operating. Section 3.3 examines the existing disposal capacity in Virginia's active MSW landfills as of 1998, relative to the current annual amount of waste disposal, and projected future fill rates. Issues relating to the determination of capacity are discussed in Section 3.4, including data sources, limitations and assumptions. In Section 3.5 the summary of the findings is presented, along with clarifications that may be useful in interpreting and applying the data.

3.2 TOTAL CURRENT PERMITTED AND TOTAL POTENTIAL CAPACITY OF ALL ACTIVE MSW LANDFILLS

Virginia currently has three types, or categories, of active MSW landfills: Subtitle D landfills; combination landfills with Subtitle D and Non-Subtitle D areas; and, Non-Subtitle D landfills. The location of all 67 active landfills is shown in Figure 3.1 on the following page and a larger fold-out map in the back cover pocket of this report. There are 40 landfills permitted since 1993 which have liners meeting Subtitle D design criteria, as well as leachate collection and gas control. At 22 of the sites containing Subtitle D cells, there are also Non-Subtitle D (HB1205) areas within the permitted facility. These 22 facilities are referred to throughout this report as 'combination' facilities. Another 27 facilities include only Non-Subtitle D cells, and have operated under the provisions of §10.1 - 1408.1(N) (HB 1205), since 1993. Table 3-1 shows the number of landfills by type and the acreage already permitted for disposal as of 1998.

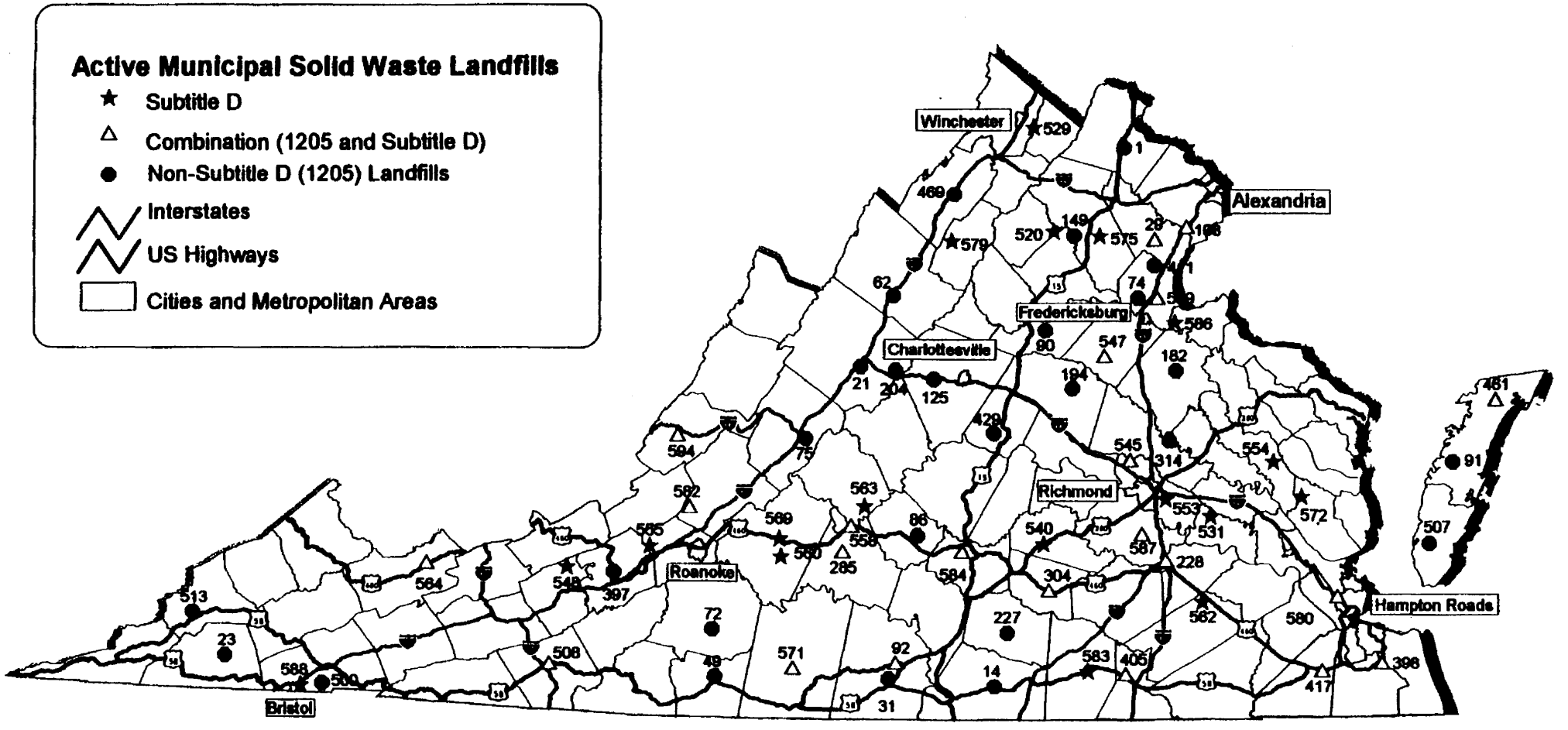
The starting point for estimating capacity remaining in 1998 was to establish values for cubic yards of current permitted capacity. Values were based upon the permitted landfill capacity specified in Part B of the solid waste facility permit application, if that number was contained in VDEQ files in Richmond. According to VDEQ databases, facilities with only Subtitle D liners contained 324,659,074 cubic yards of permitted capacity, while combination

Table 3-1 Acres of MSW Landfill Sites permitted for Waste Disposal

Type of Facility	Number of Landfills	Total Acres Permitted for Disposal	Average Acres Permitted	Range of Permitted Disposal Acres	
				LOW	HIGH
Subtitle D	18	2,564.2	142.5	9	404
Combination	22	1,303.7	59.3	8.8	250
Non-subtitle D (1205)	27	1,040.1	38.5	10	113
	TOTAL	**4,908.0**			

Source: DEQ database, 1998

Figure 3-1 Virginia Solid Waste Management Study



Developed through a collaberation of VDEQ through the Virginia Economic Development Partnership

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Norfolk District
U.S. Army Corps of Engineers

Commonwealth of Virginia
Department of Environmental Quality

facilities contained 138,053,565 cubic yards of Subtitle D capacity. Permitted capacity for Non-Subtitle D cells could not be obtained from the VDEQ database or landfill surveys for many of the combination and Non-Subtitle D facilities; however, available capacity was estimated for the Non-Subtitle D cells using the methodology described in Section 3.3.

In the original scope of this study, total potential capacity of each site was to be estimated based upon ultimate design build out as shown in the Part A permit application. The calculation of this value did not prove to be practicable for several reasons. First, in many older permits, there is no Part A application and the ultimate disposal area of a site is not indicated. Next, if all permittable facility acreage were to be developed into new landfill cells, a significant amount of capacity would be available in the future. However, making an estimate of future capacity requires judgement about operators' future business decisions and a number of other assumptions. For these reasons, no potential capacity projection is presented, although it is likely that additional capacity can and will be developed at existing sites as available landfill space is used up.

Many landfills operating Subtitle D cells have additional disposal area with Part A approval that does not have a Part B permit for construction. Other facilities may have contiguous land suitable for waste disposal that has not been addressed by a Part A that could be permitted and developed in the future. This acreage offers a potential source of future landfill capacity. New Subtitle D cells could also be developed at some Non-Subtitle D sites, or at totally new locations if a Part A for the waste disposal area is approved.

One acre of land can accommodate an average of 126,600 cubic yards of waste, based upon typical Subtitle D designs and operating practices reported by seven of the medium-size regional Subtitle D landfills in this study. The largest five of these seven had new Subtitle D capacity which ranged from 111,000 to 231,000 cubic yards per acre; the variation in capacity is due to different final design elevations and the resultant increased airspace. Based on the average capacity per acre, the tonnage of municipal solid waste landfilled in Virginia in 1998 consumed 180 acres of landfill space out of 4,908 acres permitted for waste disposal.

3.3 AVAILABLE MSW LANDFILL CAPACITY - PRESENT AND FUTURE

The objective of this section is to determine how much of the permitted capacity (cubic yards) in all of Virginia's lined and unlined landfills was available for waste disposal in 1998, and how many years that capacity will last under the scenarios of future waste disposal presented here. A projection was made of municipal solid waste to be landfilled in Virginia over the next 30 years. The assumptions governing this forecast are: (1) no increase in out-of-state imports from 1998 levels; and, (2) tonnage of waste from inside Virginia will increase at a rate no higher than the Commonwealth's population growth rate. The total available permitted capacity existing in 1998 in all of Virginia's MSW landfills was estimated to be 409,801,346 cubic yards, as shown in Table 3-2. Of this total, an estimated 387,595,797 cubic yards is Subtitle D capacity, or 95% to the total available, as shown in Figure 3-2. Based upon the projected rate of filling, the 409,801,346 cubic yards of permitted capacity existing in 1998 for all MSW landfills would be used up by 2014.

Values for available landfill capacity, or capacity remaining, in 1998 were obtained from several sources. The first source was the landfill survey data. The second major source of information was VDEQ files and databases. These sources compared very well for most Subtitle D facilities. If these two sources were unavailable, remaining capacity was estimated by multiplying an estimate of the number of years of life remaining at a landfill by the annual waste disposed at that facility; this alternate method was used primarily for Non-Subtitle D cells.

Table 3-3 shows the total annual waste disposed in 1998 by type of facility. Table 3-4 converts those 11,389,129 tons to the estimated cubic yards the waste would occupy in a landfill. Based on a conversion factor of 0.5 tons, 11,389,129 total tons of waste equates to 22,778,259 cubic yards (0.5 tons of waste equaling 1.0 cubic yards after compaction in an average landfill). A table showing 1998 municipal solid waste tonnage received at the individual permitted facilities is shown in Table 2-3 (Section 2).

3.4 ANALYSIS OF CAPACITIES AND CAPACITY ISSUES OF NON-SUBTITLE D (HB 1205) AND SUBTITLE D LANDFILLS

The purpose of this section is to evaluate how the 409,801,346 cubic yards of capacity in Virginia's 67 active landfills would be filled under several scenarios of future waste disposal. The period of analysis is 1998 through 2030. To demonstrate the effect of utilizing this capacity, a graph (Figure 3-3) was developed to show the cumulative volume of solid waste (cubic yards) projected to be landfilled during that period. The calculations supporting the graph, shown in Table 3-5, are based upon capacity of all sanitary municipal waste landfills in Virginia and the waste flows from both Virginia and out-of-state sources.

Table 3-2 Cubic Yards of Permitted Disposal Capacity Available as of 1998

Type of Facility	Number of Landfills	Permitted Disposal Capacity (in Cubic Yards)		Range of Available Capacity (1998)	
		Total Available	Average Available	LOW	HIGH
Subtitle D	18	275,084,797	15,282,489	250,000	44,000,000
Combination	22	117,286,851	5,331,221	116,000	49,000,000
Non-subtitle D (1205)	27	17,429,698	645,544	0	2,700,000
	TOTAL	**409,801,346**			

Note: Combination facilities contain an estimated 112,511,000 cubic yards of Subtitle D space.

Sources include DEQ database, landfill surveys, and calculations based on closure dates and annual waste volumes.

Figure 3-2 Percent of Available MSW Landfill Capacity in Subtitle D and Non-Subtitle D Facilities, 1998

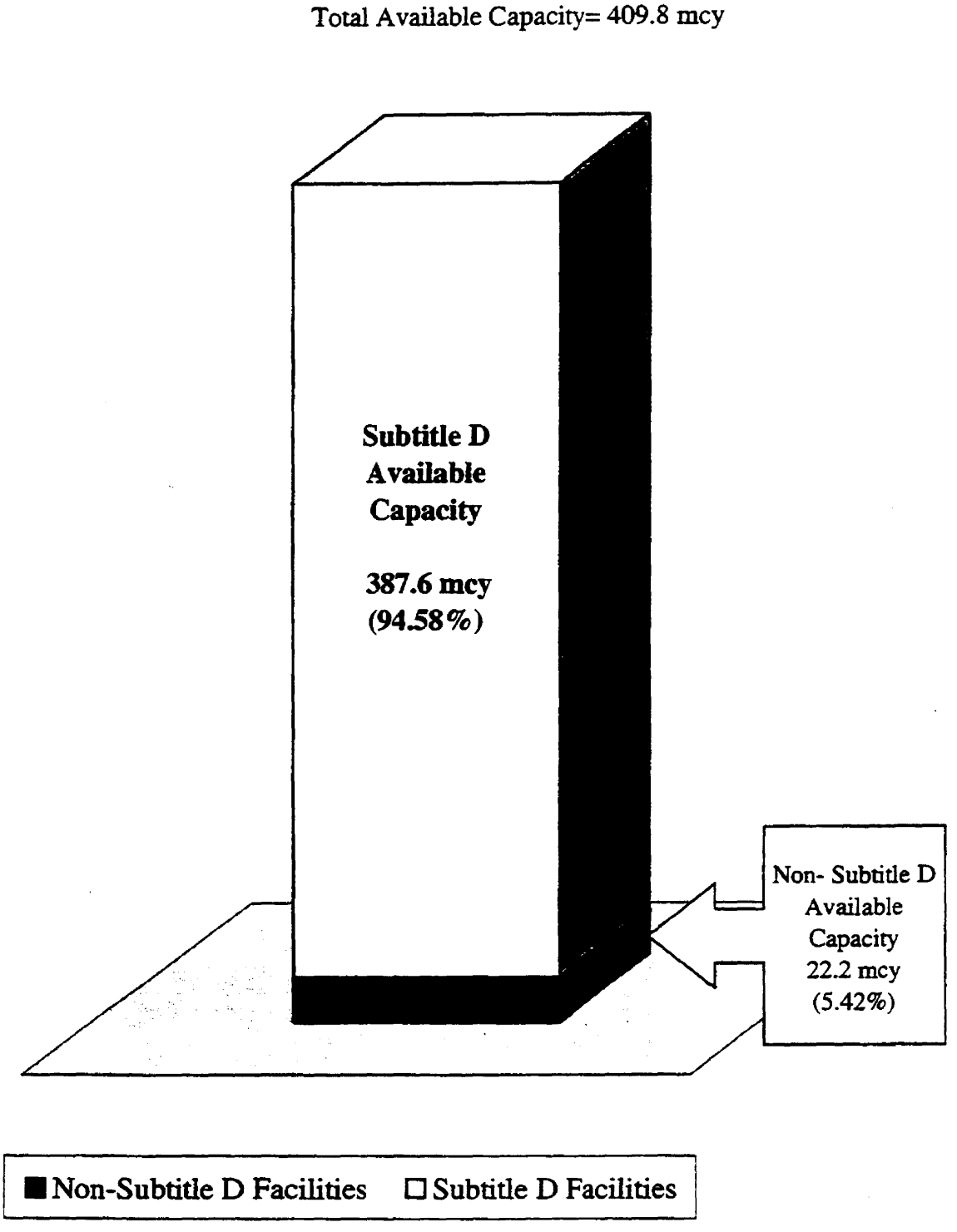


Table 3-3 Waste Disposed in Virginia MSW Landfills - Tons per Year (1998)

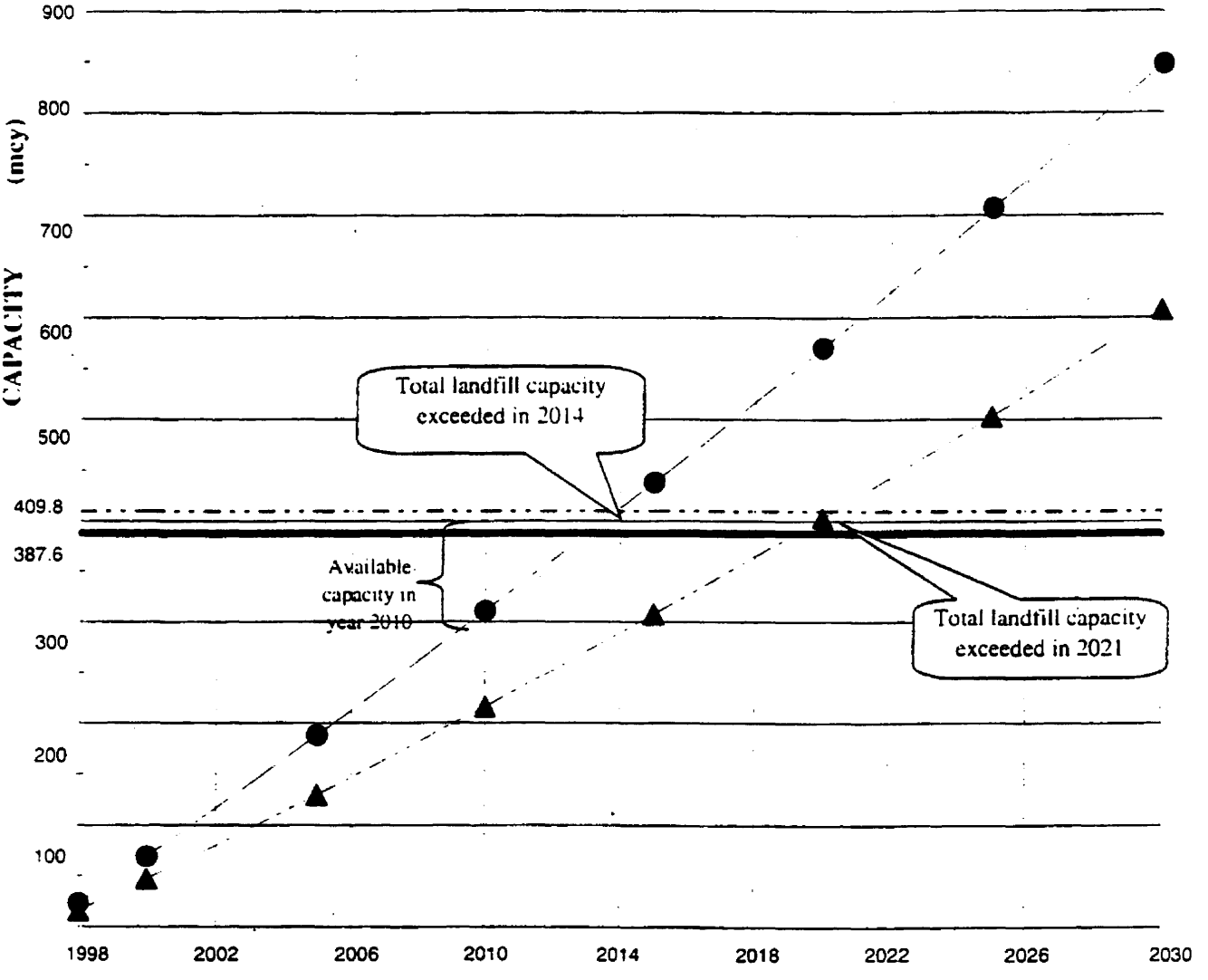
Type of Facility	Number of Landfills	Total Tons/Year Waste Disposed	Average Tons/Year Waste Disposed	Range of Tons/Year Waste Landfilled	
				LOW	HIGH
Subtitle D	18	6,219,713	345,540	1,477	1,271,987
Combination	22	4,215,949	191,634	6,932	1,007,754
Non-subtitle D (1205)	27	953,468	35,314	314	122,408
TOTAL	67	**11,389,129**	169,987		

Table 3-4 Waste Disposed in Virginia MSW Landfills - Cubic Yards per Year (1998)

Type of Facility	Number of Landfills	Total CY/Year Waste Disposed	Average CY/Year Waste Disposed	Range of CY/Year Waste Landfilled	
				LOW	HIGH
Subtitle D	18	12,439,426	691,079	2,954	2,543,974
Combination	22	8,431,897	383,268	13,864	2,015,507
Non-subtitle D (1205)	27	1,906,935	70,627	none	70,628
TOTAL	67	**22,778,259**	339,974		

Note: The cubic yards above were obtained by multiplying the tons of Table 3-3 by 2, or a conversion factor of 1 ton = 2 cubic yards of waste. Actual compaction ratios in landfills will vary.

Figure 3-3 Projected Landfill Capacity For Non- Subtitle D and Subtitle D Facilities in Virginia



Total Available Capacity in millions of cubic yards (Subtitle D Facilities)

Total Available Capacity in millions of cubic yards (Non-Subtitle D & Subtitle D Facilities)

Cumulative Total Available Landfill Capacity Used by in-state waste, millions of cubic yards

Cumulative Total Available Landfill Capacity Used by in- and out-of-state waste, millions of cubic yards

Table 3-5 Total Landfill Capacity - Non-Subtitle D and Subtitle D Facilities

Year	Population	Average Annual Population Growth Rate[a.]	Cummulative Total Available Landfill Capacity Used Values in millions of cubic yards			Total Available Capacity Values in millions of cubic yards	
			In-state waste[b.]	Out-of-state waste[c.]	In- and Out-of-state waste[d.]	Subtitle D Facilities	Non-Subtitle D & Subtitle D Facilities
Dec-98	6,791,300	1.13	15.50	7.28	22.78	387.60	409.80
Dec-00	6,992,045	1.48	47.19	21.84	69.03	387.60	409.80
Dec-05	7,372,858	1.00	129.42	58.23	187.64	387.60	409.80
Dec-10	7,737,597	1.08	216.04	94.62	310.66	387.60	409.80
Dec-15	8,137,497	0.99	307.21	131.01	438.23	387.60	409.80
Dec-20	8,522,732	0.95	402.87	167.40	570.27	387.60	409.80
Dec-25	8,907,948	0.90	503.00	203.80	706.79	387.60	409.80
Dec-30	9,293,174	0.86	607.59	240.19	847.78	387.60	409.80

NOTE: Original VDEQ data was in tons, and was convered to cubic yards based on conversion factor of 2 (0.5 ton=1 cy)

a. Derived from population estimates, Weldon Cooper Center for Public Service, University of Virginia (retrieved 7 September 1999).

b. 1998 value of in-state flows multiplied by the growth factor to project annual flow generated from in-state sources.

c. Total landfill capacity filled by out-of-state waste. Out-of-state waste is assumed to remain constant at the 1998 level in this analysis.

d. Landfill capacity filled by in- and out-of-state waste. These cummulative values are derived by adding the two previous columns.

3.4.1 Projecting and Graphing Landfill Capacity

The following assumptions, definitions and procedures were used in the analysis and calculations for Figure 3-3:

1. The starting point for the analysis is all waste landfilled in Virginia in 1998, or 11.4 million tons (converted to mcy by dividing by 0.5). Only waste being generated inside Virginia is projected to grow, based on future population increases inside the Commonwealth.

2. The "current available capacity" represents the remaining capacity in all active Virginia MSW landfills as of 1998. This value is indicated by the horizontal lines on each graph. In some cases, landfills reported this value; in others, it was calculated based on annual fill tonnage, years of life remaining, and a factor (0.5 tons = 1 cubic yard) to convert tonnage to cubic yards.

In Figure 3-3, the cumulative landfill capacity used by in-state waste is shown in the area under the lower sloped line on the plot (Total Landfill Capacity Used, In-State Waste). The upper sloped line represents the total capacity used for all waste. The cumulative quantity of out-of-state waste is shown as the area between the two curves on the graph. For any year before the available capacity has been used, the difference between landfill capacity used (the upper sloped line) and total capacity available (horizontal line) represents the remaining total landfill capacity in Virginia; after the available capacity has been exhausted, this difference represents the capacity deficit for any year.

The estimate of future waste volume was prepared on the basis of projected growth over the period of analysis (1998 to 2030) using a population-based growth rate for the Commonwealth of Virginia, as shown in the second column of table 3-5. If population is increasing, waste generated should also increase, unless the per capita amount of waste generated decreases. Population estimates for the years 1990-1998 and population projections for years 1999 through 2010 were obtained from the Weldon Cooper Center for Public Service at the University of Virginia (**http://www.virginia.edu/coopercenter/vastat/#pop**).

The annual population growth rates derived from those projections were the starting point for projecting waste growth for years 2000 through 2015. The projection of a growth factor for in-state waste between 2015 and 2030 assumes that the rate of increase will gradually decline over the second 15 year period. Population-related growth rates were only used to increase the future volume of in-state waste generated and disposed. Out-of-state waste was held at its 1998 level of 3.64 million tons, or 7.28 mcy, as shown in the third column of Table 3-5. A forecast value for each year was developed for both in and out-of-state waste, and the cumulative amounts for each year are plotted as the sloped lines in Figure 3-3. The calculation of the cumulative yards of

waste is shown in Appendix D. The year in which a sloped line crosses the horizontal landfill capacity line is the year in which all landfill capacity is used up for that flow or source of waste.

3.4.2 Landfill Survey Data

In determining capacity and fill rates of all landfills, a survey of landfill owners or operators was devised for this study to supplement VDEQ databases. The survey was faxed to the owners, operators, county and town managers or environmental departments responsible for the 67 active MSW landfills. Follow-up phone calls were made to obtain information by phone or return fax. In some cases, the initial contact person assigned the task of responding to the questionnaire to a solid waste department, county or consulting engineer involved in landfill design or operations, or to the landfill operator. A number of responses were received by mail. Out of 67 MSW landfills queried, 41 responded; not all respondents answered all questions. A copy of the survey form is included in Appendix B.

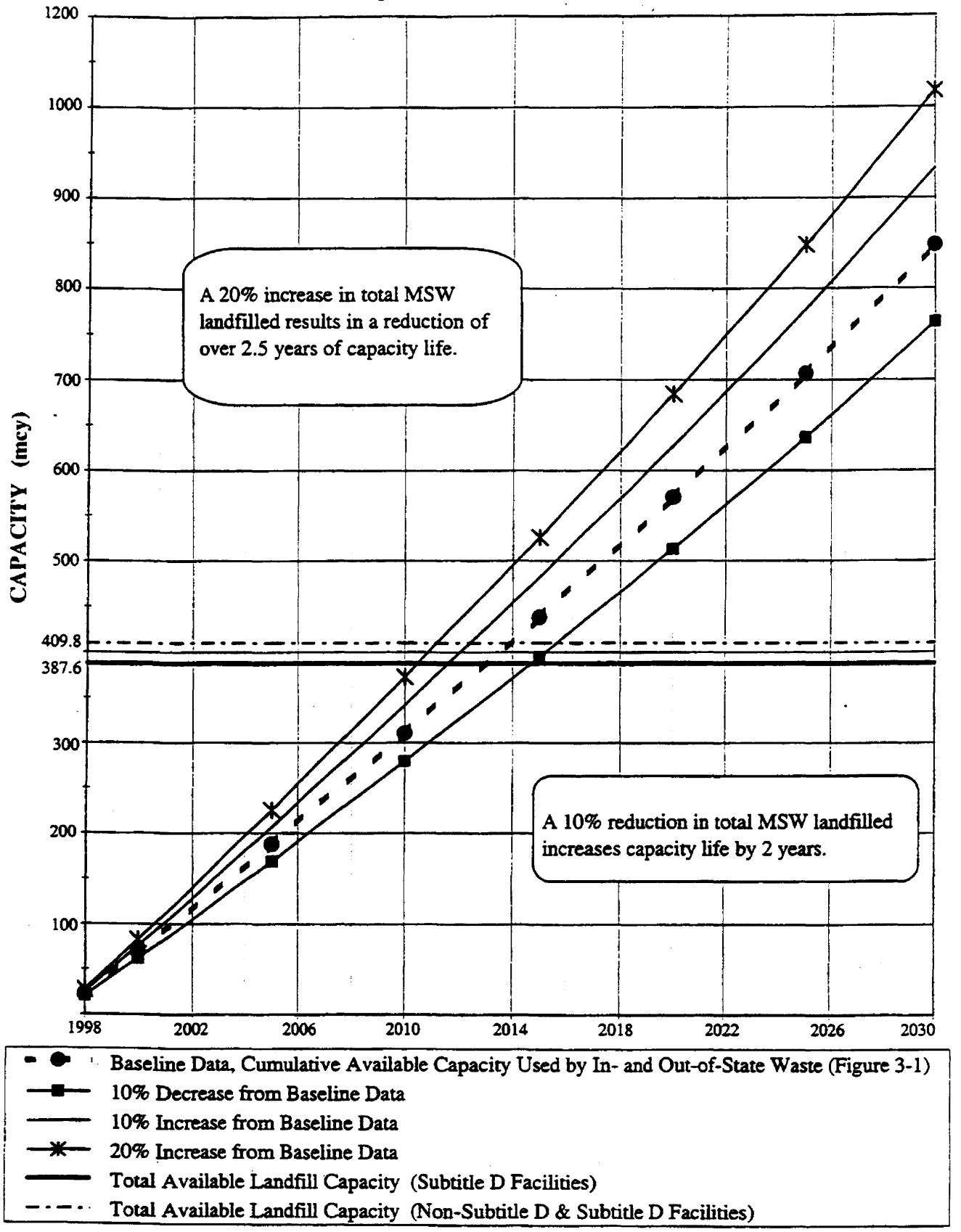
3.4.3 Interpreting Capacity Projection

Projecting the year in which landfill capacity will be exhausted is dependent upon such a large number of assumptions that it should be considered a planning exercise to be conducted regularly, as new information is available. A lack of accurate initial data values can affect the accuracy of the projections. For example, there is no requirement for landfills to measure the amount of capacity used, no automated system that tracks how much airspace each landfill uses year by year, and, therefore, no easy way to accurately determine the total landfill capacity existing in Virginia at a particular time. Also, while some facilities report waste received to VDEQ in tons (actual weights), some of the smaller facilities can only estimate a value because they are not able to weigh their incoming waste. There is no requirement for landfills to weigh incoming waste.

In order to examine the effects of the factors that create an element of uncertainty in future landfill capacity needs, it is useful to evaluate the impact of different growth rates on how long the available landfill capacity will last. To evaluate these possible effects, the projected values for total landfill capacity used were varied by -10%, +10% and +20%. The -10% factor was chosen to show the possible impact of reducing the incoming waste stream; the +10% and +20% scenario are intended to demonstrate the possible effect of increasing the quantity of waste received. A graph of this sensitivity analysis is shown in Figure 3-4. A 20% increase in the total MSW landfilled results in a reduction of over 2.5 years of capacity life, while a 10% reduction in total MSW landfilled increases capacity life by 2 years.

Volume estimates used in this report are based on tonnage originally reported to VDEQ in 1998 and converted to cubic yards based on a conversion factor of 0.5 tons = 1 cubic yard. Conversion factors vary from one landfill to another. To obtain the most accurate measurement of capacity used each year, each facility's reported annual tonnage of material landfilled should be converted

Figure 3-4 Projected Landfill Capacities
For Non-Subtitle D and Subtitle D Facilities in Virginia
Assuming -10%, +10%, +20% Growth



into a volume estimate specific to that facility's current operation. The factors which influence the amount of space each ton takes up in any given facility are the compaction rate, the predominant type of waste, and daily operations at the landfill working face. Compaction of waste within a landfill varies because it is first compacted in the truck which picks it up, and then again at the landfill, where tracked equipment is driven over the material to increase its density. Some waste arrives baled and has a much higher density per cubic yard than typically achieved by other methods. Bulky wood waste and building debris do not compact to the density of household waste, which usually is composed of more compressible materials. Based on all of these factors, actual experience has shown that compacted wastes may vary from about 1,000 pounds per cubic yard to approximately 1,800 pounds per cubic yard. The estimates in this report were based on the lower value of 1,000 pounds per cubic yard, which means that the capacity estimates are conservative.

An additional consideration in determining landfill capacity is the type of daily cover used. The regulatory standard is a minimum of 6 inches of soil cover to be applied each day. The volume of space required by soil cover reduces the proportion of the total volume of a landfill that is available for the placement of waste. Alternative cover materials of an different thickness may be approved if the alternates can demonstrate performance equivalent to the soil cover The soil cover consumes more airspace per ton of waste than alternative cover products such as spray slurries and foams, or reusable synthetic blankets.

A site specific tonnage-to-cubic yards conversion factor, which takes into account the operating procedures of an individual landfill, will provide the most accurate estimate of capacity used annually at that facility. Variations in operations or type of material accepted will affect the accuracy of this approach. In order to obtain the most accurate conversion factor, facilities will contract for a topographic survey of their working cells to measure the volume (cubic yards) of space used. When the measurement of the actual volume is compared to the waste tonnage received and the amounts of cover soil used, the landfill operator can accurately assess the efficiency of their operating procedures and make any necessary adjustments to optimize the life of the facility. Statewide inventories of remaining capacity are only as accurate as the measurements at the landfills that are reporting the data.

3.5 SUMMARY OF FINDINGS

Based on the circumstances presented in this report, the current landfill capacity available in Virginia for the total waste stream is projected to last until the year 2014, even without Non-Subtitle D capacity. This assessment is based on no significant change in Virginia's per capita waste disposal rates from 1998 levels. If per capita disposal increases in the future and is not offset by higher rates of recycling, landfill capacity may be used at a faster rate.

The availability of 14 years of landfill capacity should not be interpreted to mean there would be no impact to Virginia's communities if all Non-Subtitle D landfills were to close in the near future. There is regional variability in the number of years of available landfill life and in the cost of providing alternatives to Non-Subtitle D landfills. As the map in Figure 3-1 shows, there is a concentration of Subtitle D facilities along major highway corridors, particularly US I-95. Many of the large capacity sites are in the eastern portion of the state (east of US I-95). Communities in the far southwestern portion of the state and in a large portion of the central Piedmont region of the state (centering around Charlottesville) do not have ready access to Subtitle D landfills.

Regional changes in available capacity can occur rapidly for unforeseeable reasons. An example of this happened at landfills near the Virginia-North Carolina border in the area affected by Hurricane Floyd in 1999. Capacity was used at a much faster rate than planned because of massive influxes of bulky material from storm damage cleanups.

The timing with which new landfill capacity might be brought on line depends on such factors as the market conditions for waste disposal, and whether or not tipping fees and projected waste flows are adequate to cover development costs of new cells at existing sites. There is potential for capacity to be developed at a number of active Virginia sites if the economic conditions are favorable. While it would be desirable to have a quantitative estimate of potential capacity, there was not enough verifiable information to make such a projection.

4.0 ANALYSIS OF NON-SUBTITLE D (HB 1205) MSW LANDFILLS VERSUS SUBTITLE D MSW LANDFILLS IN VIRGINIA

4.1 OVERVIEW

This Section of the report provides an analysis of active Non-Subtitle D landfill facilities in Virginia and, where appropriate, provides a comparison with active Subtitle D landfill facilities.

The general nature of this study issue required the segregation of the analysis and the report into four main Sections which are summarized below:

1. **Potential Threat to Human Health and the Environment** - The analysis in Section 4.2 includes a comparison of the groundwater status of Non-Subtitle D landfill facilities in Virginia versus Subtitle D landfill facilities. Information from the States Survey Questionnaire and literature searches of EPA publications, reports, journals, etc., were utilized to establish the potential threat to human health and the environment posed by Non-Subtitle D facilities in comparison with Subtitle D facilities. This analysis does not provide a site by site evaluation or assessment of individual MSW landfills in Virginia.

2. **Projected Closure Dates of Non-Subtitle D (HB 1205) MSW Landfills** - The analysis in Section 4.3 provides a comparison of the most recent expected dates of closure of the Non-Subtitle D landfill facilities with the stated dates of closure provided with MSW landfill's certifications in 1993.

3. **Average and Range of Costs Associated With Closure and Corrective Action of Non-Subtitle D MSW Landfills** - The analysis and evaluation in Section 4.4 establishes the average and range of costs associated with closure and corrective action of Non-Subtitle D landfills, and the transportation of MSW to alternate Subtitle D landfill facilities. In addition, a comparison of the above transportation costs are made with the costs of constructing a new Subtitle D landfill cell on-site at an existing Non-Subtitle D landfill.

4. **Cost/Benefit Analysis Associated With Closure and Corrective Action of An Average Non-Subtitle D MSW Landfill in Virginia** - The analysis in Section 4.5 evaluates the short term potential benefits associated with the continued operation of an average Non-Subtitle D landfill facility, versus the potential long term costs and liabilities related to closure and corrective action for such a facility.

The analysis in the Sections below utilized information from the following: the VDEQ database, literature searches, the States Survey Questionnaire, the MSW Landfill Facilities Survey Questionnaire, this study scope of work, and requirements specified within the Virginia Solid Waste Management Regulations, 9 VAC 20-80-10, et seq.

4.2 POTENTIAL THREAT TO HUMAN HEALTH AND THE ENVIRONMENT OF NON-SUBTITLE D VERSUS SUBTITLE D MSW LANDFILLS

Groundwater monitoring results for Virginia's 67 active MSW landfills indicate that Non-Subtitle D cells are the primary, if not sole, source of contaminant releases. Table 4-1 presents the data from VDEQ's database. Only 13 of the 49 sites with Non-Subtitle D cells are still in the detection phase of monitoring.

Table 4-1 Number of Landfills in Detection or Assessment Phase of Groundwater Monitoring

Type of Facility	Number of Landfills	Number in Groundwater Detection	Number in Groundwater Assessment
Subtitle D	18	18	none
Combination	22	6	16
Non-subtitle D (1205)	27	7	20
TOTAL	67	31	36

Source: VDEQ Database, 1998-1999

The groundwater monitoring networks at all landfills are designed to provide the earliest possible detection of any releases of contaminants from the landfills. The groundwater is analyzed for specific waste constituents; for many of these contaminants, action levels have been established based on health and environmental factors. To accomplish the goal of early detection, the down-gradient (or compliance) wells are located as closely as possible to the waste disposal area and are installed to monitor the uppermost aquifer. The wells are sampled at least twice each year, and the data from the sampling are statistically evaluated to determine trends. An increasing trend for any waste constituent may be a preliminary indication of a release. Monitoring is conducted in accordance with the detection phase requirements until the established concentration limits are exceeded. If the limits are exceeded in the detection phase, monitoring moves to the assessment phase. During assessment monitoring, samples are analyzed for a more extensive list of contaminants. If any of the listed constituents are detected during the assessment monitoring phase, groundwater protection standards must be developed for those constituents. An exceedence of the groundwater protection standards can result in the facility moving into the corrective action phase.

While data from the groundwater monitoring program have revealed that Non-Subtitle D cells are causing contamination, characterizing the impacts of that contamination requires a detailed, site-by-site review of the data and other investigations beyond the scope of this study. Because some Non-Subtitle D landfills lack adequate liners, and/or leachate collection systems, and other environmental controls, it is not surprising that many of them are in assessment monitoring, while none of the Subtitle D facilities are. Because adverse effects on the environment can arise from the migration of leachate, the high percentage of Non-Subtitle D MSW landfills in assessment monitoring is a concern. However, it is not possible to ascertain the differences in impacts from landfills in assessment monitoring without more extensive data on each site.

The specific characteristics of leachate vary widely from landfill to landfill, and even in the same landfill over time, since the dynamic decomposition of waste can affect the proportion and strength of different constituents. However, leachate from a non-hazardous municipal solid waste landfill can contain a number of chemicals and metals that toxicological studies have shown to be harmful to life, and some that are carcinogenic. Action levels have been established for many of the proscribed waste constituents based on the toxicological effects. Studies of direct industrial or occupational exposures, either dermally or through inhalation, have also provided evidence of human health effects from chemicals which can be found in leachate. These studies are not directly applicable to individuals living near a landfill however, because the level of exposure (dose) and pathways of exposure are not the same. A contaminated groundwater water supply is probably the clearest example of a verifiable pathway of exposure for humans that may result from an off-site plume of landfill leachate. Water supply replacement is usually the measure undertaken to protect human health in such cases, and this has occurred in several states, according to the responses obtained from the States Survey in Appendix B.

Landfill leachate which reaches surface water from seepage, or through ground water discharge, can contaminate a water supply source. Documenting this effect through chemical testing of the affected water can be complicated if there are industrial point discharges occurring upstream. The effects of surface water contamination can sometimes be seen in a reduction of species diversity, or change in the distribution of species, near the suspected leachate discharge area. Often very sensitive species will disappear or become scarce in surface waters impacted by landfill leachate. These changes will in turn affect higher level organisms. The contamination of groundwater can also destroy the use of an aquifer for crop irrigation, because of the presence of metals or high levels of chlorides.

Another type of study relevant to the evaluation of environmental and human health effects of leachate from MSW landfills is the risk assessment. These studies may link a level of exposure with an increased probability of contracting cancer or another disease. Exposure estimates always involve a degree of uncertainty and judgement. Risk assessment studies are more likely to be performed for landfills on the National Priority List, or Superfund sites. Many of these landfills operated through the 1960's and 1970's, prior to the Resource Conservation and Recovery Act Regulations, and accepted quantities of hazardous waste from industrial or commercial generators in additional to municipal solid waste. In these and other respects,

they may be different from Virginia's currently operating Non-Subtitle D landfills.

A very limited review of USEPA records of decision (RODS) for eastern U.S. landfills in corrective action revealed that sites requiring extensive groundwater remediation are usually those with a history of accepting hazardous and toxic wastes, including industrial solvents, drums of chemical waste, metal finishing sludge, and PCB-containing materials. Based on an EPA memorandum dated August 21, 1987 regarding the listing of municipal landfills on the National Priorities List, it was not the intention of the Superfund program to address municipal solid waste landfills without any history of accepting hazardous wastes.

Epidemiology studies are another means to determine relationships between an exposure and a disease or other impact on health (reduced life expectancy, impaired cognitive function, etc.). These studies can take many years to conduct and are very expensive. Epidemiology studies have been done for a number of occupational exposures to toxic or carcinogenic materials such as asbestos, chromium, uranium, etc. Citing a 1997 study by B.L. Johnson on "Hazardous Waste: Human Health Effects," the Agency for Toxic Substances and Disease Registry (ATSDR) indicates that "few epidemiology studies have had sufficient statistical power to adequately investigate cancer mortality in populations residing near individual hazardous waste sites."

It would be much harder for an epidemiological study to find a correspondence between health effects and specific offsite releases (to groundwater, surface water and air) from municipal solid waste (MSW) landfills than it would from hazardous waste sites. Among the factors which would complicate the conduct and interpretation of epidemiological studies related to MSW landfill exposure are the environmental prevalence of compounds which may also be found in landfill leachate, such as lead, and the long latency period of diseases like cancer.

This study was not able to locate any epidemiology studies that examined the health effects of exposure to landfill leachate or gas emissions from non-hazardous sanitary landfills, either Subtitle D or Non-Subtitle D. The Agency for Toxic Substances and Disease Registry (ATSDR), which was established by Congress to monitor the health of people exposed to hazardous waste sites, has conducted Public Health Assessments primarily for industrial landfills with a history of accepting hazardous and toxic wastes. Two examples of ATSDR Public Health Assessments (PHA) for non-hazardous landfills are included in Appendix E. These PHA's were not able to link migration of leachate to any human health impact.

Predicting environmental or human health impacts from any group of landfills, especially a group as heterogeneous as Virginia's Non-Subtitle D landfills, would require many assumptions. Even when a priority pollutant is present in groundwater samples, that condition is not enough to predict site-specific environmental damage or human health impact. If assessment phase monitoring reveals that there is groundwater contamination and potential adverse impact to human health and the environment, corrective measures would be required. The extent of corrective measures for a site is often determined by risk assessment analysis, and the measures

implemented are designed to eliminate exposure pathways to humans. Human exposures to leachate contaminants through drinking and household uses of water are usually eliminated by providing an alternate water supply. The purpose of early detection and corrective measures is to avoid any long term adverse health effects.

Each of the 49 Non-Subtitle D landfills offers a unique situation because of one or more of its characteristics: volume of waste, types of waste received, soil and hydrology of the site, and design features such as liners, leachate collection and gas control. The best informed judgement about the health effects of operating Non-Subtitle D landfills would have to be based on a site-specific investigation of the leachate contaminants, the extent of off-site migration, the number of potentially exposed people, and the nature and duration of their exposure.

In comparing Non-Subtitle D with Subtitle D landfills, there is no guarantee that the latter facilities will not leak in the future. EPA indicated at the time the Subtitle D regulations were proposed that liners might eventually leak after many years. Geomembrane liners can develop leaks at seams, and have not been proven imperious to 30 or more years' exposure to the chemicals that form in landfill leachate. However, considerable research has been done which indicates that the materials commonly used for landfill liners retain their structural integrity and chemical resistance for many decades. Improved detection and early control of leakage are relied upon to prevent off-site contamination. Because of the redundancy of safeguards, there is an expectation that Subtitle D landfills will not require corrective action in the future.

4.3 PROJECTED CLOSURE DATES OF NON-SUBTITLE D (HB 1205) MSW LANDFILLS

This Section provides a comparison of the most recent expected dates of closure of the Non-Subtitle D landfill facilities with the estimated dates of closure provided by the owner/operator's of MSW landfills in 1993.

There are two sources of information for closure dates of Non-Subtitle D MSW landfills. The first source is the VDEQ database, which provides the date each MSW landfill was estimated to close based upon the owner/operator certification statements in 1993. The certification statements were required in accordance with the HB 1205; the certification statement indicated an estimate when the MSW facility would reach its vertical design capacity. The second source of information was from data gathered from the "Municipal Solid Waste Landfill Facilities Survey Questionnaire," which was implemented as part of this study.

Closure dates reported from both sources are shown in Table 4-2. In 1993, all but three Non-Subtitle D (HB 1205) landfill owner/operators indicated that they would close by 1999, based upon the closure dates provided in the certification statements under HB 1205. However, since the initial certification statements, at least 17 owner/operators of Non-subtitle D landfills have continued to operate past the date they originally estimated their landfill would reach design

Table 4.2 Estimated Closure Dates for Active Sanitary Landfills
From 1205 Submittals by Facilities in 1993

Facility Name	Permit #	1205 Closing date	Landfill Survey Response
Accomack	91	10/9/96	**2018**
Accomack	461	4/1/95	**2022**
Appomattox Co.	86	no information	N.R.
Augusta	21	6/30/96	N.R.
Big Bethel	580	fall 1994	**2001**
Botetourt Co.	319, 519 (582)	10/8/95, 10/7/96, old area incorporated into permit #582	N.R.
Bristol Lf	498/500	10/1/96	N.R.
Campbell Co.	285	11/1/94	N.R.
Caroline Co.	182	no information	N.R.
Carroll Co.	508	6/1/95	**2000**
City of Martinsville	49	6/27/05	N.R.
Fauquier	149	12/1/94	N.R.
Fluvana Co.	429	7/1/95	N.R.
Frankilin Co.	72	12/31/03	**2003**
Greensville Co.	405	11/1/96	**2017**
Halifax	92	no information	N.R.
Hanover Co.	314	10/1/95	N.R.
I-95	103	1995, potentially until 2025 (piggyback on ash cell)	N.R.
Independent Hill	29	4/1/97	**2003**
Ivy Lf	125	10/1/97	N.R.
Livingston #2	547	no 1205 information, currently in Subtitle D area	N.R.
Loudoun Co.	1	1996, 1997	N.R.
Louisa County	194	7/1/95	**2011**
Lunenburg County	227	12/1/98	N.R.
Lynchburg	558	no 1205 information, currently in Subtitle D area	N.R.
Madison Co.	442	8/96 for cell 4 2003-all 7 cells	N.R.
Mecklenburg Co.	14	10/5/98	N.R.
Mid County Lf.	397	1/1/98	N.R.

Table 4.3 Estimated Closure Dates for Active Sanitary Landfills
From 1205 Submittals by Facilities in 1993 (con't)

Facility Name	Permit #	1205 Closing date	Landfill Survey Response
Northampton	507	12/1/00	**2002**
Nottoway Co.	304	4/30/95	N.R.
Orange Co.	90	1997-1998	N.R.
Page Co.	89	3/1/95	N.R.
Petersburg	228	1/1/95	**2007**
Peter's Mountain	178	10/1/95	**2000**
Pittsylvania Co.	571	currently in Subtitle D area	N.R.
Quantico	411	12/1/95	N.R.
Rappahannock Regional	74, 520, 589	6/20/05	N.R.
Rockbridge Co.	75	12/1/97	**2008**
Rockingham Co.	62	10/4/96	**2000**
Scott Co.	23	closure 3/98	**2006**
Shenandoah Co.	469	7/1/95	N.R.
Shoosmith	587	no 1205 information, currently in Subtitle D area	N.R.
South Boston	31	no information	**2017**
Springfield Rd. LF	545	11/15/93	not applicable
SPSA	417	1/1/97	**2000**
Tazewell	564	no 1205 information, currently in Subtitle D area	N.R.
Va Beach Lf #2	398	1/1/98	N.R.
Waynesboro	204	10/1/05	**2002**
Wise Co.	513	no information	N.R.

Source: DEQ database 6/29/1999
Note that N.R. means either there was no response on the survey or no survey was completed

capacity. Furthermore, there are currently at least four Non-Subtitle D (HB 1205) MSW landfills intending to operate beyond 2017. It should be noted that all of the landfills which plan on operating beyond 2017 are in the groundwater assessment phase of monitoring.

The groundwater assessment phase of monitoring is required when the detection phase of groundwater monitoring indicates that there are statistically significant differences in the data between the background and compliance monitoring wells. The assessment phase of groundwater monitoring requires the landfill facility to evaluate the concentrations of solid waste constituents in the groundwater and to determine the rate and extent of migration of the constituents.

At least nine Non-Subtitle D landfill owner/operator's have indicated they will close their facility's Non-Subtitle D cells by 2003. Several Non-Subtitle D facilities are in the process of closing cells this year, or early in the year 2000.

4.4 AVERAGE AND RANGE OF CLOSURE, CORRECTIVE ACTION, TRANSPORTATION, AND OTHER COSTS FOR NON-SUBTITLE D (HB 1205) MSW LANDFILLS

The analysis in this Section is subdivided into six subsections and establishes an estimate of the average and range of costs associated with closure and an estimate of the potential costs of corrective action of Non-Subtitle D landfills. The analyses is segregated under the following areas:

1. Closure costs.
2. Corrective Action Costs.
3. Transportation and Disposal costs associated with hauling MSW to alternate Subtitle D MSW landfill.
4. Costs of constructing a new Subtitle D MSW landfill cell on-site of the Non-Subtitle D (HB 1205) landfill.
5. Other costs identified in constructing a new Subtitle D MSW landfill on-site.
6. The total estimated average cost and range of costs associated with closure and potential corrective action of a Non-Subtitle D MSW landfill.

The purpose of estimating the average and range of potential costs, and the analysis under this section, is to provide a basis for the comparison of cost-savings (or benefits) from the continued operation of Subtitle D (1205) landfills, with the potential long term costs of accelerated closure

and disposal in a Subtitle D Landfill. Corrective action is a potential long term cost (or liability) associated with Non-Subtitle D (HB 1205) landfill operation that could be affected by the choice of closure date. The above is the basis of the discussion of benefits and costs provided in Section 4.5 of this report.

Costs shown in Sections 4.4.1 through 4.4.5 were based upon: 1) the project database of Earth Tech, a civil engineering consulting firm under contract to the Army Corps of Engineers for this portion of the study; 2) the survey responses of 40 landfill operators or owners within the Commonwealth of Virginia; and, 3) other reference sources listed for each feature or construction element. The cost analysis reflects current average prices for fuel, labor, transportation (waste hauling), and material that would apply to most Virginia communities. Current tipping fees were determined from Virginia landfill survey responses believed to reflect actual prices charged to long-term customers. Survey data from Virginia landfills on costs of closure and constructing a new Subtitle D landfill cell on-site at an existing Non-Subtitle D landfill are shown in Sections 4.41 (Table 4-7) and Section 4.4.6 (Table 4-12). The averages from these values were within the cost estimate ranges developed from Earth Tech's database and were used to estimate costs for the closure and new cell construction which are summarized in Section 4.4.7. It should be noted that the closure cost estimate below does not include the cost of post-closure monitoring and care which is required for all closed MSW landfills.

Developing average or typical costs associated with closing a Non-Subtitle D landfill, transporting MSW to another Subtitle D landfill site for disposal, or constructing a new Subtitle D landfill cell on the site of a Non-Subtitle D facility, permits a comparison of the capital costs of each option. However, these costs are not sufficient for determining the relative economic or financial cost of each course of action. Any analysis used to select the least costly disposal option would have to consider remaining capacity in an active Non-Subtitle D landfill and other factors. Comparing the average cost of options presented in this report will not reveal opportunities for cost savings from regional transfer stations or landfills, which can be less expensive than operating a small Subtitle D landfill, or even a Non-Subtitle D landfill. The least cost alternatives for a community can only be identified on a case-by-case basis, and will be influenced by transportation distance to the nearest alternate facility, as well as the tipping fee which a community is able to negotiate with the new facility.

Unlike the other cost areas noted above, estimating the cost of corrective action (or groundwater remediation) for a Non-Subtitle D landfill is highly uncertain. Corrective action is considered the wild card in the analysis shown in Section 4.4 as the costs may range from zero dollars to millions of dollars, and possibly up to the level of a Superfund remediation.

The need for corrective action depends upon the nature and characteristics of the site, and the nature of the wastes that were historically disposed at the landfill. Therefore, a determination of the need for corrective action at a Non-Subtitle D MSW landfill can only be established by a detailed site investigation of a specific landfill. Decisions with significant financial consequences for one, or a group of, landfills should not rely on a broad or brief desktop analysis

such as provided within this report. Predictions of future corrective action need to be made on a case-by-case basis.

For background purposes, corrective action that may be needed for any Non-Subtitle D landfill is dependent upon the nature of the site soils, geology, hydrogeology, and setting of the MSW landfill relative to drinking water sources and sensitive ecosystems, along with the chemical properties and nature of wastes historically disposed in the landfill. Corrective action may not be required at some sites where the nature, extent, and rate of migration of the contamination are demonstrated to be naturally attenuated by the natural site characteristics. On the other hand, some MSW landfills may require extensive groundwater corrective action to meet State criteria and standards and to protect human health and the environment. In addition to corrective action for groundwater, other corrective measures may be needed at a landfill for gas and odor control, erosion control, etc.

Although the recommendation above is for case-by-case analysis, this report provides an estimated average and range of costs associated with corrective action that may be required for a Non-Subtitle D landfill. It should be noted that the estimated medium cost within this report is based upon limited data from EPA cases and the assumption that groundwater pump-and-treat would be the selected measure. Although the analysis presented here uses the medium cost developed in Section 4.4.2 to estimate a total amount of corrective action that might arise from the operation of Non-Subtitle D landfills, this is not an actual forecast of expected costs, but a planning estimate. The true average cost for corrective action at Non-Subtitle D landfills may be much different than the medium cost estimated within this report. However, there is a real potential that corrective action could be a significant cost to local communities which operate Non-Subtitle D landfills, as indicated by the range of costs from the Environmental Protection Agency Record of Decision cases discussed in Section 4.4.2 Because the true upper limits of corrective action costs could be even higher, a site specific analysis of Non-Subtitle D landfills by localities would be warranted to help establish the cost and benefits associated with the continued operation, versus closure, of a particular Non-Subtitle D landfill.

The early detection of a groundwater contamination problem and closure of an older technology landfill may minimize the potential for a community's exposure to significantly higher corrective action costs associated with continued operation of a Non-Subtitle D landfill. In essence, a site specific analysis of active Non-Subtitle D landfills is considered prudent, especially for sites which plan to use their Non-Subtitle D landfills for an extended period of time.

4.4.1 Closure Costs

Whenever a landfill closes, there will be a cost associated with constructing a cap. If closure occurs earlier than planned, the increased cost to a facility is equivalent to the interest they could have received on the cost of the cap had those funds been invested for several more years.

There is no avoiding the expense of capping a landfill; it may be delayed, but it is ultimately required at the time of closure. This section estimated a cost between $1,222,400 to $1,828,000 to close an average size, unlined Non-Subtitle D landfill of 38.5 acres, based on costs per acre shown in Table 4-3. Note that post closure monitoring and care, which are required for all closed MSW landfills, were not included in any of the cost estimates presented in this report. This estimate was developed using the following assumptions specified in the study scope (See Appendix A):

> The cap will include an 18 inch layer of material with a hydraulic conductivity of no greater than 1×10^{-5} cm/sec overlain by a variable layer based on the depth of frost penetration that should average 3 inches for the State, then overlain by a 6 inch vegetative soil layer (a total of 9 inches over the barrier soil) with vegetation established. The costs will be based on the average size of the average unlined facility in Virginia.

The capital costs for closure at a Virginia landfill site can vary from the estimate shown above because there are a variety of soil materials or geomembrane products that can meet or exceed the 1×10^{-5} cm/sec hydraulic conductivity required by VDEQ and Subtitle D regulations. The design and cost of a final cover system will be influenced by the availability of soils materials at or near the site.

In cases where the landfill cell is lined, the cap must have a hydraulic conductivity less than or equal to the bottom liner system. The design of the infiltration layer and its ability to transmit flow off the cap will vary depending on the final cover slope and bench configuration. The cost for landfill cap or closure systems at facilities that have bottom liners ranges from $3,426,100 to $4,377,800. If additional site related costs (shown in Table 4-4) were included, they could add $477,400 to each of the landfill cap cost ranges.

Table 4-3 Cost Estimate for A Subtitle D Final Cap or Cover System
(VDEQ Study Scope of Work Specifications)

Cap Component	Minimum Cost/CY	Maximum Cost/CY	Minimum Cost /Acre	Maximum Cost /Acre
9" Erosion Layer (Includes 6" for vegetation)	$7.00	$8.00	$8,470	$9,680
18" Infiltration Layer	$9.00	$15.00/cy	$21,780	$36,300
Vegetation	---	---	$1,500	$1,500
Subtotal Subtitle D Final Cover Cost/Acre (For a Non-Subtitle D landfill with no liner)			**$31,750**	**$47,480**

The complete cost of closing a landfill includes other site related cost elements in addition to the final cap or cover system. Among those costs are the items delineated in Table 4-4.

Table 4-4 Other Site Related Landfill Closure Costs

Item	Estimated Cost ($/Ac.)
Contractor Mobilization -	$ 2,500
Clearing	$ 800
Erosion Controls (sedimentation pond, ditches)	$ 4,000
Gas Vents -	$ 1,500
Regrading -	$3,600
Total of Other Landfill Closure Costs	**$12,400**

An alternate cost estimate was developed for a landfill with a bottom liner or geo-membrane system. Some of the Non-Subtitle D landfills in Virginia have liners of this type. For these sites, the final cap profile may include the following additional components (See Table 4-5):

- 24" Soil Layer (i.e. Erosion Layer).
- Geocomposite Drainage Layer.
- 60 mil Textured HDPE layer.
- 18" Infiltration Layer ($K \leq 1 \times 10^{-5}$ cm/sec).

Table 4-5 Cost Estimate - Increment For Additional Cap Components (Geomembrane Lined Landfill)

Cap Component	Minimum Unit Cost	Maximum Unit Cost	Minimum Cost ($/ac.)	Maximum Cost ($/ac.)
Additional 15" Erosion Layer	$7.00/cy	$8.00/cy	$14,117	$16,133
Geocomposite Drainage Layer	$0.45/sf	$0.55/sf	$19,602	$23,958
60 mil Textured HDPE	$0.54/sf	$0.60/sf	$23,522	$26,136
Total of Additional Final Cover System cost/acre (Final Cover System for landfills with a single liner.)			**$57,240**	**$66,230**

Adding the high values in Tables 4-3 and 4-5, plus the site costs in Table 4-4 provides the upper values of the cost range for closure or capping of a Non-Subtitle D landfill (for example, $47,480 + 66,230 + $12,400 = $126,000). The entire range of costs estimated for closure of a Non-Subtitle D landfill, per acre and for an average 38.5 acre site, is summarized in Table 4-6 on the next page.

Table 4-6 Summary of All Cap Closure System Costs

Landfill Characteristics	Table Number	Cost Per Acre		Cost Per Site (38.5 Acres)	
		Low	High	Low	High
No bottom liner	4.3	$44,000	$60,000	$1,694,000	$2,310,000
Add site costs	4.4	$12,400	$12,400	$477,400	$477,400
	Total	$56,400	$72,400	$2,171,400	$2,787,400
With geomembrane bottom liner	4.5	$101,240	$126,230	$3,897,740	$4,859,855
Add site costs	4.4	$12,400	$12,400	$477,400	$477,400
	Total	$113,640	$138,630	$4,375,140	$5,337,255

Source: Earth Tech construction database

Estimates of the costs of the landfill cap or final cover system costs were also obtained from the landfill survey conducted as part of this study. In the above survey, over half landfill owner/ operators who reported cap costs, reported costs per acre that fell within one of the above two cost ranges noted above. The landfill cap/cover system costs reported in the survey are provided in Table 4-7 on the following page.

Table 4-7 Cost of Landfill Caps Reported in Virginia Landfills Survey, 1999

Facility	Construction Cost of Cap	Acreage	Cost ($/Ac.)
1	$1,202,251	17.44	$68,936
2	$1,000,000	17	$58,824
3	$1,500,000	17.2	$87,209
4	$7,854,378	65	$160,000
5	$700,000	23.45	$29,851
6	$2,029,863	12.15	$167,067
7	$2,076,941	30	$69,231
8	$294,709	6.27	$47,003
9	$1,300,000	14	$92,857
10	$2,200,000	42	$52,381
11	$1,454,536	12.2	$119,224
12	$800,000	11.54	$69,324
13	$1,171,700	9	$130,189
14	$4,358,503	103	$42,316
15	$1,704,000	24	$71,000
16	$1,919,931.00	25	$76,797
17	$911,999	18.2	$50,110
18	$2,500,000	10	$250,000
	$34,978,811	**$457**	**$76,464.77** Average/Acre

Data from the landfill surveys indicated that the average Virginia landfill cap cost per acre was $76,465. Since this figure is between the range of closure cap costs estimated for unlined landfills and landfills with a single geomembrane liner, it would appear to be a realistic average for the type of sites being capped in Virginia. Therefore, the $76,465 cost/acre for a landfill cap is used to compute the cost of closure for an average sized Non-Subtitle D landfill cap in Virginia. An average size Non-subtitle D landfill in Virginia is 38.5 acres. Based upon the above, the total average cost of a landfill cap or cover system of a typical landfill Non-Subtitle D landfill in Virginia is estimated to be $2,943,903 per site. (38.5 acres x $76,465).

If continued operation of a Non-Subtitle D or 1205 landfill temporarily delays a more expensive option of closure and construction of a Subtitle D cell, the difference between the present value of the two options is the increment of benefit from continuing to operate a 1205 facility. Benefits may also accrue from the incremental cost differences between continued 1205 operation and transportation of waste to a Subtitle D facility, including transfer and tipping fees. Other benefits from continued operation of a Non-Subtitle landfill are counted by the landfill owners and operators, and those views will be addressed in the Summary of Findings, Section 4.6. Costs or liabilities of continued operation of a Non-Subtitle D cell are less well defined, and corrective action costs are presented as an example of a possible future liability.

4.4.2 Corrective Action costs

Unlike the other cost areas noted in Section 4.4, estimating the cost of corrective action for a Non-Subtitle D landfill is highly uncertain. That is, costs for corrective action may range from zero dollars to costs which approach those of a Superfund site, depending upon the nature and characteristics of the site, and the nature of the wastes that were historically disposed at the landfill.

In addition, it must be emphasized that the need for corrective action (or groundwater remediation) at a Non-Subtitle D MSW landfill, and the estimation of corrective action costs, should be determined by a detailed site investigation of the specific landfill. Projections of corrective action costs for any one landfill or group of landfills should not rely on the broad, desktop analysis provided in this report. Predicting if early closure of a Non-Subtitle D landfill will reduce the future need for corrective action or the cost of corrective actions would require a detailed site investigations and assessment of each landfill.

However, despite the above recommendation, this report provides an estimated average and range of costs associated with corrective action that may be required for a Non-Subtitle D landfill. The true average cost for corrective action at Non-Subtitle D landfills may be much different than the medium range value of $20,000 (capital costs) per acre estimated within this report. However, the estimated range of costs for corrective action should provide a better understanding of the potential costs associated with Non-Subtitle D MSW landfills.

As noted in Section 2.2.4.1 of this report, there are no MSW landfills in Virginia in corrective action for remediation of groundwater at this time. Therefore, cost information for potential corrective action of MSW landfills was obtained from the following sources:

- EPA Record of Decision case abstracts for landfill remediation
- Engineering studies of MSW landfills from sites other than Virginia (Earth Tech data)
- Engineering cost estimate prepared by Maryland Department of Environmental Protection

There was no additional information on cost of corrective action obtained through the States Survey performed as a component part of this study. While there are many examples of corrective action in other states, costs for those projects were not compiled at the state level or were not reported in the survey.

Corrective action may be required for a landfill site based upon the findings associated with the groundwater monitoring assessment program. (See Section 2.2.4.1, Groundwater for an explanation of the assessment phase of groundwater monitoring.) If groundwater monitoring results and the site investigation findings indicate that the nature, extent, and rate of migration of the contamination are not naturally attenuated by the site characteristics, a corrective action program would be required.

The corrective action alternatives that are implemented at municipal landfills will vary depending on the following:

- Assessment of plume
- Assessment of corrective measures
- Determination of risk to human health and the environment

The assessment of corrective measures determines what measures will be implemented for the landfill site. Corrective measures include corrective action (groundwater remediation), gas collection and treatment, upgrading the landfill cap, erosion control measures, and may include providing alternative potable water supply to nearby residents, etc.

Example costs of corrective measures implemented at sanitary landfills from other states are shown in Table 4-8. Although these examples were drawn from the Records of Decision case abstracts published by EPA's Superfund office, the eight sites listed in Table 4-8 were considered representative of conditions at older, unlined municipal solid waste landfills. The eight examples were chosen from case abstracts of 20 eastern U.S. MSW landfills to illustrate typical costs for corrective action of a MSW landfill. Among the initial 20 MSW landfills, at least 12 had a record of accepting hazardous wastes, including pesticide manufacturing waste, drums of paint waste, industrial solvents and heavy metal sludges. In addition to these practices, some of the MSW landfills in the EPA database had very poor design, such as landfilling wastes in trenches in contact with the groundwater. None of the poorly designed or sited landfills were used in this analysis, nor were the landfills that had documented history of receiving hazardous waste.

In this analysis, it should be noted that the promulgation of the Resource Conservation and Recovery Act Regulations (RCRA), 1976, as amended, does not permit MSW landfills to accept hazardous waste. However, if a landfill was in existence prior to RCRA, a MSW landfill may have accepted hazardous wastes for disposal.

Table 4.8 Corrective Action Costs from EPA Superfund Office (Records of Decision)

LANDFILLS	STATE	ACREAGE	MAJOR CORRECTIVE ACTION ITEMS	CAPITAL COST	O & M COST	CAPITAL COSTS ($/Acre)	O & M COST ($/Acre)
1. Army Creek	Delaware	44	RCRA Cap Downgradient groundwater pump system Five Year Evaluation Period	$12,340,000	$388,000/yr	$280,455/Ac.	$8,818/Ac.
2. Powersville	Georgia	15	Final Cap Install 8 groundwater monitoring wells Pipeline Extension	$4,000,000	$577,013/yr	$266,667/Ac.	$38,467/Ac.
3. Ionia City	Michigan	20	Insitu Vitrification Off Gas Collection and Treatment Landfill Cover Groundwater Monitoring	$3,630,525	$51,000/yr	$181,526/Ac.	$2,550/Ac.
4. Kummer	Michigan	40	2 wells and a water tower	$1,624,850	$28,440/yr	$40,621/Ac.	$711/Ac.
5. Combe Fill (South)	New Jersey	65	Final Cap Alternative Water Supply Active Gas Collection and Treatment Groundwater Pumping	$46,060,700	$673,000/yr	$708,626/Ac.	$10,353/Ac.
6. Novak	Pennsylvania	65	Remove Contaminated Sediments Final Cap Gas Collection Leachate Collection G.W. Monitoring	$16,105,149*	$92,459/yr	$247,771/Ac.	$1,422/Ac.
7. Old City of York	Pennsylvania	56	Removal of Contaminated Sediments Extraction System Gas Venting Groundwater Monitoring	$8,291,080*	$259,080/yr	$148,055/Ac.	$4,626/Ac.
8. Strasburg	Pennsylvania	22	Fencing (7,500LF) RCRA Cap Gas Vent	$11,306,460*	$312,471/yr	$513,930/Ac.	$14,203/Ac.

* Present Worth cost estimate including O&M costs for 30 years. Interest rate not given. In the absence of detailed cost breakdowns, these amounts are not reliable for estimating other corrective action costs.

Based upon Table 4-8, capital costs for corrective measures at this group of Non-Subtitle D landfills ranged from $40,621 to $708,626 per acre. The operation and maintenance costs from the above ranged from $711 to $38,467 per acre/year. The corrective measures in Table 4-7 vary from a final cap and gas venting, groundwater pump and treatment systems, and include a site where an alternative water supply was provided to affected residents in the communities.

The lowest cost corrective action measures may consist of the following:

1. Additional Groundwater Monitoring.
2. Security fencing and/or gates.
3. Gas vents.

Medium cost corrective action measures may consist of the following:

1. Active gas collection systems.
2. Final cover systems.
3. Alternative water supply, or pipeline extensions to connect to new water source.

The most expensive corrective measures involve groundwater pump and treatment systems. Because this measure is often used to control offsite contamination, it is discussed in more detail in Section 4.4.2.1.

The costs for corrective action have a wide range (low, medium, high) depending on the extent of groundwater contamination determined in the assessment of plume. The middle range of costs for sites listed in Table 4.8 are illustrated by Army Creek Landfill, which utilized a RCRA cap, a downgradient groundwater pump system, and a five-year evaluation period. Other sites in the medium range cost of corrective measures were Powersville Landfill and Novak Sanitary Landfill. In the middle range for capital costs per acre ($266,667 and $257,771 per acre, respectively), they list corrective measures such as final cover systems, pipeline extensions for alternative water supply, and active gas collection systems. However they have very different O&M costs, with a low of $1,422 per acre and a high of $38,467. The Kummer Sanitary Landfill, with a capital cost per acre of $40,621 and operations cost of $711 annually, is among the lowest cost of the examples. It includes measures such as additional groundwater monitoring (two wells) and a water tower to replace a contaminated water source. Other low cost measures could include security fencing and passive gas vents.

Many factors can contribute to the variance in capital and operations cost. Among them are:

- Site acreage – the lower the acreage, the higher the O&M cost per acre, and vice versa
- Extent of contamination and subsurface conditions
- Complexity of treatment system and level of maintenance required

Some of the highest capital costs are experienced at sites with a major corrective action such as a groundwater pump-and-treat system or a slurry wall. The Combe Fill South has a groundwater pumping system, and it has a capital cost per acre of $708,626/acre.

Summarizing the corrective action costs presented in the examples of Table 4.8, a range of low, medium, and high capital and O&M corrective action costs per-acre is shown in Table 4-9 below:

Table 4-9 Range of Corrective Action Costs from Table 4-8, EPA Record of Decision Case Studies

	Construction ($/Acre)	O&M ($/Acre/Year)
Low	$41,000	$750
Medium	$280,000	$9,000
High	$709,000	$39,000

These costs should be compared with the range of costs for groundwater pump-and-treat systems described in the next section.

4.4.2.1 Groundwater Recovery and Treatment as a Corrective Action

Groundwater recovery and treatment, or pump-and-treat, is a remedial technology primarily used to contain contaminated groundwater plumes. The technology is designed to pump groundwater from a contaminated aquifer at a rate that will result in a cone of depression essentially reversing groundwater flow direction in the impacted area to the recovery well, preventing further migration. The groundwater recovery system is normally designed with a network of recovery wells, which are strategically located near the downgradient edge of the contaminant plume. The recovered contaminated groundwater is directed through a treatment system specifically designed for the contaminants of concern in the aquifer. The treated groundwater is then either discharged back into the aquifer through re-injection wells, discharged to a surface water body, or to a Publicly Owned Treatment Works (POTW).

Historically, pump-and-treat was used as a final remedial alternative for restoration of impacted aquifers; however, operating history indicated that this technique is more of a migration control alternative than an actual aquifer restoration technique. The amount of time to restore an aquifer through this technique was found to be prohibitive at many sites. The overall operation and maintenance (O&M) costs will often exceed the construction costs. Currently, this technology

is used primarily as a containment technique, coupled with source remedial alternatives, as well as natural attenuation, to assist in restoration of an aquifer.

The costs associated with implementation of this technology are extremely site-specific because they are affected by hydrogeological conditions, contaminants of concern, and ultimate remedial objectives. Typical order of magnitude pump-and-treat system costs will vary based on site conditions. Sites with moderate contamination and homogeneous subsurface environments may cost $25,000/acre, while sites with difficult contaminants at significant depth (>100 feet), or in a complex subsurface environment (fractured bedrock) may cost $200,000/acre.

A low-end pump-and-treat system may consist of the following items:

- Installation of a series of downgradient groundwater extraction wells;
- Installation of a fully automated treatment and re-injection system; and
- Quarterly groundwater sampling and analysis.

A low-end system can only be installed at sites where there is minor contamination, a limited number of contaminating parameters, and a very simple and homogeneous subsurface soil condition.

A high-end pump-and-treat system may consist of the following:

- Installation of a series of downgradient groundwater extraction wells within a multiple aquifer system;
- Installation of a manually maintained treatment and re-injection system; and
- Twice per month groundwater sampling and analysis.

The high-end system will be installed in areas where contamination consists of multiple aquifers or a high number of parameters. The level of treatment may require re-injection to meet EPA drinking water standards. The groundwater conditions may include multiple and deep aquifers. The subsurface conditions may be complex and include fractured bedrock.

It is difficult to compare costs on a per-acre basis. Costs are based on the amount of contamination and the subsurface conditions of each site. However, based on Earth Tech's evaluation of construction and operation costs for three (3) facilities within the Pennsylvania and New Jersey area, the following costs are typical. The lowest costs are based on a 400-acre facility, while the high-end costs are based on a 15-acre facility.

	Construction Capital ($/Acre)	O&M ($/Acre/Year)
Low	$6,000	$1,000
Medium	$20,000	$4,000
High	$70,000	$7,000

A Maryland Division of Solid Waste Enforcement analysis of pump and treat contained in Attachment 5-3 of Section 5 also estimates the cost of groundwater extraction and treatment as corrective action for a typical landfill in Maryland. Based on 1988 price levels, they estimated a construction cost of $11,050. When that amount is increased to current price levels, the value is very close to the medium estimate of $20,000 shown above.

Corrective measures or corrective action costs cannot be assumed a an inevitable for each Non-Subtitle D (1205) facility that continues to operate until it reaches final fill elevation on an existing footprint. However, if a typical Virginia Non-Subtitle D landfill (average size, 38.5 acres) were required to install and operate a medium cost pump-and-treat system as noted above, the cost per site would be $770,000 for construction and $154,000 per year in operations and maintenance costs.

4.4.2.2 Corrective Measures for Gas and Odor Control

Some Virginia facilities have instituted gas control measures as a result of exceeding LEL's at their facility boundary. At least ten sites reported installing gas and odor control measures in order to avoid problems in the future. The cost of measures implemented exclusively for gas and odor control cost between $45,000 and $70,000 per site. This does not include a landfill which designed a gas recovery system to generate electricity. It may be possible for subsurface landfill gases to contaminate groundwater, so preventive measures address more than safety and air quality.

4.4.3 Transportation Costs

One of the options for waste disposal if a Non-Subtitle D facility closes is to transport waste to a Subtitle D facility. The following analysis was based on a transportation scenario that considered each landfill and its waste flows individually. Costs for each facility were aggregated

to obtain an average cost per ton for all Non-Subtitle D facilities' waste shipped to the nearest Subtitle D landfill. That cost per ton was $10.47, rounded to $10.50. The total cost of transporting 953,468 tons of waste from 26 facilities would be $10,011,400 (rounded to $10 million). An average one way distance of 45 miles was used, although only 4 facilities were actually further than 45 miles from the nearest Subtitle D landfill. However, waste may travel further than the closest alternative landfill if the combined cost of tipping fee and transportation make it less costly overall. This cost estimate does not capture that level of detail, but is designed to show the cost burden for the entire class of Non-Subtitle D facilities should they close. The cost per ton would be slightly higher if a transfer station is required. Only three sites appeared to have high enough waste tonnage and transit times to warrant a transfer station. The range of waste for these sites was between 60,000 and 120,000 tons and the distances were approximately 50 miles one way. Other sites may elect to use a transfer station if it is the most economical disposal option.

As the fold-out map in the back of this report shows, many Non- Subtitle D facilities are located near Virginia's borders with other states. Some of the waste included in this analysis may be landfilled in another state. Virginia waste is already being shipped to North Carolina and West Virginia.

The analysis that produced this cost estimate calculated travel distances between every Non-Subtitle D facility and 3 to 5 potential Subtitle D facilities that might accept their waste. The distances were calculated by a GIS routing software, using a map of landfill locations developed by VDEQ in collaboration with the Virginia Economic Development Partnership. The range of these distances was the starting point for Earth Tech engineers to develop a cost/ton estimate applicable to the waste flows from these 26 facilities. Appendix F contains a table of the distances and a description of the how the map was produced. Non-Subtitle D cells located on the same site with Subtitle D cells were not included in this analysis, since those flows would not be subject to higher transportation costs in the event the 1205 cell closes.

In addition to transportation costs per ton, a community would also pay a tipping fee to the Sub Title D landfill that accepts the waste. From the survey of Virginia landfills, a range of tipping fees was obtained. Many are gate prices, and higher than rates available under long term contracts with private or regional facilities. In markets where regional municipal landfills compete with private facilities, the posted prices are closer to actual charges. One of the lower gate prices reported ($30/ton) was used for this analysis. This tipping fee should be considered a high-medium estimate since the full range of Virginia fees would probably include $25 per ton among the lowest values.

To determine the impact on users of Non-Subtitle D landfills, the total amount of solid waste disposed (1998 tonnage) was multiplied by the transportation cost per ton and the estimated tipping fee. The price level for these two cost items is based on current economic conditions (e.g. fuel, labor and materials). The total of these two charges represents the community's new cost for an alternative to a 1205 landfill.

Cost of Transporting All Waste from Non-Subtitle D Landfills to Subtitle D Facilities (Including Tipping Fees)

953,468 tons x ($10.50/ton for transport + $30/ton tipping fee) = $38,615,500
(rounded to nearest hundred)

For some communities this cost per ton may be higher than their true cost of operating a Non-Subtitle D facility. For landfills that do not charge what it actually costs to provide their service (using Full Cost Accounting guidelines), the comparison is not valid and it would be difficult to determine if there was negative impact to a community. Communities with low annual waste tonnage, a long transportation distance to the nearest facilities, or long travel times due to access and road systems will face higher than average costs to transport their waste. In this analysis, the increment of difference for transportation alone could be up to $3.50 per ton. Regional differences in site characteristics, availability of landfill space within a reasonable travel time, and ability to negotiate tipping fees lower than posted or gate prices will determine if an area's cost per ton for waste disposal after 1205 closure is higher or lower than these average costs.

4.4.4. Cost of New Subtitle D Cell Construction

Communities that close their Non-Subtitle D landfills may construct a new Subtitle D landfill cell at the Non-Subtitle D landfill site as an alternative to transporting their waste to another Subtitle D landfill remote from the community. This alternative assumes there is adequate land and the site meets current Subtitle D regulatory siting requirements.

This Section of the report provides an estimate of the typical costs of constructing a Subtitle D landfill cell and the supporting rationale and information for this estimate.

A new Subtitle D cell of 8 acres constructed according to Virginia's solid waste management regulations is estimated to cost between $723,760 and $1,669,664 if built according to the minimum standards. The cost to a community of this option, versus continuing to operate a Non-Subtitle D facility until it is completely filled, is the difference in total annual costs for the number of years a 1205 cell could have operated.

This cost estimate is based upon an 8 acre cell and assumes mobilization of equipment. The estimate was based upon the following specification from the study scope:

> An eight acre cell based on a compacted sub-base overlain by 24" of 1x10-7 cm/sec, overlain by 60 mil HDPE, overlain by 12" of drainage material with 200 foot piping at 150' on center (schedule 80/SDR11 perforated pipe).

Any new cell must meet or exceed the above specification contained in the Virginia solid waste management regulations (9VAC 20-80-250). This liner design also conforms to EPA 40 CFR Part 258 (Subtitle D) which sets the minimum criteria for municipal waste landfills.

A primary source for the component costs of a Subtitle D liner system was the database of Earth Tech, which includes Subtitle D landfills constructed in the eastern US and Virginia.

Table 4.10 Construction Cost of Subtitle D Cell

Liner Component	Minimum Unit Cost	Maximum Unit Cost	Minimum Cost ($/Ac.)	Maximum Cost ($/Ac.)
12" leachate drainage layer	$11.00/cy	$25/cy	$17,747	$40,333
60 mil smooth HDPE	$.33/sf	$.50/sf	$14,375	$21,780
2.0ft compacted clay	$10/cy	$30/cy	$32,270	$96,810
Leachate System	-	-	$11,000	$15,000
Minimum Specifications Liner System Total			**$75,392**	**$173,923**
	Add Contingency (20%)		15,078	34,785
	Total Subtitle D liner		$90,470	$208,708

For every community with a Non-Subtitle D facility that chooses to build a new Subtitle D cell, the cost for an 8 acre cell would be between $723,760 and $1,669,664.

4.4.5 Other Estimated New Subtitle D Cell Costs

New Subtitle D cells are often built with additional liner components. These alternate liner systems have been permitted in Virginia. The features include

- Non-woven geotextile above the 60 mil HDPE for puncture resistance
- An increase in thickness of the leachate drainage layer from 12" to 18" for additional liner protection during construction
- Substitution of an additional HDPE geomembrane and geosynthetic clay liners for 24" compacted soil liner component. (Must prove technically equivalent)

The first two additional features have the following costs:

Table 4-11 Subtitle D Landfill Construction - Additional liner Components

Additional 6" leachate drainage layer	$11.00/cy	$25/cy	$8,873	$20,167
16 oz Non- woven geotextile above 60 mil HDPE	$1.22/sy	$1.50/sy	$5,905	$7,260
		TOTAL:	$14,778	$27,427
If these features were added to the basic cost of Subtitle D cell construction, the new range of total cost would be:			$105,248	$236,135

The cost range of $105,248 to $236,135 does not include any differential for an HDPE geomembrane and geosynthetic clay liners substituted for 24" compacted soil liner, nor a contingency factor for the additional liner components. The construction a new cell may not only include the cost for the liner system, but could include other items such as:

- Landfill Support Facilities (i.e. sedimentation basin, erosion and sedimentation control, fence, roads, groundwater wells, etc.)
- Leachate Storage Tanks
- Scale System
- Administration Support
- Earthworks
- General Conditions (i.e. bonds, utilities, engineering, etc.)
- Purchase Land

Costs reported in the survey of Virginia landfill owners and operators for new Subtitle D construction ranged from $104,000 to $371,000 per acre. These costs are listed in Table 4-12. This is consistent with the cost estimate developed above ($105,248 to $236,135). Variances may be due to site differences and some of the additional factors listed for site development, engineering and support facilities. In actual practice, the size of the cell constructed will affect the cost. Virginia landfills have built cells ranging from 3 to 35 acres, and across that range of sizes the cost per acre will vary. In the analysis which follows, the average reported cost of $215,100 is used, based upon 18 responses by Virginia landfill owners and operators with recent costs for Subtitle D cells built or under construction.

Table 4-12 Cost of New Subtitle D Cell Construction Reported in Virginia Landfills Survey, 1999

Facility	Sub-D Cell Cost	Cell Acreage	Cost ($/Ac.)
1	2,000,000	7	285,714
2	2,000,000	9	235,294
3	1,669,133	8	216,771
4	1,211,611	5	242,322
5	1,455,000	5	291,000
6	1,442,515	5	277,407
7	668,000	4	167,000
8	750,000	3	250,000
9	633,900	6	103,918
10	9,500,000	43	220,930
11	2,000,000	8	250,000
12	650,000	3	196,970
13	3,901,000	11	340,105
14	3,334,750	9	370,528
15	1,000,000	4	250,000
16	1,500,000	10	150,000
17	3,503,538	19	186,358
18	5,680,000	36	160,000
19	1,100,000	10	110,000
	$43,999,447	**205**	**$215,083 Average Cost /Acre**

4.4.6 Total Estimated Costs

The analysis in this Section summarizes all of the costs developed in Sections 4.4.1 through 4.4.4, and provides a framework for comparing the costs associated with closure of a Non-Subtitle D landfill with the costs of disposal options at Subtitle D landfills, and the costs of potential corrective action at Non-Subtitle D landfills. This summary of costs follows the same order as Section 4.4.1. through 4.4.4.

1. Closure or capping
2. Corrective action
3. Transportation and disposal (hauling waste to alternate Subtitle D MSW landfill)
3. Construction of new Subtitle D MSW landfill cell (on-site of Non-Subtitle D landfill)

By estimating the average and range of potential costs for alternatives to the continued operation of Non-Subtitle D (1205) landfills, an aggregate picture emerges of the benefits and costs associated with accelerated closure of Non-Subtitle D landfills and the diversion of waste to Subtitle D Landfills. This picture is more of a sketch, not complete enough to perform actual cost/benefit analysis of closing a Non-Subtitle D landfill before it reaches capacity. More information would be required on the timing of various actions, and the full cost of operating each type of landfill. However, this summary data may be useful for broad brush comparisons of the options to continued Non-Subtitle D landfill operation. It cannot reveal the regional differences in cost that will be most likely to affect decisions regarding the selection of options for communities considering closure of their Non-Subtitle D landfills.

Total Cost of Closure - Capping Non-Subtitle D Cells:

The average cost associated with closing a Non-Subtitle D landfill as presented in Section 4.4.1 (Table 4-6) is $76,465 per acre based on the landfill survey responses. Note that although the average size of a combination site is 59.26 acres, it is assumed here that the Non-Subtitle D cells within each combination facility would be the same size as Non-Subtitle D cells operated alone, or 38.5 acres. As shown in the calculations below, given an average cost per acre of $76,465 to close a Non-Subtitle D cell, the total cost of capping all 49 Non-Subtitle D landfills in Virginia is $144,250,000. The cost for a single site would be $2,943,900, based on this average size. There would be a cost of capping each Non-Subtitle D area whenever it closes. This cost could be expected to increase in the future due to the effect of inflation.

Average size for capping = 38.5 acres x $76,465 per acre = $2,944,000 per site (rounded)

For 27 Non-Subtitle D landfills	x	$2,943,900 = $79,485,368	
For 22 Non-Subtitle D cells in combination facilities	x	$2,943,900 = $64,765,855	
		$144,250,000	(rounded)

Additional costs were presented to illustrate the range of costs for closure systems or caps for Non-Subtitle D landfills with and without geomembrane liners. The range of estimates (displayed in Table 4-6) supports the use of the average value ($76,465/acre) from the survey data to calculate the cost of capping all Virginia Non-Subtitle D landfills.

The cost of early closure is the remaining debt that would have to be paid for capacity not used and/or the interest lost on any funds set aside for capping. It will be difficult for a community to calculate the true cost of early closure associated with capping unless they separately track the cost of providing solid waste disposal service at their landfill, using Full Cost Accounting (FCA) methods. The negative cost of early closure will be greatest for facilities intending to operate until 2017 or longer.

Potential Cost of Corrective Action

Not every Non-Subtitle D facility that continues to operate will incur corrective action costs. However, if the average size Non-Subtitle D landfill of 38.5 acres were required to implement the medium corrective action (pump-and-treat) described in Section 4.4.3, the first, or capital, cost would be $770,000, with annual operations and maintenance cost of $154,000. Without further information on the extent of contamination and the specific conditions at each Non-Subtitle D facility, it is not possible to make an informed estimated of future corrective action costs, or how they might be altered by early closure of a particular site. The same uncertainty would apply to already closed Non-Subtitle D facilities that may require corrective action. As an estimate, if all 49 sites with active Non-Subtitle D areas required this medium level of corrective action, as identified in Section 4.4.3 , the capital costs could be $37,730,000; with potential average operations and maintenance costs estimated to be $7,546,000 per year.

Total Cost of Transporting Waste to a Subtitle D Facility For Disposal

This estimate assumes that solid waste going to Non-Subtitle D facilities would be sent to the nearest Subtitle D facility able to accept the additional tonnage. A table in Appendix F shows the range of distances. Only the Non-Subtitle D sites not co-located with a Subtitle D cell would incur transportation costs, therefore, only 26 of the 27 Non-Subtitle D facilities are used in this calculation. The average annual waste flow to Non-Subtitle D facilities in 1998 was 36,672 tons. The cost per ton of transporting the waste was $10.50, based on a one-way transportation distance of 50 miles or less, plus a $30 per ton tipping fee at the Subtitle D facility. The mileage value used in this calculation is not a true average of all the minimum distances as discussed in Section 4.4.3, but rather an approximation of a median value, or 50 miles each way.

The total annual transportation and disposal cost for MSW from an average size Non-Subtitle D facility which closes would be:

36,672 tons x ($10.50/ton transportation + $30/ton tipping fee) = $1,485,200/year

The cost for all 26 Non-Subtitle D facilities would be:

26 facilities x $1,485,200 (total transportation plus tipping fee) = $38,615,400/year .

Total Cost of a New Subtitle D Landfill Cell

The average cost reported by 18 landfill survey respondents (summarized in Table 4-12) and corroborated by an independent estimate of costs, was used to estimate the impact to Virginia Non-Subtitle D landfills of constructing a new Subtitle D cell.

Using this average of $215,080 per acre to calculate the cost of a new Subtitle D cell (based on construction increments of 8 acres per cell), the capital cost would be $1,720,640 per facility.

If all 27 Non-Subtitle D facilities built Subtitle D cells on-site, the total cost would be $46,457,280.

The potential capacity of an eight acre cell, based on averages from other Virginia Subtitle D facilities is 1,012,800 cubic yards (126,600 cy/acre x 8 acres). If this capacity is divided into the capital cost it would appear that new Subtitle D cell construction is a very economic alternative on a per cubic yard basis. However, in order to compare this option with the cost of transporting waste to another facility, it would be necessary to annualize the capital cost of constructing a new Subtitle D cell, and include all the annual costs associated with the operation of a Subtitle D facility. Operations costs vary significantly based on the size of the facility, but can easily be over $1,000,000 per year when post-closure care is included. Operations costs would have to be divided by annual flows and then added to capital charges per cubic yard. The reason post-closure care must be accounted for is that any tipping fee charged by another landfill will include some amount to cover that requirement, and cost comparisons are only valid if they include all the same categories of costs, over the same period of time.

4.5 Benefit/Cost Analysis Associated with Closure and Corrective Action for an Average Non-Subtitle D (1205) MSW Landfill

To calculate the benefits and costs of continuing to operate a Non-Subtitle D landfill, versus closing the landfill early and selecting another disposal option, requires knowledge of the timing of the implementation of each alternative and useful life of the facilities, available options and time frame for implementing the options.

Some of the very large Subtitle D landfills have been permitted for capacity that will last 30 to 40 years if they continue filling at present annual rates. Other facilities have a more limited life. Where Subtitle D cells have been built to replace Non-Subtitle D landfills, new cells may be only 3 to 8 acres in size, with useful lives of only 5 to 10 years. The period of analysis used in this study to estimate future landfill capacity in Virginia is 30 years. One needs to assume a series of landfill cells (or other options) with 5 to 10 year increments, in order to compare all waste disposal methods over the 30 year period.

Reducing all of these scenarios to a common dollar basis would also require converting multiple streams of expenses (both capital costs and annual maintenance costs) to an average annual amount. This study does not present an analysis to that level of detail. Rather, it provides a generic analysis, with average costs per acre or per cubic yard are shown for several basic options, to give a general idea of the cost differences.

Only a site specific analysis of all costs, with consideration of regional factors (geology, transportation, and inter-governmental agreements) would allow an accurate estimate of benefit/cost impact of early closure of a Non-Subtitle D landfill.

One cost element that is not quantified here is debt service; this was mentioned by county and other local government officials responding to the landfill survey. That cost represents the remaining debt for loans used to finance construction of the Non-Subtitle D areas still operating. The survey did not ask directly about financing of facilities, only the expected year of closure. Because closure dates range from the year 2000 to 2017, there is no way to quantify outstanding debt and related debt service on a facility retired before its useful life is over.

It is not possible to determine a monetary benefit value for avoidance of corrective action. However, it is likely that there are real environmental benefits from closing unlined landfills where groundwater contamination exists and is migrating offsite. An example of this benefit comes from another state. New Hampshire's Non-point Source Management Plan listed unlined landfills as the state's highest priority problem because they rely on groundwater for much of their drinking water supply. In 1992 the state prioritized their unlined landfills according to environmental risks, identifying 200 that potentially threatened groundwater. After one site had been closed only 18 months, with an impermeable cap and groundwater interception trench to divert shallow groundwater flow away from the landfill, the concentration of total volatile organic compounds (VOC's) in a downgradient well decreased to below drinking water standards. Not all of Virginia's Non-Subtitle D landfills are unlined, however, and not all of them will be found to require corrective action.

4.6 Summary of Findings

Not all of Virginia's Non-Subtitle D landfills are unlined and not all of them are in assessment monitoring. However, any facility in assessment monitoring and particularly those that intend to operate for another decade or more, has the potential to cause groundwater contamination. It was the history of groundwater contamination from unlined landfills throughout the U.S. that was one of the primary drivers for implementation of Subtitle D regulations. At present, the groundwater assessment process in Virginia has not advanced to the implementation of corrective measures for the reasons given in Section 2.1.8. Without further information on the extent of contamination at each Non-Subtitle D facility, it is not possible to make an informed estimate of future corrective action costs, or how they might be altered by early closure. The same uncertainty would apply to already closed Non-Subtitle D facilities that may require corrective action. Other states which have begun implementing corrective actions for landfills often did not compile costs at the state level, and were not able to furnish much information on this survey topic (Section 5.3). Since the potential exists for corrective action in Virginia to cost up to $37.7 million (not including annual operations and maintenance) under the very broad assumptions stated in this report, reducing the problems that may require this kind of expenditure in the future could be very important.

A number of states have chosen to address problems they observe from the operation of Non-Subtitle D and unlined landfills by setting dates or conditions for their closure; a few have already closed all their unlined landfills. Other states have limited the vertical expansions allowed for unlined landfills. Several have financial assistance programs to provide localities an incentive to close facilities.

According to several respondents in the landfill owners/operators survey, closing a Non-Subtitle facility prior to its planned fill date will have economic and other impacts on a community. There are several Non-Subtitle D landfills that do not intend to close until 2017. For communities with an expectation of 17 years of future operation, early closure will mean incurring capital costs for a landfill final cap and new cell construction in the near term. Several counties indicated that even budgeting for a large increase would be a problem if they did not have at least two years to plan for the change. They were concerned about the planning time necessary to design a new cell or arrange for alternate disposal and transport, and obtain any permits required by VDEQ. Some alternatives, like developing regional cooperative agreements or siting a transfer station, can take several years to accomplish when the land use issues are controversial. Communities with debt remaining on loans used to construct the active portion of a Non-Subtitle D facility are concerned that these loans must be paid even if the landfill closes before its projected fill date. If the loans cannot be paid from tipping fees, then alternate financing plans have to be developed. Early closure may require a new closure plan because the area and contours of final fill may be very different from those expected under the originally projected closure date. For combination facilities that have physically integrated a Non-Subtitle

D cell with a Subtitle D cell and are planning to operate both for several more years, closure according to new timeline presents some additional operational and engineering challenges.

While localities are concerned about the costs of Non-Subtitle D closure and finding alternate means of waste disposal, the total Virginia Subtitle D capacity currently available would be able to absorb all the Non-Subtitle D waste without significantly reducing the life expectancy of landfill capacity in the Commonwealth. There are regions of the state where distance to the nearest Subtitle D facility could make transportation costs higher than the average values cited in Section 4.4.3. In actual practice however, a number of Virginia towns or counties with a small amount of annual tonnage have chosen to transport their municipal solid waste to a transfer station or other landfill because that proved to be more economical than operating a small landfill.

Based on the comments of officials interviewed during the landfill surveys, every Virginia community that replaces a Non-Subtitle D landfill with another waste disposal option will have slightly different choices and impacts based on their waste flow and location in the state. Many Non-Subtitle D facilities have already been closed, and the experience of the communities who have made that transition could be beneficially shared with others who are facing similar decisions.

One common theme in the responses from communities with active Non-Subtitle D landfills was to caution against a mandated year for closure that did not allow enough time for the planning and implementation of an alternative. The other most stated recommendation was to judge facilities by their individual performance and not force the closure of Non-Subtitle D facilities that are not a threat to groundwater.

5.0 STATUS OF NON-SUBTITLE D MSW LANDFILLS IN OTHER STATES AND VIRGINIA

5.1 OVERVIEW

This Section of the report provides information regarding the operational and regulatory status of Non-Subtitle D and Subtitle D landfills in Virginia and 16 other states.

Information from other states was obtained by developing and implementing the States Survey Questionnaire as a component part of this study. A summary of findings of information regarding MSW landfills is provided along with the individual survey findings for each state. Agency contact names, addresses, and phone numbers are provided, where available, to help facilitate gathering of additional information in the future, if believed necessary.

Information from the states survey is provided under the following areas:

1. General information and capacity of Non-Subtitle D And Subtitle D landfills.
2. Active Non-Subtitle D landfills.
3. Corrective action for Non-Subtitle D landfills.
4. Closure for Non-Subtitle D landfills.
5. Health and environmental effects related with Non-Subtitle D and Subtitle D landfills.
6. Monitoring of Non-Subtitle D And Subtitle D landfills.

The solid waste agencies of the following states (including VDEQ) were asked to complete the States Survey Questionnaire developed by the VDEQ: New York, Connecticut, Pennsylvania, New Jersey, West Virginia, Maryland, North Carolina, South Carolina, Georgia, Tennessee, Kentucky, Ohio, Indiana, Wisconsin, California, and Oregon. The states selected were co-located in the same general region as Virginia or were regarded as having progressive solid waste management policies and programs.

At the time of the report submittal, 16 of the 17 states receiving questionnaires had responded. In some cases, survey questions were not answered in the responses. In those cases, surrogate information sources were sought to obtain the relevant information. Where necessary, other sources of information were utilized for this study including solid waste organizations, state agencies' Internet sites, and the USEPA.

The quantity and quality of information provided by the States in their responses to the survey varied from no response to thoughtful and fully researched reports. Often the response quality appeared to be a function of the agency level of the staff person actually compiling the response. An attempt was made to present each state's information in a consistent manner. Still, some sections do contain more information than others. This does not imply any positive or negative regard for one State's program over others.

5.2 SUMMARY OF FINDINGS OF MSW LANDFILLS IN OTHER STATES

The survey results indicate that most States do not regularly compile or update much of the type of information that this survey sought to collect. Many States reported that the data are either available only at the local jurisdictional offices, or in scattered files at the State without the resources or willingness to organize the information for this survey.

California, Connecticut, Georgia, Indiana, New York, Ohio, South Carolina, Tennessee, and Virginia have currently active unlined landfills that are allowed to continue to fill to permit limits. All have some regulatory mechanism for closing these sites. Most states do not appear to be actively weighing the costs of corrective action and closure associated with the continued operation of unlined landfills against the costs of developing new or alternative waste handling methods available to communities.

Not all states have recent estimates of remaining capacity (that they reported in their response). States with recently updated capacity estimates often obtain this information from mandatory annual reports prepared and submitted by local landfill managers. Table 5-1 summarizes the available information regarding the number and capacity of MSW landfills in each category. As shown, there are states that currently have active unlined landfills. Landfill capacities are shown where specifically provided by the responding states. Some states' responses that did report disposal capacity did not distinguish MSW from CDD capacity and so were not used for this report. Blank spaces in the table indicates information was not provided by or available from State.

Table 5-1: Number of MSW landfill units and capacity.

State	Year Estimated; Source	Active Landfills	Capacity (in millions of cubic yards)	Subtitle –D	Subtitle-D Capacity (millions of cubic yards)	Unlined	Unlined Capacity (in millions of cubic yards)	Combination	Combination Capacity (millions of cubic yards)	Closure of unlined landfills
Virginia	1998; emissions, facility, inspectors	67	422	18	277.39	27	11	22	133.20	
California	NA	± 180	NA	27	NA	115	NA	38	00NA	
Connecticut	1999, permit, est. from site plan	4	12.5	1	10	1	1	1	1.5	
Georgia	1998, consultant' s report	69	358	50	235	17	10	2	13	
Indiana	1996, Interagency report	39	266	27	223	5	13	7	20	
Kentucky	1999, internal est.	26	168	26	168	0	0	0	0	1992
Maryland	1998, facility reports	20	84	20	84	0	0	1	~0	risk based
N. Carolina		39		39		0				"98 rule"
New Jersey		12	76	12		0		0		
New York	1998, annual facility reports	28		26	62.6	2	11.4			
Ohio	1997,local reports	44	400[1]	20		5		15		
Oregon				65						risk based
Pennsylvania										
S. Carolina	1999	19	105	14	95	5	10	0	0	

Table 5-1 (Continued)

State	Year Estimated; Source	Active Landfills	Capacity (in millions of cubic yards)	Subtitle –D	Subtitle-D Capacity (millions of cubic yards)	Unlined	Unlined Capacity (in millions of cubic yards)	Combination	Combination Capacity (millions of cubic yards)	Closure of unlined landfills
Tennessee		40	48	29		11				
W. Virginia		20		20		0				1995
Wisconsin	1998 Solid Waste Report	47	59	47	58	0	0	0	0	incentive program

Notes: 1. 1998 Ohio State Solid Waste Facility Data Report, OEPA, DSIWM.

Blank spaces indicate information not provided by or available from State.

5.3 MSW LANDFILLS SURVEY -- FINDINGS BY STATE

5.3.1 Virginia

General Information and Capacity of Lined and Unlined MSW Landfills

The agency contact for Virginia's response is:

Michael J. Dieter
Environmental Engineer Consultant
Office of Waste Program Management
Department of Environmental Quality
P.O. Box 10009
Richmond, VA 23240

Telephone: (804) 698-4146
Fax: (804) 698-4234

Virginia has 27 unlined MSW landfills constituting 10,862,753 cubic yards (yd^3) of available MSW capacity, 18 lined landfills providing 277,393,366 yd^3 of available capacity, and 22 combination landfills with 133,204,870 yd^3 of available capacity. This information was collected in a November 1998 telephone survey using landfill capacity data used in calculating air emissions, estimates given by the facilities and their regional inspectors.

Active Unlined MSW Landfills

The remaining available capacity of active unlined MSW landfills in Virginia is 10,862,753 cubic yards (yd^3). (At least some of this available capacity is related to vertical expansion (either recent or soon to be completed.)

In 1993, the promulgation of Amendment 1 of the VSWMR required owner's/operator's of unlined landfills to seek a variance to the regulations to allow the continued operation until the vertical design capacity of the MSW landfill was achieved. The HB 1205 provided for relief for unlined landfills and allowed the continued operation within the footprint established on October 9, 1993, until the vertical design capacity was achieved.

Under HB 1205, an unlined landfill could continue to operate upon the submittal of the following information by the owner/operator:

1. An acknowledgment that the owner or operator is familiar with state and federal law and regulations pertaining to solid waste management facilities operating after October 9, 1993, including post-closure care, corrective action and financial responsibility requirements;

2. A statement signed by a registered professional engineer that he has reviewed the regulations established by the Department for solid waste management facilities, including the open dump criteria contained therein, that he has inspected the facility and examined the monitoring data compiled for the facility in accordance with applicable regulations and, that on the basis of his inspection and review, has concluded: (i) that the facility is not an open dump, (ii) that the facility does not pose a substantial present or potential hazard to human health and the environment, and (iii) that the leachate or residues from the facility do not pose a threat of contamination or pollution of the air, surface water, or ground water in a manner constituting an open dump or resulting in a substantial present or potential hazard to human health or the environment; and

3. A statement signed by the owner or operator (i) that the facility complies with the applicable financial assurance regulations, and (ii) estimating when the facility will reach its vertical design capacity.

For more information pertaining to HB 1205, see Section 2.3, Background of Non-Subtitle D (HB 1205) and Subtitle D MSW Landfills in Virginia, of this report.)

The dates from the 1993 certification statements indicated that the unlined landfills would reach their capacity between 1993 to 2005. A list of estimated closure dates for all active sanitary landfills in Virginia from 1205 submittals in 1993 is provided in Attachment 5.1. In addition, Section 4.3 of this report provides a comparison of the projected dates of closure based upon the 1993 certification statements and the findings in the MSW Landfill Facilities Survey Questionnaire, which was a component part this study.

Corrective Action for Unlined MSW Landfills

Virginia reported that no corrective actions are currently implemented at unlined landfills. Virginia does have facilities that are in groundwater assessment monitoring that have amended their permits to establish groundwater protection standards(GPS). Once GPS are exceeded, the facility must characterize the nature of the release and initiate the assessment of the corrective measures that should be undertaken to remediate the plume of contamination. All of these activities can cause the elapse of a substantial amount of time before the facility actually undertakes a corrective action. Virginia's groundwater monitoring program is detained in

Section 2.2.4.1 of this report. Furthermore, there is no state forecast of the costs of future corrective action at unlined sites.

Closure for Unlined MSW Landfills

Because of the 1993 House Joint Resolution 494, a form was developed to determine the true costs of solid waste management operations, including landfill closure. A draft copy of this form (Identifying Costs of Solid Waste Management Services, Full Cost Workgroup, Department of Environmental Quality, April 1994) was provided by Virginia and is included in Attachment 5.2 of this report. The cost accounting guidelines associated with this form indicate that indirect costs are an essential part of full cost accounting, but are difficult to itemize. In the form, indirect costs are lumped into administrative costs.

Cost data for unlined landfills was not provided. Furthermore, Virginia has no statewide closure costs forecast.

Cap requirements are given for municipal solid waste landfills in § 9 VAC20-80-250 E 1 b. The regulations do not provide cross section diagrams. Final cover for municipal solid waste landfills in Virginia is required to have a hydraulic conductivity less than or equal to that of the bottom liner system or natural subsystems present, or have a hydraulic conductivity no greater than 10^{-5} cm/sec, whichever is less. The cap must include an 18-inch earthen infiltration layer below a 6-inch vegetative layer. Alternate final cover designs may be approved if they meet the above infiltration requirements.

Health and Environmental Effects - Lined and Unlined MSW Landfills

Virginia has 37 unlined or combination landfills in assessment monitoring. There have been 33 gas exceedences of the regulatory threshold at active sites and 44 at closed sites. It is unclear whether these exceedences represent subsurface gas or gas emissions to air. These releases were detected in the groundwater or gas monitoring programs. No damage to human health or the environment has been attributed to releases from active MSW landfills. A detailed description of Virginia's groundwater and gas monitoring programs can be found in Section 2.2.4.1 and Section 2.2.4.2 of this report.

Monitoring of MSW Landfills

Monitoring of groundwater and gas is required at all active municipal solid waste landfills (lined and unlined) in Virginia.

5.3.2 California

General Information and Capacity of Lined and Unlined MSW Landfills

The agency contact for California's response is:

Ms. Bobbie Garcia
Senior Waste Integrated Waste Management Specialist
Office of Policy and Analysis
California Integrated Waste Management Board
8800 Cal Center Drive
Sacramento, CA 95826

Telephone: (916) 255-2425
Fax: (916) 255-4207

The California Integrated Waste Management Board (CIWMB) is one of six agencies under the umbrella of the California Environmental Protection Agency (CEPA). The CIWMB is responsible for managing California's solid waste stream. The IWMB approves waste management facility permits and administers cleanup of abandoned waste sites. In response to Subtitle D requirements promulgated in 1993, the State Water Resources Control Board (SWRCB) adopted the Policy for Municipal Solid Waste Landfills (Resolution No. 93-62) that required new and expanding landfills to meet federal Subtitle D design and construction requirements.

California has over 180 landfills. Approximately 15 percent of these are Subtitle D-compliant facilities, 64 percent are unlined landfills, and 21 percent are combination landfills. Information regarding remaining landfill capacity is not readily available to the State.

Active Unlined MSW Landfills

The date of unlined landfill closures range from 1999 to 2260. More than half are scheduled to close before 2013. Of the active unlined landfills, approximately 12 have revised permits that allow vertical expansion over unlined cells. Unlined landfills can be closed in an enforcement action as necessary to protect public health and the environment (i.e., closure because of a groundwater release) under 27 CCR Section 22190. Section 22190 can be used to close any landfill if necessary (i.e., as a source control measure in corrective action).

Approximately, 12 landfills have revised permits for vertical expansion over unlined units. There is no established regulatory deadline for operating unlined landfills; however, no lateral unlined expansions are allowed.

Corrective Action for Unlined MSW Landfills

There are 68 landfills that have undergone groundwater corrective action. There are 54 landfill sites that are under groundwater evaluation monitoring (similar to assessment monitoring).

Cost data for corrective action measures at specific sites and for specific measures exist, but are not compiled at the state level and so were not available for the survey response. Sometimes, the costs of corrective action are reported by site owners, but the available cost data has not been verified by an independent source. Data for future corrective action cost projections are available, but not compiled.

Cost projections are estimated for individual sites as part of the permitting process. The discharger estimates the cost to remediate a Reasonably Foreseeable Release (RFR). RFR costs are projected for a maximum size release prior to detection by groundwater monitoring system. The state agency (Regional Water Board) then approves the cost estimate.

CIWMB administers the Solid Waste Disposal and Codisposal Site Cleanup Program that provides cleanup of sites that pose a threat to the public health or environment and where the responsible parties cannot be identified or are unable to pay for remediation. The program is funded through matching grants to local governments for solid waste disposal sites, grants to Local Enforcement Agencies (LEA, responsible for enforcement of solid waste regulations) for illegal waste dumping sites or CIWMB-sponsored cleanups using staff or contractors. Fifty-five sites have completed remediation under this program.

Closure for Unlined MSW Landfills

The State has closure cost estimates for lined and unlined landfills, but not compiled into one document, nor broken down by unlined landfills. The cost estimates are based on closure plans and previous experience from projects where costs are assigned to specific tasks.

As required under 27 CCR 21090, landfill caps must be constructed with the following layers:

- 24-inch foundation layer
- 12-inch erosion-resistant soil (or geomembrane) barrier with maximum hydraulic conductivity of 10^{-6} cm/sec

Alternatives exist as stipulated in 27 CCR 21090 (a) and 20080 (b) and (c) that allow consideration of geosynthetic clay layer (GCL), flexible membrane liner, (FML), or monolithic layer.

Copies of the data that support the above cost data are not available. The cost data for closure of MSW landfills are aggregated for all sites with information available for specific sites. The costs are self-reported by site owners and are not independently verified.

The CIWMB does have costs estimates of future landfill closure costs (lined and unlined); however, this data is not compiled. The cost estimates are based on closure plans and experience from working with programs where costs are assigned for different tasks.

Health and Environmental Effects- Lined and Unlined Landfills

The State has 35 landfills with documented releases. Of those, eight (8) are from lined landfills, 23 from unlined sites, and four (4) from combination sites. The types of releases (air, groundwater, etc.) were not provided in the survey response.

The State indicated that damage to human and health and the environment has been attributed to releases from unlined MSW landfills, damage from lined facilities is not known. Information regarding the evidence and extent of damage was not provided.

Monitoring of MSW Landfills

The State requires monitoring at lined and unlined facilities; although the State cautioned that it could not "backup the assertion that all of this monitoring is actually being performed at all California MSW landfills." Required environmental monitoring includes groundwater, gas migration in air, surface water, and cap integrity. Gas migration in soil is monitored at MSW landfills where required by Regional Waste Boards.

SWRCB's 1995 SWAT summary report to the IWMB indicated that five of the eight landfills that have been closed for more than 30 years "leaked in excess" of regulatory limits. This finding is offered as evidence of the need for the more stringent CIWMB regulations that call for monitoring of landfills "for as long as the wastes pose a threat to water quality" or, in essence, perpetuity.

5.3.3 Connecticut

General Information and Capacity of Lined and Unlined MSW Landfills

The agency contacts for Connecticut's response are:

Judy Belaval
Evonne Bolton
Planning and Standards Division
Waste Management Bureau
Connecticut Department of Environmental Protection
79 Elm Street
Hartford, CT 06106-5127

Telephone: (860) 424-3228

Connecticut has four active landfills in state: one lined, with an available capacity of 10,000,000 yd^3, two unlined, with an approximate available capacity of 1,000,000 yd^3, and one combination lined and unlined landfill, with an available capacity of 1,500,000 yd^3.

Active unlined MSW Landfills

Connecticut's two unlined landfills are scheduled to close by the year 2005. Connecticut has established the following conditions that would require an unlined, active landfill to close before the established regulatory deadline:

- The landfill has filled up before the established regulatory deadline.
- The unlined landfill has caused serious water pollution.
- The owner/operator of the unlined landfill has received an administrative order for operational problems.

The remaining available capacity in the State's two unlined landfills is approximately 1,000,000 yd^3. None of the available capacity is related to vertical expansion. The regulations that outlines the requirements for closing unlined landfills is the federal RCRA Subtitle D. The regulations that allows the landfills to remain open are the Connecticut General Statutes, Department of Environmental Protection Section 22a-209-4 and 7. Unlined landfills are allowed to operate past the established regulatory deadline only if they conform to a Connecticut Water Quality Classification System which the USEPA has deemed equivalent to the RCRA Subtitle D requirements.

Corrective Action for Unlined MSW Landfills

Approximately 20 closed unlined landfills in the State of Connecticut have undergone corrective action. The State does have some unverified, "scattered/partial costs" figures reported by specific sites; however, the State does not maintain cost data for specific corrective action measures or corrective action projects consistently.

Closure for Unlined MSW Landfills

Connecticut provided an average, unverified cost per acre to close an unlined landfill of $40,000. The range of closure costs was given as $25,000 to $300,000, estimated from data reported by sites in closure; although the Connecticut DEP does not keep supporting data and there is no cost projection for future closure costs. Landfill cap design requirements for "problem sites" include the following:

- 6-inch soil subbase
- 40-mil geomembrane geocomposite
- 18-inch vegetative support layer

Health and Environmental Effects – Lined and Unlined MSW Landfills

The two unlined landfills have documented four releases of landfill gas (causing odor complaints) and one release of leachate to surface water detected by the facility's water quality management program. Damage to the environment was documented in the form of a violation of the surface water quality standards from the release of leachate to an adjacent river.

Monitoring of MSW Landfills

Monitoring is reportedly not being performed at the unlined MSW landfills. Monitoring is being performed at the Subtitle D landfill. The specific forms of monitoring include groundwater, subsurface gas migration, nuisance odor, surface water, cap and vegetative cover inspections, and fugitive dust.

Connecticut's liner requirements were not composite-type as in Subtitle D. 5. Although these MSW landfills are permitted, they constitute essentially negligible capacity, according to the survey results.

5.3.4 Georgia

General Information and Capacity of Lined and Unlined MSW Landfills

The State of Georgia's contact for this report is:

Ms. Susan Wagner
Environmental Specialist
Solid Waste Management Program
Environmental Protection Division
4244 International Parkway, Suite 104
Atlanta, GA 30354

Telephone: (404) 362-4888
Fax: (404) 362-2693

Georgia has 69 active MSW landfills. Of these, 50 are Subtitle D facilities with 235,227,878 cubic yards of remaining capacity, 17 are unlined and provide an additional 10,111,326 cubic yards, and 2 are combination facilities with 13,048,808 cubic yards of capacity. The source of these estimates is the 1998 Remaining Capacity Report prepared by a professional engineer registered in the State of Georgia.

Two aerobic bioreactor (with liquid recirculation) landfills projects are operational, the Live Oak Landfill in Atlanta and the Baker Road Landfill in Columbia County.

Active Unlined MSW Landfills

There is no set date when the active unlined landfills are scheduled to close. Each active unlined landfill is allowed to fill up to originally permitted design capacity over footprint of waste that existed prior to promulgation of Subtitle D requirements. According to the survey response, there are no conditions that would require a facility to close before the established regulatory deadline. The Georgia Comprehensive Solid Waste Management Act (Code of Georgia 12-8-24.(e) amended 1991 and 1993) allowed landfills to modify their permit for a vertical expansion to operate two more years. All vertical expansion landfills closed by 7/1/1998, as required.

Corrective Action for Unlined MSW Landfills

Four (4) unlined landfills in the State have undergone corrective action. The Environmental Protection Division (EPD) does not have any data on total or individual site costs for corrective action measures at unlined MSW landfills. No description was offered for the way in which the cost data for corrective action at MSW landfills are tabulated. No cost information on specific

corrective action measures was available. There is no State forecast of the costs of future corrective action at unlined landfills.

Closure for Unlined MSW Landfills

Data on average per acre costs to close an unlined landfill in Georgia is not available. Georgia does not track closure costs for landfills, neither is there a forecast of future costs of unlined landfill closure. Georgia cap requirements for unlined sites include:

- 18-inch layer of 10^{-5} cm/sec material
- 6-inch topsoil layer.

Lined sites must have a liner in the cap, an 18- to 24-inch bridging (foundation over waste) layer, erosive layer, and a vegetative layer.

Health and Environmental Effects - Lined and Unlined MSW Landfills

Of the Subtitle-D landfills, five have reported contaminant releases in groundwater and 11 have recorded methane releases. Of the total (active and inactive) unlined facilities, 92 have recorded groundwater contaminants and 123 have reported methane releases. Both of the combination landfills have reported groundwater and methane releases. These releases were detected by the facilities' approved monitoring system. Remediation is underway at 16 MSW landfills, four of which are unlined. No damage to human health or the environment has been attributed to the releases.

Monitoring of MSW Landfills

Environmental monitoring of groundwater, subsurface gas migration, and surface waters is performed at all MSW landfills. Gas emissions are monitored at landfills with design capacities of at least 100,000 metric tons. Georgia has a number of MSW landfills in assessment monitoring.

5.3.5 Indiana

General Information and Capacity of Lined and Unlined Landfills

This survey was completed by:

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Office of Land Quality - Facility Data Analysis Section
Indiana Department of Environmental Management
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P.O. Box 6015
Indianapolis, IN 46206-6015

Telephone: (317) 233-3834
Fax: (317) 232-3403

Indiana currently permits 27 Subtitle D landfills, five unlined landfills, and seven combination landfills with both lined and unlined cells. The unlined landfills are allowed to fill cells up to two acres in size up to permitted limits by Title 329 Section 10-10-3 of the Indiana Administrative Code. According to the documentation provided, by the end of 1998, the state of Indiana had approximately 255,472,051 yds^3 of total available capacity. However, three of the operating landfills did not report their capacity. Based upon the facilities that did report available capacity, 223,047 yds^3 was available in the lined facilities, 12,986,000 yds^3 was available in unlined facilities, and 19,691,000 yds^3 was available in combination unlined and lined facilities.

Active Unlined Landfills

According to the Indiana Administrative Code (IAC) 329 10-10-3, unlined landfills were required to close by January 1, 1998, with up to one-year extensions granted for certain landfills (January 1, 1999).

Approximately 12,986,000 yds^3 was available in unlined facilities as of 1998. None of the remaining capacity in unlined cells is related to vertical expansion.

Landfills that were allowed to continue to operate past the regulatory deadline established by 329 10-10-3 were MSW disposal cells of less than two acres in footprint that were allowed to fill to permit levels.

Corrective Action for Unlined MSW Landfills

There have been more than 24 unlined landfills in the State that have undergone corrective action. The State did not provide data regarding costs for individual sites or specific corrective action measures. There are no state forecasts of the costs of future corrective action at unlined landfills available.

Closure for Unlined MSW Landfills

The average cost per acre to close an unlined landfill in Indiana was not provided. A contact name for this information was given as Daniella Klasmith, Senior Engineer at the Department of Environmental Management at (317) 232-8840.

Unlined landfills fall under more stringent capping requirements (329 IAC 10-22-7) than do Subtitle-D compliant landfills.

The cap requirements for unlined cells under slopes with up to 15% grade are (bottom to top):

- 12-inch drainage layer (hydraulic conductivity of 10^{-3} cm/sec or more) or geosynthetic equivalent
- 12-inch structural fill
- 12-inch compacted earth with hydraulic conductivity of 10^{-6} or less
- 30 mil (minimum) geomembrane or 60 mil minimum if HDPE
- 12-inch drainage layer (hydraulic conductivity of 10^{-3} cm/sec or more) or geosynthetic equivalent
- 18-inch protective soil layer
- 6-inch vegetative layer

On slopes with greater than 15% grades, the following layers are required:

- 24-inch soil barrier layer (hydraulic conductivity of 10^{-7} cm/sec or more) or equivalent
- 6-inch earthen vegetative layer

Maximum projected erosion rate of final cover must be no more than five tons per acre per year. Slopes must be between 4% and 33%.

Health and Environmental Effects - Lined and Unlined MSW Landfills

The State does have landfills that are in assessment monitoring; however, the number of sites and the extent of damage to human health and the environment is not tracked by the State, according to the survey response.

Monitoring of MSW Landfills

Monitoring is being performed at all lined and unlined landfills. The types of monitoring required are groundwater, gas migration in soil, cap integrity, and leachate. Gas migration in air is required for those sites with New Source Performance Standard permits.

5.3.6 Kentucky

General Information and Capacity of Lined and Unlined MSW Landfills

The State survey contact for the Commonwealth of Kentucky is

Ms. Carol Sole
Division of Waste Management
Department of Environmental Protection
14 Reilly Road
Frankfort, KY 40601

Telephone: (502) 546-6716
Fax: (502) 546-4049

There are 26 Subtitle D landfills in Kentucky with a total capacity of 168,212,375 cubic yards. This figure comes from an internal Division of Waste Management estimate completed in January 1999. There are no unlined or combination facilities still active in Kentucky.

Active Unlined MSW Landfills

All unlined landfills have closed. The state regulation that caused unlined facilities to close is 401 KAR 47:080 Sections 4 and 5. Unlined landfills that accepted MSW were not allowed to operate past 1992.

Corrective Action for Unlined MSW Landfills

Of the closed unlined landfills, 32 have required corrective action; while one landfill has completed corrective action. Cost data for corrective action measures were not available from the State. There is no state forecast of the costs of future corrective action at unlined landfills.

Closure for Unlined MSW Landfills

A cost per acre to close an unlined landfill was not provided. A state cost projection for future unlined landfills closures was not provided.

401 KAR 48:080 Section 8 requires the following cap components (from bottom to top):

- Filter fabric or other material approved by the cabinet
- 12-inch sand gas venting system with a minimum hydraulic permeability of 1 x 10-3;
- Filter fabric or other material approved by the cabinet;
- 18-inch clay layer with a maximum permeability of 1 x 10-7 centimeters per second;
- For areas of the final cap with a slope of less than 15 percent, a 12-inch drainage layer with a minimum permeability of 1 x 10^{-3} centimeters per second; and
- 36-inch vegetative soil layer.

Health and Environmental Effects - Lined and Unlined MSW Landfills

There are MSW landfills currently in assessment monitoring; however, the number of facilities and types of releases were not provided. No damage to human health and the environment has resulted from the releases, according to the survey response.

Monitoring of MSW Landfills

Monitoring of groundwater, surface water, and post-closure care is performed at the lined landfills. It appeared from the survey response that monitoring of unlined landfills was "not applicable."

5.3.7 Maryland

General Information and Capacity of Lined and Unlined MSW Landfills

The survey was completed by:

Edward Dexter, P.G.
Chief, Field Operations and Compliance Division
Maryland Department of the Environment
Solid Waste Program
2500 Broening Highway
Baltimore, MD 21224

The state of Maryland has 21 active landfills: 20 are lined, or Subtitle D landfills. One is a lined landfill, but does not meet the requirements of Subtitle D, and, therefore, is considered unlined for the purposes of this survey. There are no combination lined/unlined landfills in Maryland.

According to annual facility reports for 1998, the available capacity within these landfills is 83,786,833 cubic yards. None of this capacity is related to vertical expansion.

Active Unlined MSW Landfills

The one landfill with a liner that does not meet Subtitle D standards is scheduled to close in 2016, however the portion that does not meet the standards is scheduled to close in the near future. The two conditions that require a facility to close before the regulatory deadline are:

- If the facility fails to meet 40.CFR.258 location restrictions.
- If the facility fails to take sufficient steps to protect human health and the environment.

The state of Maryland regulates the closure of unlined landfills under the Code of Maryland Regulations (COMAR) 26.04.07. Liners for landfills were first required in 1980, and the regulations were formalized in 1988. When 40.CFR.258 first became effective in 1993, operators upgraded liners if necessary. When the Maryland program was approved in 1995, evaluations began for non-design standard sites. Unlined landfills were only allowed to continue operating if there had been and continued to be no release of pollutants, and if plans were underway to upgrade the landfill with the next new cell.

Corrective Action for Unlined MSW Landfills

Maryland reports that over 30 landfills have undergone corrective action, although there is no data available for total or individual costs for the corrective action measures. There are state forecasts for future corrective action, which were tabulated by reviewing some actual data, and estimating via typical cost estimates (Means Construction Estimating Handbook, etc.)

The 1988 Summary of Closure Costs for Sanitary Landfills, prepared by the Solid Waste Enforcement Division, estimated typical costs for installation and operation of a groundwater treatment system using either (1) a groundwater extraction system or (2) a slurry wall/collection trench system. These estimates were derived using "very limited review" of published data and standard construction cost references. The total estimated costs (including 10-year operation and maintenance costs) of the slurry wall collection trench system came to the following:

Facility	Installation	Inst. + Operations
10 acre landfill	$2.1 million	$7.5 million
50 acre landfill	$4.4 million	$31.4 million
100 acre landfill	$6.7 million	$60.7 million

The groundwater extraction system costs were as follows:

Facility	Installation	Inst. + Operations
10 acre landfill	$110,500	$ 11.1 million
50 acre landfill	$552,500	$ 54.1 million
100 acre landfill	$1.1 million	$109 million

The following assumptions were made in the calculations:

- 3-foot slurry wall and 1-foot collection trench installed to confining layer at 30 feet
- 50-foot extraction wells
- Treatment operations costs $0.20/gal

The 1988 Summary document update is provided in Attachment 5.3.

Closure for Unlined MSW Landfills

The average cost for closure of an unlined landfill in Maryland is $125,000, with the actual range between $88,000 to $250,000. Maryland requires the following cap (bottom to top):

- Greater than or equal to 2-feet of soil to protect the low-k layer from damage by puncture or settlement.
- Low permeability layer with soil less than 10^{-5} cm/sec or greater than 20 mil plastic.
- 6-inch sand drainage layer, with permeability greater than 10^{-3} cm/sec)
- Greater than or equal to 2-feet of soil, with the top 6-inches topsoil or sludge-amended soil erosion layer.

From specific site data, Maryland Department of Environment estimates an average closure cost per acre to be approximately $125,000 with a range between $88,000 to $250,000. This data is available on site by site basis, unverified basis through the local county governments.

Health and Environmental Effects – Lined and Unlined Landfills

The state of Maryland reports that there are landfills that are in assessment monitoring or that have detected gas above the lower explosive limit at the compliance boundary, or have caused a discharge or release to surface water that could be in violation of the Clean Water Act. These violations occurred at 45 unlined, pre-RCRA municipal waste landfills that are long since closed. Nine gas releases occurred, detected by gas monitoring, and 36 leachate releases occurred, detected through groundwater monitoring. The state goes on to report damage to human health and the environment has occurred as a result of these releases. The damage is in the form of groundwater contamination, rendering the water quality for isolated domestic wells to be unpotable.

Monitoring of MSW Landfills

MDE requires monitoring at both lined and unlined facilities of groundwater, subsurface gas in soil, nuisance (odor) gas, cap integrity, and, sometimes, surface water.

5.3.8 New Jersey

General Information and Capacity of Lined and Unlined MSW Landfills

The state contact for this survey response is:

Mr. Nelson Hausman
Division of Solid and Hazardous Waste
Department of Environmental Protection
P.O. Box 414
Trenton, NJ 08625

Telephone: (609) 984-6650
Fax: (609) 777-0769

There are 12 Subtitle D landfills in New Jersey with an estimated remaining capacity of 76 million cubic yards, according to facilities' reporting of topographic surveys as of March 1998.

Active Unlined MSW Landfills

No information regarding active unlined landfills was provided.

Corrective Action for Unlined MSW Landfills

Approximately 10 unlined MSW facilities have undergone corrective action in New Jersey. The State has no data on total or individual site costs for corrective action measures at unlined landfills.

New Jersey did provide a copy of an internal technical paper "Discussion Paper Landfill Closure and Remediation Issues" released to the public in April 1993. The paper assumed three scenarios based on limited closure (Scenario 1), moderate closure (Scenario 2), and full scale closure (Scenario 3).

Scenario 1 featured the following measures:

- Cap: Minimum Subtitle D
- Grading, revegetation
- Drainage Control
- Groundwater Monitoring

Limited closure was determined to have per acre costs of $66,600, $54,350, and $49.492 for 10, 30, and 60 acre sites, respectively.

The moderate closure consisted of the following measures:

1. Cap:
   - 2-inch foundation
   - 12-inch clay layer
   - 6-inch sand gas layer
   - geotextile
   - 12-inch erosion support layer
   - 6-inch vegetation layer

2. Passive Gas Venting System

This scenario resulted in per acre costs of $142,360, $127,193, and $123,093 for 10, 30, and 60 acre sites, respectively.

The full scale closure consisted of the following measures:

1. Cap:
   - 12-inch foundation layer
   - geogrid
   - 24-inch clay layer
   - geotextile
   - geomembrane
   - 6-inch sand layer
   - geotextile
   - geomembrane
   - 12-inch erosion layer
   - 6-inch vegetative layer
2. Active gas controls
3. Leachate Perimeter Controls/Passive system
4. Slurry Wall

The full scale closure scenario resulted in per acre costs of $502,340, $399,590, and $362,832 for 10, 30 and 60 acre sites, respectively.

A copy of the full paper is provided in Attachment 5.4.

Closure for Unlined MSW Landfills

The average cost per acre to close an unlined landfill in New Jersey is $135,000 with a range of $60,000 to $400,000 per acre. These costs apply to a cap with the following minimum requirements for unlined cells (bottom to top):

- 40-mil HDPE
- 12-inch drainage layer
- 12-inch vegetative layer

Supporting data for these costs are given in the technical paper in Attachment 5.4. These data are tabulated for typical sites. The New Jersey forecast for cost of future closure of unlined landfills is one billion dollars as discussed in the Attachment 5.4 paper.

Health and Environmental Effects - Lined and Unlined MSW Landfills

Although the survey response does not list the number of landfills with releases to the environment, the Discussion paper in Attachment 5.4 indicates that among the State's 578 known or suspected landfill sites, 24 are Superfund sites and approximately 117 are in some phase of remediation. The survey response indicates that damage to human health and the environment has been attributed to releases from the unlined landfills. Evidence and extent of the damage was not provided in the survey response.

Monitoring of MSW Landfills

Monitoring of groundwater, gas migration in soil, surface water, and post-closure integrity is being performed at Subtitle D landfills, but not, according to the survey response, at unlined sites.

Non-Subtitle D landfills could fill to permitted limits only with CDD. Landfill requirements similar to Subtitle D were promulgated before federal criteria.

5.3.9 New York

General Information and Capacity of Lined and Unlined MSW Landfills

This survey was completed by:

Mr. Glenn E. Milstrey
Chief, Technical Outreach & Compliance Section
Division of Solid & Hazardous Materials
New York State Department of Environmental Conservation
50 Wolf Road
Albany, New York 12233-7258

New York state has 28 active landfills: There are 26 lined landfills and two are unlined. There are no combination lined and unlined landfills in New York. As of 1998, the available capacity in the lined landfills is 62,600,000 yd^3, and the available capacity in the unlined landfills is 11,400,000 yd^3.

Active Unlined MSW Landfills

Of the two still operating unlined landfills, one is scheduled to close on January 1, 2002, and the other when it reaches volumetric capacity. All new landfills require double-composite liners. Existing unlined landfills must close early if they have caused unremediable contravention of groundwater standards. The resulting enforcement decision would probably take into account the time necessary to alter the existing local solid waste management practices. As previously mentioned, the available capacity of the active unlined landfills is 11,400,000 yd^3. Of this remaining capacity, none is related to vertical expansion. Section 27-0706 of the Environmental Conservation Law is the regulation mandating double composite liners, and also the regulation not allowing contravention of groundwater standards to be the basis for enforcement actions to close. Orders of consent by facility provide the framework for closing a landfill. If a municipality owned the landfill, extensions were granted for unforeseeable delays in the implementation of an alternative solid waste management plan.

Corrective Action for Unlined MSW Landfills

There has been corrective action at one unlined landfill in New York, however there is no data for the cost of the corrective action.

Closure for Unlined MSW Landfills

The average cost per acre to close an unlined landfill in New York is $110,000, while the range of costs per acre within the state for closure of unlined landfills is $70,000 to $400,000. These costs were reported by site owners from over 100 landfills, and verified and compiled into a 1992 report Estimated Landfill Closure Costs by Vincent Fay at (518) 457-5695. The report is provided in Attachment 5.5. There is no state forecast at this time for the future cost to close the remaining unlined landfills.

The cap components required by the New York Department of Environmental Conservation (NYDEC), regulations 360-2.15(d) include the following (bottom to top):

- 12-inch gas venting layer
- 18-inch clay barrier layer
- 40 mil minimum (or 60 mil if HDPE) geomembrane
- 24-inch soil protection layer
- 6-inch vegetative layer

Health and Environmental Effects – Lined and Unlined MSW Landfills

The state of New York has reported that there are unlined landfills that are in assessment monitoring/or have detected gas above the lower explosive limit at the compliance boundary/ or have caused a discharge or release to surface water that may be in violation of the Clean Water Act. However, they do not have this information in one central location. The violation exists at one unlined landfill (Freshkills) which reported pollution tolerant organisms detected in the surface water and sediments.

Monitoring of MSW Landfills

Monitoring is currently being performed at MSW landfills, in the form of groundwater monitoring, gas migration in soil, nuisance gas (odor) migration, surface water monitoring and regular inspections of the cap and vegetative cover.

The Subtitle D landfills were not allowed to continue to operate when state regulations were promulgated in 1993. New York's landfill criteria were stricter than those of U.S. EPA in that, among other things, New York requires double composite liner system where lower liner is specified to Subtitle D.

5.3.10 North Carolina

General Information and Capacity of Lined and Unlined MSW Landfills

The State contact for this survey for North Carolina is:

Edward F. Mussler, P.E.
Environmental Engineer
Solid Waste Section
North Carolina Department of Environment and Natural Resources
401 Oberlin Street, Suite 150
Raleigh, NC 27611

Telephone: (919) 733-0692
Fax: (919) 733-4810

As of January 1998, there are 35 Subtitle D landfills and no unlined landfills in North Carolina. As of January 1997, there were 40 unlined landfills still active. MSW capacity estimates were not provided.

Active Unlined MSW Landfills

Unlined landfills were closed by the so-called "98 rule" (Section 1600 Solid Waste Rules) that required all active MSW landfills to comply with Subtitle D criteria. The formal reference for this state regulation was not provided. All unlined landfills are closed; there is no remaining capacity in unlined cells in North Carolina.

Corrective Action for Unlined MSW Landfills

No information regarding corrective actions in North Carolina was provided.

Closure for Unlined MSW Landfills

Mr. Mussler completed a study projecting costs for a variety of landfill cap designs. Depending on the complexity and materials in the designs, the costs per acre ranged between $37,972 for the minimum Subtitle D-compliant cap design (6-inch vegetative layer, 18-inch clay layer) to $90,878 for a design that includes a 24-inch vegetative layer, a 300-mil geotextile drainage layer, and a 30-mil PVC liner over a 200-mill geotextile-gas collection layer. The full paper is provided in Attachment 5.6.

North Carolina's minimum cap requirements that apply only to unlined landfills are:

- 18-inch compacted clay layer with minimum hydraulic conductivity of 10^{-5} cm/sec
- 6-inch vegetative layer

Health and Environmental Effects - Lined and Unlined MSW Landfills

The survey response reported 38 unlined landfills with documented releases of landfill gas and leachate. The releases were detected by the groundwater monitoring networks or by gas probes. No releases from Subtitle D landfills are indicated in the survey response. Damages to human health and the environment, in the form of degraded stream waters and drinking water supplies, have been attributed to the releases from the unlined sites. An example of additional damage is damaged vegetation around some of the unlined facilities is attributed to landfill gas in the soils.

Monitoring of MSW Landfills

According to the survey response, monitoring of groundwater, gas migration in soil, gas migration in air, surface water, post-closure conditions, and leachate are performed at Subtitle D landfills, but not at unlined landfills.

5.3.11 Ohio

General Information and Capacity of Lined and Unlined MSW Landfills

The agency contact for Ohio's response to this survey was:

Mr. Bill Lutz
Environmental Specialist II
Division of Solid and Infectious Waste
Ohio Environmental Protection Agency
P.O. Box 1049
Columbus, Ohio 43216-1049

Telephone: (614) 644-3020

There are currently 44 active landfills in the State of Ohio: 20 lined landfills, five unlined landfills, and 15 combination lined and unlined landfills. The permitted capacity of the identified landfills was not available.

Active Unlined MSW Landfills

No information as to the scheduled date of closure, or the conditions that would require a facility to close before the established regulatory deadline was available for active unlined MSW landfills. Of the unknown available capacity in the unlined landfills, 100% were deemed to be related to vertical expansion.

There are currently no Ohio regulations that have caused unlined landfills to be closed or allow them to remain open. Ohio allows filling of pre-1993 Non-Subtitle D landfills over existing footprint. As of 1995 this practice was under internal review.

Corrective Action for Unlined MSW Landfills

According to the survey, there have been 15 unlined landfills in Ohio that have undergone corrective action. No corrective action cost information was available for this survey.

Closure for Unlined MSW Landfills

The requirements for unlined cells (3745-27-11 Section G.1(c.) and 3745-27-08 Section C(16) of the Ohio Administrative Code) are as follows (bottom to top):

- 24-inch soil barrier layer (10^{-7} cm/sec) or 18-inch layer (10^{-6} cm/sec) with flexible membrane liner or geosynthetic equivalent
- 12-inch granular drainage layer (minimum hydraulic conductivity of 10^{-3} cm/sec) or drainage net equivalent
- 36- to 32-inch frost protection layer
- Vegetative layer of sufficient thickness to support vegetation

Health and Environmental Effects – Lined and Unlined MSW Landfills

The State of Ohio has approximately 53 landfills that are in assessment monitoring: six unlined landfills, 40 lined landfills, and 7 combination landfills. No further information was available as to the type of release that occurred at these facilities, or as to any adverse effects to human health or the environment from these releases.

Monitoring of MSW Landfills

The types of monitoring currently being performed at both lined and unlined landfills includes groundwater, soil gas migration, odor or nuisance gas, cap and vegetative cover inspections, and leachate quality and quantity.

5.3.12 Oregon

General Information and Capacity of Lined and Unlined MSW Landfills

The State contact for this survey is:

Karyn Hanson
Intern
Solid Waste Section
Oregon Department of Environmental Quality
Lazarus Government Center
750 Front Street NE, Suite 120
Salem, Oregon 97301-1039

Telephone: (503) 378-8240

There are 65 active landfills in Oregon. All active landfills in the State are lined (Subtitle D) except a small number of sites in the eastern region where it has been demonstrated that there is no migration potential. The number of unlined sites was not provided.

MSW landfill capacity was not provided. Capacity is defined at the time of request for final closure. The State does not track this information outside of individual final closure.

Active Unlined MSW Landfills

No information was provided for active unlined MSW landfills.

Corrective Action for Unlined MSW Landfills

Almost all unlined landfills have undergone some type of corrective action to, at least, include capping, cover, and vegetation or some other method to minimize leachate production. A few have undergone more extensive remediation.

Data on corrective action measures are available on a site by site basis. The data are not tracked by the State, however. The way the cost data for corrective action at MSW landfills are tabulated is available in the State's files on specific sites. That information is not monitored by the State.

Closure for Unlined MSW Landfills

Closure costs for unlined landfills may range from $80,000 to $120,000 per acre. This estimate was provided by Mr. Tim Spencer, Senior Environmental Engineer, Oregon DEQ.

Oregon Administrative Rule 340-094-0140 requires three feet of compacted soil and a vegetative cover of natural grass. OAR 340-094-0120 requires minimum 2% and maximum 30% slopes

No other cost data were provided in the survey response.

Health and Environmental Effects - Lined and Unlined MSW Landfills

While there are MSW landfills in assessment monitoring and damage to human health and the environment has been attributed to releases from MSW landfills, this information is reported on a site by site basis and is not compiled by the State.

Monitoring of MSW Landfills

Monitoring is performed for groundwater, gas migration in soil and air, surface water, and post-closure integrity are performed according to the requirements of the sites at all MSW landfills.

5.3. 13 Pennsylvania

Pennsylvania did not respond to the survey.

General Information and Capacity of Lined and Unlined MSW Landfills

Pennsylvania Bureau of Land, Recycling, and Waste Management
Division of Waste Minimization and Planning
PO Box 6472
Harrisburg, PA 17105-8472

Sally Lohman
Telephone: (717) 787-7382

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5.3.14 South Carolina

General Information and Capacity of Lined and Unlined MSW Landfills

The State contact for this survey is:

Ms. Melinda C. Mathias
Environmental Health Manager
Division of Solid Waste Planning and Recycling
Bureau of Land and Waste Management
South Carolina Department of Health and Environmental Control
2600 Bull Street
Columbia SC 29201

Telephone: (803) 896-4207
Fax: (803) 896-4001

South Carolina has five (5) unlined MSW landfills and 14 Subtitle D landfills. MSW capacity is estimated to be 105 million cubic yards as of 1998, according to the 1999 Solid Waste Management Plan. The five unlined landfills account for an additional 10,000 cubic yards, approximately. The State lists two sites as Subtitle D landfills that are assigned unlined tonnage-in-place, thus implying that these two sites may be combination landfills.

Active Unlined MSW Landfills

The deadline for closure of all unlined landfills was October 9, 1998 (five years after the effective date of SCR 61-107.258). Unlined facilities were allowed to continue to operate if the owner/operator could show financial hardship imposed by timely closure. Two of the unlined landfills are identified as vertical expansion sites.

Landfills meeting state liner requirements that were less stringent than Subtitle D were allowed vertical expansions until 1995 (South Carolina Register 61-107.258.1 (f)). Three of the five identified unlined sites have negotiated closing dates of 2000, 2005, and 2008.

R.61-107.258 is the state regulation that caused unlined facilities to close under Title 44, Chapter 96, the Solid Waste Policy and Management Act of 1991. Counties that demonstrated financial hardship imposed by closing their unlined fills were allowed to continue to operate the landfills.

Corrective Action for Unlined MSW Landfills

There have been corrective actions at unlined landfills in South Carolina. The State does not track costs associated with closure work or corrective actions that have been implemented at unlined landfills.

Closure for Unlined MSW Landfills

Costs per acre to close unlined landfills were not provided. Data was not available.

For unlined landfills, South Carolina requires:

- 18-inch clay barrier with maximum hydraulic conductivity of 10^{-5} cm/sec
- 12-inch vegetative layer

Health and Environmental Effects - Lined and Unlined MSW Landfills

Monitoring operations have detected releases of contaminants at 45 unlined and 11 lined facilities, as well as methane releases from 11 lined and 25 lined facilities. Damage to human health or the environment has only been attributed to unlined sites. Groundwater is legally considered a public resource in South Carolina so that any releases above Safe Drinking Water Act Maximum Contaminant Levels are considered to be public health or environmental damage.

Monitoring of MSW Landfills

South Carolina requires compliance monitoring for groundwater, subsurface gas, and surface water at all MSW landfills.

The State has issued one permit for a research and development project that evaluates the effect of leachate recirculation on waste decomposition and methane generation.

5.3.15 Tennessee

General Information and Capacity of Lined and Unlined MSW Landfills

The state contact for this survey is:

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Environmental Program Specialist
Division of Solid and Hazardous Waste Management
Tennessee Department of Environment and Conservation
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There are 40 active, MSW landfills in Tennessee, 11 unlined sites along with 29 Subtitle D landfills. Altogether, these landfills constitute approximately 48 million cubic yards of capacity as calculated from the 1999 Remaining life Survey for Class I (Sanitary) Sites in Tennessee.

Active Unlined MSW Landfills

Of the 40 active landfills, 14 have 20 years or more of remaining life. It is unclear from the survey response which landfills are unlined.

Landfills existing as of October 9, 1996 were required under Rule 1200-1-7-.04(1)(b.)3.(ii) to have composite liners unless they could demonstrate their compliance with siting and final site plan criteria.

Corrective Action for Unlined MSW Landfills

Four unlined MSW landfills have undergone corrective action, though cost data for those projects are not available.

Closure for Unlined MSW Landfills

Tennessee's Division of Solid Waste Management has reported closure/post-closure costs for seven landfills. It was not clear from the data if these landfills were all unlined. Of the seven, the three sites with leachate collection systems had an average closure cost of $51,696 per acre. The four without a leachate system had an average closure cost of $16,450 per acre. The average annual post-closure care cost for all seven sites was $24,000 with a range between $8,550 and

$59,000. The two highest yearly costs were from sites with leachate collection systems; although the other site with leachate collection had a relatively low yearly cost. The summary table with these costs tabulated is provided in Attachment 5.7.

Rule 1200-1-7-.04 3. (i) requires the following cap requirements:

- 24-inch clay barrier (max. hydraulic conductivity of 10^{-7})
- 12-inch vegetative layer

Alternate designs using geosynthetic materials may be approved on a site-specific basis.

Health and Environmental Effects - Lined and Unlined MSW Landfills

Tennessee has landfills in assessment monitoring; however, the number and nature of releases are not available except at regional offices. Damage to human health and the environment has been attributed to release from unlined landfills, but not Subtitle D landfills. Evidence of this damage is contaminated groundwater and an explosion.

Monitoring of MSW Landfills

Environmental monitoring is performed at all MSW landfills. Monitoring types performed include groundwater, gas migration in soil and air, and surface water.

5.3.16 West Virginia

General Information and Capacity of Lined and Unlined MSW Landfills

The state contact for this survey is:

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Office of Waste Management
Division of Environmental Protection
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West Virginia oversees 20 active MSW landfills, all Subtitle D. Remaining capacity provided by these landfills was not included in the survey response.

Active Unlined MSW Landfills

There are no active unlined landfills in West Virginia. By 1994, all landfills with no liner were required to close. By 1995, all Non-subtitle D landfills were required to close.

Corrective Action for Unlined MSW Landfills

Information concerning the occurrence, number and costs of corrective actions at unlined landfills in West Virginia is not compiled.

Closure for Unlined MSW Landfills

West Virginia manages unlined landfill closures through its Landfill Closure Assistance Program that operates under the Division of Environmental Protection. The program is funded by tipping fees. Since its inception in 1991, the closure program has spent approximately $13.8 million closing seven landfills. The program has also spent approximately $2 million on leachate management at unlined landfills.

No information regarding the minimum requirements for landfill caps was provided in the survey response.

Health and Environmental Effects - Lined and Unlined MSW Landfills

According to the survey response, information regarding the number of landfills in assessment monitoring and the number and nature of releases is not compiled by the State.

Monitoring of MSW Landfills

Environmental monitoring is performed at all Subtitle D landfills. Monitoring at unlined sites is required, but not always performed. Monitoring is required for groundwater, gas emissions, surface water, cap integrity, and leachate at the collection point.

5.3.17 Wisconsin

General Information and Capacity of Lined and Unlined MSW Landfills

The state contact for this survey is:

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Bureau of Waste Management
Wisconsin Department of Natural Resources
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In Wisconsin, 47 Subtitle D landfills account for 58.96 million cubic yards of MSW capacity, based on the 1998 Wisconsin Solid Waste Tonnage/Capacity report.

Active Unlined MSW Landfills

There are no active unlined landfills in Wisconsin.

Chapter NR 140, Wis. Adm. Code requires the owner/operator to "take whatever actions are necessary" to avoid exceeding the Enforcement Standards and, since October 1, 1985, all new solid waste landfills in Wisconsin must be designed to meet the Preventive Action Limits.

Based primarily on the landfill performance and design experience gained in Wisconsin during the 1980's, the State's legislature established a revised set of solid waste rules (chs. NR 500 to 520, Wis. Adm. Code) in 1988. The 1988 rules required all landfills to be designed with a 5-foot clay liner and a leachate collection system and contained siting, design, and operating criteria, standards for environmental monitoring, closure, and post-closure care.

In 1989, Wisconsin provided an incentive to municipalities to close their unlined landfills. Municipalities that closed these facilities between January 1, 1988 and October 1, 1992, were paid 50% of the cost of closure after deducting $10 per capita. The program provided financial assistance for the closure of 373 dumps.

Corrective Action for Unlined MSW Landfills

Currently, there are "several dozen" corrective actions at unlined MSW landfills. The Bureau of Remediation and Redevelopment oversees corrective actions at inactive landfills.

Closure for Unlined MSW Landfills

DNR staff estimates average closure cost per acre for unlined landfills to be $100,000 with a range of $50,000 to $100,000. These estimates are taken from individual sites. For state-lead projects, some cost documentation is on file. The estimates are also based on closure costs calculated for new landfill permit applications. The statewide number of unlined landfills in need of closure is not known.

Some documentation of costs is in case files. For most sites, estimates are based on closure costs calculated for new landfills.

In 1996, Wisconsin further revised it's solid waste rules to require all MSW landfills to be designed with a composite liner (a geomembrane liner over a 4-foot clay barrier) and a composite final cover system. The final cover system components are as follows (NR 504.07, Wis. Adm. Code):

- 6-inch base layer (over waste)
- 24-inch clay (maximum hydraulic conductivity of 10^{-7} cm/sec) cap
- 40-mil (or greater) geomembrane
- 30-inch drainage layer (minimum hydraulic conductivity of 10^{-3} cm/sec)
- 6-inch topsoil

The geomembrane is not required on landfills with composite liners closing before July 1, 1996.

Thus, the revised rules now exceed the Subtitle D requirements for MSW landfills. In fact, Wisconsin was the first state in the nation to receive approval of its solid waste program by the USEPA.

Health and Environmental Effects - Lined and Unlined MSW Landfills

Although there are landfill sites in assessment monitoring, the number is unknown. Most assessment monitoring is the result of groundwater contamination or, to a lesser extent, landfill gas problems. Evidence of environmental damage from landfill releases includes deterioration of groundwater quality, contaminated water supplies, and some gas explosions. There have also been some documented cases of adverse impacts to streams due to leachate discharges.

Monitoring of MSW Landfills

The DNR staff report that no environmental monitoring of unlined landfills is being performed. At Subtitle D facilities, monitoring is conducted of groundwater, subsurface landfill gas migration, air emissions, surface water, and cap integrity.

Assessing the efficacy of various states' solid waste management programs is complex such that supporting general comparative conclusions is often impractical. It is not always possible to attribute an amount of waste diverted from landfill disposal to a particular program or policy. Often recycling and waste reduction initiatives are implemented by more than one agency, sometimes outside of the departments charged with environmental regulation. Prevailing economic and political conditions can influence a state's landfill capacity consumption rate in a way that cannot be easily addressed by state agency programs. However, some successful outcomes are notable in some states that warrant further evaluation to determine if a policy or regulatory approach can be identified as potentially responsible for the success. It can then be determined whether and/or how a similar program should be adopted in Virginia.

Nearly all states have instituted a suite of initiatives promoting and requiring recycling such as local solid waste management plans, recycled newsprint requirements, procurement preferences for recycled paper, tax credits for recycling equipment and facilities, landfill bans on waste tires, and outreach programs. States with these programs are listed in Table 6-1.

States in the Northeast with the most densely populated areas – New Jersey, and Connecticut – have made recycling mandatory. These States obviously achieve the highest recovery rates. These rates and other status indicators, from U.S.EPA's 1997 MSW Factbook, are presented in Table 6-2. Costs for recycling programs become less of an issue for their state agencies because the local governments have to comply and make financial accommodations for recycling programs.

Local governments face increasing demands for new programs like recycling and HHW collection and increasing competition from the private sector. Solid waste management has developed from being an exclusively public health issue to an economically motivated service. In addition, local governments are no longer able to guarantee that local waste will go to the local landfill. Some jurisdictions believe that without flow control, landfill tipping fees can no longer cover the costs of solid waste services.

The States' assessments of recycling markets appeared to be based often on anecdotal or qualitative data. Real data to determine the effectiveness of States' market development expenditures appeared to be nearly non-existent. Some respondents, namely, the Connecticut Bureau of Waste Management, with significant market research believed that state market development has limited effect because the markets were now global and unaffected by local demand for or supply of recyclable material. For example, scrap iron and scrap paper are two of the top exports of the U.S. When the Asian economy crashed recently, most recycling markets also crashed despite any local development efforts on the part of state agencies. Another example of the global nature of recycling markets is that products made from recycled plastics can also be made from the by-product of petroleum refining. In good economic times, petroleum refining is typically at full production, which results in a large supply of petroleum by-products at low prices. The price of recycled plastic would have to compete with that low price for the

Table 6-2. Synopsis of 1997 EPA Data of States' General Solid Waste Management Conditions

State	Number of Landfills	Landfill Capacity (years)	Disposal Rate (% by weight)	Recycling Rate (% by weight)	Combustion Rate (% by weight)	Permanent HHW Programs	Yard Waste Ban (yes/no)	Pay-As-You-Throw Programs*
Virginia	80	>10	47	35	30	11	N	1-25
California	289	>10	83	26	2	40	N	26-100
Connecticut	3	5-10	17	23	60	2	Y	1-25
Georgia	101	5-10	66	33	1	0	Y	1-25
Indiana	51	>10	69	23	8	10	Y	101-200
Kentucky	24	19#	85	18	0	0	N	0
Maryland	26	5-10	54	27	19	1	Y	1-25
New Jersey	12	<5	34	43	23	3	Y	101-200
New York	33	<5	34	32	16	13	N	1-25
North Carolina	65	5-10	76	22	2	7	Y	101-200
Ohio	51	5-10	83	15	2	1	Y	101-200
Oregon	54	>10	60	29	11	2	N	101-200
Pennsylvania	47	>10	66	20	20	3	Y	101-200
South Carolina	30	>10	71	27	2	0	Y	1-25
Tennessee	77	5-10	59	40	1	0	N	0
West Virginia	22	>10	87	13	0	0	Y	1-25
Wisconsin	51	5-10	56	40	4	4	Y	200+

Source: MSW Factbook, Ver. 4.0, Office of Solid Waste, USEPA, Washington, DC, 1997.

*: Source: Waste Age Magazine, May 1999
#: 1999 VADEQ survey information

virgin material. No state, then, could have much impact on the overall global demand for recycled products no matter how much is spent on procurement preferences or other programs. The crucial elements in a successful state recycling program, in the opinion of the Department of Environmental Protection (DEP) staff, are (1) effective legislation requiring recycling participation, and (2) a community awareness of the environmental need for recycling participation.

There were many objections, especially from local agencies, to direct comparisons of unit costs of recycling or waste reduction measures to landfill disposal costs. This approach neglects not only the role of recycling within an integrated waste management system, but also cost avoidance from landfill diversion and the non-economic considerations of local governments. There are a number of economic models, available or under development, that account for a broader allocation of resources in the decision making processes in solid waste management. One of these models, funded by the EPA and developed by the Research Triangle Institute, that analyzes the consequences of the trade-offs using a "life-cycle inventory" approach, which considers the total cost of every aspect of a material type's "life." This kind of research is beyond the scope of this study. Future support for state level policy decisions should include such robust analysis.

The responses, literature and Internet searches indicate that the solid waste agencies of most other eastern states maintained a separate planning section. This planning unit is usually responsible for compiling and analyzing data for periodic recycling and landfill status reports. This information might allow a state to take more proactive measures to adjust the course of waste management policy by knowingly constantly where the state is positioned relative to long range agency goals. On the other hand, most states in the survey don't track the kind of information that the survey asked for, such as per unit costs of waste diversion efforts. Some states reported that this and other analytical information was tracked at the local level only, and only compiled by the State with major effort for specially funded projects.

Two states in the survey for this report have instituted measures to limit the amount of airspace permitted each year based on projected future needs. South Carolina's Solid Waste Policy and Management Act of 1991 contained a innovative element known as the Demonstration of Need regulation. This regulation appeared to be unique among South Carolina's landfill permitting tools. The 1991 Act set June 30, 1999, as the date after which no more airspace can be permitted unless a formal determination of need for more capacity is made. Although the Demonstration of Need regulation is still being developed, South Carolina intends for it to be the regulatory mechanism by which landfill permit applications by public or private applicants may be denied if South Carolina's planning projection determines that more landfill space is not needed. This regulation has not yet been written, so it has not been constitutionally tested. Pennsylvania's Governor, perhaps in response to current political events, has proposed to limit permit issuances based on projected statewide landfill life expectancy.

This survey found that recycling and waste reduction technologies and processes among other states as diverse as the people who participate in them. One recycling program does not fit all communities. Direct cost comparisons are problematic because urban and rural communities face such significantly different economies of scale. Recycling is only one element in what should be a truly integrated solid waste management system; therefore, economic consequences of state level policy decisions should be analyzed at the system level.

6.3 WASTE REDUCTION AND RECYCLING SURVEY - FINDINGS BY STATE

Many states provided published documents such as annual reports of solid waste management to legislatures. Most reports provided 1998 data, although for some information, only data from earlier years was available.

Most states reported a suite of programs and policies that encourage or require increases in waste diverted from landfills. Most states require local governments to establish solid waste management plans that set recycling rate standards. In addition, many states have granted recycling tax credits. Trusts fund have been created to finance collection programs and public assistance grants for some states.

Table 6-2 indicates that, among the states surveyed, Virginia ranks fourth in MSW recycling rate (35 percent) and that Virginia had the third lowest MSW disposal rate (47 percent), according to the USEPA 1997 report. The states with the higher recycling and combustion rates for the most part had lower disposal rates. The inverse is also generally true: the states with the lowest recycling and combustion rates usually had the highest disposal rates. However, quick inferences about the states' solid waste programs should be avoided. Many qualifications and assumptions must presumably apply to the data. For example, percentage rates are usually expressed as a percentage of total waste (recycled plus disposed) generated within a state. The amount of waste buried in Virginia is large relative to other states, and this may be because the commonwealth imports approximately 2.8 million tons of MSW per year. As a percentage of solid waste generated in-state, however, Virginia's disposal rate is relatively low.

The states with the highest recycling rates were Virginia, Georgia, New Jersey, New York, and Tennessee. Connecticut had, by far, the lowest disposal rate (17 percent). Other states with low disposal rates included New Jersey (34 percent), Maryland (54 percent), New York (54 percent), and Wisconsin (54 percent). Tennessee and Georgia achieved higher than average recycling rates with low (1 percent) combustion rates. These states' survey responses indicate the initiatives that each of them believes to be effective waste diversion efforts.

6.3.1 Virginia

Virginia has not had a statewide plan or forecast that relates projected waste generation rates or volumes with projected landfill capacity, however, this report does make such forecast.

The following state legislation has been promulgated to encourage or require recycling or waste reduction practices in Virginia:

10.1-1408.M Establishes a permit processing priority for applications for facilities that accept recycling residues; must be acted on within six months of completion.

10.1-1411 Regional and Local Solid Waste Management Plans – Each locality is required to develop a comprehensive solid waste management plan and to ensure that at least 25 percent of its generated waste is recycled.

10.1-1422.01 Litter Control and Recycling Fund – provides grants to localities and others to fund local recycling programs and statewide litter prevention and recycling education programs.

10.1-1422.3 Waste Tire Trust Fund -- $0.50 per tire tax is deposited in the Waste Tire Trust fund and used to encourage the beneficial use of waste tires; reimbursement is provided based on the source of the waste tire.

10.1-1425.11 Establishes an environmental management hierarchy for the Commonwealth with a preference for pollution prevention, waste reduction, reuse, recycling, and, as a last resort, disposal.

10.1-1425.12 Pollution Prevention Assistance Program.

58.1-338 and 58.1-445.1 Recycling Tax Credit – establishes income tax credit for 10 percent of the purchase price of recycling equipment.

10.1-1408.1.K. and L. Provides for reasonable exemptions from permitting requirements for yard waste composting operations and vegetative waste management facilities.

Of the legislative measures noted above, VDEQ cites legislation 10.1-1411 Regional and Local Solid Waste Management Plans (that required to develop a solid waste management plan to ensure that at least 25 percent of its generated waste is recycled) as having the most significant impact on diverting waste from landfills. All of Virginia's localities and municipalities are covered under a total of 82 plans. Some localities have joined together to form service authorities which operate under one plan.

The VDEQ's 1993 Recycling Report is a verifiable estimate of the percentage of waste diverted from MSW landfills since state regulations to reduce waste went into effect. The report contains summarized statewide recycling data from 1991 and 1993. Legislation in 1989 required the development and implementation of regional and local solid waste management plans to achieve increases in recycling. Although baseline data from the first year of the regulation (1991) is not available, a 10 percent recycling rate was required by 1991. The 1993 report cites a 1991 rate of 19.7 percent and 33.4 percent in 1993. Assuming these rates were achieved, the increase from 1991 to 1993 was 13.7 percent, according to the report. The baseline year for calculating this waste disposal reduction was 1991, and this data is summarized in the 1993 recycling report. Virginia reports that the yearly data summaries may be compatible.

Virginia stated that although it is difficult to assign specific percentage of statewide total waste reduction to specific legislation, legislation establishing recycling goals have had an effect. Litter control and recycling grants contributed to these reductions as well as other programs and policies both at both state and local levels.

Following the establishment of the Waste Tire Trust Fund in 1990, statewide waste tire recycling has increased. According to the survey results, the amount of waste tires retrieved from the waste stream and processed for beneficial use is as follows:

- CY 1995 58,303 tons
- CY 1996 76,062 tons
- FY 1998 96,118 tons
- FY 1999 95,410 tons

In the Waste Tire Program, cost per ton to process waste tires has been:

- CY1995 $29.25
- CY 1996 $29.25
- FY 1998 $32.38
- FY 1999 $22.19

These costs do not include private sector hauling and processing that are estimated to cost up to $100 per ton.

The year-to-year comparisons are consistent due to consistent accounting methods. Seventy-eight percent of the waste tires generated in calendar years 1995 and 1996 were captured by the program's efforts. Since 1993, the Waste Tire Program has cleaned up 423 waste tire piles containing a total of 12,132,117 tires.

The costs per ton of waste disposal reduction measures are not monitored at the state level in Virginia. The June 1993 Summary of Local Government Program Database reported a curbside recycling program cost of $103.43 per ton. As Virginia stated in its questionnaire response, this figure may not include transportation and disposal costs. Local governments reported that recycling costs account for an average of 12.2 percent of their solid waste budgets. Of curbside programs with average household costs under $6.32 responding governments reported an average cost of $2.01 per household. For household costs of curbside programs that cost over $20.00, eight responding governments reported an average cost of $229.61 per household. The report did not specify these to be weekly or monthly costs. According to John Grove, Director of Recycling at the Southeastern Public Service Authority (SPSA), costs for SPSA's curbside recycling program are $1.20 per household per month.

Evidence that statewide recycling or waste reduction efforts are less expensive on a volume or weight basis than disposal in a landfill was not provided in the State survey response. Virginia indicated that, when comparing unit costs of recycling to unit costs of landfill disposal, the cost of landfill air space savings should be considered. The response cautioned that care should be taken when collecting and analyzing cost comparison data because the full cost accounting of recycling should be compared to that of disposal. For example, the SPSA tip fee is $38 per ton, but a study done by the City of Norfolk indicates that it costs $70 per ton to collect and transport garbage to the transfer stations for a total cost of $108 per ton. Full cost accounting totals for recycling vary greatly with the commodity under consideration. For tires, the full cost for recycling is the tonnage cost listed above plus the private cost of about $100 per ton.

The Report of the 1992 House Joint Resolution No. 85 Study Committee, *Interim Report on the Feasibility of Utilizing the Private Sector to Meet the Solid Waste Management Needs of Local Governments and Public Service Authorities in the Commonwealth,* recommended that a "public-private partnership or industry trade-local government association alliance" be established to "assist local governments in identifying privatization opportunities." This partnership might include, for example, an outreach or marketing arm to promote both public and private services.

The VDEQ's Division of Pollution Prevention and Compliance Assistance was created in 1998 to assist the private and public sectors in implementing their move toward a more "sustainable environment" with cleaner, less-wasteful technologies and practices. Within this Division, the Office of Pollution Prevention (OPP) provides services that cover waste discharges to air and water and includes solid waste reduction. The OPP, which has been in existance in one form or another since 1989, provides outreach services including a resource referral service, industry-specific workshops, and on-site pollution prevention opportunity assessments. OPP maintains state and regional partnerships and cooperative relationships to maximize effectiveness and understanding of regional conditions. For example, the Virginia Environmental Services Network (VESN) is a cooperative effort among the OPP, Virginia's Center for Innovative Technology and Virginia's Philpott Manufacturing Extension Partnership. The VESN is an online, searchable database of references for public and private environmental service providers,

including solid waste management consultants and contractors. These same cooperative organizations administered Virginia Pollution Prevention Grants under the 1998 Virginia Pollution Prevention Grant Program.

Other programs that VDEQ believes to have helped achieve reductions in amounts of waste generated and disposed are:

10.1-1422.05 Statewide Litter Control and Recycling Grants – Provides for educational grants.

10.1-1425.6 Recycling Programs of State Agencies – Agencies must establish programs for collection and use of recycled materials.

10.1-1425.7 Department of Business Assistance is charged with promoting the establishment of recycling industries in the Commonwealth.

10.1-1425.8 Department for Transportation; Authority and Duty – Encourages the Virginia Department of Transportation (VDOT) to establish research use of recycled materials in highway construction.

58.1-439.10 Waste Motor Oil – Tax credit for purchase of waste oil burning equipment.

58.1-3660 Pollution Control Equipment – Provides for sales tax credit for pollution control equipment.

9 VAC 20-80-740 Exemptions to Classification as Waste - Some materials may be deemed by the State to have a beneficial re-use. These materials are then no longer regarded as waste and, therefore, not regulated. Materials that would otherwise be classified and regulated as solid waste may be exempted from regulation if they are used beneficially. A beneficial use is any use of a discarded material as a substitute for natural or commercial products that does not contribute to adverse effects on human health and the environment. To be eligible for beneficial use, a solid waste must be used in the form in which it is generated; a material that has been processed or reprocessed in any way after being generated as a solid waste cannot be considered for beneficial use. Anyone may use a material beneficially, however most users prefer to have VDEQ review their proposals and issue an official beneficial use determination (BUD) in order to not incur liability for improper disposal of solid waste.

A number of local governments in the Commonwealth have initiated Pay-As-You-Throw billing systems (PAYT). The goal of PAYT, also known as variable rate or unit pricing, is to create a financial incentive to reduce solid waste discards. PAYT is a billing system in which a household pays for solid waste disposal services based on the amount of waste it generates for disposal. Traditionally, local governments have assessed a flat garbage collection tax on all households, regardless of the volume that a household may generate. In this system, there is no

economic incentive for household to reduce their waste output. On the other hand, if households could pay less for throwing out less, then they would be inclined to do so. The agencies may implement PAYT by selling bags or tags to be used for collection. For example, the EPA has cited the City of Poquoson, Virginia, as an example of a PAYT program that has succeeded in diverting a significant amount of trash from landfills. The City of Poquoson sells to households the bags in which the household garbage is set out for collection. The less garbage is generated, the fewer bags one must buy.

Judging from the 1998 Annual Report of the Virginia Recycling Markets Development Council to the Governor and The General Assembly of Virginia, markets of typical recycled materials in Virginia (from 1997 data) can be described in the following terms provided in the survey:

MATERIAL MARKET	ATTRIBUTE
Glass	Moderate
Plastics	Strong
Paper	Weak
Metals	Weak
Tires	Moderate

The Virginia survey cited Section 11-47 of the VAC as strengthening recycling markets by giving preferences to bidders with products that have the largest amount of recycled content in state contracts for product. The effective date for this legislation was unknown.

The State Agency Materials and Products Listing/Exchange (SAMPLE) was created to help state agencies avoid the costs of disposal of hazardous materials by establishing a web page for providing those materials to other state agencies that may be able to use them.

Virginia is a member of the Mid-Atlantic Consortium of Recycling and Economic Development (MACREDO), which works with other EPA Region III states on regional market development. The organization's mission is to identify, promote, and implement projects and programs that enhance recycling and economic development opportunities on a regional basis. The goals of MACREDO are to:

- Combine individual state and local recycling and job creation efforts for regional success.
- Research recycling market issues.
- Provide region-wide publications concerning the availability of recyclable materials and recycling business opportunities.
- Offer a forum for information exchange between member jurisdictions, local authorities, the private sector, and nonprofit organizations.

Virginia has 34 active materials recovery facilities (MRF) which sort waste streams to recover recyclable material. In addition, Virginia has 7 facilities which burn solid waste and recover the energy produced.

In southeastern Virginia, the Southeasten Public Service Authority (SPSA) provides an example of the economic benefits of both regionalization and waste-to-energy (WTE) implementation. Eight communities in the Tidewater area of Virginia participate in SPSA, with local government representatives on the Board of Directors. SPSA administers all facets of solid waste management, either directly or contractually, including curbside and drop-off recycling, materials recovery, yard waste composting, tire shredding and recycling, RDF processing and power generation. MSW is screened and sorted at SPSA's eight transfer stations between processable and non-processable waste. The processable waste is delivered to SPSA's RDF plant in Portsmouth. Oversized and/or metal objects and other non-burnable items are screened out of the waste stream. Screening is done by primary and secondary trommel screens, magnetic separators, and a handpicking station. At the magnetic separators, ferrous metal is separated from the waste stream and set aside for sale to industry. At the picking station, aluminum cans are recovered and also sold to industry as recycled materials. Finally, the conditioned waste material is transported by conveyor belts to the adjacent power plant. SPSA took over ownership of the power plant, which produces steam and electricity for the Norfolk Naval Shipyard, in 1999. Through this one plant, over half of the 932,968 tons of MSW generated per year, within SPSA's jurisdiction, is converted to steam or electricity by SPSA. Other details about SPSA's WTE operations are discussed in Section 7.

Another example is Odgen Martin who operates two WTE incinerators in Northern Virginia, one in Alexandria and one in Fairfax. According to the 1998 Northern Virginia Solid Waste Status Report, Ogden Martin has a capacity of nearly 4,000 tons per day and processed nearly 41 percent of the solid waste generated in northern Virginia that year. Recent federal amendments to the Clean Air Act have increased costs of the WTE plant operation, forcing the plants to charge higher tipping fees. The WTE plants require large waste in-flows not only to maintian power generation, but also to to finance their bonds. The higher tipping fees make it more economical for some waste haulers to take their trash to local landfills with lower expenses and gate fees, thus endangering flows of waste and cash to the WTE plants. Local governments have explored user fee options to ensure financing of the facility's bonds (NVPDC 1999).

6.3.2 California

The State of California reports that it has a statewide plan or forecast that compares projected waste generation rates or volumes with projected landfill capacity in the State. The Integrated Waste Management Act of 1989 (AB 939) mandated that cities and counties report their annual waste management activities to the Waste Board. AB 939 also mandated that California divert 25 percent of its solid wastes from landfills by 1995 and 50 percent by 2000. Based on the reported tonnages of solid waste diverted from landfills in California in 1995, the state has an estimated 28 years of remaining landfill capacity.

There are several laws that encourage waste reduction and recycling. The overriding piece of legislation, however, is AB 939--the Integrated Waste Management Act of 1989. The laws and regulations passed since have sought to encourage and promote waste reduction and recycling. In addition to diversion goals, local plans must provide for 15 years of disposal capacity for the undiverted waste, proper management of special wastes, and the means to keep household hazardous wastes out of landfills. The Office of Local Assistance (OLA) helps the local agencies to meet those standards.

There is a verifiable estimate of the percentage of waste diverted from MSW landfills since regulations went into effect. In 1995, California exceeded its mandated waste diversion level with a statewide average of 28 percent diversion, the equivalent of nearly 14 million tons from an estimated 50 million tons generated. In 1998, the last year for which current data is available, California diverted almost 18 million tons of 56 million tons of MSW generated for a diversion rate of 33 percent. Since passage of AB 939, California has diverted the following amounts: 1990--8.5 million tons from 50.9 million tons generated (17 percent); 1991--9.7 million tons from 49.2 million tons generated; 1992--10.2 million tons from 48.6 million tons generated; 1993--11.4 million tons from 48.1 million tons generated; 1994--12.4 million tons from 48.7 million tons generated; 1995--13.7 million tons from 49.7 million tons generated; 1996--15.9 million tons from 50.9 million tons generated; and 1997--17 million tons from 52.5 million tons generated (32 percent). This represents a 15 percent increase in waste diversion since 1990.

The California diversion rate exceeds the national average, and California is making strides towards meeting mandated 50 percent diversion rate. According to the survey, California believes that there remains a need to improve recycling and waste reduction activities in order to meet mandated levels.

The baseline year for waste generation/diversion calculations is 1990. Some jurisdictions were allowed to modify their baseline year data to more accurately reflect actual tonnages. There are more than 500 jurisdictions in California that report their annual waste management activities to the California Integrated Waste Management Board (CIWMB). Although waste reduction and recycling programs vary from city to city, the Waste Board is able to accurately calculate waste

diversion data based on certain shared characteristics. A detailed explanation of the calculation of waste diversion and disposal can be found on the CIWMB web site at: www.ciwmb.ca.gov/LGTools/DRS .

Waste reduction can be attributed in large part to AB 939. AB 939 mandated statewide solid waste diversion levels for 1995 and 2000. Additionally, there is legislation that funds the diversion and recycling of waste tires and used oil, as there are bills that speak to the reuse of materials such as paper, plastics, organic materials, construction and demolition, etc. In 1998, the state diverted (recycled) 18.5 million tons of solid waste from an estimated 56 million tons generated for a 33 percent diversion rate. However, the Board does not track specific types of solid waste reduced/diverted per specific recycling programs. There are more than 500 jurisdictions in California, each with their own reduction/recycling programs, that report to the CIWMB their annual diversion rates.

The state survey response did not provide information to determine the per unit cost of specific waste reduction measures in California is not available. Sufficient data to determine whether recycling or waste diversion efforts are less expensive on a per ton basis than disposal in a landfill was also not provided in the survey response. Disposal costs vary between landfills. The Waste Board receives an average of $1.34 per ton of wastes landfilled. The costs of reducing or recycling wastes also varies, according to material types, processes, business involved, etc. California believes that viable comparisons between reducing or recycling the individual waste types and what it costs to landfill each are difficult because most solid waste is disposed collectively.

California utilizes several varied technologies and processes to reduce waste disposal. Programs include reduction efforts, such as using both sides of paper pages and electronic mail to cut down the use of office paper, using recycled content products, educating the public on the merits of waste reduction/recycling, promoting the markets for recyclable goods, collecting reusable materials by city/county curbside pick-up, using amnesty days for tires and household chemicals, certifying used oil collection centers, and creating innovative recycling projects that may receive financial and technical assistance from the Waste Board. Some recycling projects funded by the Board include the use of compost on six farms in Southern California, the use of waste tire shreds in levees for flood protection, the use of waste tires in asphalt paving, the use of new technologies in plastics recycling, the use of waste tires in playground safety mats and in a septic tank project at a freeway public rest stop, etc.

There are several bills that have had varying degrees of impact on waste reduction and recycling in California. CIWMB does not keep information that quantifies how well specific solid waste management legislation works.

Some of the most effective solid waste reduction results involve local government and community programs that receive all, or partial, funding from the Waste Board. There are

approximately 40 designated Recycling Market Development Zones throughout the state where businesses involved in waste reduction and recycling can apply to the Waste Board for financial assistance. Cities and counties use Waste Board money to hold trash amnesty days, public awareness campaigns, establish used oil collection centers, start curbside collection programs, etc. For example, in 1997 California had 1,262 source reduction; 1,657 recycling; 433 composting; and 1,186 special wastes programs. All of these, and similar programs, have a reportedly positive effect in reducing and recycling waste.

Other effective waste reduction programs have been developed in California. Business Resource Efficiency and Waste Reduction is an umbrella program for a number of training and outreach programs. For example, the Waste Prevention Info Exchange facilitates the flow of news, fact sheets, case studies, guidebooks, and reports among interested parties. The exchange has staff able to conduct limited research. Business Kits contain fact sheets, a business waste reduction guide, and waste management plans. They are being distributed through participating local governments and the Waste Prevention Info Exchange. The landscape Waste Reduction Program targets a large portion of California's waste stream (15-20 percent) through assistance in yard waste management, on-site composting, and low-waste landscaping. CalMAX inventories available items traditionally discarded by business and industry in a free bimonthly catalog that lists materials wanted and available.

CIWMB also commits funds to recyclable materials market development. An example of this is the Recycling Market Development Zone (RMDZ), which provides incentives to businesses that use secondary materials from the waste stream as feedstock for their manufacturing processes. CIWMB offers financial assistance, product marketing, and permitting assistance. Local government incentives include relaxed building codes and zoning laws; streamlined local permit processes; reduced taxes and licensing; and increased and consistent secondary material feedstock supply.

PARIS (Planning Annual Report Information System), administered by the OLA, is a database containing information on how local jurisdictions achieve waste diversion. To demonstrate their waste diversion efforts, jurisdictions submit Annual Reports to the CIMWB. A diversion rate measurement calculator was developed by the Board for jurisdictions to calculate their diversion rates. This is an important mechanism to standardize data collection among local agencies from year to year.

The Waste Board permits more than 600 municipal solid waste facilities. There are an estimated 43 MRFs permitted by the Board. All MRFs sort materials before sending trash to landfills. There are three licensed WTE sites that burn waste—including scrap tires—to generate electrical power. California maintains a database with specific information on its many recycling and waste handling facilities at www.ciwmb.ca.gov/SWIS .

6.3.3 Connecticut

The Connecticut Department of Environmental Protection (DEP) is currently updating its MSW disposal capacity projection. The most recent edition was published in 1991. Based on preliminary figures, MSW landfill capacity is evaporating quickly in the state. The state is committed to incineration as a MSW disposal method and presently incinerates 82 percent of disposed (non-recycled) MSW in six waste-to-energy facilities in the state. Approximately 6 percent is landfilled and the remaining 12 percent is hauled out-of-state.

Connecticut is one of the few states that requires MSW recycling. The Mandatory Recycling Act (PA 87-544) required recycling of 25 percent of the state's solid waste stream by 1991. To that end, Section 22a-241b- of the DEP regulations banned many recyclable materials from disposal, including glass and metal containers, corrugated cardboard, scrap metal, white office paper, newspaper, and leaves. Connecticut achieved a recycling /source reduction rate of 25 percent in 1997 after adding several more items to the ban, including nickel-cadmium batteries, magazines, textiles, and yard waste. Section 22a-241b-3 prohibits solid waste facilities from accepting these items and Section 22a-241b-4 requires municipalities to establish recycling plans for each banned item. Section 22a-220a(a) allows municipalities to designate where certain recyclable materials that it generates shall be taken for processing. The survey credits these recycling requirements with helping to achieve the State's high recovery rates. The 1993 state legislature passed PA 93-423, an act that set a waste reduction goal of 40 percent by the year 2000. The act also encouraged municipalities to join one of ten recycling regions. The member towns of a region send their recyclables to "intermediate processing centers" strategically located in densely populated areas, allowing the towns to take advantage of economies of scale that regionalization offers.

Connecticut's Public Act 91-376 commits the state to encourage pollution prevention (PP) in the public and private sectors. The DEP emphasizes PP in all agency programs as the preferred management approach for protecting public health and the environment. The Bureau of Waste Management is charged with implementing PP through public education, industry assistance, and staff development. The Office of Source Reduction and Recycling oversees planning and implementation of the statewide mandatory recycling initiative. The office accomplishes this through the following activities:

- technical assistance;
- education and promotional activities and materials;
- compliance monitoring, reporting systems; and
- oversight of pilot recycling and waste reduction projects.

The office also administers regional and municipal recycling grants. The Office of Planning and Development is charged with the development and implementation of the E/2000 environmental plan that includes local governments' recycling projections and goals.

The DEP has monitored recycling rates since recycling became mandatory in 1991 to estimate the percentage of waste diverted from MSW. In 1992, the 540,400 tons, or 19 percent, of MSW generated in state was recovered; by 1998, that figure increased to 765,474 tons or 24 percent. Connecticut estimates that it has increased the statewide recovery rate by 5 percent in six years. The data for these figures are collected by each municipality for each month and submitted to the DEP in annual reports.

Information concerning the percentage waste reduction attributed to specific programs, or costs per ton of waste reduction measures was not provided in the State survey response. The State provided information indicating that yard trimmings represented over 21 percent of the total recovered MSW reported by the municipalities in Fiscal Year 1998. The same data indicated that corrugated cardboard accounted for 16.6 percent, yard waste constituted over 9 percent, and newspapers represented 8.8 percent. The State's survey respondent believes that Connecticut's waste reduction efforts are less expensive on a per unit basis than landfill disposal. The respondent identified the avoided tipping fees, the revenues generated from the recycling facilities, and the value added products as evidence of the economic advantages of waste reduction programs.

Other effective technologies or processes used in Connecticut that are effective in reducing waste or diverting it from landfills include:

- Backyard composting,
- Grasscycling,
- Pilot food waste composting programs,
- Fluorescent lamp recycling, and
- Electronics collection events.

More information regarding these programs is available from the Connecticut DEP Department of Planning and Standards (860-424-3365).

Connecticut indicated that recycling markets varied monthly, even daily. The State estimated the following descriptions of markets for certain items.

MATERIAL MARKET	ATTRIBUTE
Paper	Moderate (volatile at times)
Corrugated	Moderate
Chipboard	Weak
Glass	Moderate
Plastics	Moderate
Aluminum	Moderate
Ferrous Metals	Moderate
Non-ferrous Metals	Moderate

The State response indicated that the local market for recycled paper has been strengthened by the requirements for state agencies to (1) purchase recycled-content paper (Executive Order 12873) and (2) give price preferences to bidders with recycled materials in the procurement of goods.

Recycling efficiency in the State is increased by the operations of the Connecticut Resource Recovery Authority (CRRA) in Hartford. The CCRA administers contracts for the operation of numerous recycling and processing facilities (see below). Other programs of note include Special Act 93-2 that enabled the state to provide grants through the DEP for the siting of Household Hazardous Waste (HHW) centers. DEP has also partnered with community groups to establish the Hartford Neighborhood Environmental Project, a pilot program to raise community awareness of and participation in neighborhood recycling and waste prevention projects.

Other than the mandatory recycling laws, programs that the State believes to have helped achieve reductions in the amount of waste generated and the amount disposed in MSW landfills include:

- RAYCYCLE – A recycling superhero active in school programs for 8 years;
- Staff specialists to provide information and education since 1992;
- Recycling workshops for business and municipalities, held state wide when recycling became mandatory; and
- Educational program for graphic designers about recycled-content paper availability.

Connecticut has made a substantial commitment to WTE technology as a chief solid waste management element. The CRRA operates four RRFs. Of these RRFs, three are mass burn facilities and one utilizes RDF co-fired with coal. Mass burn facilities incinerate raw waste in the same form as it was collected; RDF plants process the waste to select the most efficient portion for heat generation during incineration. A more detailed description of these processes is given in Section 7. Two other mass burn facilities are privately owned, and another privately owned plant incinerates tires only. Altogether, these seven facilities have contracts to process nearly 2.2 million tons of MSW annually and produce over 215 Megawatts of power. The names and contacts for these facilities are provided in Appendix C.

6.3.4 Georgia

Georgia has a statewide forecast that compares projected waste disposal rates with projected landfill capacity. According to the 1998 Remaining Capacity Report for Unlined MSW Landfills, the remaining capacity was 10.1 million cubic yards. According to Georgia's survey response, a 1997 forecast indicated that Georgia had 14 years of permitted disposal life remaining in its unlined cells.

EPD (Environmental Protection Division) cited the Georgia Comprehensive Solid Waste Management Act of 1990 that established a per capita goal of a 25 percent reduction in waste disposal as being an important MSW diversion mechanism. EPD staff also reported that MSW composting is increasingly effective at reducing waste disposal in landfills. According to the 1998 annual report, two composting facilities are currently operating.

Georgia provided an estimate of the percentage of waste diverted from landfills since the Act of 1990 went into effect. The baseline year for this estimate was 1992, when 8.6 million tons of solid waste was disposed of in landfills. In 1998, 10.74 million tons were disposed in landfills. For those same years, the pounds per day of solid waste disposed per capita were 7.11 and 7.70, respectively.

The percentage of waste reduction attributable to specific programs arising from specific legislation was not available from the survey response. Per unit costs associated with waste reduction measures were also not available. It was reported, however, that in Fiscal Year 1998, Georgia's local governments reported costs of $370.9 million for solid waste services; of that, $19.9 million was spent for recycling, composting, and mulching activities. Information regarding the cost of recycling or waste reduction on a per unit basis as compared to the cost of landfill disposal was not provided in the State survey response.

The State reported that MSW is effective in reducing waste or diverting it from MSW landfills. Mr. Randy Hartman, at the Georgia Department of Community Affairs at (404) 679-4816 is the contact for more information regarding MSW composting.

The Georgia survey response described markets for the most common recycling material types according to the following description.

MATERIAL MARKET	ATTRIBUTE
Paper	Strong
Corrugated	Strong
Chipboard	Strong
Glass	Strong
Plastics	Strong
Aluminum	Strong
Ferrous Metals	Strong
Non-ferrous Metals	Strong

The State reported information was not available to determine whether state legislation or regulation has strengthened any of the recycling markets.

Other programs believed to have helped the State achieve reductions in the amount of waste generated and the amount disposed in landfills include the use of Pay-As-You-Throw (PAYT) billing systems by 9 counties and 13 city governments. Also, in 1998, over half of Georgia's counties and 28 percent of city governments had initiated solid waste public education programs.

Georgia's Solid Waste Management Program (Department of Natural Resources, Environmental Protection Division [EPD], Land Protection Branch) operates the Pollution Prevention Assistance Department (PPAD). This office promotes recycling and waste reduction efforts through such projects as an information center, onsite assessment, employee training, and seminars. The PPAD has formed partnerships with the U.S. Department of Defense for PP at state military installations. The PPAD has also produced guidance documents assisting localities with yard trimmings composting.

The Department of Community Affairs (DCA), under the Department of Commerce, prepared and published the 1997 Georgia Solid Waste Management Plan that established goals, objectives, and strategies to support environmentally sound management of solid waste, including waste prevention and recycling development. The DCA also publishes the Georgia Solid Waste Annual Report that presents data summaries of the year's solid waste management activities in Georgia.

Georgia reported that it has waste separation and recycling facilities that are in operation in conjunction with landfills or waste-to-energy facilities. The facility names and contacts are given in the Table 6-3. Georgia reported one RRF, Savannah Energy Systems Company, for the production of utility power. The plant processed 106848.70 tons of waste in 1998, according to the survey response. The facility contact is Ms. Margaret Chapman at (912) 236-1014.

The Georgia Environmental Facilities Authority (GEFA) makes low interest loans to local governments and authorities for environmental infrastructure development. In FY98, GEFA loaned $6.9 million to local governments for landfill construction and expansion. GEFA also

Table 6-3 Facility Names and Contacts of Waste Separation and Recycling Facilities in Georgia

County	Facility Name	City	Contact Name	Telephone No.
Appling	B-Square Recycling and Recovery	Baxley	Ronald C. Bullard	(912) 367-3891
Cherokee	Safe Medical Systems	Woodstock	William M. Wagner	(770) 425-2049
Crisp	Crisp Co.MSW Processing Facility	Cordele	J. Reginald Barry	(912) 276-2672
Fulton	Visy Paper MRF	Atlanta	Gary Bird	(404) 918-5678
Fulton	BFI of Georgia	Atlanta	Lang Herndon	(404) 792-2660
Jefferson	Jefferson Co. - MRF	Louisville	Hon. Gardner J. Hobbs	(912) 625-3332

administers the Recycling Waste and Reduction Grant Program that funds projects such as recycling facilities and equipment as well as public education and technical assistance programs. Funding for the loans comes from the Solid Waste Trust Fund.

Georgia's per capita disposal rate increased 10 percent from 1993 to 1997 (state population grew by 8.6 percent).

6.3.5 Indiana

The State of Indiana has a statewide forecast that compares projected disposal rates with projected state landfill capacity. The 1996 report indicates a statewide landfill life expectancy of 6 to 15 years of permitted capacity.

Indiana state legislation exists that requires or encourages recycling and waste reduction measures. The following sections in the Indiana Code are examples:

Section 13-20-18 of the Indiana Code (IC) established the Indiana Institute on Recycling to "develop concepts, methods, and procedures for assisting in efforts to recycle solid waste."

Section 13-20-22 provided for the state solid waste management surcharge on tipping fees at disposal sites. The regulations provided for fees assessed against waste loads generated outside of Indiana but disposed in Indiana. The surcharge money is contributed to the State Solid Waste Management Fund, which provides funds for recycling, yard waste, and waste reduction programs among others.

Section 13-19-1 established that "the policy of the state is that source reduction, recycling, and other solid waste management alternatives are preferred over incineration and landfill disposal as solid waste management methods." The section provided that goal of the state is to "reduce the amount of solid waste incinerated and disposed of in landfills in Indiana by thirty-five percent (35 percent) before January 1, 1996; and fifty percent (50 percent) before January 1, 2001 through the application and encouragement of solid waste source reduction, recycling, and other alternatives to incineration and landfill disposal."

The State does have a verifiable estimate of the percentage of waste diverted from MSW landfills since state regulations went into effect. The baseline year for the analysis of percent diversion estimate in the study of Indiana Solid Waste Disposal was 1993. In that year, out of 8.8 million tons of MSW generated in the State, 1.7 million tons of MSW were recovered (diverted) for a diversion rate of 19 percent. Section 13-19-1 of the IC set a goal of 35 percent diversion for 1996. In 1996, the diversion rate was 32.3 percent (3.5 million tons diverted from 10.7 million tons generated). The State believed that the computations of diversion rates have not been historically consistent. Indiana has achieved annual increases in the percentage of in-state non-industrial solid waste (includes construction and demolition debris (CDD), incinerators, and

sludge monofils) diverted from landfills since tracking such information began in 1993. The 1998 diversion rate was reported at 34.3 percent.

The percentage waste reduction attributed to specific programs arising from specific legislation is not known. The cost per ton of each waste reduction measure is also not known. Indiana reported that there was insufficient data to determine whether recycling or waste reduction efforts are less expansive on a per unit basis than disposal in a landfill. Robert Gedert, Indiana Department of Environmental Management Representative, at (317) 233-5431 is a contact for information regarding the efficacy of waste reduction technologies.

Information concerning the relative strengths of recycling markets was not provided in the State's response. The establishment of Solid Waste Management Districts and the establishment of the statewide Recycling Institute were given by the State response as examples of state legislation or regulations that may have strengthened recycling markets. Another program that may have helped the State achieve waste disposal reductions is the creation of the Indiana Materials Exchange. The Exchange facilitates recycling and reuse of industrial and commercial waste by maintaining and distributing listings of materials available and materials wanted. The service is funded by the Indiana Department of Environmental Management's Office of Pollution Prevention and Technical Assistance, and the listing service is provided free of charge to users.

The Office of Pollution Prevention and Technical Assistance, under the Department of Environmental Management (IDEM), is responsible for integrating PP as a voluntary option into the regulatory process, providing technical assistance, maintaining a technical resource center, and conducting broad-based educational programs. Program examples include Pollution Prevention Challenge Grants, The Indiana Recycling Grants Program, and Indiana Material Exchange.

The Office of Solid and Hazardous Waste (Operations Branch, Data Analysis and Planning Section) administers biennial reports, solid waste facility quarterly tonnage reports, and annual landfill capacity reports. The office generates data for permitting, compliance, remediation, and planning and assists solid waste management districts.

The State has no waste separation or recycling facilities operating in conjunction with landfills or MSW WTE facilities. There is one WTE facility in the State, The Indianapolis Resource Recovery Facility, operated by Ogden-Martin, Inc., that processes approximately 2,360 tons of MSW per day.

6.3.6 Kentucky

Although the state has not developed a formal forecast that compares waste generation rates with disposal capacity, the state reports 19 years of permitted MSW landfill capacity,

State legislation in the Kentucky Revised Statutes encourages recycling and waste reduction measures:

> KRS 224.43-310 established the Natural Resource and Environmental Protection Cabinet (NREPC) as the official coordinating agency for solid waste planning and management activities of local governments and districts in Kentucky. The Statute identified as a primary goal of the NREPC "to reduce the amount of solid waste disposed in municipal solid waste disposal facilities." The NREPC must produce and triennially update a solid waste management plan.
>
> KRS 224.43.310 also created the Solid Waste Reduction and Management Plan Advisory Committee, made up of stakeholder representatives, to advise and review updates to the plan.
>
> KRS 141.390 (2) established a tax credit for recycling equipment tax credit amounting 50 percent of the installed cost of the recycling or composting equipment. Pollution control facilities (that include recycling and composting sites) are granted exemptions or reductions in state and local property taxes, state sales taxes, and state ad valorem taxes.

Information to estimate the amount of waste diverted from MSW landfills since the promulgation of waste disposal reduction regulations was not provided in the State survey response.

The State's survey response did not attribute a percentage of waste reduction to specific programs arising out of specific legislation. The State response did not report a unit cost of waste reduction measures, nor any evidence that the State's recycling or waste reduction efforts are less expensive on a per unit basis than landfill disposal. Information was not available concerning other recycling or waste reduction technologies or processes being used that are effective in reducing waste or diverting it from MSW landfills.

The State estimated the following descriptions of markets for commonly recycled items

MATERIAL MARKET	ATTRIBUTE
Paper	Moderate
Corrugated	Moderate
Chipboard	Volatile
Glass	Limited Geographically
Plastics,#1	Weak
#2	Moderate
Aluminum	Moderate
Ferrous Metals	Moderate
Non-ferrous Metals	Strong

Other state legislation or regulation that has strengthened any of these recycled material markets was not provided in the survey response.

The Resource Conservation and Local Assistance Branch (RCLA, Division of Waste Management) administers several waste reduction programs (waste tires, buy recycled, etc.). RCLA operates the central file room that tracks landfill and solid waste management data as well as out-of–state waste shipped. The State assists with county Solid Waste Management Plans. RCLA implemented the Solid Waste Loan & Grant Fund that provides low interest loan funds for local governments that are available through the Kentucky Infrastructure Authority (KIA).

RCLA administers the Kentucky Recycling & Marketing Assistance (KRMA) that plans and operates recycling programs. KRMA provides market support by regional, state and local facilities listing as well as by distributing information on recycling markets and prices. KRMA assists local governments and commercial operations by providing technical information, including on-site assessments of recycling programs and facilities. KRMA works with regional cooperatives to achieve economies of scale by collecting truckload quantities. KRMA also provides public outreach services by working with state agencies, local governments and business and industry to encourage development and purchasing of products with recycled content.

The Kentucky General Assembly established the Kentucky Pollution Prevention Center (KPPC), a non-profit organization established by the general assembly (KRS 224.46-305) to promote PP and provide PP technical assistance to public and private facilities at no cost to the customer. The KPPC also offers on-site PP assessments, training workshops, seminars and teleconferences. In addition, the KPPC administers the Kentucky Industrial Materials Exchange, the Kentucky Environmental Management Systems Alliance, and the Kentucky Wood Waste Alliance. Department of Waste Management staff cited the KPPC as an effective statewide waste reduction program. There are no MRFs or incinerators operating in the State.

6.3.7 Maryland

The State of Maryland does not have a statewide plan or forecast that compares projected waste generation rates with projected landfill capacity.

State legislation exists that encourages recycling and waste reduction measures. The 1988 Maryland Recycling Act (MRA) required the City of Baltimore and the larger counties to recycle 20 percent of their solid waste, and smaller counties , those with populations of less than 150,000, to recycle 15 percent of their waste by 1994. All Maryland counties currently meet or exceed the minimum goals established by the law. The state achieved a 33 percent statewide MSW recycling rate (1,873,981 tons) for 1998. This represents an increase from 6 percent in 1988 when the Recycling Act was passed.

The State does not track estimates of the percentage of waste diverted from MSW landfills since state regulations went into effect. The State has tracked recycling, some of which was already taking place and some varies with reporting, which is not mandatory for most businesses. The baseline year for calculating reductions arising from the MRA is 1992. In that year, 824,750 tons of MSW were recovered. In 1997, 1,617,235 tons were recovered, an increase of 96 percent in tons recovered. In 1992, Maryland's MSW recycling rate was 19 percent; in 1997, the recycling rate had risen to 32 percent. Separately collected yard waste was banned from landfills in 1994. In 1993, 157,051 tons of yard waste was recycled; in 1997, the amount recycled was 298,000 tons. The data used to calculate these recovery figures are consistent in coverage (wasteshed) and by computational method.

The survey response did not attribute the percentage of waste reduction to specific legislation.

Although the State has no unit costs of recycling measures, a 1993 report of the Midshore Regional Recycling Program (made up of five Maryland county governments) calculated a cost per ton to recycle waste (including avoidance-cost of landfill space) of $74, compared to a collection and landfilling cost of $98-$128. The report indicated that privatization of recycling services had been the "key" to achieving successful recycling rates. Private sector recycling accounted for 85 percent of the material recycled within the program counties. In addition, Hartford County developed a total cost per ton of all recycling materials (including yard waste) using 1994 data. The cost per ton of the County's recycling program was estimated to be $46.16 in 1994. This cost includes annualized capital costs of new facility construction; actual operating costs would be lower.

Other recycling technologies referenced by the State as being effective in diverting waste from MSW landfills are the color separation of broken glass by the private sector firm Partners Quality Recycling Services, Inc., (contact Mr. Tom Collins [410] 682-9974) and "Grasscycling" in Montgomery, Prince George's, and Baltimore Counties.

The State provided the following descriptions, without supporting data, of markets for commonly recycled items.

MATERIAL MARKET	ATTRIBUTE
Paper	Moderate
Corrugated	Strong
Chipboard	No Report
Glass	Limited Geographically
Plastics	Limited Geographically
Aluminum	Strong
Ferrous Metals	Strong
Non-ferrous Metals	Strong

The State response cited certain legislation or regulations that have strengthened the above markets. MDE has taken steps to increase demand for recyclable materials. These steps were enabled by the 1990 legislation that not only allowed up to a 5 percent price preferences for products with recycled content, but also mandated that 40 percent of paper purchased by the state government have recycled content. The state government is the largest purchaser of recycled paper in Maryland. Other programs include the 1994 separately collected yard waste ban, the 1994 waste tire ban, and the legislation requiring recycled paper in newsprint and telephone books. MDE reports that state government requirements like these have increased the global demand for recycled paper.

Maryland is a member of the MACREDO, a regional group known that works with other USEPA Region III states on regional market development.

Maryland counties have developed programs that have helped the State achieve reductions in the amount of waste generated and the amount disposed in landfills. These programs are aimed at back yard composting, "grasscycling", PAYT, and collection of reusable construction materials. The MDE reports that the few PAYT programs that are in place have been "very effective" at both reducing waste and increasing recycling.

The MRA excludes certain materials (such as waste tires that go to tire disposal facilities) from the definition of solid waste for the purposes of tracking Maryland's recycling efforts. Maryland reports a 1998 recycling rate of 33 percent. This is indicative of a 29 percent residential recycling rate and a 38 percent commercial/industrial recycling rate.

The Maryland Department of the Environment continues to work with the Maryland Department of Business and Economic Development (DBED) and Maryland Environmental Service (MES) to develop more recycling markets. Approximately 5 million dollars is generated annually by a one dollar recycling fee placed on each new tire purchased in Maryland. The funds generated from the one dollar per tire fee are being used to clean up waste tire stockpiles, set up Maryland's

scrap tire recycling system, and fund local projects that will recycle scrap tires. Most scrap tires go to Tire Recycling Facilities (TDFs) and do not count toward recycling rate. In 1994, separated yard waste was banned from landfills. As of 1997, nearly 300,000 tons of yard waste was composted. Composted tonnage does count toward the statewide recycling rate.

A unique feature of Maryland's approach to waste disposal reduction, and environmental protection in general, is the function of the Maryland Environmental Service (MES). MES was created in 1970 by Section 3-103 Natural Resources of the Annotated Code of Maryland. MES provides water supply, waste purification, and disposal services. MES operates as both a government agency and a non-profit utility. The benefits of this structure, as cited by MES, is that MES can perform with the efficiency and quick response time of a private sector firm while retaining public accountability. MES is self-supporting and does not receive General Funds directly from the State. MES employs a recycling staff that provides a full range of recycling services to the state and to local governments including program planning and implementation; facility management and operation; and the marketing of materials. For example, in Montgomery County, MES operates a Material Recycling Facility, a yard waste composting facility, and assists the County with various recycling programs. In Baltimore County, MES operates the Baltimore County Resource Recovery Facility and the Western Acceptance Facility. MES publishes the Buy Recycled Training Manual for training of recycling professionals and local authorities. According to the provisions of the Maryland Scrap Tire Recycling Act, the MES is responsible for establishing a statewide scrap tire recycling system. The law requires MES to establish adequate scrap tire recycling capacity in Maryland to meet the scrap tire disposal needs of the state, including stockpile elimination and annual generation of scrap tires.

The 1998 Solid Waste Management Task Force Report strongly recommended as "essential' the development and dissemination of a zoning and facility siting guidelines to be developed by representatives of the State, county and municipal governments; citizens; industry; and appropriate experts. The guidelines would provide a planning tool for the optimal geographical placement of facilities while allowing for citizens' desire for local control.

Three major waste-to-energy plants are active in the state. The Baltimore RESCO Company operates a 2,100-ton per day waste-to-energy plant in Baltimore, Maryland. At the front end of the plant is a materials recovery facility that extracts and re-sells metals from the incoming raw waste loads. Montgomery County owns an 1800-ton per day waste-to-energy plant contractually operated by the Odgen-Martin Corporation. Montgomery County levies a solid waste management fee on citizens residing in incorporated areas of the county. This fee pays for disposal costs of MSW. The citizens then contract with a private hauler to collect and dispose of residential MSW. The hauler then pays no fee at the Waste-To-Energy plant (Montgomery County Resource Recovery Facility) or at the intermediate transfer stations that feed it. The free disposal ensures that waste haulers will maintain a steady flow to the plant. Therefore, the county effectively controls its waste flow to ensure the operational success of its plant and

finances the Plant's bond by its user fees from the citizens. Odgen-Martin does not conduct recyclable materials recovery (MRF) at the plant; the County contracts other MRF facilities elsewhere.

6.3.8 New Jersey

Nearly all of the information for this section came from referrals by the New Jersey respondent to the New Jersey Department of Solid and Hazardous Waste (DSHW) website. As of October 26, 1999, the State of New Jersey had not responded to Section 2 concerning recycling and waste reduction of the survey.

No statewide projection of landfill capacity is available; however, according to the Table entitled 1997 Annual Landfill Topographic Report published on the DSHW website, New Jersey's 18 active landfills have a combined capacity of 77.5 million cubic yards as of 1997. This capacity figure is consistent with the MSW capacity given in Section 1 of the state survey. The table did not indicate if all of the landfill capacity listed was permitted for MSW. In addition, according to the table entitled 1997 Generation, Disposal, and Recycling Rates in New Jersey found on the same website, the 1997 statewide MSW recovery rate was 42 percent. The method of calculation for that figure, however, is not clear.

According to Guy Watson, Bureau Chief of the Bureau of Recycling and Planning, DSHW, residential curbside recycling collection programs costs approximately $90 per ton as a statewide average. The statewide average for collection and disposal of MSW is approximately $100 to $110 per ton.

New Jersey's recovery rate as shown on the DSHW website for 1997, indicates a MSW recycling rate of 42.8%. This high rate is a result of the mandatory recycling law in place in New Jersey, according to the survey response. The only landfill ban currently in place is for yard waste. New Jersey also has a Beneficial Use Determination program. "Beneficial use" means the use or reuse of a material, which would otherwise become solid waste, in a manner good for the public. Beneficial use of a material does not constitute recycling or disposal and, therefore, is not regulated.

The State estimated the following descriptions, without supporting data, of markets for commonly recycled items

MATERIAL MARKET	ATTRIBUTE
Paper	Strong
Corrugated	Strong
Chipboard	Strong
Glass	Moderate
Plastics	Weak
Aluminum	Strong
Ferrous Metals	Strong
Non-ferrous Metals	Strong
Construction and Demolition	Moderate

All counties are SWM districts that must have a SWM plan approved by the Division of Solid and Hazardous Waste. The New Jersey Solid Waste Advisory Council (SWAC) is made up of members representative of the public, private, and non-profit sectors. The purpose of the SWAC is to make recommendations to government agencies regarding solid waste management issues. The New Jersey Buy Recycled Business Network is a group of companies publicly committed to increasing their purchase of recycled content products.

The Bureau of Resource Recovery and Technical Programs specifies design, construction, and operation standards that ensure the environmentally sound operation of the State's resource recovery facilities, incinerators, composting facilities, and beneficial use projects. These activities are accomplished under the authority of the "Solid Waste Management Act," (N.J.S.A. 13:1E et seq.) and the "New Jersey Statewide Mandatory Source Separation and Recycling Act," (N.J.S.A. 13:1E-99.11 et seq.).

Because municipalities provide curbside recycling to virtually every community in the State, the survey concluded that there is not enough supply of raw, mixed waste to support material recovery facilities. New Jersey has 22 authorized incinerators and, of those, five are waste-to-energy facilities, according to the DSHW website. These WTE plants constitute 2.37 million tons per year of MSW capacity.

6.3.9 New York

The State of New York does not have a plan or forecast that compares projected waste generation rates or volumes with projected statewide landfill disposal capacity.

The principal legislation that drives recycling and waste reduction efforts in New York is the Solid Waste Management Act of 1988. The Act sets policy for a wide range of State and local solid waste management including state policy, and state assistance for local plans. The Act establishes the Bureau of Waste Reduction and Recycling and sets state policy for waste reduction and recycling programs.

According to the State survey response, the State has a verifiable estimate of the percentage of waste diverted from MSW landfills since state regulations went into effect. The baseline estimate for 1987 was 0.7 million tons of waste recovered, representing a waste recovery of 3 percent. The current statewide recovery rate is 43 percent. The data used to calculate the reduction were consistent in planning unit (wasteshed) and computation.

New York attributed the success of reported waste reduction to programs arising from legislation. The State reported a 42 percent waste reduction through recycling support including Beneficial Use Determinations, and the Returnable Container Act. The State estimated that 12.54 million tons have been recycled including 900,544 tons of yard waste composted. Costs per ton of these measures were not provided. There is insufficient evidence, according to the State's response, to determine whether recycling or waste reduction efforts are less expensive on a per unit basis than landfill disposal.

Recycling market descriptions were not provided in the State survey response; however, the State indicated that information might be available by contacting Empire State Development, Keith Lashway, (518) 292-5340.

The Environmental Protection Fund (EPF) has fostered New York's major waste diversion programs since 1993 such as The Municipal Waste Reduction & Recycling Program (MWR&R). The MWR&R was established by the Environmental Protection Act in 1993 to award funds to projects that enhanced municipal recycling infrastructure through purchasing of equipment or construction of facilities. The Clean Water/Clean Air Bond Act of 1996 established the Municipal Recycling Projects Program. The Act provided additional State assistance to continue the enhancement of local government investment in recycling equipment, infrastructure and facilities.

6 NYCRR Part 369 established a state assistance grant program for municipal waste reduction and recycling projects pursuant to Title 7 of Article 54 and section 56-0405 of the Environmental

Conservation Law. This program provided State assistance payments for the purpose of funding municipal waste reduction and recycling projects. Examples of eligible projects include, but are not limited to, the following:

- waste reduction capital, planning, and promotion costs
- recycling equipment
- recycling structures and materials recycling facilities
  including land, buildings, roadways, and other physical improvements

Information was not provided in the survey response regarding recycling facilities or RRFs in New York State.

6.3.10 North Carolina

The State of North Carolina did not identify a plan or forecast comparing projected waste generation or disposal rates with projected MSW landfill capacity. General Statute 130A-309.09A required local governments to develop waste disposal reduction plans "to assist the State to achieve the State's forty percent (40 percent) municipal solid waste reduction goal." The 1998 North Carolina Solid Waste Management Annual Report contains a projection of annual state disposal rates based on linear regression of past annual disposal totals. According to the projection, the State will dispose of more than 1.2 tons per capita, 9 percent more MSW than 1998 levels. The report indicated that this figure was more than twice the rate needed to meet the State's waste reduction goal.

Information concerning state legislation or regulations requiring or encouraging recycling and waste reduction measures was not provided in the State survey response. North Carolina solid waste management regulations that cover recycling and waste reduction issues are identified as follows:

Section .0900	Yard Waste Facilities
Section .1000	Solid Waste Management Loan Program
Section .1100	Scrap Tire Management
Section .1400	Municipal Solid Waste Compost Facilities
Section .1500	Standards for Special Tax Treatment of Recycling and Resource Recovery Equipment and Facilities

North Carolina did not offer a verifiable estimate of the percentage of waste diverted from MSW landfills since these regulations went into effect. Nor did the State report on the percentage of waste reduction attributed to specific programs arising from specific legislation. Evidence that waste reduction or recycling measures are less expensive on a per unit basis than landfill disposal was not provided.

Division of Pollution Prevention and Environmental Assistance Service (DPPEA), in the Solid Waste Section of the North Carolina Department of Environment and Natural Resources (DENR) publishes annually the "Markets Assessment of the Recycling Industry and Recyclable Materials." In the 1998 report, market conditions for the following commonly recycled material types (included in the state survey) were described:

MATERIAL MARKET	ATTRIBUTE
Paper	Weak (Insufficient supply)
Corrugated	Moderate (Demand > Supply)
Glass	Strong (Demand > Supply)
Plastics	Strong
Aluminum	Moderate
Ferrous Metals	Moderate (Demand > Supply)

In its survey response North Carolina did not attribute the strengthening of any of the above markets to a specific legislation or regulation.

The Solid Waste Section works with local governments, industry, and citizens to implement plans and processes to minimize waste generation and disposal, prevent releases to the environment, and take enforcement action against illegal activities. In North Carolina, there are about 560 permitted facilities that manage solid waste in some manner. About 125 - 150 tax certifications are issued to companies annually for equipment and facilities used exclusively for recycling and resource recovery. More than 6 million tires have been cleaned up from 300 sites in the past few years because of efforts made by the division.

Other programs that have helped the State achieve reductions in the amount of waste generated and the amount disposed are administered by the DPPEA. The DPPEA provides free technical and other non-regulatory assistance to reduce the amount of waste released into the air and water and on the land. The DPPEA can also help interested groups locate grant and loan sources. The DPPEA staff will conduct facility waste audits and research and recommend waste reduction strategies for the facility. Commercial and government programs administered under the DPPEA include the Commercial/Governmental Waste Reduction Section and the Industrial Pollution Prevention staff. These services provide technical assistance and coordination to public (including state) and private sector organizations for waste reduction programs. The Outreach and Training Section focuses on information transfer and training services to private and public entities.

The DPPEA and the N.C. Department of Commerce jointly support the N.C. Recycling Business Assistance Center (RBAC) that trains state & local staff on PP, administers Solid Waste Management Trust Fund, and coordinates state PP (grants) campaigns. RBAC also assists with

marketing of waste reduction products and technology development and transfer. The Trust Fund finances the Solid Waste Reduction Assistance Grant Program that seeks to award up to $225,000 in grants to assist the State reach the 40 percent reduction goal by June 30, 2001.

According to the 1998 Annual Report, composting is growing slowly as a waste management method in North Carolina. Most composting efforts are aimed at yard waste or source-separated organics; there are no mixed-waste composting facilities in North Carolina. According to the North Carolina Solid Waste Management Report, low area tipping fees is cited as the primary barrier to growth in composting of MSW.

6.3.11 Ohio

Ohio's plan that compares the projected waste generation rates with the projected landfill capacity is contained in the 1998 Ohio Solid Waste Facility Data Report, prepared by the Ohio Environmental Protection Agency (OEPA). According to the report, the remaining MSW landfill capacity as of January 1, 1998, is 397.5 million cubic yards. The report also indicates that approximately 21.6 million tons of municipal solid waste were disposed in Ohio's landfills in 1997, yielding an estimated remaining capacity life of 18.4 years.

The principal piece of state legislation that requires or encourages recycling and waste reduction measures is House Bill 592. House Bill 592, passed in 1988, required the director of OEPA to develop a State Solid Waste Management Plan. Key mandates of the Plan were (1) to establish new regulations for landfills and (2) to reduce the State's dependence on landfill disposal as a waste management resource.

The 1997 Summary of Solid Waste Management in Ohio contains an estimate of the percentage of waste diverted from landfills since the regulations went into effect. Between 1990 and 1996, an estimated 48.53 million tons of solid waste was recovered or incinerated. The statewide annual diversion rate increased from 25.6 percent in 1990 to 41.8 percent in 1996. The data used to calculate these figures were consistent in coverage (wasteshed) and in computation method.

The State survey response did not attribute a percentage of the reported waste reduction to specific

programs arising out of specific legislation, nor did the response provide a cost per ton of waste reduction or recycling measures. The following attributes were reported:

MATERIAL MARKET	ATTRIBUTE
Paper	Volatile
Glass	Weak
Plastics	Weak
Aluminum	Strong
Ferrous Metals	Strong
Non-ferrous	Moderate

The State response cited Senate Bill 165 as legislation that has strengthened the above markets. Senate Bill 165, which became effective Oct. 29, 1993, better enables Ohio to meet many of the objectives for scrap tire management laid out in the original state solid waste management plan. This bill gave Ohio EPA the authority to regulate transporters of scrap tires. A ban on the disposal of scrap tires in municipal solid waste landfills was enforced when the scrap tire rules became effective in 1995.

Ohio's recycling strategy features cooperation and coordination among several relevant state departments. The Interagency Recycling Market Development Workgroup (IAWG) was created in 1994 by Ohio Revised Code 1502.10 to spearhead this interdepartmental effort. The Workgroup includes resources from the Ohio Departments of Natural Resources, Development, Transportation, and Administrative Services. The purpose of IAWG is to develop and implement strategies to promote recycling market development by coordinating state assistance for public and private programs and policies geared toward the production and use of recycled markets in Ohio. The IAWG publishes annually the Ohio Recycling Market Development Plan (ORMDP) that discusses market conditions and projections for major material categories.

The IAWG plans a number of strategic programs administered by several departments. Some examples include the Greater Cleveland Recycling Initiative, under the Department of Development, that seeks to establish a plastics recycling industry operating through area hospitals. Also under the Department of Development is the Scrap Tire and Grant Fund, with a two-year budget of $1,000,000. This Fund provides loans for qualified scrap tire firms that demonstrate they will create jobs for state citizens. The Department of Natural Resources implemented the Cooperative Marketing strategy. This strategy promotes the creation of recycling cooperatives between regional groups of public and private material recovery facilities. The Recycling Investment Forum helps to bring facilities together with potential sources of capital investment. One source may be a Recycling Market Development Grant, administered with a $1,000,000 biennial budget by the Department of Natural Resources. The Roadway Materials Project, operated by the Department of Transportation, seeks to procure an increasing amount of recycled aluminum for road equipment such as guardrails, support trusses, and light poles.

According to the State's survey response, there are no resource recovery facilities such as WTE plants in Ohio. In 1997, Ohio had 372 curbside collection programs and a total of 2,552 recycling locations in the State, according to the 1997 Summary of Solid Waste Management in Ohio.

6.3.12 Oregon

The State of Oregon reported that it has a statewide plan or forecast that compares projected waste generation rates or volumes with projected landfill capacity in the State.

State legislation exists that requires or encourages recycling and waste reduction measures. Local governments must provide an "opportunity to recycle" to all "collection service customers" in cities of 40,000 or more people. Oregon enforces some landfill bans including vehicles, large appliances, used oil, lead-acid batteries and whole tires. Oregon has also established tax credits for the purchase of recycling equipment. Agency jurisdictions have statutory recovery goals that had to be met by 1995. If these statutory goals were not met, the cities in the wasteshed had to provide two additional recycling program elements chosen from a list of options provided in the statute in their solid waste plans.

Section 459A.010 (4)(a) provided a method to calculate the statewide recovery rate. Using the stipulated method, the amount of MSW generated in the baseline year of 1992 was 3,102,778 tons. Of that amount 839,639 tons or 27 percent was recovered. That figure is intended to be compared to the 1,462,662 tons or 36 percent recovered from the 4,100,180 tons generated in 1997. According to the survey response, this reduction in disposal was determined using consistent wastesheds and computations. The percentage of waste reduction attributed to this specific program has not been calculated. In addition, the unit cost of this reduction measure has not been calculated.

Information to determine whether Oregon's recycling or waste reduction efforts are less expensive on a per unit basis than landfill disposal was not provided in the survey response. The "opportunity to recycle" law (ORS 459.005 (19)) requires recycling opportunity for only those items that can be recycled for the same or less cost than their disposal. This has been challenged periodically by local haulers.

Other privately or publicly funded programs in Oregon aimed at waste disposal reduction include the pilot programs funded by Metro, the Portland area regional government responsible for solid waste management. The pilot programs involve innovative waste management practices such as food waste composting. Information regarding Metro can be obtained from Doug Anderson (503) 797-1788. The Plastics Recycling Facility at the Garten Foundation in Salem is funded by the American Plastics Council. John Mathews is the contact for the Foundation (503) 581-4473.

Oregon's Bottle Bill, legislated in 1971, is regarded as a success, not only for litter control but also as a landfill space savings measure. The Bill requires that consumers pay a $0.05 deposit on each reusable beverage container purchased. Grocery and convenience stores are required to redeem the deposit cost on bottles brought in for redemption by consumers.

According to the survey response, the commonly recyclable materials markets may be described according to the following descriptions.

MATERIAL MARKET	ATTRIBUTE
Paper	Strong
Corrugated	Strong
Chipboard	Limited Geographically
Glass	Limited Geographically
Plastics	Volatile
Aluminum	Strong
Ferrous Metals	Limited Geographically
Non-ferrous Metals	Strong

The Recycling Tax Credit (1975 & 1979) and the Reclaimed Plastic tax credits (1989) have encouraged the development of markets for recyclables and collection programs for recyclable and compostable material. Other programs that have helped the State achieve reductions in the amount of waste generated and the amount disposed in MSW landfills include the IMEX exchange in Seattle. IMEX is Industrial Material Exchange, a free service designed to match businesses that produce wastes, industrial by-products, or surplus materials with businesses that need them. The IMEX program lists wanted or available materials in a bimonthly print catalog and on a homepage. The City of Portland also maintains a web-based "soil exchange" that lists wanted and available soils.

Oregon has four transfer stations that conduct recovery from mixed MSW. The biggest transfer facility is Metro Central in Portland (503-797-1700). Most, if not all, MSW landfills have recycling depots either near the facility or in a other county location. There is one waste-to-energy facility in the State, the Energy Recovery Facility at Brooks, Oregon. The Brooks facility, operated by Marion County (503-588-5169), processes approximately 190,000 tons of solid waste per year.

6.3.13 Pennsylvania

As of October 26, 1999, the State of Pennsylvania had not responded to Section 2, concerning recycling and waste reduction, of the survey.

"Act 101," Pennsylvania's "Municipal Waste Planning Recycling and Waste Reduction Act" of 1988 §1501(c)(1)(iii), mandates recycling in Pennsylvania's larger municipalities. It requires counties to develop municipal waste management plans and provides for grants to offset expenses. The goals of the Act are to reduce Pennsylvania's municipal waste generation; recycle at least 25 percent of waste generated; procure and use recycled and recyclable materials in state governmental agencies; and educate the public as to the benefits of recycling and waste reduction. Municipalities with populations of at least 10,000 had to implement curbside recycling programs by September 26, 1990. Municipalities with populations between 5,000 and 10,000 and more than 300 persons per square mile had to implement curbside programs by September 26, 1991. Grants are available to all municipalities to establish recycling programs. All disposal facilities provide recycling drop-off centers. Commercial, municipal and institutional establishments within a mandated municipality are required to recycle aluminum, high-grade office paper and corrugated paper in addition to other materials chosen by the municipality.

Since September 26, 1990, no waste disposal facility has accepted shipments comprised primarily of yard wastes unless a separate composting facility has been provided. The Act also makes it illegal to discard automotive and other lead acid batteries. The Act imposed a $2 per-ton fee on municipal waste entering landfills and resource recovery facilities. The fee was in effect until October 26, 1998.
ACT 101 provides for the following grants:

- Planning Grants: Counties are reimbursed for 80 percent of approved costs to prepare municipal waste management plans and related studies.

- Recycling Grants: Counties and municipalities are reimbursed for 90 percent of approved costs to establish municipal recycling programs. Municipalities defined as financially distressed under Act 47 of 1987 may receive funding for 100 percent of approved costs.

- Recycling Coordinator Grants: Counties are reimbursed up to 50 percent of approved salary and expenses for a county recycling coordinator.

- Recycling Performance Grants: Municipalities are awarded these grants for their recycling programs. The amount of the grant is based on type and weight of materials recycled and on the percentage of recyclables diverted from landfilling and incineration.

- Host Municipality Inspector Grants: A host municipality is awarded 50 percent of the approved costs of employing a certified host municipality inspector for landfills and resource recovery facilities. Training of inspectors is also available under this grant program.

- Independent Permit Application Review Grants: A municipality may be reimbursed up to $10,000 for each review by a professional engineer of a waste management facility's permit application.

- Household Hazardous Waste Collection and Disposal Grants: Municipalities and counties that establish HHW collection programs may be reimbursed up to 50 percent of approved costs for collection programs. This cannot exceed $100,000.

Pennsylvania expects (under optimal conditions) to reduce the amount of waste disposed at landfills:

- 18 percent through Waste Reduction, including backyard composting.

- 34 percent through Recycling, if all eight materials listed in Act 101 are collected.

- 9 percent through Municipal Composting.

Pennsylvania has encouraged the development of local PAYT programs and DEP offers the following case studies:

Carlisle (Cumberland Co.) combines a per-bag fee system with curbside recycling for seven of the eight materials listed in Act 101, as well as comprehensive public education on recycling, waste reduction, and composting. The borough's recycling rate averaged over 32 percent during the first 40 weeks of program operation and saved $83,504 in avoided disposal costs--a projected annual savings of $108,556 for a population of about 20,000.

Perkasie (Bucks Co.) residents have a choice of buying 40-pound or 20-pound trash bags. The program resulted in a 193 percent increase in recycling and a 41 percent decrease in the amount of waste requiring disposal. Perkasie's waste reduction level before recycling is estimated at 18 percent.

Forest City's (Susquehanna Co.) per-bag fee complements drop-off recycling and curbside collection of yardwaste. The combined programs decreased the amount of waste requiring disposal by more than 50 percent.

The Ridge Administration is proposing legislation that would permanently reduce municipal and residual waste disposal capacity in Pennsylvania. The legislation would put a three year freeze

place a cap on waste disposal capacity that would permanently reduce capacity by one-third—from the current 12 years to 8 years of capacity. After the freeze, a host community agreement would have to be in place before DEP could issue a permit for a new or expanded municipal waste, construction waste or commercial residual waste landfills or a resource recovery facility. For the first time, transfer stations would be required to have a host community agreement before DEP could issue a permit.

Pennsylvania has six WTE plants in operation, located in the southeast and south-central portions of the State.

6.3.14 South Carolina

The 1999 South Carolina Solid Waste Management Plan, produced by the Department of Health and Environmental Control (DHEC) has a forecast comparing projected waste generation rates to projected landfill capacity. The South Carolina Solid Waste Policy and Management Act of 1991 requires that DHEC develop a Demonstration of Need Regulation. Until such time as a Regulation of Need becomes effective, the total tonnage rate of waste allowed for disposal (i.e., capacity) in MSW landfills during the State fiscal year will be limited to the yearly rate of disposal plus the yearly rate of disposal in an permit application received by DHEC before the June 29, 1999. The statewide MSW landfill capacity is effectively frozen at 7.68 million tons per year. In 1998, 4.3 million tons were disposed of in MSW landfills. DHEC has determined that 7.68 million tons is more than adequate to serve the needs of the State. Therefore, no more MSW cells will be permitted until South Carolina determines that an area needs more capacity. According to the State survey response, South Carolina has approximately 16 years of landfill capacity as of June 1999.

The Act of 1991 established a 25 percent recycling goal and a statewide 30 percent waste reduction goal to be met by June 27, 1997. The state has worked to expand the number of drop-off and curbside collection programs, the variety of items accepted for recycling, and the number of households offered recycling collection. The South Carolina Department of Health and Environmental Control (DHEC) cites these expansions as contributing to the increase in recycling rates. The act also provided for the monitoring and publication of recycling results.

The baseline year for the Solid Waste Policy and Management Act was 1993, when the waste recovery rate was 5 percent. The Act stipulates that yard waste, land-clearing debris, white goods, tires and CDD may account for no more than 50 percent of the 25 percent reduction goal. Information to determine that the data used in the recovery rate calculation are consistent in coverage (wasteshed) and computational method was not provided in the survey response.

The State response did not attribute a percentage of the waste reduction to a specific program arising from specific legislation. The response did not provide a cost per ton of waste reduction

measures. The survey respondent did not provide sufficient information to determine if South Carolina's recycling or waste reduction efforts are less expensive on a per unit basis than disposal in a landfill.

The 1991 Act also created the Office of Solid Waste Reduction and Recycling (OSWRR), in the Department of Solid Waste Planning and Recycling. The OSWRR provides educational, technical, and grant assistance to the public. Important programs include:

- Resource Center: Clearinghouse for informational materials and telephone support service. Staff makes off-site presentations.

- Recycling Coordinators' Workshop: In conjunction with American Plastics Council, provides training in contract negotiations, collection, and market development.

- Institutional/Commercial Composting Project: In conjunction with S.C. Energy Office provides composting units to locations and demonstrates organic waste diversion methods.

- "Recycle Guys": Media campaign promotes recycling television and radio as well as offering awards for top recycling programs.

South Carolina described statewide recycled commodity markets as moderately volatile, aluminum and other metals were the most successful markets that help to finance the other recycling of less profitable materials. The number of composting facilities has grown from 26 in 1993 to 96 in 1998, although yard waste composting as a regionalized program is still in its infancy.

The 1999 Solid Waste Management Plan indicated that regionalization of waste management services, implementation of variable rate pricing, and inclusion of local businesses and industry into public programs should be the primary foci of future strategies to improve waste disposal reduction. Often local governments are not able to determine an accurate jurisdictional recycling rate because of lack of contact and/or information from private industry. The plan noted public misconception and the lack of recycling markets as barriers to recycling expansion.

There are four MSW processing facilities in South Carolina. Processing includes baling, sorting, and bulking waste. The Foster Wheeler Resource Recovery, Inc., under contract with Charleston County, designed, built and operates the only permitted MSW incinerator in South Carolina. The facility processes approximately 255,500 tons of MSW per year. Charleston County also entered into a contract with the U.S. Navy for sale of steam generated by the plant and with Carolina Power and Light for the sale of electricity.

6.3.15 Tennessee

A statewide plan or forecast that compares projected waste generation rates with projected landfill capacity was not available for Tennessee.

The principal legislation that requires or encourages recycling and waste reduction measures in Tennessee is the Solid Waste Management Act of 1991 (as amended through 1999). The 1999 amendments set 1995 as the new base year; however, no baseline amount or percent reduction was provided in the survey response. The percentage of waste reduction attributable to specific programs arising from specific legislation was not available. The cost per ton of waste reduction or recycling measures were not available. No evidence was provided that the State's recycling or waste reduction efforts are less expensive on a per unit basis than disposal in a landfill.

Information was not available concerning other recycling or waste reduction technologies or processes that are effective in reducing waste disposal in landfills.

According to the survey response, the following material markets may be described as follows

MATERIAL MARKET	ATTRIBUTE
Paper	Strong
Corrugated	Strong
Chipboard	Weak
Glass	Moderate
Plastics	Moderate
Aluminum	Strong
Ferrous Metals	Strong
Non-ferrous Metals	Strong

According to the State survey response, there was not enough data to evaluate how well state legislation or regulation has strengthened any of these recycling markets.

Other programs that have helped the State achieve reductions in the amount of waste generated and the amount of waste disposed of in landfills include the Tennessee Materials Exchange and Community Solid Waste Education, according to the survey response.

The Solid Waste Grant Program provides grants for recycling efforts, material recovery facilities, clean-up of waste tires, updated solid waste plans, household hazardous waste programs, solid waste education programs, and the promotion of end-use markets.

The Solid Waste Management Act of 1991 required each solid waste region to address long-range solid waste needs in ten-year plans and annual progress reports. Staff aided the planning process by providing useful information, reviewing plans, and assessing progress annually.

The Division of Community Assistance (DCA) administers the following programs:

Pollution Prevention Programs: Provides multimedia PP assistance to industry, commercial establishments, schools, institutions, homes, government, etc., through the preparation and review of PP plans, onsite visits, market development, general outreach and training.

Recycling Program: Provides coordination of recycling events; database maintenance; referral for materials exchange, such as used oil, antifreeze, and battery collection sites and transporters; and a recycling program for state employees.

Household Hazardous Waste Program: Provides household hazardous waste collection and proper disposal through weekend county events.

Tire Management Program: Includes the routine shredding of scrap tires for disposal, the abatement of unpermitted disposal sites, and assistance to reuse markets.

The following list of waste separation and recycling facilities was provided in the survey response.

Recycle America/WMI	Franklin/Williamson Co.
Sevier Solid Waste	Sevier County
RHW Material Recovery	Memphis
Resource Authority	Gallatin/Sumner Co.
Bi County Solid Waste	Clarksville
Waste Management	Jackson/Madison Co.

The following RRFs are provided in the survey response.

Nashville Thermal	Metro Nashville
Resource Authority	Gallatin/Sumner Co. – Bob Brown

6.3.16 West Virginia

West Virginia has 20 permitted MSW landfills with an average life expectancy of 22.4 years. The source of this information is the Department of Environmental Protection (WVDEP), Office of Waste Management (OWM).

West Virginia has legislation that requires or encourages recycling and waste reduction measures. Senate Bill 18 sets non-mandatory goals for recycling in municipalities with population of 10,000 people or more. West Virginia Code § 20-11-8(a) banned the disposal of tires in landfills effective June 12, 1996. A verifiable estimate of the percentage of waste diverted from MSW landfills since the regulations went into effect was not provided. The survey referred to

Conservation Education and Litter Control, Division of Natural Resources, (304) 558-3370. Information to calculate costs per ton of waste reduction measures was not available. Data were also not available as to whether recycling or waste reduction efforts are less expensive on a per unit basis than disposal in a landfill.

Information was not available regarding other recycling or waste reduction technologies or processes being used in the State that are effective in reducing waste or diverting it from MSW landfills. Data are not sufficient for assessments of recycling markets for typical materials were provided in the survey response. Information indicating any state legislation or regulation that has strengthened markets was available.

The State has no waste separation or recycling facilities that are in operation with landfills, according to the survey response. There are no resource recovery facilities in the State.

6.3.17 Wisconsin

The Wisconsin Department of Natural Resources (DNR) reports that recycling programs throughout the state diverted enough waste -- almost 1.63 million tons -- out of landfills in 1995 to "save" landfill space equivalent to the size of an average municipal waste landfill every year and a half. While that figure undoubtedly includes non-MSW material, the point is well made. Recycling costs per ton in Wisconsin ($93.81, direct costs) are roughly equal to costs for disposing in landfills or incinerators ($90.37). Currently, every state resident has access to a recycling program and 98 percent of households report participating in these programs. This information was obtained from the DNR website.

Chapter NR 544 of the Wisconsin Administrative Code (WAC) establishes criteria for "determining whether a (in-state or out-of-state) program is an effective recycling program." Only those programs deemed effective are eligible to receive state funding. The criteria includes requirements for collections programs, recycling ordinances, and record-keeping and reporting. The 1997 Wisconsin Act 27 (1997-1999 Budget) directed the Department of Natural Resources to provide state financial assistance to local solid waste management systems for expenses relating to programs for the recycling of post-consumer waste.

The Wisconsin Department of Commerce, DNR's Waste Management Program, and the University of Wisconsin coordinate recycling support staff for public assistance with contacts for business recycling sectors (auto services, food processing, wood products, etc.); community technical and financial assistance; and education and outreach. The Waste Management Program maintains the Wisconsin Recycling Market Directory provides information about businesses that buy or accept recyclable materials.

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7.0 ALTERNATIVES TO MSW LANDFILLS

7.1 OVERVIEW

According to The Characterization of Municipal Solid Waste in The United States: 1997 Update, (EPA530-R-98-007, U.S. Environmental Protection Agency, May 1998), the United States currently generates approximately 217 million tons of municipal solid waste (MSW) per year. The MSW growth rate between 1990 and 1996 was between 0.75 percent to 1.5 percent per year, approximately the same as the rate of population growth in the United States. Approximately 56 percent of the MSW in the U.S. is disposed in more than 2,400 landfills in operation today.

To combat the growing waste stream into the country's landfills, the Environmental Protection Agency (EPA) has set voluntary goals of reducing the quantity of MSW landfilled through source reduction and recycling initiatives. In addition to source reduction and recycling, there are alternative disposal technologies, such as incineration and composting, which help minimize the amount of waste being disposed in landfills.

There are many factors which influence a community's chosen method of managing and disposing their solid waste and why landfilling is the most predominant form of waste disposal in the United States. These factors include, but are not limited to:

1. Cost of the technology.
2. Availability and cost of land.
3. Energy costs.
4. Population density.
5. Political and socio-economic considerations.
6. Market supply and demand.
7. Environmental constraints.
8. Regulatory mandates.

Although cost is the overriding factor in most decisions regarding solid waste management and disposal, all of the above factors influence the analysis and the decisions made at the community level. In should be noted that anyone of the above factors could be the primary reason for selection and implementation of a solid waste management practice or disposal technology.

This section of the report does not attempt to undertake a comprehensive evaluation of the above factors regarding their influence in decisions in solid waste management and disposal as such a task is quite complex and beyond the scope of this report. However, this section provides information on the technology and economics of three alternative technologies associated with management and disposal of municipal solid waste.

7.2 EVALUATION OF ALTERNATIVES TO LANDFILLING WASTES

Based upon EPA data, the most common alternative technologies to landfills which are currently being used in the U.S. to manage or dispose of waste are the following:

1. Incineration.
2. Composting.
3. Recycling.

In 1997, approximately 27 percent of the nation's MSW was recycled and/or composted, while approximately 17 percent was disposed by incineration.

Incineration, composting, recycling all have an integral role in solid waste management programs and are viable alternatives to MSW landfills throughout the United States. In the following subsections, information is provided regarding the above three alternative technologies and on factors which impact their technical and economic feasibility. This information should provide the reader with a better understanding of the potential and feasibility of the three most practiced alternative technologies to landfilling wastes.

7.2.1 Incineration

Incineration as a waste disposal process has been an integral part of successful waste management programs in a number of communities. According to the EPA, there are 110 incinerators in the U.S. that burn MSW. The Commonwealth of Virginia has a total of seven active incinerators; four of the incinerators burn MSW. Nationwide, 17 percent of MSW is burned in incinerators.

The ability to generate and sell steam and/or electrical power for revenue and charge reasonable tipping fees makes the incineration or waste-to-energy (WTE) technology attractive. However, the problems associated with siting, feasibility studies, and obtaining local public acceptance has complicated the process of building WTE incinerators for project owners.

WTE technology gained a foothold in the U.S. when incineration became economically attractive in comparison to landfills during the oil price increases in the 1970's. WTE technology benefited further from the federal Public Utilities Regulatory Policy Act of 1978 that promoted alternative sources of utility power generation.

Since the above period, the growth of WTE technology as a waste management tool has not been constant. Low landfill disposal prices, low oil and natural gas prices, and localized political opposition, often based on public health fears, are the principal factors determining WTE economic feasibility, and; therefore, private sector investment into this major landfilling alternative.

The two most common WTE incineration technology processes are:

1. Mass burn - MSW is burned in the same form as it is generated and collected.

2. Refuse-Derived Fuel (RDF) - MSW is processed and/or formed into a usable fuel source.

These processes differ in the extent of pretreatment of the MSW before actual incineration of the MSW. The mass burn incineration technology and the RDF incineration technology require different types of furnaces and incineration conditions.

In a mass burn facility, pretreatment of the MSW includes inspection and separation to remove oversized and noncombustible items and hazardous or explosive materials. The MSW is then fed into an incinerator, where it is supported on a grate or hearth. Air is fed above or below the grate to promote combustion. Mass burn plants range from small modular plants with capacities as low as 25 tons per day to facilities with capacities of 3,000 tons of MSW per day or more.

RDF production also starts with inspection of the MSW in order to remove hazardous waste and noncombustible materials. However, in an RDF facility, the remaining or combustible MSW is then shredded and burned above a traveling grate. Unlike a mass burn facility, RDF preparation and direct firing cannot be performed economically in small plants.

An alternative type of RDF technology involves the processing and compressing of MSW into pellets or cubes for use in conventional furnaces with grates which can be located remote from the RDF processing plant.

Two other WTE technologies include cogeneration of RDF with coal or refuse gasification. RDF can be effectively mixed with coal and burned in existing coal fired utility boilers to produce electricity. By cogenerating RDF with other fuel sources, the expense of constructing a new incinerator, boiler, air pollution control equipment, and steam turbine and generator to process the RDF can be avoided. In refuse gasification, the MSW is heated to produce a combustible gas that is collected, cleaned, and used as fuel for gas engines, turbines, and industrial boilers.

Within the basic WTE technologies, a number of patented variations exist in the private sector that require differing residuals treatment and differing emission controls.

Factors which have hindered the widespread acceptance of WTE facilities are the high capital and operation and maintenance costs associated with complying with air pollution regulations

and requirements. As an air pollution point source, WTE plants are required to meet federal standards set for the following:

1. Siting requirements.

2. Combustion performance standards.

3. Emissions of particulates, cadmium, lead, and mercury.

4. Gas emissions for nitric oxides, sulfur dioxides, hydrochloric acid.

5. Emissions of ash and fugitive dust.

Construction of WTE incineration facilities are relatively expensive. Therefore, most WTE plants are started by either well capitalized municipalities and authorities, by the private sector, or by a combined partnership. In addition, construction of such facilities often require the assurance or guarantee of high waste stream flows and the future sale of power. Such facilities must be capitalized and depreciated over a substantial period of time. Such an alternative technology requires a long term commitment by a community and decisions to pursue this alternative for waste disposal is complicated due to factors associated with the long time it takes to obtain the return on the investment, etc.

WTE processes often include some form of waste separation. At a minimum, ferrous metals which tend to clog up the incinerator flow, are removed from the MSW and recycled. Often, the WTE facility is co-located with or works in conjunction with a material recovery facility (MRF). The MRF functions either to recover recyclable materials from the raw MSW or to further sort source-separated recyclables and prepare them for transportation to the recycled materials market. The WTE plant can act as a safety valve when recycled material markets are down. That is, recycled materials such as cardboard and paper may be burned as a source of energy if it recycle markets don't make it cost effective to separate, sort, and recycle the waste material. The combination WTE & MRF facility allows urban communities to become more self-sufficient with respect to the management of their solid waste and diminish the need for MSW landfills. It should be noted that WTE facilities still require landfilling of the bottom ash and air pollution control ash residues; however, such residues are a small fraction of the original MSW volume.

7.2.2 Composting

One of the characteristics of MSW that distinguishes it from construction and demolition debris is the presence of organic matter. Yard waste, vegetative waste, and food waste make up a significant proportion of the weight of MSW. Food waste in MSW as defined by the USEPA (USEPA, 1998) and includes uneaten food and food preparation wastes from residences and commercial and institutional establishments such as cafeterias and lunchrooms. Food waste and yard waste constitute approximately 10 percent and 13 percent, respectively, of total MSW

generation in the U.S. for 1996 (USEPA, 1998). Data for yard waste varies greatly geographically and is often very seasonal in nature and only includes the amounts that arrive at MSW processing facilities. (The EPA data on yard waste does not consider the amount of yard waste handled by generators and disposed of by some other means such as on-site composting or on– site disposal on the homeowner's property.)

The high moisture content of food and yard wastes, such as grass clippings, retards burning in the waste-to-energy incineration facilities. The high moisture content reduces the efficiency and the rate of the oxidation process in incinerators; the reduced efficiency may also poses problems with complete combustion, the air pollution control systems, and ensuing air emissions from the WTE plants. Consequently, many states have established guidelines to promote yard waste composting and reuse in an effort protect human health and the environment. Other states have banned yard waste altogether from MSW landfills and have required alternative means of waste management (i.e., composting).

In 1996, the U.S. managed approximately two percent of the food waste and 38 percent of yard waste generated by composting. Food waste from food packaging plants, although sometimes disposed in MSW landfills, is considered industrial waste and not included in MSW food waste estimates.

Composting is the natural process of biodegradation of labile organic matter. Composting had its beginnings as a component part of integrated solid waste management with composting of yard waste (grass trimmings, leaves, etc.). As mechanical waste separation technology and practices improved and/or expanded, more communities have been able to include food waste, other types of paper wastes, and animal waste in their feedstock for the composting process. Some communities are able to process raw MSW in composting facilities due to advanced waste separation technologies. Wastewater sewage treatment plants have increasingly turned to composting sludge as an alternative means of sludge disposal. MSW may also be combined with sludge from sewage treatment plants to produce an enhanced and more consistent compost product.

The technologies and processes developed in industrial composting have aimed to make the biodegradation process quicker, safer, and less noxious. The goal of all composting methods is to encourage the growth and metabolic activity of microbes within the composting waste while raising temperatures sufficiently to destroy pathogens from the raw waste material. This is done by: (1) mixing various waste materials to achieve the optimal balance of nutrients material, (2) optimizing airflow through the material pile, (3) retaining within the pile the proper amount of heat generated by microbiological activity.

The simplest composting practice involves placing the material in windrows and re-mixing the material periodically to re-aerate the windrow. Even though the windrows are often overlain with non-permeable covers, the turning activity may release noxious odors to the air. In addition, water that runs off from the windrows must be treated as leachate and the windrows have the

potential to attract vectors (rodents, birds), which raises health concerns in siting composting facilities.

For the above and other reasons, recent technology has been developed that allows composting to take place entirely within control chambers ("in-vessel composting"); the chambers have forced aeration and may be equipped with automated monitoring equipment. The use of "in-vessel composting" technology controls odors and leachate generation and isolates the material from vectors. The in-vessel technology is also less labor-intensive because the forced air system eliminates the need to turn the piles. The major disadvantage to the in-vessel composting system is the initial high capital cost for the procurement and installation of the equipment.

Composting facilities, whether windrow- or in-vessel-based, must comply with state and local siting, design, and operational permit regulations. All rainwater that comes into contact with the windrows, even covered windrows, must be controlled and handled as leachate and either treated in a wastewater treatment plant or discharged to a sanitary sewer. In addition, the facilities must also be designed and constructed to properly handle and channel storm water runoff. Permits for composting facilities include stipulations on acceptable types of wastes to be unloaded at the facility, feedstock mixtures, demonstrable demand for compost, environmental monitoring requirements, documentation, reporting, and final product testing standards and/or criteria.

Heavy equipment is required by both methods of composting for large scale operations that are typically utilized by municipalities. Front-end loaders or farm-type tractors are often used to mix the feedstock and place in the windrow. Windrows are most efficiently turned by specially designed equipment that re-mixes the material in place, though loaders may serve this function at smaller sites. The in-vessel composting systems require the specially built composting vessels plus forced aeration systems and odor control units. The vessels also require heavy equipment tractors for loading the compost feedstock into hoppers which feed the composting vessels.

Both types of composting systems require a bulking agent to enhance the airflow in compost. The bulking agents increase the void spaces within the composting piles and ensure the degradation process does not turn anaerobic which would create nuisance odor problems and contribute to longer composting periods. Wood chips from the wood processing industry are often used as the bulking agent in composting operations due to their low cost and availability. Large screening equipment is required to separate the cured product from the wood chips and other oversized particles. The separated wood chips from the finished compost product are reutilized in the composting facility.

The product of the composting process is a material that can safely be applied directly to soil or can be mixed with existing soil and used as a soil conditioner. As a soil conditioner, compost has been shown to improve the texture and moisture retention properties of soil due to the increase in organic matter and bulk density of compost. In addition, compost adds valuable nutrients and micronutrients to soil to promote healthy plant growth. Finished compost product can be used as a soil amendment for public horticultural projects or can be used as landfill cover

soil, etc. Alternatively, compost may be sold as an agricultural product to the public. Potential uses of compost include:

1. Home gardening.

2. Greenhouses, nurseries and cemeteries.

3. Landscaping applications such as golf courses, median strips and industrial parks.

4. Topsoil substitutes for farmland, sod, erosion control, and turfgrass; and,

5. Soil substitute or amendment for landfill cover and land reclamation activities

6. Wetland mitigation and storm water filters;

7. Bioremediation.

Similar to the other alternative waste processing practices in this section, the growth and success of MSW composting as an industry, depends not just on the cost of landfill fees, but also on the demand for the compost product. According to the Composting Council, the agriculture and silvaculture industries represent the largest potential demand (approximately 95 percent) for compost products. The largest profit margins for compost products, however, are realized from small unit retail sales such as 40-50 pound bags to individuals. Bulk retail sales is another potential market for compost products (Biocycle Magazine, 1996). Compost generally has a relatively low unit value. Therefore, the distance from supplier to the market or customer base is an important factor for consideration of the economic feasibility of this technology since transportation costs can be a significant component part of the product cost and price at market.

According to the USEPA (May 1996), compost markets are dependent on the following factors:

1. Quality and Consistency of compost.

2. Customer acceptance.

3. Distance from supplier to customer.

4. Meeting the needs of end users.

Providing results of product testing such as pH, salt content, particle size, organic matter, inert matter, and moisture helps to assure customers of product quality, though it adds significantly to the cost of production. Compost made from MSW is more likely to be contaminated than compost made from yard waste. MSW derived compost products have been slower to gain acceptance in the commercial marketplace. When the MSW derived compost product fails to meet state or local testing criteria, the material may end up in a landfill for ultimate disposal.

Composting is an effective waste management technology that can produce a useful product while diverting a portion of the waste stream from landfills for disposal. However, the composting process is not as simple as sorting recyclables from a solid waste load. It must be processed according to a strict methodology; otherwise, a useful product will not be yielded from the compost process.

7.2.3 Recycling

Recycling is probably the best known diversion practice among the public probably because of the many public outreach programs designed to increase public participation. All states surveyed for this report have at least some kind of recycling development program in place. Anecdotal evidence suggests that, although recycling awareness may be relatively pervasive, participation in recycling among the public is often driven by regulatory mandates or by economics. However, until disposal costs for waste materials increase, the recovery rates of recyclable materials will not likely approach the waste generation rates of recyclable materials in MSW streams.

The methods now used to recover recyclable materials include source-separated waste with curbside collection, and customer delivery of separated materials to drop-off and/or buy-back recycling centers. Nationally, approximately half of all households had access to curbside recycling collection in 1996. In the Northeast, over 80 percent of households had access to curbside collection; whereas, approximately 35 percent in the Southeast had access to curbside recycling (Biocycle, 1997). Drop-off centers usually serve the more sparsely populated areas. A buy-back center is typically a commercial operation that pays for the deposit of recyclable materials. These commercially operated recycling facilities are often run by paper dealers, scrap metal dealers, or waste haulers.

Nine states have container deposit laws and recycling programs and include: Connecticut, Delaware, Iowa, Maine, Massachusetts, Michigan, New York, Oregon, and Vermont; two of the states were included in this study's states survey. In a container deposit program, customers pay a deposit on a beverage purchased in a container, then the used container is returned to the seller or collection center and redeemed for the deposit amount. These container deposit programs or systems generally focus on beverage containers, which represent less than four percent of national MSW (USEPA, May 1996). The container deposit programs are considered successful means to help mitigate littering of the environment as much as they are useful in minimizing landfill space.

Further separation and processing of recycled wastes that have been source-separated usually occurs at materials recovery facilities (MRFs) or at large integrated materials recovery/transfer facilities (MR/TFs). MRFs and MR/TFs are also utilized for separation of commingled MSW. Integrated MR/TFs may include the functions of a drop-off center for separated wastes, a materials separation facility, a facility for the composting and bioconversion of wastes, a facility for the production of refuse-derived fuel, and a transfer and transport facility.

MRFs and MR/TFs are used for the following purposes:

1. To further process source separated wastes collected from various recycling collection programs.

2. To separate and recover reusable and recyclable materials from commingled MSW, and to improve the quality of the recovered waste materials.

3. To serve as the middleman in solid waste management by processing the solid waste before ultimate disposal. The processing that takes place at the transfer station usually aims to accomplish the following tasks:

   - Segregate the wastes based upon content.
   - Separate the recyclable materials from the solid waste.
   - Remove the residue and unsuitable materials from the waste streams.
   - Compact the municipal waste.
   - Grind/screen the construction/demolition waste.
   - Transfer the products to vehicles for transportation.

The separation of recyclable materials from MSW or co-mingled recyclable waste is usually low-tech and labor-intensive. Typically, mechanical separation methods are not used in MRFs or MR/TFs; laborers usually manually sort the materials. Some MRFs and MR/TFs utilize conveyor belts and other mechanical separation processes to assist the laborers in removing recyclables from dry waste loads. However, many transfer stations only do minimal sorting of the recyclable material before shipping it off to another transfer station/recycling center for further processing.

The economics of material recovery are largely dependent upon the types of materials being collected and the market demand for such materials. For a county or municipality to assess the opportunities for recycling, the available options for separation and processing waste materials must be considered. Even if it is possible to separate the materials for recycling, the county or municipality must find buyers for the material. Often prices for recycled material may vary depending upon supply and demand and other market factors. Obtaining satisfactory prices for certain recyclables may be difficult.

However, when economic conditions are aligned and the facilities are well run, recycling can be profitable for the operators as well as beneficial for the conservation of landfill space. By reducing the amount of solid waste in each load by five percent, it can extend the life of a landfill considerably.

7.3 COST/BENEFIT ANALYSIS COMPARISON OF ALTERNATIVE TO LANDFILLING WASTES

This section of the report provides further information on the technology and the emphasizes the cost/benefit analysis associated with the incineration, composting, and recycling. This section presents typical advantages and disadvantages associated with each technology and also provides costs and revenue information from actual facilities or typical facilities. The information, herein, should provide a better understanding of the type of detailed cost/benefit analysis which must be performed on a case-by-case basis when considering one of the three alternative technologies associated with management and disposal of municipal solid waste.

7.3.1 Incineration

Waste To Energy (WTE) facilities typically have basic designs based on the incoming tonnage as follows:

1. Modular/Starved Air Plant (100TPD).

2. Modular/Excess Air Plant (240TPD).

3. Mass Burn/Waterwall (800-2,250TPD).

Waste-To-Energy (WTE) is very popular in other countries such as Singapore and Japan where the available land for landfills is low, the price of land is high, and the price of energy is high relative to the United States. In the United States WTE plants are popular in urban areas nearby major cities, particularly in the Northeast.

Large WTE mass burn plants have been constructed, but only serve as part of the solution to the solid waste program in certain states. In the 1980's, the New Jersey Department of Environmental Protection (NJDEP) implemented a waste management program that emphasized resource recovery and counties were responsible for constructing WTE plants. Subsequently, WTE plants were constructed in Bergen, Camden (1050TPD), Essex (2277TPD), Gloucester (575TPD), Hudson (1500TPD), Morris (1300TPD), Mercer (1450TPD), Passaic (1300TPD), Union (1440TPD) and Warren (400TPD) Counties.

The costs borne by the counties of New Jersey for implementation of state's WTE program were high. A typical WTE plant has costs that are proportional to the facility capacity and the revenue from energy recovery is a function of the waste stream (BTU input). Costs for WTE facilities are divided into capital costs, operation maintenance costs, residue disposal costs, while revenues are obtained from electricity and/or steam generation, and from ferrous and non-ferrous metals recovery. The above costs and revenues must be evaluated in detail on a case-by-case basis in order to determine the economic viability of a WTE plant.

In a cost/benefit evaluation, advantages and disadvantages of the technology must be considered. Some of the advantages and disadvantages of WTE incineration are:

1. **Advantages:**

- Limited land use for the waste incinerator.
- Popular in urban areas.
- Potential for significant revenue gain in the sale of electricity, steam, and recyclables.
- Minimizes the potential for ground water pollution.
- May minimize overall transportation costs and traffic miles associated with MSW disposal. (Depends upon the location of the WTE plant relative to the MSW landfills being utilized, etc .)

2. **Disadvantages:**

- High capital and O&M costs impacts economic feasibility.
- Low capacity to process tonnage (i.e. 2000 – 3000tpd) in relation to large regional landfills (up to 10,000TPD).
- Public perception regarding the potential adverse impact from traffic and the related air pollution.
- Creates waste byproducts (i.e. bottom ash and fly ash) that must be disposed (Bottom ash and fly ash are 10 percent of the original MSW volume).
- Unassured waste flow unless long term contracts are secured.
- Variable waste stream with different BTU values which may affect the capacity for electrical power and steam generation.
- May result in localized increase in MSW traffic. (Depends upon the location of the WTE plant relative to the MSW landfills being utilized, etc.)

A WTE plant should be evaluated based upon the market and economic conditions as well as other factors including public perception and acceptability. A WTE plant also has specific siting and permitting requirements that must be met prior to regulatory approval. An individual siting and feasibility study needs to be performed to determine the viability of considering a WTE facility. WTE facilities may not be economically attractive in areas or states, such as Virginia, where there is an excess of capacity of landfill airspace due to a relatively low cost of waste disposal in MSW landfills.

Typical costs for operating a waste-to-energy program in Virginia may be estimated by using the Refuse Derived Fuel (RDF) Plant and Power Plant owned and operated by the Southeastern Public Service Authority (SPSA), Norfolk, Virginia, as an example. The SPSA sells electricity and steam to the adjacent Norfolk Naval Shipyard, Department of Navy.

Mr. Larry Davenport, Director of Accounting for SPSA, provided most of the cost and revenue figures presented below:

1. The operating cost of the RDF plant was $5,246,956 for fiscal year (FY) 1999.

2. The operating cost of the power plant came to $10,395,742 for FY 1999.

3. The RDF accepted 450,000 tons of waste for processing in FY 1999.

4. The average cost for the waste-to-energy facility operation came to $34.76 per ton of MSW received.

5. Sales projections for fiscal year 2000 are $8.6 million for electricity and $5.8 million for steam, or $14.4 million total sales.

6. Sales of the aluminum cans from the RDF plant provided an additional $553,436 in income for FY 1999.

7.3.2 Composting

Composting of yard waste at existing landfills can be a viable option to reducing the waste stream disposed of in landfills or WTE facilities.

The advantages and disadvantages of composting are as follows:

1. **Advantages:**

- Conserves landfill space.
- Relatively Simple operations.
- Provides the removal of material that has a high moisture content that can reduce the BTU energy value of the MSW for a WTE plant.

1. Windrows Composting Technology:

- Easy to install and operate.
- Low capital costs.

2. In-Vessel Composting Technology:

- Few operators required; low O&M costs.
- More flexible criteria for feedstock ingredients.
- Better control of leachate, odors, and vectors than the Windrow system.

2. **Disadvantages:**

- Time for compost to be cured is typically ten months.
- Public Acceptance.

1. Windrows Composting Technology:

- Requires a large land area.
- Attracts vectors and produces odors, leachate, and storm water runoff.
- Labor-intensive.

2. In-Vessel Composting Technology:

- Relatively high capital costs (per ton).
- Requires operator training.
- Market for compost is variable and seasonal and may require warehousing finished product.

Assuming land is available at the Solid Waste Facility, composting is a viable and effective waste management technology. However, the composting process is time consuming. Composting may be evaluated at Virginia's landfills depending on the composition of the incoming waste stream and the market for the product.

There is considerable variation in costs not only between the various composting systems, but also between the geographic regions of the United States. Additionally, like other alternative technologies, the operating costs are dependent on the volume and types of material processed. Capital costs typically include: the compost pad (usually asphalt), grinder, front-end loader (or farm-type loader), compost mixer, (trammel) screen. Industrial windrow systems require a windrow turner and the in-vessel systems require composting chambers, air ducts, odor-filtering bioreactor, and control equipment (blowers, monitoring instrumentation).

Yard waste compost in the U.S. varied in average retail price per cubic yard between $12 to $15 during 1996 and 1997 (USEPA, 1997). Assuming an average material density of 0.5 ton per cubic yard, the retail price range per ton is $24 to $30.

According to the Joint Service Pollution Prevention Opportunity Handbook, Naval Facilities Engineering Service Center, May 1999 (JSPPOH), composting operating costs may be estimated using information in the following models for windrow and in-vessel composting systems.

1. Windrow Composting

Assumptions:

- Process 3,000 tons per year of yard waste and food waste.
- Produce 1,500 tons per year of compost product.
- Capital costs (not including land) - $600,000.
- Solid waste disposal cost - $28 per ton.
- Cost of waste collection and hauling to landfill cost - $50 per ton.
- Avoided topsoil purchases - $25 per ton.

Estimated annual operating cost	$165,000.
Estimated topsoil savings	- $(37,500)
Net annual operating cost	$127,500

The JSPPOH estimated that collection and disposal costs of 3,000 tons of yard and food waste would be $234,000. The JSPPOH concluded that windrow composting could save an estimated $106,500 annually or $35.50 per ton. This calculation does not include revenues from sales of compost. The estimated capital costs payback period for the case study windrow composting is approximately 4.6 years.

2. In-Vessel Composting

Assumptions:

- Process 4,000 tons per year of yard waste and food waste.
- Produce of finished compost, or, an average of 2,738 tons per year (10,000-20,000 pounds per day).
- Capital costs (not including land) - $2,800,000
- Solid waste disposal cost - $28 per ton
- Cost of waste collection and hauling to landfill cost - $50 per ton.
- Avoided topsoil purchases - $25 per ton.

Estimated annual operating cost	$125,000
Estimated topsoil savings	- $(68,450)
Net annual cost	$ 56,550

According to the estimate for in-vessel composting, the gross cost to produce compost is $31.25 per ton of raw waste, or $45.65 per ton of compost product, excluding capital costs. The JSPPOH estimated that collection and disposal costs of 4,000 tons of yard and

food waste would be $312,000. The JSPPOH concluded that in-vessel composting could save an estimated $255,450 annually or $63.86 per ton. The estimated capital costs payback period for the case study in-vessel composting is approximately 11 years. These costs do not include revenues from tipping fees or sales of compost. Tipping fees for source-separated compost loads are normally lowered to provide incentive for maintaining a feedstock supply.

Other cost insights may be gained from the operating budget of the Southeastern Public Service Authority (SPSA) yard waste composting facility co-located with SPSA's landfills. The annual operating budget for FY 2000 for yard waste composting is $1,185,544. SPSA expects to receive to process 45,000 to 50,000 tons of waste for FY 2000 and to produce 13,000 tons (or 26,000 cubic yards) of compost. Average processing cost of the SPSA composting operation is between $23.71 and $26.35 per ton of waste received and $91.20 per ton (or $45.60 per cubic yard) of compost produced.

7.3.3 Recycling

Successful recovery of recyclable materials from MSW requires economic incentives and/or regulatory mandates to achieve the necessary volume of recyclable material to make recycling economically viable. As long as MSW disposal prices remain low at landfills, etc., then participation in recycling will be also remain low, unless mandated by regulations, promoted by economic incentives or subsidies. An exception to the above statement occurs when a recyclable commodity price increases to create a demand for the recycling effort.

Global aluminum scarcity has caused the price of aluminum cans in MSW to increase to the point where profits from aluminum recycling finance the recycling of other less valuable commodities in the MSW stream. Therefore, aluminum cans are an important commodity in any recycling program despite the fact that they make up less than one percent of the MSW stream (USEPA, May 1998).

MRFs and MR/TFs are increasing in popularity as an option for managing municipal solid waste. The owners and operators of these facilities employ different processes to separate and sort the recyclables from the waste stream. Some advantages and disadvantages of recycling are:

1. **Advantages:**

- Reduces waste stream that needs to ultimately be disposed.
- Provides flexibility on the location of the recycling activity such as MRFs. MR/TFs or WTE Facilities.
- Requires a relatively low capital costs.
- Produces a marketable commodity.
- Environmentally beneficial.

2. **Disadvantages:**

- Typically low tech and very labor-intensive.
- Increase in government regulation.
- Fluctuation in market prices.
- Variations in waste stream.

Recycling can be encouraged in communities by embracing programs that divert material from solid waste disposal facilities rather than pay high disposal fees. A market and economic study should be performed before a community initiates a recycling program. Often the market for commodities such as metals and paper are global in scale. Therefore, market development initiatives at the state level have only marginal effect on the commodity pricing of recyclables..

The commonly recycled materials in the MSW waste stream are paper products, yard and food waste, plastics, ferrous and non-ferrous metals, and glass. Costs of recycling programs differ not only between regions of the U.S., but also depend on the type of recyclable materials being processed. All MSW commodities require costs of bulk containers, transportation, labor (coordinator/ monitor). Corrugated cardboard and newsprint recycling economics often benefit from the use of baling/compacting equipment to achieve lower transportation costs per ton. Baling and compacting equipment costs are usually offset by savings incurred from reduced landfill disposal fees and revenue from the sale of the recycled material.

SPSA reported total recycling expenses of $1,295,982 for Fiscal Year 1999. This cost includes recycling administration and curbside collection expenses. SPSA recovered 177,416 tons in recyclable material during FY 1999. Therefore, the SPSA cost per ton of recovered material by curbside pickup and drop centers (not including yard waste) for FY 199 was $7.31. The above figure does not include some minor overhead expenses shared with other sections of SPSA. Expressed another way, the cost of SPSA's curbside collection program came to $1.20 per household per month, according to John Grove. Director of Recycling, SPSA.

7.4 Summary of Findings

Virginia has landfill capacity in excess of its own needs. Low energy prices and the low cost of land in rural Virginia has created a market which encourages disposal of MSW in landfills by Virginia's communities. The current low cost of disposal in Virginia's MSW landfills also encourages use of the Commonwealth's landfills by other States. Virginia is currently the second leading importer of MSW in the United States; Virginia is second only to Pennsylvania.

Other options are available to local communities and regional solid waste authorities for management and disposal of MSW. The three alternatives examined for this report include: incineration, composting, and recycling. All three alternatives have associated costs and potential revenues that may vary from region to region. Therefore, it is not prudent to identify a cost associated with a particular MSW technology or practice as the benefits and costs of any one

alternative varies for different regions of the Commonwealth.

Other than costs, regulatory mandates may have a significant impact on MSW management and disposal practices. However, the implementation of regulatory mandates associated with solid waste management (resource recovery programs) and/or MSW disposal may face significant political and social obstacles to acceptance communities.

The feasibility of a waste reduction or diversion program is typically best determined individually for each region or locality on a case-by-case basis. Such a determination is beyond the scope of this report.

However, some general characteristics of incineration, composting, and recycling follow that constrain their implementation to certain conditions which must be considered.

The high capital costs of incineration and the high waste flow demands of WTE technology have restricted WTE viability to densely populated areas. These areas often have limited available space for new landfill construction and have the high waste flows generated within a limited geographic area. In addition, a local industrial base to increase demand for and price of power helps to offset costs as well. Connecticut and New Jersey have made the commitment to incineration, as opposed to landfill disposal, as a cornerstone of their solid waste management plans. In Virginia, only the densely populated areas, Northern Virginia and Southeastern Virginia, have supported waste-to-energy plants.

Composting stands to grow in importance if the source separation of food wastes can be improved. Yard waste appears to originate from suburban areas or public parks without the capacity to mulch or otherwise reduce the delivery of yard trimmings. An increase in landfill tipping fees may simply increase the source reduction of yard waste, instead of increasing the incoming flows to composting facilities. There would appear to be potential savings for grocery stores, food-packaging industries, and retail restaurants to separate their organic waste in exchange for lower waste disposal costs. The increase in food waste flows to composting yards would potentially help to process the often abundant, slower degrading wastes such as wax corrugated cardboard and other food packaging. However, there may be some public health liability concerns for these businesses involved with storing culled food outside their establishments until pick up by the hauler.

More than the other alternatives, the success of recycling programs appears to rely on the landfill tipping fees and the environmental awareness of the public. Recycling as a waste diversion method has gained support as a cost saving device in businesses. It appears that, unless the financial incentive to recycle improves, unfortunately, the diversion rates of the traditionally recyclable materials may not increase significantly. Recycling programs must fit the community in terms of lifestyle routines and the political landscape. In the more rural areas, regionalization would appear to be an important first step in establishing economically viable recycling programs. The success of the regional agencies may depend on market prices; however, market

development programs may only be marginally effective because of the global scale of the important commodity markets such as metals and paper.

REFERENCES

- Southeastern Public Service Authority 1998 Annual Report

- United States Environmental Protection Agency 1998. The Characterization of Municipal Solid Waste in The United States: 1997 Update. EPA530-R-98-007, May 1998.

- Biocycle Magazine 1997 JPG Press.

DEFINITIONS

DEFINITIONS

"**Assessment monitoring**" is the phase of groundwater monitoring that must be initiated if it is determined that statistically significant differences have been detected as the result of detection monitoring. Assessment monitoring is to evaluate the rate and the extent of migration of the solid waste constituents (over 250 constituents specified in Appendix 5.1 of VSWMR) and their concentrations in the groundwater. The results of the assessment monitoring are used to establish the background for all constituents found and to determine the groundwater protection standards.

"**Closure**" means the act of securing a landfill pursuant to the requirements of VSWMR.

"**Combination landfills**" means landfills of which some portions have a Subtitle D composite liner, while other portions either have no liner or a Non-Subtitle D liner. Combination landfills typically monitor groundwater over the entire combined area. If groundwater contamination is detected, it is not possible to differential which area (Subtitle D or Non-Subtitle D) has impacted the groundwater.

"**Composite liner**" means a liner system consisting of a lower component of two feet of compacted clay having a minimum hydraulic conductivity of 1×10^{-7} centimeters per second (cm/sec) and an upper component of a synthetic flexible membrane. This is the liner required by Subtitle D criteria and VSWMR.

"**Detection monitoring**" is the initial phase of groundwater monitoring which consists of analyzing for 62 inorganic and organic hazardous constituents (listed in Appendix 5.5 of VSWMR for sanitary landfills).

"**Groundwater protection standards**" are site-specific limits developed for specific constituents that are protective of human health and the environment.

"**HB 1205**" means the 1993 amendment of Chapter 14, §10.1-1408.1(N) of the Code of Virginia which authorized landfills that were receiving waste prior to March 15, 1993, to continue to receive waste after October 9, 1993, until the vertical design capacity has been reached, provided that the facility is in compliance with the requirements for liner and leachate control design that were in effect at the time of the permit issuance.

"**Liner**" is an engineered structural component of a landfill that is designed to isolate and contain waste and leachate from the environment. A liner may be constructed from natural soil materials, soills amended with other materials, synthetic materials, or a combination of these materials.

residential, commercial and institutional solid waste.

"**MSW landfill**" means an engineered land burial facility for the disposal of household that is located, designed, constructed and operated to contain and isolate the waste so that it does not pose a substantial present or potential hazard to human health or the environment. A MSW landfill may other types of solid as allowed by VSWMR. This term is analogous to "sanitary landfill" in VSWMR.

"**Non-Subtitle D landfill**" means a landfill that may be either unlined or may have a liner which has not been demonstrated to meet the regulation in effect after 1993. Landfills of this type were typically constructed prior to October, 1993.

"**Subtitle D**" means the federal landfill design, operation, monitoring and closure standards promulgated by Resource Conservation and Recovery Act (RCRA), Subtitle D (40 CFR 258) which became effective on October 9, 1993.

"**Subtitle D landfill**" means a landfill that is underlain by a composite liner consisting of two feet of clay, combined with a flexible membrane liner, or an approved alternate liner (I. e., the liner meets EPA's Subtitle D criteria). Landfills of this type were typically constructed after October, 1993.

"**VSWMR**" means the Virginia Solid Waste Management Regulations (9 VAC 20-80-10, et seq.).

Study Mandate

Chapter 584 of the 1999 Acts of Assembly, Second Enactment

CHAPTER 584

An Act to amend and reenact § 10.1-1408.1 of the Code of Virginia and to amend the Code of Virginia by adding sections numbered 10.1-1406.2, 10.1-1408.3 and 10.1-1410.2; by adding in Chapter 14 of Title 10.1 an article numbered 2.1, consisting of a section numbered 10.1-1413.2; and by adding in Chapter 14 of Title 10.1 an article numbered 7.2, consisting of a section numbered 10.1-1454.2, relating to solid waste management.

[S 1309]

Approved March 27, 1999

Be it enacted by the General Assembly of Virginia:

1. That § 10.1-1408.1 of the Code of Virginia is amended and reenacted and that the Code of Virginia is amended by adding sections numbered 10.1-1406.2, 10.1-1408.3 and 10.1-1410.2; by adding in Chapter 14 of Title 10.1 an article numbered 2.1, consisting of a section numbered 10.1-1413.2; and by adding in Chapter 14 of Title 10.1 an article numbered 7.2, consisting of a section numbered 10.1-1454.2, as follows:

§ 10.1-1406.2. Conditional exemption for coal and mineral mining overburden or solid waste.

The provisions of this chapter shall not apply to coal or mineral mining overburden returned to the mine site or solid wastes from the extraction, beneficiation, and processing of coal or minerals that are managed in accordance with requirements promulgated by the Department of Mines, Minerals and Energy.

§ 10.1-1408.1. Permit required; open dumps prohibited.

A. No person shall operate any sanitary landfill or other facility for the disposal, treatment or storage of nonhazardous solid waste without a permit from the Director.

B. No application for a new solid waste management facility permit shall be complete unless it contains the following:

1. Certification from the governing body of the county, city or town in which the facility is to be located that the location and operation of the facility are consistent with all applicable ordinances. The governing body shall inform the applicant and the Department of the facility's compliance or noncompliance not more than 120 days from receipt of a request from the applicant. No such certification shall be required for the application for the renewal of a permit or transfer of a permit as authorized by regulations of the Board;

2. A disclosure statement, except that the Director, upon request and in his sole discretion, and when in his judgment other information is sufficient and available, may waive the requirement for a disclosure statement for a captive industrial landfill when such a statement would not serve the purposes of this chapter;

3. If the applicant proposes to locate the facility on property not governed by any county, city or town zoning ordinance, certification from the governing body that it has held a public hearing, in accordance with the applicable provisions of § 15.2-2204, to receive public comment on the proposed facility. Such certification shall be provided to the applicant and the Department within 120 days from receipt of a request from the applicant;

4. If the applicant proposes to operate a new sanitary landfill or transfer station, a statement, including a description of the steps taken by the applicant to seek the comments of the residents of the area where the sanitary landfill or transfer station is proposed to be located, regarding the siting and operation of the proposed sanitary landfill or transfer station. The public comment steps shall be taken prior to filing with the Department the notice of intent to apply for a permit for the sanitary landfill or transfer station as required by the Department's solid waste management regulations. The public comment steps shall include publication of a public notice once a week for two consecutive weeks in a newspaper of general circulation serving the locality where the sanitary landfill or transfer station is proposed to be located and holding at least one public meeting within the locality to identify issues of concern, to facilitate communication and to establish a dialogue between the applicant and persons who may be affected by the issuance of a permit for the sanitary landfill or transfer station. The public notice shall include a statement of the applicant's intent to apply for a permit to operate

the proposed sanitary landfill or transfer station, the proposed sanitary landfill or transfer station site location, the date, time and location of the public meeting the applicant will hold and the name, address and telephone number of a person employed by the applicant, who can be contacted by interested persons to answer questions or receive comments on the siting and operation of the proposed sanitary landfill or transfer station. The first publication of the public notice shall be at least fourteen days prior to the public meeting date.

The provisions of this subdivision shall not apply to applicants for a permit to operate a new captive industrial landfill or a new construction-demolition-debris landfill;

5. If the applicant is a local government or public authority that proposes to operate a new municipal sanitary landfill or transfer station, a statement, including a description of the steps taken by the applicant to seek the comments of the residents of the area where the sanitary landfill or transfer station is proposed to be located, regarding the siting and operation of the proposed sanitary landfill or transfer station. The public comment steps shall be taken prior to filing with the Department the notice of intent to apply for a permit for the sanitary landfill or transfer station as required by the Department's solid waste management regulations. The public comment steps shall include the formation of a citizens' advisory group to assist the locality or public authority with the selection of a proposed site for the sanitary landfill or transfer station, publication of a public notice once a week for two consecutive weeks in a newspaper of general circulation serving the locality where the sanitary landfill or transfer station is proposed to be located, and holding at least one public meeting within the locality to identify issues of concern, to facilitate communication and to establish a dialogue between the applicant and persons who may be affected by the issuance of a permit for the sanitary landfill or transfer station. The public notice shall include a statement of the applicant's intent to apply for a permit to operate the proposed sanitary landfill or transfer station, the proposed sanitary landfill or transfer station site location, the date, time and location of the public meeting the applicant will hold and the name, address and telephone number of a person employed by the applicant, who can be contacted by interested persons to answer questions or receive comments on the siting and operation of the proposed sanitary landfill or transfer station. The first publication of the public notice shall be at least fourteen days prior to *the* public meeting date. For local governments that have zoning ordinances, such public comment steps as required under §§ 15.2-2204 and 15.2-2285 shall satisfy the public comment requirements for public hearings and public notice as required under this section. Any applicant which is a local government or public authority that proposes to operate a new transfer station on land where a municipal sanitary landfill is already located shall be exempt from the public comment requirements for public hearing and public notice otherwise required under this section;

6. If the application is for a new municipal solid waste landfill or for an expansion of an existing municipal solid waste landfill, a statement, signed by the applicant, guaranteeing that sufficient disposal capacity will be available in the facility to enable localities within the Commonwealth to comply with solid waste management plans developed pursuant to § 10.1-1411, and certifying that such localities will be allowed to contract for and to reserve disposal capacity in the facility. This provision shall not apply to permit applications from one or more political subdivisions for new landfills or expanded landfills that will only accept municipal solid waste generated within those political subdivision or subdivisions' jurisdiction or municipal solid waste generated within other political subdivisions pursuant to an interjurisdictional agreement;

7. If the application is for a new municipal solid waste landfill or for an expansion of an existing municipal solid waste landfill, certification from the governing body of the locality in which the facility would be located that a host agreement has been reached between the applicant and the governing body unless the governing body would be the owner and operator of the landfill. The agreement shall, at a minimum, have provisions covering (i) the amount of financial compensation the applicant will provide the host locality, (ii) daily travel routes and traffic volumes, (iii) the daily disposal limit, and (iv) the anticipated service area of the facility. The host agreement shall contain a provision that the applicant will pay the full cost of at least one full-time employee of the locality whose responsibility it will be to monitor and inspect waste transportation and disposal practices in the locality. The host agreement shall also provide that the applicant shall, when requested by the host locality, split air and water samples so that the host locality may independently test the sample,

with all associated costs paid for by the applicant. All such sampling results shall be provided to the Department. For purposes of this subdivision, "host agreement" means any lease, contract, agreement or land use permit entered into or issued by the locality in which the landfill is situated which includes terms or conditions governing the operation of the landfill; and

8. If the application is for a locality-owned and locality-operated new municipal solid waste landfill or for an expansion of an existing such municipal solid waste landfill, information on the anticipated (i) daily travel routes and traffic volumes, (ii) daily disposal limit, and (iii) service area of the facility.

C. Notwithstanding any other provision of law:

1. Every holder of a permit issued under this article who has not earlier filed a disclosure statement shall, prior to July 1, 1991, file a disclosure statement with the Director.

2. Every applicant for a permit under this article shall file a disclosure statement with the Director, together with the permit application or prior to September 1, 1990, whichever comes later. No permit application shall be deemed incomplete for lack of a disclosure statement prior to September 1, 1990.

3. Every applicant shall update its disclosure statement quarterly to indicate any change of condition that renders any portion of the disclosure statement materially incomplete or inaccurate.

4. The Director, upon request and in his sole discretion, and when in his judgment other information is sufficient and available, may waive the requirements of this subsection for a captive industrial waste landfill when such requirements would not serve the purposes of this chapter.

D. *1. Except as provided in subdivision D 2,* no permit for a new solid waste management facility *nor any amendment to a permit allowing facility expansion or an increase in capacity* shall be issued until the Director has determined, after *an* investigation *and analysis of the potential human health, environmental, transportation infrastructure, and transportation safety impacts and needs* and *an* evaluation of comments by the *host* local government, *other local governments and interested persons,* that *(i)* the proposed facility ~~poses no substantial~~, *expansion, or increase protects* present ~~or potential danger to~~ *and future* human health ~~or~~ *and safety and* the environment*; (ii) there is a need for the additional capacity; (iii) sufficient infrastructure will exist to safely handle the waste flow; (iv) the increase is consistent with locality-imposed or state-imposed daily disposal limits; (v) the public interest will be served by the proposed facility's operation or the expansion or increase in capacity of a facility; and (vi) the additional capacity is consistent with regional and local solid waste management plans developed pursuant to § 10.1-1411.* The Department shall hold a public hearing within the said county, city or town prior to the issuance of any such permit for the management of nonhazardous solid waste. *Subdivision D 2, in lieu of this subdivision, shall apply to nonhazardous industrial solid waste management facilities owned or operated by the generator of the waste managed at the facility, and that accept only waste generated by the facility owner or operator. The Board shall have the authority to promulgate regulations to implement this subdivision.*

2. No new permit for a nonhazardous industrial solid waste management facility that is owned or operated by the generator of the waste managed at the facility, and that accepts only waste generated by the facility owner or operator, shall be issued until the Director has determined, after investigation and evaluation of comments by the local government, that the proposed facility poses no substantial present or potential danger to human health or the environment. The Department shall hold a public hearing within the county, city or town where the facility is to be located prior to the issuance of any such permit for the management of nonhazardous industrial solid waste.

E. The permit shall contain such conditions or requirements as are necessary to comply with the requirements of this Code and the regulations of the Board and to ~~prevent a substantial~~ *protect* present ~~or potential hazard to~~ *and future* human health and the environment.

The Director may include in any permit such recordkeeping, testing and reporting requirements as are necessary to ensure that the local governing body of the county, city or town where the waste management facility is located is kept timely informed regarding the general nature and quantity of waste being disposed of at the facility. Such recordkeeping, testing and reporting requirements shall require disclosure of proprietary information only as is necessary to carry out the purposes of this chapter. At least once every ten years, the Director shall review and issue written findings on the environmental compliance history of each permittee, material changes, if any, in key personnel, and technical limitations, standards, or regulations on which the original permit was based. The time

period for review of each category of permits shall be established by Board regulation. If, upon such review, the Director finds that repeated material or substantial violations of the permittee or material changes in the permittee's key personnel would make continued operation of the facility not in the best interests of human health or the environment, the Director shall amend or revoke the permit, in accordance herewith. Whenever such review is undertaken, the Director may amend the permit to include additional limitations, standards, or conditions when the technical limitations, standards, or regulations on which the original permit was based have been changed by statute or amended by regulation or when any of the conditions in subsection B of § 10.1-1409 exist. The Director may deny, revoke, or suspend any permit for any of the grounds listed under subsection A of § 10.1-1409.

F. There shall exist no right to operate a landfill or other facility for the disposal, treatment or storage of nonhazardous solid waste or hazardous waste within the Commonwealth. Permits for solid waste management facilities shall not be transferable except as authorized in regulations promulgated by the Board. The issuance of a permit shall not convey or establish any property rights or any exclusive privilege, nor shall it authorize any injury to private property or any invasion of personal rights or any infringement of federal, state, or local law or regulation.

G. No person shall dispose of solid waste in open dumps.

H. No person shall own, operate or allow to be operated on his property an open dump.

I. No person shall allow waste to be disposed of on his property without a permit. Any person who removes trees, brush, or other vegetation from land used for agricultural or forestal purposes shall not be required to obtain a permit if such material is deposited or placed on the same or other property of the same landowner from which such materials were cleared. The Board shall by regulation provide for other reasonable exemptions from permitting requirements for the disposal of trees, brush and other vegetation when such materials are removed for agricultural or forestal purposes.

When promulgating any regulation pursuant to this section, the Board shall consider the character of the land affected, the density of population, *and* the volume of waste to be disposed, as well as other relevant factors.

J. No permit shall be required pursuant to this section for recycling or for temporary storage incidental to recycling. As used in this subsection, "recycling" means any process whereby material which would otherwise be solid waste is used or reused, or prepared for use or reuse, as an ingredient in an industrial process to make a product, or as an effective substitute for a commercial product.

K. The Board shall provide for reasonable exemptions from the permitting requirements, both procedural and substantive, in order to encourage the development of yard waste composting facilities. To accomplish this, the Board is authorized to exempt such facilities from regulations governing the treatment of waste and to establish an expedited approval process. Agricultural operations receiving only yard waste for composting shall be exempt from permitting requirements provided that (i) the composting area is located not less than 300 feet from a property boundary, is located not less than 1,000 feet from an occupied dwelling not located on the same property as the composting area, and is not located within an area designated as a flood plain as defined in § 10.1-600; (ii) the agricultural operation has at least one acre of ground suitable to receive yard waste for each 150 cubic yards of finished compost generated; (iii) the total time for the composting process and storage of material that is being composted or has been composted shall not exceed eighteen months prior to its field application or sale as a horticultural or agricultural product; and (iv) the owner or operator of the agricultural operation notifies the Director in writing of his intent to operate a yard waste composting facility and the amount of land available for the receipt of yard waste. In addition to the requirements set forth in clauses (i) through (iv) of the preceding sentence, the owner and operator of any agricultural operation that receives more than 6,000 cubic yards of yard waste generated from property not within the control of the owner or the operator in any twelve-month period shall be exempt from permitting requirements provided (i) the owner and operator submit to the Director an annual report describing the volume and types of yard waste received by such operation for composting and (ii) the operator shall certify that the yard waste composting facility complies with local ordinances. The Director shall establish a procedure for the filing of the notices, annual reports and certificates required by this subsection and shall prescribe the forms for the annual reports and certificates. Nothing contained in this article shall prohibit the sale of composted yard waste for horticultural or

agricultural use, provided that any composted yard waste sold as a commercial fertilizer with claims of specific nutrient values, promoting plant growth, or of conditioning soil shall be sold in accordance with the Virginia Fertilizer Act (§ 3.1-106.1 et seq.). As used in this subsection, "agricultural operation" shall have the same meaning ascribed to it in subsection B of § 3.1-22.29.

The operation of a composting facility as provided in this subsection shall not relieve the owner or operator of such a facility from liability for any violation of this chapter.

L. The Board shall provide for reasonable exemptions from the permitting requirements, both procedural and substantive, in order to encourage the development of facilities for the decomposition of vegetative waste. To accomplish this, the Board shall approve an expedited approval process. As used in this subsection, the decomposition of vegetative waste means a natural aerobic or anaerobic process, active or passive, which results in the decay and chemical breakdown of the vegetative waste. Nothing in this subsection shall be construed to prohibit a city or county from exercising its existing authority to regulate such facilities by requiring, among other things, permits and proof of financial security.

M. In receiving and processing applications for permits required by this section, the Director shall assign top priority to applications which (i) agree to accept nonhazardous recycling residues and (ii) pledge to charge tipping fees for disposal of nonhazardous recycling residues which do not exceed those charged for nonhazardous municipal solid waste. Applications meeting these requirements shall be acted upon no later than six months after they are deemed complete.

N. Every solid waste management facility shall be operated in compliance with the regulations promulgated by the Board pursuant to this chapter. To the extent consistent with federal law, those facilities which were permitted prior to March 15, 1993, and upon which solid waste has been disposed of prior to October 9, 1993, may continue to receive solid waste until they have reached their vertical design capacity, provided that the facility is in compliance with the requirements for liners and leachate control in effect at the time of permit issuance, and further provided that on or before October 9, 1993, the owner or operator of the solid waste management facility submits to the Director:

1. An acknowledgement that the owner or operator is familiar with state and federal law and regulations pertaining to solid waste management facilities operating after October 9, 1993, including postclosure care, corrective action and financial responsibility requirements;

2. A statement signed by a registered professional engineer that he has reviewed the regulations established by the Department for solid waste management facilities, including the open dump criteria contained therein~~,~~; that he has inspected the facility and examined the monitoring data compiled for the facility in accordance with applicable regulations; and that, on the basis of his inspection and review, *he* has concluded *that*: (i) ~~that~~ the facility is not an open dump, (ii) ~~that~~ the facility does not pose a substantial present or potential hazard to human health and the environment, and (iii) ~~that~~ the leachate or residues from the facility do not pose a threat of contamination or pollution of the air, surface water or ground water in a manner constituting an open dump or resulting in a substantial present or potential hazard to human health or the environment; and

3. A statement signed by the owner or operator (i) that the facility complies with applicable financial assurance regulations~~,~~ and (ii) estimating when the facility will reach its vertical design capacity.

The facility may not be enlarged prematurely to avoid compliance with state or federal regulations when such enlargement is not consistent with past operating practices, the permit or modified operating practices to ensure good management.

Facilities which are authorized by this subsection to accept waste for disposal beyond the waste boundaries existing on October 9, 1993, shall be as follows:

Category 1: Nonhazardous industrial waste facilities that are located on property owned or controlled by the generator of the waste disposed of in the facility;

Category 2: Nonhazardous industrial waste facilities other than those that are located on property owned or controlled by the generator of the waste disposed of in the facility, provided that the facility accepts only industrial waste streams which the facility has lawfully accepted prior to July 1, 1995, or other nonhazardous industrial waste as approved by the Department on a case-by-case basis; and

Category 3: Facilities that accept only construction-demolition-debris waste as defined in the

Board's regulations.

The Director may prohibit or restrict the disposal of waste in facilities described in this subsection which contains hazardous constituents as defined in applicable regulations which, in the opinion of the Director, would pose a substantial risk to health or the environment. Facilities described in category 3 may expand laterally beyond the waste disposal boundaries existing on October 9, 1993, provided that there is first installed, in such expanded areas, liners and leachate control systems meeting the applicable performance requirements of the Board's regulations, or a demonstration is made to the satisfaction of the Director that such facilities satisfy the applicable variance criteria in the Board's regulations.

Owners or operators of facilities which are authorized under this subsection to accept waste for disposal beyond the waste boundaries existing on October 9, 1993, shall ensure that such expanded disposal areas maintain setback distances applicable to such facilities under the Board's current regulations and local ordinances. Prior to the expansion of any facility described in category 2 or 3, the owner or operator shall provide the Director with written notice of the proposed expansion at least sixty days prior to commencement of construction. The notice shall include recent groundwater monitoring data sufficient to determine that the facility does not pose a threat of contamination of groundwater in a manner constituting an open dump or creating a substantial present or potential hazard to human health or the environment. The Director shall evaluate the data included with the notification and may advise the owner or operator of any additional requirements that may be necessary to ensure compliance with applicable laws and prevent a substantial present or potential hazard to health or the environment.

Facilities, or portions thereof, which have reached their vertical design capacity shall be closed in compliance with regulations promulgated by the Board.

Nothing in this subsection shall alter any requirement for groundwater monitoring, financial responsibility, operator certification, closure, postclosure care, operation, maintenance or corrective action imposed under state or federal law or regulation, or impair the powers of the Director pursuant to § 10.1-1409.

O. Portions of a permitted solid waste management facility used solely for the storage of household hazardous waste may store household hazardous waste for a period not to exceed one year, provided that such wastes are properly contained and are segregated to prevent mixing of incompatible wastes.

P. Any permit for a new municipal solid waste landfill, and any permit amendment authorizing expansion of an existing municipal solid waste landfill, shall incorporate conditions to require that capacity in the landfill will be available to localities within the Commonwealth that choose to contract for and reserve such capacity for disposal of such localities' solid waste in accordance with solid waste management plans developed by such localities pursuant to § 10.1-1411. This provision shall not apply to permit applications from one or more political subdivisions for new landfills or expanded landfills that will only accept municipal solid waste generated within the those political subdivision or subdivisions' jurisdiction or municipal solid waste generated within other political subdivisions pursuant to an interjurisdictional agreement.

Q. No owner or operator of a municipal solid waste management facility shall accept wastes for incineration or disposal from a vehicle operating with four or more axles unless the transporter of the waste provides certification, in a form prescribed by the Board, that the waste is free of substances not authorized for acceptance at the facility.

§ 10.1-1408.3. Landfill siting review.

A. Before granting a permit which approves site suitability for a new municipal solid waste landfill, the Director shall determine, in writing, that the site on which the landfill is to be constructed is suitable for the construction and operation of such a landfill. In making his determination, the Director shall consider and address, in addition to such others as he deems appropriate, the following factors:

1. Based on a written, site-specific report prepared by the Virginia Department of Transportation, the adequacy of transportation facilities that will be available to serve the landfill, including the impact of the landfill on local traffic volume, road congestion, and highway safety;

2. The potential impact of the proposed landfill on parks and recreational areas, public water

supplies, marine resources, wetlands, historic sites, fish and wildlife, water quality, and tourism; and

3. The geologic suitability of the proposed site, including proximity to areas of seismic activity and karst topography.

The applicant shall provide such information on these factors as the Director may request.

B. In addition to such other types of locations as may be determined by the Board, no new municipal solid waste landfill shall be constructed:

1. In a 100-year flood plain;

2. In any tidal wetland or nontidal wetland contiguous to any surface water body;

3. Within five miles upgradient of any existing surface or groundwater public water supply intake or reservoir;

4. In any area vulnerable to flooding resulting from dam failures;

5. Over a sinkhole or less than 100 feet above a solution cavern associated with karst topography;

6. In any park or recreational area, wildlife management area or area designated by any federal or state agency as the critical habitat of any endangered species; or

7. Over an active fault.

§ 10.1-1410.2. Landfill postclosure monitoring, maintenance and plans.

A. The owner and operator of any solid waste landfill permitted under this chapter shall be responsible for ensuring that such landfill is properly closed in accordance with the Board's regulations and that the landfill is maintained and monitored after closure so as to protect human health and the environment. Maintenance and monitoring of solid waste landfills after closure shall be in accordance with the Board's regulations. At all times during the operational life of a solid waste landfill, the owner and operator shall provide to the Director satisfactory evidence of financial assurance consistent with all federal and state laws and regulations to ensure that the landfill will be:

1. Closed in accordance with the Board's regulations and the closure plan approved for the landfill; and

2. Monitored and maintained after closure, for such period of time as provided in the Board's regulations or for such additional period as the Director shall determine is necessary, in accordance with a postclosure plan approved by the Director.

B. Not less than 180 days prior to the completion of the postclosure monitoring and maintenance period as prescribed by the Board's regulations or by the Director, the owner or operator shall submit to the Director a certificate, signed by a professional engineer licensed in the Commonwealth, that postclosure monitoring and maintenance have been completed in accordance with the postclosure plan. The certificate shall be accompanied by an evaluation, prepared by a professional engineer licensed in the Commonwealth and signed by the owner or operator, assessing and evaluating the landfill's potential for harm to human health and the environment in the event that post-closure monitoring and maintenance are discontinued. If the Director determines that continued postclosure monitoring or maintenance is necessary to prevent harm to human health or the environment, he shall extend the postclosure period for such additional time as the Director deems necessary to protect human health and the environment and shall direct the owner or operator to submit a revised postclosure plan and to continue postclosure monitoring and maintenance in accordance therewith. Requirements for financial assurance as set forth in subsection A shall apply throughout such extended postclosure period.

Article 2.1.

Virginia Landfill Clean-up and Closure Fund.

§ 10.1-1413.2. Virginia Landfill Clean-up and Closure Fund established; uses.

A. There is hereby created in the state treasury a special nonreverting fund to be known as the Virginia Landfill Clean-up and Closure Fund, hereafter referred to as "the Fund." The Fund shall be established on the books of the Comptroller. The Fund shall consist of funds appropriated to it by the General Assembly and such other sums as may be made available to it from any other source, public or private, all of which shall be credited to the Fund. Interest earned on moneys in the Fund shall remain in the Fund and be credited to it. Any moneys remaining in the Fund, including interest thereon, at the end of each fiscal year shall not revert to the general fund but shall remain in the Fund. Moneys in the Fund shall be used solely for the purposes described in subsection B. Expenditures and disbursements from the Fund shall be made by the State Treasurer on warrants

issued by the Comptroller upon written request signed by the Director. This fund shall be exempt from indirect costs assessed by the Department of Accounts.

B. The Fund shall be used by the Department solely for the purposes of providing grants to local governments and to political subdivisions which exist to provide solid waste management services for the proper final closure of landfills that are owned by the local governments or political subdivisions, or which are located in the locality and have been abandoned in violation of this chapter, and are not equipped with liner and leachate control systems meeting the requirements of the Board's regulations. The Department shall prioritize landfills in need of grants pursuant to this subdivision based on the greatest threat to human health and the environment. Grants pursuant to this subsection shall not replace previously existing financial assurances provided to the Department.

C. The Director shall have the authority to access and release moneys in the Fund for purposes of this section for up to $100,000 per occurrence as long as the disbursement does not exceed the balance of the Fund. If the Director requests a disbursement in excess of $100,000 or an amount exceeding the current Fund balance, the disbursement shall require the written approval of the Governor.

Disbursements from the Fund may be made for the purposes outlined in subsection B, including, but not limited to, personnel, administrative, and equipment costs and expenses directly incurred by the Department, or by any other agency or political subdivision acting at the direction of the Department.

D. The Department shall develop guidelines which, after approval by the Governor, shall determine how the Fund can be used for the purposes of this section.

Article 7.2.

Transportation of Municipal Solid and Medical Waste by Truck.

§ 10.1-1454.2. Regulation of road transportation of waste.

A. The Board, in consultation with the appropriate agencies, shall develop regulations governing the commercial transport of nonhazardous municipal solid waste (except scrap metal and source-separated recyclables) and regulated medical waste by truck as are necessary to protect the health, safety, and welfare of the citizens of the Commonwealth, and to protect the Commonwealth's environment and natural resources from pollution, impairment, or destruction. Included in the regulations, to the extent allowable under federal law and regulation, shall be provisions:

1. Governing the transport of wastes by truck and the design and construction of the containers and trailers transporting waste by truck so that they will be designed, constructed and maintained so as to, as much as is reasonably practicable, prevent the escape of wastes and liquids and to prevent the loss or spillage of wastes to the extent possible in the event of an accident; and

2. Requiring owners of trucks transporting wastes regulated under this article to demonstrate financial responsibility sufficient to comply with the requirements of this article as a condition of operation. Regulations governing the amount of any financial responsibility required shall take into consideration (i) the risk of potential damage or injury that may result from spillage or leakage; (ii) the potential costs of containment and cleanup; and (iii) the nature and degree of injury or interference with general health, welfare and property that may result.

B. The owner or operator of a truck from which there is spillage or loss of wastes subject to regulations under this article shall immediately report such spillage or loss in accordance with the regulations of the Board and shall immediately take all such actions as may be necessary to contain and remove such wastes.

C. No person shall transport by truck wastes regulated under this article unless the containers carried thereon are designed, constructed, loaded, operated and maintained in accordance with the regulations developed pursuant to subsection A. A violation of this subsection shall be a Class 1 misdemeanor.

D. For the purposes of this section, the term "truck" means any tractor truck semitrailer combination with four or more axles.

. That the Director of the Department of Environmental Quality shall not, prior to July 1, 2000, issue any permit for a new landfill which would accept municipal solid waste. Nothing herein shall prevent the Director from acting on or issuing any permit for which a notice of intent has been filed prior to January 1, 1999, nor shall it prevent action on or the issuance of

any permit for the expansion of a facility within an area included in a determination of site suitability for a landfill made in accordance with the Board's regulations and that was approved by the Director prior to January 1, 1999. The Department of Environmental Quality shall undertake a comprehensive study of solid waste management in Virginia, including an analysis of and recommendations regarding solid waste disposal practices, projections on future landfill capacity needs, mechanisms to enhance waste reduction and recycling, and needed state and federal legislation to protect human health and the environment. The Department shall report its interim findings to the Governor and the General Assembly by December 1, 1999, and shall submit its final report to the Governor and the General Assembly by July 1, 2000.

3. That the amendments made by this act to § 10.1-1408.1 shall not apply to any notice of intent or application for, or the processing and issuance of, any permit or permit amendment for a solid waste management facility for which such notice of intent or application was submitted to the Department on or before November 13, 1998.

Copies of the Appendices to this report can be obtained by contacting:
Richard Criqui, DEQ, at 804/698-4013

APPENDIX A

PLANNING ASSISTANCE TO THE STATES PROGRAM
Letter Agreement Between

THE COMMONWEALTH OF VIRGINIA
Virginia Department of Environmental Quality and

THE U.S. ARMY CORPS OF ENGINEERS,
Norfolk District

APPENDIX B

QUESTIONNAIRES FOR COMPREHENSIVE SOLID WASTE MANAGEMENT STUDY

1. **Status of Municipal Solid Waste Landfills and Waste Reduction and Recycling in 16 States**

2. **Municipal Solid Waste Landfill Facilities Survey Questionnaire**

APPENDIX C

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

Solid Waste Management
Organizational Charts

APPENDIX D

CALCULATIONS SUPPORTING ESTIMATE OF CUMULATIVE CUBIC YARDS OF WASTE LANDFILLED OVER 30 YEAR PERIOD IN VIRGINIA

APPENDIX E

SUMMARY OF STATE RESPONSES REGARDING HEALTH AND ENVIRONMENTAL EFFECTS - UNLINED LANDFILLS

PUBLIC HEALTH ASSESSMENT
Colesville Municipal Landfill, Colesville, New York

PUBLIC HEALTH ASSESSMENT
Seattle Municipal Landfill/Kent Highlands, Kent, Washington

NEW HAMPSHIRE PRESS RELEASE
Effects of Unlined Landfills

APPENDIX F

TABLE OF DISTANCES CALCULATED FROM GIS ROUTING PROGRAM

DESCRIPTION OF PROCESS USED TO CREATE GIS MAP

APPENDIX G

NOTE

Appendix G is not included in this copy of the Interim Report. To obtain a copy of this appendix, please contact John Godfrey, Environmental Engineer Senior, Department of Environmental Quality, Division of Waste Program Coordination, Office of Waste Permitting, at (804)698-4258 or by fax at (804)698-4234.