FINAL PREFERRED WASTE MANAGEMENT SYSTEM PLAN

ST. CLAIR, MADISON AND MONROE COUNTIES, ILLINOIS

Performed for:

St. Clair County, Illinois
Madison County, Illinois
Monroe County, Illinois

East-West Gateway Coordinating Council
911 Washington Avenue
St. Louis, Missouri 63101

Technical Consultants:

Executive Services, Inc.
Gershman, Brickner & Bratton, Inc.
Campbell Design Group

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RESOLUTION NO. 92-90-R

A RESOLUTION CONCERNING THE ADOPTION
OF A SOLID WASTE MANAGEMENT PLAN
PURSUANT TO ILLINOIS REVISED STATUTES
CHAPTER 85, SECTION 5951 ET. SEQ.

WHEREAS, the Illinois General Assembly has mandated that counties take primary responsibility to plan for the management of the municipal waste within their boundaries to ensure the timely development of needed waste management facilities and programs; and

WHEREAS, the Environmental Committee has reviewed the Final Preferred Waste Management Plan as prepared by the East-West Gateway Coordinating Council; and

WHEREAS, the Environmental Committee recommends the Final Preferred Waste Management Plan as prepared by the East-West Gateway Coordinating Council for County Board consideration.

NOW THEREFORE BE IT RESOLVED by the County Board of the County of St. Clair, Illinois that the following schedule be and is hereby established to provide for the adoption and implementation of a Solid Waste Management Plan pursuant to Illinois Revised Statutes, Chapter 85, Section 5951 et. seq.

	St.Clair County	Madison County	Monroe County
Draft Plan available for public review, copies distributed to municipalities, SIMAPC, EWGCC and IEPA	4/19/90	4/19/90	4/19/90
Public Hearing on Draft Plan	5/9/90	5/9/90	5/9/90
Public comment period ends	6/9/90	6/9/90	6/9/90
* County Board consideration of adoption of Plan	6/25/90	6/20/90	6/18/90
Plan submitted to IEPA for review and comment	6/26/90	6/26/90	6/26/90
** IEPA review period ends	9/26/90	9/26/90	9/26/90
Implementation of Plan must begin on this date	9/26/91	9/26/91	9/26/91
First update of Plan finished and submitted to IEPA	9/26/96	9/26/96	9/26/96

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* All three counties agreed to adopt a uniform resolution

** Assuming there are no additional comments by the IEPA

7-a-4

BE IT FURTHER RESOLVED by the County Board of the County of St. Clair, Illinois, that the Environmental Committee is directed to take the necessary actions to accomplish the above schedule and meet all procedural requirments of Illinois Revised Statutes, Chapter 85, Section 5951.

APPROVED AND ADOPTED at a regular meeting of the County Board of St. Clair County, State of Illinois, this 25th day of June, 1990.

Chairman of the Board

ATTEST:

Clerk of the Board

REVIEWED BY:

State's Attorney

Director of Administration

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I. INTRODUCTION

A. BACKGROUND INFORMATION

Two major events indicated that the problem of solid waste management was rapidly becoming a crisis demanding action within Southwestern Illinois. First, efforts in 1985 to locate a new landfill in St. Clair County resulted in negative public response and highlighted the difficulty of providing environmental safeguards for landfills which adequately address public concern. Secondly, regional solid waste problems began spilling over into Southwestern Illinois with a large proportion of Missouri waste increasingly being transported to Illinois landfills.

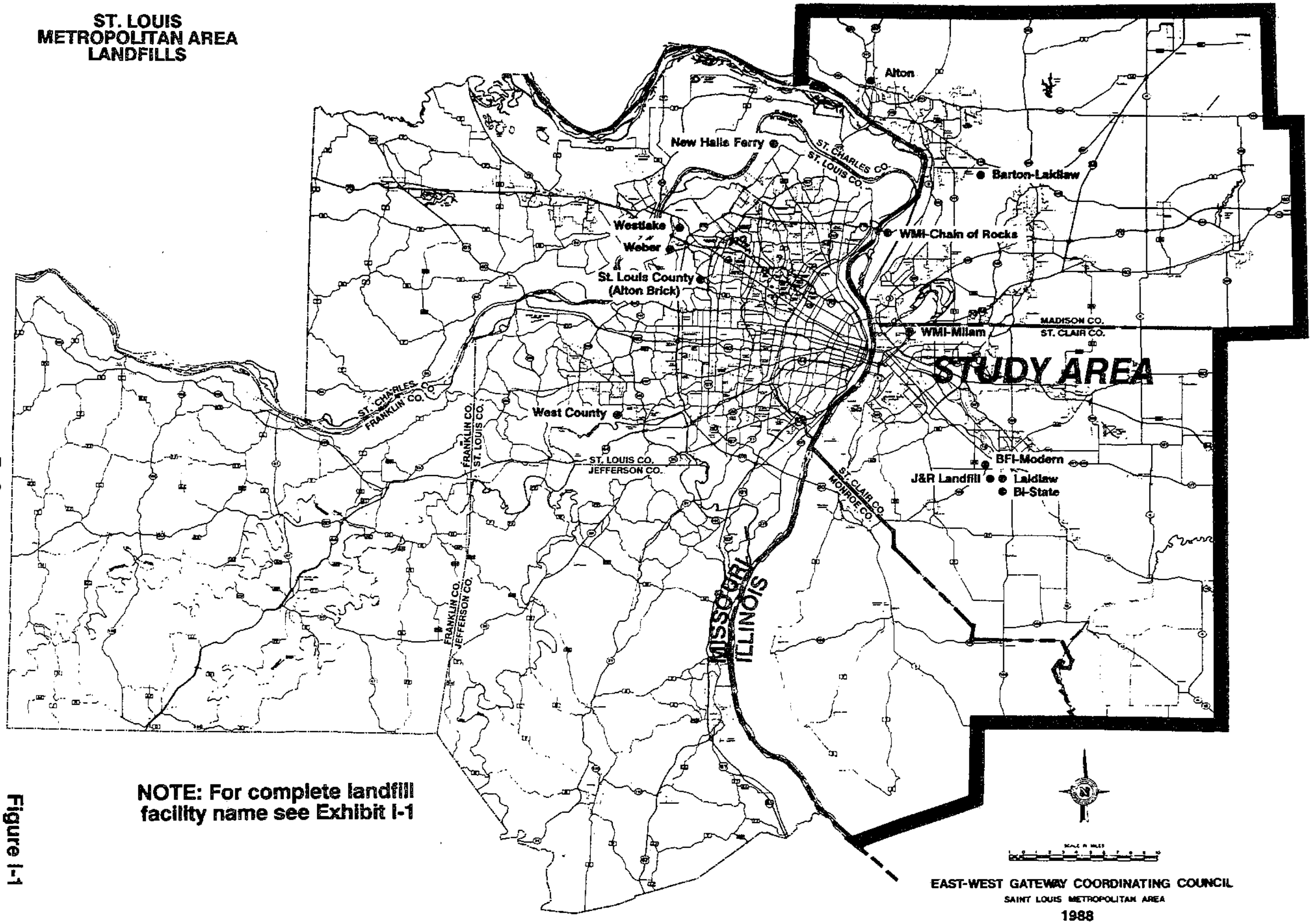
Within the St. Louis metropolitan area, there are thirteen major landfills(Figure I-1). Eight of the thirteen landfills are located within the study area in Madison, St. Clair and Monroe Counties in Illinois(Figure I-2). These eight Southwestern Illinois landfills charge waste haulers significantly lower tipping fees than their Missouri counterparts (ranged between 30 to 50 percent lower, as of December 1988). The result has been that the bulk of the St. Louis metropolitan solid waste flows to the larger Illinois landfills diminishing their capacity to handle Illinois waste.

In order to avert a major solid waste crisis, St. Clair, Madison and Monroe Counties decided in 1987 to combine efforts to develop a comprehensive, long range solid waste management program for the area. This intergovernmental cooperation resulted in the initiation of this study effort to plan for the future of solid waste management in Southwestern Illinois.

The study included two major phases: Phase I, an examination of the current solid waste management system and an assessment of solid waste disposal needs, and Phase II, the development of a solid waste management plan for the future. Phase I activities have resulted in the compilation of a comprehensive data base for Phase II planning activities. The Assessment of Solid Waste Disposal Needs, St. Clair, Madison and Monroe Counties, Illinois (Phase I Needs Study) includes information on solid waste characteristics and generation rates; existing sanitary landfills; collection systems; recycling programs; and land use, demographic and environmental data. Solid waste pathways and the existing solid waste management system are also documented. An examination of markets for recycled materials and energy was conducted. The findings of this survey effort are presented in the Market Analysis for Tri-County Solid Waste Study (Market Study) report.

This Final Preferred Waste Management System Plan represents the second step in the preparation of a solid waste managment plan for the three counties in Southwestern Illinois. The Phase II efforts have been based upon work completed in the Phase I Needs Study and the Market Study. This study has focused on solid waste management planning and alternative system

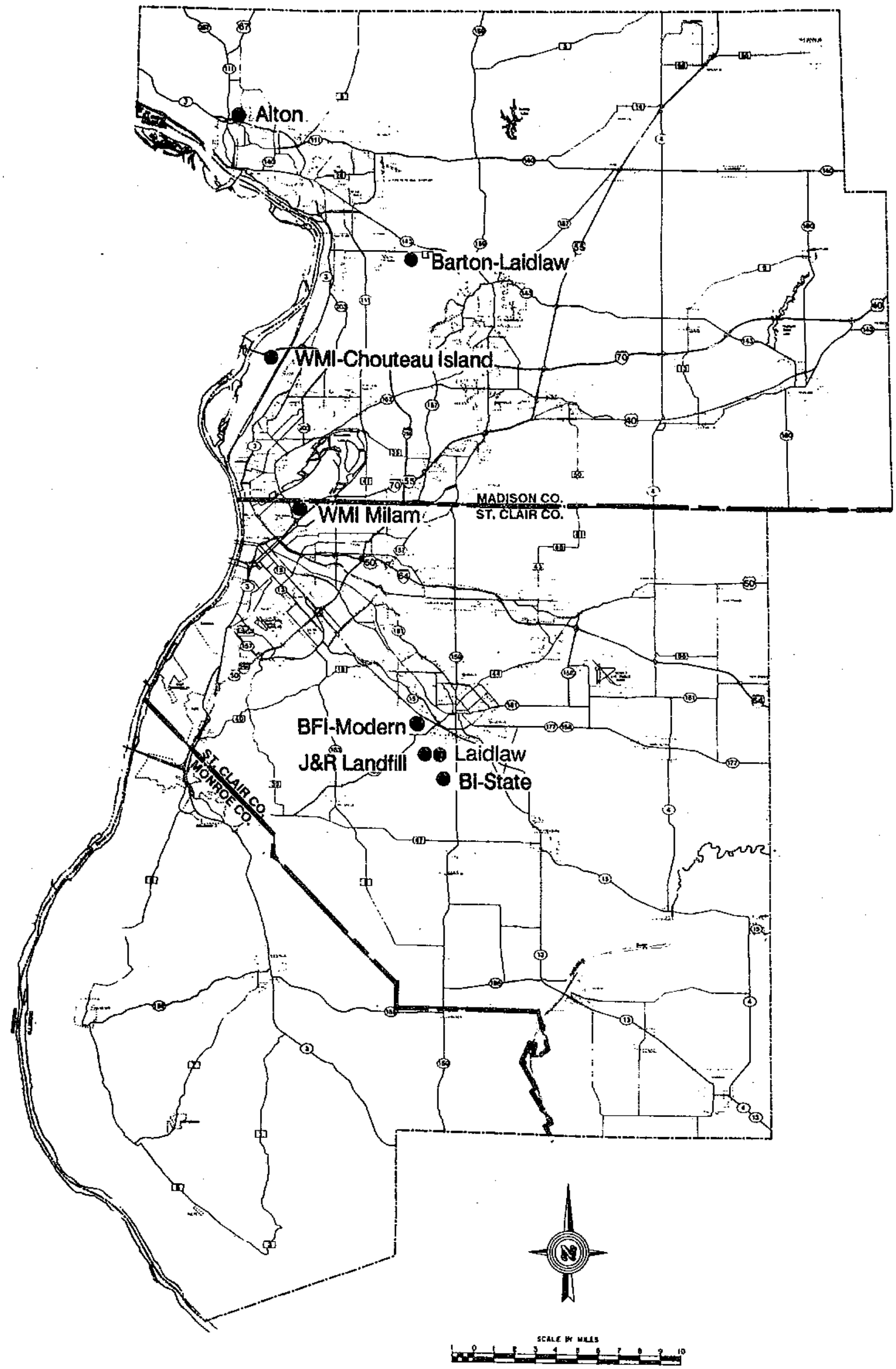
ST. LOUIS METROPOLITAN AREA LANDFILLS



NOTE: For complete landfill facility name see Exhibit I-1

Figure I-1

SOUTHWESTERN ILLINOIS LANDFILLS



EAST-WEST GATEWAY COORDINATING COUNCIL
1988

Figure I-2

analysis. The types and hierarchy of solid waste management alternatives to be examined in this phase were set forth in the Illinois Solid Waste Management Act (1986) and the Solid Waste Planning and Recycling Act, 1988 (P.A. 85-1198). The Illinois Solid Waste Management Act identified five categories of waste management alternatives which were to be a part of any solid waste management plan. The alternatives, listed in descending order of preference, include: volume reduction at the source; recycling and reuse; incineration with energy recovery; incineration with volume reduction; and landfilling.

The Solid Waste Planning and Recycling Act, signed into law on September 2, 1988, requires that counties of 100,000 population or more to develop and submit to the Illinois Environmental Protection Agency (IEPA) by March 1, 1991, an officially adopted plan to manage municipal solid waste generated within the county's boundaries for the next 20 years. The plan is a description of proposed facilities and programs, including a recycling program, that will be used to manage municipal solid waste and is to conform to the hierarchy set forth in the Illinois Solid Waste Management Act. The recycling program, which includes separate leaf collection and composting, is to be designed so that 15 percent of the municipal waste is recycled by the end of the third year of the program and 25 percent at the end of the fifth year. On August 15, 1989, the Solid Waste Planning and Recycling Act was amended by HB 1175. Counties with less than 100,000 population are required to prepare and submit to IEPA a solid waste management plan by March 1, 1995.

B. WASTE MANAGEMENT SYSTEM CONSIDERATIONS

The items discussed in this Section and in the rest of Chapter I are the basis for the analysis and review of waste manangement techniques presented in the remainder of the Final Plan. An analysis of the Phase I Needs Study and the Market Study leads to the conclusion that certain characteristics of the solid waste management plan will not be optional for decision makers and will be constrained by the existing solid waste management system and by Illinois law. Two primary characteristics seem to be in this class: (1) the need for a landfill or landfills and a recycling program which includes composting (the need for landfills is predicated on the rapid depletion of existing landfill capacity in Southwestern Illinois, which dictates that the three Counties must gain control of solid waste management in their jurisdictions); and (2) the second characteristic, the Counties' need for a recycling program, is mandated by the first characteristic and Illinois law.

A landfill must be sited in the Southwestern Illinois study area within the next five to seven years since, at the present fill rates and remaining capacity, only eight years remain from October 1988 (see Exhibit I-1 for capacity and intake data for Madison County and St. Clair County landfills) before all eight Madison and St. Clair County landfills are full. This new landfill capacity must be sufficient to provide for disposal of residue or ash from a possible waste-to-energy program, bypass

EXHIBIT I-1

MADISON COUNTY LANDFILL CHARACTERISTICS

PART I

Landfill	Owner/ Operator	Total Acreage	Annual Intake (cu. yds.)	Weekly Intake (cu. yds.)	Remaining Years	Remaining Capacity (cu. yds.)
Alton Municipal	City of Alton 4550 Alby St. Rd. Alton, IL 62002 (618) 466-0102	69	136,000	2,615.3	6* 7** 10***	788,000
Barton-Laidlaw	GSX Old Edwardsville Rd. Edwardsville, IL 62025 GSX Corporation 1838 N. Broadway St. Louis, MO 63102 (314) 241-3721	90	912,000	17,538.4	3* 2** 5***	2,300,000
WMI-Chain of Rocks	Waste Management Inc. Chain of Rocks Road Granite City, IL	279	538,000	10,346.1	44* 25** 15***	23,493,000

Sources: Available Disposal Capacity for Solid Waste in Illinois, IEPA (1988)
St. Charles County Solid Waste Management Plan (1987)

*IEPA Calculated
**Reported to IEPA by Landfill Operator
***St. Charles Report

EXHIBIT I-1
(CONTINUED)

ST. CLAIR COUNTY LANDFILL CHARACTERISTICS

PART I

Landfill	Owner/ Operator	Total Acreage	Annual Intake (cu. yds.)	Weekly Intake (cu. yds.)	Remaining Years	Remaining Capacity (cu. yds.)
Bi-State	Bi-State Disposal, Inc. P.O. Box 566 Chesterfield, MO 63107	40	469,000	9,019.2	1* 3** 5*** 6****	545,000
J & R	J & R Landfill P.O. Box 1191 Belleville, IL 62223	70	610,000	11,730.7	2°	1,800,000
law	Laidlaw Waste Systems 1838 N. Broadway St. Louis, MO 63102	107	1,351,000	25,980.7	4* 4** 8-10*** 8-9****	4,800,000
WMI-Milam	Waste Management Inc. P.O. Box 637 East St. Louis, IL 62202	205 250	323,000	6,211.5	5	1,652,000
BFI-Modern	Browning-Ferris Inc. of St. Louis 3521 Centreville Avenue Belleville, IL 62223	126	639,000	12,288.4	7* 6** 5-10*** 5-6****	4,257,000

Sources: Available Disposal Capacity for Solid Waste in Illinois, IEPA (1988)
St. Charles County Solid Waste Management Plan (1987)
St. Clair County Solid Wast Task Force Report (1986)

*IEPA Calculated
**Reported to IEPA by Landfill Operator
***St. Charles Report
****St. Clair County Solid Waste Task Force Report (1986)

°Consent Decree to Close in 2 years

waste, and nonprocessible waste including construction debris and nonrecyclable white goods. The landfill arrangement can be made up of individual landfills for each type of waste (i.e., one for residue or ash, one for bypass and nonprocessible waste, and one for construction debris and nonrecyclable white goods), or possible combinations of these.

The useful life of the system of eight landfills in the three county area has increased by about 16 months over the course of the study. During the completion of the Phase I Needs Study, the City of St. Louis has arranged for alternative disposal for 600 tons per day (TPD) of its municipal solid waste (MSW). In addition, Waste Management's Milam landfill has been granted a permit, which is reflected in Exhibit I-1, to expand. The combination of the decreased fill rate due to the diversion of MSW from the City of St. Louis and the new permit for the Milam landfill account for the extra capacity. Although this benefits the planning process because the Counties need not react to an impending crisis, it also demonstrates that the fate of the Counties' ability to plan for solid waste management is presently outside their direct control. The planning effort now underway, of which this report is a part, is a step to gain control over that fate.

The need for a reycling program is driven by Illinois State legislation which requires a solid waste management plan to have a recycling goal of at least 25 percent of the residential solid waste stream generated within the study area. The following percentages were determined to be attainable to meet the 25 percent goal:

Recyclable Material	% Material in Waste Stream[1]	% Marketable to be Recycled[2]	Portion of Goal Met
Paper	24.9%	60.0%	15.0%
HDPE and PET	0.8%	40.0%	0.3%
Aluminum	1.1%	19.0%	0.2%
Ferrous	5.3%	50.0%	2.7%
Glass	3.4%	50.0%	1.7%
Yard Waste	9.1%	56.0%	5.1%
Total Percentage of Waste Stream to be Recycled			**25.0%**

1 - Based on studies and methodologies developed for this study.
2 - Based on national studies conducted by Gershman, Brickner & Bratton, Inc.

Because these recycling goals will translate into recyclables requiring pickup from the point of recovery and transport to the market, the Counties will need to address the methods by which these recyclables will be separated from the waste stream, how they will be collected, how they will be processed (if at all) and how they will be delivered to the market. Section III of this report provides guidance to implement such a program.

Options for separation include:

--Separation into the respective components by residents and commercial establishments with:
  Delivery to drop-off centers
  Curbside pickup by compartmented hauler vehicles

--Nonsegregated (mixed) recyclables with:
  Delivery to drop-off centers
  Picked up by non-compartmented hauler vehicles

By reaching the recycling goal, a materials recovery facility (MRF) will be required to handle approximately 345 TPD by 1992. Such a facility, when operating eight hours per day, 251 days per year, will require 63 tons per hour (TPH) of nominal capacity. Of this total, 42 TPH of capacity could be located in Madison County and 21 TPH of capacity could be located in St. Clair County to reduce transportation costs. Yard waste could be handled in a single 12 TPH yard waste composting facility.

The remaining waste of 456,650 TPY, or 1,250 TPD (Phase I Assesment of Solid Waste Disposal Needs, p.117), will either go to a landfill or to a waste-to-energy facility. One option for this facility is a refuse-derived fuel (RDF) producing facility either with or without a co-located dedicated boiler. With a co-located dedicated boiler, steam and/or electricity could be sold. Two steam markets have a very good fit for the amount of steam anticipated to be generated (Jefferson Smurfit in Madison County or Monsanto MCI in St. Clair County). Electricity could be sold to these facilities or to the local utility in accordance with the Public Utility Regulatory and Policies Act of 1978 (PURPA). Alternatively, RDF could be transported to a more fragmented market with incentives in pricing to induce the markets to make their own retrofits of existing boilers or installations of new boilers designed to burn RDF, or payments from the prospective project to pay for these improvements could be made. Another option for this waste-to-energy facility is a mass burn plant producing steam and/or electricity. If a primary product is steam, one of the two large steam customers would need to be within a mile of the site selected to make it feasible to have a steam line connecting the plant and the market. Other possibilities exist if it is deemed prudent to have smaller facilities rather than one large facility.

C. WASTE-TO-ENERGY ALTERNATIVES CONSIDERED BY MADISON, MONROE AND ST. CLAIR COUNTIES

In this study effort, the different types of waste management alternatives were evaluated not as independent actions, but as potential components in a solid waste management system. Using an 85 percent availability factor for boiler equipment and 12-hour-per-day, 6-day-per-week operation for processing equipment, the alternatives considered by the Counties were:

- 130 TPH RDF processing plant only (i.e., without a dedicated boiler), selling RDF to markets with their own boiler retrofits

- one 90 TPH and one 40 TPH RDF plant only (i.e., without a dedicated boiler), selling RDF to markets with their own boiler retrofits

- 130 TPH RDF plant without a dedicated boiler, selling RDF to markets with dedicated boilers

- one 90 TPH and one 40 TPH RDF plant without a dedicated boiler, selling RDF to markets with dedicated boilers

- 1,500 TPD RDF plant with a new dedicated boiler facility, selling steam to a single large market and electricity to a local utility(ies)

- one 1,000 TPD and one 500 TPD RDF processing plant with a new dedicated boiler, selling steam to a single large market and electricity to a local utility(ies)

- 1,500 TPD plant with a new dedicated boiler, selling electricity only to a local utility(ies)

- one 1,000 TPD and one 500 TPD RDF plant with a new dedicated boiler, selling electricity only to a local utility(ies)

- 1,500 TPD mass burn plant, selling steam to a single large market and electricity to a local utility(ies)

- one 1,000 TPD and one 500 TPD mass burn plant, selling steam to a single large market and electricity to a local utility(ies)

- 1,500 TPD mass burn plant, selling electricity only to a local utility(ies)

- one 1,000 TPD and one 500 TPD mass burn plant, selling electricity only to a local utility(ies)

Other sizes could have been considered, but a logical number did not appear obvious in the context of this planning effort. Where two facilities were indicated, they were deployed such that one was in each of the two more populous Counties (Madison and St. Clair). For example, the 130 TPH RDF plant was split into a 90 TPH facility and a 40 TPH facility as shown above to reduce transportation costs.

An additional 3,000 TPD of capacity would be required to provide for the disposal of Missouri waste presently being imported into the three Counties. However, if the facilities above were owned by the three Counties, it would probably be possible to control the level of Missouri waste considered for disposal in Southwestern Illinois. In that event, it would not appear necessary to provide disposal capacity for that waste. This would also probably not be prudent unless binding commitments could be obtained for long-term (20 years) put-or-pay contracts with the City of St. Louis and St. Louis County thus affording major project financing commitments.

D. PREFERRED ALTERNATIVES SELECTED BY MADISON, MONROE AND ST. CLAIR COUNTIES FOR FEASIBILITY STUDY

During the period from November 1988 to March 1989, the East-West Gateway Coordinating Council with its consultant team met with elected officials of the three Counties and a consensus was developed on the elements of a preferred waste management system. It was determined that three scenarios were appropriate for the feasibility study presented in Section V. All of the scenarios were to be sited in a centrally located waste management park and to consist of the required facilities (the landfill, MRF, and yard waste composting facility) in order to minimize site development costs. The first of these two scenarios would not have a waste-to-energy component and would consist of the required facilities only. The second scenario would add a single 1,500 TPD waste-to-energy facility to the required facilities. The third scenario would place all the required facilities at the centrally located waste management park and two waste-to-energy facilities would be sited; one in the Alton area with a capacity of 500 TPD; and one in the Granite City area with a capacity of 1,000 TPD. These three scenarios are the subject of the feasibility study of Section V.

E. FINAL PLAN REPORT ORGANIZATION

The Final Plan Report is organized by the major components (based on the State's alternative hierarchy) of the preferred waste management system. An important element within this integrated waste management system will be volume reduction at the source methods. Section II presents information about volume reduction at the source, an important waste management strategy. A review of recycling and reuse systems and approaches, including a discussion of a municipal solid waste composting system, is contained in Section III. Waste-to-energy technology for volume reduction and energy production is described in Section IV. Section V is a feasibility study of the three preferred waste management system scenarios developed during this study. The last section of this report, Section VI, presents recommendations for the adoption and implementation of a preferred waste management system plan.

II. VOLUME REDUCTION AT THE SOURCE

A. INTRODUCTION

Volume reduction at the source is listed at the top of Illinois' hierarchy of preferred waste management strategies. Volume reduction is defined in the application as "methods to reduce generator solid waste volumes from industrial production process or consumer consumption process including private sector changes in manufacturing and packaging processes; economic incentives for volume reduction; changes in public sector purchasing and consumption patterns; and consumer education with emphasis on recycling and reuse". Many volume reduction initiatives have a corollary goal of increasing the recyclability of waste items, particularly packaging.

It should be noted that definitions of source reduction or waste minimization vary. The U.S. Environmental Protection Agency (U.S. EPA) defines source reduction as minimizing toxic substances in products, reducing the volume of material that must be discarded and manufacturing products with longer and more useful lives. Many states have adopted slightly different definitions. The Minnesota Pollution Control Agency fact sheet on waste reduction, for example, uses the definition "any activity that prevents waste". This includes reusing products in their original form, increasing product life, reducing material use in manufacturing and packaging, and changing buying and consumption habits to reduce waste. Iowa's HF 753 establishes a definition for waste reduction as follows: "practices which reduce, avoid, or eliminate both the generation of solid waste and the use of toxic materials so as to reduce risks to health and the environment and to avoid, reduce, or eliminate the generation of wastes or environmental pollution at the source."

The variety of waste reduction definitions, and the differing -- sometimes conflicting -- goals of those definitions reflect the complexity of the issue of volume reduction at the source. The following sections of this Chapter will provide a springboard for considering the issue and developing goals and strategies consistent with an understanding of the issue.

B. PACKAGING IN THE WASTE STREAM

A report prepared for the U.S. EPA Office of Solid Waste and Emergency Response in March 1988 provided an analysis of containers and packaging products in the waste stream. Increasing from approximately 24 million tons in 1960 to 42.7 million tons in 1986, packaging and containers made up approximately 30.3 percent of the total waste stream in 1986. Projections for the year 2000 suggest that this percentage will decrease by less than half of one percent.[1] Further, according to the U.S. EPA, in 1971 packaging consumed 75 percent of all glass used in the United States, along with 50 percent of all paper, 30 percent of all plastic, 14 percent of all aluminum and 8 percent of all steel.[2] These numbers, which could be expected to have increased and shifted somewhat in the ensuing 18 years, indicate the prevalence of packaging in the waste stream and the drain that such materials place on U.S. resources. The total U.S. plastics market, for example, consumes 25 million tons of plastics per year. And, according to recent figures, 40 percent of all these plastics are manufactured into disposable one-time use items that find their way into the waste stream rapidly.[3]

Because packaging materials account for nearly one-third of the municipal solid waste stream, issues such as the perceived "excessiveness" of packaging and the reusability/recyclability of packaging are gaining increasing attention. Plastics, which are often thought of as un-recyclable, and foam containers expanded with chlorofluorocarbons, which are often blamed for a deterioration of the earth's atmosphere, are becoming more frequent targets for product packaging bans. These reactions need to be carefully examined in terms of their effectiveness in achieving stated goals and their full impact. Packaging has both form and function; therefore, the role of packaging in waste generation should be examined in light of the legitimate function that it serves.

Packaging generally falls into two categories: distribution packaging and consumer packaging. Distribution packaging has as its primary goal efficient transportation of goods from point of manufacture to market and protection of those goods during transportation. Examples of distribution packaging include shipping containers and pelletizing materials. Generators of distribution packaging waste are typically manufacturers/wholesalers, and retailers and the composition of

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[1]"Characterization of Municipal Solid Waste in the United States, 1960 to 2000 (Update 1988), Final Report," prepared for U.S. Environmental Protection Agency Office of Solid Waste and Emergency Response, Franklin Associates, Ltd., March 30, 1988, p. 15.

[2]"Waste Reduction and Reuse of Municipal Waste," Wisconsin Waste Reduction and Recovery Plan, prepared by Bureau of Solid Waste Management, Wisconsin Department of Natural Resources, February 1986, p. C-1.

[3]"Plastic Packaging -- Addressing Functional Needs, Waste Reduction, and Disposal Requirements," Karl W. Kamena, presented at ASTSWMO National Solid Waste Forum on Integrated Municipal Solid Waste Management, July 17-20, 1988, Lake Buena Vista, Florida, p. 2.

distribution packaging is generally a concentrated and homogeneous mixture of corrugated cardboard, wood, low-density polyethylene, steel, and thermoformed plastic.[4]

Consumer packaging, which includes bottles, cans, pouches, and boxes, comprises product packages that consumers take home. Traditionally, these packages perform the functions of protection, communication, and convenience. The design of this type of packaging generally requires consideration of the characteristics of the product being contained, the environment to which the product will be exposed, and the preferences of the target markets. Increasingly, the post-use life of the packaging is becoming a part of packaging design.[5]

Changes in distribution packaging composition and quality have been motivated in the past primarily by economics. The more a shipment container weighed, the more it cost to transport. The less reusable a distribution packaging material was, the more money was spent on replacement. The more packaging was discarded, the more money was spent on waste removal and disposal. These "facts of life" for businesses have motivated changes in distribution packaging such as high-density polyethylene injection molded collapsible boxes to which General Motors has required a large segment of its parts suppliers to convert.

In the United States, the purchase cost of corrugated shipping containers alone amounted to almost $14 billion in 1985. While these types of escalating costs drive efforts at packaging and waste reduction in businesses and industry, most consumers appear to be willing to pay for the convenience that is often associated with excessively packaged products.

PACKAGING MAGAZINE's fourth annual consumer survey revealed that American consumers surveyed ranked microwaveability, tamper evidence, convenience, and recyclability as the four most important functions of consumer packaging. The survey also noted that the percentage of consumers who often considered the recyclability of

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[4]"Factors Influencing the Reduction of Distribution Packaging Waste," Diana Tweed, Proceedings of the 1988 Conference on Solid Waste Management and Materials Policy, January 27-30, 1988, New York, New York, pages D-11-33.

[5]"Considerations in Packaging Design -- Recyclability Aspects," Susan E. Selke and Christopher C. Lai, Proceedings of the 1988 Conference on Solid Waste Management and Materials Policy, January 27-30, 1988, New York, New York, page D-2.

packaging materials when making a product purchase decision rose from 8.7 percent in 1986 to 15.2 percent in 1988.[6]

Waste reduction studies from both Michigan and Minnesota indicated that reducing the use of packaging could produce an estimated reduction of the waste stream of approximately 10 percent. The Solid Waste Management Development Guide/Policy Plan for the Metropolitan Council of St. Paul, Minnesota estimated that a more conservative 2 percent of waste could be handled through waste reduction. However, none of the above mentioned studies provided a detailed implementation plan for how to achieve the waste reduction goals. The following section provides a discussion of some specific waste reduction strategies and target audiences.

C. STRATEGIES FOR PROMOTING VOLUME REDUCTION AT THE SOURCE

Source reduction, or waste minimization, is considered to be a proactive rather than a reactive waste management strategy. As such, it is generally promoted through three types of mechanisms:

- Education and promotion;
- Creation of special price structures and/or financial incentives; and
- Governmental regulation/prohibition.

Waste reduction activities typically have three thrusts: those aimed at consumers; those directed at government, commercial and institutional establishments; and those practices geared toward industry. The techniques of waste reduction range from educating citizens about considering environmentally sound packaging when making purchase choices to governmental procurement program changes and changes in manufacturing processes to minimize waste and increase recyclability of products.

1. Education and Promotion

Education and promotion strategies are geared toward motivating changes in the volume of waste disposed through increasing citizen awareness of the need for and opportunities to minimize waste generation. Typically, education is directed toward reducing the reliance of both residential and commercial/ institutional consumers on disposable products, raising public awareness of excessive packaging and packaging recyclability/ reusability issues, and promoting general waste consciousness.

Most people agree that public education is critical to successful recycling programs. Similarly, public education is

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[6] "Plastic Packaging -- Addressing Functional Needs, Waste Reduction, and Disposal Requirements," p.2.

deemed to be one of the most effective mechanisms for bringing about waste reduction.

An effective educational program for St. Clair, Madison, and Monroe Counties to consider to encourage waste reduction would have the following basic goals:

- To alter consumer buying habits and reduce excessive packaging purchases;
- To encourage product reuse and the purchase of reusable and more durable goods;
- To promote recyclability as a purchase consideration;
- To encourage improved consumer maintenance of goods;
- To promote the resale of used and/or refurbished items;
- To encourage reduction in paper use; and
- To promote yard waste composting and/or mulching.

Educational efforts for waste reduction programs should be carefully planned and integrated with public information activities designed for recycling and other solid waste management projects. The groundwork for waste reduction initiatives needs to be laid whenever solid waste issues are discussed. It is important for local government officials and political leaders to be informed about waste reduction as a viable waste management strategy in general and about the specifics of the region's waste reduction programs in particular.

One major thrust of promotional efforts that has been proven to be effective with recycling education is emphasizing that the behavior of the individual consumer and waste generator does make a difference. Many grassroots organizations across the country have stressed the effect that consumer acceptance and preference will have in creating a market for recyclable goods. For example, Coca Cola recently delayed release of the plastic can (part aluminum and part high-density polyethylene), and Burger King switched from foam plastic food containers to biodegradable paper containers. Largely in response to public pressure, these successes, therefore, could be highlighted in promotional literature as an example of consumer preference affecting the policy of "business and industry."

Some behavioral psychological research suggests that promoting sustained changes in behavior with regard to waste reduction, recycling, and energy conservation may be more readily accomplished through developing intrinsic versus extrinsic motivation for the desired behaviors. It is theorized that extrinsic motivation, such as "rewards" or "punishments" (direct financial incentives, such as buyback programs for recyclables, or financial disincentives, such as noncompliance fines), may be effective only as long as the reward/punishment mechanisms are in place. Intrinsic motivation, however, which depends on developing an internalized desire to carry out the prescribed behavior, has been correlated in some studies with more long lasting behavior changes. Several studies of human motivation conducted from 1975 to 1985 indicate that feeling that one's actions will have a significant impact is a key intrinsic motivator.[7]

Educational programs, therefore, that aim at making the individual consumer feel responsible for, and in control of, their purchase choices should prove to be most successful. In order to accomplish this aim, individuals need to be informed of the need to reduce waste and need to be presented with baseline data about historical waste generation, current regional waste generation quantities, and projected future generation rates. Graphic representations of waste quantities tend to be extremely impressive. Recently, Hennepin County and the City of Minneapolis, Minnesota began a $250,000 advertising campaign that includes such images as a photo showing how the County's garbage could fill the Metrodome each year and an ad depicting a family of four standing in front of a pile containing the amount of garbage that they probably generate in one year. Similar approaches -- which bring home the larger picture of waste disposal and relate the activities of the home to the larger picture -- could be employed effectively in St. Clair, Madison, and Monroe Counties.

Other promotional and educational activities that could be pursued to promote waste reduction are briefly described below. These activities are suggestions to guide the counties and are not meant to be considered prescriptive or exhaustive.

CONSUMER-ORIENTED EDUCATIONAL/PROMOTIONAL ACTIVITIES

- Promote bulk purchases in customers' reusable containers through poster and display ads in area grocery stores that have bulk foods sections. Also, promote bulk vegetable purchases.

- Promote improved maintenance of products through print and radio public service announcements (PSAs). These PSAs could be timed to coincide with seasonal changes (spring cleaning and winterizing, for example). One avenue of such promotion would be to solicit the involvement of local service stations and car dealerships in a fitness campaign for vehicles. Encouraging small appliance and tire maintenance are other ways to promote improved product

[7]Promoting Waste Recycling: An Expanded Model of Human Motivation," Raymond DeYoung, Association for Conservation Information Winter Workshop, Washington, D.C., February 14, 1989.

life, and therefore, reduce waste. Consumer publications and fact sheets (such as magazines that rank products for quality and price) are tools that consumers can consult when choosing products to get answers about which products are likely to last the longest, which should require the least maintenance, and what the costs of both purchase and maintenance are likely to be. Local consumer protection and advocacy groups also could be contacted and encouraged to support the Counties' reduction promotions.

- <u>Develop promotional campaigns</u> to encourage consumers to reuse materials and purchase products that are reusable and/or more durable. In Germany, brightly colored waste reduction posters are commonly displayed in stores, on community bulletin boards, and on bus billboards. The messages range from "Don't throw away our resources" to "Buy quality -- purchase durable goods." Similar methods could be employed by Counties. If the Counties determine that disposable products -- such as disposable cameras, lighters, pens, and razors -- are among those items that should be discouraged because of the burden placed on the solid waste disposal system, then an advertising campaign could be devised that promotes quality versus quantity. Cloth napkins versus paper, reusable dish towels and rags versus paper toweling, reusable tableware versus paper plates and plastic utensils -- these comparisons can be made in advertising that focuses on a return to reusables. This type of promotion could be supported by cooperating merchants who would prominently display such things as picnic hampers stocked with glasses, dinnerware and linens instead of paper cups, plates and napkins.

  In addition, the impact of disposable diapers on the waste stream can be highlighted. Recent data reveals that diapers may account for nearly two percent of the waste delivered to landfills. Such data could be used to emphasize the effect of single use diapers on the composition and quantity of waste being disposed. There are national associations representing diaper services and cloth diaper manufacturers. These organizations could be approached to provide funding and/or materials for a campaign promoting a return to reusable cloth diapers.

  Further, other reuse strategies could be publicized through posters displayed at libraries, public buildings, and elsewhere as deemed appropriate. These posters could emphasize such practices as writing on both sides of a sheet of paper and considering alternative uses for potential waste items. Local papers could be encouraged to run a "waste exchange" column where people could advertise needs that might be fillable through other people's throwaways -- examples include such things as seniors' centers that collect clean used pantyhose to use as stuffing for toys and other craft projects.

- Promote the resale of used and/or refurbished items through dedication of print and broadcast advertising space to promote flea markets, garage sales, and other related activities. Grassroots organizations such as the Lion's Club could be solicited to sponsor flea market days one weekend per month in which residents could purchase table space for a nominal fee that would go toward advertising costs. A list of area thrift stores and consignment shops, in addition to Goodwill Industry locations, could also be published to promote reuse opportunities.

  In Wellesley, Massachusetts, a special corner of the Recycling and Disposal Facility -- a recycling drop-off center and transfer station -- is dedicated to used books. Residents bring their unwanted paperbacks and hardback books, and a volunteer librarian organizes the receipts in various categories. Other residents are welcome to take as many books as they choose. The volunteer librarian sometimes even conducts searches to help "patrons" locate special or out-of-print materials. The Wellesley facility also has a space for used furniture, small appliances, toys and what-not. Here residents deposit unwanted belongings that still have a usable life and other Town members are free to browse and take away whatever they need from the discards. Whatever does not find a new home is disposed of by facility workers after a prescribed time period.

  Similarly, Urban Ore, a reuse center in Berkeley, California, is successfully collecting up to 100 tons per month from the Solid Waste Management Center tipping floor. The extracted materials are cleaned, repaired and sold at second-hand centers. Urban Ore, which operates as a for-profit company, pays the City of Berkeley 10 percent of its documented profit. Many of the materials recovered, including tires, appliances, and building materials, are considered nuisance materials at the landfill.

  Other opportunities for reuse could be researched on a locally specific level. Do area Scout troops collect paperback books? Do local hospitals accept book and magazine donations? Do area schools accept old clothes and formal wear, etc., for use as costumes? The answers to these types of questions could be featured in the previously described "waste exchange" column.

- Promote reductions in paper use by publicizing ways to help consumers remove their names from junk mailing lists. These methods include writing to the direct mail marketing association and indicating that you do not want your name and address sold or transferred to other mailing lists when requesting information or products through the mail. Some mail order forms have a box for checking if you do not want your name disseminated to other organizations. Being aware that mailing list selling and swapping is common practice may help consumers to selectively request catalogues and information and look for opportunities to discourage "mailing list spread" whenever possible.

- Promoting the recyclability/environmental soundness of materials and packaging can be accomplished in a number of ways. On a broad level, the Counties could encourage industry-wide initiatives toward uniform product labelling that would identify the recyclability and environmental integrity of both products and packaging.

  On a grass roots level, activities such as production of the "Environmental Shopping List" by the Pennsylvania Resources Council (PRC) could be modelled. The shopping list is distributed by PRC to identify what they consider to be "excessive" packaging and "environmentally threatening" disposable products. The Council has adopted a local approach to waste reduction, sponsoring a competition among garden and women's clubs in which PRC will award $100 to the club that is most active in changing the shopping habits of its members and the habits of the surrounding community.

  Other examples of local-level activities include the West Michigan Environmental Action Council Education Foundation's Citizen Waste Reduction Handbook, published in 1986. The book guides consumers to four basic waste minimization activities:

  -- purchase products with reduced resource use

  -- purchase products with increased product lifespans

  -- purchase reusable goods

  -- decrease overall product consumption

- Encourage consumers to request appropriate packaging. As stated earlier, the opinions of consumers count. Local organizations and civic and community groups could be encouraged to develop letter writing campaigns to manufacturers perceived to have particularly wasteful packaging methods.

- Focus on promoting the inclusion of waste reduction chapters in local educational curricula. The State of Rhode Island and many others have developed extensive curricula packages that focus on solid waste, recycling, and resource conservation. These examples can provide guidelines for effectively promoting waste reduction education in the schools. Waste reduction activities could be implemented in area schools to help students practice what is being taught.

- <u>Promoting yard waste composting and mulching</u> as an alternative to setting leaves, grass, prunings, and other yard waste out for garbage collection could be developed. A demonstration project could be developed of backyard composting activities. The results (reduced waste, usable end product, etc.) could be documented and publicized.

COMMERCIAL/INSTITUTIONAL-ORIENTED PROMOTIONAL AND EDUCATIONAL ACTIVITIES

- <u>Develop a Business Guide to Waste Reduction</u> that:

  -- promotes waste exchanges among local establishments (matching waste products of one organization with the resource needs of another)

  -- promotes the development of waste conscious procurement policies; for example, procurement policies that favor used and/or refurbished equipment, reusable products, items such as two-way envelopes, products made of recycled materials, and recyclable goods.

  -- promotes in-house reuse and recycling opportunities, such as printing and copying on both sides of paper, using scrap paper for memo pads, and reusing office file folders.

  -- encourages reduction in paper waste generation through form simplification and/or reduction, mailing list pruning, minimizing double-spacing in documents, and elimination of many interoffice memoranda by use of either electronic mail or centralized bulletin boards or message centers.

  -- encourages increases in the recyclability of the in-house waste stream through using uncoated (nonglossy) paper, switching to white ledger paper (which generally is considered more saleable as a secondary material than yellow or other colored paper), using water soluble adhesives on mailing labels (as opposed to other gum adhesives that create problems in the recycling of post-consumer paper products), and using open window envelopes (instead of plastic-lined window envelopes).

- <u>Develop procurement policies for local governments that reflect waste consciousness</u>.

  -- buying recycled materials

  -- purchasing light bulbs that do not contain heavy metal

  -- procuring long-lasting tires for the Counties' and their municipalities' vehicles

  -- purchasing products that use little packaging and establishing procurement preferences for companies that limit packaging and promote recycling.

- <u>Develop programs to provide awards and recognition</u> for businesses and organizations whose waste reduction practices are considered exemplary.

- <u>Provide waste stream evaluations</u> for businesses and institutional establishments. These waste stream audits would identify current waste generation rates (as a baseline) and identify waste reduction methods that could be employed within the basic operation of the firm or organization.

- <u>Encourage life-cycle cost strategies</u> when evaluating product purchases that take into account replacement costs and processing and disposal costs.

- <u>Develop a fact sheet</u> on waste reduction tips to be distributed to area bars and restaurants. Suggestions could focus on:

  -- <u>Reuse</u>: donate extra food to homeless and needy shelters; send grease, fat, oil, and bones to a renderer; use reusable napkins, dinnerware, and bottles

  -- <u>Recycling</u>: recycle cardboard, and glass and metal food and beverage containers; choose products in recycled or recyclable containers

  -- <u>Resource Conservation</u>: Switch from throwaways to reusables; serve beer and soft drinks on tap, thereby reducing the need for (and cost of) cans and bottles.

  Provide lists of local alternative suppliers, renderers, and recyclers.

There are some issues to consider when evaluating waste reduction strategies aimed at consumers and the commercial/institutional sector. For example, there is national trend toward smaller households. This trend affects many product purchase choices. Though buying larger containers of foods and beverages would be expected to reduce packaging waste, those bulk quantity purchases may lead to spoilage and wastage -- especially if households are increasingly smaller.

Other issues include the fact that, as yet, no quantifiable data exists about the economic impact of changing from disposable to reusable products. Some people have raised the question, for example, about the costs associated with sewage and waste water treatment from washing cloth diapers (plus electricity costs, water consumption, etc.) versus the disposal costs associated with single use diapers. The flip side of that discussion raises the question about which system -- the solid waste processing system or the sewage treatment system -- is the most appropriate system for handling the human waste contained in diapers. The diaper dilemma is just one example of how involved the disposable/reusable debate can be.

Some other points to consider include the fact that product price is often related to product quality. Promotional campaigns that attempt to steer consumer preferences toward more durable products may not be sensitive to the fact that available income levels vary. Not everyone who owns or operates a car can afford radial tires. Not everyone with a kitchen can afford the highest quality appliances. These examples illustrate that the Counties should be aware of the economic realities of its member communities when developing waste reduction goals and strategies.

2. Creation of Special Price Structures and Financial Incentives

Mechanisms for encouraging waste reduction behaviors include development of financial incentives and special price structures. Similar initiatives of this nature that have been proposed or employed in other regions are described below for consideration by the Counties in its waste reduction programming.

- Reuse Rebates: Some communities have promoted reuse of products or containers through direct financial incentives to the consumer. In addition to beverage container deposit initiatives, other strategies include selling reusable corrugated cardboard boxes at local grocery stores. These boxes are specially labelled by the distributing store. Each time a customer reuses the box rather than requesting bags from the store, they receive a rebate.

  A Minnesota grocery store, for example, charges 45 cents for a reusable box and gives 5-cent rebates when the boxes are reused. The store manager estimates that approximately 500 boxes are distributed per month; although reuse rates are considered fairly high, no cost savings calculations have been made. Bulk purchases sold in the customer's containers at a reduced rate is another possible reuse incentive.

As previously mentioned, financial incentives of this type seem to have several drawbacks:

-- The desired behavior change tends to be accomplished only while the incentive is in place, thereby creating no sustained "ethic" of waste reduction;

-- Consumers appear to be willing to pay for convenience and the cost savings associated with rebates, etc. may not be significant enough to motivate large portions of the population to carry out the waste reduction behaviors;

-- People tend to "normalize" rewards, which means that incentives have to become increasingly greater to produce continued results; and

-- Financial incentives, such as reuse rebates and buy-back schemes, have proven to be most effective among lower income populations; paradoxically, higher income groups may have more disposable income and therefore may produce more waste.

- Volume-Based User Fees: Industries and businesses commonly practice waste reduction activities because they are economically motivated to reduce costs of feedstocks and the volume-based costs of their waste disposal. Home generators, however, frequently pay one price (and that price is frequently low) for trash disposal regardless of the amount of waste they generate.

  In Wellesley, Massachusetts, participation in the Town's voluntary drop-off recycling program is extremely high. More than 90 percent of the residents who deliver their garbage to the Town's Recycling and Disposal Facility make use of the drop-off bins for glass, aluminum, tin, plastics, tires, motor oil, and fireplace ash. It is estimated that approximately 85 percent of the Town's population uses the facility for waste disposal. When asked about why recycling is so successful in the Town, Mr. Pat Berdan, Director of Public Works, cited appropriate education and a widespread environmental ethic in the community. Perhaps an equally pervasive motive for self-hauling to the facility can be found in the costs of private garbage collection. No municipal collection is offered, and residents can haul to the facility at no tipping charge. However, the 15 percent of the population that pays for private sector haulers to collect their garbage pays between $4 and $6 per bag per pickup. This price structure is believed to encourage waste reduction and recycling.

In Perry County, Pennsylvania, and elsewhere across the country, private haulers sell specially marked trash bags at their offices or at local retail outlets. Dynamite Disposal, for example, a Perry County hauler, sells two sizes of containers; 20-gallon bags at $1.35 each and 10-gallon bags at $1.00 each. When consumers purchase the bags at local retail distributors, the bags cost 10 cents more to cover the retailers' handling expenses. Since implementing the bag system, Dynamite Disposal noted several benefits:

-- Residents with smaller generation rates, such as senior citizens and active recyclers, were very happy with the new fee structure. Many such County residents realized cost savings based on their waste consciousness.

-- Families that previously grouped their trash together to avoid paying multiple collection service fees were forced to pay for actual volumes generated.

-- The average number of bags set out per household per week has decreased from an estimated 2″ to 3 bags before the new price structure to 1″ bags per week per household. Some of the volume reduction can be associated with increased recycling while the rest is the result of residents stuffing as much waste as possible into each bag.

-- The costs to the firm of purchasing the specially marked garbage bags is approximately 12 cents per bag and distribution costs are estimated to be minimal.

-- Illegal dumping, if it has increased at all, has not been noted as a problem since the advent of the new program.

Other jurisdictions have had similar successes with specially designed garbage bag tags and/or stickers. These programs are designed to establish more equity in who pays for waste disposal.

■ Extended product warranties: Extended product warranties have been promoted by some as a key factor in reducing the trend toward purchases of products that are cheaper to replace than to repair. The price structure associated with such products would necessarily be higher to account for the higher quality of the materials and workmanship. Therefore, products with extended warranties would cost more to purchase initially. The success of this type of mechanism will rely heavily on several factors:

-- The adequacy of the educational and promotional materials and efforts that will encourage consumers to look beyond initial product price to life cycle costing; and

-- The availability and quality of maintenance and service centers.

It would most likely be technically impractical to mandate specific design guidelines aimed at maximizing product lifetimes. However, some people have suggested that there would be benefits associated with requiring standardization in the production of certain durable consumer goods that would extend the product life of those goods by making them easier to repair and/or maintain. This approach, along with minimum product warranties, would probably result in manufacturing design changes to increase product life. However, there are several drawbacks:

-- How would the administrative and enforcement costs of such a strategy be paid? Some advocates have suggested creating manufacturing fees that would offset the administrative expenses;

-- Who would bear the responsibility for repairs of such warranted products, the retail establishment or the manufacturer?

-- How could prompt customer service be assured?

Some precedence for this type of initiative can be seen, however, in the federal energy efficiency standards that have been established for some products and appliances.

■ Taxation

Although consumer habits have a significant impact on waste generation, the organization of the manufacturing system will probably have to change to produce long-term and widespread changes in the waste stream. Governments have begun to seek more direct methods of influencing the role of industry in waste creation; these include various taxation strategies that have been developed to return some disposal costs to the producer.

Taxation is sometimes proposed as an alternative to bans or prohibitions on the sale or use of certain products or types of products. Generally, taxation strategies can be categorized as either:

-- providing incentives for waste minimization;

-- providing incentives for manufacturing with recycled feedstocks and/or producing recyclable materials; or

-- producing disincentives through disposal surcharges, user fees, and deposits.

Taxation strategies include product disposal charges, litter taxes, and negative pollution taxes. Product disposal charges could be assessed on products or packaging at the time of manufacture or on the consumer at the time of purchase. The first method would arguably result in waste reduction through design changes in manufacturing and packaging processes. The second method is proposed to encourage waste reduction by creating an economic disincentive for purchasing products deemed to contribute to the waste stream unnecessarily. The charges could be assessed on product classes, specific products, or specific manufacturers.

Disposal costs vary widely with the type of product and the geographical area of the disposal site. Therefore, product disposal charges that accurately reflect specific disposal costs in specific locations would be nearly impossible to administer. Methods of assessing product disposal charges include:

-- levying charges on virgin feedstocks at the point of manufacture;

-- levying excise taxes on wholesale or retail products; and/or

-- taxing by weight of a product or its feedstocks -- though this method may result in encouraging a substitution of lighter materials that may be more difficult to dispose of or recycle.

In 1989, a U.S. Congressman from Connecticut proposed a bill, H.R. 1691, that would impose a tax on manufacturers and importers of paper and paper products made without a minimum amount of recovered materials. Although the bill is not expected to be passed into legislation during the 1989 Congress, it does reflect a trend in legislation at both the state and federal level.

Litter taxes are usually excise taxes on products or materials deemed to present a litter nuisance, such as disposable convenience items. The money collected could be applied toward litter clean-up or promoting waste minimization and recycling.

Negative pollution taxes could be established based on certain baseline industry standards for "acceptable" levels of generation. If an industry exceeds that level, they would be taxed; if an industry reduces generation rates below the "acceptable" levels, they would be eligible for waste abatement subsidies.

Taxation strategies are argued by some to be a preferred waste reduction method because taxes:

-- may capture costs (for waste disposal, environmental degradation, resource use, energy consumption, etc.) that may not be figured into a product's purchase price;

-- may provide for social equity -- under such a theory, those manufacturers or consumers who make and/or purchase goods or products that are perceived to present disposal problems would bear some of the costs of disposal; and

-- may not interfere with freedom of choice as prohibitions and bans would.

However, taxation strategies raise other issues:

-- who decides which products or feedstocks are taxed and at what point in the manufacturer to purchasers chain the tax is imposed?

-- who decides how monies collected from taxation are spent?

-- If subsidies are used, how can it be determined that those paying the subsidies are gaining benefits that could not be achieved by other means?

These questions are raised to point out the complexity of the issue of taxation. The Counties should be aware of the near- and long-term effects of its own policies and those it attempts to influence on the state and federal level.

3. <u>Governmental Regulation and Prohibition</u>

In addition to taxation strategies, prohibitions and regulation are being considered or employed by many communities across the nation.

The types of governmental prohibitions that have been enacted against nonrecyclable materials include:

■ A ban in Berkeley, California, on plastic food containers made with chlorofluorocarbons.

- A ban on non-biodegradable six-pack rings passed in Alaska, California, Connecticut, Delaware, Maine, Massachusetts, Vermont, New York, Oregon, Pennsylvania, and Rhode Island; similar legislation is pending in dozens of other jurisdictions. Alternatives to non-degradable plastic rings include cornstarch-based plastics, cellulose or photosensitive additives, and cardboard packaging.

- Rhode Island's Source Reduction Task Force 1986 legislative package included bills that:

  -- declared source reduction as the number one solid waste management priority

  -- established a $5 deposit on vehicle batteries

  -- called for U.S. EPA establishment of a source reduction program to monitor source reduction efforts and provide technical assistance

  -- established a program of labelling logos to inform consumers about a product's environmental impact, reusability, recyclability, and durability.

- Environmental ministers of the European Community moved toward phasing out all ozone-depleting chemicals by the end of the century by voting to eliminate chlorofluorocarbons by the Year 2000.

- European Economic Community measures to ban plastic bags by 1991.

- Declaration by the Environmentally Sound Packaging Coalition of British Columbia, Canada, to ban plastic milk jugs.

Although some industries have attempted to respond to pressure from consumers and environmental protectionists, some have expressed opposition to waste reduction legislation that they feel unfairly limits or obstructs their right to do business. The Equal Protection Clause of the 14th Amendment and the Interstate Commerce Clause of the U.S. Constitution are frequently cited in industry's defense. Response to such claims includes protestations from recyclers and others that the government has the right to invoke police powers in the best interest of the public and the environment.

In September 1974, the First Circuit Court of Hawaii found that a statute banning the sale of plastic beverage containers violated the due process guarantees of the State's constitution and the 14th Amendment of the U.S. Constitution. Similarly, the Minnesota Supreme Court ruled that a ban on non-refillable plastic milk containers, which preserved the non-refillable paper milk containers, violated the equal protection clause of the 14th Amendment. In January 1981, however, the U.S. Supreme Court reversed that decision, stating that such legislation contained a reasonable relation to the State's goal of developing environmentally sound waste disposal alternatives.

The legality and enforceability of special waste prohibitions, however, remains questionable and should be carefully investigated as part of the Counties' planning efforts.

D. RECOMMENDATIONS AND IMPLEMENTATION GUIDELINES

Effectively meeting waste reduction goals as expressed in State legislation will require the Counties to examine a variety of policy alternatives regarding waste reduction. It will be important, to consider whether a waste reduction policy under consideration is consistent with the broader context of the social and economic welfare of the region. Such things should be evaluated as political viability, enforceability (including the costs of enforcement), and administrative difficulties and costs. Both the costs and benefits of waste reduction initiatives need to be weighed. In addition, the likely effectiveness of strategies should be evaluated in light of other policy considerations such as the political acceptability or technical feasibility of proposed waste reduction techniques.

Other considerations that should be part of implementation planning are the "hidden" side effects of certain strategies. It can be suggested that waste reduction is not accomplished if the negative environmental effects of a product are merely switched from one environmental medium to another.

One example of the type of potentially hidden dilemma that results from conflicting waste reduction goals can be seen in coffee packaging. Formerly, coffee was available most often in tin cans. The technology exists to readily recycle such containers if they are recovered from the waste stream (though markets may vary). Now, however, a shift can be seen in coffee packaging to plastic lined or coated paper sacks or metal foil laminated vacuum-packed containers that are sometimes called "bricks." Both the sacks and the "bricks" are packaged in lighter weight materials that take up less volume when disposed (and less volume and weight when shipped). The plastic/paper sacks and the foil "bricks" however, are not recyclable by today's technology. Which goal is more important -- to reduce the volume of waste or to increase the recyclability of the waste stream?

Dr. Rathje, an archeologist from Arizona State University who has been examining landfills for several years to see what they reveal about our culture, spoke to a large assembly of waste management professionals, government representatives, and environmentalists at the National Recycling Congress in St. Paul, Minnesota, in September 1988. He cautioned that many solid waste management practices and policies were being predicated upon myth. As an example he cited polls that were conducted of "average citizens," asking what percentage of the waste stream they believed was composed of disposable food service items such as the foam "clams" used to package some fast food items. He indicated that some people believed that these items made up as much as 25 percent of the waste in landfills. Mr. Rathje's landfill excavation experience indicates that these types of one-way food packaging materials account for less than 1 percent of what we currently bury. But he noted that this prevalent attitude -- or, in his words, myth -- was shaping some far reaching decisions about waste generation handling and disposal in the country. Therefore, policy makers, program decision makers, and the general public need to exercise careful judgement, based on data not supposition.

In order to implement a waste reduction strategy, several important planning steps should be pursued by the Counties:

- Establish waste reduction goals that are consistent with State legislation, regional needs, and the Counties knowledge of the composition of the region's waste stream;
- Establish policies that will promote waste reduction in a manner consistent with the established goals and the individual requirements of the Counties' member municipalities; and
- Develop programs to encourage waste reduction.

Several of the waste reduction strategies previously described may be beyond the implementation capacity of the Counties. Many initiatives -- such as taxes and prohibitions -- need State and federal level impetus. The Counties can effectively lobby for Statewide policies that encourage waste reduction. In addition, the Counties and its member municipalities can take a leadership role in establishing waste reduction programs. By developing and implementing waste reduction strategies, by tracking costs of program development and administration, and by calculating disposal and other costs savings, the Counties can serve both as an example and as a source of technical assistance. Among the programs and services that it is recommended that the Counties adopt to promote volume reduction at the source are:

- Development of in-house waste reduction policies within the Counties. The Counties and all member communities must set the example for all others to follow.

- Development of waste conscious procurement guidelines for area government and businesses. Once again the Counties must set the example for others to follow. Purchases must emphasize the use of recycled materials and/or be of durable quality and made from recyclable material.

- Promotion of waste reduction legislation on the federal, State, and local level.

- Development of waste stream assessment procedures (waste audits) for homes and businesses that will help to establish baseline data and identify progress toward waste reduction goals.

- Development of an educational campaign and related educational curricula for use in schools and by local government officials, consumer groups, clubs and service organizations, and homemakers' groups.

- Establishment of technical assistance programs targeted at residential and commercial/institutional consumers and waste generators.

- Development of mechanisms for promoting backyard yard waste composting and/or mulching.

- Development of a monitoring program and economic analysis for waste reduction activities.

- Development of a model implementation program of waste reduction initiatives for a "pilot" community (volunteer member) that includes:

  -- implementing several waste reduction measures in the municipal government offices;

  -- establishing baseline data and determining evaluation criteria;

  -- choosing one or more representative commercial/institutional entities from the community; implementing locally appropriate waste reduction initiatives; and monitoring and measuring effectiveness; and

  -- educating the public on waste reduction through the help of volunteer groups and/or civic organizations.

E. COSTS

The waste reduction measures outlined in the preceding section will not be accomplished in a vacuum. Many of the activities will be corollary to other recycling and general waste management planning activities. Therefore, isolating the costs of specific initiatives is difficult.

Using the experience of some other communities as a guide however, the cost estimates presented in Table II-1 have been developed. These costs are assumed to be year-one costs in 1989 dollars unless otherwise noted. Some expenditures will be annual while others will be one-time-only. Consultant labor rates have been assumed for promotional/educational materials.

TABLE II-1

ANTICIPATED PROGRAM COST REDUCTION AT THE SOURCE
(1989 $)

Item	Estimated Cost
■ 50% of a Full-time Employee's time dedicated to Source Reduction	$20,000 to (including fringes)
■ Waste Reduction Promotional Campaign	$15,000
-- Posters (set of four, full-color, camera ready)	
-- Radio and Print PSAs (write and place six	
-- Fact Sheets (three, camera ready)	
-- Brochure (camera ready text and design)	
-- Business Waste Reduction Kit (text design and layout)	
-- Waste Reduction Component of Curriculum (teacher guide and activity suggestions)	
■ Waste Reduction as part of the Comprehensive Solid Waste System	$30,000
-- baseline data collection	
-- evaluation and monitoring procedures	
-- procurement policy guidelines	
-- "pilot" programs	
-- technical assistance network	
TOTAL	$65,000

III. RECYCLING AND REUSE

A. INTRODUCTION

Recycling and reuse make up the second component of the Illinois EPA hierarchy of preferred waste management strategies. Similarly, these methods are considered crucial elements of Comprehensive Solid Waste Management Planning for St. Clair, Madison, and Monroe Counties.

Illinois State law requires that the recycling programs of Madison, St. Clair, and Monroe Counties be designed to achieve a recycling rate of 25 percent at the end of the fifth year of the program. Recycling is defined as any process that collects, separates, or processes and revises or returns waste or materials that would otherwise become waste to use in the form of raw materials or products. Yard waste composting is included in this definition of recycling.

The following sections detail source separation techniques for reclaiming the recyclable or reusable materials in addition to recovery methods that involve separating materials from mixed refuse after the source. Markets that are available are discussed, along with processing requirements.

In order to meet the 25 percent established in the legislation, an aggressive combination of recycling strategies will be required. The recommended strategies to achieve recycling goals are described, along with representative capital and operating and maintenance costs.

B. SOURCE SEPARATION PROGRAM ALTERNATIVES

There are many alternatives available for the recovery of recyclable material from municipal solid waste. The recycling alternatives available that will be instrumental in achieving mandated goals for residential waste are:

- drop-off locations and curbside collection of recyclables (including associated processing);
- leaf/yard waste composting; and
- food waste collection and composting.

Options for accessing the recyclables in the the commercial waste stream include:

- office paper recovery;
- corrugated recycling; and
- commercial food waste and yard waste composting.

It is useful to review the potential types and quantities of recyclable materials in the Counties' waste stream. On pages 89-90 of the Phase I Assessment of Solid Waste Disposal Needs, Table 22 shows a composition breakdown and the tonnage of each material that the Counties can strive to recycle. These data were used in the cost analysis of Chapter V.

1. Drop-Off Centers

Drop-off centers are the most common type of recycling in the nation. Because recycling is a community-specific operation, the appropriate recyclables collection system must be designed around and in consideration of conditions particular to the area of involvement. Drop-off centers alone will not be sufficient to achieve the diversion of materials necessary to meet the State goals. However, drop-offs may be appropriate in addition to curbside collection programs. To evaluate and select the most appropriate drop-off system, one must consider critical factors such as location, materials handled, population, number of centers, operations and maintenance, competition with other recycling operations, and public information. Because drop-offs would be used to provide supplemental recycling opportunities in the study area, fewer and smaller drop-off sites would be required. The specific size and locations of these sites would have to be finalized in concert with the final development of the curbside source separation program.

a. Location and Sizing

Even when used as a supplemental recycling opportunity, the convenience of a drop-off center will directly affect the amount of citizen participation. Strategically locating a drop-off center in an area of high traffic flow, where the center is highly visible, will encourage a greater level of participation.

Drop-off centers will serve users whose normal habits take them to central locations. This means that a particular center may serve residents from several municipalities. The determining factor in deciding which drop-off a person will use is generally how convenient it is to that person's everyday habits.

Shopping malls, grocery stores, post offices, and waste handling facilities can make good sites for drop-off centers. Locating drop-offs near where residents buy food is one effective method in siting a drop-off because grocery stores are generally high traffic flow areas. Careful consideration must be given, however, to available space at the drop-off sites. There must be room for cars to approach, park, and leave without creating traffic hazards. Most host shopping facilities will insist on non-interference with existing traffic flow. In addition, parks, arenas, and stadiums provide excellent opportunities for siting drop-off centers. These amusement or recreational facilities typically result in the generation of newspaper, mixed paper, and beverage containers that could be captured through appropriately-located facilities.

Host areas are usually concerned about the appearance of the drop-off site and the impact it will have on the shopping center, store or establishment. Store owners sometimes envision a drop-off as being a depository for trash that will become unsightly and drive customers away. People also frequently raise concerns about safety hazards, potential liability, and vandalism. One approach to convincing property owners to allow a drop-off to be sited on their property is to show them exactly what the facility will look like. When approaching a property owner, the Counties should have a draft agreement to submit to the owner's attorney that indemnifies the owner from damages caused by the facility. Being able to show the owner a drop-off that would be attractive, rather than detrimental to his operation, and reliably serviced and policed is usually the single most effective selling point.

b. Staffed vs. Unstaffed

Once sited, a drop-off center will require a level of staffing that will vary with the size of the center and the number and quantity of materials handled. Larger drop-off centers may require a full-time manager, laborers to assist users in unloading materials, and individuals to process the materials. These larger centers can serve as buy-back centers as well, and operate during specified hours in a day. Some locations are staffed with municipal employees, while others contract this operational responsibility out to a private entity. Agencies for the developmentally handicapped are often willing to contract for operations.

The benefits of having a staffed drop-off center include the ability to process some materials, quality assurance of materials, and assistance for participants. A center's staff can ensure that only the targeted recyclable materials are accepted at that center. Furthermore, a staffed facility allows for the opportunity to establish a buy-back option at the center. This approach will enable beverage containers to be redeemed in addition to the acceptance of other recyclables as appropriate. Buy-back centers may provide monetary incentive for participation by to community residents. Finally, having a helper to unload materials can enhance citizen participation.

Buy-back centers operate similarly to drop-off centers, with the exception that some or all of the materials are purchased. In many communities nationwide, the types of materials purchased are generally the higher-valued ones, like aluminum cans -- though purchase of materials at some buy-back centers has expanded to include other recyclables.

The disadvantages of operating a staffed drop-off include the added cost of labor and benefits and, when buy-backs are offered, the added security that may be deemed necessary because money will be kept on the site. Using volunteers as an alternative to paid labor can reduce the operational cost of a center; however, even when drop-off centers are operated by volunteers they may realize a low profit margin. Problems with volunteers can include unreliability of service, limited skills, and lack of continuity of participation.

The obvious advantage of the unmanned center over the manned site is the lower cost of operation. However, unmanned drop-off centers experience the lowest participation rates and thus receive low volumes of materials. Other disadvantages of an unmanned site are the potential for vandalism and the possibility that unacceptable materials may get mixed with the recyclables. These centers still require regular service to remove the collected materials and monitor the sites. As with a staffed center, service can be provided by volunteer labor, municipal employees, or contracted labor.

c. Design

A drop-off center should be designed to meet the specific needs of the community it serves. Smaller, low-volume centers for an urban area, for example, may be structured differently than one located in a rural area that is expected to serve a larger portion of the population. Drop-off centers may range from a small site with a few 55-gallon barrels, to larger sites consisting of equipment and trailers that can be used to process, store, and transport the materials. Sensitivity to the characteristics that are unique to the targeted community can greatly enhance the success of the drop-off materials recovery program.

Included in the text that follows are conceptual sketches of drop-off centers that range from very simple, unmanned centers to more involved, larger, staffed centers that process and store materials for shipment.

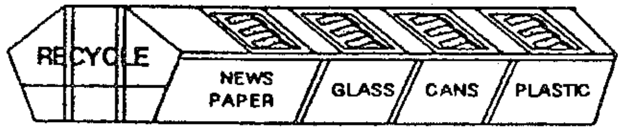
(1) Roll-Off Containers

A simple drop-off configuration could include roll-off boxes placed strategically around communities. This method is illustrated in Figure III-1.

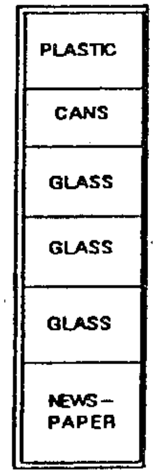
Roll-off containers come in a variety of sizes so that they can be sized to accommodate various volumes of recyclable materials. Generally, roll-off containers have a single compartment used to collect discarded materials. This type of container would be sufficient for the drop-off of either mixed recyclables or one specific type of material (i.e., newspaper).

Figur 'II-1

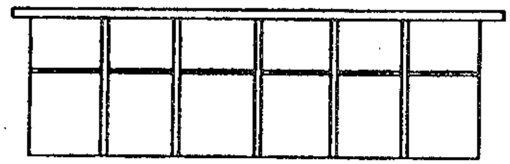
ROLL-OFF ‿NTAINERS FOR DROP-OFFS



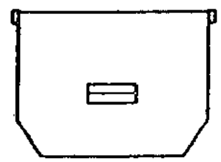
COMPARTMENTALIZED W/COVER (SIDE VIEW)



COMPARTMENTALIZED NO COVER (TOP VIEW)



ROLL-OFF MIXED MATERIALS (SIDE VIEW)



ROLL-OFF (END VIEW)

NOT TO SCALE

Roll-off containers are now being manufactured with hinged or removable dividers that allow a single container to be sectioned into several compartments. Though those specially constructed containers cost more than ordinary roll-off boxes, they allow for reduced processing costs associated with mixed recyclables being deposited in a single-compartment roll-off. Because the materials are sorted into the appropriate compartment by the participant, no sorting will be required by the collection crew or market. However, one drawback to this approach is that the smaller compartments may require that the roll-off be emptied (or pulled) more often.

Roll-off containers are also available with or without a cover. The cover increases the initial cost of the roll-off, but eliminates the need to restrict the types of materials being placed in the roll-off and the need to cover the roll-off by another means.

Hauling roll-offs can be contracted out to a private hauler as part of a market agreement, or by each of the Counties, if a truck is available to move the containers.

(2) Converted Garage/Carport

Figure III-2 illustrates one possible configuration of bays of a municipal garage being converted into a recycling drop-off center. Highway barriers, sometimes called New Jersey traffic barriers, are used to section off stalls for the three colors of glass. The barriers provide a retaining wall, as well as a push wall if a front-end loader is used to scoop up the materials and load them into a transport vehicle. These barriers are easy to install and relocate and are not as expensive as permanent concrete walls. A roll-off container stationed in the third bay is used to collect paper. Sometimes material markets will provide storage containers for recycling programs.

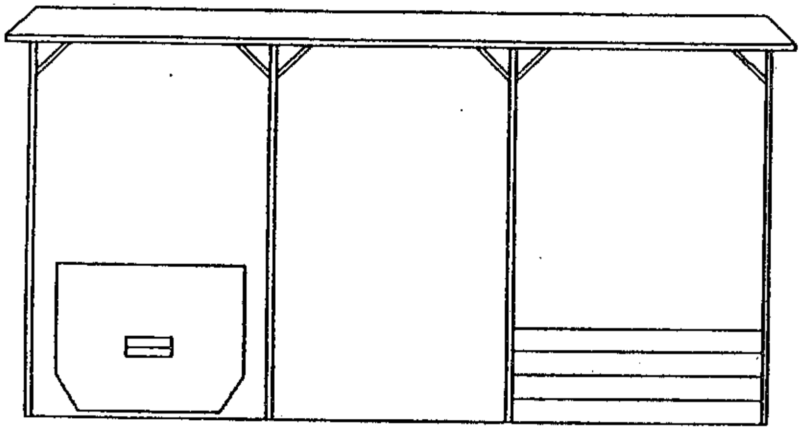
(3) Drive-Through Enclosure

Figure III-3 shows a pole-barn-type building enclosed with corrugated sheet metal. Overhead doors on either end of the building enable cars to drive through, and allow participants to drop off materials without being exposed to the elements. This particular facility could be staffed and could serve as a buy-back center for certain materials.

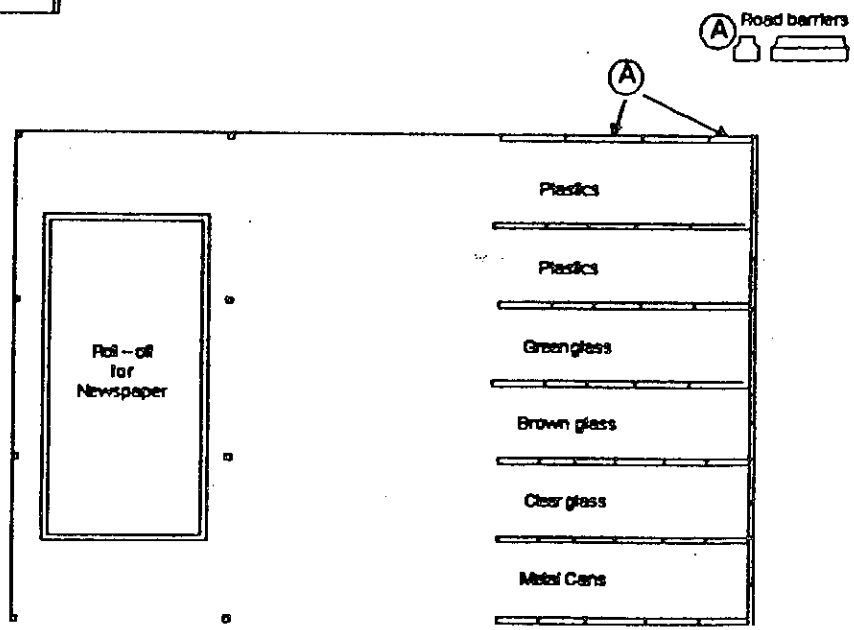
Highway barriers section off stalls for storage of all colors of glass, aluminum, and bimetal cans. Partially enclosed stalls on the opposite side of the building provide storage area for three types of paper products.

Figu II-2

CONVERTING A MUNICIPAL PARKING GARAGE INTO A DROP – OFF CENTER

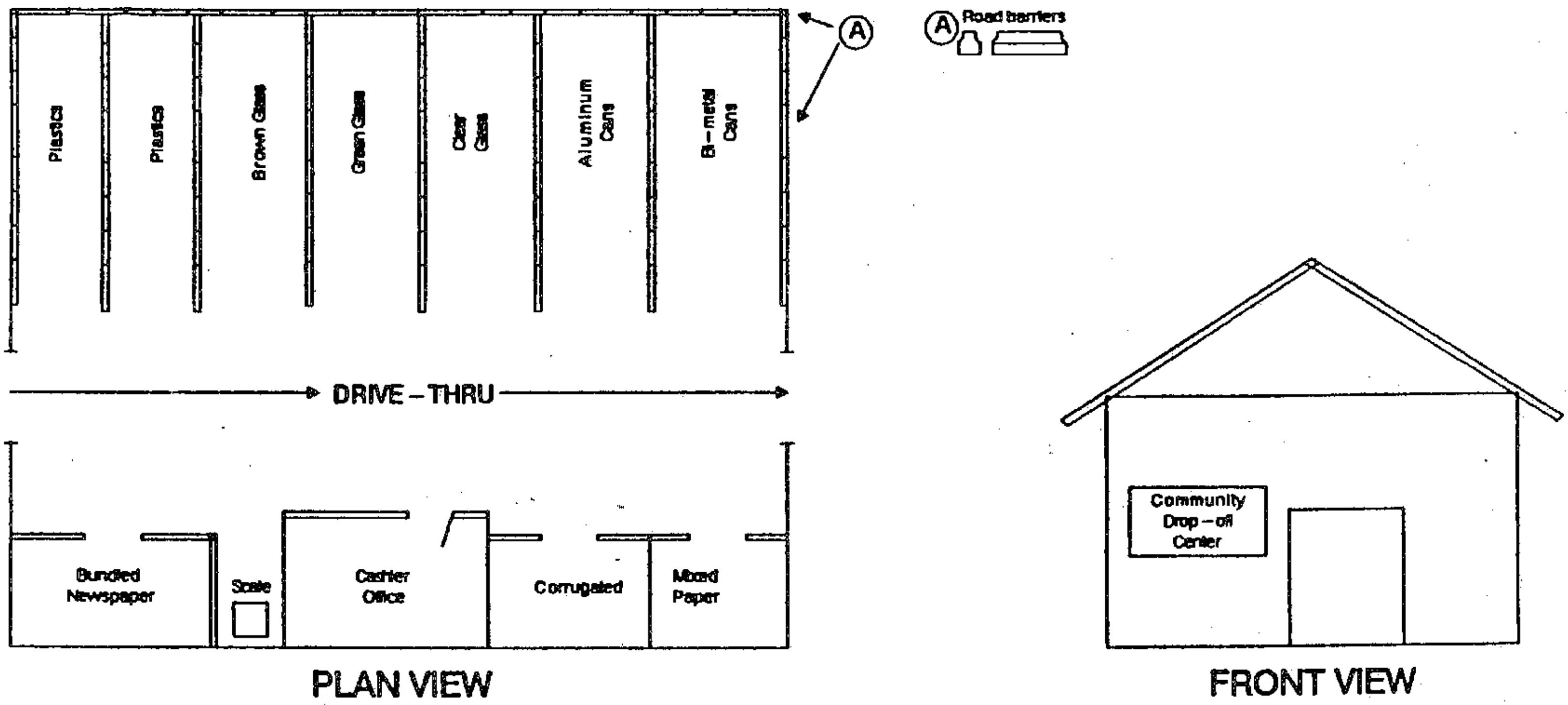


FRONT VIEW



PLAN VIEW

Figure III-3
ENCLOSED DRIVE – THROUGH DROP – OFF CENTER



(4) Trailer Drop-Off

Figure III-4 illustrates a drop-off center that uses a compartmentalized recycling trailer as a collection center. This arrangement provides storage and transportation in a single unit. When the trailer is full, it is simply pulled to a processing center or market. A fence encloses the trailer to reduce the likelihood of theft, as well as enhance its appearance. A step, built at the base of the fence, allows the community residents to deposit their recyclable materials into the trailer more easily.

(5) Staffed Drop-Off Center/Buy-back Centers

Figure III-5 shows the configuration of an elaborate drop-off center that also serves as a buy-back center. The drive-through feature protects participants from the elements while they deposit recyclables in the appropriate places. Some collection and transportation equipment may be provided by markets and may not require a capital outlay from the center.

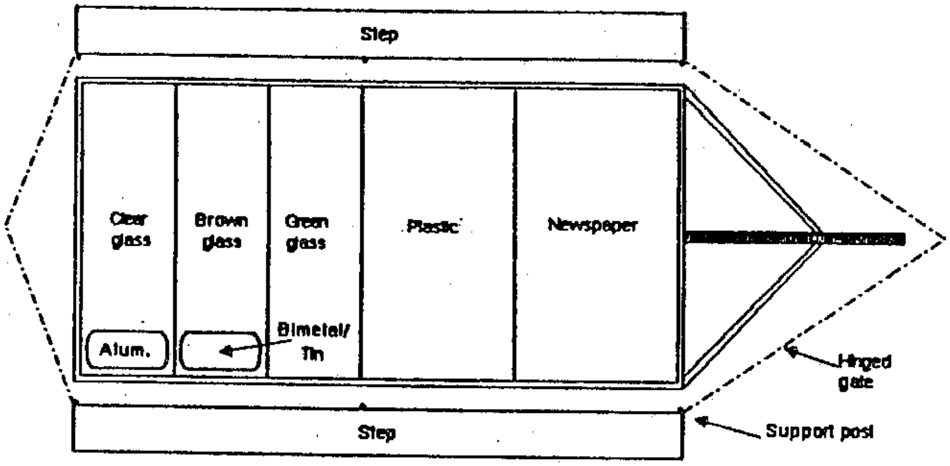
Materials preparation requirements, which vary with market requirements, can usually be enforced more effectively at buy-back centers than they can at drop-off centers or in some curbside collection programs. Purchase, shipping, and marketing terms often call for baling paper and corrugated containers, separating and densifying scrap cans, and crushing glass containers. Many buy-back centers that take in smaller volumes do minimal processing and ship loose materials to nearby processors and dealers.

To best serve the public, buy-back centers must be staffed at regular hours. The operations of a buy-back center -- weighing, processing, marketing, managing, and bookkeeping -- require a level of staffing that generally relates proportionally to the tonnages of materials recycled at the center. Most centers need several workers skilled in business operation and public contact. Mobile buy-back centers have been used to recover materials in rural and suburban areas too distant or small to support a full-time center. The effectiveness of buy-back operations depends, at least in part, on effective public education and media relations.

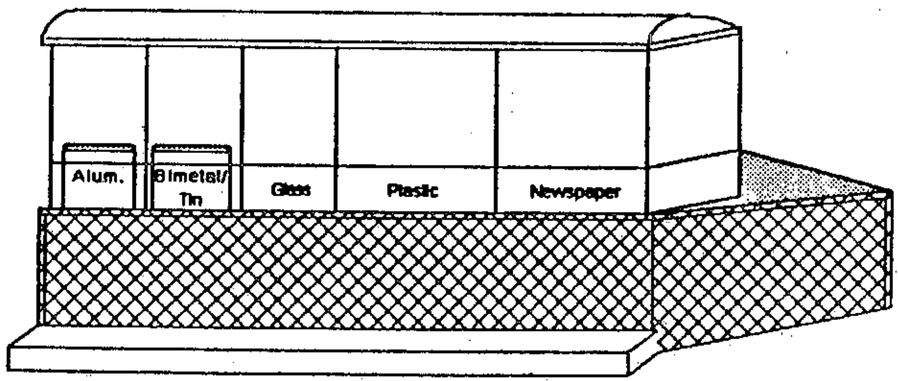
One advantage of buy-back centers is that they provide employment and income, which can be particularly important in low-income areas. It is a corollary that some citizens will collect more recyclables and be willing to travel greater distances to drop them off, if a cash incentive is involved. However, as with all drop-off facilities, an inconvenient location can prevent people from bringing materials even if a direct financial incentive is available. In some cities, zoning regulations mandate that buy-back sites be located in industrial areas rather than commercial spots. This siting issue could be expected to affect participation.

Figure III-4

COMPARTMENTALIZED TRAILER DROP – OFF CENTER



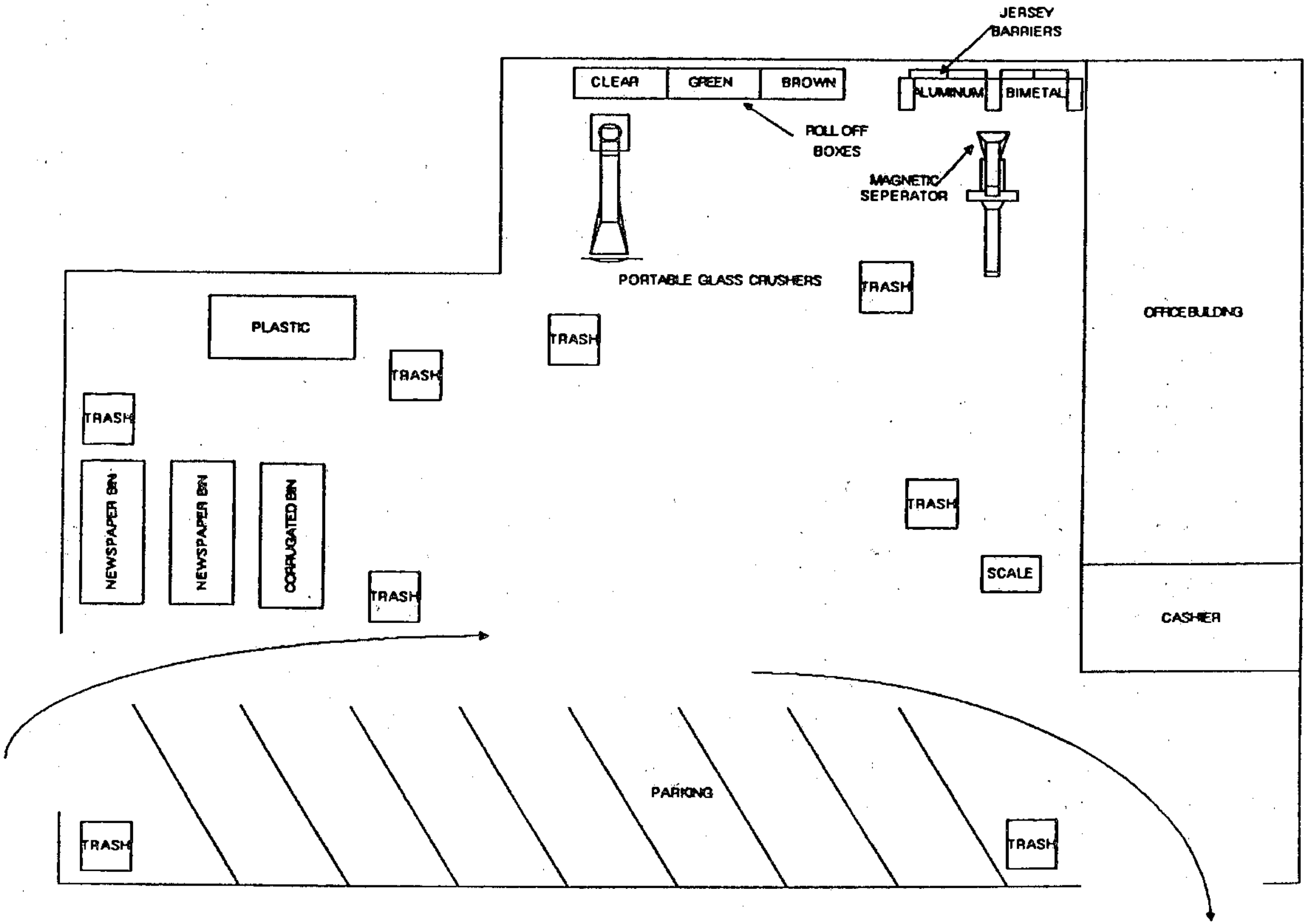
TOP VIEW



SIDE VIEW

Figure -5

RECYCLING CENTER
STAFFED DROP – OFF CENTER



(6) Igloos

Igloos are bell-shaped containers that are popular as drop-off containers in Europe and are now becoming popular in the United States. Like roll-offs, they can be placed strategically around communities. Because of their smaller size and more aesthetically pleasing appearance, their placement is not as limited as roll-offs. Igloos can be placed along sidewalks, in parks, near bus stops, in parking lots, or near any area that is heavily traveled by community members.

Figure III-6 shows the configuration of igloos and how they can be placed in the middle of a city even if only a small space is available. Materials are usually collected from igloos by a dump-bed truck with a hook/hoist used to lift the igloo over the dump bed. This arrangement allows the material inside to be emptied from the bottom of the container. Igloo containers specially manufactured for collecting paper are also available. The opening mechanisms on these igloos are constructed with minimal interior wires to reduce the possibility of paper getting caught up on the wires. In addition, the special paper igloos are fire-proof to reduce the risk of arson.

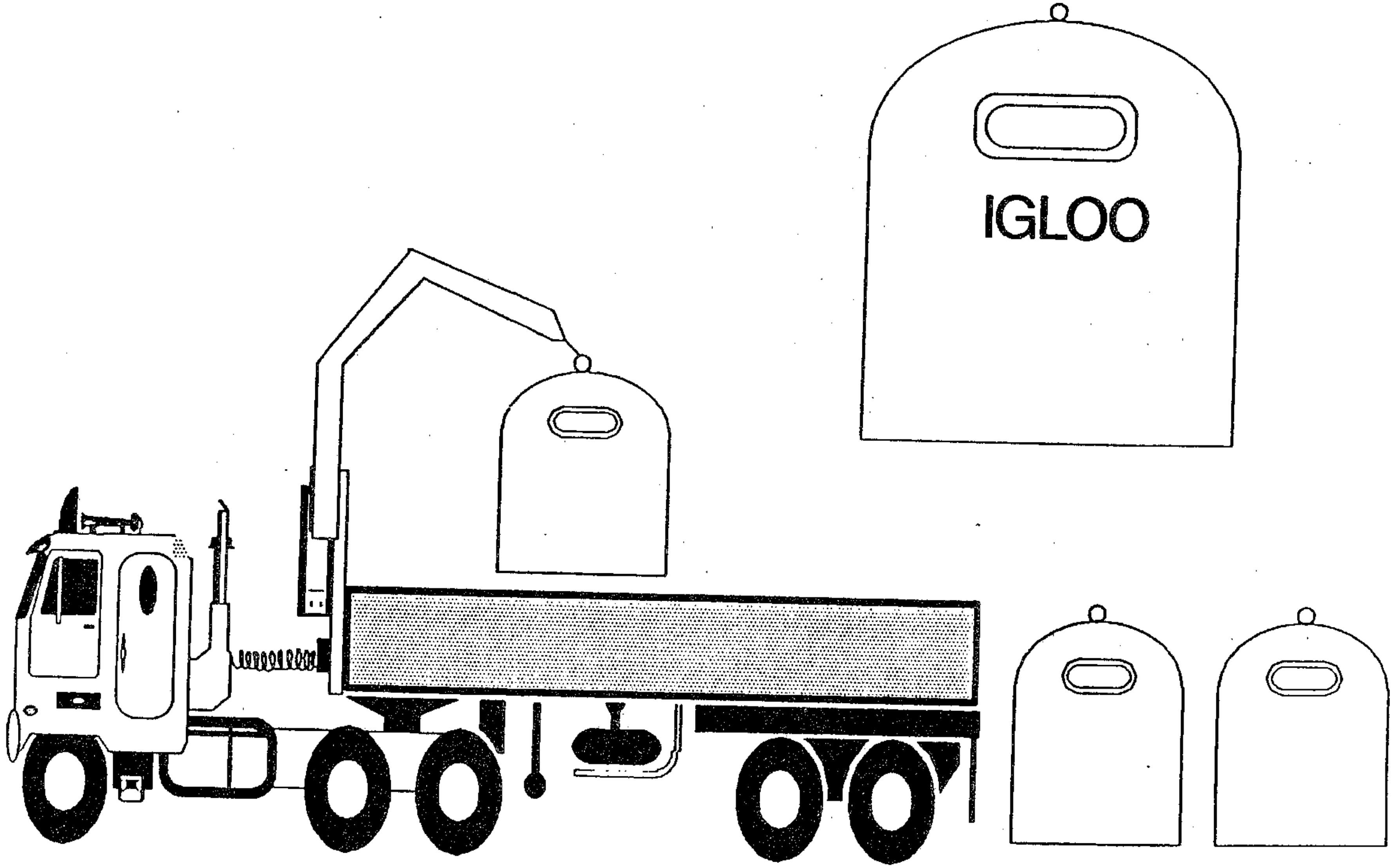
In addition to being more aesthetically acceptable than roll-off boxes, igloos are designed with relatively small openings near their top. This design feature was developed to discourage passersby from using the containers as regular trash receptacles. This same feature may present some problems of access for some users (shorter people, the elderly who might have trouble lifting recyclables to the required height, etc.).

2. <u>Curbside Collection</u>

The collection of residential recyclable material at individual households will be an essential component of the recycling program. Curbside collection provides direct access to recoverable residential waste, offers convenience to users, and can stimulate strong public support for recycling. The types of participation and recovery rates that can be achieved through a well-designed, well-publicized, and well-executed curbside collection program will be critical to achieving the State-mandated goals. However, implementing curbside collection takes extensive planning and energy on the part of the program sponsors, as well as funds sufficient to cover the cost of collection vehicles, household containers, transportation of materials, and public education.

The following section presents observations and practical advice on how to structure a curbside collection program. Information is provided on home storage containers, collection vehicles, and possible levels of material separation performed at the curbside.

Figure I-6
IGLOO RECYCLING CONTAINERS



a. Home Storage Containers

Several types of home storage containers for recyclables, are currently available. Exhibit III-1 lists some container manufacturers. The primary advantage of a home storage container is the ease it affords the resident in storing and setting out recyclables. If residents are provided with a container, they have a specific place in their homes to store their recyclable material, something to set out at the curb on collection day, and a visual reminder to recycle.

Containers are also helpful for the collection crew. If all containers in the community are uniform, it is easy to spot the recyclable container and differentiate the recyclables from the trash that is set out at the curb. In addition, when all recycling containers are the same, a certain element of peer pressure takes effect in the neighborhood. The homes that do not set the container at the curb become noticeable.

Containers may both remind the resident to recycle in general and give specific directions (which materials to include in the container or the day of the week the collection will occur). Often a community recycling logo is put on the container to identify the program. In addition, providing home storage containers may represent a commitment on the part of the sponsoring agency that lends credibility to the recycling program and spurs participation.

The primary disadvantage of supplying home storage containers is the cost. Single, reusable bins may cost approximately $7.00 per bin and stacking bins or multiple-can systems can exceed $18 per unit depending on the design, capacity, and manufacturer. This cost can be a significant investment. For example, to provide a 14-gallon container (Zarn, Inc., North Carolina) to the estimated 196,746 households (1987 estimated households from Table 28 of the NEEDS Study) would cost more than a million dollars. This cost does not include distribution or replacement costs. A distribution system must also be developed in order to deliver the containers to the households. In general, containers are delivered by the manufacturer in bulk and need to be stockpiled by the implementing agency prior to distribution to homeowners. If home owners are expected to come pick them up, that information has to be disseminated and a system developed.

Some communities assess a small deposit to the homeowner on the waste collection bill for the home storage container. If the resident leaves the community, that resident can return the container and receive the deposit back. Once containers are distributed, some communities maintain a container accounting system. Replacement containers may be provided for those that are damaged, lost, or stolen. If a resident requires numerous (and suspicious) replacement bins, a fee may be imposed. Some residents may need more containers than the number originally provided; these individuals will need a contact to request an additional container.

EXHIBIT III-1

HOME STORAGE CONTAINERS

REHRIG PACIFIC COMPANY
Mr. Vince Saia
1850 Northwestern Avenue
Gurnee, Illinois 60031
(312) 249-1505

Two types of containers -- stacking and tub type

Tub type -- $5.20/container
Stacking (milk crate configuration)
Ribbed -- $5.65/container
Solid -- $6.21/container
Set of 3 (2 ribbed, 1 solid) -- $17.51

Price discounted by:
- -- Larger quantity order, lower cost per unit
- -- All three containers in set are ribbed
- -- Incorporate recycled plastic in containers; 25 percent recycled plastic, $0.20 less per unit

CHRISTIE ENTERPRISES, INC.
Mr. George Salmorin
80 Market Street
Kenilworth, New Jersey 07033
(201) 241-0841

C700 -- $1.75 each
16" -- $3.25 each, with handles
20 gallon -- $6 each, plus freight

Made from recycled plastic (polyethylene) -- black only, no lids or covers

EXHIBIT III-1
(Continued)

HOME STORAGE CONTAINERS

HOUSEHOLD RECYCLING PRODUCTS
Mr. Pat Scanlon
Post Office Box 1124
Middleton, Massachusetts 01949
(617) 777-2207

2-cubic-foot rectangular (cost per container)	
3,000 delivered silkscreen with cover	$9.47
50,000 delivered silkscreen without cover	8.09
20-gallon barrel (cost per container)	
3,000 delivered silkscreen with cover	$8.69
50,000 delivered silkscreen without cover	7.63

ADVANCED RECYCLING SYSTEMS, INC.
Mr. Mike Nordstron
President
Post Office Box 1796
Waterloo, Iowa 50704
(319) 291-6007

PHILADELPHIA CAN COMPANY
Ms. Sandra Friedman
Sales Representative
4000 North American Street
Philadelphia, Pennsylvania 19140
(215) 223-3500

Recycling Pails for Curbside Collection

EXHIBIT III-1
(Continued)

HOME STORAGE CONTAINERS

BUSCH-COSKERY OF CANADA, LTD.
Mr. Stephen Coskery
1502 Gregwood Road
Mississauga, Ontario
Canada L5H 2T4
(416) 274-9619

Curbside Collector -- 22.25" X 17.25" X 12.50"
Recycling Pails for Curbside Pickup

AMERICAN PAPER & PACKAGING CORPORATION
4560 North 124th Street
Wauwatosa, Wisconsin 53225
(414) 462-8560

ZARN, INC.
Mr. John Ammandson
Post Office Box 1350
Northeast Market Street Extension
Reidsville, North Carolina 27323
(919) 349-3323
(919) 349-4104

Bin -- 14 gallons; 21 7/8" X 15 1/4" X 12.5"
Colors -- red, blue, green, black
Approximate cost: $5.10 each
hot stamp: $0.10 each side

EXHIBIT III-1
(Continued)

HOME STORAGE CONTAINERS

BUCKHORN MATERIAL HANDLING
Mr. Ray Gargarella
7512 Bath Road
Mississauga, Ontario
Canada L4T 1L2
(416) 678-6545

Model 18610 -- 20" X 16" X 12"
approximately 10 gallons
$6.80

Model 18611 -- 21" X 15.5" X 12"
approximately 12 gallons
$5.00

SHAMROCK INDUSTRIES, INC.
834 North 7th Street
Minneapolis, Minnesota 55411-4394
(800) 822-2342
(612) 332-2100

Three-in-one recycling container -- 20.95 gallons
13 7/8" X 24" X 17 1/4"
$7.00 each
colors -- blue, red, yellow, green

There are many types of home storage containers available. They range from single containers with no dividers to a container system that requires multiple separations by the homeowner. This latter system may include four to eight separate containers, all placed into a cart designed to be set out at the curb. Some container systems are stackable, with a different container for bottles, cans, and newspaper. Others are similar to the trash containers that residents might use in their home for their residential waste.

Providing home storage containers significantly increases participation rates in the recycling program. In Champaign, Illinois, the weekly "REEECYCLE" program originally began without supplying containers but later provided rigid, plastic containers after a test program showed that such containers increased participation rates from 15 percent to 80 percent. Though those exact increases may not be replicable, the upward trend associated with the provision of home storage containers is important to note. In addition, it was found that different types of rigid containers resulted in different participation and collection rates (households provided with square bins collected higher volumes than ones with round buckets). The provision of home storage containers has become one of the recognized building blocks in developing a successful program. Programs being planned and implemented with the goal of diverting as much waste as possible from the landfill generally provide for the supply of home storage containers to residents.

Selecting the most appropriate container to be used is a very program-specific activity. A trend appears to be developing for the use of a single household container which allows for separation of materials to occur either at the curb by the collector or at a processing facility. The single container requires the least amount of effort by the user and therefore generally results in higher participation rates.

Careful consideration must be given to selecting the optimal size container. Factors to be considered include a consideration of the materials to be recycled, the frequency of collection, any plans to add additional materials in the future, the level of separation required for the markets, and/or the processing capabilities of the program. A container for a residential recycling program that could adequately hold the types and quantities of materials expected to be recycled in the Metro region -- food and beverage containers, corrugated cardboard, mixed paper, newspaper, and plastics collected weekly -- should have a minimum capacity of 20 gallons to hold one week's worth of commingled materials. Several manufacturers make containers in the needed capacity range.

b. Curbside Separation vs. Commingled Transport

Collecting source-separated materials from homes can be accomplished in two general ways. The homeowner can place all of the designated materials into a single container that is later emptied into a single-compartment collection vehicle; or the homeowner or the collector can separate the material into different compartments. Curbside projects across the country have taken varying approaches to material separation during collection.

As discussed previously, storage of recyclables by the resident is typically planned with ease of the resident in mind. Multiple separation of material in the home is difficult and generally results in lower levels of participation. Providing the homeowner with a single container and allowing the homeowner to place all recyclables into that container for collection results in the greatest level of participation. The issue of separation at the curb or commingled collection really occurs after the homeowner has set out the material for collection.

Under a curbside-sort approach, collectors separate material during curbside collection. For example, the worker picking up the single bin of mixed recyclables would walk alongside the collection vehicle, placing materials into separate compartments. Curbside separation can be done to varying degrees. The level of separation performed by the collector is determined by market requirements and the processing capabilities of the program. The decision of whether or not to select curbside separation, as well as the extent of curbside separation, should be based on the specific requirements of the program.

Because curbside separation requires more effort by the collector, it may result in fewer stops per day by a collection crew. Generally speaking, 10 percent to 20 percent more stops can be made without performing the separation. When done properly, the benefit of curbside sorting includes minimizing processing the separated materials after the initial pick up. In some cases, a community can eliminate the need for developing, building, and operating a processing facility to upgrade the recyclables to market specifications. For the Counties, processing capacity will be required to reach Illinois' aggressive goals. As stated earlier, a modified sort is expected to be most effective.

c. Collection Equipment

Exhibit III-2 presents information about recycling collection vehicles and current manufacturers. There are a wide range of truck capacities and costs. Vehicles are available from sizes of 15 cubic yards to 31 cubic yards, and in costs ranging from less than $20,000 to more than $70,000. Selecting the most appropriate collection vehicles for a recycling program requires careful consideration and analysis of the entire program structure, for both curbside collection vehicles and those used for drop-off

EXHIBIT III-2
RECYCLING VEHICLE DATA

Manufacturer	Model Name	Rated Capacity	Body Type	Loading	Loading Heights Minimum/Maximum	Low Entry Dual Drive	Base Cost
Trucks							
Able Body	C.R.C.U.	Varies	Open top	Manual	42" - 60"	Optional	$18,000 - $24,000[1]
Amertek	RBM	27, 33	Closed	Manual	58" - 80"	Yes	$60,000
	RBA	29	Closed	Hydraulic	50"	Yes	$70,000
Dempster	Recycle King	27, 31	Closed	Manual	51" - 87"	Yes	$56,000
	Recycle King[2]	31	Closed	Combined[3]	51" - 87"	Yes	$66,000
	--	31	Closed	Hydraulic	--	Yes	$66,000
Eager Beaver	Recycler 15	15	Open top[4]	Manual	54" - 79"	Optional	$35,000
	Recycler 23	23	Open top[4]	Manual	49" - 78"	Optional	$40,000
Frink Canada	FR	27, 30, 32	Closed	Manual	50" - 83"	Yes	$55,000 - $60,000
Holden Industries	Flexi-Dump	15, 20, 24	Open	Manual	54" - 72"	No	$35,000 - $39,000
	E-Z Load	30	Closed	Hydraulic	--	No	$70,000
Jaeger	Pelican II, III	27, 31	Closed	Manual	57" - 93"	Yes	$53,500 - $55,500
	Power Pelican	31	Closed	Hydraulic	48"	Yes	$68,000
Kann Manufacturing	Curb Sorter	16, 20, 22	Open top	Manual	48" - 75"	Optional	$ 5,000 - $ 8,500[1]
Labrie	Task Force	31	Closed	Manual	55" - 73"	Yes	$60,000
	Task Force Hydraulic	31	Closed	Hydraulic	46"	Yes	$75,000
Lodal	ECO 3000	24-28	Open top[4]	Manual	49" - 71"	Yes	$59,000
	ECO 3030	31	Closed	Manual	42" - 71"	Yes	$58,500; $15,000
Peerless	MMRB2	12	Open top	Manual	40" - 56"	--	$17,000[1]
	MMRB3	17	Open	Manual	72" - 84"	--	$20,000 - $25,000[1]
Perkins	RendaCycler	22, 27	Closed	Hydraulic	43"	--	Body only
Rudco	1615-HLD	15	Open	Manual	48"	No	$40,000
	1615	15	Open	Manual	48"	No	$37,000
	2221	21	Open	Manual	48"	No	$40,000
Wayne Engineering	--	30	Closed	Hydraulic	35"	Yes	$55,000 (estimate)
Trailers							
Eager Beaver	Recycler	15			54" - 76"		$13,300 - $13,700
Holden Industries	Flexi-Dump	15, 20, 24			54" - 72"		$12,500 - $15,500
Kann Manufacturing	Curb Sorter	16			48" - 75"		--
Norcia Corporation	--	16			48" - 74"		$13,000
Multi Tek (trailer) (container)	RW-260 HD	--			--		$ 8,125
	RW-3DMC	15, 18, 20			56"		$ 5,494
	RW-12A018DD	22, 23			--		$ 5,494
	Multi Unit Hydraulic Hook	--			--		$10,000

[1] Body only.
[2] Combination
[3] Manual and hydraulic
[4] Closed optional

centers. The collection vehicle is vital to obtaining the best available collection efficiency, given the particulars of home storage systems, market requirements, transportation routes, and processing capabilities. A properly designed collection system with the most suitable collection vehicles is the backbone of a household recycling program.

If materials will be collected at the curb and hauled directly to market, then a multi-compartment vehicle is needed that provides sufficient material separation to suit the market specifications. If, on the other hand, materials processing will take place prior to marketing, then fewer (if any) compartments are needed in the vehicle. Given the parameters of the collection needs, it is likely that three compartments will be required. It is not necessary for vehicle compartments to be uniformly sized. Plastics are typically high volume materials, while paper products are expected to be present in greater quantities. Given that scenario, a three-compartment vehicle may be set up so that the paper fraction and container fraction are sorted into vehicle compartments of approximately the same size. The quantities of textiles expected to be set out on any given day are significantly smaller than the other fractions. The vehicle compartment dedicated to textiles, then, should be sized appropriately to accommodate the expected volume of materials.

(1) Vehicles to Service Drop-Off Sites

If a vehicle services drop-off sites only, then, depending on the design of the drop-off center, a compartmentalized vehicle may be appropriate. Depending also on the number of drop-offs and the quantity of material collected, that vehicle may be dedicated to the drop-off center servicing task or may be used only part-time. For servicing drop-offs, a compartmentalized trailer works well and at a lower cost than a dedicated collection truck.

Drop-off centers in the area would be expected to accept materials that have been sorted into at least the paper and container fractions. Servicing those drop-offs and emptying the recyclables into a compartmentalized vehicle would be easy. A roll-off container system will require a dedicated vehicle to load and haul the containers, empty them, and replace with an empty container. Special vehicles are also required for unloading Igloo containers.

(2) Vehicles for Curbside Collection of Multiple Materials

The choice of a 15-cubic-yard, 25-cubic-yard, or 31-cubic-yard truck for the curbside collection of multiple materials is largely route-dependent. The choice of vehicles must take advantage of certain economies that may be realized by running longer routes and servicing more homes using a larger vehicle. The recycling collection vehicles with a stated capacity of 31 cubic yards and a practical capacity of approximately 70 percent of the stated capacity or more are well suited for longer routes and large volumes of material.

Another important element in selecting the proper collection vehicle is its loading height. Exhibit III-2, presented earlier, also shows the minimum and maximum loading heights as listed by the manufacturers. A field check of selected vehicles, conducted by Gershman, Brickner & Bratton (GBB) personnel using a tape measure, showed these heights to be within three inches of what most of the manufacturers claimed. It is important to realize that as the truck fills up, the sides are raised and loading height increases. At the end of the day or at the end of the route, the collector has to lift or throw the material as high as as possible to get it into the vehicle. Loading height and total truck capacity must be considered when selecting a collection vehicle.

The Counties or their member municipalities may want to use existing trucks for collection. Although this may save the cost of new trucks for a period of time, there are other considerations. Dump trucks sometimes have the drawback of excessively high loading heights because most of them were not designed to be loaded manually. Therefore, the use of existing equipment should become an option only after consideration of the impact on the collectors' ability to load the truck. Sometimes existing trucks have been retrofitted with hydraulic tailgates that can be lowered to a level that is easy for the collectors to dump recyclables into. They can then be periodically elevated and the recyclables dumped into the truck hydraulically.

Some communities use rear-loading garbage trucks for both newspaper and mixed recyclables collection. Although there is surprisingly little initial breakage of glass from the compaction blade in such a system, there is considerable breakage upon unloading. Also, the visual impact of having garbage trucks pick up recyclable material may not be favorable.

d. Recyclables Collection Program Costs

In determining the capability of a truck to service a certain number of accounts until the selected vehicle is filled to capacity, the density of the material to be recycled becomes important. For Source Separated Recyclables collection the assumed on-truck density is 300 pounds per cubic yard. Therefore, the collection vehicle, if fully loaded, is capable of carrying 6,900 lbs. of recyclables.

3. <u>Recyclable Materials Transfer Stations</u>

Under several recycling system options, a need may arise to develop one or more transfer stations for recyclable materials. These facilities would be used primarily to handle material collected from the curbsides and to avoid having individual recycling vehicles travel long distances for unloading.

The site plan and layout would be very similar to a waste transfer station, although consideration must be given to a design that would minimize breakage of glass, match the transfer layout to the type of recycling vehicle to be used (e.g., rear- or side-unloading and the degree of material separation), and perhaps establish a means of segregating materials by type (paper, metal and glass) and perform separation during the transfer process.

The eventual location and number of material transfer stations depends on the scope of curbside collection eventually implemented and the location of any material processing facilities which are developed.

4. Materials Recovery Facility

a. Introduction

This subsection addresses the requirements and conceptual design for a recyclable materials recovery facility (MRF). The processing would consist of mechanized (baling, crushing, flattening) and manual methods to upgrade the value of the recyclable material received from the service area for future resale to commodity markets. The facility is best described as an intermediate recovery center, because the material is taken from the original source (the residents of the study area) and eventually delivered to final product markets (glass manufacturers, paper mills, etc.). Given the large quantity of recyclable of making the materials desirable to the final markets needs to be planned and implemented.

Sizing a materials recovery facility requires knowledge about input and output flows. The input stream is the quantity and form of paper, glass, metal, plastics and other materials collected and delivered to the facility. The outflow is the clean, densified products sold and sent to final markets in addition to processing residue (which may vary from 5 percent to 20 percent of the input stream). The expected deliveries each day should be calculated as accurately as possible and, once determined, used to size the roadways, tipping floor, processing equipment, material storage space and load-out containers. Each of these areas must be designed to handle the rated flow capacity, expressed in tons per day, of the facility.

Other sizing criteria are changing market specifications, the addition or deletion of materials from the program, the expected growth in materials quantities over the life of the facility, the operating hours (one shift or two, five or seven days a week), the delivery schedule (surges or steady), and the general confidence one has in the material quantity estimates.

For the St. Clair, Madison, and Monroe County area, the annual growth rate would include expansion of waste quantities due to the expected population growth as estimated in the Phase I NEEDS study. These quantities were used to establish the expected capacity of an MRF for the region. The MRF should be designed to handle the maximum throughput capacity of the combined commercial and residential waste streams. As an alternative, the Counties may wish to develop regional MRFs to serve specific districts.

The following discussion applies to a facility sized approximately for the service area. This section addresses the following topics: conceptual design for a material processing facility for mixed recyclables; discussion of alterations to facility design for receiving recyclables that have been sorted at the curbside into compartmentalized vehicles; and equipment supplier information.

b. General Design Conditions

(1) Site

Although the exact site location for such a processing facility is not known, a general site arrangement is shown in figure III-7. (An alternative site is also shown for an intermediate recovery facility located at a transfer station in Figure III-8.) Some clearing of trees and other native plant growth may be required. A site of approximately four to five acres is needed.

A single access road will carry all employee, visitor, delivery, and pickup vehicles to the processing facility. The recycling vehicles will have a circulation pattern unencumbered by pedestrians or other automobiles. The administrative area is isolated from large vehicle traffic. The material loadout zone shown on the site plan allows for vehicle maneuvering space as well as paper bale storage.

(2) Building

Figures III-9A and B, show conceptual plans for facilities sized to handle the combined waste streams. As shown in the drawing, the tipping floor and material storage bunkers are each located in separate areas of the facility so that each function can be conducted smoothly and independently of each other. Large doorways are sized according to the maximum possible height of rear-unloading trucks. The sloped roof is designed to allow for high door heights where required, yet reduces the total building volume. Skylights and translucent panels will provide natural lighting to the interior space.

The tipping floor is large enough for trucks to maneuver and to allow for storage of a maximum of at least one day's delivery of recyclables. A protective barrier surrounds the entire tipping floor; push barriers for the transfer of material to the

Figure III-7
INTERMEDIATE PROCESSING FACILITY
CONCEPTUAL SITE PLAN

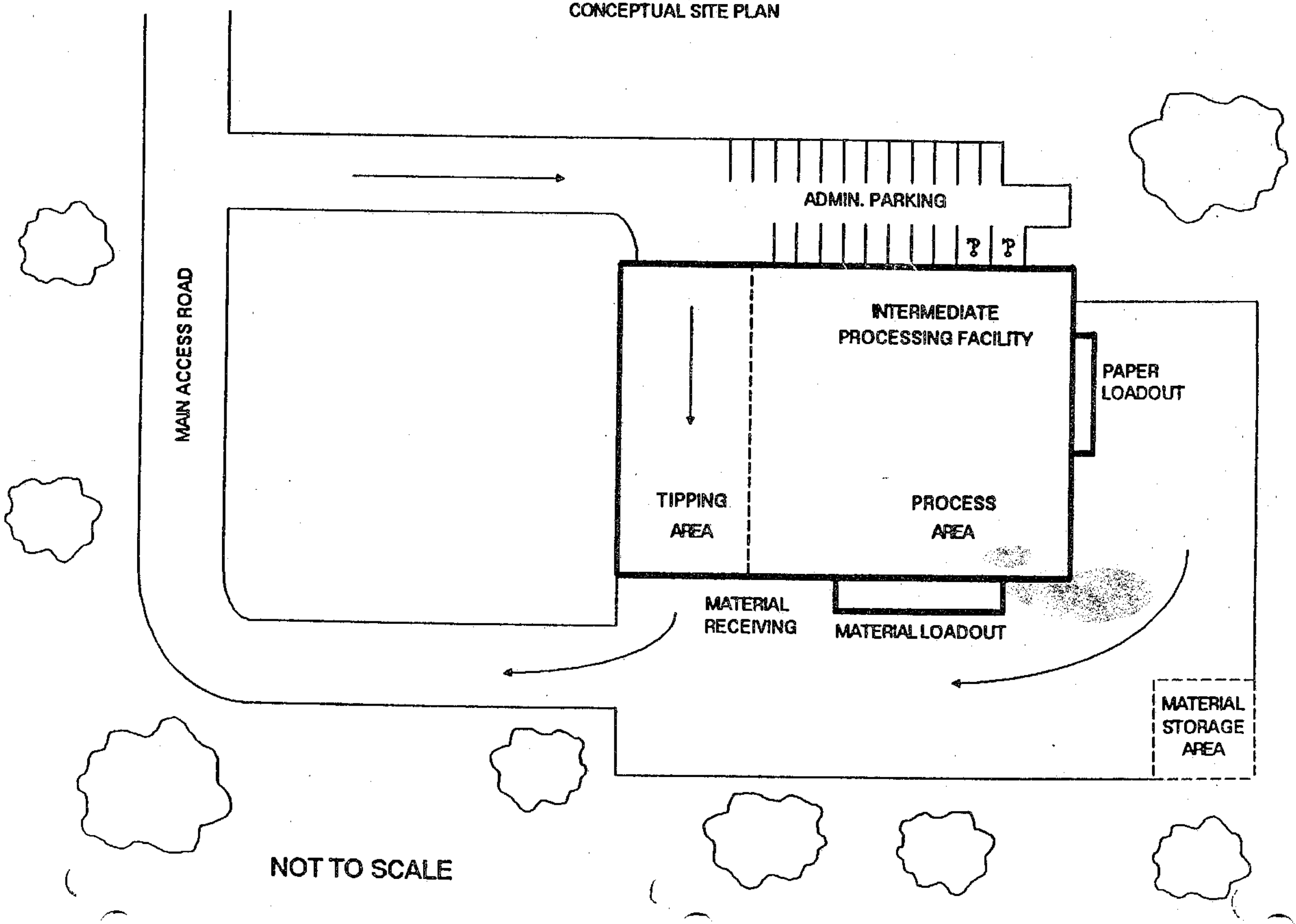
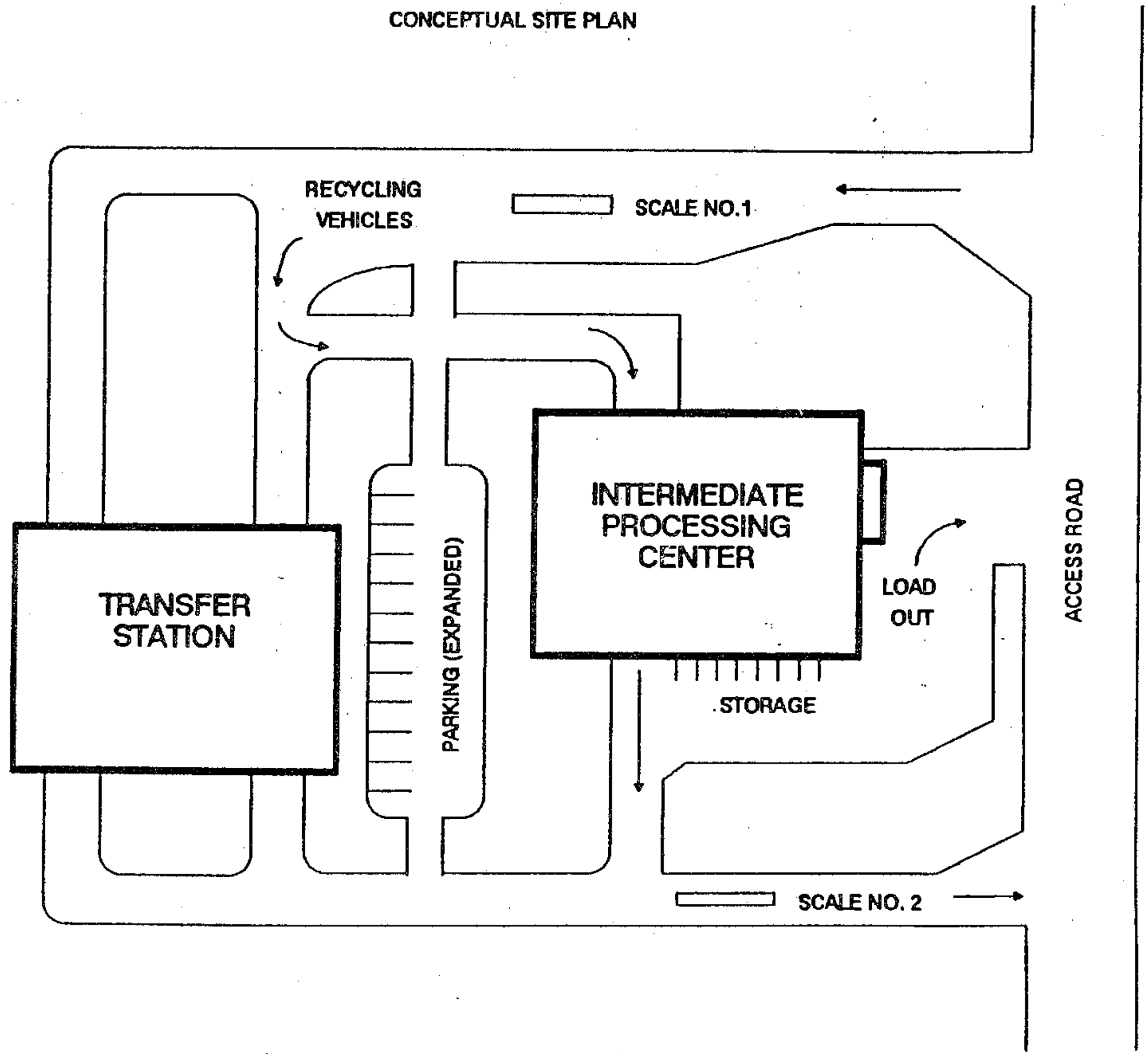


Figure III-8

INTERMEDIATE PROCESSING FACILITY

CONCEPTUAL SITE PLAN



NOT TO SCALE

FACILITY SIZED TO HANDLE COMMERCIAL AND RESIDENTIAL RECYCLABLES

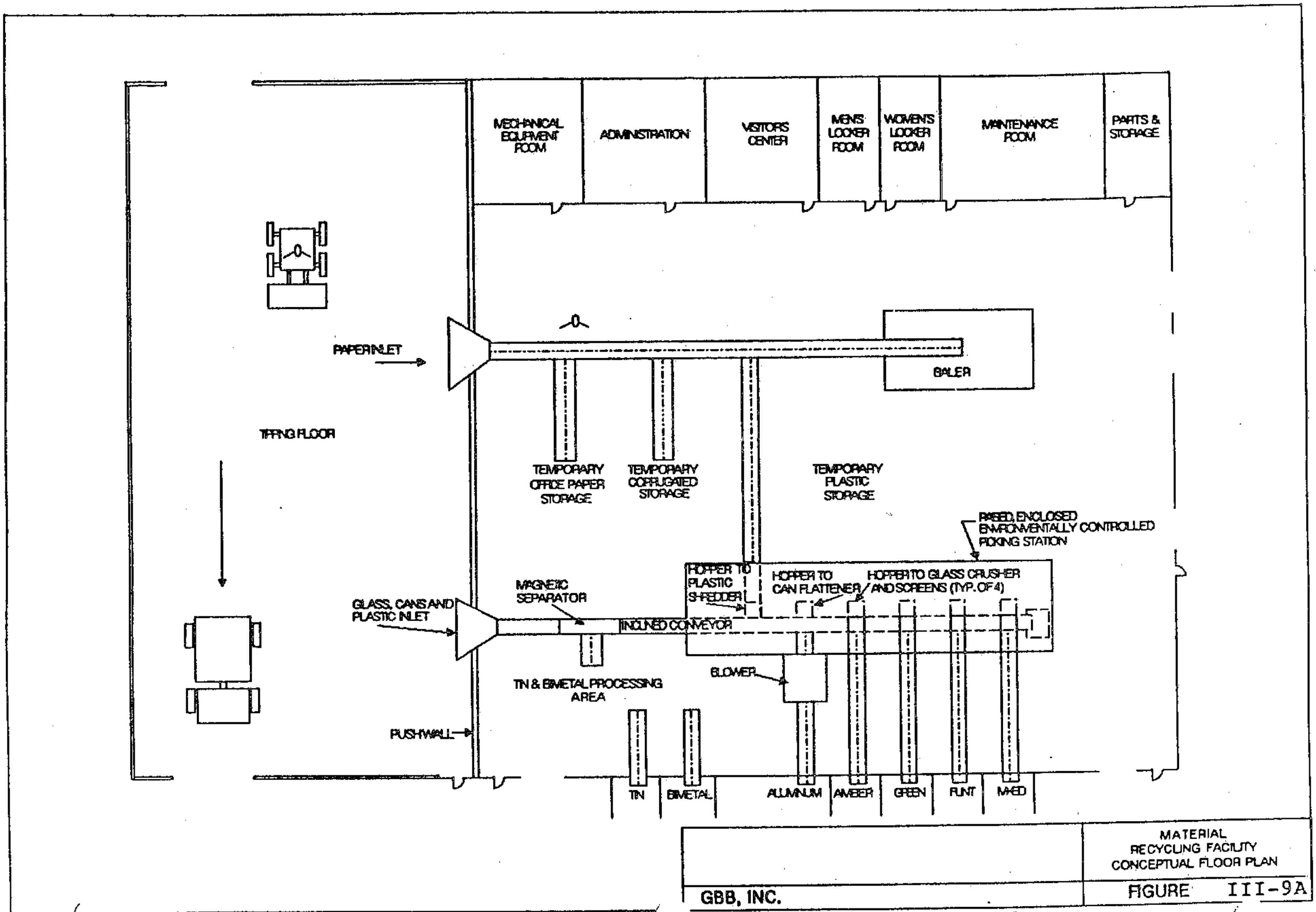


Figure III-9a

FACILITY SIZED TO HANDLE RESIDENTIAL RECYCLABLES

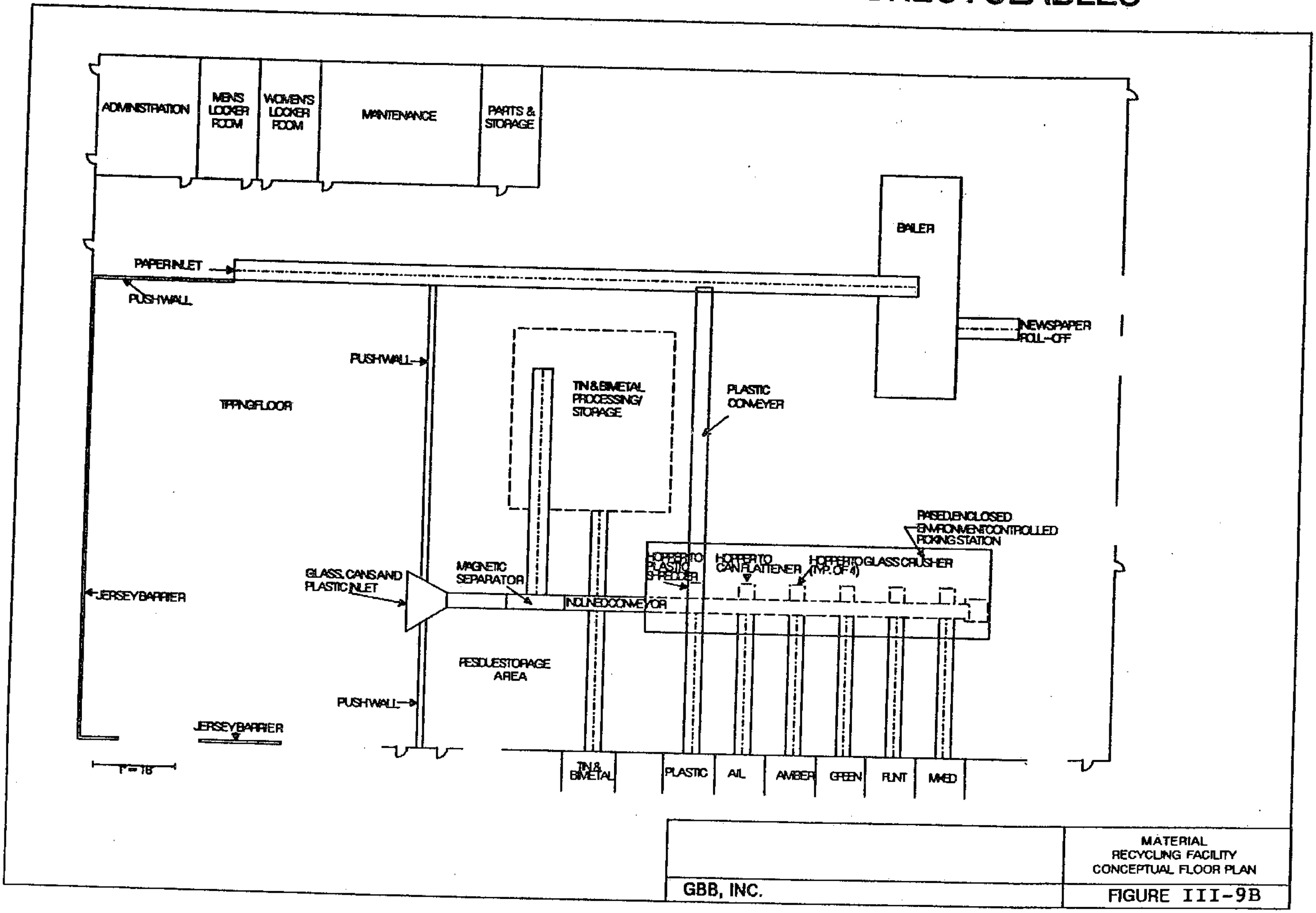


Figure III-9b

process lines are located in the paper area and in the mixed containers area; a floor-to-roof wall will separate the tipping area from the rest of the plant.

(3) Process

The process layout provides for an efficient yet flexible approach to both material handling and space allocation. Aluminum and plastic products are separated first at two separate picking stations because they tend to float on top of the heavier glass products, due to the agitation of the conveyors. Four additional picking stations within an environmentally controlled room are provided for the separation of glass by color. The input hoppers and conveyors are positioned to minimize transitions. The baling machine, which can be set up in a number of different configurations, will be used for a variety of products, but predominantly for paper and plastics. Tin and bimetal cans can be stored for several days and then loaded onto the conveyor for flattening or storage. The paper loadout area is on the east side of the building and allows space for roll-off containers.

(4) Administration and Maintenance

An administrative area, containing offices, locker rooms, a lunch room, and a visitor center, would be placed somewhere inside the building depending on the final equipment layout. Large windows and architectural features would be designed to provide an attractive entrance. The maintenance area has an outside access door as well as sufficient interior space. An enclosed viewing area would let visitors observe the process operation and learn about recycling.

c. Design Requirements

The design described in this section is based in part on visits made by GBB personnel to recycling centers in the United States and abroad and from information gathered from recycling vendors. The concept is applicable to a mixed recyclable stream of the quantity and composition of the service area.

(1) Site Requirements

The facility site is assumed to consist of approximately four to six acres of undeveloped land. Site work includes all necessary clearing, grubbing, and stripping of the site; earthwork; paving and curbing; landscaping; and the provisions for a stormwater management system, a local water supply, and a sewage system. Clearing, grubbing, and stripping on the site would be done only in those areas necessary to access or where construction is being done. Landscaping should preserve the visual and ecological character of the area.

The principal divisions of the facility requirements in designing an intermediate recovery facility include: architectural, structural, and utility building requirements; materials-receiving requirements; materials-processing requirements; and materials-storage requirements.

The type of construction material that would be used should be in accordance with current design practice and weather conditions expected in the southwestern section of Illinois. Design and materials should be such that the cost of maintenance for the buildings and equipment would be kept at an economic minimum over the life of the facility.

All vehicles should be weighed on the facility scale. The recorded weights can be used for evaluating the facility performance and documenting recycling activities. The facility is designed so that all recyclable materials are received and stored in an enclosed area. The materials-receiving facilities are designed and constructed to allow unloading inside the enclosed area.

(a) Materials Recovery Requirements

All equipment should be durable and suitable for operation under the conditions expected at the facility. Equipment must have a demonstrated ability to perform reliably in materials-processing applications and must be able to produce saleable products.

It is assumed that the recyclable products would be received as paper products or mixed containers and cans. The paper material goes through a single-stage separation process; and the glass, metal and plastics move through two stages. The total residue from both operations is estimated at 11 percent by weight and reflects the uncertainty of the quality of recyclables received at the facility. This figure may decline once the public becomes accustomed to recycling.

The main picking stations for sorting commingled color-mixed bottles and cans should be located in a safe, easily accessed, climate-controlled room located above the operating floor. The enclosure is built to avoid human inhalation of dust and for ear protection. The room should have full-length windows on both sides. Residue will drop off the end of the conveyer belt into a bin. A glass crusher, baler and can flattener will be strategically located to minimize the noise level inside this picking station.

It may be of interest to use such a facility for the employment of handicapped people. Options are available in the physical arrangement and access to the picking stations so handicapped workers can participate. These options may be in the form of wheelchair ramps, widened walkways and so forth.

A description of the processing requirements for each material follows:

i) Paper

The facility paper-processing line must be capable of accepting and baling newspaper, corrugated, and office paper to meet the specifications stipulated by dealers in the materials market survey in the early years of the program. As the program expands to meet the 25 percent goal, the facility will need to process mixed paper from the residential waste stream. The baler should be sized slightly more than the current material quantities to allow for future growth and greater operating flexibility.

ii) Glass

Color-mixed, broken, and whole glass containers will be delivered to the facility. The glass-processing line must sort glass into four colors (flint, amber, green, and mixed) and produce a saleable product that meets the material specifications for glass cullet identified in the market survey.

iii) Ferrous Cans

Tin-plated ferrous food cans (and some bimetal beverage cans) will be delivered to the facility commingled with glass, aluminum, and plastic containers. The ferrous-can-processing line should be capable of accepting mixed ferrous containers, magnetically separating the ferrous portion and detecting and separating contamination. The processing of tin-plated ferrous and bimetal cans consists of densifying the materials for ease and economy of transport.

iv) Aluminum

Because of the extensive aluminum recycling already taking place in the St. Louis metropolitan area, fewer aluminum cans are expected to be received than would otherwise be expected. The aluminum processing line will be capable of sorting aluminum from glass and ferrous containers and flattening the aluminum to meet the market specifications.

v) Plastics

It is anticipated that high density polyethylene (HDPE) containers such as dairy, liquid detergent, antifreeze, bleach, and oil bottles -- and perhaps small quantities of polyethylene terephthalate (PET) -- may be delivered to the facility commingled with the bottles and cans. In addition, to meet the 25 percent goal, mixed plastic processing capacity will be needed in future years.

The plastic processing line will be capable of sorting plastics from glass and metal containers and baling the plastics into a saleable product.

(b) Materials Storage Requirements

Processed materials will be stored in either covered containers/trailers or in an area separate from the building. Outside storage space should be available. Furthermore, during poor market conditions or if a market is lost, space is available to store several shipments of material while establishing new or better markets.

c. Equipment Supplier Information

A number of vendors and manufacturers selling glass crushers, can flatteners, and balers were contacted in an effort to develop estimated cost ranges and operating performance for representative equipment that can be used. The major vendors selling such equipment and their addresses and telephone numbers are listed in Exhibits III-3 through III-5.

Equipment specifications vary depending on the specific materials to be handled, the form in which they are to be processed, and volume of material to be handled.

(1) Can Crushing Systems

Various can crushing systems are available. The most efficient systems are self-contained. In these units, cans are fed via a conveyor to a magnetic separator that pulls off any steel cans; the remaining aluminum is then crushed and blown into a storage truck or another type of container. Suppliers also sell units that only flatten cans, units that flatten and separate without a blower, and units that are only magnetic separators. Suppliers also sell can densifiers that process the cans into uniform biscuits.

(2) Balers

There are two basic types of balers: horizontal and vertical. Both types are capable of baling recycled materials such as mixed, newspaper, plastics, and corrugated. In general, vertical balers are much cheaper than horizontal ones, but horizontal balers can handle a much higher volume of material.

EXHIBIT III-3

GLASS CRUSHER VENDOR LISTING

AMERICAN PULVERIZER COMPANY
5540 West Park Avenue
St. Louis, Missouri 63110
(314) 781-6100

AMERICAN RECYCLING SYSTEMS
Post Office Box 1067
Monroe, North Carolina 28110
(704) 289-8244

C. S. BELL
170 West Davis Street
Post Office Box 291
Tiffin, Ohio 44883
(419) 448-0791

C. P. MANUFACTURING
John O. Willis
1428 McKinley Avenue
National City, California 92050
(619) 477-3175

COUNT COMPANY
Dennis A. Pederson
1700 East Aurora
Post Office Box 3119
Des Moines, Iowa 50316
(800) 247-1655

DENS-A-CAN INTERNATIONAL
Post Office Box 11505
Pittsburgh, Pennsylvania 15238
(412) 963-7004

DREW-IT CORPORATION
Drew W. Morris
Post Office Box 10111
Greenville, South Carolina 29703
(803) 294-0357

EIOAL INTERNATIONAL SALES CORPORATION
Post Office Box 348
Wilsonville, Oregon 97070
(503) 694-2655

ERTEL ENGINEERING COMPANY
Post Office Box 3245
Kingston, New York 12401
(914) 331-4552

FALLOVA SHREDDER COMPANY, INC.
Post Office Box 645
Cohoes, New York 12047
(518) 785-3522

GEW COMPANY
Post Office Box 376
Branford, Connecticut 06405
(203) 488-2581

GRASON EQUIPMENT COMPANY
Post Office Box 714
Mansfield, Ohio 44903
(419) 526-4440

GRUENDLER CRUSHER
212 South Oak Street
Durand, Michigan 48429
(517) 288-6662
(800) 325-4974

HAZEMAG USA INC.
Post Office Box 1064
Uniontown, Pennsylvania 15401
(412) 439-3512
(412) 832-1711

HI-TORQUE SHREDDER COMPANY
230 Sherman Avenue
Berkeley Heights, New Jersey 07922
(201) 464-2002

JACOBSON, INC.
Robert R. White
2445 Nevada Avenue North
Minneapolis, Minnesota 55447
(612) 544-8781

JERSEY STAINLESS, INC.
230 Sherman Avenue
Berkeley Heights, New Jersey 07922
(201) 464-1752

MANOO ENGINEERING
3790 El Camino Real #238
Palo Alto, California 94306
(415) 856-9353

MILLER MANUFACTURING COMPANY
Richard Veeck
Post Office Box 336
Turlock, California 45381
(209) 632-3846

FRANKLIN MILLER INC.
60 Oakner Parkway
Livingston, New Jersey 07039
(201) 736-3900

BRUCE MOONEY ASSOCIATES, INC.
1849 Fairhill Road
Allison Park, Pennsylvania 15101
(412) 367-2682

PRODEVA INC.
100 Jerry Drive
Drawer R
Jackson Center, Ohio 45334-0817
(513) 596-6713
(800) 999-3271

RECYCLING EQUIPMENT MFG.
North 6512 NAPA
Spokane, Washington 99207
(509) 487-6966

RIVERSIDE PRODUCTS OIVISION
Sivyer Corporation
Post Office Box 765
Bettendorf, Iowa 52722
(309) 764-2020

SEC MAT EQUIPMENT AND
MACHINERY COMPANY LTD.
Post Office Box 296
Station "A"
Weston, Ontario
Canada M9N 3M7
(416) 244-0953

UNIVERSAL PROCESS EQUIPMENT INC.
Post Office Box 338
Roosevelt, New Jersey 08555
(609) 443-4545

WOR-TEX CORPORATION
Old Brandon Road
Hillsboro, Texas 76645
(817) 582-5354

EXHIBIT III-4

CAN FLATTENERS VENDOR LISTING

AMERICAN BALER & SHEAR SYSTEM
DIVISION OF CRANE & MACHINERY, INC.
9655 Industrial Drive
Bridgeview, Illinois 60455

AMERICAN RECYCLING SYSTEMS
Post Office Box 1067
Monroe, North Carolina 28110
(704) 289-8244

ATLANTIC SYSTEMS
1195 Airport Road
Lakewood, New Jersey 08701
(201) 364-9797

C.P. MANUFACTURING INC.
1428 McKinley Avenue
National City, California 92050
(619) 477-3175

DENS-A-CAN INTERNATIONAL
Post Office Box 11505
Pittsburgh, Pennsylvania 15238
(412) 963-7004

D & J WENDT CORPORATION
78 Industrial Drive
Post Office Box 888
North Tonawanda, New York 14120
(716) 694-7901

ENTERPRISE COMPANY
616 South Santa Fe Street
Santa Ana, California 92705
(714) 835-0541

FALLOVA SHREDDER COMPANY, INC.
Post Office Box 645
Cohoes, New York 12047
(518) 785-3522

GALLANT HENNING NOPALC, INC.
1025 South 40th Street
Milwaukee, Wisconsin 53215
(414) 645-6000

GRUENDLER CRUSHER
212 South Oak Street
Durand, Michigan 48429
(517) 288-6662
(800) 325-4974

HUSTLER CONVEYOR COMPANY
Sub. of AMERICAN PULVERIZER COMPANY
4985 Fyler Avenue
St. Louis, Missouri 63139
(314) 352-6000

INTERNATIONAL BALER CORPORATION
500 Rio Grande Avenue
Jacksonville, Florida 32205
(800) 874-8328

LINDEMANN RECYCLING EQUIPMENT INC.
500 Fifth Avenue
Suite 1234
New York, New York 10110
(212) 382-0630

MAC/SATURN CORPORATION
201 East Shady Grove Road
Grand Prairie, Texas 75050
(214) 790-7800

MILLER MANUFACTURING
Post Office Box 336
Turlock, California 95381
(209) 632-3846

MONARCH SPECIALTY SYSTEMS, INC.
713 West LaFever Street
Ossian, Indiana 46777

BRUCE MOONEY ASSOCIATES INC.
1849 Fairhill Road
Allison Park, Pennsylvania 15101
(412) 367-2686

PIQUA ENGINEERING
125 Clark Avenue
Post Office Box 605
Piqua, Ohio 45356
(513) 773-2464

PRODEVA INC.
100 Jerry Drive
Drawer R
Jackson Center, Ohio 45334-0817
(513) 596-6713
(800) 999-3271

RECYCLING EQUIPMENT MFG.
North 6512 NAPA
Spokane, Washington 99207
(509) 487-6966

SOLID WASTE SYSTEMS
412 Harrison Street
Kalamazoo, Michigan 49007
(616) 344-0064

EXHIBIT III-5

BALER VENDOR LISTING

ACCURATE, INC.
A SUDBURY COMPANY
Post Office Box 451
Williams, New Jersey 08094
(609) 629-2800

THE AMERICAN BALER COMPANY
East Center Street
Bellevue, Ohio 44846
(419) 483-5790

AMERICAN BALER & SHEAR SYSTEMS
DIVISION OF CRANE & MACHINERY, INC.
9655 Industrial Drive
Bridgeview, Illinois 60455

AMERICAN RECYCLING SYSTEMS
Post Office Box 1067
Monroe, North Carolina 28110
(704) 289-8244

BALEMASTER DIVISION OF CHICAGO MACHINE TOOL
Post Office Box 465
Crown Point, Indiana 46307
(219) 663-4525

BALER EQUIPMENT COMPANY
Post Office Drawer 1837
Portland, Oregon 97207
(503) 224-9059

BALER SERVICE & EQUIPMENT DIVISION
159 Cook Street
Brooklyn, New York 11206
(718) 456-4440

BALEWELL
980 Crown Point
Post Office Box 465
Crown Point, Indiana 46307
(219) 663-4525

BECKER MACHINERY OF AMERICA
Post Office Box 1349
Crystal River, Florida 32629
(904) 746-6311

BUSS AUTOMATION
Post Office Box 869
Lenoir, North Carolina 28645
(704) 758-2303

C & M COMPANY
Post Office Box 18321
Winston-Salem, North Carolina 27115
(800) 262-9762

C.P. MANUFACTURING INC.
1428 McKinley Avenue
National City, California 92050
(619) 477-3175

CATERPILLAR INC.
100 Northeast Adams Street
Peoria, Illinois 61629
(309) 675-1000

COUNSELOR ENGINEERING INC.
141 Colony Drive
Post Office Box 428
Hudson, Ohio 44236
(216) 656-3247

CRANSTON MACHINERY COMPANY, INC.
Post Office Box 68207
Milwaukie, Oregon 97222
(503) 654-7751

D & J WENDT CORPORATION
78 Industrial Drive
Post Office Box 888
Tonawanda, New York 14120
(716) 694-7901

DENS-A-CAN INTERNATIONAL
Post Office Box 11505
Pittsburgh, Pennsylvania 15238
(412) 963-7004

EAST CHICAGO MACHINE TOOL
Post Office Box 465
Crown Point, Indiana 46307
(219) 221-7662

ECON SCRAP SHEAR COMPANY, INC.
446 Cordele Road
Albany, Georgia 31705
(912) 436-0291

ECONOMY BALER COMPANY
AN AMBACO COMPANY
Hickory Street
Bellevue, Ohio 44811
(419) 483-5790
(419) 483-6710

ELY ENTERPRISES, INC.
3560 West 140th Street
Cleveland, Ohio 44111
(216) 252-8090

EXHIBIT III-5
(Continued)
BALER VENDOR LISTING

ENTERPRISE COMPANY
616 South Santa Fe Street
Santa Ana, California 92705
(714) 835-0541
(714) 835-0551

ENVIRD EQUIPMENT SALES, LTD.
Post Office Box 760
Floral Park, New York 11002
(516) 359-1212

EQUIPMENT CONTROL, INC.
Route 16, Box 184
Statesville, North Carolina 28677
(704) 878-9591

FOX MANUFACTURING COMPANY
3530 West Peterson Avenue
Chicago, Illinois 60659
(312) 463-4947

FRANK MILLER & SON INC.
435 Mt. Hope Street
North Attleboro, Massachusetts 02760
(617) 695-0211

GALLAND HENNING NOPAK, INC.
1025 South 40th Street
Post Office Box 15500
Milwaukee, Wisconsin 53215
(414) 645-6000

GENSCO EQUIPMENT COMPANY, LTD.
53 Carlan Avenue
Toronto, Ontario
Canada M4M 2R6
(416) 465-7521

CARL O. GOETTSCH COMPANY
2203 Carew Tower
441 Vine Street
Cincinnati, Ohio 45202

HARMONY ENTERPRISES
GPI DIVISION
704 Main Avenue North
Harmony, Minnesota 55939
(507) 886-6666

HRB BALER DIVISION
(Harris Press & Shear, Inc.)
A SUBSIDIARY OF AMHOIST
63 South Robert Street
St. Paul, Minnesota 55107
(612) 293-4279

INGOLD'S HICO INC.
Post Office Box 548
Bel Air, Maryland 21014
(307) 879-9114
INDUSTRIAL SERVICES OF AMERICA, INC.
Post Office Box 32428
Louisville, Kentucky 40232
(502) 368-1661

INTERNATIONAL BALER CORPORATION
Post Office Box 6922
Jacksonville, Florida 32236
(904) 356-7411
(800) 231-9286

J.V. MANUFACTURING, INC.
Post Office Box 326
Springdale, Arizona 72764
(501) 751-7320

J.W. INTERNATIONAL CORPORATION
Post Office Box 31331
Charleston, South Carolina 29407
(803) 571-4321

KILKOM, INC.
Spokane Industrial Park
Building 13
Spokane, Washington 99216

LINDEMANN RECYCLING EQUIPMENT
500 Fifth Avenue
Suite 1234
New York, New York 10110
(212) 382-0630

LOAD KING MFG. COMPANY
Post Office Box 40606
Jacksonville, Florida 32203
(904) 354-8882

LOGEMANN BROTHERS COMPANY
3150 West Burleigh Street
Milwaukee, Wisconsin 53210-1999
(414) 445-3005
MAC/SATURN CORPORATION
201 East Shady Grove Road
Grand Prairie, Texas 75050
(214) 790-7800

MARATHON EQUIPMENT COMPANY
Post Office Box 609-A
Vernon, Alabama 35592-0620
(205) 695-9105
(800) 633-8974

MAREN ENGINEERING CORPORATION
Post Office Box 278
South Holland, Illinois 60473
(312) 333-6250

MAYNE MACHINERY COMPANY
Post Office Box 8785
Waco, Texas 76714
(817) 772-2033

McCLAIN INDUSTRIES, INC.
Box M
Utica, Michigan 48087
(313) 264-3611

EXHIBIT III-5
(Continued)
BALER VENDOR LISTING

BRUCE MOONEY ASSOCIATES, INC.
1849 Fairhill Road
Allison Park, Pennsylvania 15101
(412) 367-2686

MOSLEY MACHINERY COMPANY, INC.
Post Office Box 1552
Waco, Texas 76703-1552
(817) 799-2491
(800) 422-2253

NATIONAL BALING PRESS COMPANY, INC.
841 East 43rd Street
Brooklyn, New York 11210
(718) 434-3811
PBE
611 Moorefield Park Drive
Post Office Box 35698
Richmond, Virginia 23236
(804) 323-3519

PHILADELPHIA TRAMRAIL COMPANY
2207 East Ontario Street
Philadelphia, Pennsylvania 19134
(215) 533-5100
(800) 523-3654

PIQUA ENGINEERING
125 Clark Avenue
Post Office Box 605
Piqua, Ohio 45356

PROGRESS WATER TECHNOLOGIES
Post Office Box 33042
St. Petersburg, Florida 33733
(813) 894-0972

RECYCLING EQUIPMENT MANUFACTURERS
North 6512 [illegible]
Spokane, Wa[illegible]gton 99207
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ALAN ROSS MACHINERY CORPORATION
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Northbrook, Illinois 60062
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SEC MAT EQUIPMENT AND
MACHINERY COMPANY LTD.
Post Office Box 296
Station "A"
Weston, Ontario
Canada M9N 3M7
(416) 244-0953

SEGCO PRODUCTS INC.
Post Office Box 406
Baxley, Georgia 31513
(912) 367-4661
(800) 447-3526

SIERRA INTERNATIONAL MACHINERY
1820 East Brundage Lane
Post Office Box 1340
Bakersfield, California 93302
(805) 327-7073

SUPER MARKET SERVICES, INC.
Post Office Box 13108
Port Everglades, Florida 33316
(305) 525-0439

VAN DYK BALER CORPORATION
234 Fifth Avenue
New York, New York 10001
(212) 683-2610

VER-TECH INC.
2892 Vicksburg Lane
Minneapolis, Minnesot[illegible] [illegible]447
(612) 559-2590

VICRON INDUSTRIES, INC.
1000 Enterprise Place
Suite 1000
Arlington, Texas 76017
(817) 467-1161

WESSCO, DIVISION OF
INDUSTRIAL SERVICES OF AMERICA, INC.
Post Office Box 32428
Louisville, Kentucky 40232
(502) 368-1661

WOR-TEX CORPORATION
Post Office Box 636
Hillsboro, Texas 76645
(817) 582-5354

Verticle balers are used primarily by stores and commercial establishments to pull out recyclables like cardboard from their waste stream and bale it as they go. Maximum volumes that vertical balers can handle rarely exceed one ton per hour.

d. Costs

The economic components of a recycling system can be separated into three major categories: capital costs, operation and maintenance costs, and material revenues. Capital costs are incurred when procuring the new facilities and equipment necessary to handle and transport the recovered materials; these costs recur when the recycling system expands or requires replacement of equipment or facilities. Operation and maintenance costs are those particular to the daily activities of recycling. Material revenues are the receipts from the sale of material to markets, net of any transportation costs or other charges. Each of these costs is significant, and collectively they represent the level of comprehensive commitment needed to implement and operate a recycling system.

(1) Capital Costs

The estimated capital costs for the MRF are described in the analyses of Chapter V. Capital costs included are those costs that would be amortized over a 20-year operational life of the MRF, including land acquisition, design, engineering and construction management, utilities, building, and all equipment, as well as startup and testing. Capital costs are projected to escalate at 5 percent per year until construction commences.

The plan of Chapter V is also based on the MRF being publicly owned and capital cost being financed by a public entity. Design and construction is expected to require one year and is based on being performed by a full-service private vendor, such that operation begins in January 1992.

(2) Operation and Maintenance Costs

Operations and maintenance costs include all of the costs required to receive, process, and load materials at the building. Operations and maintenance costs are summarized in chapter V and are based on the quantity of materials projected to be received.

Annual costs include the plant operating personnel, fringe benefits for the personnel, utility expenses, disposal costs for waste residue, insurance premiums, supplies, equipment maintenance, site upkeep, and also a contingency for unexpected expenses.

(3) Revenues

Revenues that will be realized from the operation of the MRF will be the end result of the sequence of activities including collection, transfer and hauling, processing, and marketing. Potential collection methods to be used were identified previously. Most of the materials will be delivered directly by the local collection route vehicles. Processing to upgrade the materials assumed for the revenues was also previously described in this Section.

5. Leaf and Yard Waste Composting

Developing a yard waste composting system is attractive for several reasons. First, the market for the end product, mulch, or compost, is generally available at the local level through the municipality or area landscapers. Second, yard waste, particularly leaves, may already be collected separately, making the system less complicated to develop. Third, yard waste is relatively easy to identify, relatively easy to separate, and represents a significant portion of the waste stream. Significant reductions in land disposal of waste can be achieved via composting of these materials.

Out of all the alternatives for managing yard wastes, the simplest and perhaps most positive is backyard composting and mulching. Both are methods of processing yard waste at the point of generation, rather than transporting the yard waste to a different location for processing. Processing at the point of generation is the least costly management alternative. All municipal collection, processing, and distribution costs are avoided for yard wastes that are composted by homeowners.

Backyard and municipal yard waste composting are complementary activities. The Counties and their member municipalities should encourage backyard composting as part of their overall yard waste management program. Participation in backyard composting and mulching will depend in part on the public's understanding of the need to participate and the methods for the composting process. Cooperation on the part of residents, therefore, will depend heavily on effective public information efforts.

When these practices are successfully promoted by a municipality, a portion of the community's yard waste ceases to be a waste management problem. Whether the motivation is concern for the environment or avoidance of the cost of yard waste collection, home composting, mulching, and leaving grass clippings on the lawn should be the first concept promoted in a public information campaign. Local nurseries, hardware stores, garden clubs, community gardens, and master gardener programs can be important participants in this publicity effort.

Several different municipal composting systems have been developed. The windrow system, which involves creating rows of leaves that are open to the outside air, is the most common method. Also, three different levels of technology for leaf composting can be considered. The one most appropriate for a given application depends primarily on the site selected, the equipment used, and manpower available.

If a large area that is well isolated from sensitive neighboring land uses is available, a very low-cost leaf composting system is possible. Leaves brought to the site are formed immediately into large windrows (for example, 12 feet high by 24 feet wide) using a front-end loader. Once each year the windrow is turned and reformed. An additional windrow is constructed with the new leaves each fall. After three years, the material in a windrow is usually sufficiently well stabilized to be used as compost.

With this approach, some odor can be expected prior to the first turning, and more severe odors may be released during the first turn. Usually by the second turning, odors have diminished. Because of these odors, an extensive buffer zone of up to a quarter mile or more to sensitive neighboring land uses is recommended. This buffer zone requirement can make the total land requirements quite large, even though only a small portion of the site is used for the compost piles. This low-tech approach might be successfully employed in a wooded area (so that only a small clearing would be required); at an isolated industrial site or public works yard.

The obvious advantage of this approach is that it is inexpensive. Only a few days per year of front-end loader operation is required. Even wetting of the incoming leaves may not be necessary except in very dry years, because the large piles will conserve moisture and the long composting time period should maximize exposure to considerable precipitation.

In densely populated areas, siting of a low-technology facility is rarely possible. Therefore, the necessary conditions for rapid composting have to be more nearly met. Rapid composting depends on adequate moisture content, oxygenation, and temperature control.

The simplest way to achieve the desired temperature range is to build moderate size piles (6 feet high by 12 to 14 feet wide). After the first burst of microbial activity, which lasts approximately one month, two windrow piles can be combined to form another similarly sized pile. Water addition, which can be accomplished by wetting the leaves prior to windrow formation, is usually necessary to provide adequate moisture. Using this approach, it is possible to produce a finished compost in 16 to 18 months. Slight odors may be produced early in the composting cycle, but these are usually not detectable more than a few yards away from the windrows. After 10 to 11 months, large curing piles are formed around the perimeter of the site, freeing the original area to accept the new leaf collection. Costs of this system are still quite low, as only three operations with a front-end loader are required after initial windrow formation (one combining, one turning, and one curing pile formation). Less total area is needed for this mid-level technology method than the low-technology approach because of the reduced buffer requirement.

High-technology yard waste processing involves specialized equipment, full-time operators, monitoring of conditions, and aggressive marketing. This approach is used where space is very limited and/or large volumes of yard waste require handling. Leaves are normally placed in a grinder, then mixed with grass clippings and formed into windrows. Brush is often separated and chipped. Windrows are either aerated by forced pressure or by weekly turning by using specialized machines. Piles are continually monitored for temperature and moisture. A compost can be produced in 12 months. Compost is then screened to remove stones, plastic, metal, sand, and other undesirable materials to make it more valuable. High-tech processing sites are often paved, and portions of the processing may be covered by a roof as a control measure.

Many communities begin composting operations with only leaves in the first year. All yard wastes can be composted, but it is advisable to begin composting with leaves alone, adding new materials as experience is gained. Municipal composting of both leaves and grass clippings is not as widely practiced as composting leaves alone. Although grass clippings are readily compostable, they release ammonia as they compost, which poses odor problems that make this option difficult to implement. Optimal means of co-composting leaves and grass clippings are not yet fully developed. If the grass clippings could be delivered to a leaf-composting site without causing odor problems, they could be incorporated into the partially composted leaf windrows. A 3:1 ratio of partially composted leaves to grass clippings is recommended, although a 50:50 ratio may also be satisfactory in some cases. The partially composted leaves act as a bulking agent to improve penetration of oxygen to the grass clippings. Research is currently being conducted across the country to determine the best ways to co-compost leaves and grass clippings. Some issues of concern with the addition of grass to leaf composting operations include the affects of chemicals that are used to fertilize many lawns. Research into this potential problem is ongoing and preliminary results have not been definitive.

Wood tends to decompose very slowly, making composting of woody materials impractical in most cases. Thus woody materials should not be intentionally incorporated in leaf composting windrows. Tree trunks and large branches can usually be easily given away or even sold as firewood. For smaller diameter woody materials, chipping produces a useful mulch. For example, various Wisconsin communities have had great success using wood chips as mulch or bedding for municipal landscaping, park pathways, and school playgrounds. In many communities, residents appreciate free wood chips for their own yards.

The following subsection provides preliminary design information and cost estimates for municipal yard waste composting facility. Certain assumptions, which are outline below, have been made in generating these estimates.

a. Design and Operation

Based on a 1992 waste generation rate of approximately 34,054 tons per year of yard wastes (Phase I Assessment of Solid Waste Disposal Needs, p. 112), and assuming that approximately 47 percent of that waste could be collected through a reasonably aggressive yard waste collection program, 16,000 tons per year of yard wastes has been selected as the preliminary design point. This will be received over a 7-8 month period. Assuming a 300 pounds per cubic yard conversion factor, 106,700 cubic yards of yard waste per year could be expected to be received at a yard waste facility.

Wastes that can be used in municipal yard waste composting operations include leaves, grass clippings, garden wastes, prunings, tree trimmings, and brush. Grass and brush are put into the collection system throughout the growing season, whereas most leaves are collected in the Fall and to a lesser extent in the Spring.

b. Collection System

Similar to the collection of recyclable materials, there are two methods of collection yard waste: Curbside and drop-off. Drop-off collection depends on the community residents (the waste generators) to deliver materials to a designated site. This option is the most economical to the Counties because the purchase of specialized collection vehicles is not necessary. However, this program cannot be expected to generate the volumes obtained from a curbside collection program despite the ban of yard wastes from landfills. In order to maximize recovery of available yard wastes, an aggressive collection system will need to be considered.

Curbside collection systems rely on the residents to place yard waste in bags or loose piles at the curb. Several different vehicles, including vacuum trucks, compactor trucks, front-end loaders equipped with claws, and street sweepers, have been used successfully for existing programs across the United States. The preferred approach toward collection would be to use existing equipment, such as vehicles used for bulky item collection or compaction-type vehicles, for bagged leaf collection. To do this would minimize the capital and operating costs of such collection.

c. Facility Siting

Many factors must be considered when selecting potential municipal yard waste composting sites. These factors include accessibility, nearness to residences and streams, traffic patterns, public acceptance, environmental impacts, land and area requirements, and permit requirements.

The land area required for a composting operation varies with the volume and types of yard waste composted and the type of equipment used for processing the materials. For low-level technology systems, a minimum of one acre per 3,000 to 3,500 cubic yards of plant waste collected is required for the composting operation.

A buffer zone is required between the site and neighboring land to minimize the possibility of odor, noise, dust, and unaesthetic visual effects. A buffer zone of at least 50 feet should be provided between the composting operation and the property line. At least 150 feet should be allowed between composting activities and any sensitive neighboring land uses, such as residences or other land uses that may be considered sensitive.

The composting site should be relatively close to the waste sources in order to reduce transportation time and costs. Roads providing access to the site should be capable of supporting project-related traffic without having an adverse impact on road conditions, traffic patterns, or noise levels. Water and electrical service should be available at the site.

Site size requirements vary with the technology used for composting. For a low-level system, approximately 20 to 25 acres would be required to process the yard waste expected to be collected in the entire service area. Those quantities could be processed on as small as a 5-acre site according to a vendor of a forced aeration composting system,

If a large parcel of land is unavailable or it is undesirable to process all yard wastes at one site, a few smaller sites can be developed. For example, in Ocean County, New Jersey, approximately 120,000 cubic yards of leaves are processed in four county-wide leaf composting sites.

The surface of the site should be level or slightly sloped, and well drained. A paved surface or a hard dirt surface is desirable. This type of surface could withstand the weight of the heavy loaders and turner machinery without large ruts being formed. Steeply sloped land is unsatisfactory because of problems with erosion, vehicular access, and equipment operation. Windrows should run up and down rather than across slopes to allow leachate and runoff to move between piles, rather than through them. Sites that drain directly into streams and lakes must be avoided.

Local ordinances will also need to be reviewed and may need to be revised to allow composting at residences and at a municipal or publically run site. An acceptable site location is important in obtaining public support of the project. Composting operations will sometimes be noisy because of the truck traffic and equipment involved, although the buffer area will provide adequate protection to the adjacent parcels of land. Odors, flies, dust, and other nuisances may occur if the operation is mismanaged, but will be minimal if processing is adequate to ensure that aerobic digestion prevails and no anaerobic digestion occurs. Making the windrow too large is a major cause of odor production at yard waste composting sites. With an initial high concentration of readily degradable material, there is a high demand for oxygen in the composting process. If the windrows are too large, sufficient oxygen cannot penetrate from the outside and a large anaerobic core develops. Under anaerobic conditions decomposition slows down, switching to odor-producing acid fermentation.

A second important source of odor production is failure to form windrows quickly once the yard wastes are collected. Unless the collected yard waste is very dry, leaves cannot be simply dropped at the site for later composting or collected and stored elsewhere without risking odor production. The recommended solutions for eliminating the odors are:

- sprinkle limestone in powdered form directly onto surfaces from which odors are escaping. This method is the simplest odor elimination approach;
- turn large windrows more frequently;
- use smaller initial windrows, as this windrow configuration allows for better aeration; and
- Allow no more than one to two days between collection of leaves and formation of windrows. Grass should be mixed into windrows on the same day as collection.

Communities often locate composting operations at existing or closed waste-handling facilities such as landfills, transfer stations, and sewage treatment plants. Figures III-10 and III-11 show the conceptual site layouts for both mid- and low-technology options. The basic components of the system include a receiving and mixing area, a windrow area, a final curing/storage area, a 45-by-60-foot prefabricated metal building that would serve as a warehouse and an office, combination building with an asphalt floor, and extension of water, sewer, and electric service lines.

d. Equipment

The equipment necessary for composting operations depends on such factors as the types of waste handled, size of the site, and time required to produce a final product of desired quality.

There are four primary pieces of equipment required to produce a quality product in a 12- to 14-month period at a mid-level technology site:

Figure III-10
COMPOST FACILITY LAYOUT
(Low – Level Technology)

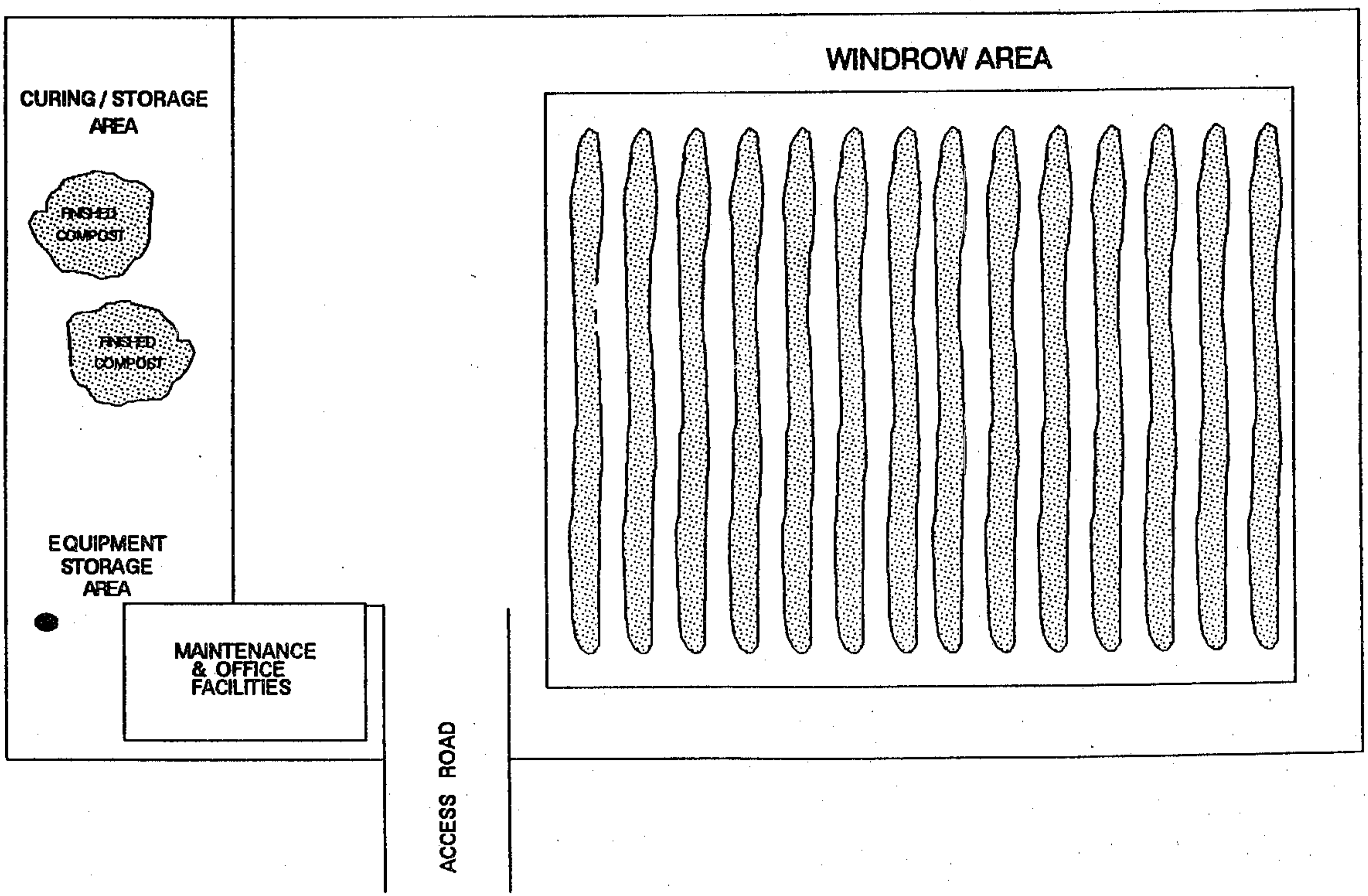
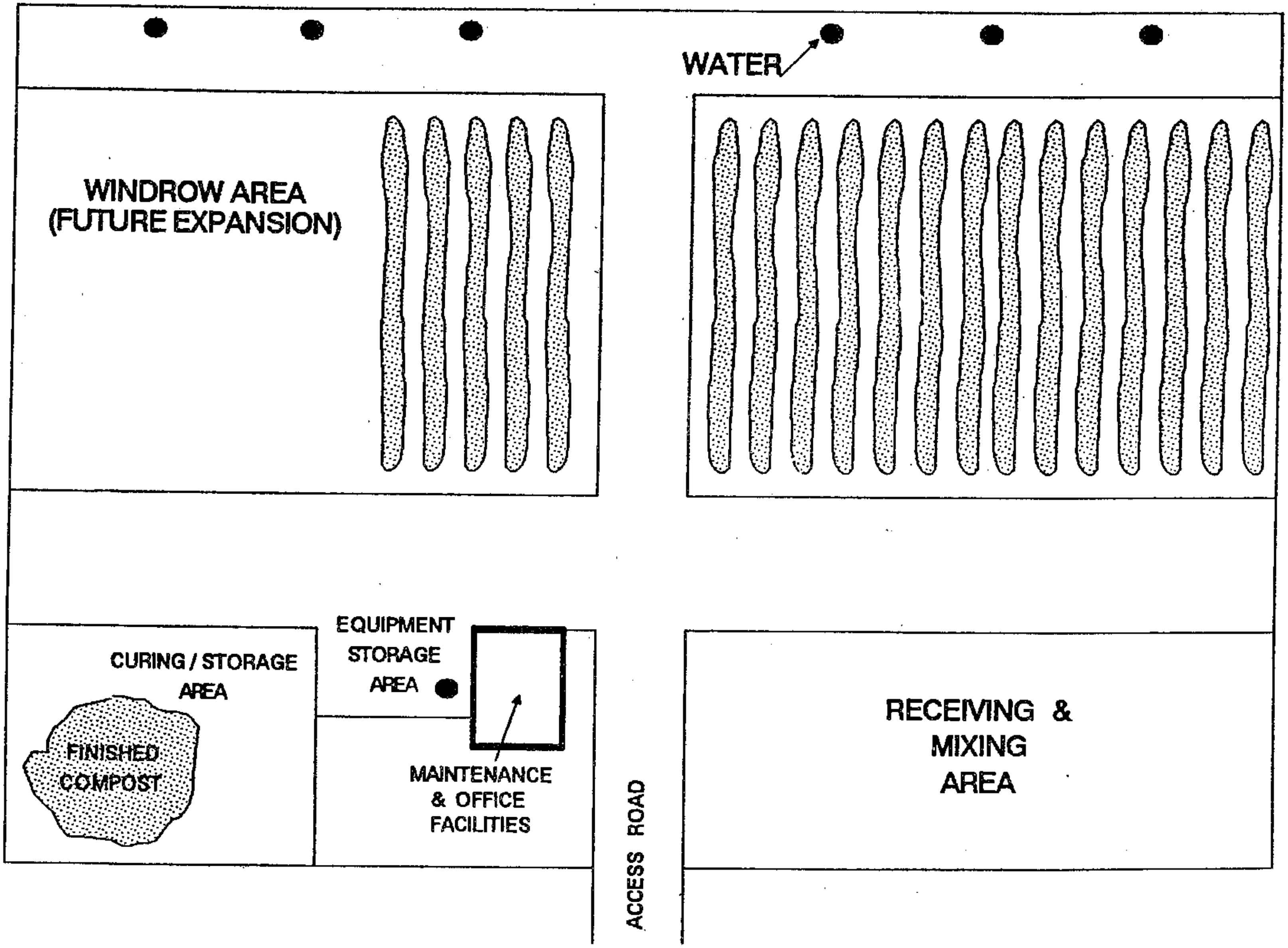


Figure III-11
COMPOST FACILITY LAYOUT
(High – Level Technology)



- a compost turner capable of processing 2,000 tons of compost per hour;
- a portable hammermill "Tub" grinder, capable of processing 10 to 25 tons per hour of a wide variety of woody materials into useful and saleable end products;
- a front-end loader with a six-yard bucket and claw attachment; and
- a compost screen system.

Miscellaneous equipment and supplies include a fuel tank, a chain saw, 500 feet of heavy-duty flexible rubber hose, spare parts for the major equipment, hand tools minor maintenance and repair, and personnel safety equipment, such as hardhats.

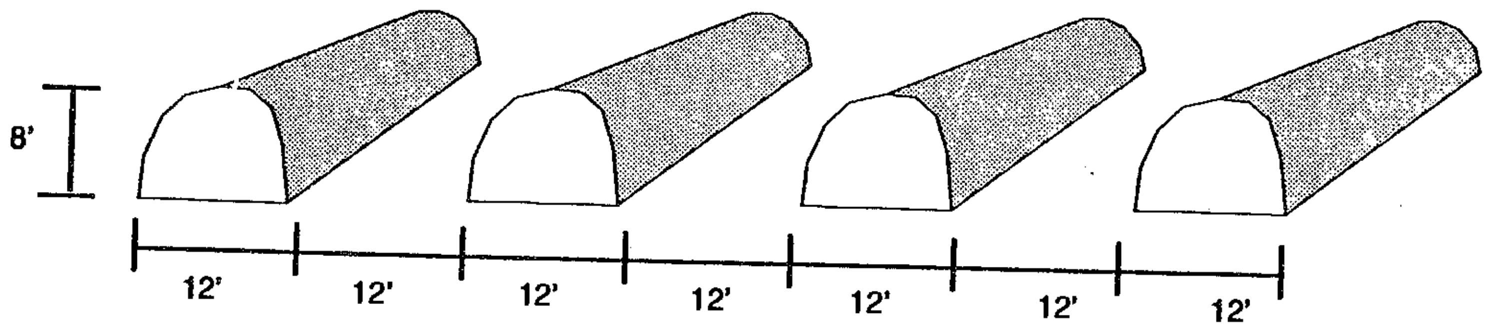
e. Operating Plan

For a mid-level technology system capable of composting incoming wastes in 12 to 14 months, the following operations plan is appropriate. Incoming loads of yard waste will be directed either to the windrow area or the receiving area. Loads go to the receiving area if the materials require grinding, blending, or removal of obvious contaminants. Unwanted materials such as metal objects, rocks, and large pieces of wood should be removed manually. Loads of brush and woody plant wastes will be directed to a corner of the receiving area, where they will be ground in the "Tub" grinder.

After wastes are sorted and blended, or if the incoming loads are exceptionally clean, the wastes will be placed into windrows using the front-end loader. Windrows are designed to maintain the air, moisture, and temperature required for composting and to minimize space requirements. The windrows should initially be 6 feet to 8 feet high and 12 feet to 14 feet wide (see Figure III-12). Windrows that will be left over winter should be 10 feet to 12 feet high and 30 feet to 40 feet wide to prevent freezing in Illinois' cold climate. The length of the windrows may be adjusted to fit the site. Each windrow will be turned frequently (once per week for the first few weeks and then once per month) with the compost turner. After approximately one month, much of the initial oxygen demand of the leaves has been exerted and the windrows have been reduced to about half their original size through decomposition. At this point, two windrows can be combined to form a single one about the same size as each of the initial windrows. Combining the windrows will help conserve heat during colder weather. Portions of the center of the new, combined windrow may go anaerobic temporarily, but significant odors and acidification are not expected because much of the readily degradable material has already been consumed by the microorganisms.

Figure III-12

Windrow Pile Formation



These containers would require servicing daily or as needed. There would be a significant cost to the building owners to provide this service. One of the purposes of trash chutes is to avoid paying for collection on each floor. Adding a separate recycling collection on each floor will cancel any savings from the chute system unless a reduction of waste collection costs through reducing size of trash containers or frequency of collection can be realized.

(3) Outdoor Dumpsters

Many apartment or condominium buildings require residents to carry their trash outside to a dumpster which is emptied periodically by a contract or municipal hauler. In these situations, program designers should take advantage of occupants habits by placing one or more additional containers for recyclables next to the trash container.

(4) Other Methods

Other methods of storage and collection at multifamily dwellings include regular trash cans (30 to 90 gallons), drums, wheeled carts, or bins. These containers could be emptied by manual labor, hydraulic tailgates or specialized lift devices. When selecting the best storage container for recyclables, consideration of collection efficiency, labor requirements, and access should be given.

(5) Integration of Storage, Collection and Processing

When designing a multifamily recycling storage and collection system one must always keep in mind that the program is only one component of a larger program involving storage and separation by residents, manual and/or mechanical collection, delivery to some type of processing/storage facility and marketing of materials. How each of these activities are accomplished must take all the other steps into consideration.

Materials should not be designated for collection if no market arrangement exists or if required processing or storage can not be accommodated. Containers used by multifamily programs must be compatible with available collection trucks. Collection trucks must be able to deliver material in an acceptable manner to the processing facility, which must be able to accept it, handle it, process it, and sell or otherwise move the material.

Equipment selected for each component of the system must be compatible with and integrated into the rest of the process. Therefore it is important to have a single point of coordination to oversee system component design and equipment selection.

Another consideration when planning for recyclable materials collection from multifamily residences is the home storage of the facilities and then supplement these with a single, reduced sized facility at the landfill. Pursuing this option will take coordination on the part of both the Counties and their municipalities and joint marketing of the compost product should be considered.

6. <u>Commercial Recycling</u>

a. Multifamily Collection

The principal behind collection of recyclables from multifamily residential dwellings is no different than from curbside collection from single-family residences -- maximize ease of participation for the resident. Planning for collection of recyclables from multifamily units must take into account existing "trash habits." Most apartment buildings, for example, have established procedures for refuse disposal. Residents may take their garbage to a "trash room," may access trash chutes, or may be required to take their waste to an outside dumpster. The mechanism chosen for collecting recyclables should mirror the approach used for regular trash disposal if possible.

(1) Trash Room

Apartments and multifamily units that have designated rooms or areas for trash often utilize containers or stationary compactors which can be serviced from outside the building. Designated recycling containers could be placed next to the trash container. Some modifications may be necessary to make recycling easy for residents and still take advantage of similar habits. For example, a chute could be installed next to the trash hopper to direct recyclables outside to a container that can be serviced from outside the building. Any modifications or additions to buildings or structures should meet all zoning, fire, and other local codes and requirements.

(2) Trash Chutes

High-rise buildings that are equipped with trash chutes on each floor offer challenges to recycling system designers. Chutes are usually made to accept waste from each floor and direct it into a single chute running the full height of the building. The chutes generally empty into containers in the basement or ground floor. It would be difficult to take advantage of this system to collect recyclables. The one conceivable way to use the chutes would be to provide special bags for recyclables and separate the bags out of the trash containers at the bottom. Specially designed recycling bags that may have application in such situations were described more fully in the previous section on collection containers. Several communities in Oregon have recently begun such collection programs and are reporting success. Another system that would be perhaps more viable would involve placing special containers on each floor for recyclables near the trash chutes.

This analysis is always specific to each community and usually specific to each building.

b. Collection of Recyclables from the Commercial Waste Stream

When designing recyclables collection systems for the commercial sector, it is critical to understand what is being generated that can be efficiently recovered from the commercial waste stream. Industry typically recovers and recycles much preconsumer scrap, sometimes called runaround scrap. Other commercial recycling activities exist -- a small manufacturing facility on the Eastern Shore of Maryland, for example, encourages their assembly line workers to accumulate bits of copper wire scrap. These little pieces of wire are stored in bins next to each workers' station and the proceeds from selling the scrap wire are used for employee social functions and facility improvements. However, the most prevalent commercial sector recycling programs involve recovery of paper products, mostly corrugated cardboard.

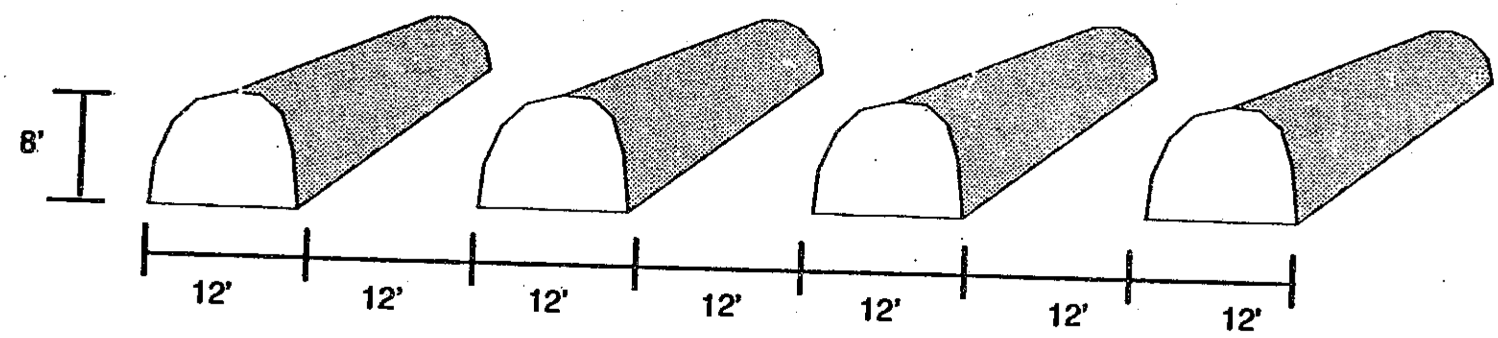
(1) Corrugated Cardboard

Designing a system for the collection of recyclables from the commercial establishment must take into consideration how the waste stream is generated and how it leaves the generator. As with other recycling activities, source separation and participant education is the key to success. For a corrugated cardboard recovery operation, it is essential to work with the existing waste disposal system to collect the corrugated before it becomes contaminated with the rest of the waste stream. Collection and separation needs to occur at the point of generation before recyclable materials are mixed with other refuse.

Corrugated cardboard is estimated to compose approximately 18 percent of the combined residential and commercial waste stream of the area. Corrugated recovery, therefore, will need to be aggressively pursued to meet recycling goals. Ways to maximize corrugated recovery include establishing a mandatory corrugated recycling initiative and incentives for source separation. For example, in a corrugated recovery program, tipping fees could be reduced or eliminated for corrugated-rich loads and/or the generator could be paid for the materials. In many waste management systems, facilities for recovering cardboard are located at transfer stations or landfills. Commercial haulers are offered incentives through reduced tip fees or required by ordinance or regulation to deliver cardboard loads to designated areas, usually close to a baler. This material is dumped onto a tipping floor and picked through by workers (thus the term "dump and pick"). The acceptable cardboard is pushed or placed into a baler hopper or feed conveyor.

A significant portion of waste from commercial retail establishments (fast food restaurants, grocery stores, shopping

Figure III-12
Windrow Pile Formation



Combining should be done by moving and turning both windrows, not by placing one on top of the other. The maximum degree of mixing and fluffing is desired.

Composting windrows should be monitored to ensure that decomposition proceeds properly. Monitoring should consist of daily temperature readings at several points in each windrow and twice-per-week inspections for moisture content, physical appearance, and internal windrow odor. Water should be added to the piles when wastes become dry during the decomposition period. The rule of thumb indicates that optimally the leaves should be moist like a damp sponge. When a handful is squeezed several droplets of water should squeeze out. If the leaves are dry and crumbly, water should be added. When decomposition is completed, the compost will be moved to the final storage area to cure for at least a month before use and then screened to improve the physical quality of the finished compost.

As early as is practical in the spring (March or April), each windrow should be turned. Turning mixes the material, redistributes the moisture in the windrow, reoxygenates the interior, and exposes the formerly cool edges to the hotter internal temperatures. The result is an increased rate of decomposition and improved destruction of any pathogens and weed seeds. The destruction of plant pathogens and weed seeds is particularly important if the final compost is to be considered saleable to nurseries and landscapers.

As with the prior combining operation, maximum mixing and fluffing is desired during turning. At this time additional water may be added if the material is too dry; however, every effort should be made to provide sufficient water at the time of initial windrow formation.

f. Personnel

The operation requires workers that will share the major operational tasks of directing loads of yard waste, hand sorting whenever required, grinding woody materials, mixing, forming windrows, turning composted materials, monitoring, and screening the final product.

g. Costs

Several options are possible for developing a yard waste composting project. A large site designed to serve the needs of the service area could be developed at the existing landfill. Such a site would receive yard waste collected throughout the service area. Alternatively, smaller regional sites could be developed, which would accept yard waste from smaller geographical areas. Total capital and operating costs may be greater, but transportation costs would be reduced. As an option to several composting facilities, municipalities could be encouraged to site facilities and then supplement these with a single, reduced sized facility at the landfill. Pursuing this option will take coordination on the part of both the Counties and their municipalities and joint marketing of the compost product should be considered.

6. Commercial Recycling

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Materials should not be designated for collection if no market arrangement exists or if required processing or storage can not be accommodated. Containers used by multifamily programs must be compatible with available collection trucks. Collection trucks must be able to deliver material in an acceptable manner to the processing facility, which must be able to accept it, handle it, process it, and sell or otherwise move the material.

Equipment selected for each component of the system must be compatible with and integrated into the rest of the process. Therefore it is important to have a single point of coordination to oversee system component design and equipment selection.

Another consideration when planning for recyclable materials collection from multifamily residences is the home storage of the materials. Apartments typically have small kitchens and limited storage space. Home storage containers for these units must be sized appropriately so as not to become a nuisance. Commingled collection is generally advisable under such settings -- one storage container takes up less space than three. As with single-family residential collection, the householder may deliver commingled materials to the set-out point. Under such a scenario, commingled materials would probably be taken to a centralized sorting and processing facility. Another approach would involve residents collecting the materials in a commingled fashion in the home, but sorting the materials into appropriate bins at the point of set-out.

Many apartment buildings use 2- to 6-yard dumpsters for regular garbage collection. These containers are almost always mechanically dumped. If the same system is to be used for collection of recyclables, setting out commingled materials may minimize glass breakage in dumping because paper, cardboard, plastics, and cans act as a buffer for the glass. Some specialized collection trucks have rubber floors and/or flaps that affect the flow of incoming materials and serve to minimize breakage.

With multifamily residential dwellings, it is most common to have refuse collection accomplished by private sector haulers, even if the rest of the residential sector is serviced entirely by municipal collection. In these settings, private collection of recyclables could be expected.

(6) Incentives for Multifamily Recycling Programs

Several states have adopted mandatory recycling legislation which requires all residences, including multifamily dwellings, to separate recyclables from trash and requires collection of these recyclables. In these states such laws are clearly the major influencing factor.

There are however, clear economic incentives for owners and managers of apartment buildings and others responsible for paying waste collection costs. If residents are provided with recycling opportunities that are convenient, reliable and well presented, participation rates can be expected to be high. Good participation results in significant diversion of material from the waste stream. Waste stream reduction can result in smaller trash containers or less frequent dumping which can result in a savings in the building's collection costs.

Careful analysis of waste collection savings versus increased costs for recycling collection must be completed before any conclusions or potential savings are reached. Consideration must be given to those who actually do the collection, how the building is charged for recycling collection (direct billing, taxes) revenues from the sale of material, potential waste collection and landfill tipping fees savings, and other factors.

This analysis is always specific to each community and usually specific to each building.

b. Collection of Recyclables from the Commercial Waste Stream

When designing recyclables collection systems for the commercial sector, it is critical to understand what is being generated that can be efficiently recovered from the commercial waste stream. Industry typically recovers and recycles much preconsumer scrap, sometimes called runaround scrap. Other commercial recycling activities exist -- a small manufacturing facility on the Eastern Shore of Maryland, for example, encourages their assembly line workers to accumulate bits of copper wire scrap. These little pieces of wire are stored in bins next to each workers' station and the proceeds from selling the scrap wire are used for employee social functions and facility improvements. However, the most prevalent commercial sector recycling programs involve recovery of paper products, mostly corrugated cardboard.

(1) Corrugated Cardboard

Designing a system for the collection of recyclables from the commercial establishment must take into consideration how the waste stream is generated and how it leaves the generator. As with other recycling activities, source separation and participant education is the key to success. For a corrugated cardboard recovery operation, it is essential to work with the existing waste disposal system to collect the corrugated before it becomes contaminated with the rest of the waste stream. Collection and separation needs to occur at the point of generation before recyclable materials are mixed with other refuse.

Corrugated cardboard is estimated to compose approximately 18 percent of the combined residential and commercial waste stream of the area. Corrugated recovery, therefore, will need to be aggressively pursued to meet recycling goals. Ways to maximize corrugated recovery include establishing a mandatory corrugated recycling initiative and incentives for source separation. For example, in a corrugated recovery program, tipping fees could be reduced or eliminated for corrugated-rich loads and/or the generator could be paid for the materials. In many waste management systems, facilities for recovering cardboard are located at transfer stations or landfills. Commercial haulers are offered incentives through reduced tip fees or required by ordinance or regulation to deliver cardboard loads to designated areas, usually close to a baler. This material is dumped onto a tipping floor and picked through by workers (thus the term "dump and pick"). The acceptable cardboard is pushed or placed into a baler hopper or feed conveyor.

A significant portion of waste from commercial retail establishments (fast food restaurants, grocery stores, shopping malls, department stores) is cardboard. Generally, if corrugated cardboard is collected separately from trash for these businesses, the size of trash containers can be reduced, sometimes by half. Some state or local governments require cardboard separation at all commercial establishments. Private paper dealers and/or haulers may put baling equipment on-site to encourage separation, collection, and storage of the target material.

The collection mechanism for recyclables in the commercial sector will probably vary little from the collection of garbage. Typically collection is mechanized. Sometimes adding a separate container for cardboard is all that is necessary. If cardboard makes up the largest component of the waste stream, then a smaller container for noncardboard may be the only adjustment. Obviously, local markets, processing capabilities, and possibly other factors must be considered in starting a commercial collection system.

(2) Office Paper Collection

Many office buildings generate more office paper than any other type of waste. If this material can be captured in a recycling project and diverted from the waste stream, the waste collection costs of a business can be reduced. The key to office paper recycling programs, as with other recycling efforts, is education and separation. In order to achieve diversion goals, it will be necessary for the Counties and their member municipalities to aggressively target the available high-grade office paper and clean computer printout paper from the area's commercial waste stream. The markets for mixed waste paper have traditionally been volatile and generally provide marginal revenues. However, the market value of high-grade office paper and clean computer printout paper is stronger.

Systems designed for collection of such office waste need to consider the point of generation -- usually someone's desk, the copier, and computer work stations. Storage containers appropriately placed at these points can be used to recover uncontaminated office paper waste. Depending on market requirements, only white paper may be accepted, staples may need to be removed, and card stock may not be acceptable. Other grades of paper allow a wide variety of common papers to be recovered. Whatever the market constraints, the waste generator and source separators need to be informed and reminded often of the requirements.

Common approaches to office paper recycling include "second bin" systems and desktop systems. Second bin approaches usually involve storage bins (like home storage containers) strategically located near points of generation for collection of recovered paper. These bins may be collected weekly, biweekly, or on an as-needed basis. Sometimes private haulers are contracted to go through a facility, consolidating paper into a centralized cart, or a facility employee may be responsible for consolidation.

The desktop system usually allows for a side-caddy bin or a desktop basket for placing recyclable paper products. Under this approach, the individual would empty these containers into more centralized storage areas until the paper was shipped and/or collected.

Markets for recovered office paper may supply and/or lease storage systems, may provide for collection, and may pay for recovered materials and/or provide free collection. Some markets may supply on-site processing equipment, such as shredders or balers, to maximize recovery efficiency.

The success of such programs, as with all recycling activities, depends on the appropriate mix of recycling strategies with existing waste collection methods and the education of the waste generator as to the ins and outs of recycling.

C. MIXED WASTE RECYCLING TECHNOLOGY

In contrast to source separation recycling, the alternative technologies discussed here involve processing of the mixed waste to produce recovered materials and/or fuel. Those that rely entirely on sale of materials and biological processes have not demonstrated commercial feasibility; and those that combust a refuse-derived fuel are subject to the same concerns as mass burn facilities.

An overview description of each of the alternative technologies is provided on the pages that follow. These descriptions highlight each of the technologies. Project examples, where applicable, are also provided.

Both landfilling and mass burn waste-to-energy facilities can accept mixed waste. Alternative disposal technologies, on the other hand, all require some degree of preprocessing (front-end processing) to separate the MSW stream into its various components before the technology can be applied to the combustible or organic fraction of the MSW stream (see Figure III-13).

A typical front-end mechanical processing system separates mixed MSW by a series of shredders, screens, magnets, and density separators (some versions are called air classifiers) into three end products: combustible organic materials such as paper and plastics; noncombustibles such as metals and glass; and process rejects and residue that require landfilling. These residues contain both combustible and noncombustible materials. The types of equipment utilized and the order in which such equipment is used to process MSW depend on the subsequent technology being applied and on the end product desired. In addition, individual companies offering these technologies have developed different approaches or arrangements, which are felt to be proprietary. Table III-1 summarizes the primary vendors of mechanical front-end processing

Figure III-13
Alternative Technology Waste Flow

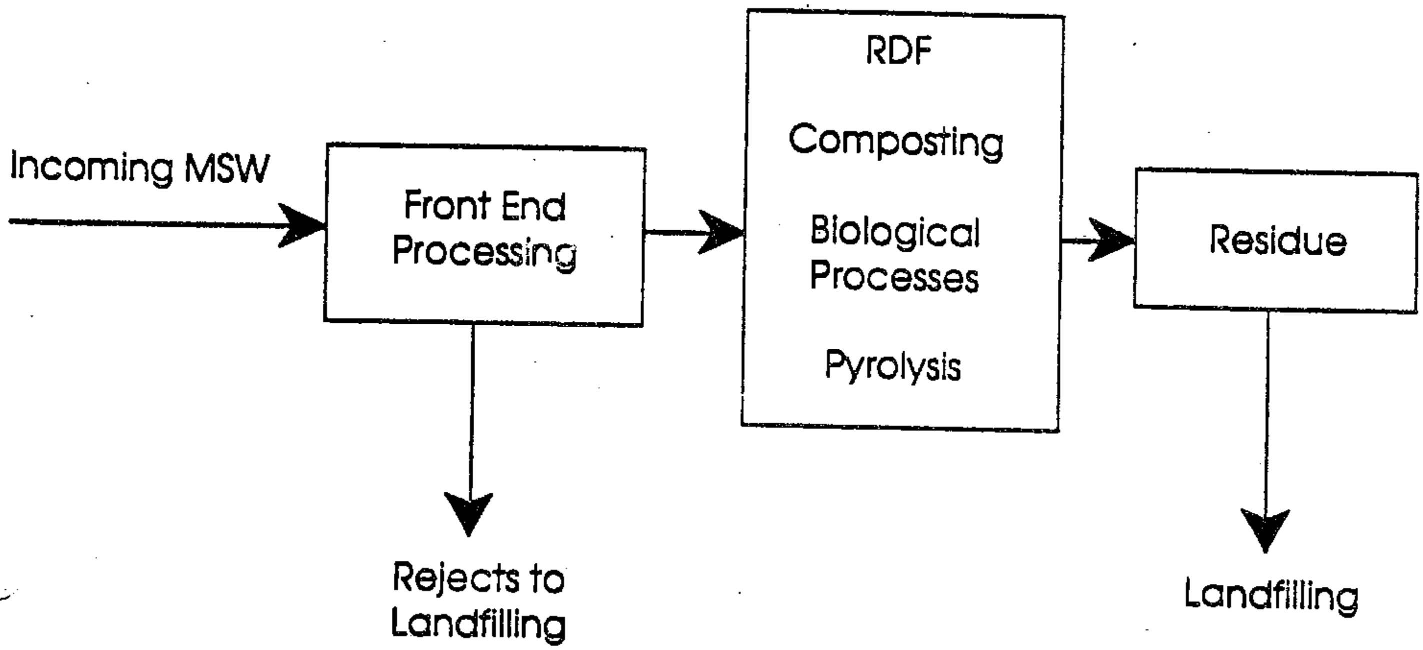

TABLE III-1

MECHANICAL SEPARATION SYSTEM VENDORS AND PROJECTS

VENDOR	PROJECT	CAPACITY (TPD)	PROCESS	STATUS
Waste Management, Inc./NCRR Oak Brook, Illinois	City of New Orleans	750	MSW processing: materials recovery	Facility complete in 1978 and ceased operations in 1982 due to economic reasons
ORFA Cherry Hill, New Jersey	Germany	650	MSW processing: materials recovery; fiber production	Under construction
	Montreal	450-500	MSW processing: materials recovery; fiber production	Permit stage
	Philadelphia	450-500	MSW processing: materials recovery; fiber productino	In shakedown
	Boston	450-500	MSW processing: materials recovery; fiber production	Permit stage
Flakt, Inc. Sweden (No longer in the mechanical separation business)	Stockholm Sweden	5.5 (TPH)	MSW processing: materials recovery	Pilot project from 1974 to 1976. Facility has since been shipped to Japan for use as a demonstration project.
	Lovsta, Denmark	110,000	MSW processing: materials recovery	Operational since 1979
	Stockholm, Sweden	55,000	MSW processing: materials recovery; connected to an MSW incineration facility	Operational since 1980
	Wijster, Netherlands	N/A	Materials recovery capable of recovering (annually): 16,000 tons of paper; 3,500 tons of metals; 4,500 tons of plastics; and 40,000 tons of organics for composting	Operational

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(.tinued)

MECHANICAL SEPARATION SYSTEM VENDORS AND PROJECTS

VENDOR	PROJECT	CAPACITY (TPD)	PROCESS	STATUS
Sorain-Cecchini Rome, Italy	Rome West	600	MSW processing; materials recovery	Start-up in 1964
	Rome East	1,200	MSW processing; materials recovery	Start-up in 1967
	Rio de Janeiro, Brazil	450	MSW processing; materials recovery	Start-up in 1971
	Perugia, Italy	220	MSW processing; materials recovery	Start-up in 1972
	Pomezia, Italy	20	Plastic film cleaned and regranulated into reusable plastic pellets	Operational pilot plant
	Oiso, Norway	750	MSW processing; materials recovery	Start-up in 1985
	Toronto, Canada	250	MSW processing; materials recovery	Under construction
Raytheon Service Company Burlington, Massachusetts	Delaware Reclamation Project (design/construction/operation)	1,000 MSW, 350 digested sewage sludge	MSW processing; materials recovery; RDF and compost production	Operational
Dano System Sorengo, Switzerland	200 facilities worldwide utilizing the patented Dano Bio-Digester (a few are provided below)	N/A	Mechanical processing materials recovery Bio-Digestion; RDF production; compost production	Operational in New Zealand, Japan, South America, Africa, Iceland, India, Indonesia, Syria, Singapore, and Europe
	Salford Plant Manchester, England	2,688	MSW processing; materials recovery; compost production	Operational since 1979
	Fredericksund Plant Copenhagen, Denmark		MSW processing; materials recovery; compost production	Operational
	Berganland Plant Oberpullendorf, Austria		MSW processing; materials recovery; compost production	Operational
	Duisburg Plant Huckingen, West Germany		MSW processing; materials recovery; compost production	Operational

systems and their associated projects. The remainder of this section reviews systems that have employed (and/or currently employ) a mechanical separation system for materials recovery and other end products.

1. <u>The ORFA Process</u>

ORFA's patented non-burn system consists of five main processes to convert MSW into totally recyclable fractions. The basic components of the process are:

- size reduction
- ferrous removal
- drying
- ozone treatment of separated fiber stream to biologically stabilize and sanitize
- air classification to separate fibrous and nonfibrous materials

The ORFA process first shreds the incoming MSW, then magnetically removes ferrous materials. An air classifier separates light materials (e.g., paper, film plastic) from heavier materials (stones, plastic, wood, compact waste, etc.). Heavy materials are fed into a hammermill, and light materials are run through a cutting mill (shredder) for reduction to the desired size. These two fractions are brought together again and fed into a dryer-sterilization drum. The material is then fed directly into a ozonization drum for stabilization. The main function of ozoning is biological stabilization through the destruction of fat and butyric acids, and to eliminate any remaining odors. The resulting material is sifted into coarse, medium, and fine particles. Additional air classifiers separate each of the three streams into light and heavy fractions. The light fractions of each are the ORFA Fiber product. The heavy fractions are mixed glass, sand, gravel, metals, and plastics, which ORFA claims can be used for cement blocks, tiles, or roadfill.

ORFA Fiber is expected to be marketed to the pulp and paper industry as a secondary fiber, serving as a substitute for standard recycled paper. Other potential markets for the ORFA Fiber include fuel pellets (RDF), kitty litter, combination boxboard, medium density insulation board, wet machine board, gypsum liner, bulking agent for compost, and other paper industry products.

The granulate material consists of plastic, sand, glass, nonferrous metals, and other dense materials. It is to be used as landfill cover. Testing is underway to determine the economic viability of separating out various portions of the granulate fraction for sale, particularly the glass and aluminum portions.

Ferrous is classified as municipal scrap and would be sold to local scrap dealers and markets.

Of the total MSW stream going into a facility, approximately 50 percent is recovered as the ORFA Fiber product, 5 percent is recovered as ferrous metal, and 8-10 percent is recovered as heavy fraction granulate. Approximately 14-16 percent of the incoming MSW ends up as dust collected in the baghouse, with much of the remainder being moisture evaporated during the drying process. Although ORFA claims no dependence on landfill, the material captured in the baghouse is landfilled, and 1-2 percent of the incoming waste can't be processed and becomes bypass waste.

ORFA has a 200 TPD facility that began commercial operation in Philadelphia in early 1989. A pilot plant is operating in Switzerland, and a 650 TPD facility is now under construction in Germany. A 450 to 500 TPD plant is in planning in Montreal, and two plants are planned in the United States, in Philadelphia and Boston.

The existing facility in Philadelphia is designed to process waste that is 90 percent unsorted and unseparated MSW and 10 percent commercial. However, early reports from the start-up phase indicate a waste stream that appeared to be heavily commercial and primarily paper.

2. Flakt, Inc., System

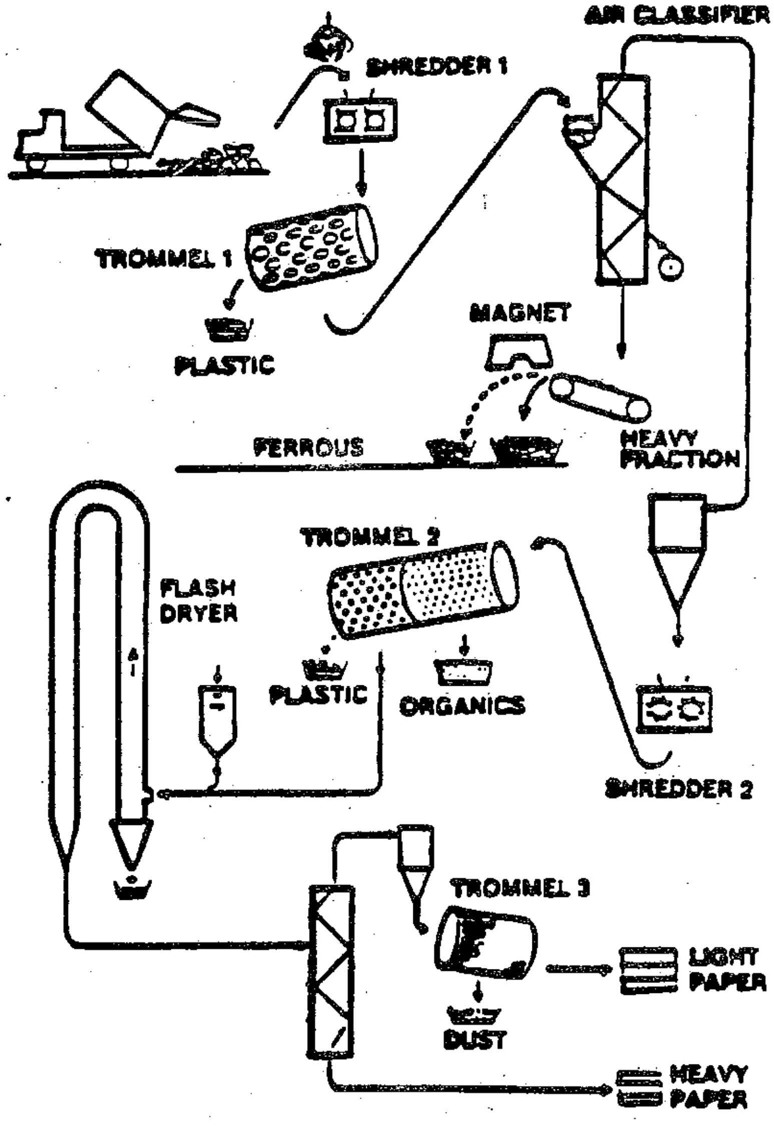
The FLAKT system for mechanical recovery of materials from MSW employs the dry method, in which the various substances are sorted and recovered without the addition of water. Undesirable constituents such as dust and food remnants, which represent an appreciable proportion of MSW, are claimed to be separated more effectively, thus making the final product commercially more attractive.

A pilot plant operated from 1974 to 1976 in Stockholm, Sweden, at the Hogdalen MSW waste-to-energy plant. The plant, schematically presented in Figure III-14, had a nominal capacity of five and a half tons per hour. The front-end processing system components of the plant consisted of a primary shredder, a primary trommel screen, an air classifier, a magnetic belt separator, a secondary shredder, and a secondary trommel screen.

The primary back-end component associated with this pilot plant was the flash dryer, which rendered the processed paper product biologically stable. This allowed it to be stored, transported, and handled.

After extensive development, work on the pilot plant was completed at the end of 1976, and commercial application was studied in detail. The plant was subsequently disassembled and

Figure III-14
Flow Sheet of Flakt MSW Pilot Plant
(Stockholm, Sweden)



shipped to Japan, where it was reassembled for demonstration use. During 1977, an order for a plant with a rated capacity of 110,000 tons per year was received from a state-owned Dutch company. This plant, located in Lovsta, Denmark, began operating in 1979. In early 1978, the City of Stockholm ordered a similar plant with a capacity of 55,000 tons per year. This plant became operational in 1989. In addition to the facilities just described, a plant was constructed at Wijster in the Netherlands.

Given the current depressed state of the secondary materials markets, Flakt's future interest in MSW recycling is not clear. Most observers expect that Flakt will limit its activities to a maintenance level until the market for paper extracted from MSW improves. The high capital costs associated with equipment-intensive processing such as that used in the Flakt plants pose another obstacle. In the late 1970s and up until 1989, Flakt had a U.S. representative for waste-to-energy activities, after which they withdrew from the U.S. market.

3. Sorain-Ceccini System

Sorain-Ceccini (Sorain) has five fairly traditional materials processing facilities operating in Italy, Brazil, and Norway, and a number more in planning or under construction, including a facility at the front end of the North County project in San Marcos, California.

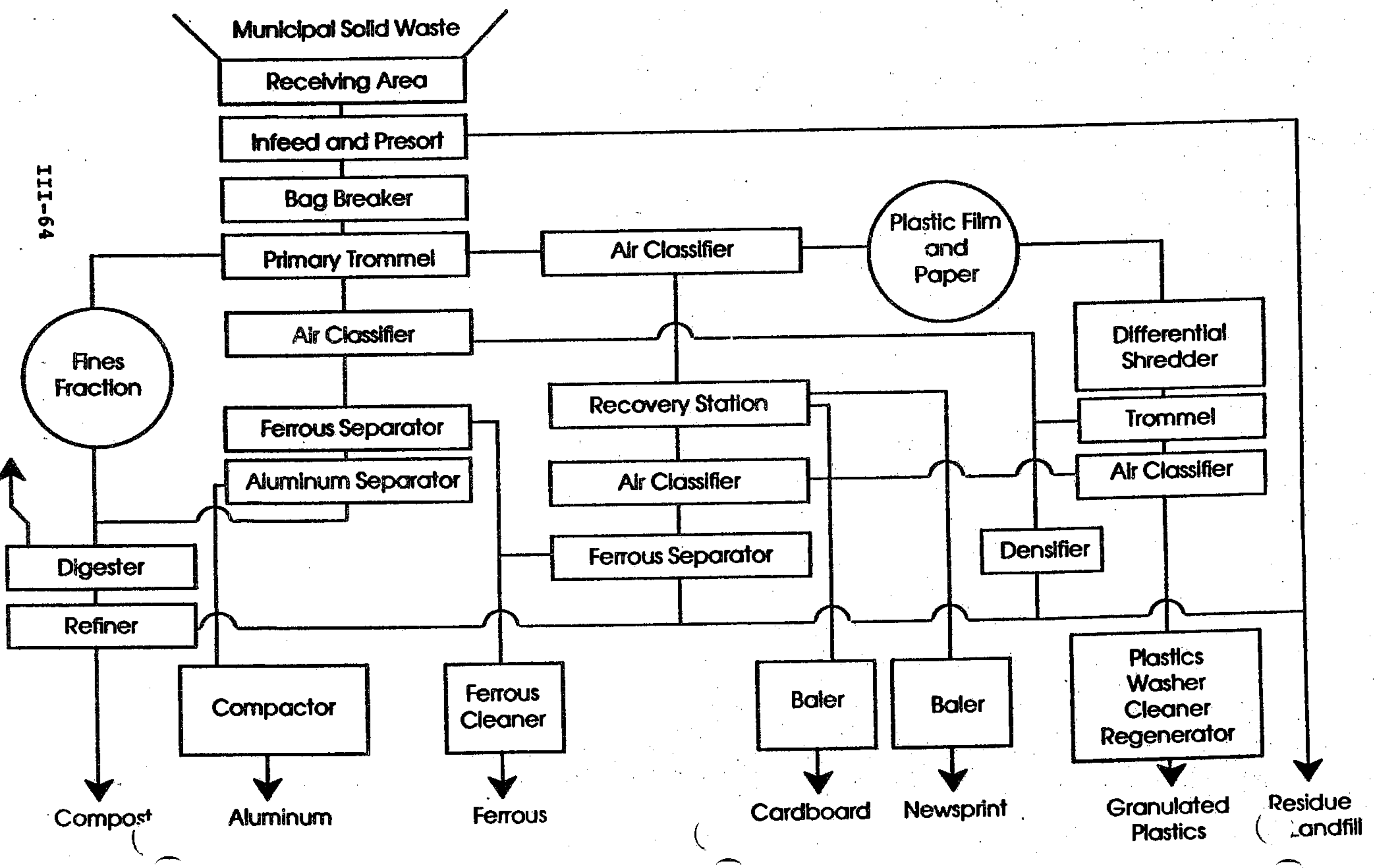
A unique aspect of the Sorain system is a film plastic regeneration process, which is only operational at a 20 TPD pilot plant in Pomezia, Italy. Film plastic is recovered at several Sorain-Ceccini facilities, however. The Sorain process removes film plastic (nonchlorinated, low-density polyethylene material) by air classifying oversize materials from the primary trommel (this is called presorting). The presorted material is sent to a differential shredder, which shreds paper but not plastic film or textiles. A second trommel screen removes the shredded paper and a second air classifier removes the textiles. The remaining material, primarily film plastics, is shredded again then prewashed, dewatered, washed again, and dried. The dried plastic is melted and granulated for re-use.

Process steps handling other fractions of the MSW stream resemble traditional RDF processing (See Figure III-15). These steps include screening, shredding, magnetic separation, and air classification. Other process steps associated with the system include digestion of fines for compost production and various materials separation and processing components.

Potential products recovered from the Sorain-Ceccini system include:

- baled paper (corrugated, newsprint, and/or mixed)

Figure III-15
Mechanical Recovery System



- baled film plastic

- ferrous metal

- aluminum

- compost (made from fines and the organic fraction)

- refuse derived fuel (RDF)

In the United States, where a different waste composition will change the output product mix, restrictions on contaminants in the waste products may limit the use of compost.

In recent years, Sorain has attempted to enter the U.S. waste-to-energy market. Sorain has completed feasibility assessments for recycling plants in more than a dozen cities, and is working on construction of the 1,650 TPD North County Recycling and Energy Recovery Center in San Marcos, California. Sorain technology will be used for the MSW handling system and will include the film plastic recovery process. A facility start-up scheduled for early 1989 has been delayed.

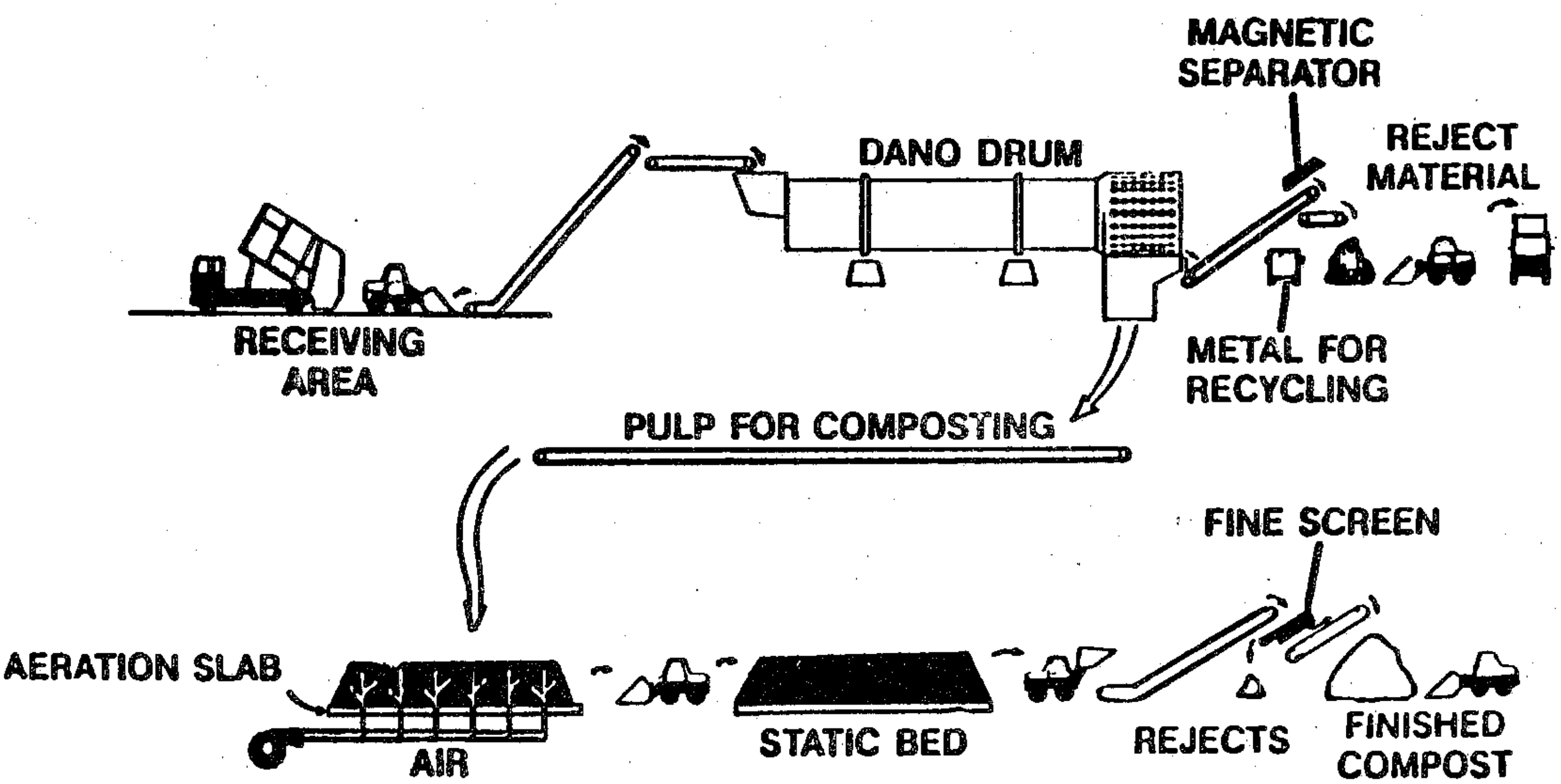
In order for Sorain to be a viable turnkey or full-service vendor in the United States, they will need to develop experience in this country and a solid track record. In addition, Sorain will need to develop or find the organization necessary to provide the management and financial requirements that are needed to compete in the U.S. market.

4. <u>Dano System</u>

The Dano system can be used to process MSW in a variety of ways. It can produce compost for horticulture and agriculture, or an RDF product that can be burned with other fuels or alone. Either of these two products mentioned can be produced with or without sewage sludge. Other materials (metals, glass, and plastics) can also be recovered by adding a mechanical processing component, thus reducing the volume of materials destined for a landfill site even further.

The basic process flow of the Dano system is illustrated in Figure III-16. MSW is deposited on a tipping floor and conveyed into the mixing chamber. Bulky materials are separated prior to the mixing chamber. The Dano Digester is a large rotating cylinder in which the MSW becomes hot, from friction and aerobic reactions, and moist, from added water. The material is mixed in the digester and is readily broken down. The output from the Dano tube is a homogeneous pulp of semi-mature compost and separate inorganic "rejects." When the material exits the tube, the fine material passes through the first screen, while the coarser material passes through a second screen. The oversized material is the "reject" fraction.

Figure III-16
The Dano System



The small fraction of the material, mostly plastic and glass fragments, could be put to several uses, including road bedding and rehabilitating nonfriable land. The remainder is sent to a fermentation cell, where it can be dried quickly for the production of the RDF or finished in the aerobic reaction method for the production of compost. The decision to make RDF or compost depends on market conditions.

The extraction of metal, glass and plastic can be accomplished by subjecting the reject material to further processing. Magnetic separation and screening can be provided at this stage and still keep the plant relatively simple.

Typical recovery rates from the Dano system include 35 percent recovered as compost and 14 to 16 percent recovered as a RDF (plastics, paper and wood fibers). Much of the rest may be recovered as saleable recycled products (glass, metals, plastics). The actual amount of material that would have to be landfilled would depend on the availability of alternative uses. The Dano system has been used successfully worldwide in many different countries.

5. Buhler-Miag

The Buhler-Miag system processes MSW, sometimes with sewage sludge, to produce a humus-like substance while recovering materials such as paper, plastics, glass, and metals. In addition, the system can produce a refuse-derived fuel product used to fire industrial boilers. Buhler-Miag, and its parent company, the Buhler Group, has built over 100 waste processing plants around the world, mostly in Europe, Africa, and the Middle East.

The first waste processing facility built in the U.S. using Buhler-Miag technology opened in 1987 in Hopkins, Minnesota. The Reuter Resource Recovery Plant, owned by Reuter, Inc., has a design capacity of 400 TPD of MSW based on an 8-hour shift and recovers plastics, corrugated, aluminum, and ferrous metals, as well as producing a densified RDF product. A composting component is planned but is not currently in operation. The facility could be expanded to 800 TPD by going to a double shift.

The process begins with trucks depositing their wastes on a tipping floor, where hazardous wastes and large bulky items are separated out. The remaining MSW is fed into two receiving hoppers by a front-end loader and is moved by conveyor to a rotary drum sieve, where it is separated into three fractions according to material size.

Fine material, which is primarily organic, will be hauled to the company's composting facility after completion. Medium and large fractions are carried by conveyors past a "picking station," where such product as aluminum, corrugated, and plastics are manually removed from the waste stream. Large items are conveyed to a hammer mill for size reduction and then combined with the medium fraction for further processing.

From the picking station, the medium-sized fraction goes through further mechanical processing, including ferrous recovery, air classification, secondary shredding, and densification of the resulting RDF product.

The fine, organic fraction is shipped to the company's composting site, where it will be mixed with water before it is conveyed and discharged to composting piles (windrows). A windrow turning machine will mix and moisten the raw compost, while an aeration system provides oxygen for decomposition. This site is currently being developed in Chaska, Minnesota, and will have a 300 TPD capacity.

Reuter's estimated recovery rates for MSW processed at their facility include 40 to 50 percent for RDF, 25 percent for compost, and 15 percent for recyclables (plastics, corrugated, aluminum, ferrous metals). This leaves 10 to 20 percent destined for landfilling.

Currently, the compostable fraction of the waste stream is being landfilled. Most of the RDF is being burned at two paper mills in Wisconsin and two Northern States Power Company Power Plants in Minnesota. Some RDF is being stored until additional markets can be found.

D. RECYCLABLE MATERIALS MARKET ANALYSIS

1. Introduction

The success of any recycling program depends on the security of the market for recycling. If no market or use exists or if market is not created for a material, then it cannot be recycled. This section provides a general overview of the various types of markets that exist for potentially recyclable materials (including compost), describes the types of recyclables that exist in the waste stream, and discusses the use of recyclables as commodities. The Markets Study identifies materials markets within the area.

2. Materials Markets

There are two types of markets available for all classes of recyclable materials: intermediate and final markets. The category of intermediate markets includes two smaller subsections, processors of scrap and brokers of recyclable materials, whereas the group of final markets would encompass those involved in the last step of the recycling process.

Final markets generally pay higher prices for recyclable materials than do intermediate markets because they often rely on the intermediate markets to process the needed materials to conform to higher standards of acceptability. A scrap processor for instance, generally will purchase a wide variety of scrap materials (from industrial, commercial, and private sources), and accumulate a quantity of a material sufficient to warrant processing. When the processor has enough of these goods, he will process them to final market specifications (for example, baling loose cardboard, separating aluminum and steel cans from each other before compressing them) and then transport them to these markets. A scrap broker may have arranged for the final market destination of the processed goods -- often a scrap broker may never even see the material he buys and sells -- or the scrap processor may have done so, acting as both processor and broker. The materials upgrade is but one service that the intermediate market provides; it may also furnish containers as well as pickup and delivery of materials. Finally, the processor transfers the cost of these services to the final market in the price that is charged to the final market for the goods.

The final market manufactures products from the recyclable materials purchased. Usually a final market will accept only one type of material, but some markets are now purchasing multimaterials -- processing some and acting as intermediate markets for others. Although one cannot overlook the services that the intermediate market can provide, often the price paid for goods by the final market is sufficiently higher than that paid by the intermediate market to warrant by-passing the latter and selling recyclables directly to the final market. Also, in some situations, one may be able to access a final market more easily than an intermediate market. In the case of the Counties, both intermediate and final recycled material markets are available.

3. <u>Recyclable Materials</u>

a. Paper

There are four types of paper found in the municipal solid waste (MSW) stream:

- newsprint
- corrugated cardboard
- printing and office paper
- mixed paper

Exhibit III-6 provides a listing of all paper stock grade classifications, and Exhibit III-7 provides guidelines and specifications for each type of waste paper.

EXHIBIT III-6

PAPER STOCK GRADE CLASSIFICATIONS

AMERICAN PAPER INSTITUTE		PAPER STOCK INSTITUTE OF AMERICA	
CODE	GRADE	CODE	GRADE
1103	- Mixed	1	- Mixed Paper
		2	- Grade Not Currently in Use
		3	- Super Mixed Paper
1105	- Boxboard Cuttings	4	- Boxboard Cuttings
		5	- Mill Wrappers
		48	- Printed Thermomechanical Pulp
NEWSPAPERS			
1209	- News, Printed (Old & Overissue)	6	- News
		7	- Special News
		8	- Special News De-ink Quality
		9	- Over-Issue News
1226	- News, Unprinted	24	- White Blank News
		25	- Groundwood Computer Printout
		26	- Publication Blanks
1244	- Other Groundwood Papers	22	- Mixed Groundwood Shavings
		23	- Grade Not Currently in Use
		27	- Flyleaf Shavings
		44	- Coated Groundwood Sections
CORRUGATED			
1311	- Corrugated, Old Boxes	10	- Grade Not Currently In Use
		11	- Corrugated Containers
1314	- Corrugated, New Cuttings	12	- Grade Not Currently in Use
		13	- New Double-Lined Kraft Corrugated Cuttings
		14	- Grade Not Currently in Use

PULP SUBSTITUTES & HIGH GRADE DEINKING

(Print free grades are reported as Pulp Substitutes and printed grade, if deinked, are reported as High Grade Deinking.)

EXHIBIT III-6
(Continued)

1421 - Brown Kraft	15	- Used Brown Kraft Bags
	16	- Mixed Kraft Cuttings
	17	- Grade Not Currently In Use
	18	- New Colored Kraft
	19	- Grocery Bag Waste
	20	- Kraft Multi-Wall Bag Waste
	21	- New Brown Kraft Envelope Cuttings
1447 - Bleached Kraft	28	- Coated Soft White Shavings
	29	- Grade Not Currently in Use
	30	- Hard White Shavings
	31	- Hard White Envelope Cuttings
	32	- Grad Not Currently in Use
	37	- Manila Tabulating Cards
	47	- Unprinted Bleached Sulphate
	49	- Unprinted Thermomechanical Pulp
1446 - Printed Bleached Kraft	45	- Printed Bleached Sulphate Cuttings
	46	- Misprint Bleached Sulphate
1443 - Ledger Grades	33	- New Colored Envelope Cuttings
	34	- Grade Not Currently in Use
	35	- Semi-Bleached Cuttings
	36	- Colored Tabulating Cards
	38	- Sorted Colored Ledger
	39	- Manifold Colored Ledger
	40	- Sorted White Ledger
	41	- Manifold White Ledger
	42	- Computer Printout
	43	- Coated Book Stock

1615 - Other   1S-31S Specialty Grades such as paper stock containing wet strength, poly-coatings, plastic, foil and hot melt glues. Also included are manifold ledger containing carbon paper, books with covers, tab cards in small boxes on skids, magazines, carbonless paper, solid fibre containers, plastic windowed envelopes and textile boxes.

Source: American Paper Institute, 1987 Annual Statistical Summary Waste Paper Utilization, Second Edition, July 1988.

EXHIBIT III-7

SPECIFICATIONS FOR PAPER

News

Consists of baled newspapers containing less that 5 percent of other papers.

- Prohibitive materials may not exceed 1/2 of 1 percent
- Total outthrows may not exceed two percent

Corrugated Containers

Consists of baled corrugated containers having liners of either test liner, jute, or kraft

- Prohibitive materials may not exceed 1 percent
- Total outthrows may not exceed 5 percent

Mixed Paper

Consists of a mixture of various qualities of paper not limited as to type of packing or fiber content.

- Prohibitive materials may not exceed 2 percent
- Total outthrows may not exceed 10 percent

Source: Circular PS-88 Paper Stock Standards and Practices, Paper Stock Institute of America.

According to the American Paper Institute, 1987 Annual Statistical Summary in Waste Paper Utilization, 2nd Edition, more than 13 million tons of newspaper were consumed in the United States with almost 4.5 million tons of that total being recycled.

The major source of old newspaper (ONP) is individual homes. ONP accounts for an estimated 5.23 percent of the total waste stream. ONP is used primarily in the manufacture of paperboard and newsprint, with a small percentage of ONP used in making cellulose insulation.

The large majority of old corrugated containers (OCC) end a useful life at retail, wholesale, and industrial establishments, with a major portion being discarded in individual homes. OCC is the most commonly recycled paper product, with nearly 100 percent going to manufacture paperboard products (such as wallboard).

Printing and Office Paper (POP), which has the highest value of all post-consumer paper, is primarily generated at commercial establishments such as banks and insurance companies. Government offices also generate considerable amounts of POP. While POP is present in the home, it is usually generated in much smaller quantities and is difficult to separate from lower value paper, such as envelopes. Recycled POP is used primarily in the manufacture of tissue paper (i.e., bathroom and facial tissue, towels, and napkins) with lesser amounts being used for paper products used in writing, duplicating, and computer work.

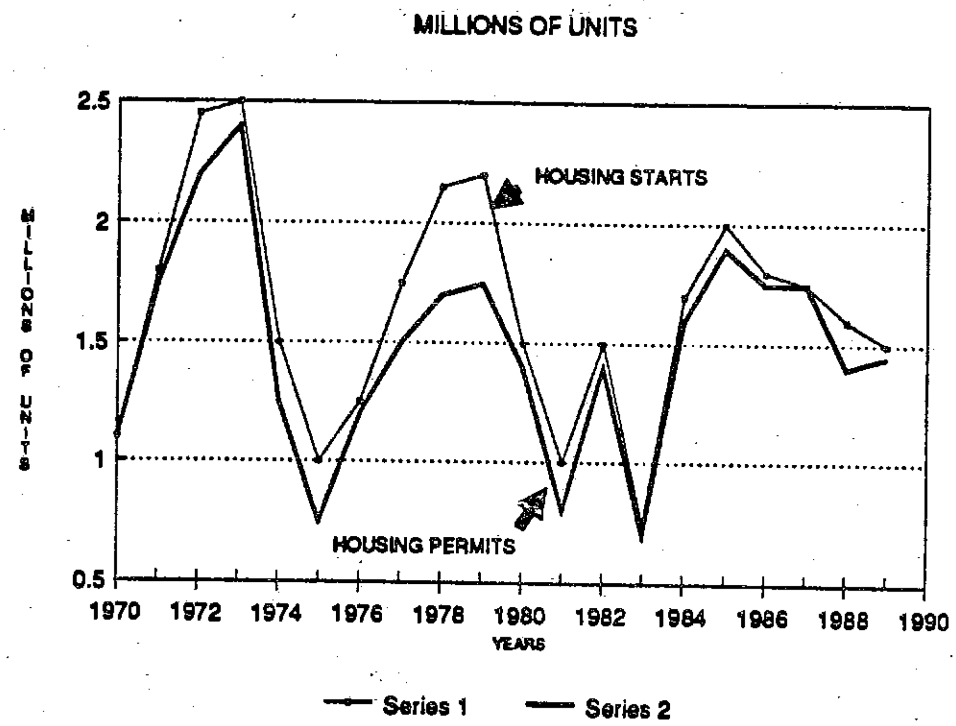
Mixed Paper, amounts to nearly a third of all paper generated in MSW and makes up approximately 15 percent of the Metro area's waste stream.

The demand for the lower grades of paper -- ONP, OCC, and mixed -- has historically fluctuated wildly. Because so much recycled paper is used in paperboard production and construction (i.e., wallboard and insulation), when the construction industry declines or the general economy is weak, the demand for and price of recyclable paper falls. Conversely, if housing starts improve and the economy is sound, demand and prices for lower grades of paper are typically strong. Figure III-17 illustrates residential construction activity since 1970. Figures III-18, III-19, and III-20 illustrate waste paper consumption since 1970 and the correlation between housing starts and waste paper consumption. Because its primary end use is in basic consumer products (i.e., towels and tissues) the demand and price for POP is steadier and higher than the lower grades. (see Figure III-21).

b. Glass

Glass is manufactured primarily from sand and silicon dioxide. Other materials used in glass manufacturing include sodium, soda ash, and calcium from limestone. Glass manufacturers produce three categories of products: containers, flat glass, and pressed and

Figure III-17
Residential Construction Activity



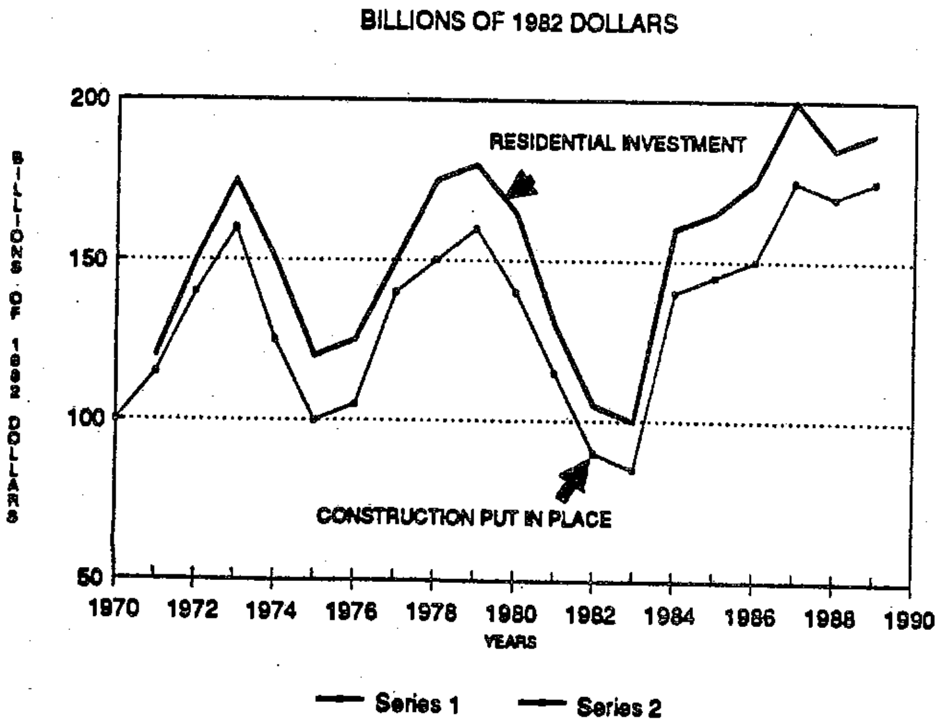
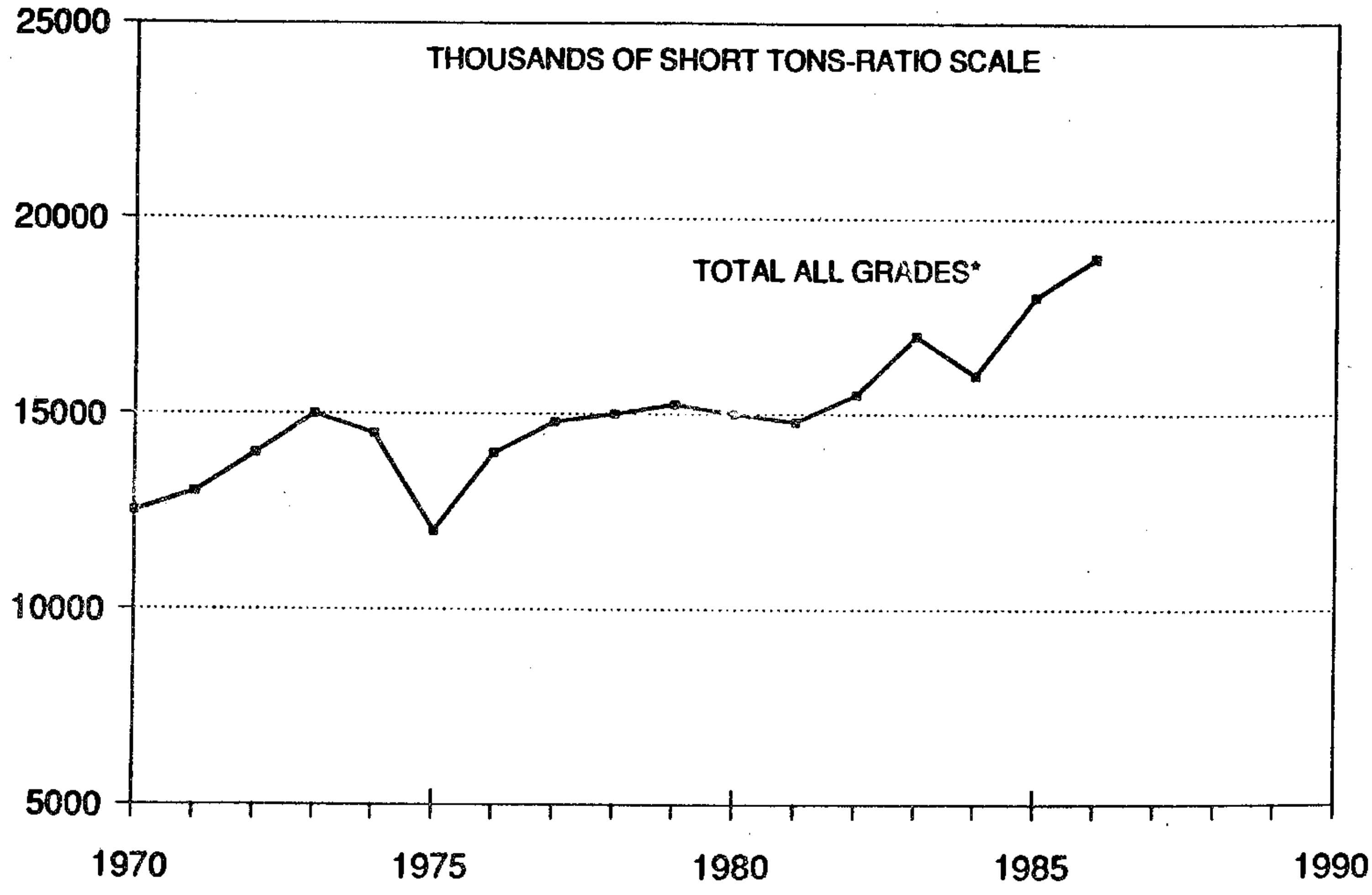


Figure III-18

U.S. WASTE PAPER CONSUMPTION BY GRADE

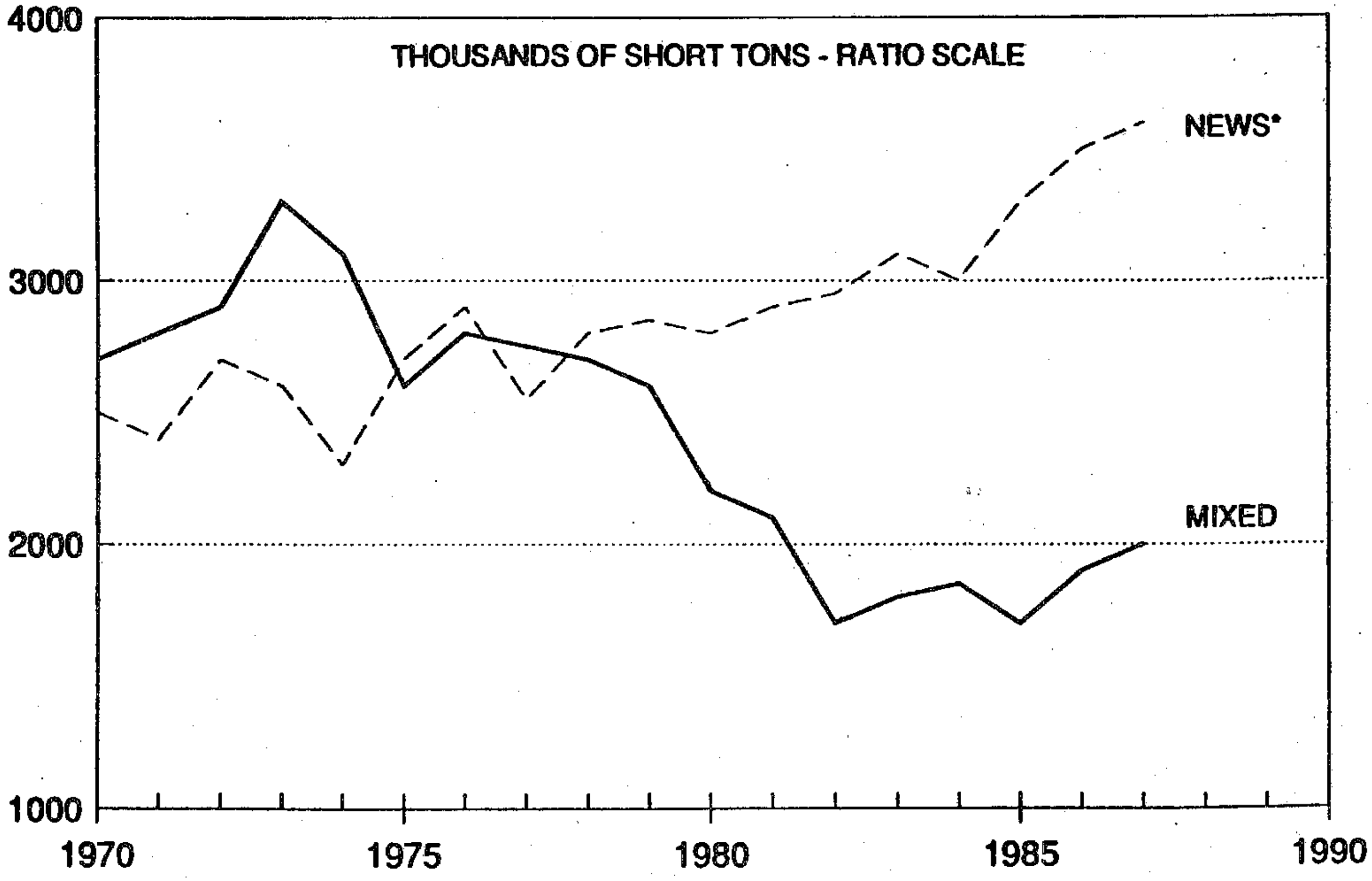


AMERICAN PAPER INSTITUTE

*INCLUDES "OTHER USES"

Figure III-19

U.S. WASTE PAPER CONSUMPTION BY GRADE

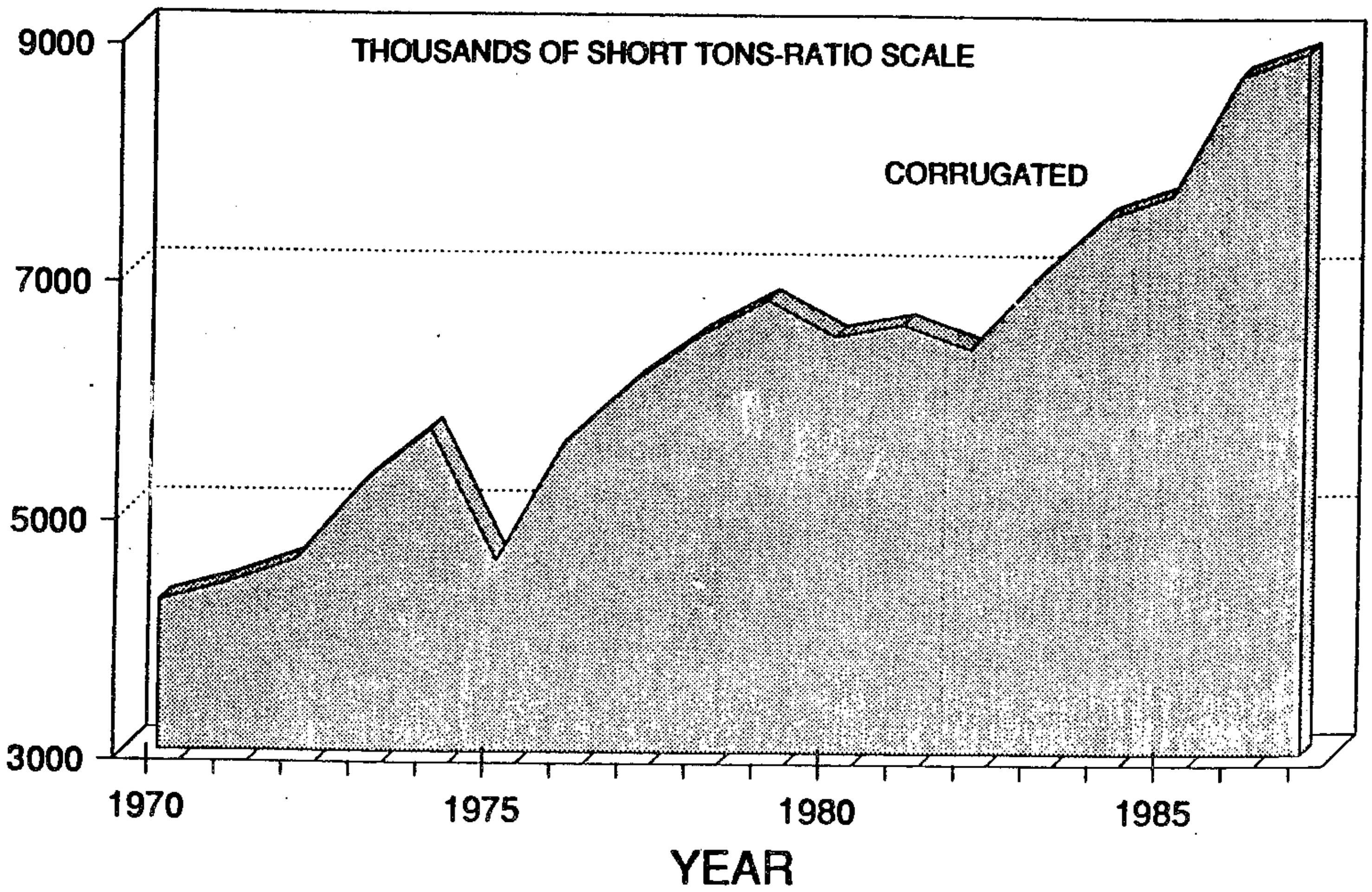


AMERICAN PAPER INSTITUTE

*INCLUDES "OTHER USES"

Figure III-20

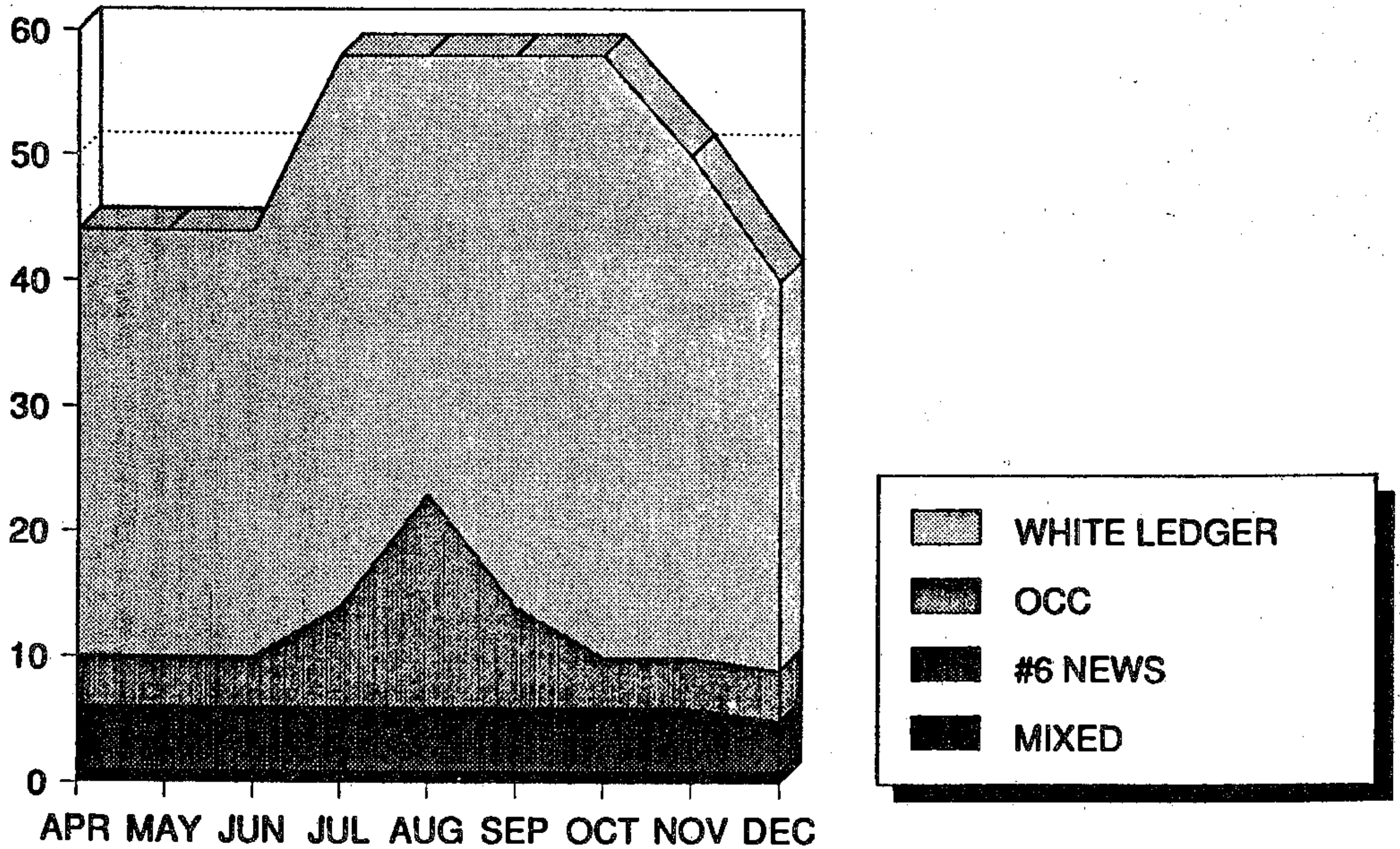
U.S. WASTE PAPER CONSUMPTION BY GRADE



AMERICAN PAPER INSTITUTE

Figure III-21

WASTE PAPER PRICES



SOURCE: FIBER MARKET NEWS, DEC. 1988

blown glass. Glass containers account for 70 percent of all the glass manufactured and make up approximately 90 percent of the glass in MSW. Flat glass is used mainly for windows. Pressed and blown glass includes ornamental and decorative glass and other glass products such as light bulbs. These three types of glass have different chemistries, and only container glass is pertinent to this study. Glass accounts for approximately 3.40 percent of the MSW in the area.

It is projected that in order to meet the 25 percent recycling goal in 1992, 50 percent of marketable residential and commercial glass will be recovered.

The glass industry uses waste glass, or cullet, as an alternative to raw materials. Before 1970, almost all cullet used in the manufacturing process was from "in-house" sources. Since 1970, when only 24,000 tons of cullet were purchased by the glass industry, cullet use from private and municipal recycling has increased to more than one million tons annually. Figure III-22 illustrates prices paid for cullet from January 1981 - January 1989.

With today's glass-processing technology, it is possible to use nearly 100 percent cullet in glass furnaces. This increased use of cullet is advantageous because cullet melts at a lower temperature than the raw materials, allowing the glass manufacturer to save energy. Also, lower furnace temperatures prolong furnace refractory life.

Glass containers are manufactured in three primary colors: clear (flint), brown (amber), and green. Nationally, approximately 65 to 70 percent of all containers are flint, with roughly equal amounts (15 to 18 percent) of brown and green bottles being generated. Thus, the demand for flint cullet is greater than the demand for either amber or green. Exhibit III-8 provides general accepted market specifications for recycled cullet.

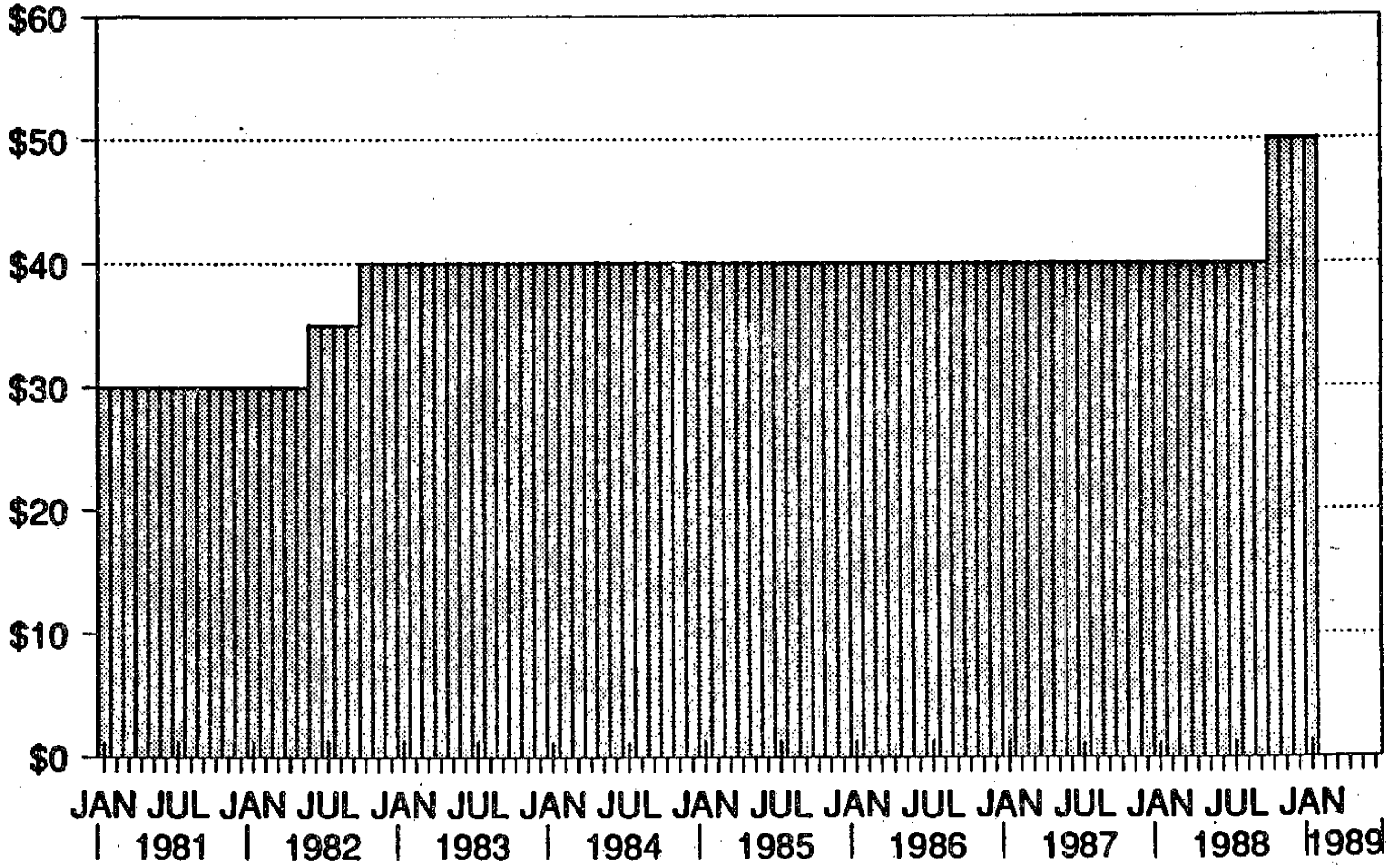
c. Aluminum

Aluminum is present in a variety of mineral structures. Currently it is primarily recovered from bauxite, an ore found principally in South America, Africa, and the Caribbean. Sources of bauxite within the United States are found in Arkansas, Georgia, and Alabama. Extraction of aluminum from bauxite requires a large amount of electricity. Aluminum in municipal waste is found in several forms or alloys: food container aluminum (i.e., cans and foil); aluminum (i.e., pots, pans, and appliances); extrusions (i.e., lawn furniture); and castings (i.e., auto parts, other pots & pans). Food container aluminum, particularly aluminum cans, has the highest market value.

Aluminum has a high value per weight -- unfortunately, in general, it represents only a minor fraction of MSW. It is

Figure III-22

GLASS MARKET PRICES HISTORY



SOURCE: OWENS-BROCKWAY, INC.

EXHIBIT III-8

SPECIFICATIONS FOR FURNACE-READY CULLET

- Only glass container glass is acceptable
- Permissible color mix level are
  - -- Flint glass

    95 - 100% flint
    0 - 5% amber
    0 - 1% green
    0 - 5% other colors

  - -- Amber glass

    90 - 100% amber
    0 - 10% flint
    0 - 15% green
    0 - 5% other colors

  - -- Green glass

    80 - 100% green
    0 - 20% amber
    0 - 15% flint or Georgia green
    0 - 5% other colors

- Glass must be free of excessive moisture
- Glass must be free of <u>any</u> refractory materials. Grounds for rejection include:
  - -- the presence of pottery, porcelain, china, dinnerware, brick, tile, clay, and so forth, larger than one inch.
  - -- the presence of more than <u>one particle</u> of any of the materials listed above larger than an eight of an inch, but less than one inch in a 200-pound sample (four 5-gallon pails of crushed cullet will weigh approximately 200 pounds)

EXHIBIT III-8

(Continued)

SPECIFICATIONS FOR FURNACE-READY CULLET

-- the following listing illustrates other examples of refractory particles which will place cullet shipments subject to rejection

i) the presence of more than <u>two grains</u> of Quartzite, sandstone, or sand pebbles larger than U.S. 16 mesh (1.19mm) per ten pounds of sample

ii) any clay particles (e.g., kaolin, kaolinite, anauxite)and/or spinel larger than U.S. 20mesh (.84mm) or more than 50 particles larger than U.S. 30 mesh (.59mm) per ten pounds of sample

iii) any alumina silicate refractory heavy minerals (e.g., kyanite, mellite, sillimanite, andalusite) larger than U.S. 30 mesh (.59mm) or more than ten grains larger than U.S. 40 mesh (42mm) per ten pounds of sample

iv) any alumina refractory heavy minerals (e.g., corrundum) larger than U.S. 40 mesh (.42mm)

v) the presence of zircon, cassiterite, chrome, or similar refractory particles larger than U.S. 60 mesh (.25mm)

Glass must be free of metallic fragments and objects. Grounds for rejection include:

-- the presence of any metal fragments or objects larger than 1.5 inches (e.g., wide mouth jar lids, soda cans, food cans, coffee cans, etc.)

-- the presence of more than one metallic particle or object larger than three eights of an inch but less than 1.5 inch (e.g., bottle cap size) per 200 pounds of cullet (four 5-gallon pails of crushed cullet will weigh approximately 200 pounds)

-- the presence of more than two metallic particles or objects less than three eights of an inch per 50 pounds of cullet.

The cullet as received should also be free of wire, staples, nails, bolts, welding rods, and so forth, and other similar objects.

At the present time, metallic foil from bottle labels will not be considered as metallic contamination.

EXHIBIT III-8
(Continued)

SPECIFICATIONS FOR FURNACE-READY CULLET

Glass must be free of dirt, gravel, limestone chips, asphalt, concrete, and so forth.

Glass must be free of excessive amounts of paper, cardboard, wrap, plastics, and so forth (labels are acceptable)

Large amounts of glass that is excessively decorated (e.g., painted on labels) must be kept separate.

Source: Owens-Brockway, Inc.

projected that 19 percent of residential and commercial aluminum will be recovered and contribute to the 1992 recycling goal of 25 percent.

In the 1970s the U.S. aluminum industry turned to recycling as a major source of material. According to the Aluminum Association, in 1988 almost 25 percent of all the aluminum used in the United States came from recycled aluminum. The recycling rate of aluminum cans currently exceeds 50 percent. The U.S. aluminum industry, particularly corporations such as Alcoa and Reynolds Metals, strongly supports the recycling of aluminum.

Demand for aluminum has been steady over the past three years, although prices have fluctuated. As of this writing, the prices paid and demand for aluminum are at an all-time high. Prices for aluminum are illustrated in Figure III-23.

d. Ferrous Metals

In recent years, the market demand for steel scrap has fluctuated and has generally been declining (see Figure III-24). The reduction in steel scrap markets is linked to the decline in U.S. steel-producing capacity. According to Phoenix Quarterly, in 1977 U.S. steel-production capacity peaked at 160 million net tons (mnt). The production capacity is now estimated to be 110 million metric tons and is expected to drop further to 102 million metric tons, by 1990. The Institute of Scrap Recycling Industries believes several factors contributed to the elimination of U.S. steel-producing capacity, including an oversupply of the market by foreign government-controlled steel producers and decreased demand for steel products. The effect on the steel scrap industry, coupled with a drop in the real price of steel scrap, has resulted in a loss of markets.

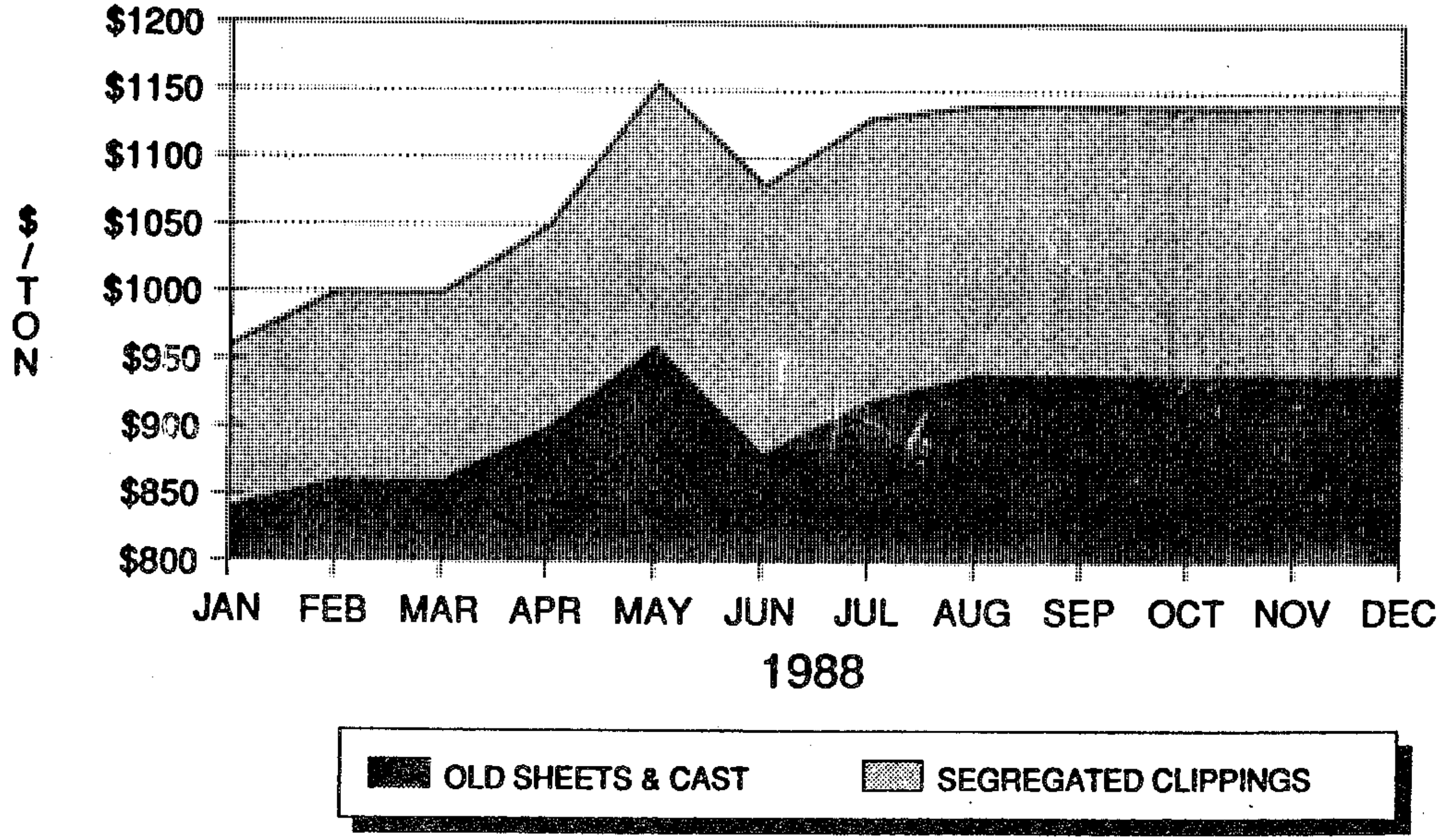
Figure III-24 illustrates the fluctuation in the price for #1 heavy melting steel from January 1987 to January 1989. Any steel that the region will be able to market would be considered #2 heavy bundle steel, which is low quality and commands a much lower price than the #1 steel. (#1 steel is industrial steel which is available, for instance, from dismantled airplanes, ships, and buildings; #2 steel includes food container cans, used brake pads, etc.)

Most of the ferrous metal in residential MSW can be broken down into two categories: bulky ferrous (i.e., white goods and appliances) and container ferrous (i.e., food and beverage cans). There are actually two types of steel cans in residential MSW: Bimetal cans, made up of a steel body and aluminum top, and "tin" cans, which are primarily steel that has been coated with a layer of tin to retard rusting. Bimetal cans are typically low in value because of their multiple material composition. However, the Steel Can Recycling Institute has recently been formed as an industry organization that promotes the recyclability of both bimetal and

Figure III-23

ALUMINUM MARKET PRICES*

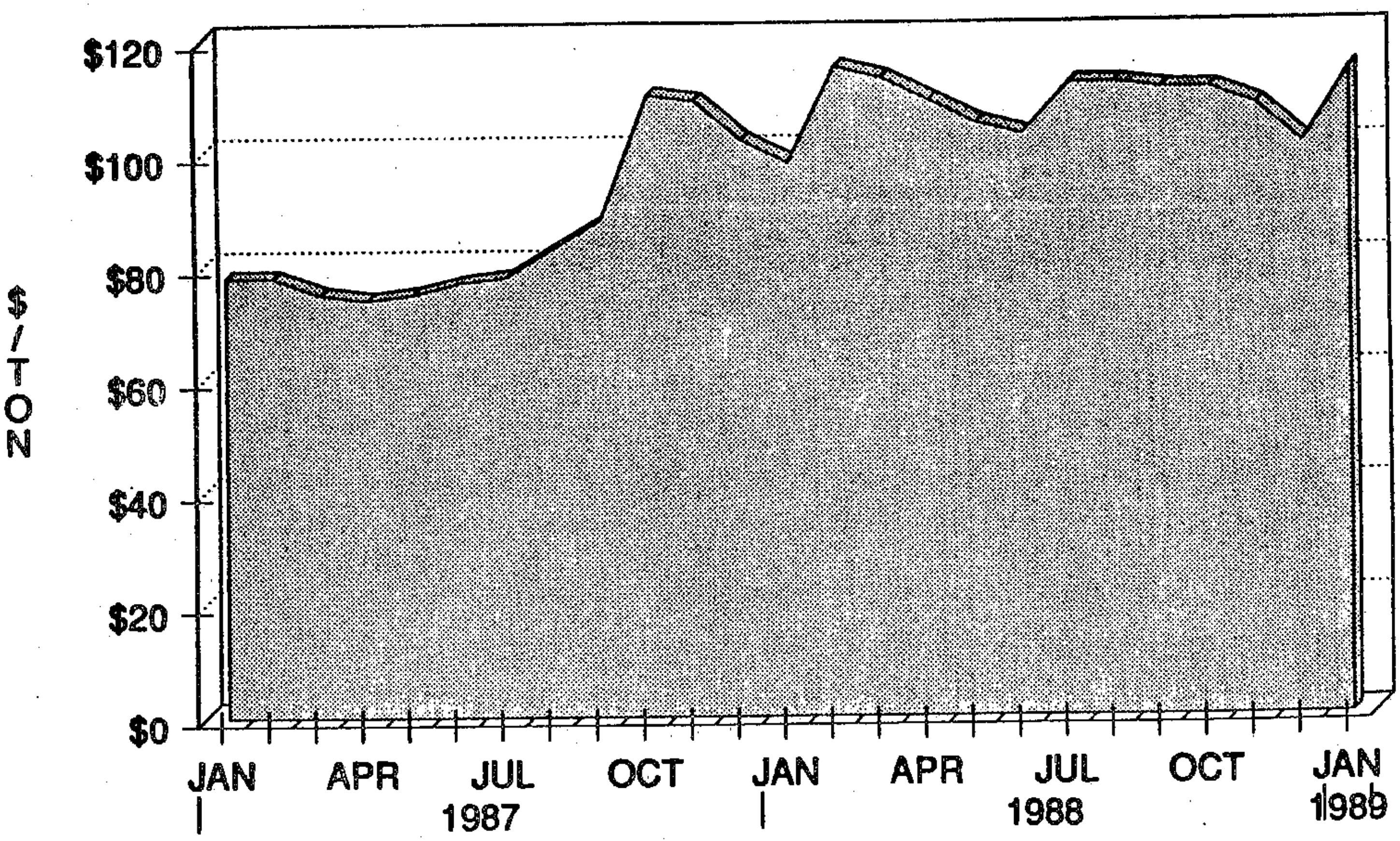
1988



*BASED ON A QUOTED FOB PRICES IN NY FROM IRON AGE

Figure III-24

STEEL MARKET PRICES HISTORY*



* #1 HEAVY MELTING STEEL

tin cans. Approximately 5.00 percent of the Metro-area waste stream consists of ferrous metals.

The primary market for "tin" cans is the detinning industry, which chemically removes the tin from the cans and sells the clean steel cans to the steel industry. Exhibit III-9 provides generally accepted specifications for scrap ferrous cans.

e. Plastics

Included in the many plastic resin types typically found in MSW are: high-density polyethylene (HDPE), low-density polyethylene (LDPE), polyethylene terephthalate (PET) and polyvinyl chloride (PVC). These and other resin types can be recycling into a variety of products, including pillow stuffing, tire cord, sleeping bag filler, fiberglass, bathtubs, shower stalls, corrugated awnings, and molded products such as lumber or vehicle stops. Because plastic is a lightweight/high volume material, it requires more storage space and has higher transportation costs than most recyclable commodities. For example, 2-litre soda bottles are made from PET; because the bottles are mostly air, they take up a great amount of space and are often difficult to compact. Plastic that has been shredded or punctured and baled can be transported much more economically. Exhibit III-10 provides the specifications currently quoted by one of the largest PET recyclers in the United States. In spite of these constraints, there is a great deal of interest in recycling plastic because it is a growing component of the MSW stream. In the Madison, Monroe, and St.Clair county area, approximately 0.6 percent of the municipal solid waste stream is composed of HDPE or PET containers (Phase I Assessment of Solid Waste Disposal Needs, p.89).

f. Compost

Compost is a medium adaptable for several land applications because of its high organic content, low fertilizer value, and physical characteristics. It can be used as an amendment to improve poor quality soils, a growing medium for plants, a topsoil conditioner while preparing land for plantings, a top dressing for established planted area, a mulch for existing plantings, and a potting mix component for both indoor and outdoor growing.

The primary use of composted yard waste is an a soil amendment. In this capacity, compost increases the water-holding capacity of sandy soils, improves the structure of clay soils, promotes bacterial action in soil, supplys micronutrients absent from commercial fertilizers. A second major use for compost is as a basic ingredient in various soil amendment container mixtures, such as potting soils or mulches. Aggressive marketing of these products would require a mixing and bagging facility.

EXHIBIT III-9

SPECIFICATIONS FOR FERROUS CANS

Tin Cans[1]

Four items for consideration

1. Aluminum

   - no aluminum contamination accepted

2. Paper labels

   - no paper labels remaining on cans is acceptable (lithograph is acceptable)

3. Can Ends

   - desirable -- both ends removed and placed inside flattened can body, no more than two ends per can
   - acceptable -- one end removed
   - unacceptable -- neither end removed or more than two ends per can

4. Organics

   - desirable -- can washed with no food or liquid residue
   - acceptable -- unwashed but with no food or liquid residues
   - unacceptable -- cans with food or liquid residue remaining

Bimetal Cans[2]

Specifications not available, only that cans should be baled into 24 inches by 36 inches bales.

---

[1]Source: AMG Detinning, Pittsburgh, PA

[2]Source: Weirton Steel Company, Weirton, West Virginia

EXHIBIT III-10

SPECIFICATIONS FOR POLYETHYLENE TEREPTHALATE

- Only PET and associated container material is acceptable
- Bales must be free of all foreign material except those associated with the bottle, i.e., paper label, aluminum, or plastic cap, base cup and adhesive
- Unacceptable -- plastic bags, corrugate, or other foreign material

Source: Wellman, Inc.

Potential markets for compost include landscaping companies, greenhouses, nurseries, sod farms, topsoil and potting soil vendors, golf courses, local government agencies, and the general public. Local farms may also provide a substantial market for compost. The market value of compost varies with location, demand, and compost quality. Clean wood collected through a yard waste program can be chipped and sold as mulch.

4. Recyclables as Commodities

In order for recycling to work, adequate markets must exist for all of the materials. Programs in many communities have experienced setbacks in their recycling programs due to the faltering of one or more markets. In these cases, materials separated out have been put into storage, and ultimately landfilled. Successful recycling is therefore market driven.

Recyclable materials separated out from the waste stream become commodities, similar to the new materials used to make nearly every manufactured item. For example, aluminum beverage cans, either flattened, baled, or shredded, become a metal commodity similar to aluminum produced from bauxite (ore), because the recycled aluminum is essentially pure aluminum and can be used to manufacture any or all of the same products manufactured using ore derived aluminum.

The same type of relationship exists between raw (or virgin) materials sources and recyclable materials sources for the other materials to be considered for a community recycling program: ferrous metals, paper, glass, and plastics. However, the relationship is not identical in all cases. The processing requirements for making paper from virgin material (wood pulp) are different to varying degrees, depending on the type of paper being made, than those for making paper from recycled paper. If a paper mill has the processing equipment to make paper only from virgin material, and cannot use recycled paper as feedstock material, then for this kind of mill recycled paper is not interchangeable with virgin wood pulp. Due to the significant proportion of paper mills in the United States that have the capability to use either recycled or virgin material,the overall market for recycled paper does function as a commodity market. The mills that can use more than one type of recycled paper as feedstock, and in various combinations of virgin material are collectively another factor for recycled paper to be dealt with as a commodity by the markets.

Commodities markets function on a worldwide basis. Suppliers are indifferent regarding the destination of their commodities, as long as the objective of the highest price, net of transportation costs, is achieved, a corollary objective is that the market will be a repeat customer, since the supplier needs continuing markets for his commodities. Dropping one customer to supply another, whether he is a domestic or foreign entity, for a higher price, will not pay off in the long run if the new customer does not offer repeat business. The first supplier will be displaced by another supplier for the market dropped, and the first supplier may have difficulty reacquiring the original customer.

Many factors affect the commodities' markets, and thus the prices paid for recyclable materials. Domestic production and production capacity imports, consumption, energy and transportation costs, changing technology, new product opportunities and others affect the markets for recyclable materials. For international markets all of the same forces plus foreign trade tariffs, currency exchange rates, trade policy and programs, and other political forces are factors.

Export markets for recyclable materials have been developed in the United States at even increasing rates. Greatly expanded recycling program on the East Coast for example have generated more paper than regional mills could absorb. Paper is now the number one export (in annual tons) for the Port of New York City.

The greater quantity of factors involved in the export markets serve to increase the volatility of prices paid for recycled materials. It is important to understand that domestic users (markets) of recyclable materials must compete with export markets for the same materials. Domestic markets would rather not compete with export markets. They would rather not pay a higher price that foreign competition can bid them up to.

The factors that can increase prices can also drive them down, although the principles of economics will limit the lower end. Below a certain price, suppliers will no longer be willing to supply the materials. Once the price drops below the full cost of producing virgin raw material, recyclable material will begin to displace virgin material (where they are interchangeable).

In addition once actual industry production limitations on recyclable materials are needed, suppliers have another reason (different from the search for a higher price) to look for export markets.

All of the market forces at work affect the value of recyclable materials. Prices offered by recyclables have changed significantly in recent times, some increasing, some decreasing. Probably the most important point to realize in the understanding of materials markets is that prices are likely to vary in either direction from any current price. A recycling program should therefore be designed and implemented such that it is not dependent upon materials prices.

E. PUBLIC EDUCATION

To achieve 25 percent reduction/recycling, the Counties will be asking every resident and business in its service area to change their manner of handling trash. This request must be accompanied by information explaining what should be changed; how the changes will occur; when they will take place; and why they are necessary. If the program is to be successful, information and education will be a foundation elements.

Recycling public education programs should have three goals: (1) to inform people about the need for recycling, (2) to communicate the specifics of participating in the program(s), and (3) to motivate people to act on the supplied information, thereby changing their existing waste disposal behavior.

The State of Illinois has mandated aggressive planning levels for recycling. To achieve those goals, the Counties will need to pursue an aggressive recycling program that targets residents, businesses, and institutions and provides both instructional and motivational messages.

1. Public Information Directed Toward Opinion Leaders

Successful solid waste management projects typically hinge on a solid waste crises, such as diminishing landfill space and rising disposal costs; legislative impetus, and strong leadership. With recycling activities, technical feasibility and environmental soundness are not generally questioned. However, the sociopolitical and institutional factors affecting project development may make or break the project. Therefore, it is essential to a successful recycling program that support from municipal and community leaders be fostered. The media also plays a significant role in influencing public opinion.

Local opinion leaders need to be informed about the area's waste disposal problems and educated as to how the Counties' existing and planned recycling activities can realistically be expected to address those problems.

Activities and materials that can be developed to inform opinion leaders include:

- A press kit to be distributed to local print and broadcast media representatives. These kits would include information about the Counties, the State legislation, and solid waste issues nationwide. A contact person would also be identified.

- A photo and video library that could be accessed by local media when they need backup on supplemental footage or photographs for a story on recycling.

- Regular media conferences in which media representatives are asked how the Counties can best promote a thorough understanding of recycling among the press. These conferences should establish the Counties as a cooperative source of information and help to eliminate some garbage myths.

- Municipal workshops to promote the Counties' recycling program and increase municipal support of the Counties' goals.

- A volunteer training program.

  Developing a strong and well-informed volunteer network will supplement and enhance the Counties' efforts to promote recycling. Volunteers can be used to help distribute materials, staff hotlines, and participate in school assembly programs, fairs, parades, and other special events.

- A bureau of informed speakers on recycling.

  The speakers bureau can be advertised to local civic groups, community organizations, and schools.

2. <u>Public Education Directed Toward Residents</u>

Though informed municipal and community leadership will assist in laying the groundwork for the Counties' educational efforts, a wider audience must also be reached. The Counties will need to direct public educational efforts toward the average citizen, capitalizing wherever possible on the avenues of communication opened through educational efforts aimed at local opinion leaders. As stated earlier, the goal of the educational activities should be to give specific instructions about how and why to recycle and to motivate people to actually recycle.

Several national polls have revealed that most people feel that recycling is a good and beneficial thing. However, through surveys and focus groups, certain barriers to participation in recycling activities have been identified --people think it will be too much trouble; they lack information about how they should go about recycling; and they mean to recycle but they just don't get around to it.

The first barrier -- inconvenience -- can be overcome through design of source separation and collection systems that are sensitive to the demographics of the target populations and geared toward ease of participation. The second and third barriers -- lack of information and motivation -- can be addressed through aggressive and sustained public education activities described in this section.

Activities and materials that can be used to promote recycling in the residential sector include:

- Recycling program theme and logo
- Articles and editorials
- Newspaper supplements
- Recycling headlines
- Print advertisements
- Radio and television public service announcements
- Videotapes and slide presentations
- Newsletters
- Brochures and flyers
- Reinforcement incentives (giveaways such as magnets, bumper stickers, t-shirts, coloring books, hats, pins, and posters)
- Recycling program mascot
- Bus and billboard advertisement
- Point-of-sale materials (such as shelf cards in grocery stores, posters, and grocery bag art)
- Banners and signs

- Contests and special events (recycling fairs, litter clean-ups, grade openings, etc.)

- School assembly programs

- Curriculum supplements on recycling and volume reduction

- Backyard composting workshops and demonstration projects

- A recycling directory

In addition, to these general promotional and educational activities, specific public education programs will need to be developed for the various programs that make up the Counties' overall recycling system.

As curbside collection of recyclables and food waste is implemented, for example, an accompanying community education effort will need to be developed. The components of this effort could include:

- Brochures delivered approximately three weeks before the curbside collection begins that announces the service, details the materials being collected, and explains how, when and where these materials should be placed for collection.

- Community meetings held approximately two weeks before collection begins.

- Fact sheets or flyers placed in the home storage containers. Containers should be marked with the Counties' logo and be delivered approximately one week before collection begins.

- Refrigerator magnets, delivered with the home storage containers, to remind residents of their collection day.

- Media advertisement of the curbside collection kick-off.

- Kick-off activities at which local media representatives are issued a prepared statement and a County official sets out the first bin of recyclables.

- Follow-up surveys issued to select residents to identify start-up difficulties, service problems, resident satisfaction with container style and size, and so forth.

- Door hangers or "Post-it" notes that can notify those residents who have placed improper or improperly prepared materials out for collection.

- Periodic newsletters or flyers to residents to advise them of program expansions or changes and thank them for program successes.

For the opening of new drop-off capacity, public education activities could include flyers distributed int he neighboring communities, public service announcements, paid advertising, and grand openings featuring local celebrities, giveaways, and an appearance of the Counties' mascot.

Multifamily residences and condominium communities should be specifically targeted through promotional campaigns. The promotional materials should be designed to reflect:

- The specific collection mechanism employed, and

- The demographics of the resident population.

The Counties should dedicate staff time to assist resident managers, property management firms, and condominium associations in establishing the parameters of both effective collection and effective public education. Each County could assist in setting up community meetings, providing building-specific technical assistance, and responding to the inquiries of the residents and haulers. Public education specific to multifamily units could include posters for trash rooms, signs for elevators and building common areas, door hangers, flyers, and other types of promotion as appropriate.

3. Public Education Directed Toward Commercial/ Institutional Establishments

The commercial waste stream represents a significant portion of the total waste stream and commercial sources generate large quantities of recyclables -- corrugated cardboard, office paper, construction and demolition debris, food wastes, and yard wastes. In order to guarantee the high levels of participation in commercial recycling activities, that will be critical to meeting the 25 percent recycling goal, the County will need to develop an aggressive educational program directed toward the commercial sector.

Information programs aimed at commercial generators of recyclables could include such components as fact sheets, "How To" kits, commercial workshops, creation of a public/private sector task force, and placement of articles in business and trade publications.

4. Public Education Costs

An aggressive and sustained public education program to motivate citizens and commercial/institutional/industrial establishments within the service area to participate in the recycling programs will require substantial planning and a substantial budget.

The costs of public education programs depend on the scope and nature of the specific activities and materials pursued. If four-color printing, television broadcasts, originally-produced videos, consultant labor, and a significant amount of paid advertising, costs would be expected to be higher than programs that utilize in-house printing, volunteer labor, one-color printed materials, and tailored versions of other communities' programs.

During a peak public education year, when services and facilities are in-place in the majority of the service area, public education costs could be expected to fall within the ranges shown in Table III-2 for a program that contains all or most of the components listed in the previous subsections. These cost ranges are approximate and do not reflect any specific printing or production costs for the St. Louis metropolitan area.

TABLE III-2

ESTIMATED PUBLIC EDUCATION COSTS
(1989 $)

Expense Category	Cost Range
Public Education for Opinion Leaders	$ 7,500 -- $ 30,000
Public Education for Residents (Program-Specific and General)	$147,500 -- $400,000
Public Education for the Commercial Sector	$ 20,000 -- $ 70,000
TOTAL	$175,000 -- $500,000

F. ENFORCEMENT

The success of a recycling program depends on an equal level of commitment to each component of the project. Program planning, development, implementation, and promotion are traditionally the focus of commitment in the initial stages of a program.

An enforcement policy consists of four main components: 1) determining when to use enforcement; 2) developing a method of enforcement; 3) implementing inspection procedures; and 4) establishing a method for recordkeeping. Each of these components are discussed below.

1. <u>When To Use Enforcement</u>

The timing for the implementation of enforcement is critical. For example, starting an enforcement program too soon can be counterproductive. Fining residents or businesses for not recycling before efficient and convenient programs have been developed can discourage them from recycling in the future. On the other hand, those who make the effort to follow recycling regulations eventually become discouraged if their neighbor (who is not recycling) is not reprimanded or penalized in some way.

2. <u>Method of Enforcement</u>

While enforcement generally connotes a negative impression, one of the important (and positive) factors of an effective enforcement program is education. An individual cannot be expected to participate in a program if they do not know their responsibilities or why their participation is important. Therefore, developing a incremental method for enforcement (with education as its initial step) may induce more people to participate.

Phase One: The first time an individual or business is found to be in violation:

- They are notified of the violation, usually in the form of a letter or by affixing a bright sticker to their uncollected refuse containers.

- They are instructed as to the details of the recycling program, such as how they should participate in the future and why.

- They are given a fixed period of time to participate or further action will be taken.

If this is accomplished in an informative yet friendly manner, those that were unaware or were somewhat interested in participating will do so.

Phase Two: An individual or business found to be in repeat violation, is to provide the same information distributed in the first phase, but it should be more strongly worded and a specific penalty for non-compliance identified.

Phase Three: The last phase is for those that are defiantly in non-compliance. The objective of taking the time and energy in the initial phases is to provide assistance rather than penalty. However, once these individuals have been identified, enforcement penalties should be imposed.

3. Inspections

Inspections are the primary means of identifying those that are not recycling. They can be established at two locations: at the point of generation or at solid waste facilities. If inspections can not be administered at both points, then individual inspections at the generator level will establish direct contact between the producer and the inspector.

Inspections at the point of generation must be performed by an individual who has access to trash and recycling receptacles. In New Jersey where mandatory recycling is in the advanced stages, garbage haulers, health officers, recycling coordinators or even local police were instructed to act as inspectors. In Middlesex County, N.J. special inspectors were hired to go to individual businesses, assess their recycling practices and identify necessary improvements. After these businesses are given individual instructions as to how they can set up a recycling program, a follow-up visit completes the inspection procedure.

The advantage of having inspectors at solid waste facilities is that loads with excessive quantities of recyclable materials can be readily identified from large commercial loads. It is sometimes difficult, however, to identify violators when loads arrive at the facility containing refuse from a variety of sources. It will be difficult, therefore, to reach the third phase of enforcement described above if this is the only type of enforcement utilized.

4. Recordkeeping

Each component of the enforcement policy development requires that specific information be kept on record. For example, inspectors will need to report the number of facilities visited and who received first or repeat violations. The same will also be true at the solid waste facilities where detailed information about the truck which brought in a load with excessive quantities of recyclables must be obtained and recorded.

It is not recommended that the Counties or the municipalities begin an enforcement program until programs for recycling are in place. Incorporating a consistent and practical enforcement program into the recycling program, however, will become essential if the Counties seek to reach their 25 percent recycling goal.

IV. COMBUSTION — WASTE-TO-ENERGY RECOVERY OPTIONS

A. INTRODUCTION

On the basis of the potential energy markets examined and the available waste from the Madison, Monroe, and St. Clair County area, three energy recovery technologies were identified as being viable for review:

- mass burn - direct combustion
- mass burn - controlled-air (modular) incineration
- refuse-derived fuel (RDF) processing/incineration

A mass burn system combusts solid waste in the same form as it is delivered to a resource recovery facility. Only large, easily identifiable items, such as appliances, are removed before the waste is incinerated. The direct combustion classification applies to incineration that takes place in a single chamber, in the presence of excess combustion air. Controlled-air (modular) incineration is combustion that is carried out in two or more stages, with substoichiometric air (less air than required for complete combustion) being supplied to the primary combustion chamber. The combustible gases formed under this condition are completely burned in one or more of the sequential stages.

With an RDF system, solid waste is processed for removal of noncombustible materials. The degree of separation will depend on the combustion process used. For example, a spreader stoker combustion system can operate well with a high level of inorganic material (metal, glass) present in the RDF, whereas with a fluidized bed unit a refined RDF is necessary.

For each energy recovery technology, four aspects of energy recovery are addressed:

- technical review of the recovery process
- facility process parameters
- construction and operating features
- auxiliary services

B. TECHNICAL REVIEW

This subsection is divided into five parts:

- waste receiving, storage, handling preparation
- furnaces/boilers
- air pollution control equipment
- steam turbine-generators
- ancillary equipment

These subjects are addressed for each of the recovery technologies.

1. Waste Receiving, Storage, Handling, and Preparation

a. Receiving

Waste can generally be delivered to a recovery facility in three ways:

- Compaction trucks used to collect waste from homes or commercial operations

- Transfer trailers in which the waste from several compaction trucks and noncompaction vehicles is consolidated, usually for a long distance haul

- Noncompaction vehicles, such as trucks used by small collection companies, and cars or pickup trucks used by individuals

Operators of recovery plants typically discourage the delivery of waste in noncompaction vehicles. The extra time necessary to unload such waste can cause congestion in the receiving area. Either the vehicles concerned could be routed to a transfer station or a separate receiving area could be established.

In general, waste received at a recovery plant is required to be weighed. Weighing, done primarily to establish a record for billing purposes, provides a guide to the plant manager on waste throughput.

After weighing, vehicles proceed to the receiving area, or tipping floor, where waste is unloaded for storage. An enclosed tipping floor is commonly used. Enclosure controls litter, keeps moisture from the refuse, controls odor, and generally makes the plant aesthetically pleasing.

The design of an enclosed tipping floor provides two options. One alternative allows trucks to have sufficient room to maneuver inside the building. This approach requires a door on each of two sides of the facility through which trucks can enter and leave. The second alternative is to have several doors along the front of the facility. Trucks would move into position outside the facility, then back up into the plant and the storage area. In terms of the truck maneuvering area, the two approaches are comparable.

The drive-through approach has the entire maneuvering area enclosed. The resulting increased cost can be justified, particularly in a populated area, on the basis of aesthetics and environmental considerations. With the back-up approach, if not properly screened, the storage area can be in full view from the outside. The limited area that can be opened with a drive-through system can allow the receiving/storage area to be kept under negative pressure. A flow of air from the outside to the inside of the building is thus ensured. The air extracted from the waste receiving/storage area (with its associated odor) is used as combustion air. Either approach to waste receiving can be used with the three types of recovery systems under consideration.

b. Storage

(1) Direct Combustion

The waste received at a direct combustion facility is stored in a concrete pit; see Figure IV-1. Waste can be stored above the tipping-floor level. The crane operator can position waste to slope away from the tipping floor, or waste may be packed so that it rises as a vertical wall from the edge of the receiving floor to a height equal to the depth of the pit.

The center portion of the pit would be kept sufficiently free of waste so that trucks can unload continuously. The pit would be designed for two to three days' storage. This provision allows uninterrupted recovery plant operations over weekends and on holidays when no waste is delivered. The pit would have a drain to remove water that might separate from refuse delivered to a facility. This water would require treatment before discharge.

(2) Controlled-Air Incinerator

At a controlled-air incinerator the waste is stored on the tipping floor, which also serves as the receiving area; see Figure IV-2. The amount of floor space required will depend on the design throughput and the height to which waste will be piled for storage.

(3) Refuse-Derived Fuel

An RDF processing facility typically is designed to process all the waste delivered on the day it is received. Some storage is necessary, however, to handle any waste surges. Most waste is typically delivered to a waste disposal site at two times during the day -- late morning and mid-afternoon -- periods when collection trucks are full and must be unloaded. Thus, surge storage is needed for the ability to provide consistent, uninterrupted flow of waste according to processing equipment capacity. As described for controlled-air incinerators, solid waste would typically be stored on the tipping floor.

Figure IV-1

TYPICAL MASS BURN COMBUSTION FACILITY

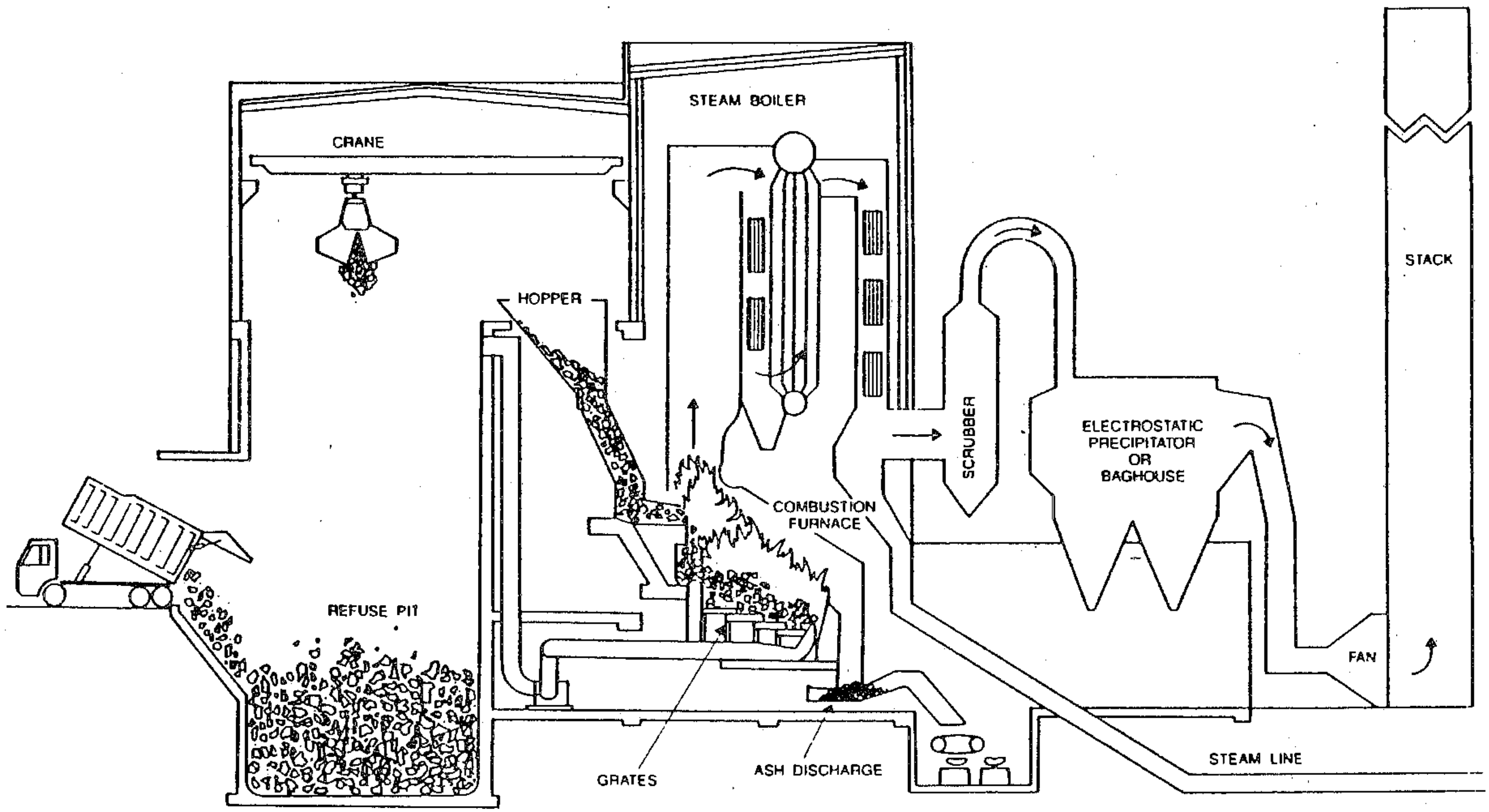
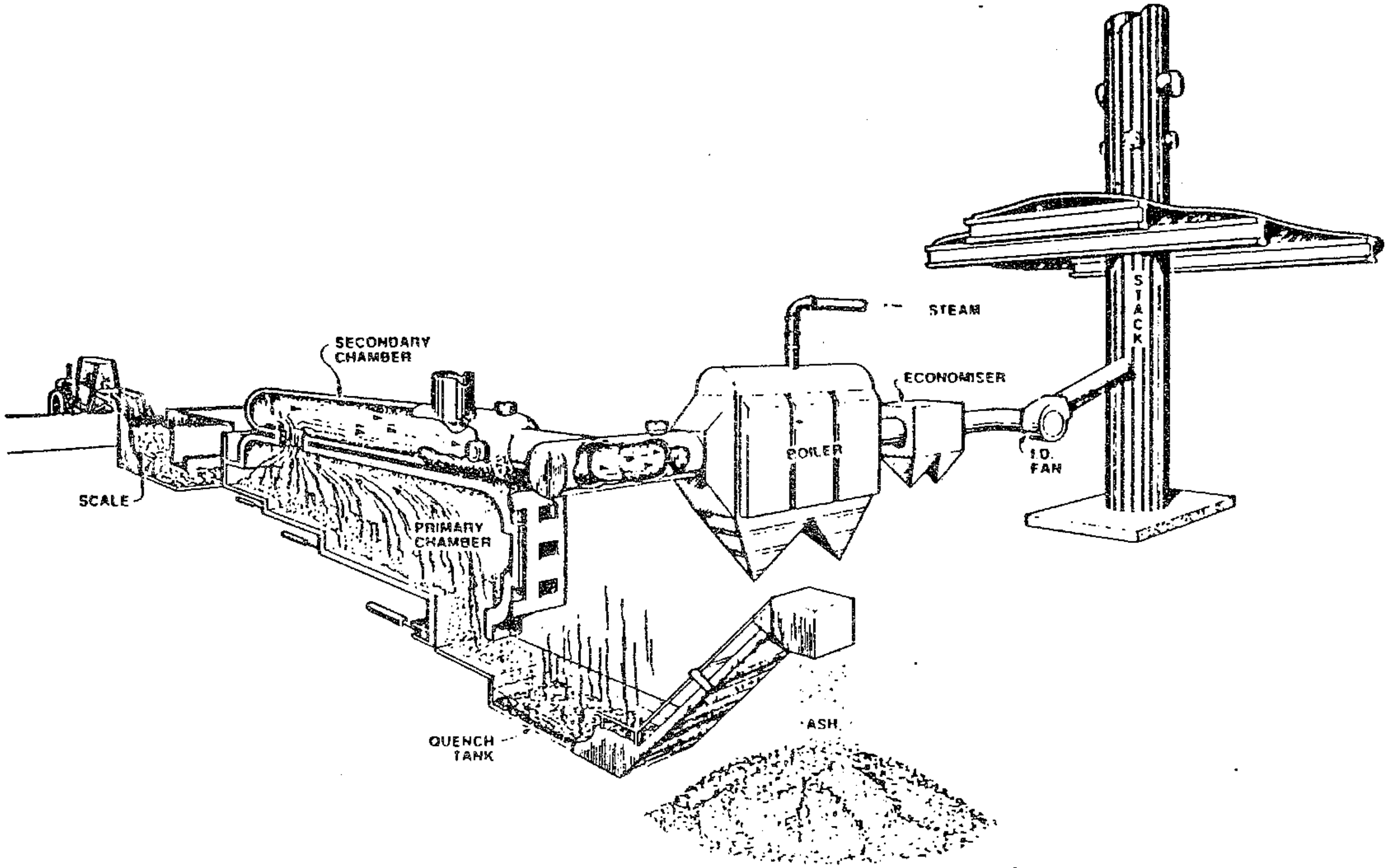


Figure IV-2

DIAGRAM OF A CONTROL-AIR INCINERATOR



c. Handling

(1) Direct Combustion

An overhead crane is used to lift waste from the storage pit into the incinerator feed chute; see Figure IV-1. The facility sizes under consideration for Madison, Monroe and St. Clair Counties would have two crane systems. Though one should be of sufficient capacity to feed an incinerator chamber at the design rate, the provision of two cranes allows for solid waste to continue to be fed to incinerators when one crane is down for maintenance or repair.

(2) Controlled-Air Incinerator

In a typical controlled-air incinerator, solid waste is handled with a small front-end or skid loader, which is used to move the incoming waste into the storage pile as well as to feed refuse into the incinerator modules (see Figure IV-2).

(3) Refuse-Derived Fuel Processing

Waste would be moved from the storage area on the tipping floor to the RDF processing equipment with a large front-end loader. Two loaders, conceptually similar to the units illustrated in Figure IV-2 would be used, with one serving as backup unit.

d. Preparation

(1) Direct Combustion

There is little preparation of the waste received at a direct combustion facility. Trucks with bulky waste, such as white goods (refrigerators) or construction/demolition debris, are anticipated to be handled via other solid waste management methods. The occasional large appliance entering a pit could be picked out by the crane operator.

Other large, bulky items that are combustible, such as pallets or furniture, are either reduced or set aside. An hydraulic shear and shredder can be used to reduce the size of combustible bulky items.

The presence of tires in the waste may also present difficulties. The high, rapid energy release with the combustion of a whole tire can be a problem in an incinerator if several tires were to be fed into the incinerator together. If tires are brought to a waste-to-energy facility, to avoid hot spots in the incinerator, tires can either be shredded and the tire pieces mixed with the waste in the pit or the crane operator can periodically feed single tires into the incinerator.

(2) Controlled-Air Incinerator

Plant operations at a controlled-air incinerator are similar to a direct combustion system. The loader-operator would be responsible for separating any noncombustible bulky items that might be delivered to the facility. Tires should be fed to the incinerator individually, with reasonable intervals between them, by the loader operator.

(3) Refuse Derived Fuel Processing

The process that transforms solid waste into RDF involves either dry or wet preparation. Wet RDF processing was rejected for the Counties' plan as a viable option because of the performance record of such systems and the apparent lack of interest by vendors in marketing this system. Dry processing of waste into RDF can take several forms. A typical process flow schematic is presented in Figure IV-3. The dry process preparation method has been used in many years in Madison, Wisconsin and nearby Ames, Iowa and most recently in such regional locations as Ramsey/Washington County, Minnesota, and La Crosse County, Wisconsin. These types of RDF project typically include five steps:

- shredding (flail mill)
- magnetic separation
- trommelling (or disc screen)
- shredding (hammer mill)
- air classification

These process stages, shown to be effective commercially, are described below:

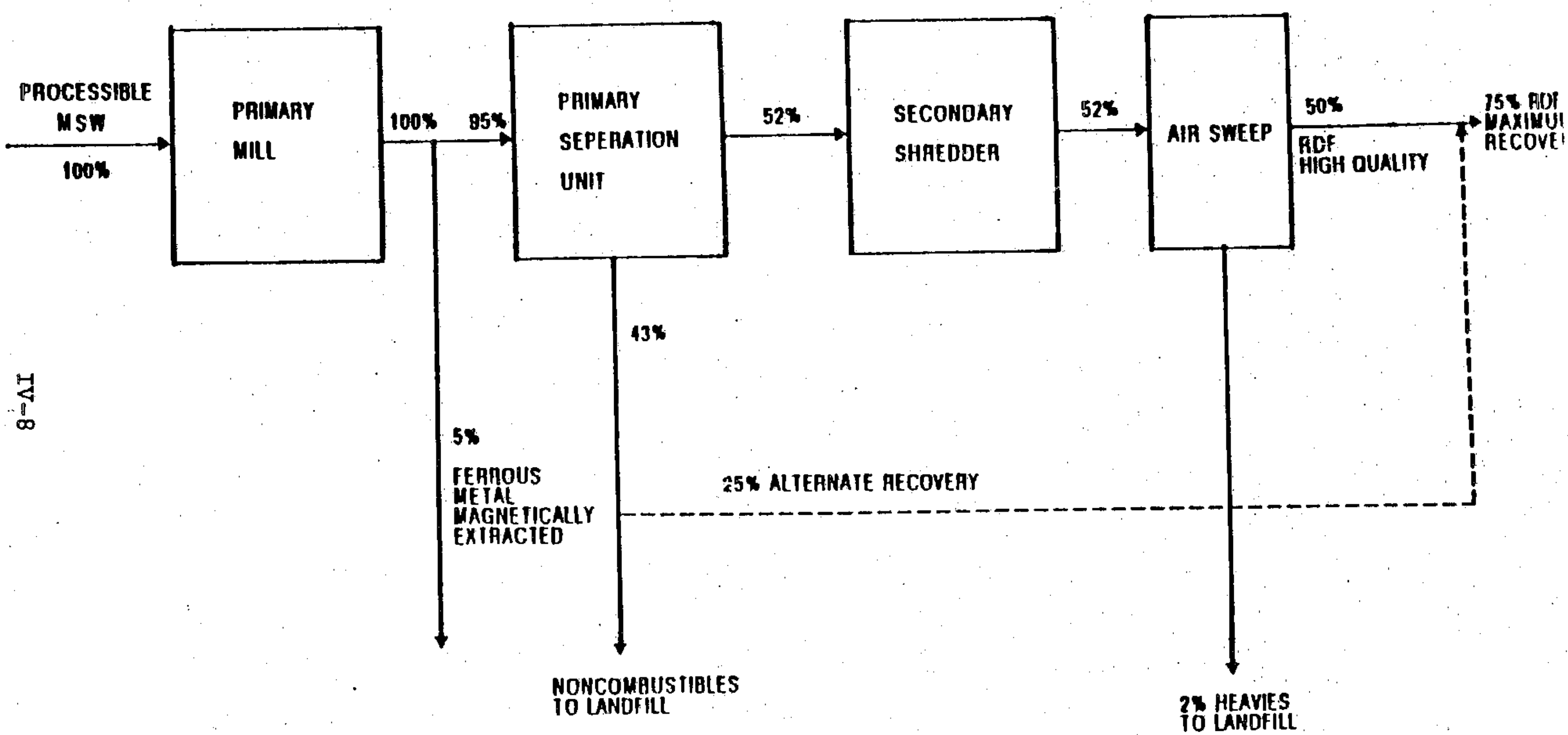
A pan conveyor would carry refuse from the storage area to the first processing step, shredding. A low-speed (30 to 60 rpm), high-torque flail mill, fitted with shearing discs, can shear tires and break open plastic bags and containers. (Some of these containers contain flammable liquid and cause explosions further downstream.) The mill does not grind glass into fine particles (which could lead to slagging problems in the furnace).

The sheared waste discharged from the flail mill, typically of a nominal 10-12 inch size range, is transported past a magnetic separator by a belt conveyor. A drum or an overhead belt magnet (either permanent or electromagnet) can be used to separate ferrous material. An overhead belt electromagnet is typically used. The ferrous metal separated can be sold as scrap or taken to a landfill for disposal. If the market for scrap ferrous is weak, the material can be stockpiled for sale at a later date (or landfilled if absolutely no market is available).

After passing the magnetic separator, the solid waste would be conveyed to a trommel or a disk screen. These devices would be

Figure IV-3

RDF PROCESSING FLOW DIAGRAM AND MASS BALANCE



used to separate heavy noncombustibles, such as glass and sand, from light combustibles, such as paper and plastic. Paper, plastic, other light combustibles, and light noncombustibles are discharged from the trommel to a belt conveyor feeding the secondary, high-speed shredder.

The secondary shredder would be equipped with a shaft fitted with heavy, hard-faced steel hammers. A high-horsepower electric motor spins this shaft/hammer assembly at high speed and would pulverize the waste to particles of about three to four inches (note: smaller sizes achieved based on the RDF market requirements).

The shredded material would be discharged into an air-classification system. The air classifier's upward-moving stream of air would carry the lighter, combustible materials upward, while the heavier, noncombustibles would drop. A cyclone would remove the combustibles from the air stream. The noncombustibles could be considered for further processing for material recovery or composting, or could be landfilled.

The prepared solid waste, or RDF, from the shredder would be transported either pneumatically or on a belt conveyor to an RDF storage area. Bins with live-bottom retrieval systems or horizontal/vertical screw conveyors, concrete bunkers, and concrete pads can be used for storage. The RDF would be fed from the storage area to the furnace.

(a) Types of RDF

Fluff, densified, and dust are terms used to describe the type of products that can be produced with dry RDF processing. The production process for all three is similar through the fluff stage. Additional processing is required to obtain the densified and dust types of RDF. Market requirements typically determine the type of RDF that is produced.

i) Fluff RDF

This type of RDF has a relatively small particle size. Depending on the application, the typical size may be about four inches for use in a spreader stoker or fluidized bed boilers down to approximately 0.75 inches for suspension-fired boilers. Fluff RDF has been used in both dedicated boiler and co-fire applications.

Although several configurations are in use, a typical process system to produce fluff RDF is shown in Figure IV-3. Waste is unloaded into a pit or onto the receiving floor and then conveyed to a flail mill. The flail mill separates the waste mass for further downstream processing and opens any bags containing refuse. Magnetic separation of the ferrous metal is the next stage in the processing. An additional RDF processing step is conducted by the use of a trommel screen. This equipment is a rotating, slightly inclined screen that allows waste to flow through the cylinder in a lift-and-drop fashion while removing many of the remaining small noncombustible materials through the screen holes.

The waste that passes through the trommel is fed into a shredder, which reduces the particle size of the waste. The shredder waste is fed into an air classifier. An air classifier is typically a vertical column in which an upward-flowing air current separates the lighter, more combustible materials from the remaining noncombustibles. During this separation process, some of the combustible material is diverted from the RDF and exits the system with the inorganics. This lowers the total energy available from a given quantity of MSW. The loss, however, tends to be minor. If the smaller (0.75 inches) particle size is desired, then the waste would be shredded again at this point.

The lighter material obtained from the air classifier is fluff RDF. A problem common to all types of fluff RDF is limited storage capacity. The material will compress under its own weight, which makes retrieval for use difficult. In general, fluff RDF storage is limited to 24 hours.

ii) Densified RDF (d-RDF)

Densified RDF (d-RDF) is produced by compressing fluff RDF into pellets or briquets. This requires that fluff RDF be produced in the smaller (i.e., typically 0.75 - 1.0 inches) particle size. Densified RDF is usually produced to be cofired with coal in lump form or wood. Longer-term storage and transportation advantages are important features of d-RDF.

2. Furnaces/Boilers

Refuse feed is combusted inside a furnace, using one of a number of feed mechanisms and a grate (in the case of a fluidized bed system, a distribution plate). In addition to the waste feed rate, air feed rate and directioning mechanisms are the critical controls. Most of the process control can be automated, bringing about efficient combustion of waste, with as much of its heat content released in the form of gaseous combustion products as feasible. Bottom ash, combined with flyash removed from the combustion product gases by the scrubber/baghouse, would be discharged to an ash-handling/storage system for landfill disposal.

The hot combustion gases from the furnace would pass through the boiler section, where heat is transferred to water in the boiler tubes and other efficiency-improving stages (such as a superheater, an economizer, or both), producing steam. The combustion gases would pass through the pollution control system before being emitted to the atmosphere.

The steam produced could be sold to a steam market or it could be fed to a steam turbine generator, generating electricity. With cogeneration systems, as much steam as is required or available is extracted at an intermediate stage from the steam turbine for the thermal energy application.

a. Direct Combustion

Direct combustion systems, waterwall incinerators, and refractory-lined incinerators with heat recovery are the most common methods for energy recovery in the United States and in other parts of the world.

(1) Waterwall Incinerators

Solid waste is transferred from the storage pit by a bridge crane fitted with a grapple to the feed hopper/chute assembly. The hopper/chute assembly, which is typically kept full of solid waste, leads directly to the feed table at the top of the combustion chamber stoker assembly. The chute may be water cooled because some solid waste may smolder and burn in the chute. By keeping it water cooled, heat deformation of the metal is avoided. The solid waste may be either gravity fed to the stoker or fed by a hydraulic ram feeder unit.

Within the combustion chamber, the stoker assembly extends from the end of the feed table to the ash-discharge area. The stoker consists of a number of grates or grate bars that support the combustion of refuse by permitting the entry of stoker or undergrate air into the combustion chamber. Depending on the manufacturer, the stoker provides the mechanism for the tumbling and mixing of refuse by either mechanical or hydraulic action. Depending mainly upon the stoker width, waterwall units have been constructed for MSW waste-to-energy projects from 100 TPD to 1,000 TPD unit capacity.

Flame patterns inside the furnace should avoid direct flame impingement on any of the tubes on the combustion chamber walls. Flame impingement will cause thermal corrosion of the boiler tubes while creating a reducing atmosphere at the tube-flame interface. This reducing atmosphere will cause corrosive materials to attack the boiler tubes.

Typically, within the combustion chamber, there are three zones of activity: drying zone, combustion zone, and burn-out zone. The drying zone is needed to remove most of the moisture from the solid waste so that when the refuse enters the combustion and burn-out zones, it will burn completely and efficiently. The air required for the combustion process is supplied by the forced-draft fan. Ductwork from the forced-draft fan distributes combustion air to primary air channels beneath the stoker grates as well as to secondary air injectors above the grate system around the fire box. The injection of secondary air allows for the control of the fireball height, and ensures that any sparklers that may rise from the combustion bed are completely burned. Waterwall incinerators usually require excess air in the range of 40 to 80 percent above stoichiometric conditions.[1] Air from the storage area is typically the source of the combustion air. In this way, odors from the storage area are pulled into the combustion chamber and destroyed. This controls the spread of odor from waste storage to areas outside the plant.

Because the boiler unit is in the hottest portion of the furnace, or combustion chamber, steam superheater banks may be installed in areas of high gas temperature. In solid waste-fired waterwall units, upper limits of 750°F and 600 psig for steam are typically set to avoid high-temperature corrosion of the waterwall tubes however, certain metallurgy will allow for higher steaming conditions. Pressures and temperatures above these typical settings require that special boiler tubes be used to provide a corrosion allowance as well as to ensure boiler integrity. Superheater steam temperature is controlled by attemperators that inject water or steam into the superheater header to control abnormally high-temperature steam.

The waterwall tubes tie into common headers at the base and at the top of the boiler. The upper waterwall header is suspended from the ceiling or roof of the facility, and the bottom header is supported by high-tension springs. The superheater tubes also tie into a common header and, like the waterwall tubes, typically hang vertically inside the boiler. (The superheater may be either a single-pass or a multiple-pass unit, depending on the degree of superheat required for steam. Multiple-pass units, because more area is available for heat transfer, will provide for the greater amount of superheat.) This type of "floating" construction allows the boiler tubes to expand and contract with temperature variations inside the boiler. Some units may be fitted with an economizer, or economizing bank, which is situated downstream of the boiler. The economizer uses waste heat in the form of flue gas to heat boiler feed water. Structurally, the economizing section is a bank of tubes that horizontally span the width of the flue gas duct.

Due to the light nature of solid waste, large amounts of flyash generated during the combustion of solid waste in direct combustion systems. Therefore, the superheaters and economizers must be cleaned by soot blowers. Soot blowers, particularly those that use steam, may cause erosion of the tubes, eventually leading to tube failures. The flyash is very corrosive as well as erosive. This ash contributes to the destruction of superheater and economizer tubes. These problems have been partially alleviated by installing stainless steel shields on the superheater tubes. Bottom ash,

[1]Stoichiometric condition refers to the amount of air containing the exact amount of oxygen needed for full and complete refuse combustion.

which remains on the grate system is discharged at the end of the stoker into an ash handling system. This system design could be of the dry type or wet/quench type.

Depending on the amount of air needed for proper combustion and furnace temperature/pressure control, a waterwall system can recover energy over a range of efficiencies. The average range of thermal efficiency is approximately 68-70 percent. At burning rates lower than 50 percent of capacity in a combustion chamber, lower efficiencies and various operating problems can be expected. This is due to a nonuniform distribution of fuel (i.e., solid waste) on the grate, which causes air to circumvent fuel through bare spots in the fuel bed. Combustion air will follow the path of least resistance (e.g., it is much easier for air to flow through a hole in a grate bar than through a foot or more of refuse). The inadequate fuel/combustion air mixing causes the incomplete firing of refuse in the furnace, thereby affecting combustion rates and efficiencies. Typically, a facility in the size ranges under consideration for the Counties would have two or three units.

(2) Refractory-Lined Incinerators

These systems are so named because of a thick (6 to 8 inches), heat-resistant coating on the inside walls of the combustion chamber. This refractory coating both decreases the transfer of heat produced from the combustion process to areas outside the incinerator unit and protects the outer shell from extreme and sudden changes in furnace temperature. The main difference between a refractory-lined unit and a waterwall unit is that with a waterwall unit the boiler is part of the combustion chamber, whereas in refractory-lined units the boiler is located downstream of the incinerator.

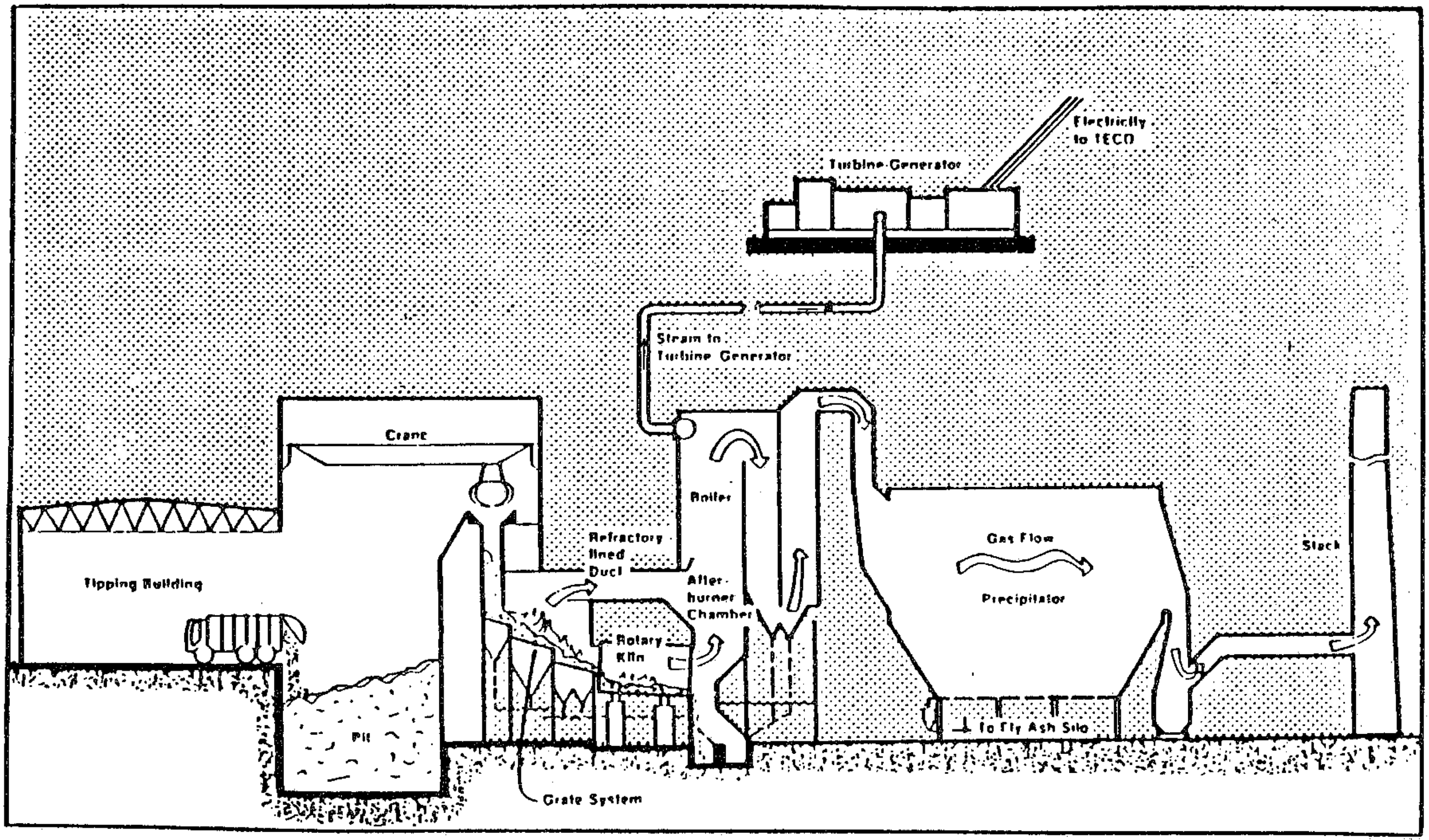
The waste-feed system and the combustion grate chamber with refractory-lined units is similar to the methods outlined for waterwall incinerators. A cross-section view of a refractory-lined incinerator is presented in Figure IV-4. Unit sizes of refractory-lined incinerators for MSW projects have typically ranged from 50 TPD to about 300 TPD.

Energy recovery with refractory-lined units is done in a waste-heat boiler downstream of the combustion chamber. The hot gases from combustion are removed from the incinerator by the induced draft fan and passed through the waste-heat boiler. The gases release their heat to the boiler tubes by convection, and through conductive heat transfer this heat to the pressurized boiler water. Upstream of the convection or boiler section of the unit, a superheater section may be located. Downstream of the boiler, an economizing section may be situated to use waste gas heat.

The boiler efficiency with a refractory-lined incinerator will generally be less than a waterwall system. The average range

Figure IV-4

CROSS SECTION OF A REPRESENTATIVE REFRACTORY-LINED INCINERATOR



of thermal efficiencies of refractory-lined incinerators is approximately 65 percent.

Refractory-lined incinerators require a large volume of air to provide both combustion air for the burning process and cooling air for the furnace wall and the feed-grate system. Because the furnace draft system (forced-draft fan, induced-draft fan, appropriate ductwork, and motors) and air pollution control equipment costs are directly related to the quantity of air to be used/treated, these incremental costs are higher with refractory-lined units than with waterwall incinerators.

(3) Controlled-Air Incinerators

Controlled-air incinerators use two or three combustion stages and are commonly referred to as modular incinerators. This term evolved from the shop-fabricated, modular construction used in building these units.

As depicted in Figure IV-5, a controlled-air incinerator consists of primary and secondary (afterburner) combustion chambers connected to a wasteheat boiler system. Efficient combustion of the waste fuel is achieved by controlling the amount of oxygen introduced to the system. One of the main benefits of this type of unit is the minimal field installation/erection work required, as the units are usually shipped as easily combined components with wiring, plumbing, and instrumentation being factory assembled. Unit sizes for MSW projects (50 TPD to 150 TPD capacity), however, have brought about shipment of large subsections that require more field assembly/erection. For example, the Springfield, Massachusetts facility has three 120 TPD units, constructed to form a 360 TPD plant.

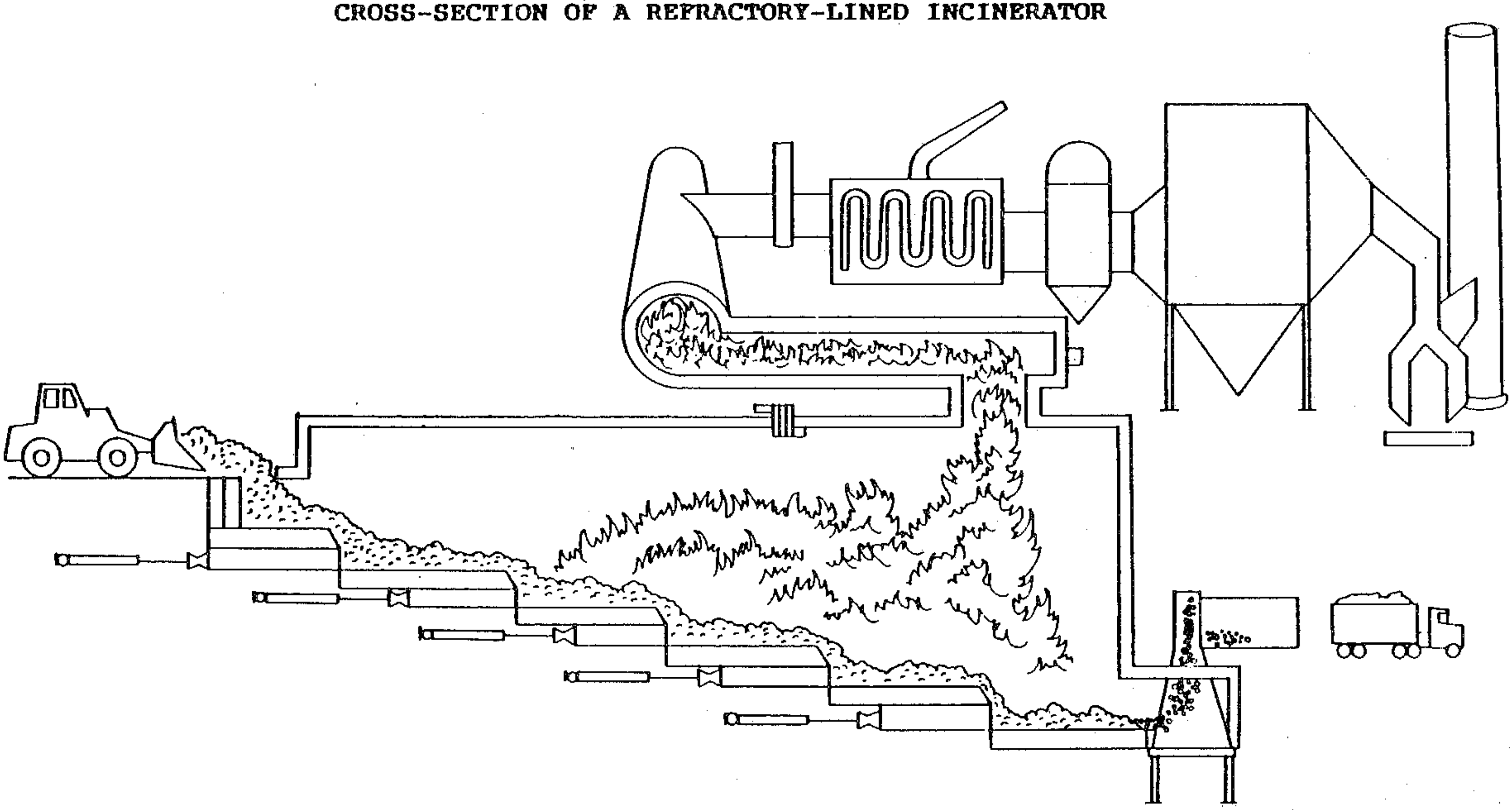
Hydraulically operated, ram-type feeders transfer the solid waste into the combustion chamber. In the combustion chamber, waste is moved through the primary chamber by means of an internal ram-type stoker system similar in concept to the reciprocating stoker assembly found in some direct-combustion units. The action of these rams, combined with the declining step arrangement of the floor, helps to agitate the solid waste and expose new surfaces for combustion.

Combustion air for the grate system is provided by a forced-draft fan located upstream of the stoker section of the energy recovery unit. The forced-draft fan directs air from underneath the grate system into the combustion chamber, bringing combustion air into contact with the refuse.

Controlled-air systems provide for the burning of combustible gases produced by the starved-air combustion of the waste in the primary section in the secondary chamber (afterburner). In the afterburner section, those combustible gases are completely burned with excess air. Temperatures in the primary chamber typically

Figure IV-5

CROSS-SECTION OF A REFRACTORY-LINED INCINERATOR



range from 1,500°F to 1,800°F, whereas in the secondary chamber they typically range from 1,800°F to 2,000°F. The hot, gaseous products of combustion are the heating medium in the boiler section following the secondary combustion chamber. The typical thermal efficiency of controlled-air incinerator system will be about 60 percent.

b. RDF Combustion

Cofiring and dedicated boiler are the two approaches to combustion of RDF. RDF dedicated boilers and associated combustion system are specifically designed to burn this fuel. Such systems include spreader stokers, fluidized bed, and even mass burn units. A spreader stoker is most commonly associated with RDF dedicated boiler facilities. Fluidized bed units are receiving more attention recently as an RDF combustion system.

(1) Dedicated Boiler -- Spreader Stoker

Operation of a dedicated boiler (see Figure IV-6) is very similar to that of a mass burning waterwall unit, with the major differences located in the fuel-feed system. The dedicated boiler will receive fuel (i.e., the RDF) in its combustion chamber by either gravity or pneumatic feed. As RDF is fed into the boiler, the very light dust particles are burned almost instantaneously in suspension. The ash is carried in the gas stream and removed by the air pollution control equipment. Heavier RDF particles fall to the front of the stoker. There, the heavy particles are combusted on the grate.

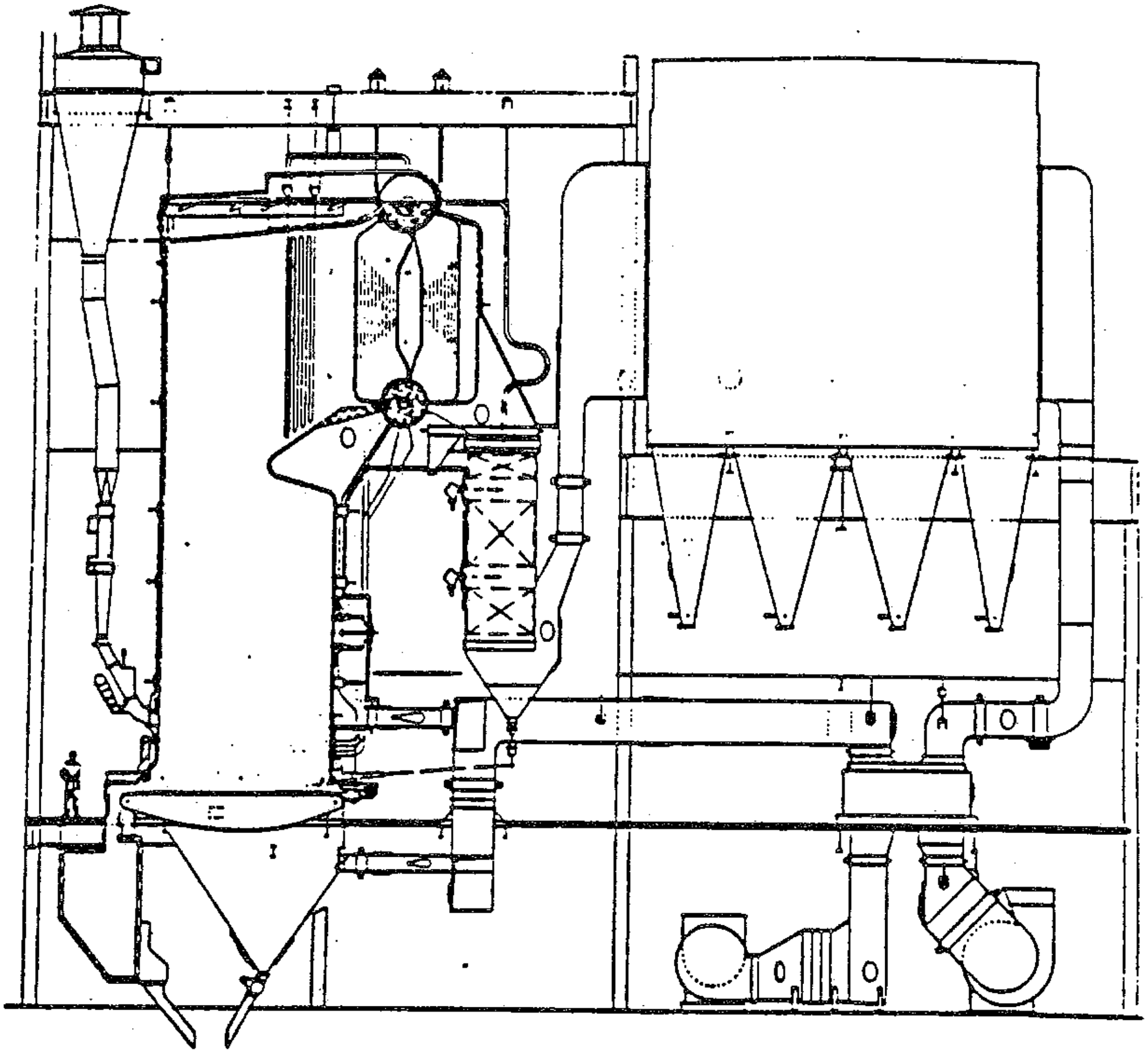
The stoker assembly is a moving-grate type made up of a number of grate bars. The speed of the stoker is adjustable to facilitate complete combustion on the grate. Some boilers are fitted with a coking plate at the rear of the boiler that starves the fuel of oxygen, in essence creating a pyrolysis zone at the rear of the boiler. This plate also helps keep the flame away from the rear wall of the boiler, thus reducing the probability of tube wear and corrosion at that spot.

Once on the grate, hot air, supplied by the forced-draft fan from an air preheater, initiates the combustion of refuse. As the fuel moves closer to the front end of the boiler, it is slowly combusted. At the front of the boiler, depending on steam load conditions, an ash bed depth of 4 to 6 inches can be expected. The sandy, dry ash is discharged into an ash pit. The distance fuel is distributed into the boiler is controlled by the RDF-fuel spouts. By controlling the amount of air to the spouts, RDF can be effectively moved forward or backward in the boiler.

The combustion chamber of an RDF dedicated boiler is normally very tall in order to facilitate the combustion residence time needed for suspension burning. Combustion air for the suspension burning is supplied by the overfire air system. This system of air

Figure IV-6

SIDE VIEW OF AN RDF-FIRED BOILER (SPREADER STOKER)



nozzles is typically located between 2 and 15 feet into the stoker. It provides an adequate supply of air for the complete combustion of suspended particles as well as keeping the flame away from the lower waterwall sections of the furnace where it is most intense. This air is delivered from the air preheater to the forced-draft fan, which distributes the air to the overfire nozzles.

The hot gases of combustion are carried away by the induced-draft fan, which pulls the gas from the combustion chamber through the boiler (convection tube bank), where it surrenders its heat to the boiler tubes and boiler water and through the economizer, air preheater, or both to the air pollution control equipment.

As with waterwall direct combustion units, boiler pressure should be kept at subatmospheric conditions to ensure that noxious fumes are retained in the boiler. Air supplied to the combustion chamber is in excess of 40 percent above stoichiometric conditions. As with waterwall incinerators, circulating water serves to keep the combustion chamber cool as well as to absorb some of the heat of combustion. As the hot gases rise through the boiler furnace area, they pass through the superheater tube bank and heat the saturated steam to the desired degree of superheat. (As with waterwall units, the degree of superheat is controlled by attemperators on the superheater discharge header.) The hot gases then pass through the convection tube bank of the boiler, the economizer, and/or air preheater and finally to the air pollution control system.

Steam, either superheated or saturated, is piped to either a turbine-generator set or ultimate steam users via a common distribution header. Steam generated from these units also typically range from saturated steam to superheat conditions of 600°F, 750 psig. One such exception is the Occidental Energy Company's RDF cogeneration system at Niagara Falls, New York, which operates at 750°F, 1,250 psig steam.

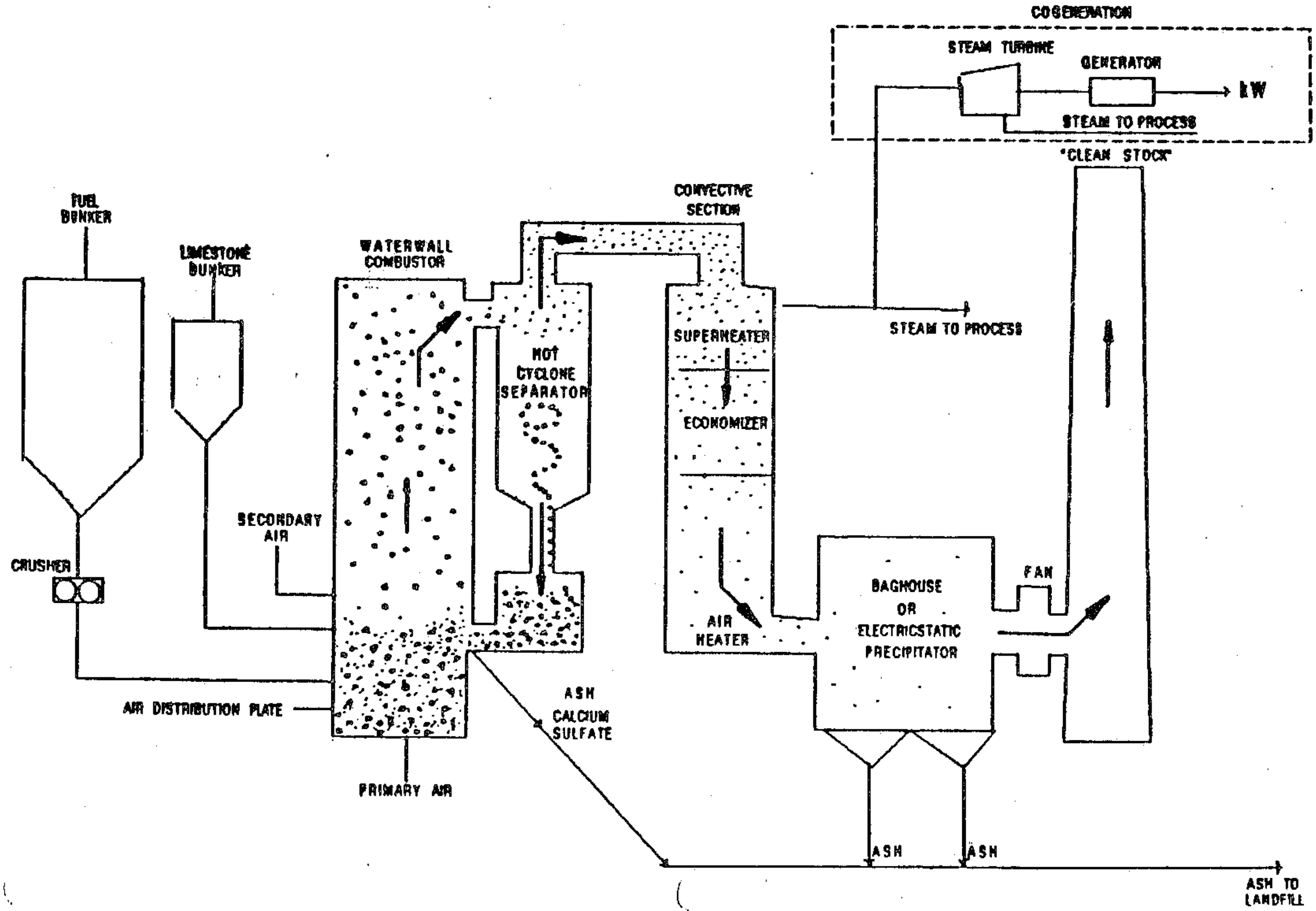
(2) Dedicated Boiler -- Fluidized Bed

Fluidized-bed combustion has been developed in the United States primarily as a means of burning high-sulfur and low-grade coal and adding limestone to the bed to absorb the sulfur, thus reducing or eliminating the need for postcombustion acid gas controls.

Fluidization is the suspension of material in an upward flow of gas. The material in a fluid-bed combustor consists of a small amount of fuel mixed with a large amount of inert material. The primary material is usually one of several types of sand but also includes ash from the fuel and limestone. A diagram illustrating the combustion process in a fluidized bed system is shown in Figure IV-7. The theoretical advantages of fluidized bed combustion include:

Figure IV-7

FLUIDIZED BED COMBUSTION WITH DEDICATED BOILER



- Improved combustion due to turbulent mixing of fuel, inert material, and air

- Reduced nitrogen oxide (NO_x) formation, slagging, and clinkering because combustion temperatures are limited to 1,600°F or lower

- Stabilized combustion due to the thermal flywheel effect of heat absorption by the large inventory of inert material in the bed

- Acid gas absorption by adding limestone to the bed

It is important to note that, while some of the theoretical advantages have been demonstrated with a fluidized combustion system burning coal, they have not been fully demonstrated when burning MSW (RDF). Ninety percent HCl and 70 percent SO_2 reduction with in-bed lime addition but without the use of a downstream scrubber reactor tower has not yet been demonstrated. These important air pollution control criteria, among others, are being made definitive air pollution control requirements. Thus, the theoretical advantages attributed to fluidized combustion systems have not been proven to the point of basing a system procurement on the theoretical advantages offered by vendors of such systems.

Fluidized-bed combustion is accomplished by passing air from within a bed of inert material and adding solid fuel to the bed so that it is ignited in the bed. As air passes upward through the bed material and fuel, a pressure drop will take place in the air flow. With sufficient velocity, the pressure drop equals the weight of the bed material and fuel, and fluidization occurs.

Early fluidized-bed combustion (FBC) was of the bubbling-bed design, characterized by a dense bed in the bottom of the reactor with a clear phase above. More recent designs use a circulating fluidized-bed (CFB) technique characterized by a dense lower bed and a less dense upper zone.

The clear phase region above the region of the turbulent inert material and fuel in the FBC bubbling-bed technologies is known as the freeboard. The CFB design has gas velocities in the range of 20 to 30 feet per second, compared to 10 to 20 feet per second typical for the FBC designs. Because of greater velocity with CFB, the density of the fuel/air mixture is reduced, and the interface layer between the bed and the freeboard no longer exists.

A significant amount of the bed material and fuel particles in the CFB are carried over out of the combustion region because of the higher velocities and are captured and recycled into the fluidized-bed reactor. Although some bubbling-bed designs have cyclonic separators for solids capture, all CFBs must have such separators. The bubbling-bed design, with lower air velocity, experiences less carryover of bed material and fuel.

Bubbling-bed and circulating-bed technology have been used to burn coal as well as wood, peat, and MSW. In order for solid waste to be burned in most fluidized bed technologies, the solid waste must be processed into an RDF.

There are several solid-waste-burning, fluidized-bed combustors operating in Japan as well as in Europe. The problems in burning solid waste derive mostly from the presence of glass, which has a low fusion temperature. To prevent this glass from causing excessive clinker formation, bed temperatures must be kept in the 1,500 to 1,600°F range. Temperatures in the 1,600 to 1,800°F range (if desired) may be attained above the bed if the RDF contains only a very small percentage of glass.

Tests of fluidized combustion units on solid waste from the United States have given satisfactory results and have provided important information for their commercial application. The stabilizing effect on combustion of the inert bed material has caused interest in fluidized combustion for solid waste and also a variety of other low-grade fuels, including high-moisture fuels. Fluidized combustion systems have been applied extensively in this country for biomass combustion, such as wood waste and agricultural waste.

Due to the current interest level in fluidized bend combustion applications in the U.S., a short overview of the application of this technology on U.S. solid waste is provided herein:

- FRANKLIN, OHIO (BLACK-CLAWSON)

  In the late 1960's the City of Franklin, Ohio applied for a federal grant to demonstrate an innovative process involving wet grinding, fluid separation, resource recovery, and incineration as means of solid waste disposal. This experiment, by the federal Environmental Protection Agency and Black-Clawson Company, appears to be the first commercial application of a fluidized-bed combustion system (i.e., incinerator only for volume reduction) for MSW disposal in the United States.

  At the Franklin Plant, the MSW was separated, then the remainder was pulped made into a slurry, and pumped to the fluidized-bed incinerator. The fluid-bed reactor was a 25-foot (inside diameter) vertical cylindrical unit supplied by Dorr-Oliver, Inc. In this unit, room-temperature air was blown into a windbox upward through a perforated plate and gravel-dispersal layer into a layer of sand, which became fluidized by exposure to the air. The exhaust gases were cleaned of particulate matter in a Venturi Scrubber and were discharged through a gravity separator as a clean, nonpolluting, odor-free white plume. Sludge from the adjoining sewage treatment plant was dewatered in a cone press and then burned in the fluid-bed reactor.

The plant began operating in June 1971, processing 50 tons of waste per eight-hour day, three days a week. The plant continued to run until 1979, when it was decided that it was not economically feasible to continue operation. The plant was not receiving enough waste, and the tip fee for the waste it was taking in was unrealistically low. These conditions, together with the need to purchase a great deal of electricity and city water, put the plant at an operating loss, forcing its eventual closure.

- DULUTH, MINNESOTA -- WESTERN LAKE SUPERIOR DISTRICT

The Western Lakes Superior Sanitation District, serving 150,000 people in and around the City of Duluth, Minnesota, commissioned a study in 1974 to evaluate disposal alternatives for sludge and solid waste. The evaluation resulted in a recommendation to construct a fluidized-bed system to dispose of sewage sludge and prepared MSW. The facility was designed in 1975-1976, and construction was finished in December 1978 at a total cost of $20 million. In 1979 the facility was started up (several months late) because of problems when the fluidized-bed combustion system supplier filed for bankruptcy.

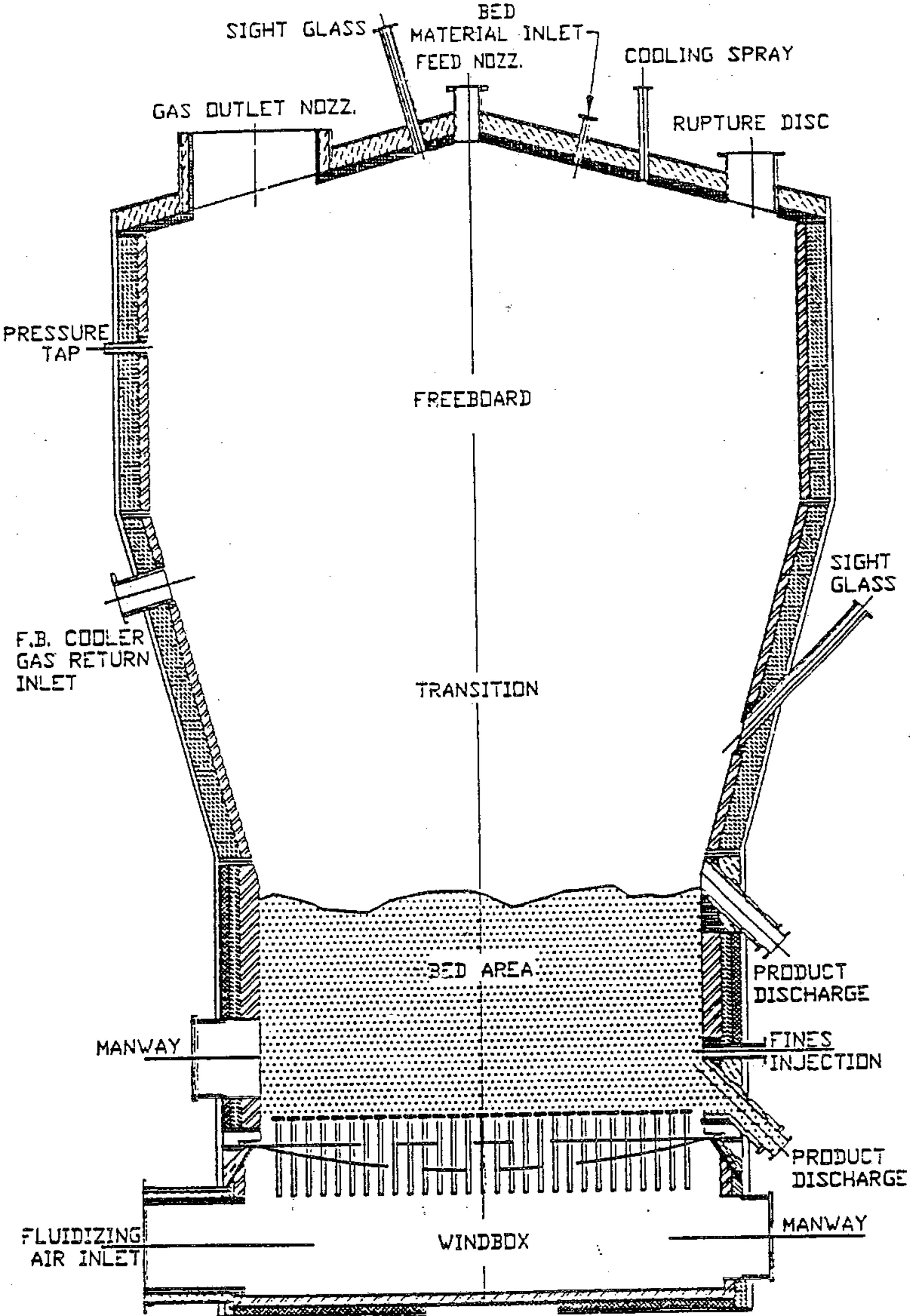
Conceptually, the design mixture of solid waste and sludge required approximately 200 tons per day of solid waste to incinerate 340 tons per day of sludge. Each of the two fluidized-bed reactors was designed to feed 160 tons of RDF per day.

Each combustion unit, (see Figure IV-8) is 45 feet high and has an inside diameter of 34 feet at the freeboard. The top of the windbox is an orifice plate which supports the sand bed and allows the fluidizing air to enter the bed. The unit is refractory lined. Sludge is fed into the combustion unit at the top of the units, then through dump gates and a knife gate. Flue gases enter cyclone separators, then waste heat type boilers, then Venturi Scrubbers. The steam, produced at 250 psig, is used only for in-plant use. After commercial operations began in 1980 considerable difficulties ensued. Through 1981 and 1982, various modifications were made to both the processing and the incineration system. Finally in early 1984, the District took bids for total revamping of the RDF processing and feed systems. On June 3, 1985, the RDF processing facility began operating again and has received and processed most all Duluth MSW since that time.

The new RDF processing system is now operated for about 40 hours per week to process MSW from the Duluth area and from

Figure IV-8

TYPICAL COPELAND FLUIDIZED BED REACTOR



Carlton County, MN. Approximately 50 percent by weight of the incoming MSW is recovered as a high-grade fuel, and the remainder is loaded out to the landfill; this 50 percent rejection represents about 35 percent by volume and includes nonprocessable materials.

- **NORTHERN STATES POWER/LA CROSSE COUNTY, WISCONSIN**

Northern States Power Company (NSP) is an investor owned utility headquartered in Minneapolis, Minnesota. Their French Island Power Plant, located in La Crosse, Wisconsin, was initially built in 1940 as a single 12.5 Mw coal-fired unit with a second similarly sized coal-fired unit added in 1948. One of these renovation projects completed in late 1981 was the conversion of NSP's French Island Unit 2 from an oil-fired peaking unit to an atmospheric fluidized bed (AFB) cycling unit to burn wood waste and other low Btu fuels. This unit has been in service, on a five-day-per-week two-shift basis. NSP has also retrofitted Unit 1 in a similar manner. Thus, the two boilers are now converted for the firing of refuse-derived fuel (RDF)/wood waste.

The French Island Unit 2 wood waste burning fluidized bed facility was completed in December 1981 at a cost of $6.3 million. In 1982, the first full year of operation, this facility which operates two shifts per day, five days per week, achieved an operating availability of 87 percent. The unit burned about 350 tons of wood waste daily until October 1987, when RDF blending was initiated. Energy Products of Idaho (EPI), the AFBC contractor for the French Island Units 1 and 2 completed waste wood/RDF test burns in October 1986 at its Coeur d'Alene, Idaho, test facility.

The integrated RDF processing plant and AFB combustion facilities began initial operation in October 1987 at a cost of approximately $21 million.

The major RDF Processing plant project activities included the following:

-- new plant access road

-- inbound-outbound truck scales

-- RDF receiving building and tipping floor

-- RDF processing line (50 TPH)

-- RDF storage-reclaim bin (150 ton)

-- RDF metering bins (two) and pneumatic transport lines

-- Trailers (four) for residue and ferrous transport

The major boiler plant activities completed as a direct result of the La Crosse County/NSP 20-year Service Agreement included:

-- Unit 1 AFB boiler conversion

-- Unit 1 wood waste storage bin (300 T)

-- Unit 1 wood metering bin and pneumatic transport system

-- Unit 1 and 2 RDF/wood blending system

-- Unit 1 and 2 Bailey Net 90 boiler control system

-- Unit 1 (Multiclone) ash collector

-- Unit 1 gravel bed particulate collection system

Each boiler is connected to a common steam header furnishing steam to two 15 Mw steam turbine generators. The electrical output is connected to the NSP electrical grid. The fluid bed combustion system for both Unit 1 and 2 consists of rectangular containment vessels attached to the bottom of the existing furnace (see Figure IV-9). This fluidized bed vessel contains the above-bed fuel injection system, the over-fire combustion/under-bed fluidizing air system, the bed material feed and tramp drawdown systems, the in-bed cooling water system and the fluid-bed preheat burner system.

3. Air Pollution Control

The following subsections summarize the detailed information on air pollution control systems used on waste-to-energy facilities.

a. Electrostatic Precipitators (ESP)

Electrostatic precipitation involves use of an electrostatic field for precipitating or removing solid or liquid particles from a gas in which particles are entrained. The ESP consists of a series of plates parallel to the flow of flue gas housed in an enclosure. These are collecting electrode plates and are grounded. Between a set of collecting plates is a discharge electrode, typically a wire, which is maintained at a high electrical potential. A charge is generated on the particles in the gas stream and they are attracted to the collecting plates. Striking the collecting plates, the particles adhere and the charge is

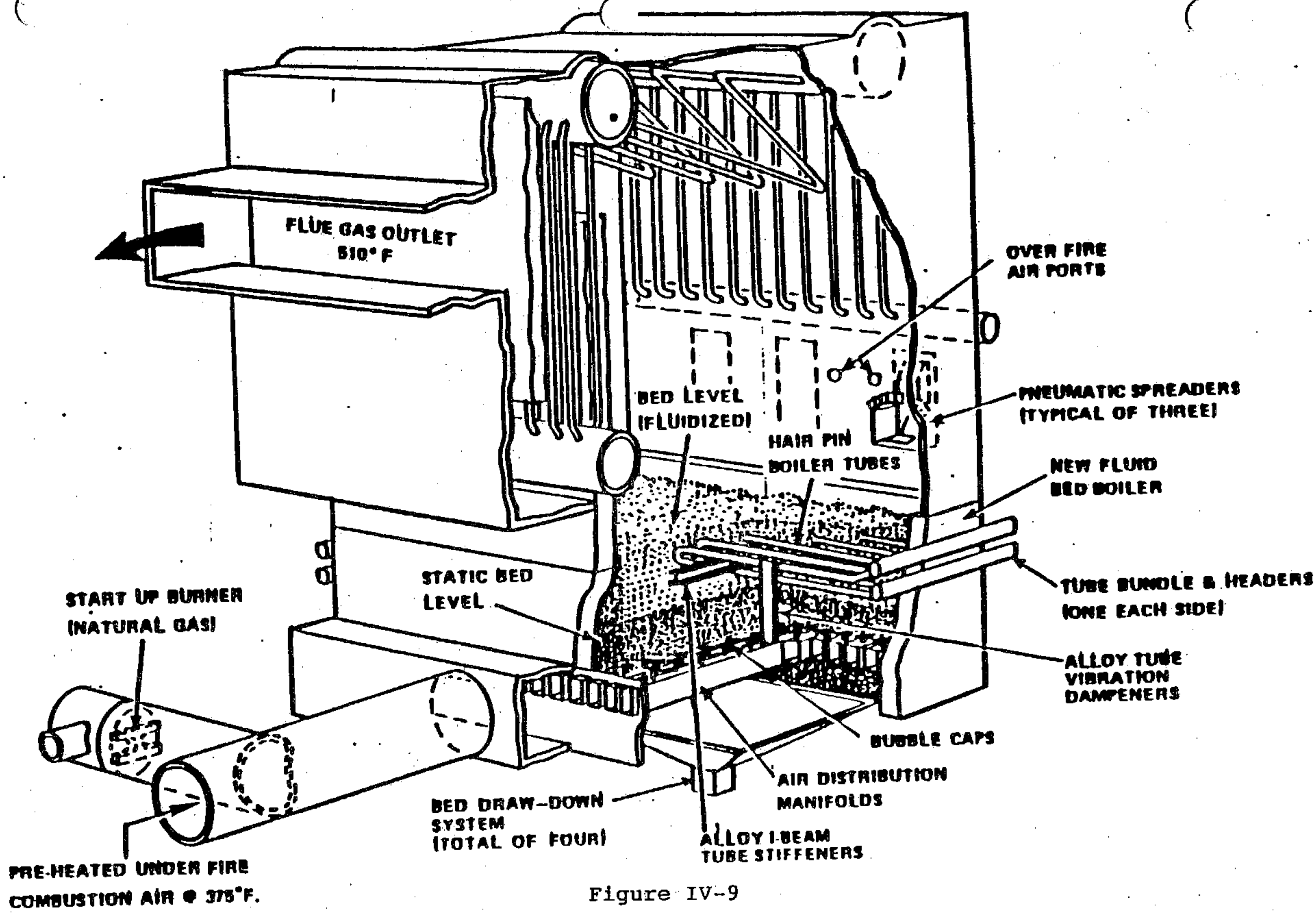


Figure IV-9

**FLUID BED COMBUSTION CHAMBER
AND AIR PREHEAT BURNER ARRANGEMENT**
UNIT NO. 2 (UNIT NO. 1 SIMILAR)

drained. The collecting plates are rapped periodically by hammers to cause the particulate matter to fall to the bottom of the enclosure for removal. Multiple sets of plates or fields are used to increase the efficiency of ESPs which are sensitive to the concentrations of pollutants in the gas stream. Fluctuations in concentration require additional fields and extremely sophisticated voltage control to maintain the high efficiencies for a state-of-the-art waste-to-energy facility.

ESPs can be made extremely efficient by adding additional fields; four fields have been used in some waste-to-energy plants. ESPs are least effective capturing particles in the 0.5- to 2-micron range. This size range is significant because the particles are of respirable size (capable of entering the lungs). Also, the greater surface area provided by the fine particles provides increased carrying capacity for dioxins and heavy metals.

ESPs represent the most commonly used particulate control device with both European and North American energy recovery facilities. Test reports from these facilities document removal efficiencies of 98 percent and greater.

The advantages of ESPs are their relatively high overall efficiencies (associated primarily with removal of larger-sized particles), absence of water requirements, lower pressure drop across the device, and relatively low operating cost.

b. Fabric Filters (Baghouse)

Fabric filtration (often referred to as baghouses) use mechanical screening to trap solid particles. In this type of unit, effluent gas is passed through a porous material (a filter usually in the shape of a bag) that collects particulate matter above a certain size on the filtering material. Particles are initially captured and retained on fibers of the cloth by means of interception, impingement, diffusion, gravitational settling, and electrostatic attraction. After a cake accumulates on the filter, the cake itself becomes the collecting medium. A portion of this cake is periodically removed by mechanical shaking, reverse air flow, or pulse air jets.

Performance tests have shown that smaller particles are retained once a filter cake has built up on the filtering surface, in effect decreasing the mesh size. Fibers used as filtering media have included fiberglass, possibly teflon coated, and other synthetic materials. The ideal fiber exhibits temperature, acid, and abrasion resistance.

Other factors affecting fabric-filter design are size and shape of filters, filter arrangement, spacing of bags, and method of cleaning. Systems are very efficient for collecting particles, specifically those less than 2 microns; efficiencies over 99 percent are common. If properly designed and operated, consistently high particulate removal efficiencies can be achieved. Tests from the Framingham, Massachusetts facility exhibited 99.8 percent removal efficiency.

c. Scrubbers

There are three major types of scrubbers: wet scrubbing systems, spray reactor or semidry systems, and dry powder injection.

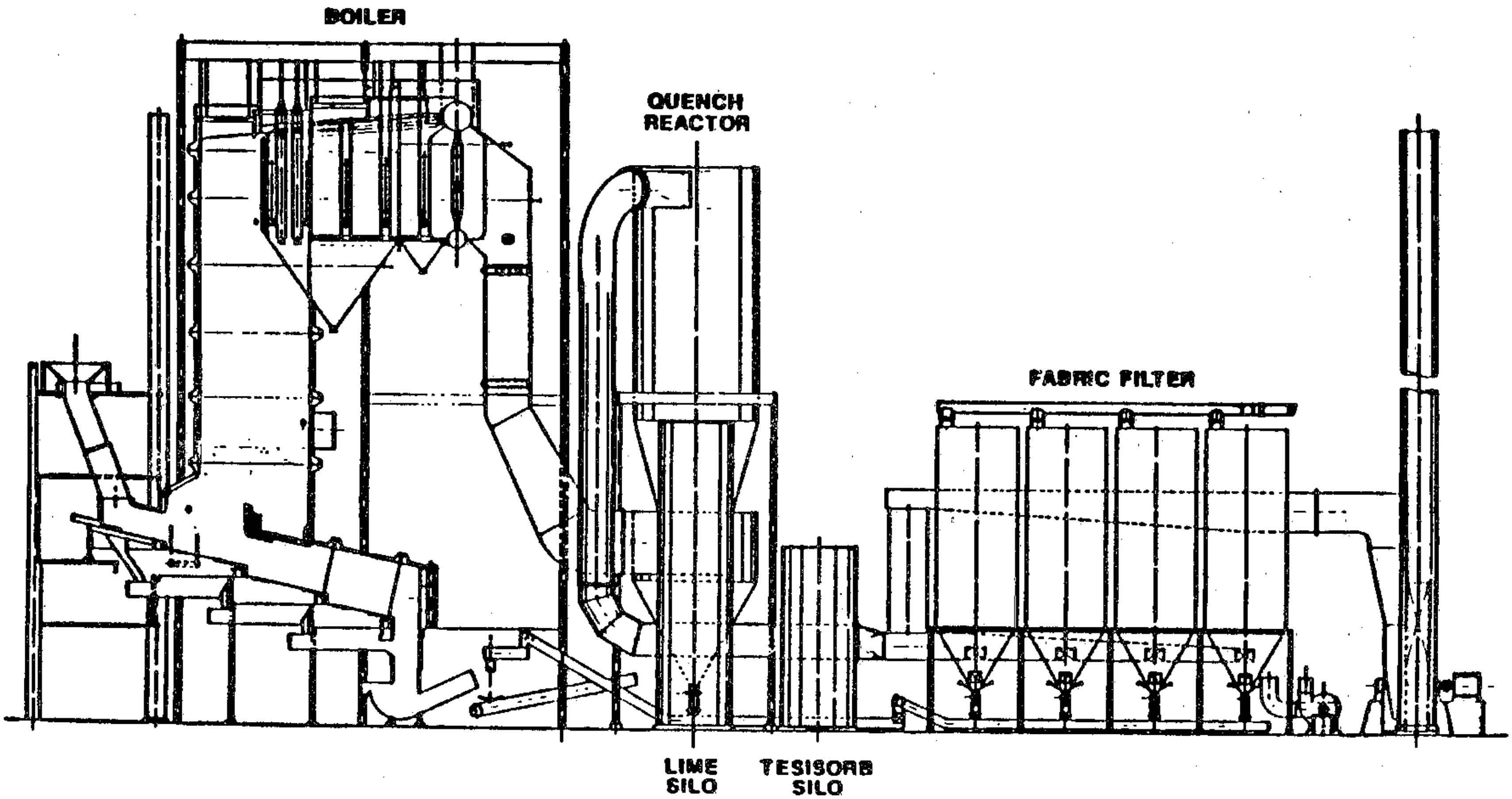
Wet scrubbing systems use a liquid solution to absorb or scrub contaminants from flue gas. Scrubber design and characteristics of liquid determine contaminant removal efficiencies. Low-to-medium-energy wet scrubbers may reduce flyash particulate, sulfur dioxide (SO_2), and acid gases, but additional particulate control may be necessary. Wet scrubbers augmented with alkaline reagents may encounter scaling and corrosion, which may be minimized by design changes and use of corrosion resistant materials. These units typically have a liquid or slurry waste that must be disposed.

Spray reactor or semidry scrubbing involves spraying precise amounts of water in the slurry so that it evaporates in the spray reactor. Spray dryers inject atomized droplets of alkaline or caustic slurries to react with contaminant gases and form neutral salts such as calcium sulfate ($CaSO_4$), calcium chloride ($CaCl_2$), sodium sulfate (Na_2SO_4), and sodium chloride (NaCl). Dried droplets can remove 90 percent or more of the hydrochloric acid (HCl) and 60 to 80 percent of the sulfur oxides (SO_x). The dried solids are collected in particulate-control devices. Removal efficiency for SO_x may be dramatically increased by use fabric filters at the back end of scrubbing systems due to the extension of the reaction time in the cake on the filters. Spray dryers use the heart in the flue gases to evaporate the slurry water. A temperature drop of 450°F to 300°F is generally required for this purpose. Close control of temperature is maintained by adjusting the quantity of water sprayed. Acid emissions are controlled by adjusting the amount of lime in the slurry.

Dry powder injection of the acid gas control reagent is the third type of unit. Dry powder scrubbers do not involve the complications of slurry preparation and atomization. Recently, test data on the performance of dry (powder) injection scrubbers has become available. The Quebec City test data, for example, show that dry powder injection can achieve HCl removal in excess of 85 percent and SO_x removal in excess of 90 percent with the flue gas temperature of 120°C (248°F). These results show the importance of temperature reduction below 300°F and preferably below 250°F. In these tests, water sprays were used to control gas temperature. Multiple-stage boilers and air preheaters are also used to lower flue gas temperature. Scrubbers with baghouses have been recently put into commercial operation at facilities such as Marion County, Oregon; Commerce City, California; and Babylon, New York. A typical system is presented in Figure IV-10.

Figure IV-10

COMMERCE REFUSE TO ENERGY FACILITY BOILER AND APC EQUIPMENT



4. Steam Turbine Generator

To produce power, superheated steam is typically fed into a steam turbine. As the steam enters, it is expanded through a stationary nozzle. The expanded steam jet strikes the blades on the turbine, rotating them. This rotary movement is converted to electricity in the generator.

In a turbine, the power output is a function of several factors. One is the temperature/pressure of the steam, which indicates the enthalpy or energy in the steam. Enthalpy is expressed as Btu per pound of steam. Another factor is the steam flow expressed as the number of pounds of steam per unit of time, such as an hour. The theoretical steaming rate (TSR) indicates the pounds of steam necessary to produce a kilowatt of electricity. The basic efficiency of the turbine-generator (T-G) set is another important consideration. Basic efficiency generally is directly related to the size of a T-G set (see Table IV-1).

TABLE IV-1

TYPICAL T-G SET EFFICIENCY LEVELS VS. ACTUAL kW OUTPUT LEVELS

T-G Set Size Range (kW)	Net Efficiency (%) Turbine Generator Multistage Design
500 - 1,000	45-58
1,000 - 3,000	58-65
3,000 - 7,000	65-72
7,000 - 15,000	72-77
and above	78-81

Two types of systems for converting steam to electricity were considered for applications to this plan: condensing turbine, (all-electric), and extraction turbine, for cogeneration applications.

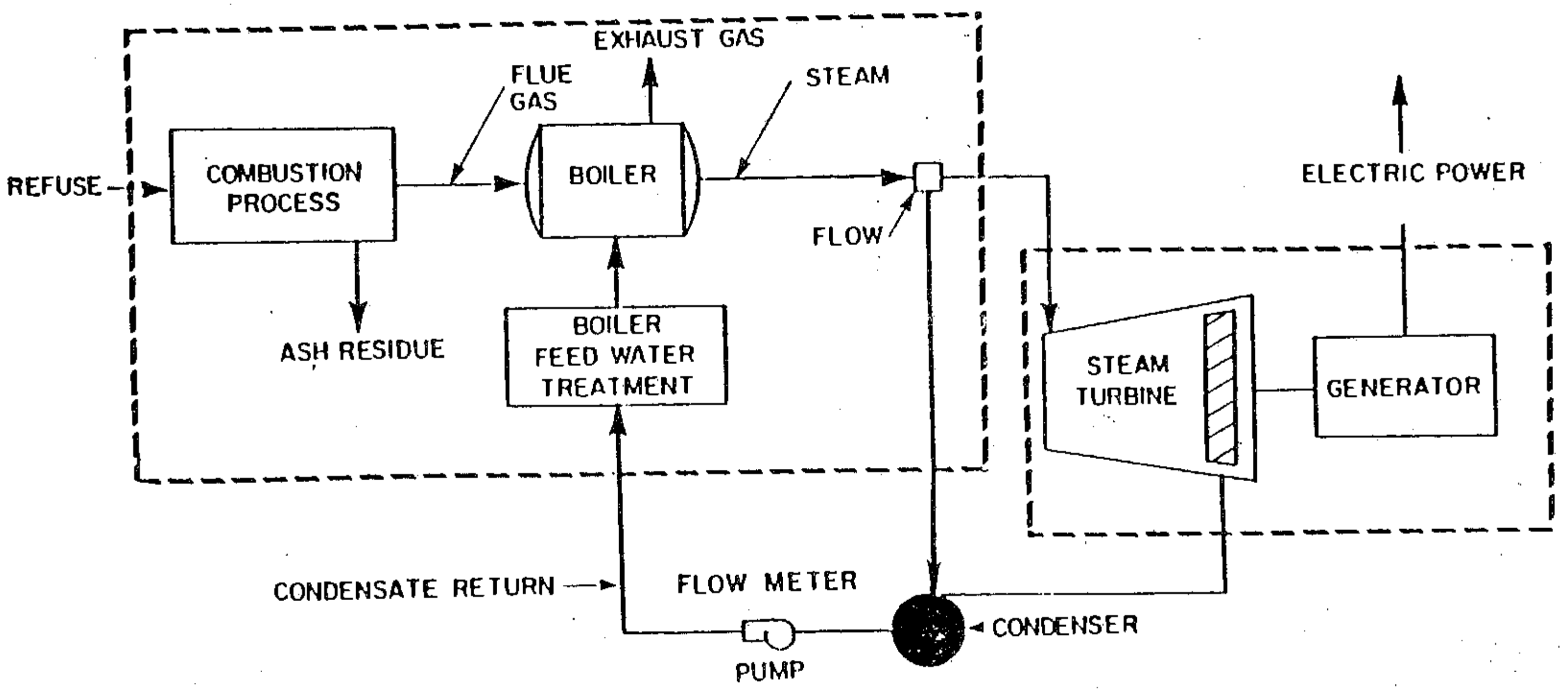
a. Condensing Turbines

In a condensing turbine, depicted in Figure IV-11, the steam leaves the turbine below atmospheric pressure. The lower the exhaust pressure of steam from the turbine, the more the energy extracted from the steam, and the more electricity that can be generated from that steam.

A condensing turbine produces mechanical power, which turns the generator shaft and thus generates electricity. No major

Figure IV-11

BASIC COMPONENTS OF A WASTE-TO-ENERGY SYSTEM
WITH A CONDENSING TURBINE



thermal energy is extracted for other uses, e.g., off-site steam customers.

b. Extraction Turbine

An extraction turbine operates similarly to a condensing turbine but does differ from it in that some steam can be extracted at one or more intermediate stages in the course of its passage through the turbine. Steam not extracted would be condensed just as in a condensing turbine (see Figure IV-12).

A pound of steam extracted from the turbine would release less energy (via the turbine) than if it had passed all the way through the turbine to reach the condensing stage. Thus, less mechanical power (hence electricity, in this case) would be produced. This performance concept is portrayed in Figure IV-13. The extracted steam, however, does still contain sufficient thermal energy that it can be usefully used for other purposes, such as process energy to an industrial steam customer.

5. <u>Auxiliary Equipment</u>

There are several pieces of auxiliary equipment associated with the mass burning and RDF approaches to energy recovery.

These auxiliary components include

- fans
- residue handling
- boiler feedwater equipment

In addition, large-scale mass burning systems typically have equipment to recover materials from the residue; RDF production facilities have auxiliary equipment for dust control.

a. Fans

Forced draft and induced draft are two types of fan systems. The former type is usually classified as part of the combustion air system, and the latter is associated with the air pollution control system.

The forced-draft fan system is used to force air into a combustion chamber for underfire air, for overfire air, and for fluidizing air.

Underfire, or primary, air is fed into the combustion chamber below the grates in a direct combustion unit and in RDF dedicated boilers and along the base of the primary chamber in a controlled-air incinerator.

Overfire, or secondary, air is fed into the combustion chamber above waste fuel burning on the grate to aid in completing

Figure IV-12

BASIC COMPONENTS OF A WASTE-TO-ENERGY SYSTEM WITH AN EXTRACTION TURBINE

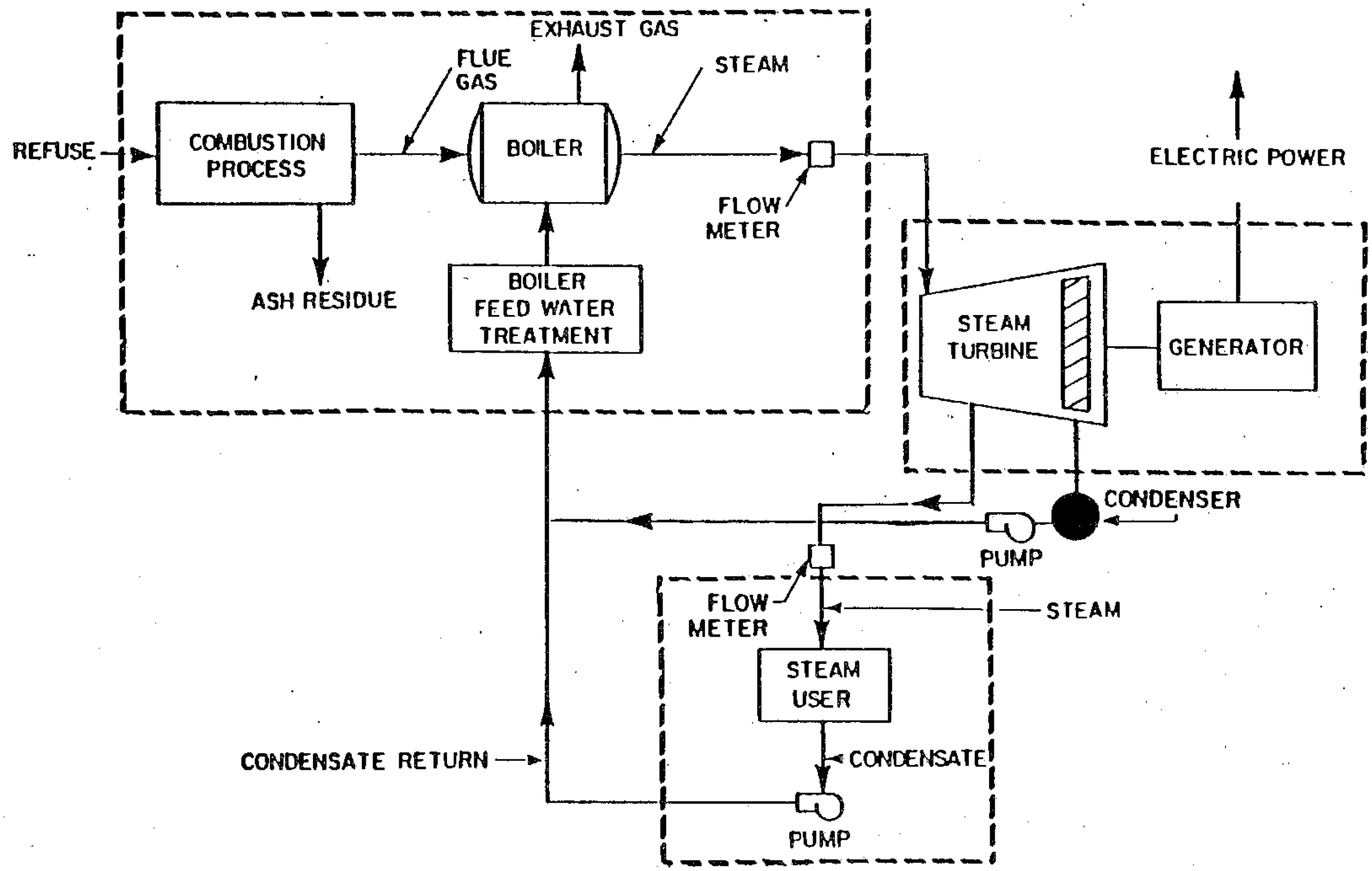
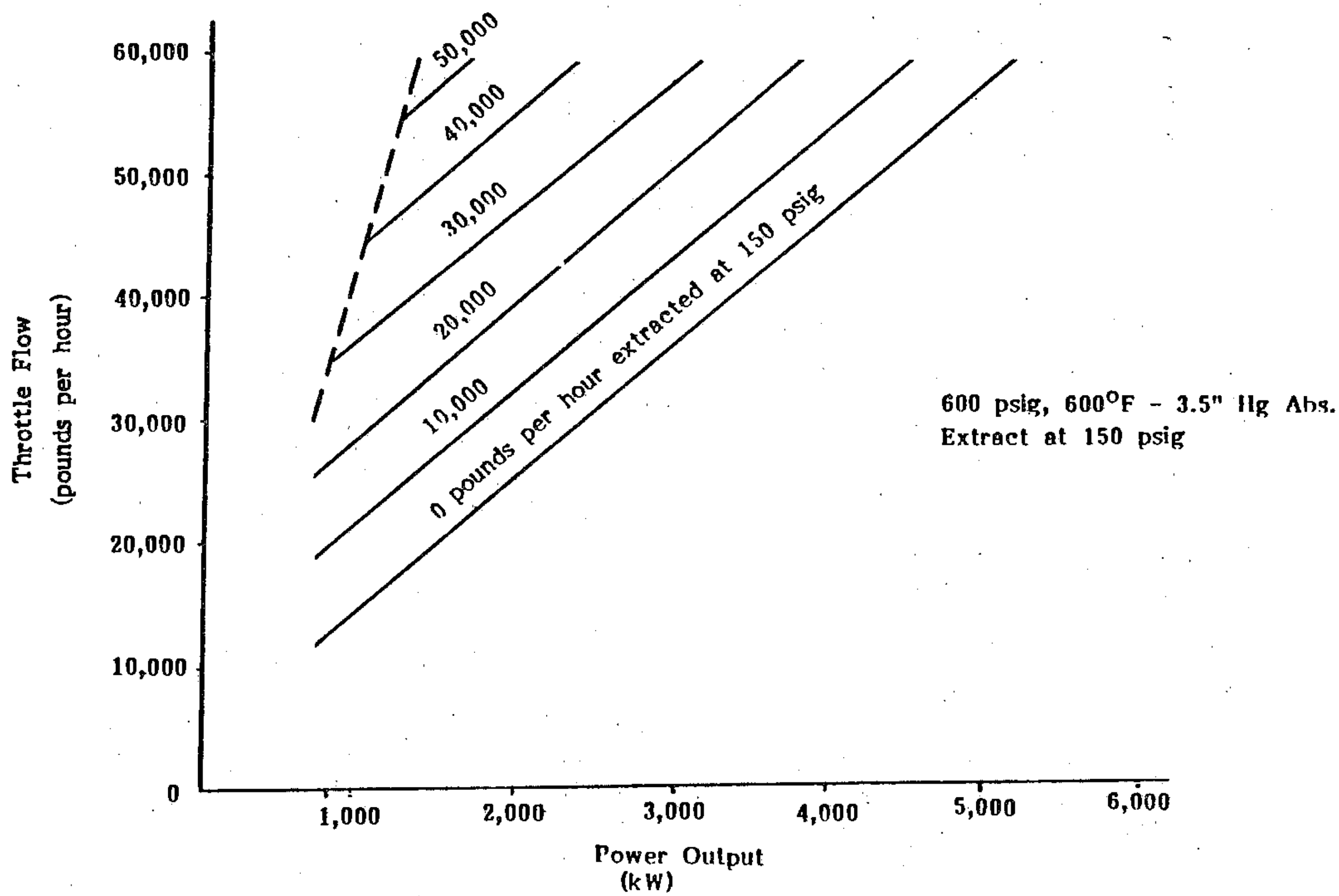


Figure IV-13

SAMPLE POWER OUTPUT OF AN EXTRACTION TURBINE



combustion of the volatile gases produced and of the small suspended particulate of fuel.

Secondary air for a controlled-air unit can be fed into the secondary chamber, where the volatile gases are burned. The primary air for a direct combustion system can be drawn from the enclosed receiving area/pit to remove air carrying offensive odors.

The induced-draft fan is used to draw the combustion gases from the furnace through the boiler and the air pollution control device to the stack.

b. Residue Handling

There are two sources of residue with a solid fuel combustion system: bottom ash and flyash/scrubber residue. The bottom ash/residue is discharged from the combustion chamber. Flyash/scrubber residue would be recovered from the exhaust gas in a baghouse, for example, and is usually combined with the bottom ash/residue for disposal.

Ash is either discharged into a water-filled trench (referred to as a wet/quench type system) or only lightly sprayed with water to cool the residue and to control dust (i.e., a dry type system). The wet (or moistened) ash could be either stored on an interim basis before transport, or loaded directly into trucks, to a landfill.

c. Boiler Feedwater Equipment

The boiler feedwater system would include a deaerator, makeup water chemical treatment, and a condensate collection and return system, as well as boiler feedwater pumps. Each facility would have a minimum of two boiler feedwater pumps. One pump could be steam-turbine driven, whereas the other, a spare, would be electric-motor driven. Each pump would be capable of supplying total required feedwater at maximum load.

C. CONSTRUCTION/OPERATION PROCESSES

This subsection addresses the work schedule and the labor force required during both construction and operational phases of a project. This impact during these phases of a project will vary between the direct construction, RDF system, and the controlled-air incinerator option.

1. Construction Phase

The construction phase will depend on the technology chosen, the site and general site arrangement, and lead time associated with procurement of equipment.

The mass burn - direct combustion and an RDF system will take 21 to 27 months to reach mechanical completion. Another three to four months will be necessary for start-up, shakedown, and performance testing.

With the controlled-air systems with power production, it will take 18 to 21 months to reach mechanical completion and typically another three months for start-up, shakedown, and performance testing.

The three basic components of the construction phase are engineering, construction and start-up, and performance testing.

For the mass burn - direct combustion and RDF systems, the basic engineering activities would span about a 5-month period at the beginning of the project. One important activity in engineering is the component specifications that would be used in acquiring the necessary equipment for the facility.

The construction activities would include site work, concrete work, structural steel, boiler erection, mechanical installation, electrical installation, insulation, and painting. In several activity areas, there is an overlap between task areas. This occurs because there are several different tasks that would take place in each task.

Shakedown testing should take about three months, with the facility testing being done over a period of a few weeks to a month once performance testing commences.

2. Operation Phase

All of the technologies examined in the development of this plan could supply energy (e.g., steam, hot water, or both) 24 hours per day, seven days per week. However, a system to produce RDF would probably operate ten hours per day, six days per week. Regular maintenance would be done on the remainder of the second shift on a daily basis.

The combustion facilities -- direct combustion and controlled-air incinerator -- would be expected to have an annual operating factor of 83 to 85 percent. The remaining 15 to 17 percent would include scheduled maintenance (approximately 10 percent) and forced outages (approximately 5 to 7 percent). Scheduled maintenance would most likely occur during the winter months (January, February) when waste generation is at an annual low. During this period, each of the combustion units would be taken out of service on a staggered basis for annual maintenance. Because any of the proposed waste-to-energy facility's being evaluated for the Counties would have two or three units (incinerators/boiler trains), the facility would continue to operate during most periods of maintenance and repair. The scheduled annual maintenance period for an incinerator unit, for example, will be one to two weeks.

Forced outages, which by definition as unscheduled, will occur on a random basis throughout a year.

D. GENERAL ASSESSMENT OF ENVIRONMENTAL FACTORS

This subsection provides a discussion of the general environmental factors the public often associates with solid waste disposal operations. The air quality and ash residue factors are covered in the next section.

1. Water

Waste-to-energy facilities are required to comply with federal standards regulating wastewater discharge, in addition to meeting state and local requirements pertaining to water use. The sources of wastewater discharge vary, depending on the recovery system and the energy output. The following subsections outline the sources and the control of wastewater discharge.

a. Mass Burn and RDF Combustion

Sources of wastewater from mass burning and RDF combustion systems include:

- continuous and intermittent blowdown;
- equipment and facility washdown;
- pretreatment filter backwater;
- demineralizer-neutralized regenerate;
- quench water;
- site drainage; and
- sanitary water.

The first two wastewater sources would be used to provide the water needed for the ash quench tank. Depending on the approach used at a specific facility, certain wastewater (e.g., blowdown, pretreatment filter backwater, demineralizer-neutralized regenerate) possibly could be used as washdown water.

The ash quench water system is used to cool incinerated bottom ash/residue and flyash in the mass burn combustion options (except for the fluidized bed option). Water loss in the quench tank is a result of two conditions: (i) evaporation and (ii) absorption by the ash/residue. The hot bottom ash/residue (700 to 800°F) causes the water temperature in the quench tank to remain at a relatively high temperature. A result is the loss of a small amount of water due to evaporation. The actual quantity lost will depend on the amount of debris that floats on the surface. A high percentage of floating debris reduces the surface area of the quench tank from which water can evaporate. In a mass burning facility, about 20 to 40 percent of the weight of the ash/residue discharged from the quench tank is water.

To control the build-up of suspended and dissolved solids, the water in the quench tank could be circulated to a clarifier. Part of this circulation system could include a tank for storage of any excess water that might enter the quench system. This eliminates the need to discharge water from the quench tank.

The drainage of free water from ash stored at the plant site, if any, must also be managed. The ash/residue will be discharged from the quench tank into a bin or truck. Any free water would drain from the ash/residue while this material is being stored. For small volume systems, drainage of free water can be improved by tilting the storage container. Maximum drainage of free water at the plant site, or the use of a different type of ash extruder system on the larger size plants, will reduce the amount of water that could leak during transit of the ash/residue to a disposal site. A drain should be located near the ash/residue discharge point. Water that enters the drain should be piped to the circulation system.

Site drainage water from landscaped and other waste free road surface areas should be kept separate from other wastewater and waste receiving, ash handling, and other activities, so that it can be sent directly to a storm sewer.

Drainage from truck loading and unloading areas and other roadways subject to contamination should be captured along with sanitary water used in-plant and be piped directly to a public sewerage system.

b. RDF Production

The sources of wastewater at an RDF production facility are:

- Equipment and facility washdown;
- Site drainage; and
- Sanitary water.

The equipment and facility will be cleaned at least once per week to maintain facility cleanliness. A production facility sited adjacent to the combustion unit will have an available source of wastewater, such as blowdown, that can be used for washing. Without a supply of wastewater, a production facility would have to purchase water and possibly provide for the settling of solids in the washdown water. Relatively detailed wastewater characterization data were developed at the 300 TPD EPA demonstration St. Louis, Missouri facility. At this plant, the asphalt area was washed down twice weekly. The refuse receiving area was swept. During washdown, 35 gallons of water per minute were used, or a total of 2,000 gallons.

As with a mass burn or dedicated boiler, site drainage, and sanitary water could be discharged directly to a sanitary sewer.

c. Cooling Tower

While evaporative cooling towers are typically set up so there is no significant wastewater discharge, they do consume large quantities of water. The water used is discharged to the atmosphere as water vapor. For an electric-only waste-to-energy facility, this is typically 400 to 500 gallons per ton of solid waste. A cooling tower can be utilized as a means of transferring waste heat from electrical production to the atmosphere. Aircooled condensers can be substituted for cooling towers. They use no water but are more expensive.

d. National Pretreatment Standards

If waste-to-energy facility discharges into a publicly owned treatment works, the major water quality standards that must be met are the National Pretreatment Standards. These standards are based on requirements of the Federal Water Pollution Control Act as amended by the Clean Water Act of 1977 (P.L. 95-217). The Clean Water Act established responsibilities of federal, state and local governments, industry, and public to implement standards that would control pollutants that pass through or interfere with the treatment processes of publicly owned wastewater treatment facilities or that may contaminate sewage sludge.

The design of each wastewater treatment facility must limit pollutants according to the facility's particular situation and incorporate these limitations into the applicant's National Pollutant Discharge Elimination System (NPDES) permit. As an example, in some cases, heat may be beneficial and accelerate the effectiveness of a wastewater treatment process, particularly in cold weather or cold climates. However, because the average wastewater treatment facility includes biological processes that could be damaged above 104°F, a national standard was established to set a baseline for local standards to be developed that limits thermal discharge to a wastewater treatment facility.

"General Pretreatment Regulations for Existing and New Sources of Pollution" are codified in 40 CFR 403, with specific regulations affecting "Steam Electric Power Generating Point Sources" established in 40 CFR 423. These standards include general discharge prohibitions that apply to all non-domestic discharges into wastewater treatment facilities. Standards for new sources, such as waste-to-energy facilities, are based upon the best available demonstrated technology economically achievable.

For energy recovery facilities that generate electricity, the "Small Unit Subcategory of the Steam Electric Power Generating Point Source Category" of the National Pretreatment Standards applies. Pretreatment standards delineated in 40 CFR 423.B are for "any small industrial facility primarily engaged in generation of electricity (less than 25 megawatts per unit or less than 150 megawatts per system) for distribution and sale which results primarily from a process using fossil-type fuel (coal, oil, or gas), or nuclear fuel in conjunction with a thermal cycle employing the steamwater system as the thermodynamic medium." Since waste-fired power plants fall into this size range and use a steam-water system, these standards apply.

e. Noise

The noise generated during construction and operation of a facility will vary. Site preparation and construction noise sources include vehicles transporting crews and materials to and from the site, transit and use of heavy equipment to clear and prepare the site, transport of materials to the site, equipment used in actual construction, construction activities themselves, and removal and disposal of site preparation and construction-related wastes. However, these noises will be short-term.

During operation of the facility, the highest potential source of noise is vehicle noise generated by refuse trucks. Other sources of noise include vehicles conveying ash residues and nonprocessible waste from the facility, unloading of waste materials, hydraulic feed of wastes to the boilers, and fans and turbines. These activities, however, will occur within an enclosed structure. The expected measurement of peak noise levels in and near a waste-to-energy facility are shown in Table IV-2.

Potential for impact is a function of the receptors and their sensitivity. Maximum ambient noise levels vary with land use and time of day.

f. Odor and Dust

Odor and dust are potential problems created when waste is unloaded and stored. These problems are normally controlled at the tipping floor or pit and by the combustion facility. Combustion air is drawn from the tipping area so that the facility is under a slight negative air pressure. Thus, potential odors and dust are destroyed in the combustion process.

g. Litter

At a waste-to-energy facility, the problem of blowing litter is normally controlled by unloading the solid waste inside a building. In addition, good housekeeping and fences surrounding the facility would catch any litter that does escape the building. Ash/residue hauled from the facility should also be covered to prevent airborne dusts and properly drained to prevent water leakage.

Table IV-2

MEASUREMENTS OF PEAK NOISE LEVELS NEAR RESOURCE RECOVERY PLANTS[1]

Vehicle Noise	Location	Noise Level dB(A)
Refuse vehicle starting	At 25 feet	85
Refuse vehicles on level ground at constant speed	At 25 feet	80
Refuse vehicle on slope constant speed	At 25 feet	83
Four vehicles discharging in tipping area at the same time	At 50 feet outside	62
<u>External Noise Level</u>		
General plant noise	At 150 feet At 300 feet At 1,000 feet	57 52-54 45-46
Cooling tower (mechanical draft)	At 95 feet At 400 feet At 800 feet	69 60 54
<u>Internal Noise Levels</u>		
General plant noise	Inside metal recovery area Boiler room	90-92 78-82
Turbines	Inside turbine room	88
Vehicles tipping	Tipping area	88-91

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[1]Source: "Anticipation of Environmental Impacts of Facilities Urged" by Allen Serper, P.E., <u>Solid Waste Management/Resource Recovery Journal</u>, March 1978.

h. Vectors

Management procedures at a waste-to-energy facility generally preclude problems with vectors such as rats and flies. Rapid turnover of waste should be planned. This prevents rats from establishing homes and reproducing. Fly eggs and larvae are also destroyed.

i. Community Factors

A waste-to-energy plant will have other effects on the community. Factors affected include employment, population, community service, and property value.

Construction and operation of waste-to-energy plant will generate employment opportunities. The construction phase will provide a transient and varying level of employment, with as many as 200 people on-site. Some increased use of fast food and other convenience businesses nearby also may be expected during this phase. However, because of the relatively short duration of the oonstruction phase, no population growth would be expected.

Plant operating employment would be stable. Depending on the size of operation, permanent employment at the sizes of waste-to-energy plant being considered for Madison, Monroe and St. Clair Counties may range from about 30 to 70 persons. For example, a smaller plant (i.e., 500 TPD) may employ 30 to 35 persons, whereas 45 to 60 persons may be employed at a plant with 750 TPD capacity. Direct effect on population growth would be minimal. The key determinant affecting the variance would be how contract maintenance is performed and whether the ash/residue hauling is done by staff or under contract to a third party.

The typical community service that would be affected by a waste-to-energy plant is fire protection. There should be little effect on other services, given the minimal impact on population.

Fires have been reported in waste storage areas of incinerators. The incoming waste pits normally have some storage capacity (i.e., 2 to 3 days of design capacity) to allow for continuous operation on weekends and holidays when little waste is delivered. A proper fire protection and prevention program is necessary to prevent serious problems.

Property value is of prime concern to owners near a proposed industrial development project, especially one that creates emotional concerns, such as a waste-to-energy plant. If the facility is located within an existing industrial area or some distance from residences, effect on property values should be minimal or nonexistent.

A study was conducted regarding property values in the area surrounding the 1,500 TPD Saugus, Massachusetts waste-to-energy plant. The results indicated no significant change in property values resulting from operation of the plant.

j. Visual Impact

The visual problems oftentimes associated with garbage or old incinerators by the general public include litter, white goods or other "junk" piled up on premises, and black smoke from a tall "smokestack." As covered earlier, litter is not the problem at a waste-to-energy facility that it may be at a landfill because the trucks unload inside a building away from winds and out of sight of the general public. White goods or other scrap metal should not be stored on-site, but rather hauled daily to a sanitary landfill or scrap metal dealer, as appropriate. Modern waste-to-energy facilities have significantly improved combustion controls and air pollution control equipment that eliminates the "black smoke" associated with old incinerators that were used several years ago.

By paying attention to aesthetics during design and construction, waste-to-energy facilities can appear as attractive, appropriate buildings in the specific location. Waste-to-energy facilities should not have a negative visual impact.

2. <u>Analysis of Air Emissions</u>

In this subsection, the potential environmental impacts associated with air quality are addressed. The types of emissions and the methods used to control the emissions are described.

a. Sources of Air Pollutants

The combustion process of solid waste or RDF is the prime potential cause of air emissions associated with waste-to-energy systems. The characteristics of flue gas, before entering the air pollution control device, depend on various factors, including

- Composition of refuse or RDF feed
- Combustion temperature
- Amount and flow patterns of excess combustion air
- Combustion approach: grate (mass burning), spreader stoker, and fluidized bed
- Flue gas velocities
- Combustion residence time

In addition to stack gas, there are air emissions due to vehicle traffic, such as trucks that deliver refuse or RDF to a facility and haul residue to a disposal site. The amount of such emissions is very site specific and typically involves tradeoffs with the existing waste hauling system. These types of air quality concerns are not covered by this subsection.

b. Types of Air Emissions

A variety of emissions are discharged into the atmosphere as a result of the solid waste combustion process. The ten pollutants reviewed in this subsection include:

Criteria Pollutants	Noncriteria Pollutants
Particulates	Hydrogen chloride (HCl)
Nitrogen oxides (NO_x)	Hydrogen fluoride (HF)
Sulfur oxides (SO_x)	Mercury (Hg)
Carbon monoxide (CO)	Dioxins
Total hydrocarbons (THC)	
Lead (Pb)	

The pollutants in the left-hand column, together with ozone, form a group for which national ambient air quality standards have been established (see later section, Table XI).

(1) Particulates

Particulate matter is carried by the gaseous products of combustion as a result of burning solid waste or RDF. This particulate matter consists of common earth minerals such as silicon, calcium, aluminum, magnesium, titanium, and iron. In addition, small amounts of volatile metals such as zinc, tin, lead, cadmium, berillium, antimony, and arsenic are contained in particulate.

Particulate levels requiring capture are related to the degree of turbulence in the combustion chamber. Controlled-air incinerators, which operate at less than stoichiometric conditions in the primary chamber, typically have low particulate levels. Waterwall incinerators for either direct combustion of refuse or RDF have lower particulate levels than commonly associated with traditional refractory-lined incinerators. The large volume of combustion air required to cool refractory-lined incinerator walls creates a high degree of turbulence in the furnace. Regardless of fuel type or combustion system used, pollution control equipment exists that can control particulate emissions.

(2) Nitrogen Oxides (NO_x)

Emissions of NO_x from combustion sources are due either to the conversion of nitrogen in the fuel to nitrogen oxides or to fixation of atmospheric nitrogen at high temperatures. It is believed that nitrogen oxide (NO) is formed mainly on the flame front where the temperature is high and oxygen is available. The NO formed in the furnace subsequently oxidizes to nitrogen dioxide (NO_2) in the atmosphere.

(3) Sulfur Oxides (SO_x)

When solid waste is burned, the small levels of sulfur it contains may react with oxygen to form sulfur dioxide (SO_2) and small quantities of sulfur trioxide (SO_3) in the flue gas, as well as various sulfates in the bottom ash and flyash.

Emissions of SO_x upon incineration of refuse are a function of its sulfur content. Typically, sulfur levels in solid waste are low, about 0.12 percent on an as-received basis. By comparison, the average sulfur content of Western coal is 0.4 percent and Eastern coal is in excess of one (1.0) percent. Seasonal variations are found in the sulfur content of solid waste, largely because of waste variations.

(4) Carbon Monoxide (CO)

CO, the product of incomplete combustion, is potentially the most abundant gaseous pollutant emitted upon incineration of municipal solid waste. The quantity of CO produced depends on the design and operation of the furnace. Improved design of over-fire air nozzles in the combustion chamber and computer controlled multizoned under-fire air chambers have reduced the amount of incomplete combustion. Additional research and development of direct combustion and RDF furnaces will reduce CO levels even further.

(5) Total Hydrocarbons (THC)

Another product of incomplete combustion is THC, usually in the form of low molecular weight hydrocarbons, aldehydes, and organic acids. This pollutant combines with nitrogen oxides to form photochemical oxidants, or smog, under warm, sunny conditions. Hydrocarbons and NO_x are precursors to ozone, a prominent constituent of smog. Because ozone is highly toxic, efforts are directed to control THC and NO_x. Improvements in combustion controls are lowering the THC emissions along with CO.

(6) Metals

Metals and metallic compounds are found distributed throughout municipal refuse, not just associated with large metallic objects. Many metals, such as silver, chromium, lead, tin, and zinc, are used in metallic surface coatings, galvanizing, and solders. These metals may become volatile during the combustion process. Plastic objects contain metallic compounds (cadmium, chromium, and lead, in particular) as stablizers and other additives. Chromium and lead are also found in inks and paints associated with paper, fabric, and plastic substrates. Mercury can be found in trace amounts in paper and yard waste. Discarded batteries are sources of mercury, nickel, and cadmium. Metals and metallic compounds may change phases or may form new metallic compounds, but they are not destroyed in the combustion process. The metals and metallic compounds will leave the combustor in the stack gas or in the ash residues. Operating temperature affects metals emissions by affecting the partitioning between phases. Thus one would expect stack gas concentrations of metals to be related to feed concentration and operating conditions. But according to the EPA Report to Congress, Municipal Waste Combustion Study, June 1987, the data also tend to show a strong effect of control devices.

(7) Lead (Pb)

Lead is found in many of the major components of the combustible fraction of MSW and also appears in metallic forms in some of the metal fractions, such as in the solder in ferrous cans. Based on laboratory analysis of samples taken during the four waste sorting periods, much of the lead in the waste stream is found in HDPE/PET plastics. Lead, which is melted, may be retained in the bottom ash, but the majority will be vaporized in the combustion process and carried with the combustion products. The level of Pb emissions depends on the efficiency of the particulate control system.

(8) Mercury (Hg)

Mercury and mercury compounds are found in municipal solid waste in trace quantities that are difficult to detect. A significant source of mercury (and cadmium) is batteries that are discarded with municipal waste. Smaller sources of mercury include mixed paper and yard waste. Mercury is the most difficult of the metals to remove from the gaseous products of combustion because it tends to remain in the vapor state and pass through electrostatic precipitators (ESPs) and fabric filters. However, when chlorine is also present in vapor, mercury reacts with the chlorine to form chlorides that can be collected as particulates.

Metallic mercury is generally thought to volatilize, so control might be accomplished through cooling and condensation. Research in Germany has also indicated a possible chemical reaction with alkaline sorbents. Moreover, the data gathered at Quebec under varying temperature conditions indicate that it may be possible to optimize mercury control through cooling. This is a subject of continuing study.

(9) Hydrogen Chloride (HCl) and Hydrogen Fluoride (HF)

Hydrogen chloride and Hydrogen fluoride emissions result from the combustion of halogen-containing materials in refuse. Most of the chlorine is contributed by paper, food, and yard waste and by chlorinated plastics. Organic chlorine is found in chlorinated plastics, such as polyvinyl chloride (PVC), in addition to rubber, paper, and textiles. Inorganic chlorine is generally in the form of soluble salts such as sodium and potassium chlorides. The main contributors of fluorine are fluorinated plastics. The emissions levels of both HCl and HF depend on the collection efficiency of the emissions controls. As the percentage of plastics in the waste stream increases, the potential exists for increased emissions of these two pollutants.

(10) Dioxins and Furans

Polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzo-furans (PCDF) are toxic organic compounds that have been identified in trace quantities in the emissions from facilities burning municipal solid waste. PCDDs are a group of compounds with 75 possible isomers that represent different numbers and positions of the chlorine atoms attached to a pair of benzene rings. These rings are connected by two oxygen molecules in the case of PCDD and one oxygen molecule in the case of PCDF.

PCDD has received the most attention from an environmental health standpoint. The toxicity of each isomer is believed to be related to the location of the chlorine atoms. The group of isomers (called congeners) with chlorine atoms in all available positions (octa-PCDD or OCDD) is more stable and much less biologically active than the congeners with chlorine atoms only in four of the available positions. The isomer with the 2,3,7,8 positions occupied by chlorine, the tetra-chlorinated dibenzo-p-dioxin (TCDD), is the one about which the most is known and is the most toxic. The other isomers of dioxins and furans have lower degrees of toxicity; hence measurement of total PCDD and PCDF cannot be used directly to analyze risk. Various methods for assigning equivalent toxicities to the various isomers and congeners have been proposed. The equivalent toxicity ranges from 3 to 60 times that of 2,3,7,8 TCDD, depending on the distribution and the multiplying factors applied. Multiplying factors have been determined by different health organizations in different ways. Those currently in use give roughly equivalent although different toxic estimates.

There are many factors influencing the emissions of PCDD and PCDF and the relative magnitudes (or distribution) of the chlorine atoms, hence the equivalent toxicity. Among these are (i) furnace or combustion temperatures; (ii) furnace volume and retention time; (iii) opportunity to reach boiler tubes before combustion is complete; (iv) provision of the right amount of combustion air in the right places and with sufficient energy; (v) effectiveness of mixing combustible gases with the right amount of air; (vi) heating up the furnaces with auxiliary burners before feeding MSW, and providing auxiliary fuel if necessary to maintain temperature and eliminate poor combustion conditions; (vii) continuous monitoring and control of combustion; and (viii) proper training and supervision of operators.

c. Options for Controlling Emissions to the Atmosphere

The pollutants shown in the summary emissions table (Table IV-3) include several major classes of substances for which control may be possible: particulate matter, organics, acid gases, metals, and NO_x. There are basically two approaches to controlling emissions from municipal waste combustors. One approach is to alter the combustion process to reduce emissions, sometimes called combustion control. The other is adding air pollution control (APC) equipment to clean the combustion gases. This approach may be called postcombustion control, flue gas cleaning, or flue gas treatment. These two approaches are not exclusive and are often used together for a comprehensive control strategy.

For municipal waste combustors, the total control problem involves a slate of pollutants. Moreover, application of control technology for one pollutant or class of pollutants may have positive or negative effects on control of other pollutants. For example, enhanced combustion should reduce the emissions of other organic pollutants in addition to PCDD and PCDF. Moreover, alkaline scrubbers, when combined with particulate control devices, can reduce not only acid gases but also some organic species and volatile metals. On the other hand, maximizing the combustion efficiency may increase the potential to form NO_x. Devising a control strategy, then, involves consideration of control techniques for each of the classes of pollutants present, but also requires consideration of the effects of a selected control technique on the whole list of pollutants.

In addition to positive and negative effects of air pollution control equipment on different air pollutants, another important consideration concerns cross-media effects. Some pollutants, notably metals, may be captured and prevented from being emitted to the atmosphere, but they are not destroyed. Increased capture means that the ash residues contain more metals.

The following sections describe available control techniques for each pollutant class. Then optimum strategies for controlling the whole list of pollutants from the stack gases are considered.

(1) Flue Gas Control Technologies

The most commonly used pollution control device to date is a dry ESP. Other devices used at waste-to-energy facilities in operation or those under construction include fabric filter systems (baghouses), electrostatic granular filters, and scrubbers. Technology for the control of NO_x includes staged combustion, thermal reduction, and catalytic reduction.

TABLE IV-3

SUMMARY OF EMISSIONS MEASURED FROM THE THREE MAJOR CLASSES OF MUNICIPAL WASTE COMBUSTORS[1]

Pollutant	Mass Burn	Modular	RDF-Fired
Particulate Matter	5.5 - 1.530 mg/Nm^2	23 - 300 mg/Nm^2	220 - 530 mg/Nm^2
	(0.0^{0}2 - 0.669 gr/dscf)[3]	(0.012 - 0.13 gr/dscf)[2]	(0.096 - 0.230 gr/dscf)[2]
Sulfur dioxide	0.04 - 401 ppmdv	61 - 124 ppmdv	55-188 ppmdv
Nitrogen oxides	39 - 380 ppmdv	260 - 310 ppmdv	263 ppmdv[2]
Carbon monoxide	18.5 - 1.350 ppmdv	3.2 - 67 ppmdv	217 - 430 ppmdv
Hydrogen chloride	7.5 - 447 ppmdv	160 - 1270 ppmdv	96 - 780 ppmdv
Hydrogen fluoride	0.62 - 7.2 ppmdv	1.1 - 16 ppmdv	2.1 ug/Nm^3 [2]
Arsenic	0.452 - 233 ug/Nm^2	6.1 - 119 ug/Nm^2	19 - 160 ug/Nm^2
Beryllium	0.0005 - 0.33 ug/Nm^2	0.096 - 0.11 ug/Nm^2	21 ug/Nm^3 [2]
Cadmium	6.2 - 500 ug/Nm^2	21 - 942 ug/Nm^2	34 - 370 ug/Nm^2
Chromium	21 - 1.020 ug/Nm^2	3.6 - 390 ug/Nm^2	490 - 6,700 ug/Nm^2
Lead	25 - 15,000 ug/Nm^2	237 - 15,500 ug/Nm^2	970 - 9,600 ug/Nm^2
Mercury	9 - 2,200 ug/Nm^2	130 - 705 ug/Nm^2	170 - 440 ug/Nm^2
Nickel	230 - 480 ug/Nm^2	<1.92 - 553 ug/Nm^2	130 - 3,600 ug/Nm^2
TCDD	0.20 - 1,200 ng/Nm^2	1.0 - 43.7 ng/Nm^2	3.5 - 260 ng/Nm^2
TCDF	0.32 - 4,600 ng/Nm^2	12.2 - 345 ng/Nm^2	32 - 680 ng/Nm^2
PCDD	1.1 - 11,000 ng/Nm^2	63 - 1540 ng/Nm^2	54 - 2,840 ng/Nm^2
PCDF	0.423 - 15,000 ng/Nm^2	97 - 1810 ng/Nm^2	135 - 9,100 ng/Nm^2

mg/Nm - milligrams per nanometer
gr/dscf - grams per dry standard cubic feet
ppmdv - parts per million (dissolved)
ug/Nm - micrograms per nanometer
ng/Nm - hanograms per nanomter

[1]EPA Report to Congress, Municipal Waste Combustion Study.

[2]Only one test.

[3]Standardized to 12% CO.

i. Electrostatic Precipitators (ESP)

As noted earlier, electrostatic precipitators involve the use of an electrostatic field for precipitating or removing solid or liquid particles from a gas in which particles are entrained (see Figure IV-14).

ii. Fabric Filter

Fabric filters (often referred to as baghouses) use mechanical screening to trap solid particles. Figure IV-15 illustrates a typical fabric filter. The effluent gas is passed through a porous material (a filter usually in the shape of a bag) that collects particulate matter on the filtering material.

iii. Scrubber

There are three major types of scrubbers: wet scrubbing systems, spray reactor or semi-dry systems, and dry powder injection.

Wet scrubbing systems use a liquid to absorb or "scrub" contaminants from flue gas (see Figure IV-16).

Spray reactor or semi-dry (wet/dry) scrubbing, as depicted in Figure IV-16 have been used in the majority of modern waste-to-energy plants built (or contracted for) in the past five years. A technical description was provided earlier.

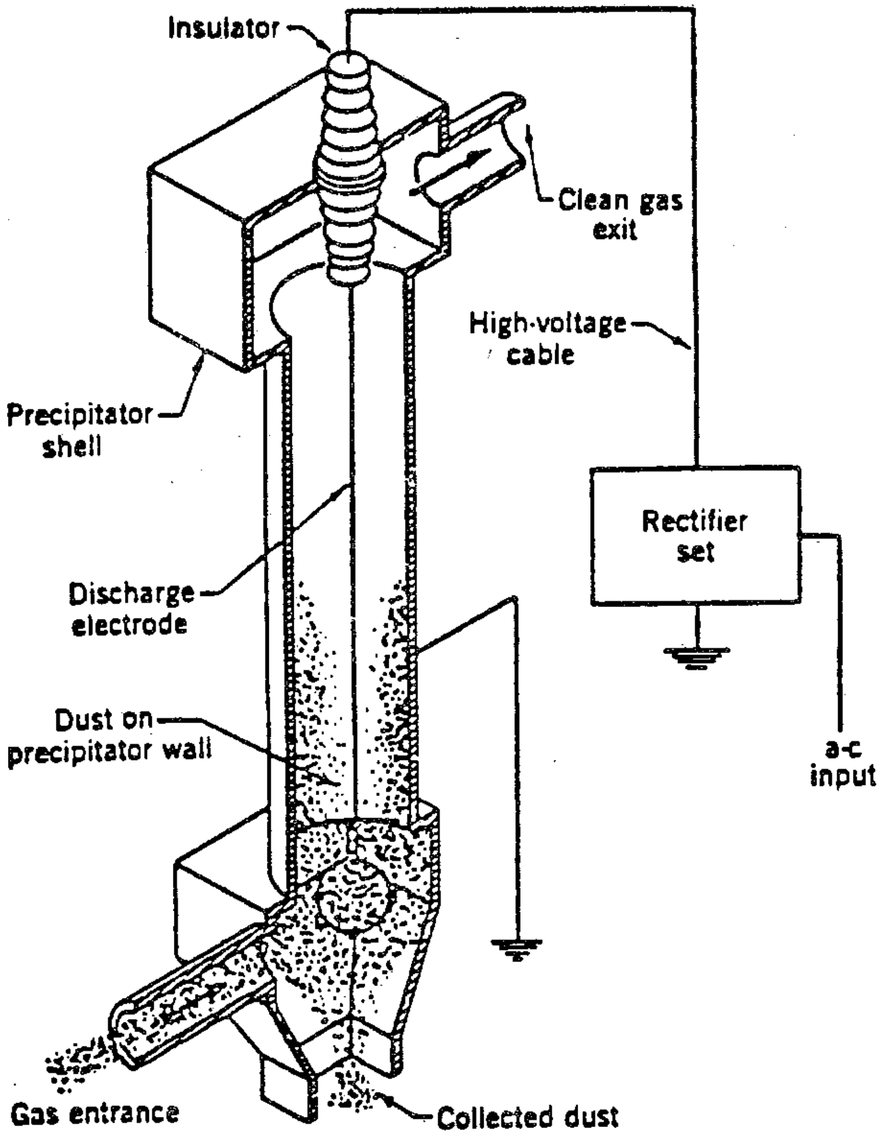
iv. Nitrogen Oxides Control

Nitrogen oxides (NO_x) are produced and emitted by all waste combustion processes. Mass burning systems and stoker and suspension boilers all combust at a relatively high temperature, producing NO_x at a rate of about 0.44 to 0.55 pounds per million Btu of waste. On a volume basis, this is in a range of 240 to 300 volume parts per million (VPPM, corrected to 7 volume percent of oxygen, on a dry basis).

Fluidized bed combustion units, operating at lower peak temperatures, produce NO_x at a rate of approximately 0.15 to 0.2

Figure IV-14

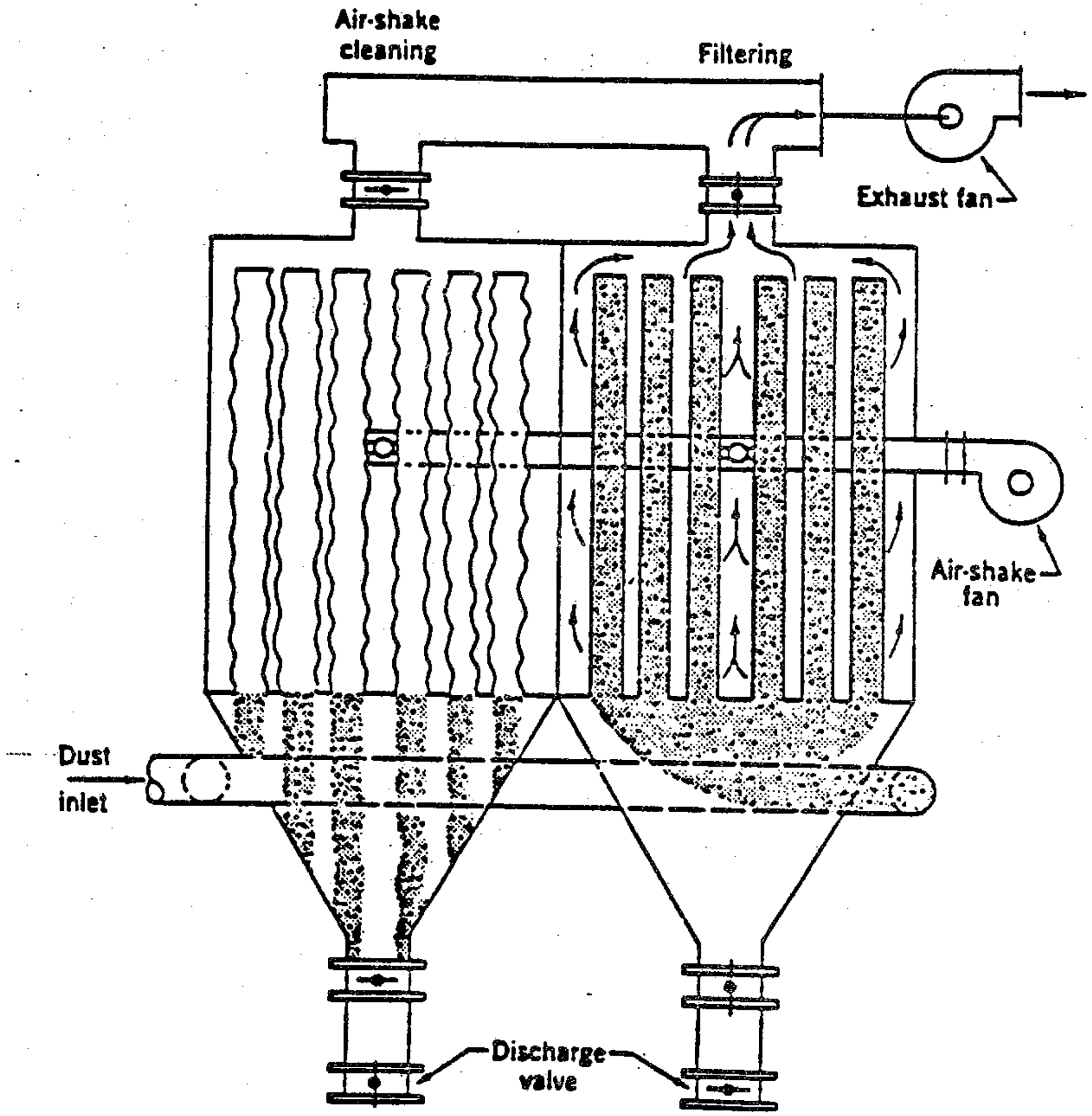
ELECTROSTATIC PRECIPITATOR FLOW DIAGRAM



Source: **Engineering and Economic Analysis of Waste to Energy Systems, U.S. EPA, EPA-600/7-78-086, May 1978.**

Figure IV-15

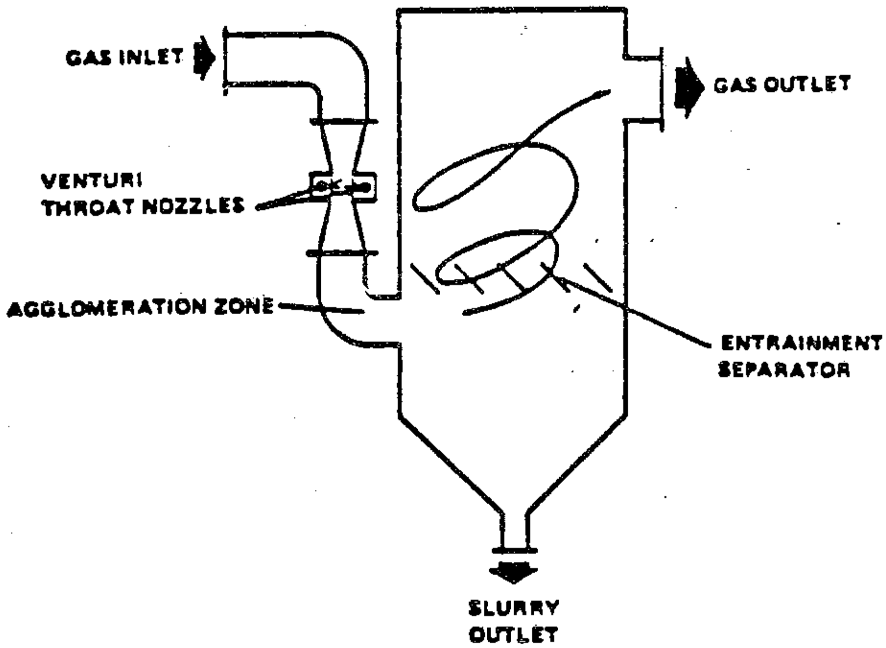
FABRIC FILTER FLOW DIAGRAM



Source: Engineering and Economic Analysis of Waste-to-Energy Systems, U.S. EPA, EPA-600/7-78-086, May 1978.

Figure IV-16

WET SCRUBBER FLOW DIAGRAM



Source: Engineering and Economic Analysis of Waste to Energy Systems, U.S. EPA, EPA-600/7-78-086, May 1978.

pounds per million Btu of waste.[2] On a volume basis, the NO_x production is 133 to 177 VPPM. The higher relative volume basis (concentration) NO_x rates are due to the fact that the fluidized bed units operate at lower excess air than the other processes do.

Three major technologies exist for control of NO_x: staged combustion, thermal NO_x reduction, and catalytic reduction.

Staged combustion involves lowering of the excess air and admitting over-fire air in multiple stages within the furnace. The purpose is to supply sufficient air to complete combustion, yet supply it in separate stages at locations in the direction of gas flow to avoid temperature peaks associated with excess oxygen (air) supplied in a restricted location of the furnace. Because uncontrolled NO_x production and also the effects of each staged combustion design are particular to each boiler manufacturer and also because of the lack of testing data available, no generalizations can be made regarding the rate of NO_x production with and without staged combustion.

Exxon Corporation has patented a thermal NO_x reduction process called Thermal $DeNO_x$. This is a noncatalytic process that uses ammonia injection, invented only 12 years ago. Test results have shown a 55 to 70 percent reduction of NO_x with this system. The capability of the process is reduced with the lowering of gas temperature at the ammonia injection point. Hydrogen can be added for those applications of lower temperatures. A fluidized bed unit being constructed in California to incinerate wastewater treatment sludge will add hydrogen because the gas temperature expected at the ammonia injection point is 1,550°F. A fluidized bed unit burning wood waste that started in California in 1986 uses staged combustion and Exxon Thermal $DeNO_x$. Although actual emissions are not known, the unit was permitted on the basis of emitting less than 0.1 lb. NO_x per million Btu of fuel. The mass burning waste-to-energy facility in Commerce, California that started in 1986 uses the Exxon process also.

The third technology for NO_x reduction is catalytic reduction. This process also injects ammonia into the gas stream, but uses a catalyst bed to capture NO_x. Although effective in reducing NO_x, it is receiving less attention because of its higher cost of operation, attributed to periodic replacement of the catalyst.

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[2]Summary results of the tests at Northern States Power French Island Generating Station, fluidized bed unit showed NO_x production on wood firing to be at 86 PPM (dry), or 0.14 pounds per million Btu. For 25 percent RDF, 75 percent wood firing, NO_x was produced at 116.4 PPM (dry), or 0.143 per million Btu.

d. Specific Emission Control Approaches[3]

(1) Organics Control

The municipal waste combustion process is designed to convert organic materials to CO_2 and water. However, some organic materials are emitted. The presence of organics in the exhaust gas is a sign of incomplete combustion. Incomplete combustion can also be indicated by high levels of CO. Consequently, one would expect high levels of CO to be accompanied by a high level of organics.

Several theories have been postulated for ways that organic compounds, including dioxins and furans, may appear in stack gases from waste-to-energy facilities.

The first possible mechanism involves breakthrough of unreacted organic species present in the refuse. A second theory involves the reaction of organic precursors in the waste. For example, relatively simple reactions can convert chlorophenols and polychlorinated biphenyls to PCDD/PCDF. These precursors can be in the refuse and can be produced by pyrolysis in oxygen-starved zones.

A third mechanism involves the synthesis of PCDD/PCDF from a variety of organics and a chlorine donor. Again, the simplest mechanism involves those species that are structurally related to PCDD/PCDF; however, a full spectrum of plausible combustion intermediate chemistry could be proposed to lead to precursors and eventually to PCDD/PCDF.

The final possible mechanism shown involves catalyzed reactions of organic precursors escaping the combustion zone on fly ash particles at low temperatures. These hypothesized mechanisms can be broadly classed into three main ways that organics may appear in the exit gases from combustors:

- Lack of destruction of organics originally present in the feed refuse;
- Conversion of precursors present in the feed or formed in the combustion processes to organic compounds emitted from the stack; and
- Lack of destruction of precursors in the combustion system and conversion of the precursors to other organic substances downstream of the combustion zone at low temperatures.

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[3]Some of the information presented in this subsection is excerpted information presented in the EPA Report to Congress, Municipal Waste Combustion Study: Combustion Control of Organic Emissions.

Although it is not certain which, if any, of these basic mechanisms dominates, all three basic formation mechanisms would be minimized by achieving complete combustion, thereby converting all organic species to CO_2.

Thermodynamic considerations indicate that under excess air conditions and temperatures characteristic of waste-to-energy facilities, there is no theoretical barrier to achieving essentially zero emission levels for these species. In spite of this, emission measurements have shown the presence of significant quantities of organic species in exit gases from some facilities. Existence of these species (either in the flame or in the exhaust) indicates a failure in the combustion process caused by insufficient mixing and characterized by escape of local fuel-rich pockets of gas. This perplexing formation may be more easily understood when the heterogeneity of municipal refuse is considered. MSW is a heterogeneous fuel containing items of all sizes, shapes, and compositions. Pieces of waste may combust unevenly, causing fuel-rich pockets of gas to form in the furnace. If these fuel-rich pockets are not sufficiently mixed with air, incomplete combustion will result and organic materials may be emitted.

However, theoretical kinetic and equilibrium considerations indicate that the destruction of organic species can be achieved rapidly in the presence of sufficient oxygen at elevated temperatures. Therefore, control of organic emissions requires development of a combustion control strategy that ensures that all organic materials down to the molecular level are exposed to enough air and to a high enough temperature for enough time to destroy them.

Conditions within the municipal waste combustor that would satisfy the above goals are

- Mixing of fuel and air to prevent the existence of fuel-rich pockets in the combustion gases;
- Sufficiently high temperatures in the presence of sufficient oxygen for destruction of organic species; and
- Prevention of quench zones or low temperature pathways that would allow partially reacted or unreacted fuel from exiting the combustion zone of the furnace.

(2) Combustion Control

To achieve the thorough combustion required to minimize emissions of organic species, manufacturers of waste-to-energy systems equipment are paying a great deal of attention to three combustion parameters: time, temperature, and mixing (turbulence). However, the simplistic view of optimization of combustion by the three T's (time, temperature, and turbulence) is not directly valid in this context. For example, the gas phase residence time should not be considered solely a necessary reaction time but should also be considered a mixing time. Time is required for air and intermediates to mix, but once mixed at sufficient temperature, the destruction reaction takes place virtually instantaneously. There is no need to hold the mixed gases at this temperature for a longer time. Furthermore, turbulence on its own is not sufficient to ensure the necessary mixing. Two separate, highly turbulent stream tubes in the furnace will not mix despite their high turbulence level unless they come into contact. Thus, mixing of the furnace gases with air requires that the turbulent jets be dispersed throughout the combustion gases. Finally, the definition of a mean temperature must be made with the minimum required temperature and expected variability around the mean in mind.

With the goal of complete combustion in mind, the EPA has developed a set of combustion strategy elements termed good combustion practices. These control strategy elements are summarized in Table IV-4 for mass burn, modular, and RDF units, respectively. Also shown are preliminary specifications for each of the elements.

Several cautionary notes are associated with these specifications. First, these recommendations are preliminary and have not been verified in field tests. There are no test data that explicitly show the effects of these practices on emissions. Moreover, as with any general principles, the specific designs of individual systems must be considered.

Recent test data obtained from the new municipal waste combustor in Tulsa show that low concentrations of organics may be achieved by optimizing combustion conditions even though the design and operating conditions cannot be directly related to the preliminary targets in Table IV-4. Although no postcombustion control devices were installed specifically for removal of organic species, the organic concentrations are lower than those measured in any similarly equipped facility, indicating thorough optimization of the combustion process. In fact, the concentrations of TCDD, TCDF, PCDD, and PCDF were on the same order but lower than the concentrations measured at the Wurzburg facility, which is equipped with a dry scrubber/fabric filter system.

Another illustration of the possibility of decreasing organic emissions through combustion optimization is the municipal waste combustor in Quebec. In Quebec, an older facility was modified to reflect current low-emission design philosophy. Concentrations of PCDD and PCDF were measured before and after the modifications as follows:

Tabl IV-4

GOOD COMBUSTION PRACTICES FOR THE MINIMIZATION OF (ATC EMISSIONS FROM MUNICIPAL WASTE COMBUSTIONS [1]

Practice	Mass Burn Preliminary Target	RDF Preliminary Target	Starved-Air Preliminary Target
Design temperature at fully mixed height	1,800°F at fully mixed height	1,800°F at fully mixed height	1,800°F at fully mixed height
Under-fire air control	At least four separately adjustable plenums. One each under the drying and burnout zones and at least two separately adjustable plenums under the burning zone.	As required to provide uniform bed burning stoichiometry	
Over-fire air capacity (not an operating requirement)	40 percent of total air	40 percent of total air	80 percent of total air
Over-fire air injector design	That required for penetration and coverage of furnace cross-section	That required for penetration and coverage of furnace cross-section	That required for penetration and coverage of furnace cross-section
Auxiliary fuel capacity	That required to meet start-up temperature and 1,800°F criteria under part-load operations	That required to meet start-up temperature and 1,800°F criteria under part-load operations	That required to meet start-up temperature and 1,800°F criteria under part-load conditions
Excess air	6-12 percent excess oxygen (dry basis)	3-9 percent excess oxygen (dry basis)	6-12 percent excess oxygen (dry basis)
Turndown restrictions	80-110 percent of design - lower limit may be extended with verification tests	80-110 percent of design - lower limit may be extended with verification tests	80-110 percent of design - lower limit may be extended with verification tests
Start-up procedures	On auxiliary fuel to design temperature	On auxiliary fuel to design temperature	On auxiliary fuel to design temperature
Use of auxiliary fuel	On prolonged high CO or low furnace temperature	On prolonged high CO or low furnace temperature	On prolonged high CO or low furnace temperature
Oxygen in flue gas (continuous monitor)	6-12 percent dry	3-9 percent dry	6-12 percent dry
CO in flue gas (continuous monitor)	50 ppm in 4 hour average-corrected to 12 percent CO_2	50 ppm on 4 hour average-corrected to 12 percent CO_2	50 ppm on 4 hour average-corrected to 12 percent CO_2
Furnace temperature (continuous monitor)	Minimum of 1,800°F (mean) at fully mixed height across furnace	Minimum of 1,800°F (mean) at fully mixed height	Minimum of 1,800°F (mean) at fully mixed plane (secondary chamber)
Adequate air distribution	Verification test	Verification test	Verification test

[1]EPA Municipal Waste Combustion Study Report to Congress.

	Before	After
PCDD	800 - 3980 ng/Nm^3	12 - 205 ng/Nm^3
PCDF	100 - 1100 ng/Nm^3	49 - 336 ng/Nm^3

These data are preliminary and corrected to 12 percent CO_2. These data indicate the possibility of using a combination of combustion system design and operational tuning to reduce PCDD and PCDF emissions significantly. However, the specific changes appropriate for a specific facility and the likely effectiveness of those changes in reducing organic emissions must be determined on a case-by-case basis.

An important factor in operation of an optimally designed and tuned municipal waste combustor in a continuously optimized manner is operator training. The Northeast States for Coordinated Air Use Management (NESCAUM) and the American Society of Mechanical Engineers (ASME) have developed a training course for resource recovery facility operators. In addition, NESCAUM is working with ASME to develop a formal accreditation program for training and certification of operators of resource recovery facilities, to be administered by ASME. Certification of operators has now been included in the requirements for operating permits in Connecticut, New Jersey, New York, and Vermont.

(3) Flue Gas Treatment

The previous discussion has dealt exclusively with destruction of organic materials to minimize organic emissions through design and operation of the combustion process. Control of organic emissions may also be accomplished through postcombustion control techniques. Although no conventional mass burn facilities using afterburners have been identified, this type of control device might be used to control organic emissions. Direct flame afterburners operating at 2,000°F for a 1-second residence time have demonstrated the ability to achieve greater than 98 percent destruction of hazardous wastes, even for chlorinated organics.

Recent tests have indicated that alkaline scrubbing systems can achieve significant control of organic emissions although the mechanism for capture is not clear. Condensation and capture of particulates or aerosols is likely, but chemical reaction with caustic reagents is also a possibility. Combinations of acid gas control equipment with particulate control equipment would be required. Table IV-5 shows control efficiencies for PCDD with various combinations of equipment.

(4) Acid Gases

Control of acid gases (HCl, HF and SO_2) requires scrubbing or devices for gas/liquid or gas/solid contact. Water alone is a reasonably effective sorbent for very reactive acid gases such as HCl and HF, but an alkali sorbent is necessary for substantial SO_2 control.

Table IV-5

CONTROL EFFICIENCY DATA FOR PCDD [1]

	Percentage efficiency
Spray dryer + ESP Reported by manufacturer	48 - 89[2]
Spray dryer + fabric filter Tested by manufacturer	High T52 - 93[2] Low T97 - 99.82[2]
Spray dryer + fabric filter Environment Canada	>99.9
Dry injection + fabric filter Environment Canada	200°C99.4 110°-140°C>99.9

[1]EPA Municipal Waste Combustion Study Report to Congress, June 1987.

[2]Range for different homologs. (A homolog is a member of a series of organic comounds whose structure differs regularly by some radical (e.g.,=CH2) from that of its adjacent neighbors in the series.

Effective acid gas control is possible with dry, semi-dry and wet scrubbers. HCl and HF are relatively easy to control, whereas SO_2 control is favored by wet or semi-dry systems with lower flue gas temperatures. The most effective control of acid gases is by wet alkali scrubbers, but wet scrubbing produces waste water that must be treated.

Combination dry and semi-dry scrubbers may control acid gases more effectively than once-through spray drying and may be similar in effectiveness to spray drying with recycle. Combination wet-dry systems may be the most effective for acid gas control but are increasingly complex. Table IV-6 shows acid gas control efficiency data included in the EPA's Emissions Data Base. These data are supported with emission test reports from the EPA Municipal Waste Combustion Study: Emission Data Base for Municipal Waste Combustors.

(5) Particulate Matter

Control of particulate matter emissions is currently accomplished use of ESPs, fabric filters, and wet scrubbers. Modern ESPs can achieve removal efficiencies greater than 99 percent.

Fabric filters have not generally been applied directly to flue gas from municipal waste combustors, but they have been used as sorbent collectors and secondary reactors for dry and semi-dry scrubbers. Three reasons that fabric filters have not been applied directly to municipal waste combustor flue gas are (i) attack by acid gases upon fabric, (ii) fabric blinding by "sticky" particles, and (iii) baghouse fires caused by unstable combustion and carryover of sparks into the flue. ESPs and wet scrubbers are somewhat more forgiving of these phenomena and have generally been preferred. However, upstream scrubbing of acid gases with sorbent accumulation on fabric materials can address the problems mentioned above, so that fabric filters become an attractive choice for control of particulate matter emissions. Fabric filters used in this way with upstream sorbent injection are capable of particulate matter control to concentrations of less than 0.02 gr/dscf.

Wet scrubbers are not likely to be applied to municipal waste combustors for control of particulate matter emissions in the future. Although wet scrubbers account for nearly one fifth of existing particulate matter control systems in the United States, they have disadvantages that are likely to eliminate them from future selection. First, used alone without additional particulate matter controls, they are not as effective as other control equipment in controlling particulate matter. It is unlikely that wet scrubbers can meet current or future particulate matter emission requirements without very high pressure losses accompanied by erosion and increased maintenance requirements. Second, wet scrubbers will absorb acid gases, including HCl, and, if they are

Table IV-6

EXPECTED EFFECTIVENESS OF ACID GAS CONTROLS (PERCENT REMOVAL)

Control	Pollutant HCl	HF	SO_2
Dry sorbent injection + fabric filter[1]	80	98	50
Dry sorbent injection + fluid bed reactor/ESP[2]	90	99	60
Spray dryer - ESP	95+	99	50-70
(Recycle)[3]	(95+)	(99)	(70-90)
Spray dryer baghouse	95+	99	70-90
(Recycle)[3]	95+	(99)	(80-95)
Spray dryer + dry sorbent Injection + fabric filter[4]	95+	99	90+
Wet scrubber[5]	95+	99	90+
Dry/wet scrubber[5,6]	95+	99	90+

[1]T = 160-180°C. T is the temperature at the exit of the control device.

[2]T = 230°C

[3]T = 140-160°C

[4]T = 200°C

[5]T = 40-50°C

[6]Consists of a spray dryer that atomizes spent scrubber liquor from two venturi scrubbers, one for HCl control and the other for SO_2 control, to dispose of liquid wastes. The venturi scrubbers are in series and follow the particulate control device, which is just downstream of the spray dryer. This system, by proper selections of feed stream compositions to the venturis, can also be used for NO_x control.

not designed to handle the accumulating acids, they will have significant operating problems.

Efficient particulate matter capture devices also provide enhanced capture of other pollutants in the flue gas in solid or aerosol form, for example, metals and large organic molecules. These captured materials then become part of the ash residue from the process.

(6) Metals

Effective control of particles and low flue gas temperatures are major factors in the control of metals emissions. Sorbents are not suspected of playing a major role. Nevertheless, scrubber systems combined with particulate control devices have achieved effective metals removal because they cool the incoming flue gas. Metals and metallic compounds enter the combustor in the solid waste material and are not destroyed in the combustion process, although they may change phase or react to form other metallic compounds. Because they are not destroyed, they must leave the combustion process in the bottom ash, fly ash, or stack gas. Metals and metallic compounds carried by the flue gas enter particulate matter collectors as solids, liquids, and vapors, and as the flue gas cools, the vapor portion converts to collectible solids and liquids.

On the basis of theoretical vapor pressure considerations, reduction of flue gas temperatures to below 200°C (392°F) in combination with high-efficiency particulate collection should result in 99 percent reduction of metals, except for mercury (Hg), arsenates $(AsO_4)^{-3}$, and selenium (SeO_2 and Se_6). Increased reduction in concentrations of these compounds occurs as temperatures are lowered.

Recently collected metals data from a pilot-scale test in Quebec are summarized in Table IV-7. The inlet and outlet concentrations data show that the alkaline scrubber/fabric filter system effected greater than 99.9 percent removal efficiency for all metals except mercury. The collection efficiency for mercury ranged from 91 to 97 percent, except for the high-temperature (209°C) test in which a negative control efficiency was measured. Environmental Canada characterized this result as indicative of no mercury removal. Also measurements of metals in the ash residues showed that the solids collected by the fabric filter were enriched with metals. The fabric filter slides contained by far the highest concentration and the highest quantities of total metals.

In other tests, metals control efficiency data show 95-98 percent control or greater for heavy metals except mercury. Seventy-five to 85 percent control of mercury vapor has been reported with a spray dryer combined with a baghouse; 35 to 45 percent control has been reported with a spray dryer plus ESP.

Table -7

INLET/OUTLET METAL CONCENTRATIONS FROM QUEBEC PILOT PLANT TESTING (ug/Nm³ @ 8% O_2) [1]

Metal	Location	Dry Injection 110°C[2]	Dry Injection 125°C[2]	Dry Injection 140°C	Dry Injection >200°C	Spray Dryer 140°C	Spray Dryer 140°C +Recycle
Zinc (Zn)	Inlet	99,000	108,000	93,000	91,000	77,000	88,000
	Outlet	7	5	6	10	5	6
Cadmium (Cd)	Inlet	1,300	1,300	1,500	1,000	1,200	1,100
	Outlet	0.4	0.4	ND	0.6	ND	ND
Lead (Pb)	Inlet	41,000	44,000	34,000	35,000	36,000	34,000
	Outlet	4	3	5	6	1	6
Chromium (Cr)	Inlet	3,100	1,900	2,000	1,900	1,400	1,700
	Outlet	0.4	0.4	1	0.5	0.2	0.7
Nickel (Ni)	Inlet	1,000	1,800	1,300	800	700	2,500
	Outlet	1.3	0.4	0.7	2	1.3	2
Arsenic (As)	Inlet	150	100	130	80	110	130
	Outlet	0.02	0.04	0.04	0.07	0.04	0.03
Antimony (Sb)	Inlet	2,000	800	1,000	1,500	1,000	2,200
	Outlet	0.2	0.4	0.6	0.5	0.3	0.6
Mercury (Hg)	Inlet	440	480	320	450[3]	190	360
	Outlet	40	13	20	610	10	19

NOTE: Concentrations rounded off for simplicity.

ND - Not detected

[1] EPA Municipal Waste Combustion Study Report to Congress.

[2] Based on one test run, except for mercury, which is based on two test runs.

[3] Negative control efficiency; no capture of mercury occurred.

(7) Multipollutant Control Strategies

In devising a control strategy for minimizing emissions to the atmosphere from municipal waste combustors, a starting place is alteration of design or operating practices that may cause or exacerbate pollutant formation, that is, combustion controls. With the potential for pollutant formation in the process minimized, the next logical step would be the use of postcombustion flue gas cleaning equipment to remove remaining pollutants from the flue gases. However, this straightforward approach is complicated because the control problem consists of many different pollutants emitted together, so the effects of the various control options on other pollutants must be considered.

In the previous discussion on control options, the potential for minimizing organic emissions through a combustion optimization strategy was presented. However, the combustion strategy may do little for the control of other pollutants. In fact, whereas combustion optimization is expected to have little impact on acid gases and particulate matter, it may increase emissions of NO_x and some metals.

The preliminary combustion control strategy is probably most incompatible with NO_x emissions minimization. High-temperature, well-mixed, excess-air conditions favor the formation of NO_x from both thermal fixation of molecular nitrogen and the conversion of fuel nitrogen. Traditionally, NO_x emissions from municipal waste combustors have not been controlled, and the need to control NO_x emissions has been confined to fairly localized areas. As previously pointed out, NO_x emissions can be reduced by flue gas cleaning processes. It is not clear what effect NO_x control systems may have on other pollutants, but they are not expected to provide significant removal potential for other pollutants.

High-efficiency particulate collection devices, such as ESPs and fabric filters, have the potential for collection of metals and organics that exist in the stack gases in particulate or aerosol form. Furthermore, when combined with cooling to promote condensation, this collection potential is enhanced. Adding to these possible processing steps, the use of alkali sorbents enhances the collection still further by increasing the potential for collecting organic materials such as PCDD and PCDF and acid gases.

An approach to minimizing a whole list of emissions to the atmosphere from municipal waste combustors would be

- Optimization of the combustion process;
- Flue gas treatment using alkaline scrubbers in conjunction with ESPs or fabric filters at a temperature conducive to promoting condensation; and

■ Flue gas treatment for NO_x control, if necessary.

Table IV-8 provides pollutant removal efficiencies for selected emissions using a multipollutant control approach in a pilot-scale testing. Additional commercially operating facility test results are becoming available for comparison and evaluation.

e. Air Quality Standards

Federal air quality requirements that apply to waste-to-energy systems are National Ambient Air Quality Standards (NAAQS), Prevention of Significant Deterioration (PSD), New Source Performance Standards (NSPS), and National Emission Standards for Hazardous Air Pollutants (NESHAP).

(1) National Ambient Air Quality Standards (NAAQS)

In planning any waste-to-energy project, it is important to consider air standards in the geographical area of the plant. The first step in assessing local air standards is to determine the level of compliance with NAAQS. As directed in Section 109 of the Clean Air Act, the EPA has promulgated national primary and secondary ambient air quality standards for six criteria pollutants: sulfur oxides, total suspended particulates, carbon monoxide, photochemical oxidants (ozone), nitrogen dioxide, and lead.

Both primary standards, which are designed to protect public health, and secondary standards, which are designed to protect public welfare, have been promulgated for the criteria pollutants as shown in Table IV-9.[4] Areas that exceed NAAQS for a pollutant are in nonattainment; those areas that meet or are below the NAAQS criteria for a pollutant are in attainment. An area can be in attainment for some pollutants and in nonattainment for others.

In a nonattainment area, no new major source of nonattained pollutant can be constructed unless pollution control technology is incorporated that will provide the lowest achievable emission rate (LAER) <u>for that pollutant</u>. LAER is defined as the most stringent emission limitation of a pollutant determined by a state or achieved in practice by the class or category of source. To obtain a construction permit in a nonattainment area, pollution offsets, based on the Emission Offset Interpretative Ruling, from other area sources are required in addition to LAER. These measures must actually bring down the net ambient air concentration of the offending pollutant after the new source begins operation.

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[4] Iowa DNR has adopted the EPA NAAQS.

Table IV-8

COMPARISON OF PILOT-SCALE TESTS OF MULTIPOLLUTANT CONTROL EQUIPMENT

Pollutant	Pollutant Removal Efficiency	
	Percentage Spray Dryer/ESP	Percentage Spray Dryer/ Fabric Filter
Mercury[1]	35-40	75-85
Lead	65-75	95-98
Cadmium	95-97	95-97
Arsenic	93-98	95-98
Particulate matter	>99	>99
Dioxins	48-89	>99[2]
Furans	64-85	>99[2]

[1]Vapor only

[2]At 110°C (222°F)

Table IV-9

NATIONAL AMBIENT AIR QUALITY STANDARDS FOR CRITERIA POLLUTANTS

	Primary Standard[1]		Secondary Standard[1]	
	ug/m[2]	ppm	ug/m[3]	ppm
Sulfur oxides (as dioxide)				
Annual arithmetic mean	80	0.03	-	-
24-hour concentration	365[3]	0.14	-	-
3-hour concentration	-	-	1,300[3]	0.5
Suspended particulates				
Annual geometric mean	75	-	60[2]	-
24-hour concentration	260[3]	-	150[3]	-
Carbon monoxide				
8-hour concentration	10 mg/m2	9.0[3]	Same as primary	
1-hour concentration	40 mg/m[2]	35.0[3]		
Ozone				
1-hour	235[4]	0.12[4]	Same as primary	
Nitrogen oxides				
Annual arithmetic mean	100	0.05	Same as primary	
Lead				
Maximum arithmetic mean averaged over a calendar quarter	1.5	-	Same as primary	

Source: 40 CFR 50.4 through 50.12 (July 1, 1980)

[1]Standards are shown in micrograms per cubic meter (ug/m[3]) and parts per million (ppm), where meaningful, unless otherwise noted.

[2]A guide for assessing achievement of the 24-hour standard.

[3]Not to be exceeded more than once a year.

[4]Not to be exceeded more than 1 day per year (3-year average).

(2) Prevention of Significant Deterioration (PSD)

Once attainment/nonattainment status of an area is identified, the applicability of PSD must be determined. PSD regulations apply only to areas that are in attainment or unclassified because of lack of monitoring data to determine status. New or modified major stationary sources located in a PSD region are required to undergo a preconstruction review and permit process. Twenty-eight major stationary sources that have the potential to emit 100 tons per year (TPY) of regulated pollutants were identified in the 1977 Clean Air Act Amendments. One source is incinerators capable of burning 250 TPD or more of refuse. Waste-to-energy plants capable of firing 250 TPD or more are automatically classified as major stationary sources and required to use the best available control technology (BACT) for each pollutant exceeding the 100 TPY level.[5] All other regulated pollutants emitted at rates in excess of specified significant amounts also are subject to BACT, as shown in Table IV-10.

If PSD applies, then a PSD permit is required. There are five major points that a PSD permit application must address, in addition to the use of BACT: (i) ambient air quality analysis; (ii) analysis of impacts to soils, vegetation, and visibility; (iii) no adverse impacts on a Class 1 area, which includes National Parks of more than 5,000 acres and memorials and wilderness areas of more than 6,000 acres; (iv) adequate public participation; and (v) start of construction on time.

(3) New Source Performance Standards (NSPS)

These regulations are designed to control emissions of air pollutants from 28 categories of new or modified sources. Among the regulated source categories are incinerator units capable of burning 50 TPD or more. The applicable standard is 0.08 grains per dry standard cubic foot (gr/dscf) corrected to 12 percent CO_2. This standard applies to individual incinerator units.

(4) National Emission Standards for Hazardous Air Pollutants (NESHAP)

The NESHAP were established under Section 112 of the 1970 Clean Air Act. Regulations have been promulgated for four hazardous air pollutants: asbestos, beryllium, mercury, and vinyl chloride. Incinerators have been identified as a source for beryllium and mercury.

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[5]At this time, it is expected that BACT for an Agency project will include acid gas and particulate control (e.g., a scrubber/baghouse combination).

Table IV-10

EPA DE MINIMUS EMISSION RATES

Pollutant	Quantity (TPY)
Carbon monoxide	100
Nitrogen oxides	40
Sulfur dioxide	40
Particulate matter	25
Ozone	40
Lead	0.6
Asbestos	0.007
Beryllium	0.0004
Mercury	0.1
Vinyl chloride	1
Fluorides	3
Sulfuric acid mist	7
Hydrogen sulfide (H_2S)	10
Total reduced sulfur (including H_2S)	10
Reduced sulfur compounds (including H_2S)	10

Source: 40 CFR 51.24(b) (23) (August 7, 1980)

3. Ash Residue Quality

a. Ash Generation Amounts/Ash Quantity Calculations

In the Municipal Waste Combustion Study report to Congress (June 1987), the U.S. Environmental Protection Agency (EPA) states that the volume reduction resulting from combustion of municipal wastes ranges from 70 to 90 percent. The actual value experienced depends on many variables. These include (i) where in the solid waste management system the incoming volume of waste is measured (e.g., in the packer trucks, on the floor of a transfer station, in a waste-to-energy facility pit, or in the landfill); (ii) amount of source separation or materials recovery achieved; and (iii) landfill system design and operation.

It is possible to calculate the relative volumes of landfill required for ash residues as compared with MSW. The accuracy of the results of this calculation depends on the validity of the assumptions of quantities and densities used in the calculations.

To obtain the volume MSW and ash occupy in a landfill, one would divide the weights of MSW and ash residues by their respective bulk densities. This requires realistic bulk densities based on actual measurements.

For normal landfilling of MSW, compacted in situ, bulk densities have been found to vary from 1,000 to 1,400 pounds per cubic yard, from top to bottom. Average densities of large, well-run landfills like those in Southwestern Illinois may exceed 1,400 lb/cu yd.

One ton of MSW would therefore occupy:

From: "Worst Case" 2,000 (lb)/1,000 (lb/yd^3) = 2.00 yd^3
To: "Best Case" 2,000 (lb)/1,400 (lb/yd^3) = 1.43 yd^3

Reported bulk densities of ash residues from modern waste-to-energy facilities range from 1,800 to 2,700 lb/yd^3, at an average moisture content of about 25 percent. Ash from the scrubber/baghouse-equipped facility achieves much higher densities.[6]

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[6]Tests conducted by a geotechnical laboratory, ATEC Associates of Virginia, Inc., for the Marion County, Oregon facility show that the minimum possible density obtainable for ash residue for that facility is 80 pounds per cubic foot (2,160 pounds per cubic yard). This means that if the ash is poured from a reasonable height (2 to 4 feet), this density is obtained. If the ash residue is compacted, maximum dry density is about 135 pounds per cubic foot (3,645 pounds per cubic yard). Therefore, with adequate compaction, one may expect in-situ densities in excess of 3,000 pounds per cubic yard. (ATEC Associates of Virginia, Inc., February 12 and May 14, 1987).

The inert, noncombustible content of MSW that becomes the ash residue is typically 20 to 25 percent of the MSW by weight on a dry basis. For this calculation we assumed 22.5 percent to be a reasonable average. Thus one ton of MSW produces 550 pounds of dry ash.

The ash disposed in a landfill can be assumed to have a typical moisture content of 25 percent. This increases the weight to 1.25 x 550 or 688 pounds per ton of MSW.

This wet ash would occupy:

From: "Worst Case" 688 (lb)/1,800 (lb/yd^3) = 0.38 yd^3
To: "Best Case" 688 (lb)/2,200 (lb/yd^3) = 0.25 yd^3

We now compare the volumes that would be occupied by the raw MSW with the volume required by the ash residue and calculate the volume reduction resulting from burning the MSW.

Using the ranges in density, the least volume reduction occurs when the MSW is most dense and the residue is least dense:

Minimum MSW volume = 1.43 yd^3
Maximum ash volume = 0.38 yd^3

The ash occupies 0.38/1.43 = 26.6 percent of the MSW volume so the "worst case" volume reduction is from 1.43 to 0.38, or:

$$\frac{(1.43 - 0.38)}{1.43} = 73.4\%$$

The maximum volume reduction results when the MSW is least dense and the ash is most dense:

Maximum MSW volume = 2.00 yd^3
Minimum ash volume = 0.25 yd^3

The ash occupies 0.25/2.00 = 12.5 percent of the MSW volume. Thus the "best case" volume reduction is:

$$\frac{(2.00 - 0.25)}{2.00} = 87.5\%$$

Thus we see that the range of volume reduction is from 73.4 to 87.5 percent in accordance with these assumptions.

(1) Daily Cover Impact

The above does not take into account the daily cover generally required at MSW landfills. Assuming 20 percent dirt or sand must be used in both cases, there would be no net change in volume reduction.

On the other hand, if daily cover requirements are reduced for covering the ash residues, the net reduction in landfill volume would be substantially increased. If no cover was needed for ash, the volume reduction would increase to 79 percent at worst and 90 percent at best.

(2) Source Separation Impact

When source separation is included in the calculations, the quantities of ash per ton of MSW will be reduced. With 25 percent recycling, ferrous and aluminum cans and substantial amounts of paper and cardboard would be removed -- perhaps 5 percent paper, 10 percent yard waste, and 10 percent glass and metal. Because the glass and metals are hollow objects, they may have the same density as the MSW, that is, removal will not change the MSW density. On the other hand, removing glass and metals will greatly change the quantity of ash residue.

One ton of MSW after source separation might still take the same volume in the landfill. However, the relative amounts of ash residue would be reduced from 22.5 percent to 12.5 percent after removing the 10 percent glass and metals. Thus, this residue would now occupy less than half the volume required before source separation. The volume reduction is then likely to be 90 to 95 percent. If the ash residue was recycled, the landfill volume would be even further reduced.

(3) Nonprocessible Waste Impact

Allowance should be made for noncombustible waste, which may be 5 to 15 percent of MSW. Some of this could be recycled, however, such as white goods and wood.

The amount of bypass waste, that is, waste in excess of facility capacity, would be project specific. Some facilities manage to operate without bypassing any raw waste to the landfill, or could do so if necessary. Bypass waste can be avoided, if desired, by sizing a facility for the largest seasonal waste volume, allowing for future waste stream increases, or building redundancy into the system to enhance availability beyond the standard 85 percent. The Signal facility in Baltimore was designed to handle waste from Baltimore and participating jurisdictions; the private vendor is responsible for finding outside waste to fill the additional processing capacity.

Precisely how much landfill space is conserved by incineration is a subject of considerable controversy within the waste field. Variables in waste composition, processing technology, compaction densities, amount and types of recycling, and so forth all lead to a wide range of possible reduction achievements. The above discussion demonstrates that a 90 percent reduction is possible under certain circumstances. However, a conservative estimate of 80 percent reduction may be used.

b. Ash Characteristics

(1) Metals

The components of bottom ash and flyash are mainly silica and alumina, with small amounts of metals. When testing for total metal content, it is conventional laboratory practice to report metals as oxides, because this is the most common form of most of the earth metals. It is not an error to report the metals as oxides; however, it is certainly important to recognize that the metals actually exist in many other chemical forms such as sulfates, chlorides, and hydroxides as well as in more complex mineral forms.

Discussing the total amount of metals in the ash is only one aspect of this complex issue. One must also determine how much of these metals could actually be dissolved in water, making them mobile and bioavailable. Whereas the pure metals and their oxides are essentially insoluble, metal compounds, especially the chlorides, are highly soluble.

(2) pH vs Solubility

Typical solubility curves for lead and cadmium in flyash are based on extensive ash residue testing done at the University of Massachusetts on residues from the Saugus plant. These show minimum leaching of cadmium at a pH of about 10 and of lead at about 7, but high leaching occurred at a pH of 5 (used in the Extraction Procedure, or EP, toxicity test) and at pH values above 8.

These data do not indicate the chemical form of the metals. Different compounds have different solubility curves. Sulfides and hydroxides of various metals have minimum solubilities in the pH range from 9 to 11.

Because pH is the determining factor, the actual leaching that can occur will depend on the pH of the leaching liquid. The ash residues are naturally alkaline, and the addition of lime from scrubber sludge will increase this alkalinity. As reported by Cundari and Lauria, the pH of ash leachate remained quite consistent over the 25 years represented by their laboratory analysis, falling between 10.2 and 10.6, well above neutral. The addition of lime interpret individual sample data (such as the Gascoyne Laboratory sample of Baltimore ash) as being representative.

Several papers have contained detailed data on ash residues, showing their probability distributions. These data show that on given days the distribution of soluble lead falls in a fairly limited range, but in different weeks or months substantial differences in the mean values are found. The conclusion that must be drawn from this is that systematic sampling and analysis of ash residues is necessary in order to supervise processing, disposal, and use of these residues. As a larger database is accumulated, the number of samples needed to supervise it may decrease.

With systematic analysis of ash residues, the producer can develop methods of controlling or treating these materials so that they can be kept consistently below the levels that would be classed as hazardous. For example, research performed recently by Donnelly, Jons, and Mahoney[7] has shown that proper control and supervision of the processes within the facility can produce nonhazardous flyash and scrubber products from acid gas control systems.

(3) Dioxin

The presence of dioxins in waste-to-energy facility ash residue is related to two major factors: the efficiency of combustion and the efficiency of the air quality control equipment. When proper temperatures (1,800 to 2,200°F), mixing of combustion gases, and burning time are present in a well-operated facility, the amount of dioxins in the exit gases is so low that it is difficult to measure them. The precursors for dioxin formation (benzene rings and chlorine) that may have survived the combustion process and are present in the exit gases have the potential to form dioxins in the air pollution control equipment or the stack if the exit gases remain for any length of time at the temperatures at which dioxin formation occurs (400 to 800°F).

Facilities that have an acid gas scrubber cool the exit gases abruptly by use of a water spray to about 280°F. This arrests the formation of toxic organics such as dioxins and causes the metals to condense onto the flyash particles. The more efficient the pollution control equipment, the more dioxins found in the exit gases will be collected with the ash. Table IV-11 shows the range of dioxin found in ash residue (flyash only unless otherwise noted) in the form of the most toxic isomer, 2,3,7,8-TCDD.

During the Swedish Moratorium, the Ministry of the Environment examined the issue of dioxins in ash residue and concluded that the

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[7] "A Viable Approach to MSW Volume Reduction." by J.R. Donnelly, E. Jons, and P.F. Mahoney, at Conference on Solid Waste Management and Materials Policy, New York, Feb 14, 1987.

Table IV-11

DIOXIN LEVELS

SAMPLE	2,3,7,8-TCDD (ng/g)
<u>Soil</u>	
Midland, Michigan	0.3-100
<u>Metropolitan dust</u>	
St. Louis, Missouri	0.12
<u>Mufflers</u>	
Diesel trucks	0.003
Auto	ND-0.004
<u>Other sources</u>	
Fireplace soot	ND-0.1
<u>Municipal waste incinerators</u>[1]	
Nashville, Tennessee	0.4
Japan	0.1-8.0
Japan (bottom ash)	0.01-6.7
Italy	0.032-0.29
Saugus, Massachusetts	0.1-0.2
Saugus (combined ash)	0.00-0.02
North Andover, Massachusetts	0.1-0.4
North Andover (combined ash)	0.02-0.10

ND = <0.1 ng/g

Source: U. Mass/Amherst Incinerator Ash Management Project, March 30, 1987.

[1]Flyash only unless otherwise noted.

dioxins were so firmly bonded to the ash particles that they would not leach out (Report on Waste-to-Energy Facilities, June 1986). If the ash particles were inhaled, however, the dioxins would become bioavailable. Therefore, proper ash management (to avoid airborne flyash particles) is a necessary part of municipal solid waste disposal planning.

For a Madison, Monroe and St. Clair County waste-to-energy facility, regular testing of ash residues will likely be required under Illinois or Federal law. It is anticipated that the combined bottom ash, flyash, and scrubber product will, like the ash residue from the Westchester RESCO facility, be both alkaline and nonhazardous. Good housekeeping practices, such as proper storage and handling of ash, are needed whether the ash is hazardous or not. Such management can be required in a facility operator's contract, and standards can be maintained by the County at which the ash landfill is located.

(4) Ash Toxicity

Metals are concentrated in the ash by combustion, but as discussed above, the key is that the solubility of these metals (a combination of the chemical form of the metals and the pH of the leachate) determines whether they are hazardous or not.

State-of-the-art requirements for landfills include liners with leachate collection and treatment. Present regulations on landfilling are designed to deal with the much more troublesome MSW which has acids that readily leach metals from the MSW, and which contains high levels of organic pollutants as well. The Swedish Report on Waste-to-Energy Facilities noted that the buffering effect of the alkaline ash may be beneficial in codisposal of raw MSW and ash, reducing the acidity and thereby reducing the solubility of the metals in the MSW and in the ash.

As shown in Table IV-12, experience from actual facilities and test data show leaching of five key metals to be significantly lower in ash-only disposal, well below the EP Toxicity test limit.

In addition to the more detailed discussion presented in the preceding section, there are other items of recent concern that have been raised:

- Some metals such as lead appear highly leachable even under alkaline conditions. However, it takes highly alkaline conditions, not the alkalinity that usually results from the ash itself or from normal amounts of lime addition. If high alkalinity does occur for some reason, treatment methods are available.

- Lime addition has been demonstrated to actually enhance the leaching of lead in several studies. It is true that excessive amounts of lime would increase the lead mobility,

Table IV-12

ASHFILL VS. SANITARY LANDFILL LEACHATE QUALTIY

Leachate parameter (mg/1)	Pilot Monofill (a)	Sanitary Landfill (a)	Active Landfill (b)	Closed Landfill (b)	Solidified Material (c)	EP Tox Limit (EPA)
Arsenic	<.005	<.003-.03			.002	5.0
Cadmium	.01-.05	<.05-.1	<.02-.15	<.02-.15	<.06	1.0
Chromium	<.01-.12	ND-.08	<.05-.08	<.05-.10	<.01	5.0
Lead	<.05-.13	.02-1.0	<.1-.5	<.1-.9	<.02	5.0
Mercury	<.0005		<.0005-.106		.006	0.2

(a) K.L. Cundari and J. M. Lauria, "Ashfills and Leachate," Waste Age (November 1986, pp. 82-88).

(b) K. Fichtel and W. Beck, "Auslaugverhalten von Ruckstanden aus Abfallverbrennungsanlagen (2)," Mull und Abfall (November 1984, pp. 331-339).

(c) J.R. Donnelly, E. Jons, and P.F. Mahoney, "A Viable Approach to MSW Volume Reduction," presented at Conference on Solid Waste Management and Materials Policy, New York, February 14, 1987.

but under properly controlled operating conditions the lead would not be excessive.

- The stability of ash alkalinity is very limited under typical disposal conditions. This may be true when small amounts of ash are disposed of in MSW landfills, where the acidity of the MSW leachate can overcome the buffering effect of the ash. This is not typical disposal in that ash is disposed in ash monofills or in totally separate cells of sanitary land fills.

(5) Toxicity Tests

It is important to note that the EP Toxicity test is appropriate for raw waste-only landfills. There is general agreement that the EP Toxicity test is not appropriate for an ash-only environment. The U.S. EPA is presently working to develop a new test, along with sampling and testing protocols, for ashfills.

Whether a new test will be applied to all ash, or only residue destined for ash-only landfills, is not yet known. Whether or not the EP Toxicity test is presently required for all waste-to-energy facilities is discussed under the next heading.

(6) Regulations

In an effort to protect our land from unsafe solid waste and hazardous waste disposal practices, the Resource Conservation and Recovery Act (RCRA) was passed in 1976. The major programs of RCRA created a new federal hazardous waste regulatory program and prohibit open dumping of solid wastes. Hazardous waste regulations, authorized by Subtitle C of RCRA, were promulgated by EPA on May 19, 1980. Municipal solid waste-to-energy facilities are covered by these regulations, but the extent of coverage is currently subject to debate. The facilities largely affected are those having hazardous process residue. These facilities must dispose of residue in accordance with RCRA regulations. Waste-to-energy facilities that accept only residential waste are excluded from the regulations (40 CFR 260) because these wastes are specifically identified as nonhazardous. However, wastes from small businesses, offices, and industries are subject to regulation and therefore must be tested to determine if they are classified as hazardous under the regulations. A waste is considered hazardous if it is ignitable, corrosive, reactive, or toxic or if it is listed in the regulations. Residues from waste-to-energy facilities are <u>not</u> listed as hazardous wastes, but in some instances the residues (flyash, bottom ash, and/or combined ash) have been tested and have failed the EP Toxicity tests. However, as noted earlier, there is general agreement that the EP Toxicity Test is not appropriate for incinerator ash.

Toxicity is the characteristic of greatest concern with waste-to-energy facility residues, including noncombustible materials derived from RDF production. The EP test is designed to identify those toxics that might be leached from a landfill in quantities that pollute a ground or surface water source. Samples of flyash, bottom ash (quenched or dry), and combined ash have been tested with the EP Toxicity Test. The residue that most often fails the toxicity test is the flyash. When the flyash and bottom ash streams were mixed, which occurs automatically within some process units, most of the combined ash samples passed the test.

When ash streams are mixed in the process unit, facilities may need to apply for a hazardous waste treatment permit to mix flyash with bottom ash. Other options include petitioning for an exclusion or disposing of ash at an approved hazardous waste disposal site. This type of disposal is significantly more expensive than conventional landfilling.

It is the responsibility of the owner (or operator) of a waste-to-energy facility to determine whether residues are hazardous under the new regulations. If the residues are hazardous, the owner (or operator) must notify EPA and comply with either the requirements for a hazardous waste generator or the requirements for an owner or operator of a hazardous waste treatment, storage, or disposal facility.

E. WASTE-TO-ENERGY IMPLEMENTATION PLAN

1. Preprocurement Planning

There are many steps that the Counties would need to take and decisions to be made before a waste-to-energy project could be implemented. Determining who will be the implementing agency, energy market, waste supply, environmental impacts, residue/bypass disposal issues, ownership/operations, type of procurement, type of financing, facility site, and public information are several important topics. These topics need to be addressed early on in a project and are summarized below.

a. Implementation Agency

The first decision that must be made is establishing which entity will take the lead on project development. Past planning efforts have been conducted by the East-West Gateway Coordinating Council and it could continue. However, such a project will require regional cooperation.

Regardless of which entity takes the project development lead, resources must be devoted to the project. In-house resources include staff, office space, equipment, and supplies. Particular attention should be given to designation of a full-time project manager for the lead agency.

b. Energy Markets

Since the primary energy market identified in the Markets Study is Union Electric, discussions and eventually negotiations should be undertaken with this market to determine the actual methodology for calculating the value of the energy -- most likely electricity -- and to come to terms on other contractual issues.

Clarification on the rate for electricity will be important in making final decisions on which project to pursue, as well as even whether to make a final decision on implementing the project. The market "deal" and siting issues are tantamount in developing the procurement documents.

c. Waste Supply

Waste supply discussions should be held with member communities to determine their interest in participating in a waste-to-energy project and the quantities of waste they would supply. These jurisdictions could designate the resource recovery facility as the disposal site. As an alternative, efforts could be initiated to implement waste flow control under state authorization (or amend state legislation if necessary).

As noted in this report, consideration needs to be given to the effect of waste reduction, recycling and composting on the available waste stream for the resource recovery facility. Programs to reduce and recycle some amount of the waste stream need to be factored into the decision for project sizing so as not to oversize or undersize the facility (and to implement new state law). These items have been considered in the facility sizes presented in this report.

d. Facility Site

Obtaining a site on which to build the facility (and getting it permitted) is a critical project component. The difficulties in securing a site, and/or the time required to do so, often are not fully appreciated. The ideal site should be as close to the proposed energy market as possible, keeping in mind all of the environmental considerations. Obtaining options to purchase the site and developing a strategy for site acquisition and permitting should be accomplished before procurement commences so that they can take place as procurement proceeds.

e. Residue/Bypass Disposal Site

Residue and bypass from a waste-to-energy facility will need to be properly disposed. The Counties will need to determine if the existing landfill site can be used for disposal of this material, and, if so, what, upgrading is needed. If this site cannot be utilized for residue/bypass disposal, another site will have to be identified for disposal. Close tracking of proposed federal legislation will be required.

f. Environmental Impacts

Potential environmental impacts as well as the appropriate pollution control equipment need to be addressed. These issues need to be addressed early on and will have direct impacts on facility siting and operation. Existing and proposed state and federal regulations should be reviewed and understood as to minimize delays and problems in later stages of environmental permitting.

g. Public Information

A program to inform the public should be initiated. This program should include media releases, presentations by the project manager to local interest groups, and publication of a fact sheet on the project. Timely releases of factual information will reduce problems due to misunderstanding by the public.

Another activity that the Counties should consider at this stage is visits to several operating waste-to-energy facilities. These trips would enable staff and elected officials to inspect actual facilities, which is important in gaining a perspective on the look of these plants and their operating conditions.

h. Ownership/Operations

Available options for ownership/operations structure for proposed project include: private ownership/private operation, public ownership/public operation, and public ownership/private operation. Costs and the allocation of project risks can differ between these options.

i. Procurement Approach

As with ownership/operations structure, several approaches to project procurement are available. The traditional A/E approach has a community hire a firm to design and build a facility that will be owned and operated by that community upon completion of construction. A turnkey approach is similar but differs in that the firm that designs the facility will operate it for a period of time before the community takes over operation. Finally, with a full-service approach the community would contract with a company to design, build and operate a facility over a long-term period. Such a facility could be either privately owned or publicly owned. The procurement approach taken will likely have cost and project risk implications different than the other approaches.

j. Financing

A review of financing options should be done by the Counties' financial advisers as well as an adviser familiar with waste-to-energy projects. A number of financing methods are available for implementing a project and should be analyzed to determine the best method for a given project.

2. Procurement

If pre-procurement planning issues on markets, waste supply, implementing authority, and so forth are favorably resolved, actual procurement may begin.

Development and issuance of a Request for Proposals (RFP) and selection of a contractor are the basic tasks in this phase of project implementation.

An RFP should be prepared that specifically defines the technical performance requirements and financing and contractual plans. To aid in defining these plans, the RFP may contain a draft of a Memorandum of Understanding (MOU). The MOU defines the key business issues and presents a risk matrix prior to contract negotiations.

Prior to release of the RFP, notices should be sent to local newspapers as well as the trade press. Direct contact should also be made with the active contractors in the field. Shortly after release of the RFP, a preproposal meeting should be held so that prospective proposers can make inquiries and learn more about the project opportunity.

The proposals received would be evaluated based on the criteria established in the RFP. Typical criteria include technical, management, cost, performance guarantees, and qualifications. A particular concern with qualifications is a "reference facility." This facility should be a plant that has at least a year of operating data. The data from this facility will be important in substantiating the claims of a proposer.

3. Contract Negotiations

The contract negotiations activities can be divided into two parts: (i) Memorandum of Understanding and (ii) project contracts. The latter area includes project-related contracts with the facility contractor, as well as with area jurisdictions, energy markets, etc.

a. Memorandum of Understanding (MOU)

The MOU is a legal document signed by the lead parties on both sides prior to contract negotiations. Essentially, the MOU defines the project in specific terms and describes the framework of areas to be negotiated in the next part of this phase. The objective of an MOU is to ensure that the contract parties are in agreement as to the basic underpinnings of the project prior to detailed negotiation. Such an agreement will tend to reduce the time required for contract negotiations as it forces acknowledgement of the project level of guarantees, baseline costs, and construction timelines. MOUs usually do not include termination or default conditions nor detailed scopes of supply. It is rather an overview document that establishes negotiation principles and a timeline.

A draft MOU may be included in the RFP to allow prospective proposers to understand the contractual position of the Counties. A proposer's objection to a major risk assumption can also be stated in the proposal. This would be one way to allow the contractor selection portion of the procurement phase to include preliminary discussion on certain key contractual issues. This initial understanding on a company's position on a key contract issue could influence the vendor selection process. The key elements in an MOU are shown in Table IV-13.

b. Project Contracts

A variety of contracts are typically negotiated with an energy recovery project. These contracts include facility agreement, waste supply agreement, product sales agreement, residue disposal agreement, and site lease or purchase agreement.

Several other agreements are important to the financing of the project, including bond purchase agreement, trust indenture, and guaranty agreement.

(1) Service Agreement

A Service Agreement (which may be a combination of construction contract, operating contract, and lease agreement) is made between the development agency and a private contractor for the construction and typically the operation of the waste-to-energy facility. It typically requires the contractor to build the facility to specifications, conduct performance tests, and operate the facility for a specified period. The details of the construction schedule, performance test(s), disbursement of funds, and technical equipment and performance specifications are spelled out in this agreement. Financial obligations for facility maintenance and modification, as well as conditions and remedies of default are also detailed. Separate construction and operating agreements may be negotiated rather than incorporating both in a Service Agreement.

TABLE IV-13

KEY ELEMENTS: MEMORANDUM OF UNDERSTANDING

- Principal responsibilities of each party that is a signatory to the MOU as well as third parties (e.g., subcontractors).
- Position of negotiation exclusively and best efforts language
- Designation of the Negotiation Team, lead negotiators and document distribution list
- Completion schedule objectives (elements and dates)
- Language on bonds outstanding and damage claims (e.g., bid bond forfeiture) for failure to negotiate "in good faith"
- Location of negotiation sessions
- Rights of each party to exercise option to terminate MOU (including timing notifications and claims actions)
- Implementation agency position on development funds inclusion in bond or project financing proceeds
- Detailed description of all vendor parties and subcontractors to be involved with the Facility
- Rules for handling controversy and arbitration
- Overview of the Plant Description
- Capital and operational cost proposal forms, from proposals
- Performance Guarantees (including throughput, Energy Output, Availability)
- Anticipated Monthly Operating Schedule
- Project contract structure, diagrammatic presentation of relationships between contracts
- Basis for revenue projections, cash flow projections, and service fee
- Corporate or parent company financial guarantee for construction and operation
- Copy of contractor's bid bond/surety

(2) Waste Supply Agreement

A waste supply agreement (also sometimes termed service contract(s) or user subdivision contracts) is entered into between the party or parties supplying waste to the project and the operator of the plant or the development agency. In the latter case, the development agency then contracts with the private operator or assigns the waste supply contracts to the operator.

The waste supply agreement specifies the quantities and reference composition of waste to be delivered and the payments (tipping fees) to be made to the operator. This agreement is usually on a "put or pay" basis, where the users must deliver a minimum quantity of waste or pay for any shortfall in guaranteed deliveries.

Communities should discount the waste stream for current/ projected recycling activities. This agreement also addresses situations of default, conditions and responsibilities whereby waste must be diverted from the facility (i.e., to landfill), regulations affecting the facility (i.e., more stringent environmental codes), and other areas such as revenue sharing.

(3) Product (Energy and/or Materials) Sales Agreement

The Energy or Materials Sales Agreements spell out the technical specifications of the energy and/or materials to be supplied from the Project and supplied the markets. Electricity voltage, steam temperature and pressure and recovered materials contamination levels are examples of information to be negotiated. The hourly (steam and electricity) output and gross annual outputs are also included.

(4) Residue Disposal Agreement

The disposal of residues resulting from the combustion process as well as other residues from air pollution control equipment and certain bypass raw refuse is essential to the operation of the project. An agreement for the disposal of such residues, via sanitary landfill, would be executed between the project operator and the Counties.

(5) Site Lease or Site Purchase Agreement

A site lease or site purchase agreement is entered into between the developer and a site owner or the facility owner/operator and a site owner. This agreement sets forth the terms of lease, the length of lease, the use restrictions on the property such as access, construction and removal of structures, and maintenance of the property.

(6) Bond Purchase Agreement

This agreement is entered into between the agency issuing the bonds, the lessee (i.e., owner/operator) of the facility, the guarantors of the lessee, if any, and the underwriters who will purchase the bonds for sale to the investors (i.e., bondholders) in the project. This agreement specifies the commitment of the underwriters to purchase the bonds (in a private placement, the agreement is directly with the bondholders), the type of bonds, the purchase price and interest rate, opinions of bond counsel, other legal opinions, government approvals, bond ratings, and details and conditions of the bond closing.

(7) Trust Indenture

A trust indenture is an agreement between a financial institution acting on behalf of all bondholders and the development agency, which sets forth the terms of the revenue pledge to the project and places limits on the use of bond proceeds and project revenues. It is an agreement that essentially safeguards the interests of the bondholders. A trustee (i.e., the financial institution) controls all disbursements and oversees the distribution of revenues to special funds (i.e., dept service reserve, bond fund, construction fund, revenue fund, operation and maintenance reserve fund). The indenture describes the structure and function of each special fund and specifies the mechanisms for the flow of revenues into and out of the funds, the priority of funds, and the interrelationship of certain funds. In short, the indenture provides the framework for the application of project revenues and the control of disbursements to ensure that debt service payments and certain revenue guarantees are met.

(8) Guaranty Agreement

This agreement is entered into between the trustee (indenture trustee) and a guarantor (usually the parent firm of a private operating subsidiary) who agrees to guarantee the performance of the operator. This agreement may place restrictions on the business activities of the guarantor. It will be critical to the marketability of the bonds in the project if an operating subsidiary or joint venture subsidiary arrangement will operate the project rather than the parent firm directly. In most private ownership projects involving systems vendors, a new subsidiary or limited partnership is set up to develop and own and operate the project. This subsidiary would have limited capitalization, and the resources of a financially strong parent (or other guarantor) are essential to protect the development agency and provide for a financeable project.

4. <u>Environmental Permitting</u>

Prior to project financing and construction, one or more environmental permits will need to be obtained from federal, state and local regulatory agencies. These may include an air pollution control permit, a solid waste (sanitary) disposal permit, and possibly a water pollution control permit.

A typical environmental permitting process will include an analysis of environmental impacts through the preparation of an Environmental Impact Statement (EIS) or an Environmental Impact Report (EIR). Impacts associated with facility air emissions and the disposal of ash are two areas that receive considerable attention in such a process. Identification of area as non-attainment will also be an important factor. Air pollutant dispersion modeling is required along with the preparation of a Health Risk Assessment (HRA) to determine the health impacts of the facility on individuals living in the surrounding area. Very often specific air quality standards are established and/or a particular type of air pollution control system is prescribed for a facility as conditions of their permit.

Also of concern is the disposal of ash residue from a facility. Recent activity in some states indicates that regulatory agencies are beginning to require ash management plans which include treatment of ash and the designation, before facility permits are obtained, of an environmentally acceptable landfill for disposal of ash residue. The Counties should have a clear understanding of any operating plan changes for the designated landfill that may be required before accepting large quantities of ash from a waste-to-energy plant.

5. Financing

If a decision is made to enter into a construction contract and the project receives all required permits and approvals, the project would enter the financing phase.

In the financing phase, the bonds for the project would be issued. There would be financing activity in the previous phases that would involve the development agency's financial advisor. These activities would be focused on advice/guidance during these previous phases.

The financing phase may involve two components: (i) bond feasibility study and (ii) bond issuance. The bond feasibility study is a separate report that examines the specific project structure/recovery technology to be financed. This study, which would be done by the consulting team, would provide an assessment as well as an opinion on the viability of the proposed project. This report would be part of the Official Statement distributed by the investment banker to prospective bond purchasers.

A letter of credit for the entity that will finance the project may be required to be issued by a major financial organization, usually a major international bank. The objective of the letter of credit is to provide an independent assessment of the financial stability, and therefore credit rating, of the entity guaranteeing the project financing. This assessment is very important to determine the types of financing available for a project and the interest that will be paid to the bondholders. The investment banker and financial advisor will provide crucial information to the project team and the issuer of the letter of credit.

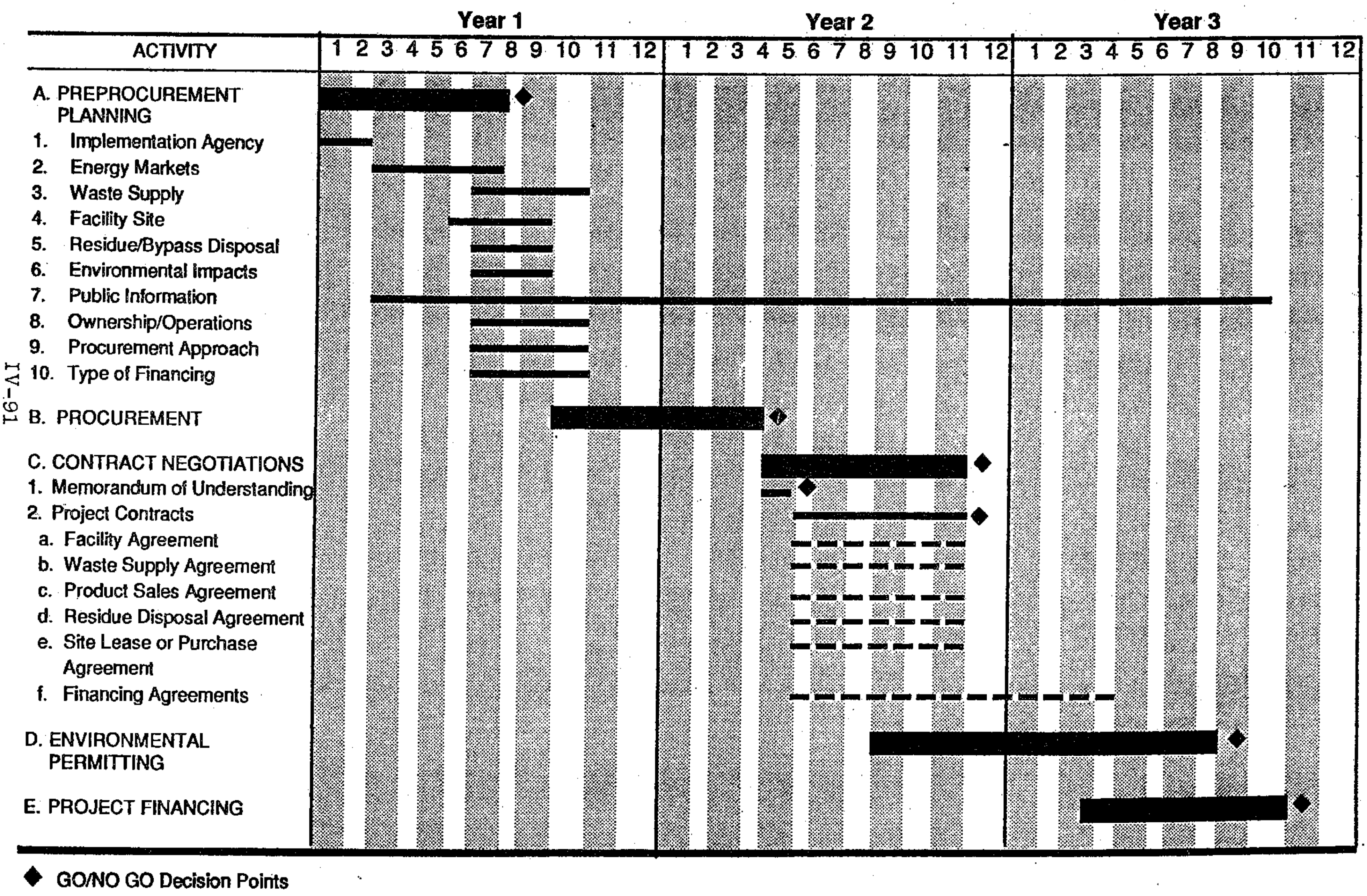
6. Implementation Schedule

The period from the decision to begin preprocurement planning to financing is anticipated to take approximately two to three years. This timetable includes the following activities and schedule and is schematically presented in Figure IV-17. There are several points along the path at which positive decisions would need to be made by the Counties to keep the project under development or to maintain this schedule. Construction adds 24 to 30 months such that the earliest that a facility could begin commercial operations is the latter part of 1994. Chapter V assumes that the facilities would begin operations in early 1995.

- Preprocurement planning - six months
- Procurement - six months
- Contract negotiations - four months
- Environmental permitting - 12 months
- Financing - two months
- Construction - 24 to 30 months

FIGURE V-17

Waste-to-Energy Implementation Schedule



V. ECONOMIC PROJECTIONS AND EVALUTATION OF PREFERRED SYSTEM ALTERNATIVES

This section describes in detail the economic projections associated with the preferred solid waste management system and its optional components. These projections, and an evaluation of the alternative components, constitute the Feasibility Study that is required by the Illinois Environmental Protection Agency as part of the Solid Waste Management Plan for Madison, Monroe, and St. Clair Counties.

Three scenarios have been developed and evalutated. The first is a baseline, landfill-only scenario against which the costs of the other alternatives, or scenarios, can be compared. Scenarios 2 and 3 describe systems with differing waste-to-energy components.

A. COMMON FACILITIES REQUIRED

Illinois State law requires Madison, St. Clair and Monroe Counties to plan for 25 percent recycling. As described in Section I, in order to achieve 25 percent recycling, a yard waste composting facility and materials recovery facility will be required components of the solid waste management system. These two facilities are required in all three of the alternatives, or scenarios, and will be sited at the centrally located waste management park as described in Section I.

The materials recovery facility will be sized to handle 345 tons of waste per day. The yard waste composting facility will handle 12 tons of waste per hour.

In all three scenarios, an additional facility, a landfill, will be located at the central waste management park. The landfill in the baseline scenario will accept unprocessed solid waste and will comply with proposed federal regulations which require the installation of a double composite liner system. The other two scenarios will require a landfill for unprocessed solid waste with a double composite liner and a dedicated landfill for handling ash from the waste-to-energy facility, or facilities, with a single composite liner. In all three scenarios, construction and demolition waste can be landfilled in an unlined area of the landfill at the centrally located waste management park.

For purposes of the Feasibility Study, the location of the waste management park was assumed to be at, or near, the centroid of solid waste generation in the three county area. The general boundaries of the centroid are Interstate 55-70 on the south, Interstate 255 on the west, State Route 157 on the east and State Route 162 on the north.

B. DESCRIPTION OF SCENARIOS

The three scenarios investigated in the Feasibility Study are presented below and are summarized in Table V-I and detailed in Figures V-1, 2, and 3.

1. Scenario 1 - Landfill Only

In this scenario, the centrally located waste management park would contain the common facilities, namely the materials recovery facility, the yard waste composting facility and a relatively large landfill. The landfill would be sized to handle 20 years of solid waste from the three county area. An area of 201 acres would be required to site this landfill.

2. Scenario 2 - Single Waste-to-Energy Facility

In this scenario, in addition to a landfill of 96 acres, a single, 1,500 ton per day waste-to-energy facility would also be located in the central waste management park. This facility is assumed to operate at an 85 percent availability factor such that, on average, it would be able to process 1,275 tons of waste per day. This facility would not operate at its total capacity in 1995, but by 1999, more Solid Waste would be available than capacity and some solid waste would be by-passed to the double lined portion of the landfill.

3. Scenario 3 - Two Waste-to-Energy Facilities

In this scenario, instead of a single 1,500 ton per day central facility, a 1,000 ton per day facility would be sited near the Granite City area and a second facility with the capacity of 500 tons per day would be sited in, or near, Alton. The required central landfill would be 96 acres in size, exactly the same as in Scenario 2, since the combined capacity of the two facilities would be exactly equivalent to the capacity of the single waste-to-energy facility in Scenario 2. The Alton facility would operate at capacity immediately when commercial operations begin; the Granite City facility would suffer the shortfall in the first four years that would be experienced in Scenario 2.

C. ASSUMPTIONS USED FOR PROJECTIONS

1. Capital Costs and Debt Service

Detailed estimates of costs, revenues and debt service for components of the various scenarios are presented in Tables V-2 through V-5. Estimates for the cost of the waste-to-energy facilities for the three sizes under consideration are based upon the 1,500 ton per day facility having three trains of equipment,

TABLE V-1

SUMMARY REVIEW OF SCENARIO COMPONENTS

	Scenario 1	Scenario 2	Scenario 3
201 Acre Landfill	X		
96 Acre Landfill		X	X
345 TPD Materials Recovery Facility	X	X	X
12 TPH Yard Waste Composting Facility	X	X	X
500 TPD W-T-E Facility			X
1.000 TPD W-T-E Facility			X
1,500 TPD W-T-E Facility		X	

Figure V-1

Scenario 1 in 1995

Madison County would send **403,104** tons of Solid Waste to the Central Facility, an average distance of 8.44 miles

Monroe County would send **12,160** tons of Solid Waste to the Central Facility, an average distance of 17.36 miles

St. Clair County would send **223,672** tons of Solid Waste to the Central Facility, an average distance of 9.86 miles

Of the total **639,016** tons:

- all **Construction and Demolition Waste** would go directly to the unlined portion of a 201 acre landfill
- separated **Yard Waste** would go to the Composting Facility which would produce compost that would go to markets
- mixed **Recyclables** would go to the Materials Recovery Facility which would produce products that would go to final markets and a small amount of residue which would join the remainder of the Solid Waste going to the larger double lined portion of the 201 acre landfill

Figure V-2

Scenario 2 in 1995

Madison County would send **403,104** tons of Solid Waste to the Central Facility, an average distance of 8.44 miles

Monroe County would send **12,160** tons of Solid Waste to the Central Facility, an average distance of 17.36 miles

St. Clair County would send **223,672** tons of Solid Waste to the Central Facility, an average distance of 9.86 miles

Of the total **639,016** tons:

- all **Construction and Demolition** Waste would go directly to the unlined portion of a 96 acre landfill
- separated **Yard Waste** would go to the Composting Facility which would produce compost that would go to markets
- mixed **Recyclables** would go to the Materials Recovery Facility which would produce products that would go to final markets and a small amount of residue which would go to a double lined portion of the 96 acre landfill
- **444,950** tons of Solid Waste would go to a 1,500 TPD Waste-to-Energy Facility
- 122,361 tons of **Ash** which would go to a single lined portion of the 96 acre landfill

Figure V-3

Scenario 3 in 1995

Madison County would send **155,125** tons of Solid Waste to the Alton Waste-to-Energy Facility, an average distance of 7.52 miles; **125,558** tons of Solid Waste to the Granite City Waste-to-Energy Facility, an average distance of 9.36 miles; and **122,421** tons of Solid Waste to the Central Facility, an average distance of 8.44 miles

Monroe County would send **8,467** tons of Solid Waste to the Granite City Waste-to-Energy Facility, an average distance of 19.07 miles; and **3,693** tons of Solid Waste to the Central Facility, an average distance of 17.36 miles

St. Clair County would send **155,744** tons of Solid Waste to the Granite City Waste-to-Energy Facility, an average distance of 12.33 miles; and **67,928** tons of Solid Waste to the Central Facility, an average distance of 9.86 miles

Of the total **639,016** tons:

- o all **Construction and Demolition Waste** would go directly to the unlined portion of a 96 acre landfill
- o separated **Yard Waste** would go to the Composting Facility which would produce compost that would go markets
- o mixed **Recyclables** would go to the Materials Recovery Facility which would produce products that would go to final markets and a small amount of residue which would join any by-pass Solid Waste going to the double lined portion of the 96 acre landfill
- o 42,659 tons of **Ash** from the Alton Waste-to-Energy Facility would be sent 24 miles to the single lined portion of the central landfill
- o 79,702 tons of **Ash** from the Granite City Waste-to-Energy Facility would be sent 8 miles to the single lined portion of the central landfill

TABLE V-2

LANDFILL CAPITAL COSTS

LANDFILL CAPITAL COSTS	L.F. w/ WTE	L.F. w/o WTE
Site Characterization	173,497	256,139
Preliminary Development Cost	1,090,555	1,707,593
Land Acquisition	955,723	1,987,638
Clearing and Grubbing	247,854	554,968
Excavate & Stockpile	5,006,641	11,227,422
Liner - Single Composite	3,668,232	0
- Double Composite	19,332,574	68,581,191
Leachate Pumps	356,909	785,493
Leachate Pre-treatment	3,965,656	5,122,778
Ponds (Recharge Basin)	20,820	51,228
Ditch Construction	39,657	93,918
Gas Management	1,427,636	3,415,185
Groundwater	158,626	356,033
Site Structures	2,220,767	1,912,504
TOTAL CAPITAL COSTS (1989 $)	38,665,147	96,052,088

TABLE V-3

WASTE-TO-ENERGY CAPITAL COSTS

WASTE-TO-ENERGY CAPITAL COSTS	1,500 TPD	1,000 TPD	500 TPD
Engineering, Design & Construction. Mgmt.	17,500,000	15,000,000	14,000,000
Site Work	4,500,000	3,500,000	2,200,000
Buildings	19,500,000	16,000,000	11,000,000
Solid Waste & Residue Handling Equipment	3,000,000	2,500,000	2,000,000
Combustion/Energy Generation	54,000,000	38,000,000	22,500,000
Water Treatment	850,000	700,000	500,000
Power Generation/Condensing & Cooling	13,000,000	9,500,000	8,000,000
Electrical Switchgear & Transmission	3,500,000	2,500,000	2,000,000
Steam Mains and In-plant Pumping & Piping	5,500,000	4,000,000	2,500,000
APC Equipment (scrubbers & baghouses)	9,500,000	6,000,000	3,000,000
Exhaust Stack	1,800,000	1,500,000	800,000
Initial Spare Parts	1,100,000	800,000	600,000
Insurance and Bonds	2,300,000	2,000,000	1,800,000
Start-up, Acceptance Testing, Monitoring	5,100,000	3,700,000	3,000,000
SUBTOTAL	141,150,000	105,700,000	73,900,000
Contingency (@ 15%)	21,172,500	15,855,000	11,085,000
TOTAL CAPITAL COST (1989 $)	162,322,500	121,555,000	84,985,000

TABLE V-4

YARD WASTE COMPOSTING CAPITAL COSTS

YARD WASTE COMPOSTING CAPITAL COSTS-26,000 TPY	
Engineering, Design and Construction Management	335,000
SITE CONSTRUCTION	
Grading	145,000
Access Road, Paving	120,000
Preparation Area, Asphalt	165,000
Maintenance and Office Facility	55,000
Utility Hook-ups	35,000
SUBTOTAL	520,000
EQUIPMENT	
Front-end Loader (2)	320,000
Compost Turner	200,000
Chipper	35,000
Shredder	50,000
Screener	40,000
Dump Truck	35,000
Miscellaneous Equipment	20,000
SUBTOTAL	700,000
TOTAL CAPITAL COSTS (1989 $)	1,555,000

TABLE V-5

MATERIALS RECOVERY FACILITY CAPITAL COSTS

###Materials Recovery Facility###	345 TPD
Engineering, Design, and Construction Management	1,350,000
Site Work	760,000
Building	4,050,000
Conveyor System	2,530,000
Tin/Steel Processing	680,000
Glass Processing	590,000
Aluminum Processing	190,000
Plastic Processing	300,000
Paper Processing	680,000
Other Equipment	1,010,000
Insurance and Bonding	420,000
Start-up and Testing	170,000
SUBTOTAL	12,730,000
Contingency (@ 15%)	1,909,500
TOTAL CAPITAL COST (1989 $)	14,639,500

the 1,000 ton per day facility having two trains and the 500 ton per day facility having a single train. The size of the train, therefore, in each of the cases would be 500 tons per day.

It has been assumed that the capital costs of the facility would be paid for by revenue bonds bearing an interest rate of 8 1/2 percent per annum. This interest rate would imply that the facilities would be financed with tax-exempt debt and, therefore, would be publicly owned facilities. This interest rate has been used to determine the debt service of all of the facilities, namely the yard waste composting facility, the material processing facility, the landfill and the various waste-to-energy facilities.

2. Operating Costs and Cost and Price Escalation

The economic projections associated with the alternative scenarios contain estimates for operating costs and have been projected over a 20 year period for all of the facilities. The rate of inflation has been assumed to be 5 percent per annum.

3. Revenues and Escalation

The only significant revenues assumed for the various scenarios include those from the sale of electricity and steam and those from the sale of recyclable materials. The revenue assumed for electricity is 1 1/2 cents per kilowatt hour starting in 1995 and escalating thereafter at the general rate of inflation, assumed, as above, to be five percent. The most significant revenue is that for recyclable aluminum. The revenue for aluminum is assumed to be $1,200 per ton starting in 1989 and escalating at the general rate of inflation thereafter.

The value that has been assumed for newsprint at the present time is $0. The value of newsprint has been relatively volatile in the recent past, bringing as much as $30 per ton but also requiring payments of as much as $20 per ton to remove collected newspaper. It also has been assumed that yard waste would be given away at the yard waste composting facility. The value of plastic was assumed to be $118 a ton, escalating at one half the rate of general inflation. The value of glass is assumed to bring $32 a ton in 1992 and the value would also escalate at one half the rate of inflation.

For transportation costs, the analysis examined only the cost of transporting residential waste. This will allow for the projection of the average cost per household for implementing each of the scenarios. In Scenarios 1 and 2, since all of the waste would be brought to the central facility, the distance from each of the centroids of the counties to the central facility was used to determine the transportation costs. The distance from Madison County to the central facility is 8.44 miles; from St. Clair County, 9.86 miles; and from Monroe County, 17.36 miles.

To determine the transportation costs in each case, the cost of $0.30 per ton mile was used. This figure is consistent with transportation costs in the midwest.

Scenario 3 contains a somewhat more complex transportation cost analysis with two waste-to-energy facilities and the central facility to be considered. Transportation costs for hauling waste to each of the facilities from the centroids of each of the three counties was figured as well as the costs for hauling ash from the facilities to the central landfill.

Transportation costs for Scenario 3 were determined in the following way: in all cases it was assumed that solid waste from Monroe County and St. Clair County would go to the Granite City area facility. For transportation analysis purposes, no waste from Monroe or St. Clair Counties would ever go to the landfill at the central waste management park since they are much closer to the Granite City area facility and they would not be able to supply the entire 1,000 tons per day of capacity. The waste from Madison County would first fill up the Alton area facility (500 tons per day) and this facility would be at capacity at all times. Madison County would generate more waste than the Alton area facility could accept. The remainder of the Madison County waste would go to the Granite City area facility to fill up the remaining capacity of that facility.

For Scenario 3, in the first three years of operation of the waste-to-energy facilities (projections indicate a statistically insignificant shortfall in the fourth year), there is not quite enough waste in the three counties to completely fill up both of the facilities and have both facilities operating at capacity. To that extent, a slight over-capacity at the Granite City area facility would ensue. However, after those first three years, Madison County would have more waste than would be required to completely fill up the Granite City area facility and some waste would then be diverted to the central landfill. This has the effect of minimizing the transportation costs since Madison County is the closest county to the central waste management park at 8.44 miles while the other two counties are further away. However, it should be noted that all of Madison County's residential waste would go to the Alton waste-to-energy facility since Madison County's residential waste would not exceed the capacity of that facility in any year in the projections.

D. SUMMARY OF COST PROJECTIONS

Tables V-6 through V-7 present the projections of the expected disposal costs, by scenario, for the next 23 years for Madison, St. Clair and Monroe Counties. The projections include the cost per ton for all waste arriving at the facilities, assuming that all waste pays the same fee at all of the facilities. The projections also present a monthly household cost for residential waste disposal which includes the average transportation cost, averaged over all of the study area, plus collection cost.

TABLE V-6

PROJECTED DISPOSAL COSTS FOR SCENARIOS 1 AND 2

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
SCENARIO 1 TOTAL COST												
# Net MRF Cost	2,541,662	2,558,858	2,575,682	2,592,082	2,607,975	2,623,074	2,643,301	2,657,635	2,669,540	2,681,254	2,690,273	2,697,548
# Net Y.W. Cost	825,524	856,693	889,421	923,785	959,867	997,753	1,037,533	1,079,303	1,123,161	1,169,212	1,217,565	1,268,336
# Net W.T.E Cost	0	0	0	0	0	0	0	0	0	0	0	0
# Net L.F. Cost	25,242,817	25,503,282	25,776,771	26,063,935	26,365,456	26,682,054	27,014,481	27,363,330	27,730,031	28,114,858	28,518,925	28,943,197
Total Cost	28,610,003	28,918,834	29,241,874	29,579,802	29,933,298	30,302,881	30,695,316	31,100,468	31,522,732	31,965,323	32,426,764	32,909,081
Total Tons	614,132	622,315	630,609	639,016	647,536	656,173	664,730	673,407	682,203	691,122	700,166	709,334
Total Facilities' Cost per Ton	46.59	46.47	46.37	46.29	46.23	46.18	46.18	46.18	46.21	46.25	46.31	46.39
Total Residential Waste	250,753	253,726	256,733	259,777	262,856	265,973	268,669	271,392	274,143	276,922	279,729	282,564
Total Facilities Cost for Residential Waste	11,681,592	11,790,564	11,904,942	12,024,977	12,150,918	12,282,947	12,406,335	12,533,906	12,667,382	12,807,991	12,955,071	13,109,364
Transportation Cost	822,309	873,653	928,203	986,160	1,047,736	1,113,157	1,180,729	1,252,404	1,328,430	1,409,071	1,494,609	1,585,339
Total Cost for Residential Waste	12,503,902	12,664,217	12,833,145	13,011,136	13,198,653	13,396,104	13,587,064	13,786,309	13,995,811	14,217,062	14,449,680	14,694,704
Total Cost per Ton for Residential Waste	49.87	49.91	49.99	50.09	50.21	50.37	50.57	50.80	51.05	51.34	51.66	52.00
Total Households	202,086	203,143	204,205	205,273	206,347	207,426	208,470	209,519	210,574	211,634	212,699	213,770
Number of Tons per Household	1.24	1.25	1.26	1.27	1.27	1.28	1.29	1.30	1.30	1.31	1.32	1.32
Res. Coll. Cost/Month/Household	8.10	8.51	8.93	9.38	9.85	10.34	10.86	11.40	11.97	12.57	13.20	13.86
Cost per Month per Household	13.26	13.70	14.17	14.66	15.18	15.72	16.29	16.89	17.51	18.17	18.86	19.59
Cost per Ton Including Collection	128.23	131.66	135.26	139.04	143.00	147.15	151.69	156.43	161.41	166.63	172.10	177.83
SCENARIO 2 TOTAL COST												
# Net MRF Cost	2,541,662	2,558,858	2,575,682	2,592,082	2,607,975	2,623,074	2,643,301	2,657,635	2,669,540	2,681,254	2,690,273	2,697,548
# Net Y.W. Cost	825,524	856,693	889,421	923,785	959,867	997,753	1,037,533	1,079,303	1,123,161	1,169,212	1,217,565	1,268,336
# Net W.T.E Cost	0	0	0	37,789,997	38,411,352	39,060,753	39,739,906	40,504,925	41,308,811	42,152,891	43,039,175	43,969,773
# Net L.F. Cost	11,246,969	11,507,435	11,780,924	9,387,896	9,555,408	9,731,296	9,915,977	10,109,894	10,313,505	10,527,298	10,751,780	10,987,486
Total Cost	14,614,156	14,922,987	15,246,026	50,693,760	51,534,602	52,412,876	53,336,718	54,351,756	55,415,017	56,530,654	57,698,793	58,923,143
Total Tons	614,132	622,315	630,609	639,016	647,536	656,173	664,730	673,407	682,203	691,122	700,166	709,334
Total Facilities' Cost per Ton	23.80	23.98	24.18	79.33	79.59	79.88	80.24	80.71	81.23	81.80	82.41	83.07
Total Residential Waste	250,753	253,726	256,733	259,777	262,856	265,973	268,669	271,392	274,143	276,922	279,729	282,564
Total Facilities Cost for Residential Waste	5,967,025	6,084,285	6,206,957	20,608,363	20,919,603	21,244,996	21,557,464	21,904,487	22,268,475	22,650,924	23,051,699	23,472,091
Transportation Cost	822,309	873,653	928,203	986,160	1,047,736	1,113,157	1,180,729	1,252,404	1,328,430	1,409,071	1,494,609	1,585,339
Total Cost for Residential Waste	6,789,334	6,957,938	7,135,160	21,594,523	21,967,339	22,358,153	22,738,193	23,156,891	23,596,905	24,059,995	24,546,307	25,057,431
Total Cost per Ton for Residential Waste	27.08	27.42	27.79	83.13	83.57	84.06	84.63	85.33	86.08	86.88	87.75	88.68
Total Households	202,086	203,143	204,205	205,273	206,347	207,426	208,470	209,519	210,574	211,634	212,699	213,770
Number of Tons per Household	1.24	1.25	1.26	1.27	1.27	1.28	1.29	1.30	1.30	1.31	1.32	1.32
Res. Coll. Cost/Month/Household	8.10	8.51	8.93	9.38	9.85	10.34	10.86	11.40	11.97	12.57	13.20	13.86
Cost per Month per Household	10.90	11.36	11.85	18.15	18.72	19.32	19.95	20.61	21.31	22.04	22.82	23.63
Cost per Ton Including Collection	105.44	109.17	113.06	172.08	176.36	180.85	185.75	190.96	196.43	202.17	208.19	214.59

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
SCENARIO 1 TOTAL COST											
* Net MRF Cost	2,702,481	2,704,003	2,697,093	2,692,580	2,708,054	2,706,407	2,701,169	2,694,638	2,685,262	2,752,471	2,819,920
* Net Y.W. Cost	1,321,646	1,377,621	1,436,395	1,498,107	1,562,906	1,630,944	1,702,384	1,777,396	1,856,159	1,938,859	2,025,695
* Net W.T.E Cost	0	0	0	0	0	0	0	0	0	0	0
* Net L.F. Cost	29,388,681	29,856,440	30,347,587	30,863,291	31,404,780	31,973,344	32,570,336	33,197,178	66,976,708	67,667,801	68,393,448
Total Cost	33,412,808	33,938,064	34,481,075	35,053,979	35,675,740	36,310,695	36,973,888	37,669,211	71,518,129	72,359,132	73,239,064
Total Tons	718,631	728,057	737,615	747,306	754,198	763,006	771,852	780,737	789,660	798,371	807,275
Total Facilities' Cost per Ton	46.50	46.61	46.75	46.91	47.30	47.59	47.90	48.25	90.57	90.63	90.72
Total Residential Waste	285,420	288,321	291,244	294,196	297,031	299,922	302,792	305,663	308,533	310,399	313,191
Total Facilities Cost for Residential Waste	13,271,008	13,439,974	13,614,696	13,799,891	14,051,366	14,272,962	14,504,590	14,747,702	27,943,328	28,132,576	28,413,864
Transportation Cost	1,681,579	1,783,661	1,891,942	2,006,797	2,125,894	2,253,528	2,388,611	2,531,569	2,682,850	2,842,931	3,012,313
Total Cost for Residential Waste	14,952,587	15,223,635	15,506,638	15,806,687	16,177,260	16,526,491	16,893,201	17,279,270	30,626,178	30,975,507	31,426,177
Total Cost per Ton for Residential Waste	52.39	52.80	53.24	53.73	54.46	55.10	55.79	56.53	99.26	99.79	100.34
Total Households	214,846	215,927	217,014	218,106	219,203	220,306	221,414	222,527	223,646	224,770	225,899
Number of Tons per Household	1.33	1.34	1.34	1.35	1.36	1.36	1.37	1.37	1.38	1.38	1.39
Res. Coll. Cost/Month/Household	14.55	15.28	16.04	16.85	17.69	18.57	19.50	20.48	21.50	22.58	23.70
Cost per Month per Household	20.35	21.16	22.00	22.89	23.84	24.82	25.86	26.95	32.91	34.06	35.30
Cost per Ton Including Collection	183.83	190.12	196.70	203.60	211.10	218.82	226.92	235.42	286.29	295.97	305.51
SCENARIO 2 TOTAL COST											
* Net MRF Cost	2,702,481	2,704,003	2,697,093	2,692,580	2,708,054	2,706,407	2,701,169	2,694,638	2,685,262	2,752,471	2,819,920
* Net Y.W. Cost	1,321,646	1,377,621	1,436,395	1,498,107	1,562,906	1,630,944	1,702,384	1,777,396	1,856,159	1,938,859	2,025,695
* Net W.T.E Cost	44,946,901	45,972,885	47,050,169	48,181,317	49,369,022	50,616,113	51,925,558	53,300,475	54,744,138	56,259,984	57,851,623
* Net L.F. Cost	11,234,977	11,494,843	11,767,703	12,054,205	12,355,032	12,670,901	13,002,563	13,350,809	23,698,511	24,082,451	24,485,589
Total Cost	60,206,006	61,549,353	62,951,360	64,426,210	65,995,014	67,624,365	69,331,673	71,123,317	82,984,070	85,033,766	87,182,827
Total Tons	718,631	728,057	737,615	747,306	754,198	763,006	771,852	780,737	789,660	798,371	807,275
Total Facilities' Cost per Ton	83.78	84.54	85.34	86.21	87.50	88.63	89.83	91.10	105.09	106.51	108.00
Total Residential Waste	285,420	288,321	291,244	294,196	297,051	299,922	302,792	305,663	308,533	310,399	313,191
Total Facilities Cost for Residential Waste	23,912,817	24,374,451	24,856,059	25,363,017	25,993,017	26,581,701	27,198,316	27,845,167	32,423,262	33,060,359	33,823,493
Transportation Cost	1,681,579	1,783,661	1,891,942	2,006,797	2,125,894	2,253,528	2,388,611	2,531,569	2,682,850	2,842,931	3,012,313
Total Cost for Residential Waste	25,594,396	26,158,112	26,748,001	27,369,813	28,118,911	28,835,229	29,586,927	30,376,735	35,106,113	35,903,291	36,835,806
Total Cost per Ton for Residential Waste	89.67	90.73	91.84	93.03	94.66	96.14	97.71	99.38	113.78	115.67	117.61
Total Households	214,846	215,927	217,014	218,106	219,203	220,306	221,414	222,327	223,646	224,770	225,899
Number of Tons p[illegible] Household	1.33	1.34	1.34	1.35	1.36	1.36	1.37	1.37	1.38	1.38	1.39
Res. Coll. Cost[illegible]/Household	14.55	15.28	16.04	16.85	[illegible]7.69	18.57	19.50	20.48	21.50	22.58	23.70
Cost per Month p[illegible] Household	24.48	25.38	26.32	27.30	[illegible]8.38	29.48	30.64	31.85	34.58	35.89	37.29
Cost per Ton Inclu[illegible] Collection	221.12	228.05	235.30	242.90	[illegible]	259.86	268.84	278.27	300.81	311.84	322.79

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
SCENARIO 3 TOTAL COST										
# Net MRF Cost	2,704,003	2,697,093	2,692,580	2,708,054	2,706,407	2,701,169	2,694,638	2,685,262	2,752,471	2,819,920
# Net Y.W. Cost	1,377,621	1,436,395	1,498,107	1,562,906	1,630,944	1,702,384	1,777,396	1,856,159	1,938,859	2,025,695
# Net W.T.E Cost	59,594,729	61,020,400	62,517,354	64,089,156	65,739,548	67,472,460	69,292,017	71,202,553	73,208,615	75,314,980
# Net L.F. Cost	11,494,843	11,767,703	12,054,205	12,355,032	12,670,901	13,002,563	13,350,809	23,698,511	24,082,451	24,485,589
Total Cost	75,171,196	76,921,591	78,762,247	80,715,148	82,747,800	84,878,576	87,114,860	99,442,484	101,982,396	104,646,184
Total Tons	728,057	737,615	747,306	754,198	763,006	771,852	780,737	789,660	798,371	807,275
Total Facilities' Cost per Ton	103.25	104.28	105.39	107.02	108.45	109.97	111.58	125.93	127.74	129.63
Total Residential Waste	288,321	291,244	294,196	297,051	299,922	302,792	305,663	308,533	310,399	313,191
Total Facilities Cost for Residential Waste	29,768,902	30,372,141	31,006,762	31,790,738	32,526,402	33,297,254	34,105,943	38,853,840	39,649,834	40,598,585
Transportation Cost	1,878,669	1,992,506	2,113,258	2,238,595	2,372,805	2,514,817	2,665,121	2,824,142	2,993,374	3,172,440
Total Cost for Residential Waste	31,647,571	32,364,647	33,120,020	34,029,332	34,899,207	35,812,070	36,771,063	41,677,982	42,643,208	43,771,026
Total Cost per Ton for Residential Waste	109.76	111.13	112.58	114.56	116.36	118.27	120.30	135.08	137.38	139.76
Total Households	215,927	217,014	218,106	219,203	220,306	221,414	222,527	223,646	224,770	225,899
Number of Tons per Household	1.34	1.34	1.35	1.36	1.36	1.37	1.37	1.38	1.38	1.39
Res. Coll. Cost/Month/Household	15.28	16.04	16.85	17.69	18.57	19.50	20.48	21.50	22.58	23.70
Cost per Month per Household	27.49	28.47	29.50	30.63	31.77	32.98	34.25	37.03	38.39	39.85
Cost per Ton Including Collection	247.09	254.58	262.45	271.19	280.07	289.40	299.19	322.11	333.56	344.93

TABLE V-7

PROJECTED DISPOSAL COSTS FOR SCENARIO 3

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
SCENARIO 3 TOTAL COST													
* Net MRF Cost	2,541,662	2,558,858	2,575,682	2,592,082	2,607,975	2,623,074	2,643,301	2,657,635	2,669,540	2,681,254	2,690,273	2,697,548	2,702,481
* Net Y.W. Cost	825,524	856,693	889,421	923,785	959,867	997,753	1,037,533	1,079,303	1,123,161	1,169,212	1,217,565	1,268,336	1,321,646
* Net W.T.E Cost	0	0	0	48,586,077	49,461,315	50,380,315	51,345,266	52,358,463	53,422,321	54,539,371	55,712,274	56,943,822	58,236,947
* Net L.F. Cost	11,246,969	11,507,435	11,780,924	9,387,896	9,555,408	9,731,296	9,915,977	10,109,894	10,313,505	10,527,298	10,751,780	10,987,486	11,234,977
Total Cost	14,614,156	14,922,987	15,246,026	61,489,840	62,584,565	63,732,438	64,942,078	66,205,294	67,528,527	68,917,134	70,371,892	71,897,192	73,496,052
Total Tons	614,132	622,315	630,609	639,016	647,536	656,173	664,730	673,407	682,203	691,122	700,166	709,334	718,631
Total Facilities' Cost per Ton	23.80	23.98	24.18	96.23	96.65	97.13	97.70	98.31	98.99	99.72	100.51	101.36	102.27
Total Residential Waste	250,753	253,726	256,733	259,777	262,856	265,973	268,669	271,392	274,143	276,922	279,729	282,564	285,428
Total Facilities Cost for Residential Waste	5,967,025	6,084,285	6,206,957	24,997,257	25,405,149	25,833,259	26,248,081	26,681,622	27,136,279	27,613,987	28,114,828	28,640,316	29,191,401
Transportation Cost	867,306	921,351	978,778	1,039,771	1,104,575	1,173,430	1,244,528	1,319,938	1,399,919	1,484,753	1,574,725	1,670,143	1,771,343
Total Cost for Residential Waste	6,834,331	7,005,636	7,185,735	26,037,028	26,509,724	27,006,689	27,492,610	28,001,560	28,536,198	29,098,740	29,689,553	30,310,460	30,962,743
Total Cost per Ton for Residential Waste	27.26	27.61	27.99	100.23	100.85	101.54	102.33	103.18	104.09	105.08	106.14	107.27	108.48
Total Households	202,086	203,143	204,205	205,273	206,347	207,426	208,470	209,519	210,574	211,634	212,699	213,770	214,846
Number of Tons per Household	1.24	1.25	1.26	1.27	1.27	1.28	1.29	1.30	1.30	1.31	1.32	1.32	1.33
Res. Coll. Cost/Month/Household	8.10	8.51	8.93	9.38	9.85	10.34	10.86	11.40	11.97	12.57	13.20	13.86	14.55
Cost per Month per Household	10.92	11.38	11.87	19.95	20.56	21.19	21.85	22.54	23.27	24.03	24.83	25.68	26.56
Cost per Ton Including Collection	105.62	109.36	113.26	189.18	193.64	198.33	203.44	208.81	214.45	220.37	226.58	233.09	239.92

Several adjustments have been made to account for the three years transition period during which the waste-to-energy facilities would be under construction in scenarios 2 and 3, and the 96 acre landfill would be accepting all wastes. This is accounted for by adjusting the first three years of operation and maintenance costs for the 96 acre landfill to be the same as the operation and maintenance costs for the same period for the 201 acre landfill in Scenario 1. An additional adjustment is required for the last three years of costs for the 201 acre landfill in Scenario 1. This is done by escalating the fixed costs in Scenario 1 by the inflation which would have ensued over the 20 year period in order to put in place an equivalent sized landfill at that point in time. This would essentially mean siting a landfill in the year 2012 which would be the same size as the landfill sited in 1992 and would satisfy the same federal requirements. Those costs are, therefore, consistent with the new proposed federal regulations, but not with regulations which may be put in place in the next 20 years. The appendix contains the projections for all of the scenarios which support the summary and figures contained in this section.

E. EVALUATION OF EACH OF THREE SCENARIOS

The options, or scenarios, examined in this report require evaluation according to a set of eight criteria that have been established between the Illinois Environmental Protection Agency and the Counties. Each of the three scenarios contain common elements which have been incorporated into the cost analysis of this Section of the report but do not affect the relative costs or ranking of the scenarios. Therefore, except for the discussion on hierarchy, the common elements are not discussed in detail. The common elements of the preferred waste management system include those reduction at the source recommendations in Section II which are accepted and implemented by the Counties; the materials recovery facility and associated programs instituted to collect and transport recyclable materials and/or recyclable fractions of the solid waste stream to that facility; and the yard waste composting facility and associated programs to collect and transport compostible materials to that facility.

1. Hierarchy

The Illinois Solid Waste Management Act of 1986 established the State's commitment to address solid waste handling according to the following solid waste management hierarchy: 1) Volume reduction at the source; 2) Recycling and reuse; 3) Incineration with energy recovery; 4) Incineration for volume reduction; and 5) Landfilling.

It is the common elements of each of the three scenarios which score the highest with regard to the State's hierarchy. The reduction at the source program that will be instituted by the Counties is at the top of the hierarchy and corresponds to the order of the discussion in this report (Section II, Reduction at the Source being the first technical discussion). It should be noted that this is presently estimated as accounting for 9.1% of the waste stream in 1995.

The materials recovery facility (MRF), the yard waste composting facility and their associated collection and transportation programs are ranked second in the hierarchy as the MRF is the recycling component and the composting facility is the reuse component. The waste handled at these facilities is estimated as 14.3% of the waste stream in 1995.

Scenario 1 which contains the 201 acre landfill scores lowest with regard to the hierarchy since it relies on the lowest ranking solid waste disposal technique in the hierarchy for disposal of 84% of the solid waste flow. Scenarios 2 and 3 rank considerably higher since they both incorporate the third highest alternative element of the hierarchy-- incineration with energy recovery. The net waste (tons of solid waste incinerated less ash generated) incinerated in 1995 is estimated to be 45.9% of the total solid waste stream.

To rank each of the scenarios on the basis of their performance with respect to the hierarchy, composite scores have been calculated by multiplying the percentage of the waste stream in each scenario which is "handled" by respective hierarchy techniques and summing the scores. (The lower the composite score, the better the performance, given that hierarchy position "1" equates to volume reduction at the source, the most preferred technique.) Composite scores for 1995 are:

Scenario 1

% Waste Stream		Hierarchy Position		Score
9.1%	x	1	=	0.091
14.3%	x	2	=	0.286
76.6%	x	5	=	3.830
		Composite Score		4.207

Scenario 2 and 3

% Waste Stream		Hierarchy Position		Score
9.1%	x	1	=	0.091
14.3%	x	2	=	0.286
45.9%	x	3	=	1.377
30.7%	x	5	=	1.535
		Composite Score		3.289

to implement the plan does exist, however, additional effort will be required to put in place a management structure to carry out the implementation of the programs and facilities required which are discussed in detail in Section VI of this report.

Table V-8 presents the range of capabilities of local and special units of government to provide for solid waste management services. The applicable special units of government considered for purposes of this study include the Bi-State Development Agency, the Southwestern Illinois Development Authority, Joint Action Agencies, and a three County Solid Waste District.

a. Local Units of Government

Illinois laws are very flexible in extending the powers needed by local government to deal with solid waste management. All units of local government have the ability to provide or contract for solid waste management services and may establish fees for such services. Further, all units of local government are able to incur debt in the form of revenue bonds to provide services and establish facilities. However, only cities, villages and townships are able to levy a property tax to pay for such services and are permitted the ability to issue general obligation bonds. While counties are directly excluded from this possibility, county building commissions may be in a position to issue general obligation bonds for solid waste management projects and facilities.

b. Special Units of Government

(1) Bi-State Development Agency

The Bi-State Development Agency, created in 1949 by interstate compact between Missouri and Illinois, has broad authority under its enabling legislation to plan, design, construct and operate waste management and resource recovery facilities of all types and capabilities. In order to finance these facilities, Bi-State can borrow money and issue bonds, notes or other financing instruments which are payable out of revenues. These financial instruments shall have a maturity date not to exceed 30 years, bear interest at a rate not exceeding 14 percent per annum, and not be sold for less than 95 percent of par value. A mortgage or deed of trust against any Bi-State property may also be secured.

Bi-State may establish contracts and lease agreements to carry out solid waste management services and may charge and collect fees for use of facilities owned and operated by it. However, Bi-State cannot levy taxes.

Bi-State is governed by a ten member Board, five of whom are resident voters of the State of Missouri and five are resident voters of the State of Illinois. The members are appointed by the Governors of Missouri and Illinois and confirmed by the Senate in each State.

TABLE V-8

ABILITY TO LEVY TAXES, ESTABLISH CHARGES AND INCUR DEBT TO PROVIDE FOR SOLID WASTE MANAGEMENT SERVICES

Management Structure	Levy Taxes	Establish Charges	Bonding Revenue	Bonding G.O.
County	No	Yes	Yes	Yes
City	Yes	Yes	Yes	Yes
Village	Yes	Yes	Yes	Yes
Township	Yes	Yes	Yes	Yes
Special Units of Government				
Bi-State Development Agency	No	Yes	Yes	No
Southwestern Illinois Development Authority	No	Yes	Yes	No
Joint Action Agency	No	Yes	Yes	No
Solid Waste District	Yes	Yes	Yes	Yes

(2) Southwestern Illinois Development Authority

The Southwestern Illinois Development Authority was created under P.A. 85-591 by the General Assembly in 1987 as a political subdivision, body politic and municipal corporation. Its purpose is to promote development in Madison and St. Clair Counties. The Authority has broad powers to provide and contract for services which directly or indirectly impact economic development in southwestern Illinois. The Authority can issue revenue bonds for projects relating to those services including solid waste management projects and may establish contracts, lease or loan agreements with any person or corporation to carry out eligible projects or services. The Authority may enter into intergovernmental agreements with the Counties of Madison and St. Clair, however, it cannot levy taxes.

The Authority is governed by a ten member Board. The Directors of the Illinois Departments of Commerce and Community Affairs and Central Management Services serve as two Ex-Officio members of the Board. Four public members are appointed by the Governor with the consent of the Senate, and two each are appointed by the County Board Chairmen of Madison and St. Clair Counties.

(3) Joint Action Agency

Local municipalities are authorized to coorperate in the performance of their responsibilities under the Intergovernmental Cooperation Act. By intergovernmental agreement, any two or more municipalities may establish a joint Action Agency to provide for solid waste management services. The Agency would be a municipal corporation which has the power to provide and contract for services and may issue revenue bonds. The Agency could not, however, levy taxes.

The governing body of a Municipal Joint Action Agency would be a Board of Directors made up of one Director from each municipality. The appointment of Directors would be by ordinance of the corporate authorities of member municipalities.

(4) Solid Waste Disposal District

Under the Solid Waste Disposal District Act, not less than 1% of the voters in any county may petition the court to order the question to be submitted to voters whether a Solid Waste District shall be organized. Districts may be organized which embrace more than one county (but not more than 5 adjoining counties).

The District has the power to levy taxes on property at a rate not exceeding .05% of the equalized assessed valuation. The District can also charge and collect fees for services, issue tax anticipation warrants, and issue and sell bonds.

The District is governed by a Board of Trustees. Should the District enbrace three counties, the Board shall consist of five Trustees. One Trustee shall be a resident of the County with the smallest population and each of the other Counties shall have two resident Trustees. Trustees must be qualified voters in the District who do not hold any other public office and are not officers of any political party. Trustees are appointed by the presiding officer of the County Board with the advice and consent of the Board.

Given the complexity of implementing a plan for solid waste management in the three County area, the most workable mechanism for accomplishing the task would appear to be the formation of a Solid Waste District. It is the one special unit of government which possesses the same ability as local governments to finance solid waste management systems and facilities, and the one unit of government specifically and solely enabled to deal with solid waste management.

6. Technical Feasibility

All three scenarios are technically feasible. This conclusion is supported by the discussions in Sections II, III and IV of this report.

7. Environmental Effects

The environmental effects of each component of the non-landfill facilities and programs have been discussed in Sections II, III, and IV of this report. Overall, Scenario 1 will use far greater scarce land resources than either Scenario 2 or 3. Scenario 3 will require a few more acres than Scenario 2 due to the siting requirements for three separate locations.

Air impacts will be greater in Scenario 2 than Scenario 3. In Scenario 3, the air impact is lessened because it is dispersed over three sites whereas Scenario 2 concentrates the emissions at one location.

Other environmental impacts for each of the scenarios are compared and presented in Exhibit V-1. These impacts merely are noted and have not been weighted with respect to significance.

An additional note on environmental effects can be inferred from a close reading of "Managing Municipal Solid Waste: A Comparative Risk Analysis of Landfill and Resource Recovery Facilities," November 1988, ESRG Report No. 87-103, Energy Systems Research Group, Inc. On pages iv and v of that report, cancer risks are estimated from controlled landfills and resource recovery facilities. The conclusion is that the risk to the exposed population is roughtly comparable. Thus, in the context of this study, since the areal extent of the facility in Scenario 1 is so much larger, the exposed population, and therefore the risk, is likely to be greater than that in Scenarios 2 and 3.

EXHIBIT V-1

ENVIRONMENTAL IMPACTS OF SCENARIOS

	Scenario 1	Scenario 2	Scenario 3
Air quality at or near ground level	+	=	=
Air quality above ground level (>500 ft)	-	+	=
Organic emissions	++	=	=
Ground water	+	=	=
Traffic	=	=	+
Land use	++	-	=
Noise	=	=	=
Litter	++	=	=
Explosion	+	=	=
Vectors of disease	+	=	=
Road Fogging/Icing	-	=	=
Water consumption	-	=	=
Odors	+	=	=
Dust	+	=	=
Aesthetic degradation	+	-	=

++ Far greater impact than the other scenarios
\+ Greater impact than the other scenarios
= Either the same as one or two of the other scenarios or between the other two scenarios
\- Less than the other scenarios

8. Liabilities to Counties

The possible liabilities to the Counties for facilities established under this plan are as follows:

a. Superfund liability under CERCLA if contamination of groundwater occurs (Scenario 1 has the greatest potential)

b. Fines and/or shutdown under State Clean Air Act if the facilities exceed emission limits (Scenario 2 and 3)

c. OSHA (Scenario 2 and 3)

d. Risk of Methane Migration/explosions into neighboring properties (Scenario 1)

e. Nuisance complains including noise, odors, vectors and so forth (Scenario 1 greatest risk overall, although Scenario 3 has more truck traffic than 1 or 2 because of trucking ash to the central landfill and trucks cause the most noise and nuisance.)

VI. RECOMMENDATIONS FOR ADOPTION AND IMPLEMENTATION

The results of the feasibility study of the preferred solid waste management system are described in this section and recommendations concerning the implementation of the plan are made. The process to be followed by Madison, Monroe and St. Clair Counties to adopt the plan, and the timetable associated with plan implementation, are detailed. Lastly, required local and State legislative initiatives to help insure the success of plan implementation are suggested.

A. RECOMMENDED PLAN

The components of the recommended plan for implementation by the three Counties include strategies to be adopted to achieve volume reduction of waste at the source, the required county-wide recycling and reuse programs and facilities, a viable waste-to-energy element and a state-of-the-art landfill to handle both ash and by-pass waste. Recommended criteria for siting are presented and a comprehensive public education program designed to assist in the implementation of the plan is detailed.

The recommendations made in this section are based, in part, on the need to address the limitations of the capacity of the existing system and satisfy State planning mandates. In addition, the recommendations presented represent the most cost effective and efficient means of satisfying the preferences of the three Counties with regard to implementation of a solid waste management system.

1. Volume Reduction at the Source

Volume reduction at the source is at the top of Illinois' hierarchy of waste management alternatives. To be successful, it will be necessary for the three Counties to pursue certain planning steps as a prerequisite to development of specific waste reduction programs.

RECOMMENDATION: Establish waste reduction goals and policies to promote those goals that are consistent with State legislation, regional and County needs, and the particular composition of the region's waste stream.

(See Ch II pg II-5)

RECOMMENDATION: Develop waste reduction assessment procedures, such as waste audits, for homes, institutions and businesses that will help establish baseline data and identify progress toward waste reduction goals.

The ability of the Counties to set goals and policies for waste reduction is limited somewhat by the fact that certain strategies may be beyond the capability of the Counties to carry out. Many initiatives, taxes and prohibitions for example, require State legislative action. (Examples include regulatory bans on plastic food containers made with chlorofluorocarbons, non-biodegradable six-pack rings, deposits on bottles and vehicle batteries; and taxation strategies including product disposal charges, litter taxes and negative pollution taxes.) The Counties should lobby for State initiatives which encourage waste reduction and should take a leadership role in establishing waste reduction programs.

RECOMMENDATION: As an example for others to follow, cities, villages, townships and the Counties should implement in-house policies and procurement guidelines to effect waste reduction and promote use of recycled materials.

RECOMMENDATION: The development of volunteer pilot community programs for waste reduction initiatives should be encouraged by the Counties. These pilot programs would include implementing waste reduction strategies in municipal government offices and selected commercial or institutional settings, and educating the public concerning the strategies to be used to promote waste reduction.

2. Recycling and Reuse

The second component of Illinois' hierarchy of waste management alternatives is recycling and reuse. The recycling element of the plan for the Counties is designed to comply with the Solid Waste Planning and Recycling Act (P.A. 85-1198) which requires that countywide programs be created and implemented following an established schedule. The program is designed so that 15 percent of municipal waste is recycled at the end of the third year and 25 percent at the end of the fifth year of the program. To administer the program, a recycling coordinator will be designated for each County. In Madison and St. Clair Counties, recycling coordinators have been named and are in the process of assisting with the implementation of recycling programs.

Potential markets for at least three recyclable materials are to be identified and provisions for the separate collection and composting of leaves and other yard waste will be made. The recycling program will also include provisions for compliance by residents and commercial/institutional firms such as incentives and penalties.

The successful implementation of a recycling program is critical to satisfying the goals of the adopted solid waste management plan of each County. To help insure the success of the recycling program, a public information and education program is a required element of the solid waste plan. Appendix B contains a description of a public education effort for the Counties recycling programs.

The implementation of the recycling program, as required in the Act, will be the primary responsibility of the County recycling coordinator. In order to reach the ambitious goal set forth in the Act to recycle 25 percent of the municipal waste by the end of the fifth program year, it will be necessary to to mount a vigorous research, planning and development effort.

Waste reduction goals and policies will be established. These goals and policies will need to be consistent with State legislation, regional needs and the particular composition of the region's waste stream. In addition, a comprehensive public education and information effort will be conducted. The tasks to be undertaken for the development and implementation of a countywide recycling program are described below.

The recycling coordinator will be responsible for coordinating all recycling program activities in each County. The coordinator will be working with members of the County Board Environment Committee, the County Health or Environment Department and the Solid Waste Task Force Advisory Committee. The coordinator will serve as liaison to the local public officials, businesses, institutions, local waste management industry, and the general public.

As part of program research and development, local governments, individuals, groups and businesses engaged in recycling activities, processing and marketing, will be identified. Volunteer and private sector drop-off and buy back centers will be promoted as a compliment to any residential recycling program and to encourage participation in recycling.

The needed components for one or more recycling centers and/or composting facilities in each County will be planned for and evaluated. The County recycling coordinator will work with cities, villages and townships to implement programs appropriate to assist in meeting the goals set for recycling. Also to be considered will be participation by the County in the development, the construction and operation of these centers.

Research is to be conducted to determine what potential markets exist for recyclables and what activities may need to be undertaken to develop those markets. The Market Analysis Report developed for this study should prove useful in the development of these markets. Potential markets for a minimum of three recyclable items are to be identified.

Waste reduction assessment procedures, such as waste audits, for homes, institutions, businesses and local governments will be developed. These procedures will help establish baseline data and identify progress toward waste reduction goals.

Specialized recycling programs for the separation of corrugated cardboard and office paper will be designed and implemented with the assistance of commercial and institutional facilities in the county. Mandatory corrugated cardboard recycling initiatives (by ordinance) and/or incentives (reduced tipped fees) for source separation will be pursued to maximize recovery.

Provisions for the separate collection and composting of leaves and other yard waste will be planned and implemented. Through a strong public education program, backyard composting and mulching would be encouraged. A system for curbside yard waste collection will be developed which will utilize existing equipment and vehicles.

The feasibility of and means to provide for the payment of recycling credits to public and private parties engaged for recycling will be researched.

The recycling program will provide technical assistance to municipalities. Municipalities will be aided in the development and implementation of pilot recycling and composting projects. An objective of these projects will be to test the economic feasibility and environmental benefits of various recycling techniques. Municipalities would also be encouraged and assisted in the development of pilot waste reduction programs. These programs would include implementing waste reduction strategies in municipal government offices and selected commercial or institutional settings, and public education efforts. Assistance to obtain grants and loans from the Solid Waste Management Fund and other funding programs will also be given.

To implement a successful recycling program, the coordinator will investigate and pursue the development and enactment of appropriate municipal and County mandatory separation and flow control ordinances and provisions for compliance with recycling activities, including penalties and incentives.

The public information and education portion of the recycling program will be designed to educate and inform both local officials and the general public. The benefits of recycling and the requirements for compliance with the County program will be addressed in this effort. Through a comprehensive and ongoing publicity campaign, an awareness will be fostered that all residents have a responsibility to participate in recycling. To obtain technical assistance in the development of recycling publicity, advertising and marketing campaigns, the coordinator will work with the Illinois Department of Energy and Natural Resources.

Monitoring will be performed to measure the level of compliance with and the effectiveness of the County recycling program. The total number of tons of recycled materials by type will be annually documented for individual and specialized recycling programs in operation in the County.

RECOMMENDATION: Each city, village or township should have a recycling program to meet the 25 percent State recycling goal. Cities, villages or townships could accomplish the goal with joint venture programs, which may include the building of a materials recovery facility or facilities.

The collection of residential recyclable materials at the curbside offers convenience to users, direct access to recoverable waste by the collectors and helps to maximize participation and support from the public. Providing home storage containers for recyclables also can improve participation in the program significantly. Containers afford residents ease in storing and setting out recyclables. The container is a visual reminder to recycle. For collectors, if containers are uniform, it is easy to differentiate the recyclables from other trash set out at the curb. Use of certain types of containers may make it easier for the collector to do a modified sort at the curbside as is recommended. Providing containers represents a commitment by the sponsoring agency that lends credibility to the recycling program which would tend to increase participation.

RECOMMENDATION: Provide residents with home storage containers for storage of commingled recyclables. The containers would be provided by the collectors and would be of such design that curbside separation is enhanced.

Drop-off and buy-back recycling centers already exist in the three County area and continuation of these programs is both expected and appropriate in addition to curbside collection of recyclables. Some of the programs are volunteer and community service based, others are operated by collectors in the recycling "business." Buy-back programs improve overall program participation by providing a cash incentive to recycle.

RECOMMENDATION: Promote volunteer and private sector drop-off and buy back centers as a complement to the curbside program and to encourage maximum overall participation by the public in recycling.

Yard waste composting, while a required element of a County recycling program, is an attractive strategy for managing solid waste for several reasons. First, the market for the end product is the local resident who may have a need for compost, or mulch. Second, yard waste is easily separable from other waste and represents a significant portion of the waste stream. Third, a yard waste composting system is less costly and complicated to develop than many other waste management strategies.

The simplest, cheapest and most easily implemented alternative for managing yard waste is to promote backyard composting and mulching. Both are methods of processing yard waste at the point of generation, rather than transporting waste to a different location for processing. All collection, processing and distribution costs are avoided.

RECOMMENDATION: Backyard composting should be encouraged as a waste management technique through a strong public education program informing residents about the benefits of composting and the methods to use to handle yard waste.

Backyard composting cannot be expected to bear the entire burden of recycling of 56% of compostable yard wastes, which is the goal set forth in this plan. Yard waste collection and recycling programs in each of the three Counties should be established to help attain the goal.

RECOMMENDATION: Each city, village or township individually should update local waste contracts to include yard waste pick-up for composting.

Collection methods for yard waste are similar to those for recyclable materials, primarily curbside and drop-off. A drop-off system cannot be expected to generate the volumes obtained from a curbside collection program despite the ban of yard wastes from landfills.

RECOMMENDATION: Establish a system of curbside yard waste collection. The preferred approach would be to use existing equipment, such as vehicles used for bulky item collection or compaction-type vehicles, for bagged waste collection. This would minimize the capital and operating costs for yard waste collection. This should be done in each city, village or township and coordinated by the County.

Collection of recyclables from the commercial waste stream is also an important factor in meeting the 15 percent goal for year three of the recycling program and the 25 percent goal for year five of the program. While industry typically recovers and recycles much of its preconsumer scrap, recovery of paper products should be pursued as part of the recycling program directed specifically at the commercial sector. A significant portion of waste from commercial and retail establishments (fast food restaurants, grocery stores, shopping malls) is cardboard. Generally, if corrugated cardboard is collected separately from garbage for these businesses, the size of trash containers can be reduced, sometimes by half.

RECOMMENDATION: Establish a requirement for the separation of corrugated cardboard and office paper by commercial establishments. Mandatory corrugated cardboard recycling initiatives (by ordinance) and/or incentives (reduced tip fees) for source separation should be set to maximize recovery. This should be done in each city, village or township and coordinated by the County.

3. Waste-to-Energy

On the basis of potential energy markets examined and available waste from Madison, Monroe and St. Clair Counties, three energy technologies were identified as being viable:

Mass burn - direct combustion
Mass Burn - controlled-air (modular) incineration
Refuse-derived fuel (RDF) processing/incineration

In this report there were two waste-to-energy scenarios evaluated. In Scenario 2, a 1,500 ton per day waste-to-energy facility would be developed at a location central to the three County area. This facility was assumed to operate at an 85% availability factor and would be able to process 1,275 tons of waste per day. In Scenario 3, a 1,000 ton per day facility would be sited near the energy markets in the Granite City area and a 500 ton per day facility would be sited in, or near, Alton.

Each Scenario was evaluated against a set of criteria established by the Illinois Environmental Protection Agency. The evaluation criteria included: waste management hierarchy rank, implementation cost, disposal cost, financial feasibility, management and institutional authority, technical feasibility, environmental effects and liabilities to the three Counties.

Scenarios 2 and 3 ranked the same with regard to the hierarchy (and higher than Scenario 1 without waste-to-energy) since both incorporate the third highest alternative element of the hierarchy-- incineration with energy recovery. The net waste incinerated in 1995 is estimated to be 45.9% of the total waste stream. Both scenarios were deemed technically feasible.

Both Scenarios 2 and 3 were deemed to be financially feasible. However, implementation costs for Scenario 2, at $2,700,000, were $800,000 less expensive than for Scenario 3. Disposal costs for both scenarios were about equal, although costs for Scenario 2 were less than for Scenario 3. Capital costs for Scenario 2 total $162,322,500, while capital costs for Scenario 3 total $206,540,000.

With regard to environmental considerations, Scenario 2 will require the least scarce land resources. Traffic impacts, with two sites, would be more adverse in Scenario 3. There would also be greater aesthetic degradation with Scenario 3 given its multiple facilities.

Recognizing the complexity involved in the implementation of any waste-to-energy facility, and the difficulty in reaching agreement among the three Counties as to management structure, financing and operating arrangements, the Counties have elected to pursue a modified Scenario 3. The revised Scenario 3 would provide the necessary waste-to-energy capacity at dispersed locations which would be capable of handling the disposal requirements of the individual Counties.

RECOMMENDATION: Implementation of a revised Scenario 3 should be pursued by the three Counties with each County responsible for evaluation of the need for a waste-to-energy facility or facilities to accommodate disposal of waste generated within its boundaries, if a satisfactory agreement that is acceptable to all Counties could not be worked out.

Implementation of this recommendation would not preclude the three Counties from working out an agreement for implementation of a single, or multiple, site plan for waste-to-energy in the future. The recommendation only realistically recognizes the difficulties in working out such an agreement at this time.

4. Landfill Requirements

Additional landfill capacity required over the period of the plan will be developed as a state-of-the-art facility, or facilities, designed in accordance with all applicable standards from local, State and federal regulatory agencies.

For planning purposes, design specifications for a centrally located single site are detailed. While it is possible that only one site may be developed to accommodate the needs of the three Counties, multiple new or expanded existing sites may be developed in response to the needs of the individual Counties.

Assuming development of a single site, the landfill will be 100 feet in height and 77.83 acres in area with a 100 foot buffer zone around the perimeter. The total landfill footprint which includes the buffer zone will be 95.65 acres.

The facility will be segregated into three compartments for handling the ash residues and by-pass waste. The first compartment, sized at 18.91 acres, is to be used only for ash disposal from the waste-to-energy plant, or plants. This ash disposal compartment will be designed with a single 60 mil thick synthetic liner. The liner material could consist of synthetics ranging from hypalon to polyvinyl chloride to a high density polyethylene.

The second compartment will be for by-pass waste from the waste-to-energy plant, or plants, and any materials recovery facilities. The second compartment with a total land area of 43.48 acres, therefore, will be designed to handle municipal solid waste which will require a double synthetic liner. The two synthetic liners (each will be 60 mil in thickness) will be separated by several feet of earth fill. A leak detection system will be installed between the two liners.

The third compartment will be a 15.44 acre area for handling construction and demolition debris. This area will be lined with a compacted, low permeability soil. This single three compartment landfill as described is designed to handle the three County ash disposal and by-pass waste needs for a twenty year design period.

The landfill will contain state-of-the-art pollution control features. This facility will have an advanced leachate collection system consisting of perforated pipes placed on liner surfaces and leachate pump system which will transport the leachate to an on-site pre-treatment facility or it will be pumped directly to a near-by wastewater treatment plant capable of processing landfill leachate. This 96 acre landfill will, also, have an active methane gas management system which will collect the landfill gases for either flaring to the atmosphere or to an on-site energy recovery system.

The landfill will have a comprehensive groundwater monitoring program to insure that any site specific or near-by aquifers are not threatened. The site will have approximately ten piezometers (monitoring wells) strategically placed around the landfill perimeter. The final number of monitoring wells and their placement will be determined by a hydrogeologist. The proposed facility will have a stormwater management plan which will minimize the surface water infiltration of the landfill cells.

The environmental impact of the proposed landfill will be minimized by utilizing state-of-the-art design and operation methods. Also, the landfill will be sited in accordance with the Local Siting Process (SB 172 Process). To provide an additional environmental safeguard, the General Siting Criteria developed specifically for this project (the General Siting Criteria are found in the Appendix, page A-39) should be considered. By using the Siting Criteria, which includes a total point ranking system and which emphasizes environmental sensitive criteria, it will be possible to select the most environmentally sound and secure site for the landfill. The environmentally sensitive criteria included in the General Siting Criteria are: ground water pollution potential, traffic, leachate, gas production, odors, fires, vectors, noise, aesthetics, air pollution, dust, critical flora and fauna habitats, drainage characteristics, presence of floodplain and soil characteristics. An environmental analysis of landfill technology is contained in the Alternative Analysis Report.

5. <u>Location of Facilities</u>

In order to minimize development and transportation costs, the components of the preferred waste management system should be located together, if feasible, at a site central to Madison, Monroe and St. Clair Counties.

RECOMMENDATION: If feasible, due to the proximity of steel mills and industrial sites, a 300 to 500 ton per day waste-to-energy facility which sells electricity or steam to nearby markets should be sited in the Alton area. Similarly, in the Granite City area, a 300 to 500 ton per day waste-to-energy facility should be sited. These facilities would be intended to accommodate Madison County waste. If feasible, a 500 ton per day waste-to-energy plant should be sited in Sauget close to industrial sites serving as markets for steam or electricity. This facility would be intended to accommodate St. Clair County waste and could accept waste from Monroe County, if acceptable to both Counties.

The materials processing facility, the yard waste composting facility and a landfill for by-pass waste and ash would be located within the park. The waste-to-energy facility also could be located at the park, or, more likely, would be sited close to an industrial market if steam is a product.

To site such waste management parks, environmental, transportation and land use characteristics must be taken into consideration. Environmental characteristics would include drainage, geology and soils, and potential for disturbances from waste management operations. The adequacy of the transportation system to handle the increased volume, weight and size of vehicles associated with waste management operations would have to be evaluated. Existing land use and zoning at, and adjacent to, the park site must be a consideration also, as well as the size and extent of area needed as a buffer.

General siting criteria have been developed to allow local decision makers to evaluate sites put forward by private sector bidders in anticipation of a solicitation of proposals to develop the waste management park. These siting criteria are presented in the Appendix to this report.

6. Public Education and Information Program

A required component of the solid waste management plan development process is a program to educate and inform the public about the plan, the required recycling program and strategies to be followed to reduce waste volume at the source. The goal of the public education element is to create understanding and acceptance of the plan among local officials and the general public, and foster participation by residents in recycling and volume reduction programs. Elements of a public education program are found in Sections II and III of this report and an outline for a model program is presented in the Appendix.

RECOMMENDATION: A comprehensive program should be adopted which educates and informs local officials and the public about the plan, the required recycling program and strategies for volume reduction of waste at the source.

7. Management Structure

Given the complex nature of implementing the preferred plan for solid waste management over the three County area, it becomes necessary to address the issue of management structure at the earliest opportunity. The most workable mechanism for accomplishing the task appears to be the formation of a Solid Waste Disposal District as provided for under P.A. 76-1204.

Formation of a Solid Waste Disposal District, as a special unit of government, creates a mechanism under which the Counties can finance, build and operate needed facilities. The District also would have the power to levy taxes on property at a rate not exceeding .05% of the equalized assessed valuation. Policy control would rest with a five member Board composed of one member from Monroe County (the county with the smallest population), and two members each from Madison and St. Clair Counties.

As currently written, the Solid Waste Disposal Act would require a petition for a referendum to be submitted to the voters for the formation of a District. The Act requires a majority of those voting on the proposition in each township shall be necessary for approval of the creation of the District. Without changes in the Act, formation of the District would be extremely difficult to accomplish in the three County area.

RECOMMENDATION: The Environment Committees of Madison, Monroe and St. Clair Counties should continue to implement the solid waste management plan. A steering committee of the three Counties should be formed and should meet to provide regional coordination. The steering committee should have no taxing powers. Members would report to their respective County Boards. The committee should consist of two members from Madison County, two from St. Clair County, one from Monroe County, and the County Board Chairman from each of the Counties.

The steering committee should investigate the need for the formation of a regional Solid Waste Disposal District. If formation of a District is deemed desirable, the suitability of the current legislation governing the formation of the District should be addressed and steps should be taken to modify the Solid Waste Disposal District Act.

8. Financing

Public financing of solid waste management facilities, in particular waste-to-energy plants, is difficult to accomplish. From a financial perspective, there are numerous financial uncertainties, or risks, which must be mitigated to attract traditional bond buyers. Bond investors expect minimum risk. With regard to any proposed system, the following three issues must be carefully considered:

1. Guaranteed Revenue Flow - A guaranteed revenue flow must be demonstrated to ensure the viability of a facility over the long term. This guarantee might include contracts which state that fees will be collected even if the solid waste stream is absent or is otherwise interrupted.

2. Commitment of a Market - The market for a produced product (electricity or fuel for electricity in the case of a waste-to-energy plant) must be demonstrated.

3. Acceptable Risk Arrangements - Bond investors require certain guarantees of the return of the bond proceeds. Risk sharing arrangements among the Solid Waste District (as a special unit of government), contractor, operator and manufacturer must be structured to satisfy the investment community. Bond insurance, letters of credit, and other risk mitigating measures will be required.

It has been assumed that the capital costs of the facilities would be paid for by revenue bonds bearing an interest rate of 8 1/2 percent per annum. This interest rate would imply that the facilities would be financed with tax-exempt debt and, therefore, would be publicly owned facilities. This interest rate has been used to determine the debt service of all of the facilities. namely the yard waste composting facility, the material processing facility, the landfill and the various waste-to-energy facilities.

Financing of the waste management facilities would involve two phases: a bond feasibility study and the actual bond issuance. The bond feasibility study is a separate report that examines the specific project structure and technology to be financed. This study, which would be done by a financial consultant and an adviser familiar with waste-to-energy projects (assuming financing is being sought for such a facility), would provide an assessment as well as an opinion on the viability of the proposed project. This report would be part of the official statement on the project distributed by the investment banker to prospective bond purchasers.

RECOMMENDATION: A financial adviser and consultant familiar with waste-to-energy projects should be solicited by each of the Counties, if deemed necessary and advisable, at the time of final adoption of the preferred plan to assist with a bond study and issue.

B. REQUIRED LOCAL AND STATE LEGISLATIVE INITIATIVE

In order to implement the preferred solid waste management plan, a number of legislative initiatives need to be pursued to enable Madison, Monroe and St. Clair Counties to act to manage solid waste disposal. In some cases, only a clarification, or strengthening, of existing legislation is needed. In other cases, new legislation will be needed granting the Counties the powers necessary to carry out the plan.

RECOMMENDATION: The following broad legislative initiatives should be pursued-

- **Securing of local siting powers**
- **Strengthening flow control legislation at the County and Municipal levels**
- **Mandatory Municipal participation in the plan for solid waste management**
- **Strengthening requirements for closure and post-closure procedures including securing of financial assurance instruments**
- **Strengthening of reporting requirements regarding waste disposal volume and composition**
- **Promotion of legislation concerning source reduction measures**
- **Ordinance requiring separation of corrugated cardboard at all commercial establishments**
- **Modification of utility buy-back rates to fully take into account avoided capacity cost savings**
- **Increased grant funding for local recycling programs**
- **Promotion of use of recycled materials to stimulate markets**

C. PLAN ADOPTION PROCESS AND PROGRAM IMPLEMENTATION

The process to be followed in the adoption of the preferred solid waste management plan is outlined in the Solid Waste Planning and Recycling Act and its amendments. Because this study effort was begun before the Act became law, the process of public plan development was not strictly followed. However, the Counties will be able to satisfy the requirements of the Act by undertaking the plan adoption process described below which encompasses the full intent of the Act's public participation component.

After the Draft Preferred Waste Management System Plan is received by each County, the County is to notify all municipalities and interested members of the public that the plan has been received and that the review process has begun.

The County then will initiate a mandated 90 day public review period for the Draft Plan. The County is to submit copies of the Draft Plan to IEPA, all areawide planning agencies and the County health department for review and comment. The Draft Plan is also to be made available for public examination.

One public hearing in each County is to occur during this public review period. The County Board Chairman will set the date for the public hearing and appoint a Hearing Officer and Committee. A public notice of the hearing date is to be published three weeks before the public hearing. The Draft Plan and comments on it are to be submitted to the public record ten days before the hearing. At the public hearing, the Draft Plan will be presented, testimony given and comments accepted. For 30 days after the hearing, written comments on the Draft Plan will be accepted. These comments are to be addressed by the County and included with the final plan document.

At the end of this review period, the County Board will be presented with the Draft Plan and comments. The County Board is required to adopt the Final Preferred Waste Management System Plan within 60 days of the end of the public review period. After adoption, the County then has ten days in which to submit the Final Plan to IEPA. The deadline for submission of the Final Plan to IEPA by Madison County and St. Clair County is by March 1, 1991. In Monroe County, the Final Plan must be submitted before March 1, 1995.

IEPA has a 90 day period in which to review the Final Plan. The plan can be approved by IEPA or returned to the County with specific suggestions for revisions. If the Final Plan is returned, the County has 90 days to revise the plan, adopt it and resubmit it to IEPA. In Madison and St. Clair Counties, the Final Plan is to resubmitted to IEPA no later than September 1, 1991. The resubmission deadline for Monroe County is before September 1, 1995.

To complete the entire process for review and adoption of a Final Plan will take a minimum of six months. A timeline for the adoption process is presented in Figure VI-1. After the Final Plan is adopted, the County, or Counties, have one year in which to begin implementation.

Upon final adoption of the Plan, implementation of its various elements will take place according to the particular needs of the three Counties over the 20 year planning horizon. Initially, the Counties will continue to expand the programs each has in place. These programs, for the most part, include recycling, composting, public education and monitoring elements as have been detailed in the Plan. Counties will begin to monitor the composting and recycling programs underway in their jurisdictions and the effects of those programs on the rate at which existing landfill capacity is being used up.

PLAN ADOPTION PROCESS

Preferred Solid Waste Management Plan

MANDATORY DEADLINES	DAYS TO COMPLETION	ACTIVITY
	90 Days	PUBLIC REVIEW PERIOD
	1-60 Days	COUNTY ADOPTION
March 1, 1991	1-10 Days	SUBMIT PLAN TO IEPA
May 31, 1991	90 Days	IEPA REVIEW
	1-90 Days	COUNTY REVIEW
September 1, 1992	1-365 Days	IMPLEMENTATION

Figure VI-1

In Madison County, a recycling coordinator has been hired and the County is providing financial grant assistance to actively encourage local jurisdictions to undertake composting and recycling programs. The 1990-1991 school year will see a recycling curriculum introduced into County schools through the cooperation of the Regional Superintendent of Schools in the County. The Regional Superintendent of Schools also will receive a grant to implement a paper recycling program in County schools. One percent of the paper purchased by Madison County during the next fiscal year will be recycled paper.

In St. Clair County, a recycling coordinator has been hired and the County is actively encouraging recycling and composting programs. An extensive public information program has been undertaken by the County and in particular through the efforts of Proud Partners, Inc., an arm of the economic development organization Belleville Economic Progress. Monroe County, recycling and composting programs are being encouraged through municipalities.

Table VI-1 lists the current programs underway in various jurisdictions throughout the three County area.

Three years after final adoption of the Plan, there will be an assessment of the adequacy of remaining landfill capacity and whether or not the goal of recycling 15 percent of municipal waste has been met. At that time, the need to expand landfill capacity in the various jurisdictions will be determined and needed adjustments in recycling and composting programs will be determined. It is anticipated that as recycling and composting programs become more widespread and successful, some change in the manner in which programs are operated may be warranted due to economies of scale. Perhaps programs which had been independent would elect to combine in joint ventures or existing solid waste management facility operators or haulers specializing in particular programs might offer more economical centralized program operation for composting or recycling.

Five years after final adoption of the Plan, there will be a second assessment of the adequacy of remaining landfill capacity and, at this time, whether or not the goal of recycling 25 percent of municipal waste is being met. The need for additional landfill capacity and the need to modify composting and recycling programs will be determined. At this point, the construction of a materials recovery, composting and waste-to-energy facility, or facilities, will be considered.

The decision concerning whether to construct such facilities, siting and the operating plans will be based on an assessment by each County of the need to bring such projects online. The decision could be for a single County, or two Counties, to independently undertake such a project, or projects, or to jointly act as a three County consortium.

Table VI-1

Recycling and Composting Programs
Current and Planned

Madison County

Jurisdiction	Program	Funding*	Status
Edwardsville	Recycle (C)	$11,000	Operating
Glen Carbon	Recycle (C)	$11,000	Operating
Collinsville	Recycle (C)	$11,000	Start 5-1-90
Bethalto	Recycle (C), Apartment	$ 6,488	Start 5-1-90
Madison	Recycle (C)		Start 7-1-90
Wood River	Recycle (C)		Start 7-1-90
St. Jacob	Recycle (C)	$ 3,952	Start 7-1-90
Livingston	Recycle (C)	$ 5,000	Planning
Alhambra	Recycle (D)	$ 3,000	Planning
Highland	Composting	$10,933	Planning
Alton	Composting	$11,000	Planning
Maryville	Recycle		Planning
Troy	Recycle (C)		Planning
Godfrey, Moro & Foster Twshp	Recycle (C)		Planning
Pontoon Beach	Recycle (C)		Planning
Roxana	Recycle (C)		Planning
S. Roxana	Recycle (C)		Planning
Hamel	Recycle (D)		Planning
Marine	Recycle (C)		Planning
New Douglas	Recycle (D)		Planning

St. Clair County

Jurisdiction	Program	Funding	Status
Millstadt	Recycle (C)		Operating
Mascoutah	Recycle (C)		Operating
Belleville	Recycle (C)		Planning

Monroe County

Jurisdiction	Program	Funding	Status
Columbia	Recycle (D)		Operating

* Grant assistance through the County
(C) Curbside Recycling Program
(D) Drop-off Recycling Program

Once a decision is made to undertake either an expansion of landfill capacity, or construction of a materials recovery, composting or waste-to-energy facility by one or more Counties, the schedule for implementation will generally follow that outlined in Figures VI-2, VI-3, VI-4, VI-5 and VI-6. The timetable would be the same whether the facilities were being implemented by a single County or a joint venture of two or more Counties.

It is anticipated that all proposed waste handling facilities would be constructed under public/private agreements and partnerships. In this manner, the expertise of waste management companies currently operating in the three County area could be taken advantage of and integrated into the local governments' desire for public management and control.

Figur -2

Landfill Implementation Schedule

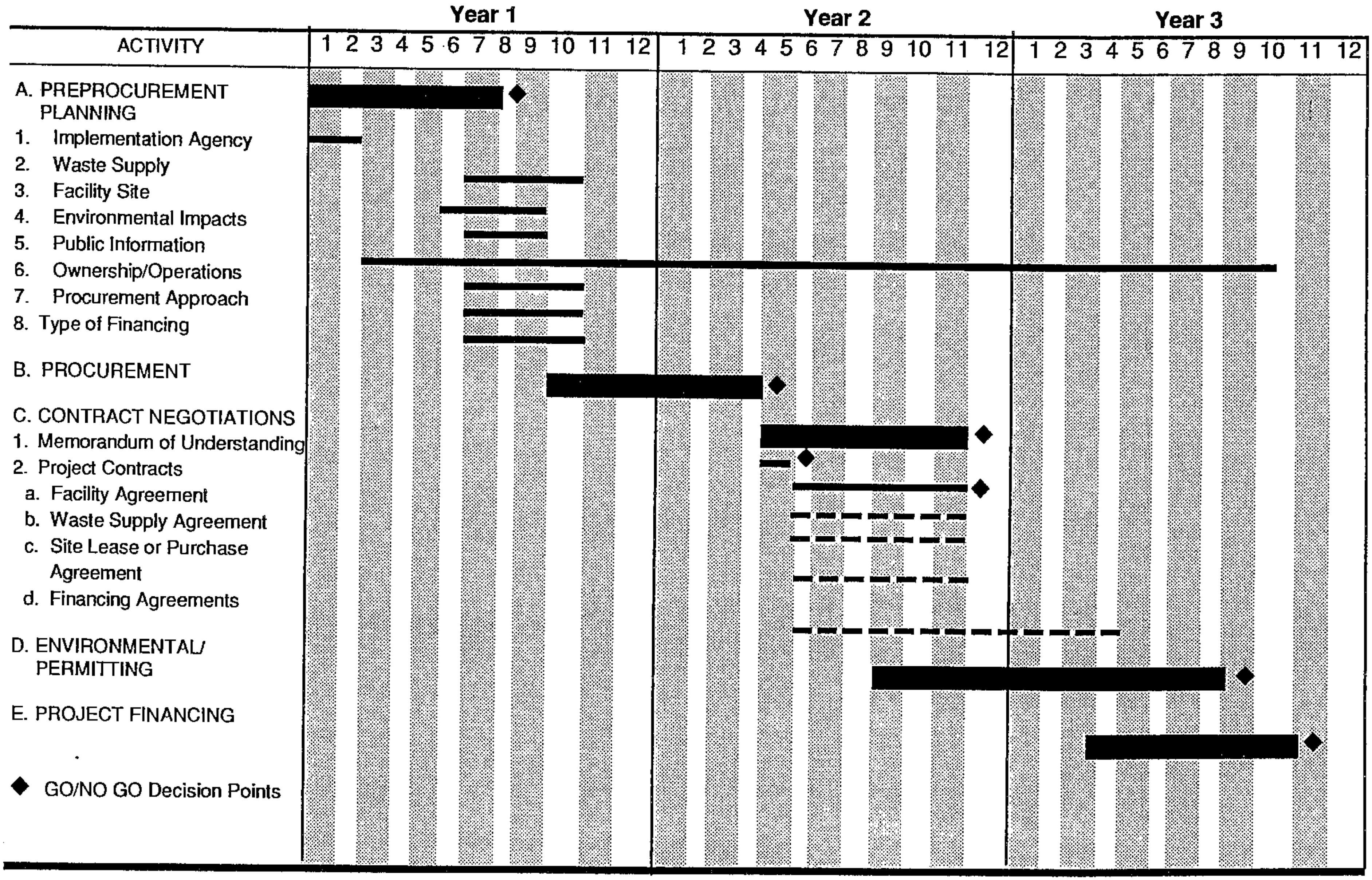


Figure VI-3

Material Recovery Facility Implementation Schedule

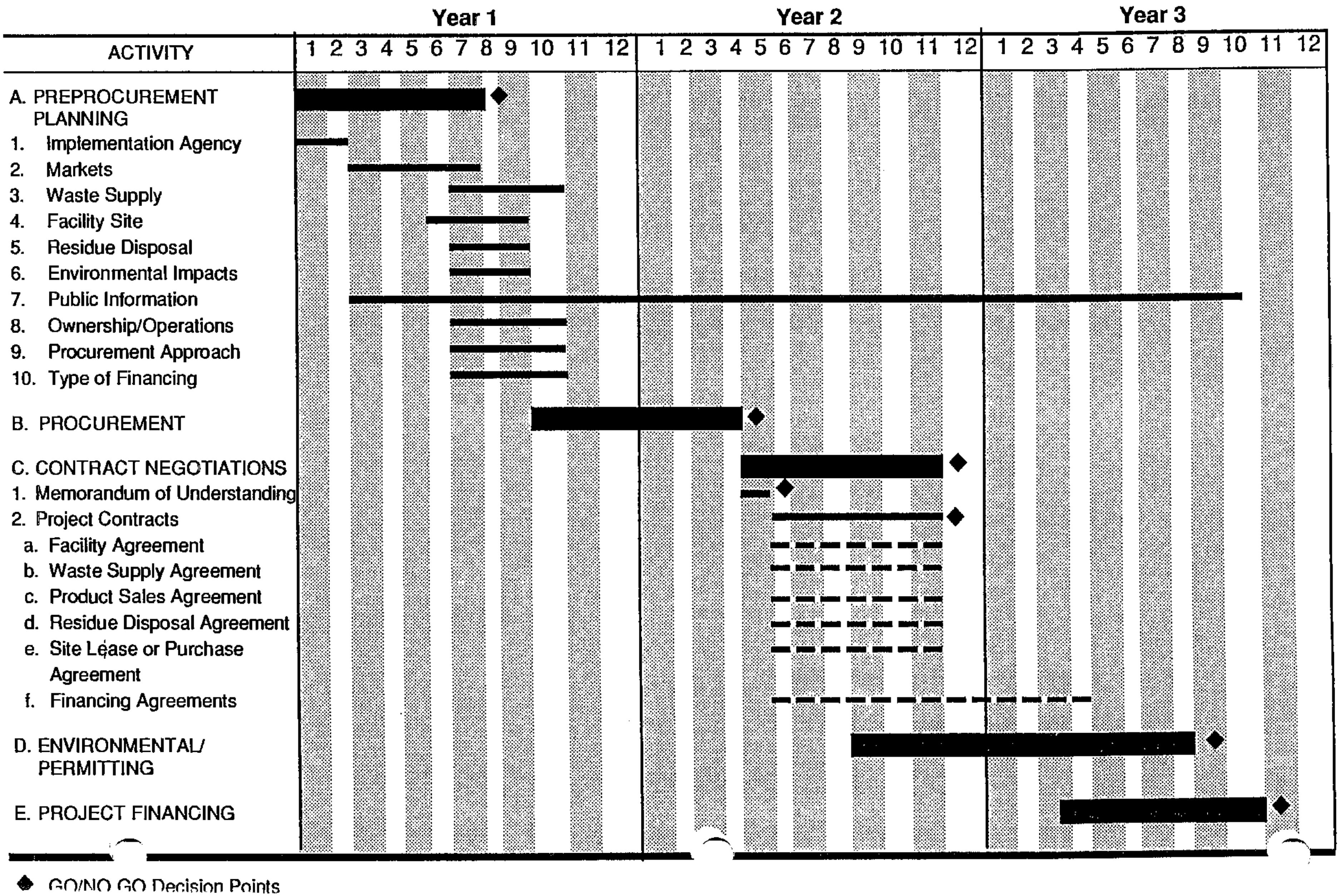
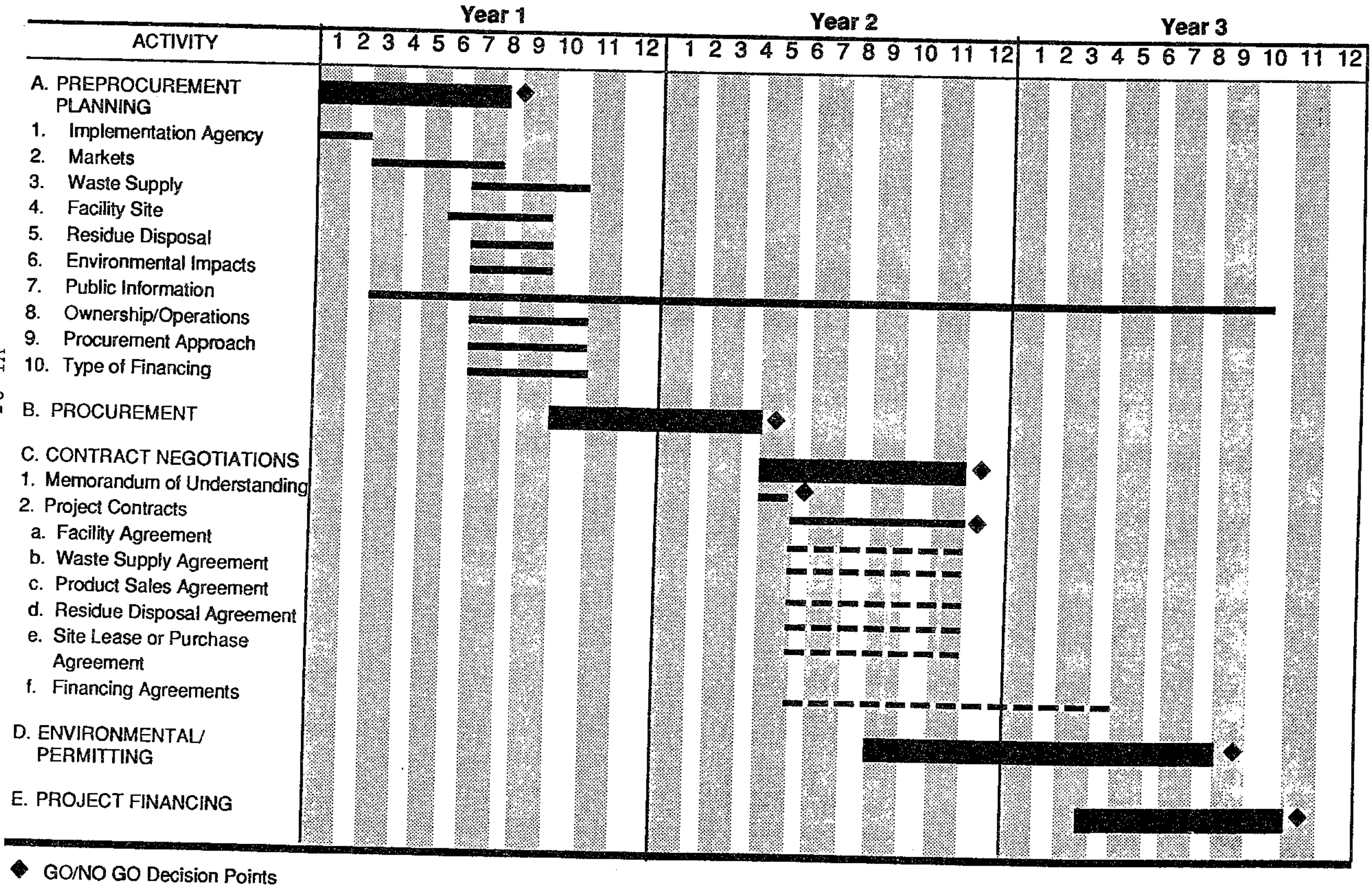


Figure V

Implementation Schedule



Figur(-4

Composting Implementation Schedule

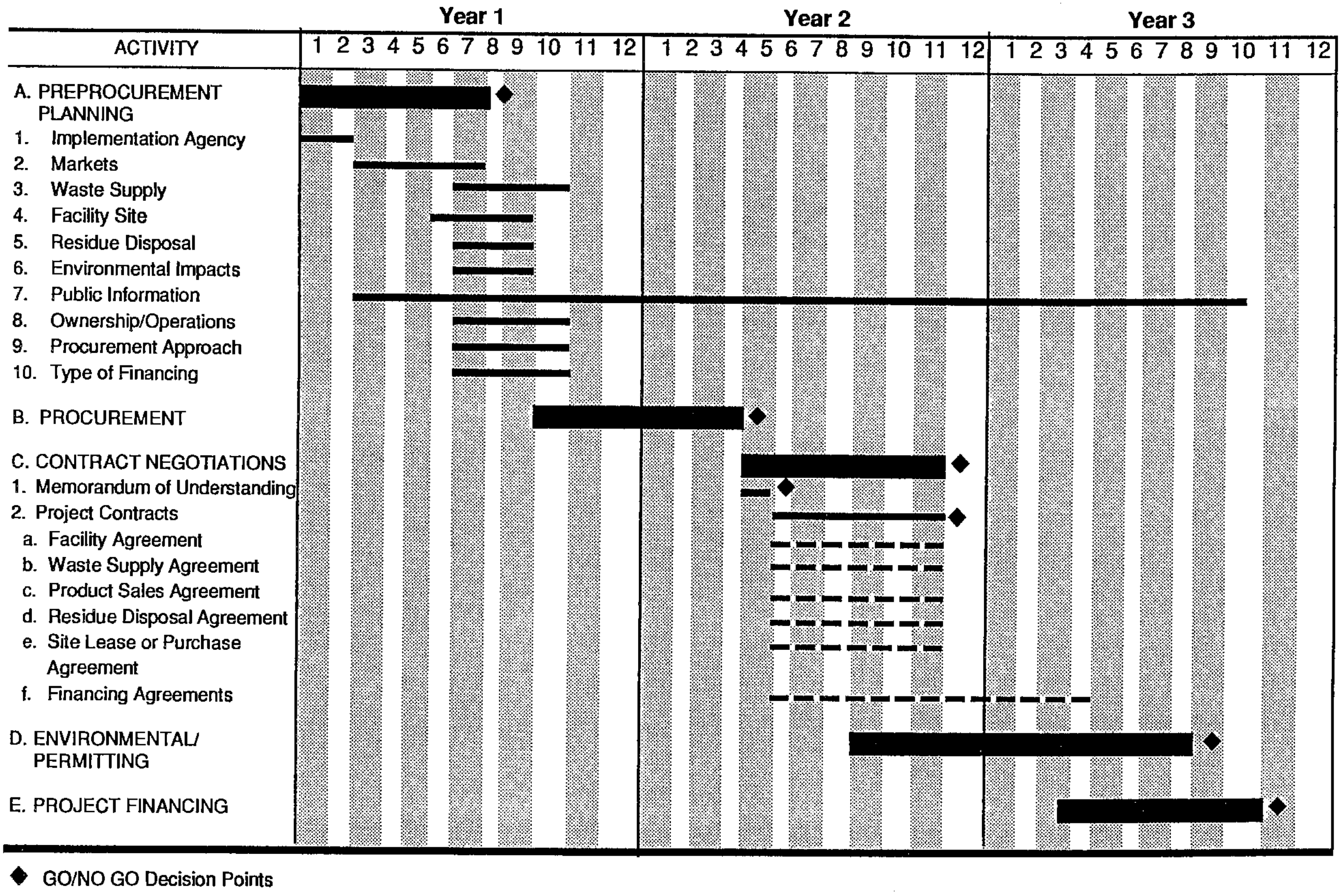
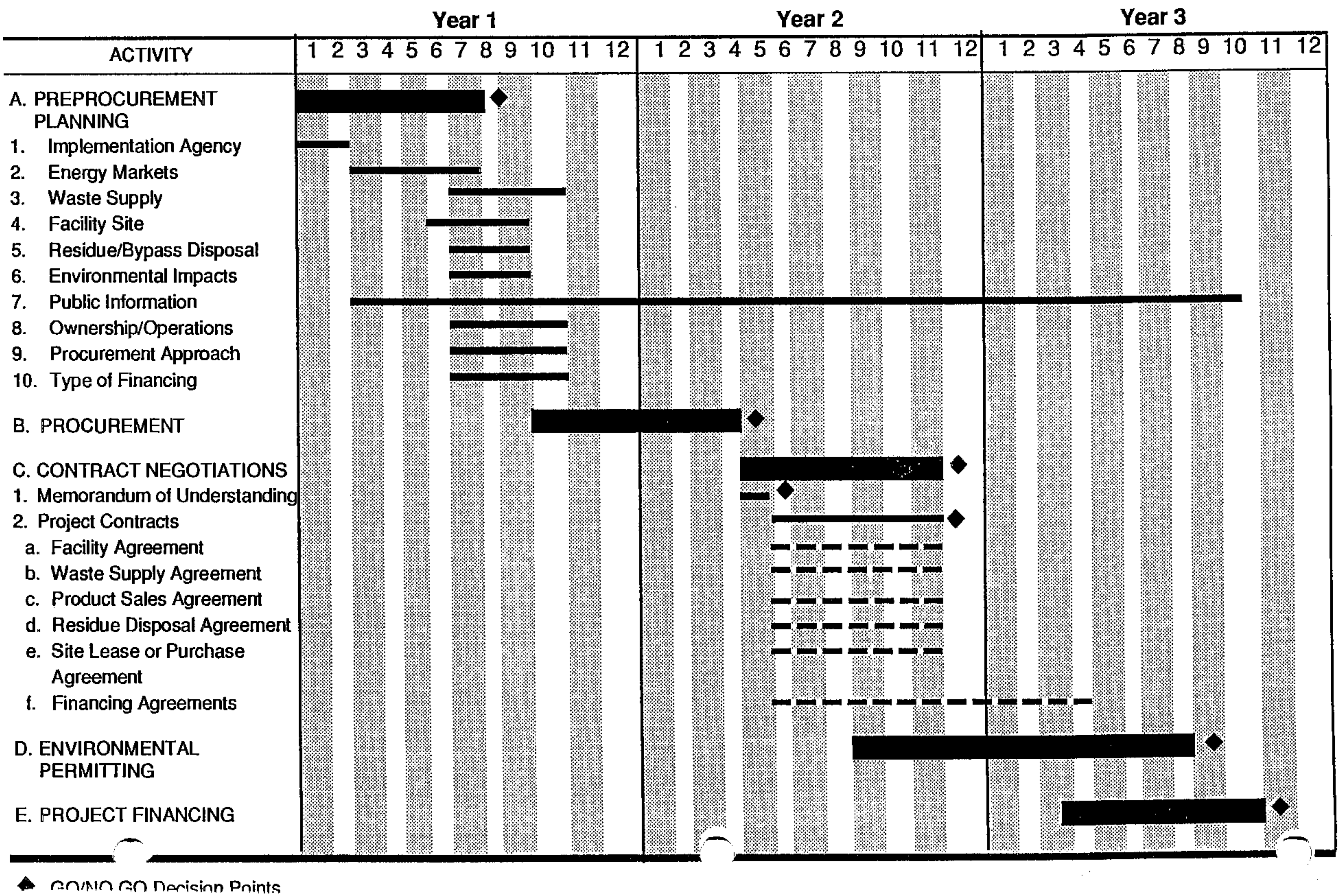


Figure VI-5

Waste-to-Energy Implementation Schedule



APPENDIX

I. ECONOMIC PROJECTIONS FOR PREFERRED SYSTEM ALTERNATIVE

A. SYSTEM ALTERNATIVES COST ANALYSIS

1. Landfill Cost Analysis

LANDFILL ANALYSIS	
SIZING - landfill with W-T-E	
height (feet) =	100
l' = 3h + SQRT((v/h) - (3h^2)) (yards)	614
area of landfill (square yards) =	376,478
feet per mile =	5,280
square feet/mile =	27,878,400
acres per square mile =	640
square feet per acre =	43,560
square yards per acre =	4,840
area of landfill (acres) =	77.83
total area of landfill w/100' buffer (square yards)	462,954
total area of landfill w/100' buffer (acres)	95.65

TYPE OF WASTE	CUBIC YARDS	PERCENT	ACRES
Total Construction & Demolition (20 years)	1,767,408	19.84%	15.44
Total Ash Residue (20 years)	2,164,319	24.29%	18.91
Total MSW (20 years)	4,977,040	55.87%	43.48
TOTAL TO LANDFILL (20 YEARS)	8,908,767	100.00%	77.83

SIZING - MSW-only landfill	
height (feet) =	100
l' = 3h + SQRT((v/h) - (3h^2)) (yards)	919
area of landfill (square yards) =	845,071
feet per mile =	5,280
square feet/mile =	27,878,400
acres per square mile =	640
square feet per acre =	43,560
square yards per acre =	4,840
area of landfill (acres) =	174.60
total area of landfill w/100' buffer (square yards)	972,085
total area of landfill w/100' buffer (acres)	200.84

TYPE OF WASTE	CUBIC YARDS	PERCENT	ACRES
Total Construction & Demolition (20 years)	1,767,408	7.86%	13.72
Total MSW (20 years)	20,717,540	92.14%	160.88
TOTAL TO LANDFILL (20 YEARS)	22,484,948	100.00%	174.60

LANDFILL CAPITAL COSTS	L.F. w/ WTE	L.F. w/o WTE
Site Characterization	173,497	256,139
Preliminary Development Cost	1,090,555	1,707,593
Land Acquisition	955,723	1,987,638
Clearing and Grubbing	247,854	554,968
Excavate & Stockpile	5,006,641	11,227,422
Liner - Single Composite	3,668,232	0
- Double Composite	19,332,574	68,581,191
Leachate Pumps	356,909	785,493
Leachate Pre-treatment	3,965,656	5,122,778
Ponds (Recharge Basin)	20,620	51,228
Ditch Construction	39,657	93,918
Gas Management	1,427,636	3,415,185
Groundwater	158,626	356,033
Site Structures	2,220,767	1,912,504
TOTAL CAPITAL COSTS (1989 $)	38,665,147	96,052,088

LANDFILL COST ANALYSIS - Ash/Bypass Landfill	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Operation & Maintenance	5,209,313	5,469,778	5,743,267	3,350,239	3,517,751	3,693,639	3,878,321	4,072,237	4,275,848	4,489,641	4,714,123
Closure Cost											
Closure Sinking Fund Payment	444,639	444,639	444,639	444,639	444,639	444,639	444,639	444,639	444,639	444,639	444,639
Closure Sinking Fund Balance (@ 7% earnings)	444,639	920,403	1,429,470	1,974,173	2,557,004	3,180,633	3,847,917	4,561,910	5,325,883	6,143,334	7,018,007
Post Closure Annual Maintenance	0	0	0	0	0	0	0	0	0	0	0
PCAM Sinking Fund Payment	566,735	566,735	566,735	566,735	566,735	566,735	566,735	566,735	566,735	566,735	566,735
PCAM Sinking Fund Balance	566,735	1,173,140	1,821,995	2,516,269	3,259,142	4,054,017	4,904,532	5,814,584	6,788,340	7,830,258	8,945,110
Debt Service Payment (@ 8.5%)	5,026,283	5,026,283	5,026,283	5,026,283	5,026,283	5,026,283	5,026,283	5,026,283	5,026,283	5,026,283	5,026,283
TOTAL ASH/BYPASS LANDFILL COST	11,266,969	11,507,435	11,780,926	9,387,896	9,555,408	9,731,296	9,915,977	10,109,894	10,313,505	10,527,298	10,751,780
TOTAL TONS RECEIVED AT THE LANDFILL	517,416	524,340	531,358	215,883	218,229	220,606	222,917	230,230	237,703	245,281	252,966
LANDFILL COST PER TON OF INCOMING WASTE	21.74	21.95	22.17	43.49	43.79	44.11	44.48	43.91	43.39	42.92	42.50

LANDFILL COST ANALYSIS - Ash/Bypass Landfill	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Operation & Maintenance	4,949,829	5,197,320	5,457,186	5,730,046	6,016,548	6,317,375	6,633,244	6,964,906	7,313,152	7,678,809	8,062,750	8,465,887
Closure Cost										19,504,176		
Closure Sinking Fund Payment	444,639	444,639	444,639	444,639	444,639	444,639	444,639	444,639	444,639	1,179,760	1,179,760	1,179,760
Closure Sinking Fund Balance (@ 7% earnings)	7,953,906	8,955,319	10,026,830	11,173,348	12,400,121	13,712,769	15,117,302	16,620,152	18,228,202	1,179,761	2,442,104	3,792,811
Post Closure Annual Maintenance	0	0	0	0	0	0	0	0	0	1,075,033	1,128,785	1,185,224
PCAM Sinking Fund Payment	566,735	566,735	566,735	566,735	566,735	566,735	566,735	566,735	566,735	1,503,715	1,503,715	1,503,715
PCAM Sinking Fund Balance	10,138,003	11,414,397	12,780,140	14,241,084	15,805,122	17,478,215	19,268,425	21,183,949	23,233,560	25,298,592	27,433,723	29,672,575
Debt Service Payment (@ 8.5%)	5,026,283	5,026,283	5,026,283	5,026,283	5,026,283	5,026,283	5,026,283	5,026,283	5,026,283	13,336,226	13,336,226	13,336,226
TOTAL ASH/BYPASS LANDFILL COST	10,987,484	11,234,977	11,494,843	11,767,703	12,054,205	12,355,032	12,670,901	13,002,563	13,350,809	23,698,511	24,082,451	24,485,509
TOTAL TONS RECEIVED AT THE LANDFILL	260,739	268,664	276,600	284,809	293,055	305,133	312,665	320,233	327,839	335,483	344,007	352,724
LANDFILL COST PER TON OF INCOMING WASTE	42.14	41.82	41.55	41.32	41.13	40.49	40.53	40.60	40.72	70.64	70.01	69.42

ANDFILL COST ANALYSIS - MSW-only Landfill	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
peration & Maintenance	5,209,313	5,469,778	5,743,267	6,030,430	6,331,952	6,648,549	6,980,977	7,330,026	7,696,527	8,081,353	8,485,421
losure Cost	0	0	0	0	0	27,332,926	0	0	0	0	34,884,509
losure Sinking Fund Payment	6,065,589	6,065,589	6,065,589	6,065,589	6,065,589	6,065,589	6,065,589	6,065,589	6,065,589	6,065,589	6,065,589
losure Sinking Fund Balance (@ 7% earnings)	6,065,589	12,535,769	19,500,261	26,930,868	34,881,618	16,055,994	23,265,502	30,938,276	39,169,544	47,977,001	22,516,471
ost Closure Annual Maintenance	0	0	0	0	0	0	0	0	0	0	0
CAM Sinking Fund Payment	1,481,606	1,481,606	1,481,606	1,481,606	1,481,606	1,481,606	1,481,606	1,481,606	1,481,606	1,481,606	1,481,606
CAM Sinking Fund Balance	1,481,606	3,066,924	4,763,215	6,578,246	8,520,329	10,598,338	12,821,849	15,200,984	17,746,659	20,470,531	23,385,074
ebt Service Payment (@ 8.5%)	12,486,310	12,486,310	12,486,310	12,486,310	12,486,310	12,486,310	12,486,310	12,486,310	12,486,310	12,486,310	12,486,310
TAL MSW-ONLY LANDFILL COST	25,242,817	25,503,282	25,776,771	26,063,935	26,365,456	26,682,054	27,014,481	27,363,530	27,730,031	28,114,858	28,518,925
TAL TONS RECEIVED AT THE LANDFILL	517,416	524,340	531,358	538,472	545,683	552,993	560,259	567,627	575,100	582,678	590,363
NDFILL COST PER TON OF INCOMING WASTE	48.79	48.64	48.51	48.40	48.32	48.25	48.22	48.21	48.22	48.25	48.31

DFILL COST ANALYSIS - MSW-only Landfill	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
ration & Maintenance	8,909,692	9,355,177	9,822,936	10,314,082	10,829,787	11,371,276	11,939,840	12,536,832	13,163,673	13,821,857	14,512,950	15,238,597
sure Cost	0	0	0	0	44,522,436	0	0	0	0	59,587,361	0	0
sure Sinking Fund Payment	6,065,589	6,065,589	6,065,589	6,065,589	6,065,589	6,065,589	6,065,589	6,065,589	6,065,589	16,093,813	16,093,813	16,093,813
sure Sinking Fund Balance (@ 7% earnings)	30,158,213	38,334,876	47,093,906	56,465,368	21,939,677	29,541,643	37,674,305	46,377,309	55,689,310	16,093,813	0	0
t Closure Annual Maintenance	0	0	0	0	0	0	0	0	0	2,810,448	2,950,964	3,098,515
M Sinking Fund Payment	1,481,606	1,481,606	1,481,606	1,481,606	1,481,606	1,481,606	1,481,606	1,481,606	1,481,604	3,931,142	3,931,142	3,931,142
M Sinking Fund Balance	26,503,636	29,840,496	33,410,937	37,231,308	41,319,106	45,693,049	50,373,168	55,380,896	60,739,165	66,111,604	71,719,591	77,572,589
Service Payment (@ 8.5%)	12,486,310	12,486,310	12,486,310	12,486,310	12,486,310	12,486,310	12,486,310	12,486,310	12,486,310	33,129,897	33,129,897	33,129,897
L MSW-ONLY LANDFILL COST	28,943,197	29,388,681	29,856,440	30,347,587	30,863,291	31,404,780	31,973,344	32,570,336	33,197,178	66,975,708	67,667,801	68,393,448
L TONS RECEIVED AT THE LANDFILL	598,154	606,060	614,077	622,206	630,452	642,532	650,062	657,630	665,235	672,880	681,404	690,121
FILL COST PER TON OF INCOMING WASTE	48.39	48.49	48.62	48.77	48.95	48.88	49.19	49.53	49.90	99.54	99.31	99.10

2. Waste-to-Energy Cost Analysis

WASTE-TO-ENERGY CAPITAL COSTS

	1,500 TPD	1,000 TPD	500 TPD
Engineering, Design & Construction. Mgmt.	17,500,000	15,000,000	14,000,000
Site Work	4,500,000	3,500,000	2,200,000
Buildings	19,500,000	16,000,000	11,000,000
Solid Waste & Residue Handling Equipment	3,000,000	2,500,000	2,000,000
Combustion/Energy Generation	54,000,000	38,000,000	22,500,000
Water Treatment	850,000	700,000	500,000
Power Generation/Condensing & Cooling	13,000,000	9,500,000	8,000,000
Electrical Switchgear & Transmission	3,500,000	2,500,000	2,000,000
Steam Mains and In-plant Pumping & Piping	5,500,000	4,000,000	2,500,000
APC Equipment (scrubbers & baghouses)	9,500,000	6,000,000	3,000,000
Exhaust Stack	1,800,000	1,500,000	800,000
Initial Spare Parts	1,100,000	800,000	600,000
Insurance and Bonds	2,300,000	2,000,000	1,800,000
Start-up, Acceptance Testing, Monitoring	5,100,000	3,700,000	3,000,000
SUBTOTAL	141,150,000	105,700,000	73,900,000
Contingency (@ 15%)	21,172,500	15,855,000	11,085,000
TOTAL CAPITAL COST (1989 $)	162,322,500	121,555,000	84,985,000

WASTE-TO-ENERGY COST ANALYSIS - 1,500 TPD

		1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Solid Waste to Landfill w/o W-T-E Mgmt Plan		614,132	622,315	630,609	639,016	647,536	656,173	664,730	673,407	682,203	691,122	700,166
Less: Recycled Waste		96,716	97,976	99,252	100,544	101,854	103,180	104,472	105,779	107,104	108,445	109,803
Less: Construction & Demolition		69,663	69,809	69,956	70,103	70,250	70,398	70,471	70,543	70,616	70,689	70,762
Less: Non-Processible Waste		22,388	22,727	23,070	23,418	23,772	24,130	24,489	24,854	25,224	25,599	25,980
Potential W-T-E Throughput	(TPY)	425,365	431,804	438,331	444,950	451,661	458,465	465,299	472,230	479,260	486,389	493,621
W-T-E throughput (@ 85% cap. fact. 1500 TPD)	(TPY)	0	0	0	465,375	465,375	465,375	465,375	465,375	465,375	465,375	465,375
Actual Waste Processed at W-T-E	(TPY)	0	0	0	444,950	451,661	458,465	465,299	465,375	465,375	465,375	465,375
Residue/Ash Generated (@ 27.5%)	(TPY)	0	0	0	122,361	124,207	126,078	127,957	127,978	127,978	127,978	127,978
Bypass Waste to Landfill or to 500 TPD W-T-E	(TPY)	425,365	431,804	438,331	0	0	0	0	6,855	13,885	21,014	28,246
EXPENSES												
OPERATION & MAINTENANCE												
Facility Operating Personnel					2,493,258	2,620,021	2,751,022	2,888,573	3,033,002	3,184,652	3,343,884	3,511,079
Fringe Benefits					873,742	917,429	963,301	1,011,466	1,062,039	1,115,141	1,170,898	1,229,443
Facility Maintenance					4,020,287	4,221,301	4,432,366	4,653,985	4,886,684	5,131,018	5,387,569	5,656,947
Operating Materials					2,278,163	2,392,071	2,511,674	2,637,258	2,769,121	2,907,577	3,052,956	3,205,604
Operating Supplies					804,057	844,260	886,473	930,797	977,337	1,026,204	1,077,514	1,131,389
Equipment Replacement Fund (2% of equip. cost)					2,461,756	2,584,843	2,714,086	2,849,790	2,992,279	3,141,893	3,298,988	3,463,937
Contract Services					804,057	844,260	886,473	930,797	977,337	1,026,204	1,077,514	1,131,389
Equipment Rentals					147,411	154,781	162,520	170,646	179,178	188,137	197,544	207,421
Utilities					1,360,197	1,428,207	1,499,617	1,574,598	1,653,328	1,735,994	1,822,794	1,913,934
Residue Hauling to Landfill					49,193	52,431	55,802	59,551	62,539	65,666	68,949	72,397
Insurance					1,072,077	1,125,680	1,181,964	1,241,063	1,303,116	1,368,271	1,436,685	1,508,519
TOTAL OPERATION & MAINTENANCE COST					16,366,197	17,185,286	18,045,380	18,948,523	19,895,960	20,890,758	21,935,296	23,032,061
Debt Service (@ 8.5%)					24,427,213	24,427,213	24,427,213	24,427,213	24,427,213	24,427,213	24,427,213	24,427,213
TOTAL 1,500 TPD W-T-E COST					40,793,410	41,612,499	42,472,592	43,375,736	44,323,172	45,317,970	46,362,508	47,459,273
REVENUES												
Total Steam Output (1000 lbs./year)					0	0	0	0	0	0	0	0
Steam Value ($/1000 lbs.)					0	0	0	0	0	0	0	0
Total Steam Revenue					0	0	0	0	0	0	0	0
Steam Revenue Share with Vendor (@ 10%)					0	0	0	0	0	0	0	0
Steam Revenue to Authority					0	0	0	0	0	0	0	0
Total Electricity Output (kWh/year)					222,475,057	225,830,439	229,232,506	232,649,391	232,687,500	232,687,500	232,687,500	232,687,500
Electricity Value ($/kWh)					0.015	0.016	0.017	0.017	0.018	0.019	0.020	0.021
Total Electricity Revenue					3,337,126	3,556,829	3,790,933	4,039,811	4,242,497	4,454,621	4,677,353	4,911,220
Electricity Revenue Share with Vendor (@ 10%)					333,713	355,683	379,093	403,981	424,250	445,462	467,735	491,122
Electricity Revenue to Communities					3,003,413	3,201,146	3,411,839	3,635,830	3,818,247	4,009,159	4,209,617	4,420,098
TOTAL W-T-E REVENUES TO COMMUNITIES					3,003,413	3,201,146	3,411,839	3,635,830	3,818,247	4,009,159	4,209,617	4,420,098
NET COST OF W-T-E FACILITY					37,789,997	38,411,352	39,060,753	39,739,906	40,504,925	41,308,811	42,152,891	43,039,175
ACTUAL WASTE PROCESSED AT W-T-E					444,950	451,661	458,465	465,299	465,375	465,375	465,375	465,375
W-T-E COST PER TON OF PROCESSED WASTE					84.93	85.04	85.20	85.41	87.04	88.76	90.58	92.48

WASTE-TO-ENERGY COST ANALYSIS - 1,500 TPD		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Solid Waste to Landfill w/o W-T-E Mgmt Plan		709,334	718,631	728,057	737,615	747,306	754,198	763,006	771,852	780,737	789,660	798,371	807,275
Less: Recycled Waste		111,178	112,571	113,981	115,409	116,855	111,666	112,945	114,223	115,501	116,780	116,967	117,154
Less: Construction & Demolition		70,834	70,908	70,981	71,054	71,127	71,301	71,394	71,487	71,580	71,673	71,711	71,796
Less: Non-Processible Waste		26,366	26,758	27,155	27,558	27,966	28,562	28,933	29,307	29,683	30,060	30,485	30,916
Potential W-T-E Throughput	(TPY)	500,956	508,395	515,941	523,595	531,358	542,669	549,734	556,835	563,972	571,146	579,208	587,409
W-T-E throughput (@ 85% cap. fact. 1500 TPD)	(TPY)	465,375	465,375	465,375	465,375	465,375	465,375	465,375	465,375	465,375	465,375	465,375	465,375
Actual Waste Processed at W-T-E	(TPY)	465,375	465,375	465,375	465,375	465,375	465,375	465,375	465,375	465,375	465,375	465,375	465,375
Residue/Ash Generated (@ 27.5%)	(TPY)	127,978	127,978	127,978	127,978	127,978	127,978	127,978	127,978	127,978	127,978	127,978	127,978
Bypass Waste to Landfill or to 500 TPD W-T-E	(TPY)	35,581	43,020	50,566	58,220	65,983	77,294	84,359	91,460	98,597	105,771	113,833	122,034
EXPENSES													
OPERATION & MAINTENANCE													
Facility Operating Personnel		3,686,633	3,870,964	4,064,512	4,267,738	4,481,125	4,705,181	4,940,440	5,187,462	5,446,835	5,719,177	6,005,136	6,305,393
Fringe Benefits		1,290,915	1,355,461	1,423,234	1,494,396	1,569,116	1,647,572	1,729,950	1,816,448	1,907,270	2,002,633	2,102,765	2,207,903
Facility Maintenance		5,939,795	6,236,785	6,548,624	6,876,055	7,219,858	7,580,851	7,959,893	8,357,888	8,775,782	9,214,571	9,675,300	10,159,065
Operating Materials		3,365,884	3,534,178	3,710,887	3,896,431	4,091,253	4,295,815	4,510,606	4,736,136	4,972,943	5,221,590	5,482,670	5,756,803
Operating Supplies		1,187,959	1,247,357	1,309,725	1,375,211	1,443,972	1,516,170	1,591,979	1,671,578	1,755,156	1,842,914	1,935,060	2,031,813
Equipment Replacement Fund (2% of equip. cost)		3,637,134	3,818,991	4,009,941	4,210,438	4,420,960	4,642,008	4,874,108	5,117,813	5,373,704	5,642,389	5,924,509	6,220,734
Contract Services		1,187,959	1,247,357	1,309,725	1,375,211	1,443,972	1,516,170	1,591,979	1,671,578	1,755,156	1,842,914	1,935,060	2,031,813
Equipment Rentals		217,792	228,682	240,116	252,122	264,728	277,965	291,863	306,456	321,779	337,868	354,761	372,499
Utilities		2,009,631	2,110,112	2,215,618	2,326,399	2,442,719	2,564,854	2,693,097	2,827,752	2,969,140	3,117,597	3,273,476	3,437,150
Residue Hauling to Landfill		76,016	79,817	83,808	87,998	92,398	97,018	101,869	106,963	112,311	117,926	123,823	130,014
Insurance		1,583,945	1,663,143	1,746,300	1,833,615	1,925,295	2,021,560	2,122,638	2,228,770	2,340,209	2,457,219	2,580,080	2,709,084
TOTAL OPERATION & MAINTENANCE COST		24,183,664	25,392,847	26,662,489	27,995,613	29,395,394	30,865,164	32,408,422	34,028,843	35,730,285	37,516,800	39,392,640	41,362,272
Debt Service (@ 8.5%)		24,427,213	24,427,213	24,427,213	24,427,213	24,427,213	24,427,213	24,427,213	24,427,213	24,427,213	24,427,213	24,427,213	24,427,213
TOTAL 1,500 TPD W-T-E COST		48,610,876	49,820,059	51,089,702	52,422,826	53,822,607	55,292,376	56,835,635	58,456,056	60,157,498	61,944,012	63,819,852	65,789,484
REVENUES													
Total Steam Output (1000 lbs./year)		0	0	0	0	0	0	0	0	0	0	0	0
Steam Value ($/1000 lbs.)		0	0	0	0	0	0	0	0	0	0	0	0
Total Steam Revenue		0	0	0	0	0	0	0	0	0	0	0	0
Steam Revenue Share with Vendor (@ 10%)		0	0	0	0	0	0	0	0	0	0	0	0
Steam Revenue to Authority		0	0	0	0	0	0	0	0	0	0	0	0
Total Electricity Output (kWh/year)		232,687,500	232,687,500	232,687,500	232,687,500	232,687,500	232,687,500	232,687,500	232,687,500	232,687,500	232,687,500	232,687,500	232,687,500
Electricity Value ($/kWh)		0.022	0.023	0.024	0.026	0.027	0.028	0.030	0.031	0.033	0.034	0.036	0.038
Total Electricity Revenue		5,156,781	5,414,620	5,685,351	5,969,619	6,268,100	6,581,505	6,910,580	7,256,109	7,618,914	7,999,860	8,399,853	8,819,846
Electricity Revenue Share with Vendor (@ 10%)		515,678	541,462	568,535	596,962	626,810	658,150	691,058	725,611	761,891	799,986	839,985	881,985
Electricity Revenue to Communities		4,641,103	4,873,158	5,116,816	5,372,657	5,641,290	5,923,354	6,219,522	6,330,498	6,857,023	7,199,874	7,559,868	7,937,861
TOTAL W-T-E REVENUES TO COMMUNITIES		4,641,103	4,873,158	5,116,816	5,372,657	5,641,290	5,923,354	6,219,522	6,530,498	6,857,023	7,199,874	7,559,868	7,937,861
NET COST OF W-T-E FACILITY		43,969,773	44,946,901	45,972,885	47,050,169	48,181,317	49,369,022	50,616,113	51,925,558	53,300,475	54,744,138	56,259,984	57,851,623
ACTUAL WASTE PROCESSED AT W-T-E		465,375	465,375	465,375	465,375	465,375	465,375	465,375	465,375	465,375	465,375	465,375	465,375
W-T-E COST PER TON OF PROCESSED WASTE		94.48	96.58	98.79	101.10	103.53	106.08	108.76	111.58	114.53	117.63	120.89	124.31

WASTE-TO-ENERGY COST ANALYSIS - 1,000 TPD

		1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Solid Waste to Landfill w/o W-T-E Mgmt Plan		614,132	622,313	630,609	639,016	647,536	656,173	664,730	673,607	682,203	691,122	700,166
Less: Recycled Waste		96,716	97,976	99,252	100,544	101,854	103,180	104,472	105,779	107,104	108,445	109,803
Less: Construction & Demolition		69,663	69,809	69,956	70,103	70,250	70,398	70,471	70,543	70,616	70,689	70,762
Less: Non-Processible Waste		22,388	22,727	23,070	23,418	23,772	24,130	24,489	24,854	25,224	25,599	25,980
Potential W-T-E Throughput	(TPY)	425,365	431,804	438,331	444,950	451,661	458,465	465,299	472,230	479,260	486,389	493,621
W-T-E throughput (@ 85% cap. fact. 1000 TPD)	(TPY)	0	0	0	310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250
Actual Waste Processed at W-T-E	(TPY)	0	0	0	310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250
Residue/Ash Generated (@ 27.5%)	(TPY)	0	0	0	85,319	85,319	85,319	85,319	85,319	85,319	85,319	85,319
Bypass Waste to Landfill or to 500 TPD W-T-E	(TPY)	425,365	431,804	438,331	134,700	141,411	148,215	155,049	161,980	169,010	176,139	183,371
*****EXPENSES*****												
OPERATION & MAINTENANCE												
Facility Operating Personnel					2,103,950	2,209,148	2,319,605	2,435,585	2,557,365	2,685,233	2,819,494	2,960,469
Fringe Benefits					737,053	773,905	812,600	853,231	895,892	940,687	987,721	1,037,107
Facility Maintenance					2,680,191	2,814,201	2,954,911	3,102,656	3,257,789	3,420,679	3,591,713	3,771,298
Operating Materials					1,474,105	1,547,810	1,625,201	1,706,461	1,791,784	1,881,373	1,975,442	2,074,214
Operating Supplies					670,048	703,550	738,728	775,664	814,447	855,170	897,928	942,825
Equipment Replacement Fund (2% of equip. cost)					1,775,627	1,864,408	1,957,628	2,055,510	2,158,285	2,266,200	2,379,510	2,498,485
Contract Services					670,048	703,550	738,728	775,664	814,447	855,170	897,928	942,825
Equipment Rentals					120,609	126,639	132,971	139,620	146,601	153,931	161,627	169,708
Utilities					947,448	994,820	1,044,561	1,096,789	1,151,629	1,209,210	1,269,670	1,333,154
Residue Hauling to Landfill					274,405	288,125	302,531	317,658	333,541	350,218	367,729	386,115
Insurance					670,048	703,550	738,728	775,664	814,447	855,170	897,928	942,825
TOTAL OPERATION & MAINTENANCE COST					12,123,530	12,729,707	13,366,192	14,034,502	14,736,227	15,473,038	16,246,690	17,059,025
Debt Service (@ 8.5%)					18,292,287	18,292,287	18,292,287	18,292,287	18,292,287	18,292,287	18,292,287	18,292,287
TOTAL 1,000 TPD W-T-E COST					30,415,818	31,021,994	31,658,480	32,326,789	33,028,514	33,765,326	34,538,978	35,351,312
*****REVENUES*****												
Total Steam Output (1000 lbs./year)					0	0	0	0	0	0	0	0
Steam Value ($/1000 lbs.)					0	0	0	0	0	0	0	0
Total Steam Revenue					0	0	0	0	0	0	0	0
Steam Revenue Share with Vendor (@ 10%)					0	0	0	0	0	0	0	0
Steam Revenue to Authority					0	0	0	0	0	0	0	0
Total Electricity Output (kWh/year)					155,125,000	155,125,000	155,125,000	155,125,000	155,125,000	155,125,000	155,125,000	155,125,000
Electricity Value ($/kWh)					0.015	0.016	0.017	0.017	0.018	0.019	0.020	0.021
Total Electricity Revenue					2,326,875	2,443,219	2,565,380	2,693,649	2,828,331	2,969,748	3,118,235	3,274,147
Electricity Revenue Share with Vendor (@ 10%)					232,688	244,322	256,538	269,365	282,833	296,975	311,824	327,415
Electricity Revenue to Authority					2,094,188	2,198,897	2,308,842	2,424,284	2,545,498	2,672,773	2,806,412	2,946,732
TOTAL W-T-E REVENUES TO AUTHORITY					2,094,188	2,198,897	2,308,842	2,424,284	2,545,498	2,672,773	2,806,412	2,946,732
NET COST OF W-T-E FACILITY					28,321,630	28,823,097	29,349,638	29,902,505	30,483,016	31,092,553	31,732,566	32,404,580
ACTUAL WASTE PROCESSED AT W-T-E					310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250
W-T-E COST PER TON OF PROCESSED WASTE					91	93	95	96	98	100	102	104

WASTE-TO-ENERGY COST ANALYSIS - 1,000 TPD

		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
olid Waste to Landfill w/o W-T-E Mgmt Plan		709,334	718,631	729,057	737,615	747,306	754,198	763,006	771,852	780,737	789,660	798,371	807,275
ess: Recycled Waste		111,178	112,571	113,981	115,409	116,855	111,666	112,985	114,223	115,501	116,780	116,967	117,154
ess: Construction & Demolition		70,834	70,908	70,982	71,054	71,127	71,301	71,394	71,487	71,580	71,673	71,711	71,796
ess: Non-Processible Waste		26,364	26,758	27,153	27,558	27,966	28,562	28,933	29,307	29,683	30,060	30,485	30,916
otential W-T-E Throughput	(TPY)	500,956	508,395	515,941	523,595	531,358	542,669	549,734	556,835	563,972	571,146	579,208	587,409
-T-E throughput (@ 85% cap. fact. 1000 TPD)	(TPY)	310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250
ctual Waste Processed at W-T-E	(TPY)	310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250
sidue/Ash Generated (@ 27.5%)	(TPY)	85,319	85,319	85,319	85,319	85,319	85,319	85,319	85,319	85,319	85,319	85,319	85,319
pass Waste to Landfill or to 500 TPD W-T-E	(TPY)	190,706	198,145	205,691	213,345	221,108	232,419	239,484	246,585	253,722	260,896	268,958	277,159
EXPENSES**													
ERATION & MAINTENANCE													
cility Operating Personnel		3,108,493	3,263,917	3,427,113	3,598,469	3,778,392	3,967,312	4,165,677	4,373,961	4,592,659	4,822,292	5,063,407	5,316,577
inge Benefits		1,088,962	1,143,410	1,200,581	1,260,610	1,323,641	1,389,823	1,459,314	1,532,279	1,608,893	1,689,338	1,773,805	1,862,495
cility Maintenance		3,959,863	4,157,856	4,365,749	4,584,037	4,813,238	5,053,900	5,306,595	5,571,925	5,850,521	6,143,048	6,450,200	6,772,710
erating Materials		2,177,925	2,286,821	2,401,162	2,521,220	2,647,281	2,779,645	2,918,627	3,064,559	3,217,787	3,378,676	3,547,610	3,724,990
erating Supplies		989,966	1,039,464	1,091,437	1,146,009	1,203,310	1,263,475	1,326,649	1,392,981	1,462,630	1,535,762	1,612,550	1,693,177
ipment Replacement Fund (2% of equip. cost)		2,623,409	2,754,580	2,892,309	3,036,924	3,188,770	3,348,209	3,515,619	3,691,400	3,875,970	4,069,769	4,273,257	4,486,920
tract Services		989,966	1,039,464	1,091,437	1,146,009	1,203,310	1,263,475	1,326,649	1,392,981	1,462,630	1,535,762	1,612,550	1,693,177
ipment Rentals		178,194	187,104	196,459	206,282	216,596	227,426	238,797	250,737	263,273	276,437	290,259	304,772
ities		1,399,812	1,469,802	1,543,292	1,620,457	1,701,480	1,786,554	1,875,881	1,969,676	2,068,159	2,171,567	2,280,146	2,394,153
idue Hauling to Landfill		405,421	425,692	446,976	469,325	492,7[illegible]	517,431	543,303	570,468	598,991	628,941	660,388	693,407
urance		989,966	1,039,464	1,091,437	1,146,009	1,203,310	1,263,475	1,326,649	1,392,981	1,462,630	1,535,762	1,612,550	1,693,177
L OPERATION & MAINTENANCE COST		17,911,976	18,807,575	19,747,953	20,735,351	21,772,119	22,860,725	24,003,761	25,203,949	26,464,146	27,787,354	29,176,721	30,635,557
Service (@ 8.5%)		18,292,287	18,292,287	18,292,287	18,292,287	18,292,287	18,292,287	18,292,287	18,292,287	18,292,287	18,292,287	18,292,287	18,292,287
L 1,000 TPD W-T-E COST		36,204,263	37,099,862	38,040,241	39,027,639	40,064,406	41,153,012	42,296,048	43,496,236	44,756,434	46,079,641	47,469,009	48,927,845
*REVENUES*****													
l Steam Output (1000 lbs./year)		0	0	0	0	0	0	0	0	0	0	0	0
Value ($/1000 lbs.)		0	0	0	0	0	0	0	0	0	0	0	0
l Steam Revenue		0	0	0	0	0	0	0	0	0	0	0	0
Revenue Share with Vendor (@ 10%)		0	0	0	0	0	0	0	0	0	0	0	0
Revenue to Authority		0	0	0	0	0	0	0	0	0	0	0	0
Electricity Output (kWh/year)		155,125,000	155,125,000	155,125,000	155,125,000	155,125,000	155,125,000	155,125,000	155,125,000	155,125,000	155,125,000	155,125,000	155,125,000
ricity Value ($/kWh)		0.022	0.023	0.024	0.026	0.027	0.028	0.030	0.031	0.033	0.034	0.036	0.038
Electricity Revenue		3,437,854	3,609,747	3,790,234	3,979,746	4,178,733	4,387,670	4,607,053	4,837,406	5,079,276	5,333,240	5,599,902	5,879,897
ricity Revenue Share with Vendor (@ 10%)		343,785	360,975	379,023	397,975	417,873	438,767	460,705	483,741	507,928	533,324	559,990	587,990
ricity Revenue to Authority		3,094,069	3,248,772	3,411,211	3,581,771	3,760,860	3,948,903	4,146,348	4,353,665	4,571,349	4,799,916	5,039,912	5,291,908
W-T-E REVENUES TO AUTHORITY		3,094,069	3,248,772	3,411,211	3,581,771	3,760,860	3,948,903	4,146,348	4,353,645	4,571,349	4,799,916	5,039,912	5,291,908
ST OF W-T-E FACILITY		33,110,195	33,851,090	34,629,030	35,445,867	36,303,546	37,204,109	38,149,700	39,142,571	40,185,085	41,279,725	42,429,097	43,635,937
WASTE PROCESSED AT W-T-E		310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250
COST PER TON OF PROCESSED WASTE		107	109	112	114	117	120	123	126	130	133	137	141

WASTE-TO-ENERGY COST ANALYSIS - 500 TPD

		1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Solid Waste to Landfill w/o W-T-E Mgmt Plan		684,132	622,315	630,609	639,016	647,536	656,173	664,730	673,407	682,203	691,122	700,166
Less: Recycled Waste		96,716	97,976	99,252	100,544	101,854	103,180	104,472	105,779	107,104	108,445	109,803
Less: Construction & Demolition		69,663	69,809	69,956	70,103	70,250	70,398	70,471	70,543	70,616	70,689	70,762
Less: Non-Processible Waste		22,388	22,727	23,070	23,418	23,772	24,130	24,489	24,854	25,224	25,599	25,980
Potential W-T-E Throughput	(TPY)	425,365	431,804	438,331	444,950	451,661	458,465	465,299	472,230	479,260	486,389	493,621
W-T-E throughput (@ 85% cap. fact. 500 TPD)	(TPY)	0	0	0	155,125	155,125	155,125	155,125	155,125	155,125	155,125	155,125
Actual Waste Processed at W-T-E	(TPY)	0	0	0	155,125	155,125	155,125	155,125	155,125	155,125	155,125	155,125
Residue/Ash Generated (@ 27.5%)	(TPY)	0	0	0	42,659	42,659	42,659	42,659	42,659	42,659	42,659	42,659
Bypass Waste to Landfill or to 1000 TPD W-T-E	(TPY)	425,365	431,804	438,331	289,825	296,536	303,340	310,174	317,105	324,135	331,264	338,496
****EXPENSES****												
OPERATION & MAINTENANCE												
Facility Operating Personnel					1,643,059	1,746,232	1,833,522	1,925,198	2,021,458	2,122,531	2,228,658	2,340,091
Fringe Benefits					581,602	610,662	641,218	673,276	706,940	742,287	779,402	818,372
Facility Maintenance					1,340,096	1,407,100	1,477,455	1,551,328	1,628,895	1,710,339	1,795,856	1,885,649
Operating Materials					670,048	703,550	738,728	775,664	814,447	855,170	897,928	942,825
Operating Supplies					402,029	422,130	443,237	465,398	488,668	513,102	538,757	565,695
Equipment Replacement Fund (2% of equip. cost)					1,129,701	1,186,186	1,245,495	1,307,770	1,373,158	1,441,816	1,513,907	1,589,602
Contract Services					536,038	562,840	590,982	620,531	651,558	684,136	718,343	754,260
Equipment Rentals					93,807	98,497	103,422	108,593	114,023	119,724	125,710	131,995
Utilities					533,358	560,026	588,027	617,429	648,300	680,715	714,751	750,488
Residue Hauling to Landfill					411,607	432,187	453,797	476,487	500,311	525,326	551,593	579,172
Insurance					402,029	422,130	443,237	465,398	488,668	513,102	538,757	565,695
TOTAL OPERATION & MAINTENANCE COST					7,763,372	8,151,540	8,559,117	8,987,073	9,436,427	9,908,248	10,403,661	10,923,844
Debt Service (@ 8.5%)					12,789,026	12,789,026	12,789,026	12,789,026	12,789,026	12,789,026	12,789,026	12,789,026
TOTAL 500 TPD W-T-E COST					20,552,398	20,940,566	21,348,143	21,776,099	22,225,453	22,697,274	23,192,687	23,712,870
****REVENUES****												
Total Steam Output (1000 lbs./year)					0	0	0	0	0	0	0	0
Steam Value ($/1000 lbs.)					0	0	0	0	0	0	0	0
Total Steam Revenue					0	0	0	0	0	0	0	0
Steam Revenue Share with Vendor (@ 10%)					0	0	0	0	0	0	0	0
Steam Revenue to Authority					0	0	0	0	0	0	0	0
Total Electricity Output (kWh/year)					21,329,688	21,329,688	21,329,688	21,329,688	21,329,688	21,329,688	21,329,688	21,329,688
Electricity Value ($/kWh)					0.015	0.016	0.017	0.017	0.018	0.019	0.020	0.021
Total Electricity Revenue					319,945	335,943	352,740	370,377	388,896	408,340	428,757	450,195
Electricity Revenue Share with Vendor (@ 10%)					31,995	33,594	35,274	37,038	38,890	40,834	42,876	45,020
Electricity Revenue to Authority					287,951	302,348	317,466	333,339	350,006	367,506	385,882	405,176
TOTAL W-T-E REVENUES TO AUTHORITY					287,951	302,348	317,466	333,339	350,006	367,506	385,882	405,176
NET COST OF W-T-E FACILITY					20,264,447	20,638,218	21,030,678	21,442,760	21,875,447	22,329,768	22,806,805	23,307,694
ACTUAL WASTE PROCESSED AT W-T-E					155,125	155,125	155,125	155,125	155,125	155,125	155,125	155,125
W-T-E COST PER TON OF PROCESSED WASTE					130.63	133.04	135.57	138.23	141.02	143.95	147.02	150.25

WASTE-TO-ENERGY COST ANALYSIS - 500 TPD		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Solid Waste to Landfill w/o W-T-E Mgmt Plan		709,334	718,631	728,037	737,615	747,306	754,198	763,006	771,852	780,737	789,660	798,371	807,275
Less: Recycled Waste		111,178	112,571	113,981	115,409	116,855	111,666	112,945	114,223	115,501	116,780	116,967	117,154
Less: Construction & Demolition		70,834	70,908	70,981	71,054	71,127	71,301	71,394	71,487	71,580	71,673	71,711	71,796
Less: Non-Processible Waste		26,366	26,758	27,155	27,558	27,966	28,562	28,933	29,307	29,683	30,060	30,485	30,916
Potential W-T-E Throughput	(TPY)	500,956	508,395	515,941	523,593	531,358	542,669	549,734	556,835	563,972	571,146	579,208	587,409
W-T-E throughput (@ 85% cap. fact. 500 TPD)	(TPY)	155,125	155,125	155,125	155,125	155,125	155,125	155,125	155,125	155,125	155,125	155,125	155,125
Actual Waste Processed at W-T-E	(TPY)	155,125	155,125	155,125	155,125	155,125	155,125	155,125	155,125	155,125	155,125	155,125	155,125
Residue/Ash Generated (@ 27.5%)	(TPY)	42,659	42,659	42,659	42,659	42,659	42,659	42,659	42,659	42,659	42,659	42,659	42,659
Bypass Waste to Landfill or to 1000 TPD W-T-E	(TPY)	345,831	353,270	360,816	368,470	376,233	387,544	394,609	401,710	408,847	416,021	424,083	432,284
****EXPENSES****													
OPERATION & MAINTENANCE													
Facility Operating Personnel		2,457,095	2,579,950	2,708,947	2,844,395	2,986,614	3,135,945	3,292,742	3,457,380	3,630,249	3,811,761	4,002,349	4,202,466
Fringe Benefits		859,290	902,255	947,368	994,736	1,044,473	1,096,696	1,151,531	1,209,108	1,269,563	1,333,041	1,399,693	1,469,678
Facility Maintenance		1,979,932	2,078,928	2,182,875	2,292,018	2,406,619	2,526,950	2,653,298	2,785,963	2,925,261	3,071,524	3,225,100	3,386,355
Operating Materials		989,966	1,039,464	1,091,437	1,146,009	1,203,310	1,263,475	1,326,649	1,392,981	1,462,630	1,535,762	1,612,550	1,693,177
Operating Supplies		593,979	623,678	654,862	687,605	721,986	758,085	795,989	835,789	877,578	921,457	967,530	1,015,906
Equipment Replacement Fund (2% of equip. cost)		1,669,082	1,752,536	1,840,163	1,932,171	2,028,780	2,130,219	2,236,730	2,348,566	2,465,995	2,589,295	2,718,759	2,854,697
Contract Services		791,973	831,571	873,150	916,807	962,648	1,010,780	1,061,319	1,114,385	1,170,104	1,228,610	1,290,040	1,354,542
Equipment Rentals		138,593	145,325	152,801	160,441	168,463	176,887	185,731	195,017	204,768	215,007	225,757	237,045
Utilities		788,013	827,413	868,784	912,223	957,834	1,005,726	1,056,012	1,108,813	1,164,254	1,222,466	1,283,590	1,347,769
Residue Hauling to Landfill		608,131	638,538	670,464	703,988	739,187	776,146	814,954	855,701	898,487	943,411	990,581	1,040,110
Insurance		593,979	623,678	654,862	687,605	721,986	758,085	795,989	835,789	877,578	921,457	967,530	1,015,906
TOTAL OPERATION & MAINTENANCE COST		11,470,036	12,043,538	12,645,714	13,278,000	13,941,900	14,638,993	15,370,945	16,139,492	16,946,467	17,793,790	18,683,480	19,617,654
Debt Service (@ 8.5%)		12,789,026	12,789,026	12,789,026	12,789,026	12,789,026	12,789,026	12,789,026	12,789,026	12,789,026	12,789,026	12,789,026	12,789,026
TOTAL 500 TPD W-T-E COST		24,259,062	24,832,564	25,434,740	26,067,026	26,730,926	27,428,021	28,159,971	28,928,518	29,735,493	30,582,816	31,472,506	32,406,680
****REVENUES****													
Total Steam Output (1000 lbs./year)		0	0	0	0	0	0	0	0	0	0	0	0
Steam Value ($/1000 lbs.)		0	0	0	0	0	0	0	0	0	0	0	0
Total Steam Revenue		0	0	0	0	0	0	0	0	0	0	0	0
Steam Revenue Share with Vendor (@ 10%)		0	0	0	0	0	0	0	0	0	0	0	0
Steam Revenue to Authority		0	0	0	0	0	0	0	0	0	0	0	0
Total Electricity Output (kWh/year)		21,329,688	21,329,688	21,329,688	21,329,688	21,329,688	21,329,688	21,329,688	21,329,688	21,329,688	21,329,688	21,329,688	21,329,688
Electricity Value ($/kWh)		0.022	0.023	0.024	0.026	0.027	0.028	0.030	0.031	0.033	0.034	0.036	0.038
Total Electricity Revenue		472,705	496,340	521,157	547,215	574,576	603,305	633,470	665,143	698,400	733,321	769,987	808,486
Electricity Revenue Share with Vendor (@ 10%)		47,270	49,634	52,116	54,722	57,458	60,330	63,347	66,514	69,840	73,332	76,999	80,849
Electricity Revenue to Authority		425,434	446,706	469,041	492,494	517,118	542,974	570,123	598,629	628,560	659,988	692,988	727,637
TOTAL W-T-E REVENUES TO AUTHORITY		425,434	446,706	469,041	492,494	517,118	542,974	570,123	598,629	628,560	659,988	692,988	727,637
NET COST OF W-T-E FACILITY		23,833,627	24,385,857	24,965,699	25,574,533	26,213,808	26,885,047	27,589,848	28,329,889	29,106,932	29,922,828	30,779,518	31,679,042
ACTUAL WASTE PROCESSED AT W-T-E		155,125	155,125	155,125	155,125	155,125	155,125	155,125	155,125	155,125	155,125	155,125	155,125
W-T-E COST PER TON OF PROCESSED WASTE		153.64	157.20	160.94	164.86	168.99	173.31	177.86	182.63	187.64	192.89	198.42	204.22

3. Materials Recovery Facility Cost Analysis

Materials Recovery Facility
Capital Costs

	345 TPD
Engineering, Design, and Construction Management	1,350,000
Site Work	760,000
Building	4,050,000
Conveyor System	2,530,000
Tin/Steel Processing	680,000
Glass Processing	590,000
Aluminum Processing	190,000
Plastic Processing	300,000
Paper Processing	680,000
Other Equipment	1,010,000
Insurance and Bonding	420,000
Start-up and Testing	170,000
SUBTOTAL	12,730,000
Contingency (@ 15%)	1,909,500
TOTAL CAPITAL COST (1989 $)	14,639,500

MATERIALS RECOVERY FACILITY COST ANALYSIS

		1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
OPERATION AND MAINTENANCE												
Plant Operating Personnel		1,227,083	1,288,637	1,352,858	1,420,501	1,491,526	1,566,103	1,644,408	1,726,628	1,812,960	1,903,608	1,998,788
Fringe Benefits (35%)		429,479	450,953	473,500	497,175	522,034	548,136	575,543	604,320	634,536	666,263	699,576
Utilities		208,373	218,791	229,731	241,217	253,278	265,942	279,239	293,201	307,861	323,254	339,417
Maintenance and Repair		254,678	267,411	280,782	294,821	309,562	325,040	341,292	358,357	376,275	395,088	414,843
Supplies		150,491	158,016	165,917	174,212	182,923	192,069	201,673	211,756	222,344	233,461	245,134
Equipment Renewal and Replacement		243,101	255,256	268,019	281,420	295,491	310,266	325,779	342,068	359,171	377,130	395,986
Residue Disposal		353,076	370,729	389,266	408,729	429,166	450,624	473,155	496,813	521,654	547,736	575,123
Equipment Leasing (rolling stock)		127,339	133,706	140,391	147,411	154,781	162,520	170,646	179,178	188,137	197,544	207,421
Insurance		162,068	170,171	178,679	187,613	196,994	206,844	217,186	228,045	239,448	251,420	263,991
Miscellaneous		104,184	109,396	114,865	120,609	126,639	132,971	139,620	146,601	153,931	161,627	169,708
TOTAL OPERATION AND MAINTENANCE COST		3,259,872	3,422,866	3,594,009	3,773,709	3,962,395	4,160,515	4,368,540	4,586,967	4,816,316	5,057,131	5,309,988
Debt Service (@ 8.5%)		1,903,065	1,903,065	1,903,065	1,903,065	1,903,065	1,903,065	1,903,065	1,903,065	1,903,065	1,903,065	1,903,065
TOTAL MRF COST		5,162,937	5,325,930	5,497,074	5,676,774	5,865,459	6,063,579	6,271,605	6,490,032	6,719,380	6,960,196	7,213,053
****REVENUES****												
RECYCLING MATERIAL QUANTITY PROJECTIONS												
Yard Waste	(1)	13,870	13,924	14,088	14,254	14,422	14,591	14,760	14,890	15,041	15,194	15,349
Paper	(2)	51,172	51,854	52,545	53,246	53,955	54,675	55,390	56,115	56,850	57,594	58,340
Aluminum	(3)	1,418	1,437	1,455	1,476	1,495	1,515	1,535	1,555	1,575	1,596	1,617
Ferrous	(4)	18,233	18,476	18,722	18,972	19,225	19,481	19,736	19,995	20,256	20,522	20,790
Glass	(5)	5,799	5,877	5,955	6,035	6,115	6,196	6,278	6,360	6,443	6,527	6,613
Plastic	(6)	1,023	1,037	1,051	1,065	1,079	1,093	1,108	1,122	1,137	1,152	1,167
MATERIAL PRICES												
Yard Waste		0	0	0	0	0	0	0	0	0	0	0
Paper		0	0	0	0	0	0	0	0	0	0	0
Aluminum		1,389	1,458	1,531	1,608	1,688	1,773	1,861	1,954	2,052	2,155	2,263
Ferrous		15	15	15	15	15	15	15	15	15	15	15
Glass		32	33	34	35	36	37	37	38	39	40	41
Plastic		188	193	198	203	208	213	219	224	230	235	241
MATERIALS REVENUES												
Yard Waste		0	0	0	0	0	0	0	0	0	0	0
Paper		0	0	0	0	0	0	0	0	0	0	0
Aluminum		1,969,700	2,095,050	2,229,979	2,372,692	2,524,538	2,686,102	2,857,326	3,039,464	3,233,213	3,439,313	3,658,550
Ferrous		273,497	277,140	280,865	284,580	288,375	292,220	296,040	299,925	303,840	307,830	311,850
Glass		185,583	193,941	202,470	211,225	220,140	229,269	232,286	241,680	251,277	261,080	271,133
Plastic		192,406	200,141	208,098	216,195	224,432	232,914	242,652	251,328	261,510	270,720	281,247
TOTAL MATERIALS REVENUES		2,621,274	2,767,072	2,921,392	3,084,692	3,257,485	3,440,505	3,628,304	3,832,397	4,049,840	4,278,943	4,522,780
NET MATERIALS RECOVERY FACILITY COST		2,541,662	2,558,858	2,575,682	2,592,082	2,607,975	2,623,076	2,643,301	2,657,635	2,669,540	2,681,254	2,690,273

MATERIALS RECOVERY FACILITY COST ANALYSIS

		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
OPERATION AND MAINTENANCE													
Plant Operating Personnel		2,098,727	2,203,664	2,313,847	2,429,539	2,551,016	2,678,567	2,812,496	2,953,120	3,100,776	3,255,815	3,418,606	3,589,536
Fringe Benefits (35%)		734,555	771,282	809,846	850,339	892,856	937,499	984,373	1,033,592	1,085,272	1,139,535	1,196,512	1,256,338
Utilities		356,380	374,207	392,917	412,563	433,191	454,851	477,594	501,473	526,547	552,874	580,518	609,544
Maintenance and Repair		435,505	457,364	480,232	504,244	529,456	555,929	583,725	612,912	643,557	675,735	709,522	744,998
Supplies		257,391	270,261	283,774	297,962	312,861	328,504	344,929	362,175	380,284	399,298	419,263	440,226
Equipment Renewal and Replacement		415,786	436,575	458,404	481,324	505,390	530,660	557,193	585,052	614,305	645,020	677,271	711,135
Residue Disposal		603,879	634,073	665,777	699,066	734,019	770,720	809,256	849,719	892,205	936,815	983,655	1,032,838
Equipment Leasing (rolling stock)		217,792	228,682	240,116	252,122	264,728	277,965	291,863	306,456	321,779	337,868	354,761	372,499
Insurance		277,190	291,050	305,602	320,883	336,927	353,773	371,462	390,035	409,537	430,013	451,514	474,090
Miscellaneous		178,194	187,104	196,459	206,282	216,596	227,426	238,797	250,737	263,273	276,437	290,259	304,772
TOTAL OPERATION AND MAINTENANCE COST		5,575,487	5,854,262	6,146,975	6,454,324	6,777,040	7,115,892	7,471,686	7,845,271	8,237,534	8,649,411	9,081,881	9,535,976
Debt Service (@ 8.5%)		1,903,065	1,903,065	1,903,065	1,903,065	1,903,065	1,903,065	1,903,065	1,903,065	1,903,065	1,903,065	1,903,065	1,903,065
TOTAL MRF COST		7,478,552	7,757,326	8,050,039	8,357,388	8,680,104	9,018,956	9,374,751	9,748,335	10,140,599	10,552,476	10,984,946	11,439,040
****REVENUES****													
RECYCLING MATERIAL QUANTITY PROJECTIONS													
Yard Waste	(1)	15,505	15,622	15,822	15,982	16,145	16,300	16,457	16,615	16,722	16,930	16,940	16,950
Paper	(2)	59,112	59,886	60,670	61,464	62,268	62,850	63,589	64,328	65,066	65,805	65,900	65,950
Aluminum	(3)	1,638	1,660	1,681	1,703	1,726	1,742	1,762	1,783	1,803	1,824	1,825	1,827
Ferrous	(4)	21,062	21,338	21,167	21,900	22,187	22,394	22,658	22,921	23,184	23,447	23,500	23,600
Glass	(5)	6,699	6,787	6,876	6,966	7,057	7,123	7,207	7,290	7,374	7,458	7,470	7,480
Plastic	(6)	1,182	1,198	1,213	1,229	1,245	1,257	1,272	1,287	1,301	1,316	1,332	1,347
MATERIAL PRICES													
Yard Waste		0	0	0	0	0	0	0	0	0	0	0	0
Paper		0	0	0	0	0	0	0	0	0	0	0	0
Aluminum		2,376	2,494	2,619	2,750	2,888	3,032	3,184	3,343	3,510	3,685	3,870	4,063
Ferrous		15	15	15	15	15	15	15	15	15	15	15	15
Glass		42	43	45	46	47	48	49	50	51	52	53	54
Plastic		247	253	260	266	273	280	287	295	302	309	317	325
MATERIALS REVENUES													
Yard Waste		0	0	0	0	0	0	0	0	0	0	0	0
Paper		0	0	0	0	0	0	0	0	0	0	0	0
Aluminum		3,891,762	4,139,840	4,403,732	4,684,445	4,983,052	5,281,118	5,610,348	5,959,297	6,329,116	6,721,018	7,061,819	7,423,443
Ferrous		315,939	320,070	317,505	328,500	332,805	335,916	339,860	343,812	347,760	351,706	352,500	354,000
Glass		281,358	291,841	309,420	320,436	331,682	341,906	353,131	364,524	376,084	387,812	395,910	403,920
Plastic		291,954	303,094	315,380	326,914	339,985	351,962	365,001	379,534	393,001	406,676	422,245	437,797
TOTAL MATERIALS REVENUES		4,781,004	5,054,845	5,346,037	5,660,295	5,987,524	6,310,902	6,668,346	7,047,167	7,445,961	7,867,213	8,232,475	8,619,120
NET MATERIALS RECOVERY FACILITY COST		2,697,548	2,702,481	2,704,003	2,697,093	2,692,580	2,708,054	2,706,407	2,701,169	2,694,638	2,685,262	2,752,471	2,819,920

4. Yard Waste Compost Facility Cost Analysis

YARD WASTE COMPOSTING CAPITAL COSTS-26.000 TPY	
Engineering, Design and Construction Management	335,000
SITE CONSTRUCTION	
Grading	145,000
Access Road, Paving	120,000
Preparation Area, Asphalt	165,000
Maintenance and Office Facility	55,000
Utility Hook-ups	35,000
SUBTOTAL	520,000
EQUIPMENT	
Front-end Loader (2)	320,000
Compost Turner	200,000
Chipper	35,000
Shredder	50,000
Screener	40,000
Dump Truck	35,000
Miscellaneous Equipment	20,000
SUBTOTAL	700,000
TOTAL CAPITAL COSTS (1989 $)	1,555,000

YARD WASTE COMPOST FACILITY COST ANALYSIS	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
OPERATION AND MAINTENANCE COSTS													
Operating Personnel	210,000	220,500	231,525	243,101	255,256	268,019	281,420	295,491	310,266	325,779	342,068	359,171	377,130
Fringe Benefits (35%)	73,500	77,175	81,034	85,085	89,340	93,807	98,497	103,422	108,593	114,023	119,724	125,710	131,995
Fuel	110,000	115,500	121,275	127,339	133,706	140,391	147,411	154,781	162,520	170,646	179,178	188,137	197,544
Utilities	22,000	23,100	24,255	25,468	26,741	28,078	29,482	30,956	32,504	34,129	35,836	37,627	39,509
Maintenance and Repair	70,000	73,500	77,175	81,034	85,085	89,340	93,807	98,497	103,422	108,593	114,023	119,724	125,710
Supplies	23,000	24,150	25,358	26,625	27,957	29,354	30,822	32,363	33,981	35,680	37,465	39,338	41,305
Miscellaneous	30,000	31,500	33,075	34,729	36,465	38,288	40,203	42,213	44,324	46,540	48,867	51,310	53,876
TOTAL OPERATION AND MAINTENANCE COST	538,500	565,425	593,696	623,381	654,550	687,278	721,642	757,724	795,610	835,390	877,160	921,018	967,069
Debt Service (@ 8.5%)	202,143	202,143	202,143	202,143	202,143	202,143	202,143	202,143	202,143	202,143	202,143	202,143	202,143
Total Y.W Cost	740,643	767,568	795,839	825,524	856,693	889,421	923,785	959,867	997,753	1,037,533	1,079,303	1,123,161	1,169,212

YARD WASTE COMPOST FACILITY COST ANALYSIS	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
OPERATION AND MAINTENANCE COSTS													
Operating Personnel	395,986	415,786	436,575	458,404	481,324	505,390	530,660	557,193	585,052	614,305	645,020	677,271	711,135
Fringe Benefits (35%)	138,595	145,525	152,801	160,441	168,463	176,887	185,731	195,017	204,768	215,007	225,757	237,045	248,897
Fuel	207,421	217,792	228,682	240,116	252,122	264,728	277,965	291,863	306,456	321,779	337,868	354,761	372,499
Utilities	41,484	43,558	45,736	48,023	50,424	52,946	55,593	58,373	61,291	64,356	67,574	70,952	74,500
Maintenance and Repair	131,995	138,595	145,525	152,801	160,441	168,463	176,887	185,731	195,017	204,768	215,007	225,757	237,045
Supplies	43,370	45,538	47,815	50,206	52,716	55,352	58,120	61,026	64,077	67,281	70,645	74,177	77,886
Miscellaneous	56,569	59,398	62,368	65,486	68,761	72,199	75,809	79,599	83,579	87,758	92,146	96,753	101,591
TOTAL OPERATION AND MAINTENANCE COST	1,015,422	1,066,193	1,119,503	1,175,478	1,234,252	1,295,964	1,360,763	1,428,801	1,500,241	1,575,253	1,654,016	1,736,716	1,823,552
Debt Service (@ 8.5%)	202,143	202,143	202,143	202,143	202,143	202,143	202,143	202,143	202,143	202,143	202,143	202,143	202,143
Total Y.W Cost	1,217,565	1,268,336	1,321,646	1,377,621	1,436,395	1,498,107	1,562,906	1,630,944	1,702,384	1,777,396	1,856,159	1,938,859	2,025,695

5. Residential Transportation Cost Analysis

YEAR	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
RESIDENTIAL TRANSPORTATION COST ANALYSIS											
Scenarios 1 & 2											
Residential Waste Quantities											
Madison	118,605	120,091	121,595	123,119	124,661	126,223	127,521	128,832	130,157	131,495	132,848
Monroe	8,523	8,636	8,752	8,869	8,987	9,107	9,222	9,339	9,457	9,577	9,698
St. Clair	123,625	124,998	126,386	127,789	129,208	130,643	131,925	133,220	134,528	135,848	137,182
Total	250,753	253,725	256,733	259,776	262,856	265,973	268,668	271,391	274,142	276,921	279,728
Cost Calculations											
Madison											
One way miles to Central Facility.	8.439	8.439	8.439	8.439	8.439	8.439	8.439	8.439	8.439	8.439	8.439
Cost per Ton-Mile	0.35	0.36	0.38	0.40	0.42	0.44	0.47	0.49	0.51	0.54	0.57
Madison total hauling cost	347,602	369,555	392,894	417,707	444,087	472,132	500,937	531,287	563,588	597,853	634,201
Monroe											
One way miles to Central Facility.	17.360	17.360	17.360	17.360	17.360	17.360	17.360	17.360	17.360	17.360	17.360
Cost per Ton-Mile	0.35	0.36	0.38	0.40	0.42	0.44	0.47	0.49	0.51	0.54	0.57
Monroe total hauling cost	51,382	54,671	58,171	61,895	65,858	70,074	74,309	79,226	84,241	89,573	95,243
St Clair											
One way miles to Central Facility.	9.860	9.860	9.860	9.860	9.860	9.860	9.860	9.860	9.860	9.860	9.860
Cost per Ton-Mile	0.35	0.36	0.38	0.40	0.42	0.44	0.47	0.49	0.51	0.54	0.57
St Clair total hauling cost	423,325	449,427	477,138	506,558	537,791	570,951	605,383	641,891	680,601	721,645	765,164
Total Residential Hauling Cost	822,309	873,653	928,203	986,160	1,047,736	1,113,157	1,180,729	1,252,404	1,328,430	1,409,071	1,494,609
Total Residential Tons	250,753	253,725	256,733	259,776	262,856	265,973	268,668	271,391	274,142	276,921	279,728
Total Residential Cost Per Ton	3.28	3.44	3.62	3.80	3.99	4.19	4.39	4.61	4.85	5.09	5.34

YEAR	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
RESIDENTIAL TRANSPORTATION COST ANALYSIS												
Scenarios 1 & 2												
Residential Waste Quantities												
Madison	134,214	135,594	136,989	138,397	139,821	141,075	142,435	143,794	145,154	146,513	147,873	149,233
Monroe	9,821	9,946	10,072	10,199	10,328	10,439	10,561	10,683	10,805	10,927	11,049	11,172
St. Clair	138,328	139,888	141,261	142,647	144,047	145,289	146,629	147,969	149,309	150,650	151,990	153,330
Total	282,363	285,427	288,321	291,244	294,196	296,802	299,624	302,446	305,268	308,090	310,912	313,734
Cost Calculations												
Madison												
One way miles to Central Facility.	8.439	8.439	8.439	8.439	8.439	8.439	8.439	8.439	8.439	8.439	8.439	8.439
Cost per Ton-Mile	0.59	0.62	0.65	0.69	0.72	0.76	0.80	0.84	0.88	0.92	0.97	1.02
Madison total hauling cost	672,760	713,662	757,051	803,078	851,904	902,524	956,784	1,014,213	1,074,992	1,139,315	1,207,382	1,279,407
Monroe												
One way miles to Central Facility.	17.360	17.360	17.360	17.360	17.360	17.360	17.360	17.360	17.360	17.360	17.360	17.360
Cost per Ton-Mile	0.59	0.62	0.65	0.69	0.72	0.76	0.80	0.84	0.88	0.92	0.97	1.02
Monroe total hauling cost	101,272	107,682	114,498	121,746	129,452	137,378	145,933	155,004	164,614	174,798	185,589	197,023
St Clair												
One way miles to Central Facility.	9.860	9.860	9.860	9.860	9.860	9.860	9.860	9.860	9.860	9.860	9.860	9.860
Cost per Ton-Mile	0.59	0.62	0.65	0.69	0.72	0.76	0.80	0.84	0.88	0.92	0.97	1.02
St Clair total hauling cost	811,308	860,235	912,112	967,118	1,025,441	1,085,991	1,150,810	1,219,395	1,291,962	1,368,737	1,449,960	1,535,883
Total Residential Hauling Cost	1,585,339	1,681,579	1,783,661	1,891,942	2,00[illegible],797	2,125,894	2,253,528	2,388,612	2,531,569	2,682,850	2,842,931	3,012,313
Total Residential Tons	282,563	285,427	288,321	291,244	294,196	296,802	299,624	302,446	305,268	308,090	310,912	313,734
Total Residential Cost Per Ton	5.61	5.89	6.19	6.50	6.82	7.16	7.52	7.90	8.29	8.71	9.14	9.60

YEAR

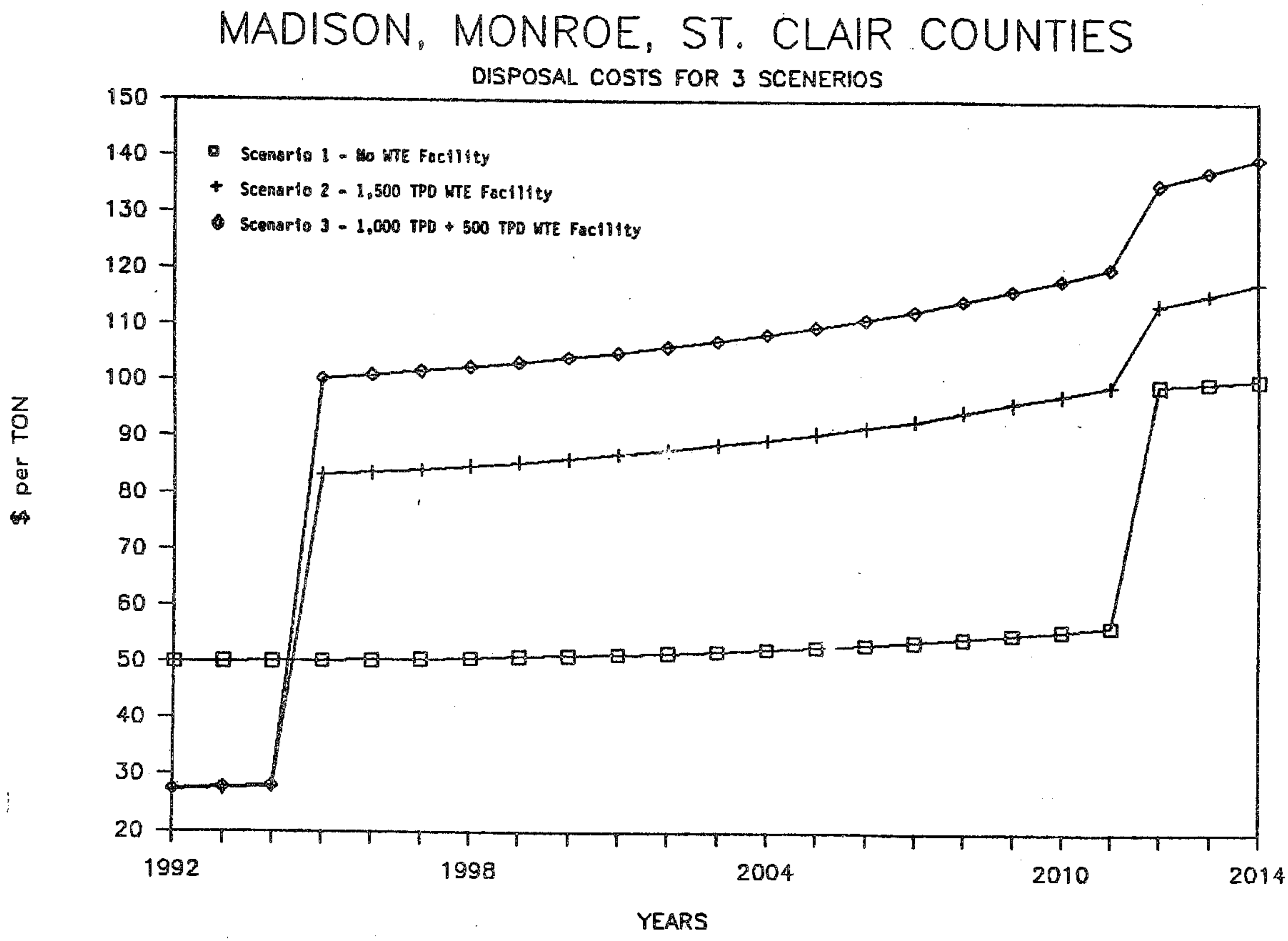
Scenario 3

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Residential Waste Quantities											
Madison											
Recycling	45,759	46,390	47,029	47,677	48,335	49,001	49,629	50,266	50,911	51,564	52,225
Other	72,846	73,701	74,566	75,442	76,326	77,222	77,891	78,566	79,246	79,931	80,623
Total	118,605	120,091	121,595	123,119	124,661	126,223	127,521	128,832	130,157	131,495	132,848
Monroe											
Recycling	3,288	3,336	3,385	3,434	3,484	3,535	3,589	3,644	3,699	3,756	3,813
Other	5,235	5,300	5,367	5,434	5,502	5,572	5,633	5,695	5,758	5,822	5,886
Total	8,523	8,636	8,752	8,869	8,987	9,107	9,222	9,339	9,457	9,577	9,698
St Clair											
Recycling	47,696	48,286	48,882	49,486	50,098	50,717	51,344	51,978	52,620	53,271	53,929
Other	75,930	76,712	77,504	78,303	79,110	79,926	80,582	81,242	81,908	82,577	83,253
Total	123,625	124,998	126,386	127,789	129,208	130,643	131,925	133,220	134,528	135,848	137,182
Total											
Recycling	96,743	98,012	99,296	100,598	101,917	103,253	104,562	105,887	107,230	108,590	109,967
Other	154,010	155,713	157,437	159,179	160,939	162,720	164,106	165,504	166,912	168,330	169,761
Total	250,753	253,725	256,733	259,777	262,856	265,973	268,668	271,391	274,142	276,920	279,728
Cost Calculations											
Madison											
Alton Capacity	155,125	155,125	155,125	155,125	155,125	155,125	155,125	155,125	155,125	155,125	155,125
Recycling											
One way miles to Central Facility	8.439	8.439	8.439	8.439	8.439	8.439	8.439	8.439	8.439	8.439	8.439
Cost per Ton Mile	0.35	0.36	0.38	0.40	0.42	0.44	0.47	0.49	0.51	0.54	0.57
Hauling Cost	134,109	142,756	151,958	161,755	172,186	183,287	194,918	207,291	220,448	234,439	249,317
Other											
One way miles to Alton	7.52	7.52	7.52	7.52	7.52	7.52	7.52	7.52	7.52	7.52	7.52
Cost per Ton Mile	0.35	0.36	0.38	0.40	0.42	0.44	0.47	0.49	0.51	0.54	0.57
Hauling Cost	190,245	202,102	214,697	228,077	242,291	257,392	272,603	288,713	305,773	323,837	342,972
Madison Total Hauling Cost	324,353	344,857	366,656	389,832	414,477	440,679	467,520	496,004	526,221	558,276	592,289
Monroe											
Nat Steel Capacity	310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250
Recycling											
One way miles to Central Facility	17.360	17.360	17.360	17.360	17.360	17.360	17.360	17.360	17.360	17.360	17.360
Cost per Ton Mile	0.35	0.36	0.38	0.40	0.42	0.44	0.47	0.49	0.51	0.54	0.57
Hauling Cost	19,823	21,118	22,500	23,967	25,531	27,200	28,997	30,913	32,949	35,129	37,445
Other											
One way miles to Nat Steel	19.07	19.07	19.07	19.07	19.07	19.07	19.07	19.07	19.07	19.07	19.07
Cost per Ton Mile	0.35	0.36	0.38	0.40	0.42	0.44	0.47	0.49	0.51	0.54	0.57
Hauling Cost	34,670	36,856	39,188	41,661	44,291	47,097	49,994	53,071	56,348	59,816	63,497
Monroe Total Hauling Cost	54,493	57,974	61,687	65,627	69,823	74,298	78,990	83,984	89,290	94,945	100,942

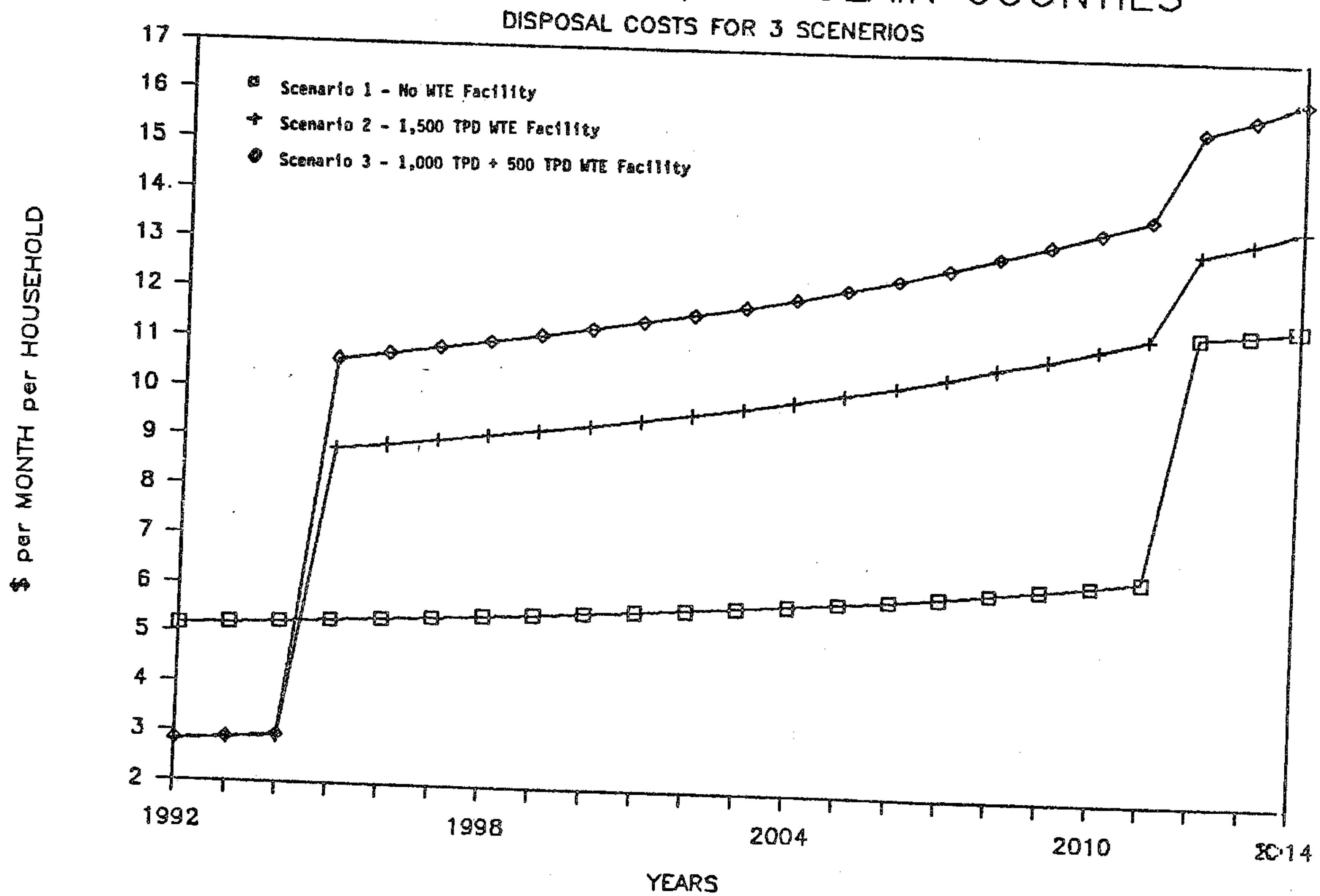
YEAR	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
St Clair											
Nat Steel Capacity	310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250
Recycling											
One way miles to Central Facility	9.86	9.86	9.86	9.86	9.86	9.86	9.86	9.86	9.86	9.86	9.86
Cost per Ton Mile	0.35	0.36	0.38	0.40	0.42	0.44	0.47	0.49	0.51	0.54	0.57
Hauling Cost	163,323	173,611	184,541	196,163	208,518	221,649	235,609	250,444	266,214	282,983	300,802
Other											
One way miles to Nat Steel	12.33	12.33	12.33	12.33	12.33	12.33	12.33	12.33	12.33	12.33	12.33
Cost per Ton Mile	0.35	0.36	0.38	0.40	0.42	0.44	0.47	0.49	0.51	0.54	0.57
Hauling Cost	325,136	344,909	365,894	388,149	411,757	436,804	462,409	489,506	518,195	548,548	580,691
St Clair Total Hauling Cost	488,460	518,520	550,435	584,312	620,275	658,453	698,018	739,950	784,409	831,532	881,494
Total Hauling Cost	867,306	921,351	978,778	1,039,771	1,104,575	1,173,430	1,244,528	1,319,938	1,399,919	1,484,753	1,574,725
Total Residential Waste (Tons)	250,753	253,725	256,733	259,777	262,856	265,973	268,668	271,391	274,142	276,920	279,728
Total Residential Hauling Cost Per Ton	3.46	3.63	3.81	4.00	4.20	4.41	4.63	4.86	5.11	5.36	5.63

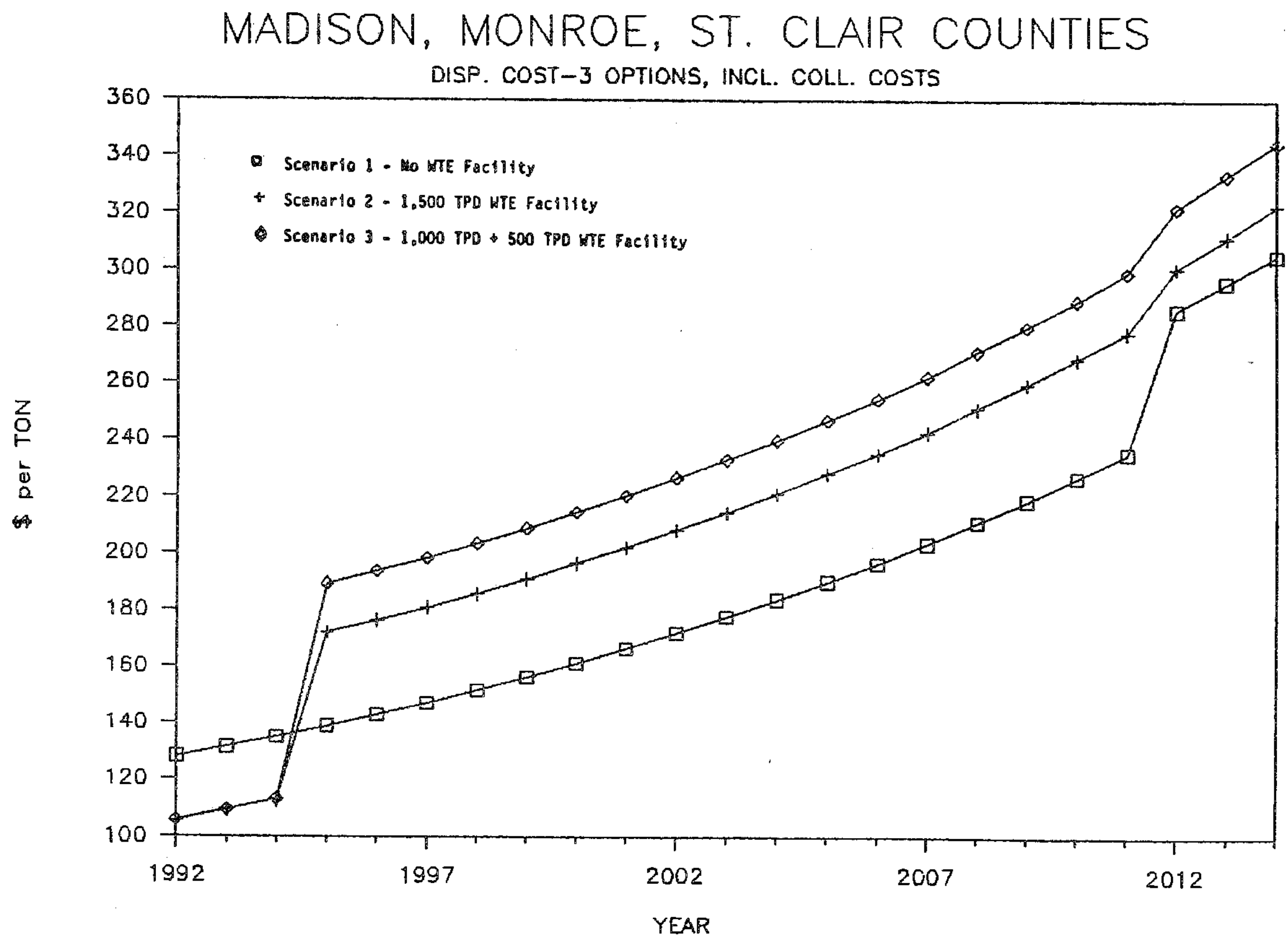
YEAR	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Scenario 3												
Residential Waste Quantities												
Madison												
Recycling	52,895	53,574	54,261	54,958	55,663	56,191	56,843	57,494	58,146	58,797	58,896	58,995
Other	81,319	82,020	82,728	83,439	84,158	84,884	85,592	86,300	87,008	87,716	88,977	90,238
Total	134,214	135,594	136,989	138,397	139,821	141,075	142,435	143,794	145,154	146,513	147,873	149,233
Monroe												
Recycling	3,871	3,930	3,989	4,050	4,112	4,158	4,215	4,271	4,328	4,385	4,401	4,416
Other	5,951	6,016	6,082	6,149	6,217	6,281	6,346	6,412	6,477	6,542	6,649	6,755
Total	9,821	9,946	10,072	10,199	10,328	10,439	10,561	10,683	10,805	10,927	11,049	11,172
St Clair												
Recycling	54,595	55,270	55,953	56,645	57,345	57,870	58,517	59,163	59,811	60,457	60,535	60,615
Other	83,933	84,618	85,308	86,002	86,702	87,419	88,113	88,806	89,499	90,192	91,454	92,715
Total	138,528	139,888	141,261	142,647	144,047	145,289	146,629	147,969	149,309	150,650	151,990	153,330
Total												
Recycling	111,361	112,774	114,206	115,653	117,120	118,219	119,574	120,929	122,285	123,640	123,832	124,027
Other	171,202	172,654	174,118	175,590	177,076	178,584	180,051	181,517	182,983	184,450	187,080	189,708
Total	282,563	285,428	288,322	291,243	294,196	296,803	299,625	302,446	305,268	308,090	310,912	313,735
Cost Calculations												
Madison												
Alton Capacity	155,125	155,125	155,125	155,125	155,125	155,125	155,125	155,125	155,125	155,125	155,125	155,125
Recycling												
One way miles to Central Facility	8.439	8.439	8.439	8.439	8.439	8.439	8.439	8.439	8.439	8.439	8.439	8.439
Cost per Ton Mile	0.59	0.62	0.65	0.69	0.72	0.76	0.80	0.84	0.88	0.92	0.97	1.02
Hauling Cost	265,141	281,972	299,867	318,905	339,146	359,481	381,835	405,518	430,622	457,216	480,885	505,778
Other												
One way miles to Alton	7.52	7.52	7.52	7.52	7.52	7.52	7.52	7.52	7.52	7.52	7.52	7.52
Cost per Ton Mile	0.59	0.62	0.65	0.69	0.72	0.76	0.80	0.84	0.88	0.92	0.97	1.02
Hauling Cost	363,230	384,679	407,399	431,446	456,922	483,907	512,340	542,407	574,200	607,816	647,381	689,384
Madison Total Hauling Cost	628,371	666,651	707,267	750,351	796,067	843,387	894,175	947,925	1,004,822	1,065,031	1,128,266	1,195,162
Monroe												
Nat Steel Capacity	310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250
Recycling												
One way miles to Central Facility	17.360	17.360	17.360	17.360	17.360	17.360	17.360	17.360	17.360	17.360	17.360	17.360
Cost per Ton Mile	0.59	0.62	0.65	0.69	0.72	0.76	0.80	0.84	0.88	0.92	0.97	1.02
Hauling Cost	39,916	42,550	45,349	48,344	51,538	54,721	58,244	61,969	65,936	70,145	73,921	77,881
Other												
One way miles to Nat Steel	19.07	19.07	19.07	19.07	19.07	19.07	19.07	19.07	19.07	19.07	19.07	19.07
Cost per Ton Mile	0.59	0.62	0.65	0.69	0.72	0.76	0.80	0.84	0.88	0.92	0.97	1.02
Hauling Cost	67,408	71,552	75,953	80,630	85,597	90,802	96,329	102,198	108,395	114,957	122,679	130,867
Monroe Total Hauling Cost	107,324	114,102	121,302	128,974	137,136	145,523	154,574	164,167	174,331	185,102	196,600	208,748

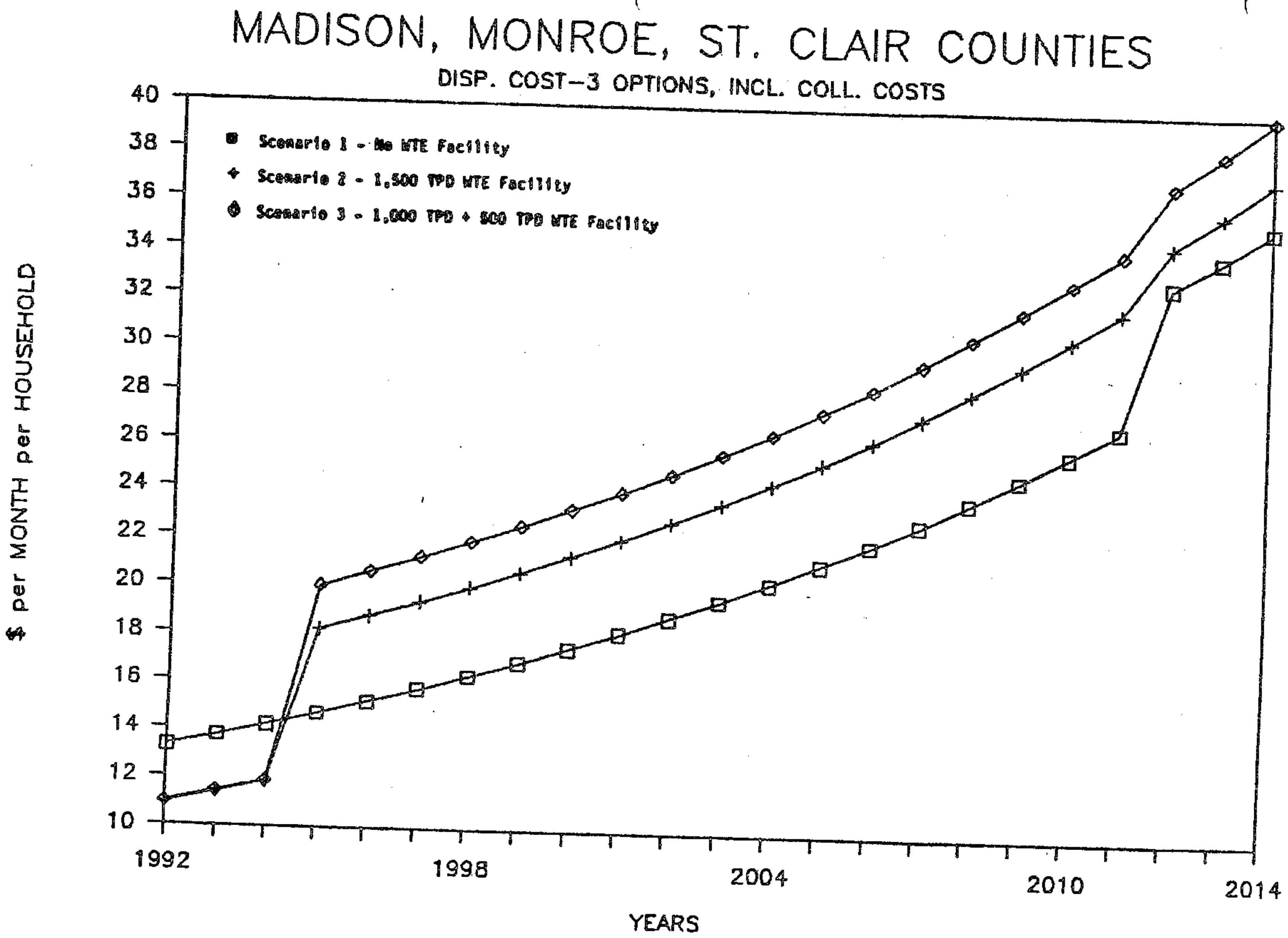
YEAR	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
St Clair												
Hat Steel Capacity	310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250	310,250
Recycling												
One way miles to Central Facility	9.86	9.86	9.86	9.86	9.86	9.86	9.86	9.86	9.86	9.86	9.86	9.86
Cost per Ton Mile	0.59	0.62	0.65	0.69	0.72	0.76	0.80	0.84	0.88	0.92	0.97	1.02
Hauling Cost	319,743	339,881	361,285	384,041	408,226	432,562	459,268	487,555	517,540	549,286	577,495	607,171
Other												
One way miles to Hat Steel	12.33	12.33	12.33	12.33	12.33	12.33	12.33	12.33	12.33	12.33	12.33	12.33
Cost per Ton Mile	0.59	0.62	0.65	0.69	0.72	0.76	0.80	0.84	0.88	0.92	0.97	1.02
Hauling Cost	614,706	650,709	688,815	729,140	771,829	817,122	864,789	915,170	968,427	1,024,722	1,091,014	1,161,360
St Clair Total Hauling Cost	934,449	990,590	1,050,101	1,113,181	1,180,055	1,249,684	1,324,057	1,402,725	1,485,967	1,574,009	1,668,508	1,768,530
Total Hauling Cost	1,670,143	1,771,343	1,878,669	1,992,506	2,113,258	2,238,595	2,372,805	2,514,817	2,665,121	2,824,142	2,993,374	3,172,440
Total Residential Waste (Tons)	282,563	285,428	288,322	291,243	294,196	296,803	299,625	302,446	305,268	308,090	310,912	313,735
Total Residential Hauling Cost Per Ton	5.91	6.21	6.52	6.84	7.18	7.54	7.92	8.31	8.73	9.17	9.63	10.11


MADISON, MONROE, ST. CLAIR COUNTIES
DISPOSAL COSTS FOR 3 SCENERIOS
Scenario 1 - No WTE Facility
Scenario 2 - 1,500 TPD WTE Facility
Scenario 3 - 1,000 TPD + 500 TPD WTE Facility
$ per TON
150
140
130
120
110
100
90
80
70
60
50
40
30
20
1992
1998
2004
2010
2014
YEARS

MADISON, MONROE, ST. CLAIR COUNTIES




MADISON, MONROE, ST. CLAIR COUNTIES
DISP. COST-3 OPTIONS, INCL. COLL. COSTS
Scenario 1 - No WTE Facility
Scenario 2 - 1,500 TPD WTE Facility
Scenario 3 - 1,000 TPD + 500 TPD WTE Facility
$ per TON
360
340
320
300
280
260
240
220
200
180
160
140
120
100
1992
1997
2002
2007
2012
YEAR


MADISON, MONROE, ST. CLAIR COUNTIES
DISP. COST–3 OPTIONS, INCL. COLL. COSTS
Scenario 1 - No WTE Facility
Scenario 2 - 1,500 TPD WTE Facility
Scenario 3 - 1,000 TPD + 500 TPD WTE Facility
$ per MONTH per HOUSEHOLD
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
1992
1998
2004
2010
2014
YEARS

B. SOLID WASTE FLOW ASSUMPTIONS

EAST-WEST GATEWAY COORDINATING COUNCIL
WASTE FLOW ASSUMPTIONS - YEAR
SOLID WASTE FLOWS

15-Aug-89

		1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
MADISON COUNTY: Residential Waste		118,605	120,091	121,595	123,119	124,661	126,223	127,521	128,832	130,157	131,495	132,848
Commercial/Institutional Waste		56,803	57,495	58,195	58,904	59,621	60,347	60,992	61,644	62,302	62,968	63,641
TOTAL MADISON COUNTY WASTE		175,408	177,586	179,790	182,022	184,282	186,570	188,513	190,476	192,459	194,463	196,488
MONROE COUNTY: Residential Waste		8,523	8,636	8,752	8,869	8,987	9,107	9,222	9,339	9,457	9,577	9,690
Commercial/Institutional Waste		3,157	3,201	3,246	3,292	3,338	3,385	3,427	3,470	3,513	3,557	3,601
TOTAL MONROE COUNTY WASTE		11,679	11,837	11,998	12,160	12,325	12,492	12,649	12,809	12,970	13,134	13,300
ST. CLAIR COUNTY: Residential Waste		123,625	124,998	126,386	127,789	129,208	130,643	131,925	133,220	134,528	135,848	137,182
Commercial/Institutional Waste		76,259	77,104	77,959	78,823	79,696	80,579	81,368	82,165	82,970	83,783	84,604
TOTAL ST. CLAIR COUNTY WASTE		199,885	202,102	204,345	206,612	208,904	211,222	213,294	215,386	217,498	219,631	221,785
Total Industrial Waste		288,330	292,774	297,287	301,869	306,522	311,246	316,403	321,809	327,224	332,731	338,330
Total Residential Waste		250,753	253,726	256,733	259,777	262,856	265,973	268,669	271,392	274,143	276,922	279,729
Total Commercial/Institutional Waste		136,219	137,800	139,400	141,018	142,655	144,311	145,788	147,279	148,786	150,308	151,846
TOTAL SOLID WASTE GENERATION	(TPY)	675,302	684,300	693,420	702,664	712,033	721,530	730,940	740,480	750,153	759,961	769,904
TOTAL Res. & Commercial/Institutional Waste	(TPY)	386,972	391,526	396,133	400,795	405,512	410,284	414,456	418,671	422,929	427,230	431,575
Recycling Required	(TPY)	96,743	97,881	99,033	100,199	101,370	102,571	103,614	104,668	105,732	106,808	107,894
Present Recycling	(TPY)	4,900	4,930	4,959	4,989	5,020	5,050	5,080	5,109	5,139	5,170	5,200
Additional Recycling Required	(TPY)	91,843	92,952	94,074	95,209	96,350	97,521	98,534	99,556	100,593	101,638	102,694
Yard Waste (@ 56.0% of table 31)	(TPY)	19,070	19,295	19,522	19,751	19,984	20,219	20,424	20,632	20,842	21,054	21,268
Paper (@ 7.6% of table 34)	(TPY)	51,172	51,854	52,545	53,246	53,955	54,675	55,390	56,115	56,850	57,594	58,348
Aluminum (@ .21% of table 34)	(TPY)	1,418	1,437	1,456	1,476	1,495	1,515	1,535	1,555	1,575	1,596	1,617
Ferrous (@ 2.7% of table 34)	(TPY)	18,233	18,476	18,723	18,972	19,225	19,481	19,736	19,995	20,256	20,522	20,790
Glass (@ 0.9% of table 34)	(TPY)	5,799	5,877	5,955	6,035	6,115	6,196	6,278	6,360	6,443	6,527	6,613
Plastic (@ 0.2% of table 34)	(TPY)	1,023	1,037	1,051	1,065	1,079	1,093	1,108	1,122	1,137	1,152	1,167
Total Waste Recycled	(TPY)	96,716	97,976	99,252	100,544	101,854	103,180	104,472	105,779	107,104	108,445	109,803
Solid Waste to Landfill w/o W-T-E Mgmt Plan		614,132	622,315	630,609	639,016	647,536	656,173	664,730	673,407	682,203	691,122	700,166
Less: Recycled Waste		96,716	97,976	99,252	100,544	101,854	103,180	104,472	105,779	107,104	108,445	109,803
Less: Construction & Demolition		69,663	69,809	69,956	70,103	70,250	70,398	70,471	70,543	70,616	70,689	70,762
Less: Non-Processible Waste		22,388	22,727	23,070	23,418	23,772	24,130	24,489	24,854	25,224	25,599	25,980
Potential W-T-E Throughput	(TPY)	425,365	431,804	438,331	444,950	451,661	458,465	465,299	472,230	479,260	486,389	493,621
Potential W-T-E Throughput	(TPD)	1,165	1,183	1,201	1,219	1,237	1,256	1,275	1,294	1,313	1,333	1,352
W-T-E throughput (@ 85% cap. fact. 1500 TPD)	(TPY)	465,375	465,375	465,375	465,375	465,375	465,375	465,375	465,375	465,375	465,375	465,373
W-T-E throughput (@ 85% plant capacity factor)	(TPD)	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275
Actual Waste Processed at W-T-E	(TPY)	0	0	0	444,950	451,661	458,465	465,299	465,375	465,375	465,375	465,375
Residue/Ash Generated (@ 27.5%)	(TPY)	0	0	0	122,361	124,207	126,078	127,957	127,978	127,978	127,978	127,978
Bypass Waste to landfill	(TPY)	425,365	431,804	438,331	0	0	0	0	6,855	13,885	21,014	28,246
LANDFILL USAGE SUMMARY WITH W-T-E (cu. yds.)												
Residue/Ash Generated (1 cy/ton)		0	0	0	122,361	124,207	126,078	127,957	127,978	127,978	127,978	127,978
Bypassed Waste (2 cy/ton)		850,731	863,607	876,663	0	0	0	0	13,710	27,769	42,029	56,492
Non-Processible Waste (2 cy/ton)		44,775	45,453	46,140	46,837	47,543	48,259	48,979	49,708	50,448	51,199	51,960
Construction & Demolition Waste (1.25 cy/ton)		87,079	87,262	87,445	87,629	87,813	87,998	88,088	88,179	88,270	88,361	88,452
TOTAL CUBIC YARDS OF WASTE TO LANDFILL PER YEAR		982,585	996,322	1,010,248	256,827	259,563	262,335	265,024	279,575	294,465	309,567	324,882
cumulative cy w/ W-T-E =		8,908,767										
***LANDFILL USAGE SUMMARY W/O W-T-E (c												
Bypassed Waste (2 cy/ton)		850,731	863,607	876,663	889,900	903,322	916,930	930,598	944,460	958,319	972,779	987,242
Non-Processible Waste (2 cy/ton)		44,775	45,453	46,140	46,837	47,543	48,259	48,979	49,708	50,448	51,199	51,960
Construction & Demolition Waste (1.25		87,079	87,262	87,445	87,629	87,813	87,998	88,088	88,179	88,270	88,361	88,452
TOTAL CUBIC YARDS OF WASTE TO LANDFILL		982,585	996,322	1,010,248	1,024,366	1,038,678	1,053,187	1,067,665	1,082,347	1,097,237	1,112,339	1,127,654
cumulative cy w/o W-T-E =		22,484,948										

EAST-WEST GATEWAY COORDINATING COUNCIL
WASTE FLOW ASSUMPTIONS - YEAR
SOLID WASTE FLOWS

		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
MADISON COUNTY: Residential Waste		134,214	135,594	136,989	138,397	139,821	141,075	142,435	143,794	145,154	146,513	147,873	149,233
Commercial/Institutional Waste		64,321	65,008	65,702	66,404	67,114	67,736	68,413	69,089	69,766	70,442	71,119	71,795
TOTAL MADISON COUNTY WASTE		198,535	200,602	202,691	204,802	206,934	208,811	210,847	212,883	214,920	216,956	218,992	221,028
MONROE COUNTY: Residential Waste		9,821	9,946	10,072	10,199	10,328	10,439	10,561	10,683	10,805	10,927	11,049	11,172
Commercial/Institutional Waste		3,646	3,692	3,738	3,784	3,831	3,872	3,917	3,961	4,006	4,051	4,095	4,140
TOTAL MONROE COUNTY WASTE		13,467	13,637	13,809	13,983	14,160	14,311	14,478	14,644	14,811	14,978	15,145	15,311
ST. CLAIR COUNTY: Residential Waste		138,528	139,888	141,261	142,647	144,047	145,289	146,629	147,969	149,309	150,650	151,990	153,330
Commercial/Institutional Waste		85,432	86,269	87,114	87,967	88,829	89,593	90,418	91,243	92,068	92,893	93,718	94,543
TOTAL ST. CLAIR COUNTY WASTE		223,960	226,157	228,375	230,615	232,876	234,882	237,047	239,212	241,377	243,543	245,708	247,873
Total Industrial Waste 20-Oct-89		344,023	349,812	355,698	361,684	367,770	371,019	376,333	381,647	386,961	392,275	398,514	403,964
Total Residential Waste		282,564	285,428	288,321	291,244	294,196	297,051	299,922	302,792	305,663	308,533	310,399	313,191
Total Commercial/Institutional Waste		153,400	154,969	156,555	158,156	159,774	161,250	162,750	164,293	165,878	167,505	168,978	170,528
TOTAL SOLID WASTE GENERATION	(TPY)	779,987	790,209	800,574	811,084	821,741	829,319	839,005	848,732	858,501	868,313	877,891	887,682
TOTAL Res. & Commercial/Institutional Waste	(TPY)	435,964	440,397	444,876	449,400	453,971	458,301	462,672	467,085	471,540	476,038	479,377	483,719
Recycling Required	(TPY)	108,991	110,099	111,219	112,350	113,493	114,575	115,668	116,771	117,885	119,010	119,844	120,930
Present Recycling	(TPY)	5,230	5,259	5,289	5,320	5,350	5,380	5,410	5,440	5,470	5,500	5,500	5,500
Additional Recycling Required	(TPY)	103,761	104,840	105,930	107,030	108,143	109,196	110,259	111,332	112,415	113,510	114,344	115,430
Yard Waste (@ 56.0% of table 31)	(TPY)	21,484	21,703	21,923	22,146	22,371	22,582	22,800	23,017	23,235	23,452	23,670	23,888
Paper (@ 7.6% of table 34)	(TPY)	59,112	59,886	60,670	61,464	62,268	62,850	63,589	64,328	65,066	65,805	65,900	65,950
Aluminum (@ .21% of table 34)	(TPY)	1,638	1,660	1,681	1,703	1,726	1,742	1,762	1,783	1,803	1,824	1,825	1,827
Ferrous (@ 2.7% of table 34)	(TPY)	21,062	21,338	21,617	21,900	22,187	22,394	22,658	22,921	23,184	23,447	23,500	23,600
Glass (@ 0.9% of table 34)	(TPY)	6,699	6,787	6,876	6,966	7,057	7,123	7,207	7,290	7,374	7,458	7,470	7,480
Plastic (@ 0.2% of table 34)	(TPY)	1,182	1,198	1,213	1,229	1,245	1,257	1,272	1,287	1,301	1,316	1,332	1,347
Total Waste Recycled	(TPY)	111,178	112,571	113,981	115,409	116,855	117,949	119,287	120,625	121,964	123,302	123,697	124,091
Solid Waste to Landfill w/o W-T-E Mgmt Plan		709,334	718,631	728,057	737,615	747,306	754,1[illegible]	763,006	771,852	780,737	789,660	798,371	807,275
Less: Recycled Waste		111,178	112,571	113,981	115,409	116,855	117,9[illegible]	119,287	120,625	121,964	123,302	123,697	124,091
Less: Construction & Demolition		70,834	70,908	70,981	71,054	71,127	71,301	71,394	71,487	71,580	71,673	71,711	71,796
Less: Non-Processible Waste		26,366	26,758	27,155	27,558	27,966	28,247	28,616	28,987	29,360	29,734	30,148	30,569
Potential W-T-E Throughput	(TPY)	500,956	508,395	515,941	523,595	531,358	536,701	543,709	550,753	557,833	564,950	572,815	580,818
Potential W-T-E Throughput	(TPD)	1,372	1,393	1,414	1,435	1,456	1,470	1,490	1,509	1,528	1,548	1,569	1,591
W-T-E throughput (@ 85% cap. fact. 1500 TPD)	(TPY)	465,375	465,375	465,375	465,375	465,375	465,375	465,375	465,375	465,375	465,375	465,375	465,375
W-T-E throughput (@ 85% plant capacity factor)	(TPD)	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275
Actual Waste Processed at W-T-E	(TPY)	465,375	465,375	465,375	465,375	465,375	465,375	465,375	465,375	465,375	465,375	465,375	465,375
Residue/Ash Generated (@ 27.5%)	(TPY)	127,978	127,978	127,978	127,978	127,978	127,978	127,978	127,978	127,978	127,978	127,978	127,978
Bypass Waste to landfill	(TPY)	35,581	43,020	50,566	58,220	65,983	71,326	78,334	85,378	92,458	99,575	107,440	115,443
LANDFILL USAGE SUMMARY WITH W-T-E (cu. yds.)													
Residue/Ash Generated (1 cy/ton)		127,978	127,978	127,978	127,978	127,978	127,978	127,978	127,978	127,978	127,978	127,978	127,978
Bypassed Waste (2 cy/ton)		71,161	86,041	101,132	116,440	131,967	142,652	156,668	170,755	184,916	199,149	214,879	230,886
Non-Processible Waste (2 cy/ton)		52,732	53,515	54,310	55,115	55,932	56,495	57,233	57,974	58,719	59,468	60,296	61,139
Construction & Demolition Waste (1.25 cy/ton)		88,543	88,634	88,726	88,817	88,909	89,127	89,243	89,359	89,475	89,592	89,639	89,745
TOTAL CUBIC YARDS OF WASTE TO LANDFILL PER YEAR		340,415	356,168	372,146	388,350	404,786	416,252	431,121	446,067	461,089	476,188	492,792	509,748
cumulative cy w/ W-T-E =													
***LANDFILL USAGE SUMMARY W/O W-T-E (c													
Bypassed Waste (2 cy/ton)		1,001,911	1,016,791	1,031,882	1,047,190	1,062,717	1,073,402	1,087,418	1,101,505	1,115,666	1,129,899	1,145,629	1,161,636
Non-Proce[illegible]e Waste (2 cy/ton)		52,732	53,515	54,310	[illegible]115	55,932	56,495	57,233	57,974	58,719	59,468	60,[illegible]	61,139
Construc[illegible] Demolition Waste (1.25		88,543	88,634	88,726	[illegible]817	88,909	89,127	89,243	89,359	89,475	89,592	[illegible]	89,745
TOTAL CUBIC YARDS OF WASTE TO LANDFILL		1,143,187	1,158,940	1,174,918	1,171,[illegible]	1,207,558	1,219,024	1,233,893	1,248,839	1,263,860	1,278,960	1,295,[illegible]	[illegible],312,520
cumulative cy w/o W-T-E													

II. RECOMMENDATIONS FOR ADOPTION AND IMPLEMENTATION

A. GENERAL SITING CRITERIA

SITE SELECTION

Preferred Alternative - Illinois Solid Waste Management System

The selection of a suitable site, or sites, for the preferred solid waste management system alternative will be the result of the careful evaluation of reasonable "candidate" sites, most likely brought forward by the solicitation of proposals from the private sector. The Counties of Madison, St. Clair and Monroe will make the selection, in part, by the application of various land use, transportation and environmental criteria used to test the relative feasibility of the candidate sites.

Each of the criteria to be applied has been ranked, or weighted, with regard to its significance to all others. Within each criteria, points are awarded to candidate sites depending on how well, or poorly, a site meets the test of the criteria.

The criteria are grouped as follows:

ENVIRONMENT

- Pollution Control
- Drainage
- Presence of Flood Plain
- Soil Characteristics

TRANSPORTATION

- Haul Distance
- Access
- Importation of Cover Soil

LAND USE

- Existing Land Use
- Adjacent Land Use
- End-State Land Use

CRITERIA FOR SITE SELECTION - DESCRIPTION AND WEIGHTING

The criteria for site selection and the relative weights and evaluation points assigned are described in detail below. The more significant criteria in each of the Environment, Transportation and Land Use categories are listed first. Within each category, evaluation points for site performance are given.

While the use of these criteria in the comparison of candidate sites is intended to be objective and analytical, some element of subjective judgement will invariably be required in the application of some of the criteria. Ultimately, however, the selection of the "best" site, or sites, will be based on a comparison of the overall performance of all the candidate sites as measured by the composite score each rates when tested against the given criteria.

ENVIRONMENT

Pollution Control

Do the following factors present possible problems due to location or geological characteristics of the proposed site?

Ground water pollution potential

Vehicular traffic

Leachate

Gas production

Odors, fires, vectors

Noise, aesthetics

Air pollution, dust

Critical flora or fauna habitats

16	Less than 3 factors present
12	3 to 4 factors present
4	5 to 6 factors present
0	7 or more factors present

Drainage

What are the existing drainage patterns of the proposed site? Will drainage-ways existing at the proposed site need to be relocated or transformed to accommodate the new fill area? Are there drainage areas adjacent to the site which may require monitoring or improvement before landfill operations may take place?

8 Existing drainage is suitable
6 Minor on-site or off-site improvements required
0 Major on-site or off-site improvements required

Presence of Flood Plain

Is any or all of the proposed site located within the limits of a flood prone area?

6 Protected from 100 year flood, or not located within 100 year flood plain
4 Minor improvements required, less than 50% in 100 year flood plain, or less than 50% not protected from 100 year flood
2 Major improvements required, over 50% in 100 year flood plain, or over 50% not protected from 100 year flood
0 100% within flood plain or not able to be improved

Soil Characteristics

What is the existing soil type and is it capable of sustaining landfill operations?

5 Clay
4 Clayey-Silty Sand
3 Silt
2 Clayey-Silty Gravel
1 Clean Sand or Gravel

TRANSPORTATION

Haul Distance

What is the combined average haul distance in miles from the various collection areas to the proposed site?

15	0 to 5 miles
10	6 to 10 miles
5	11 to 15 miles
0	Over 15 miles

Access

Will vehicular traffic need to be routed through residential or commercial areas or can it be routed through industrial, agricultural or vacant land? Are access roads adjacent to the site capable of handling the increased volume, weight and size of vehicles associated with the proposed solid waste management operations?

12	No access problems
8	Minor access problems
4	Moderate access problems
0	Major access problems

Importation of Cover Soil

Is there ample and suitable cover soil available on the proposed site or will cover material need to be imported?

3	Suitable soil available
2	Limited importing required
1	Moderate importing required
0	Major importing required

LAND USE

Existing Land Use

What is the existing (or zoned) land use of the proposed site?

- 12 Landfill, vacant, or vacant and zoned for landfill
- 10 Industrial
- 8 Agricultural
- 4 Commercial
- 0 Residential, recreational, or environmentally sensitive

Adjacent Land Use

What is the land use adjacent to the proposed site? Are there residential or commercial areas that could be encroached upon by the presence of the site or significantly affected by operational disasters (fire, spill) at the site? Is there an airport adjacent to the site that could be affected by birds attracted to the fill area?

- 10 Vacant or landfill
- 8 Industrial
- 6 Agricultural
- 4 Commercial
- 0 Residential

End-State Land Use

What is the proposed use of the site once solid waste management operations have ceased?

- 3 Industrial or commercial
- 2 Active recreation or park
- 1 Passive recreation, open space, buffer, green belt
- 0 No use proposed

SCORING

Maximum Score	Criteria	
	ENVIRONMENT	30 Points
16	Pollution Control	
8	Drainage	
6	Presence of Flood Plain	
5	Soil Characteristics	
35	Maximum Total Environment Points	
	TRANSPORTATION	30 Points
15	Haul Distance	
12	Access	
3	Availability of Cover Soil	
30	Maximum Total Transportation Points	
	LAND USE	25 Points
12	Existing Land Use	
10	Adjacent Land Use	
3	End-State Land Use	
30	Maximum Total Land Use Points	
	TOTAL	90 Points

B. MODEL PUBLIC EDUCATION AND INFORMATION PROGRAM

Recycling Program

Public Information and Education Element

Introduction

On August 24, 1988, the Solid Waste Planning and Recycling Act was signed into law in the State of Illinois. The Act recognizes that, in this age of inadequate and rapidly diminishing disposal capacity for municipal waste, counties should have the primary responsibility to plan for management of municipal waste within their boundaries.

The Act requires each county of 100,000 population or more to develop a comprehensive waste management plan that places substantial emphasis on recycling. The Act encourages pilot recycling projects, provides incentives for decreased generation of municipal waste and promotes composting of yard waste.

By March 1, 1991, each county of 100,000 population or more is required to submit to the Illinois Environmental Protection Agency (IEPA) an officially adopted plan for the management of municipal waste generated within its boundaries for the next 20 years. The plan must address the generation and processing of municipal waste, consider waste management alternatives and identify responsible entities for implementing the plan.

The Solid Waste Planning and Recycling Act requires that a countywide recycling program be implemented. The program is to be designed so that 15 percent of municipal waste is recycled by the end of the third year of plan implementation and 25 percent at the end of the fifth year. To administer the program, a recycling coordinator is to be designated.

Potential markets for at least three recyclable materials are to be identified and provision for separate collection and composting of leaves is required. The recycling program also must include provisions for compliance, including incentives and penalties.

The successful implementation of a recycling program is critical to meeting the goals of the adopted solid waste management plan of a county. To help insure the success of the recycling program, a public information and education program is a required element of the solid waste plan.

This public information and education effort should present basic information on recycling, the need for recycling in the county and the benefits of recycling. It is to be designed to gain the support and acceptance of recycling by local public officials and the general public.

A discussion of the tasks to be undertaken for the development and implementation of a countywide recycling program and a comprehensive public information and education program follows. General cost estimates for elements of the education and publicity effort also are presented so that adequate consideration might be given to programming and budgeting.

The major responsibility for the public information and education program will be that of the recycling coordinator for each county. The coordinator will work with the Environment Committee of the County Board, and serve as liaison to municipalities and the general public.

Implementing a Recycling Program

The implementation of a recycling program, as required in the Act, will be the primary responsibility of the county recycling coordinator. In order to reach the ambitious goal set forth in the Act to recycle 25 percent of municipal waste by the end of the fifth year following the adoption of the plan, it will be necessary to mount a vigorous research, planning and development effort. To make the program successful, a comprehensive public education and information effort also must be undertaken.

The general tasks involved in setting up and maintaining a workable recycling program include:

Program Coordination

- Coordinate all recycling program activities, working with the members of the County Board Environment Committee and any Solid Waste Task Force Advisory Committee established by the County Board for the purpose of providing input for program implementation.
- Serve as liaison to the local public officials, businesses, institutions, the local waste management industry, and the general public.

Program Research, Planning and Development

- Identify persons, groups or businesses engaged in recycling activities within the county.
- Plan for, develop and assist in the construction and/or operation of one or more recycling centers.
- Identify potential markets for recyclable materials.
- Work with commercial and institutional establishments to implement specialized recycling programs.
- Plan for and implement provisions for the separate

collection and composting of leaves.

- Assist municipalities to develop and implement pilot recycling projects to test the economic feasibility and environmental benefits of various recycling methods.
- Assist in the development and enactment of municipal and county mandatory separation and flow control ordinances as may be required to implement a successful recycling program.
- Research the feasibility of and means to provide for the payment of recycling diversion credits to public and private parties engaged in recycling.
- Assist in the development and enactment of municipal and county provisions for compliance with recycling activities, including incentives and penalties.
- Assist the county and municipalities to obtain grants and loans from the Solid Waste Management Fund.

Public Education and Information

- Educate and inform public officials and the general public of the benefits derived from recycling.
- Inform public officials and the general public of the requirements for compliance with the county recycling program.
- Foster an awareness that all residents have a responsibility to participate in recycling through the development of a comprehensive and ongoing publicity campaign.
- Work with the Illinois Department of Energy and Natural Resources to obtain technical assistance for the development of recycling publicity, advertising and marketing campaigns.

Program Monitoring and Evaluation

- Monitor compliance with and effectiveness of county recycling program.
- Document annually the total number of tons of material recycled by category of material for individual recycling programs operating in the county.

The Public Education and Information Element

The goal of the public education and information activity is to create understanding and acceptance of recycling as a beneficial solid waste management technique and to encourage residents to participate in recycling. To be effective, this recycling promotion effort must be comprehensive and ongoing.

The general public, while receptive to learning about recycling, has little knowledge about recycling and will need to be informed about the county's plan. To actually change the behavior of the public and make them active participants in recycling will require a vigorous program of positive reinforcement regarding the needs for and benefits of recycling.

There are many techniques which may be employed to educate the public and publicize local recycling efforts. The availability of funding and manpower resources will be key to structuring the scope of the county's program. The techniques and ideas presented are basic to any promotional campaign and many require only minimal expenditure of funds.

The activities involved in undertaking a comprehensive and ongoing recycling promotional effort include:

Project Coordination

- Develop recycling program identity with logo and theme
- Develop data base of interested community "help" groups, busineses and individuals to promote recycling program
- Coordinate activities with municipalities, local recyclers and waste management industry, businesses, schools, and "help" groups

Public Relations

- Establish clearinghouse for information
- Set-up a speaker's bureau and designate a program spokesperson
- Prepare news releases
- Hold press conferences
- Develop press kit, including fact sheet
- Publish recycling program newsletter
- Prepare and distribute print publicity features to newspapers
- Produce radio and television public service announcements
- Hold workshops
- Organize tours

Promotions

- Set-up special outreach programs
- Establish special ongoing educational programs in local schools
- Hold contests to publicize program
- Organize community drives

Advertising and Marketing (creative, production, placement)

- Produce paid media advertising campaigns
- Develop and produce brochures, posters, flyers
- Design recycling displays for local exhibition
- Produce slide show
- Create souvenirs for distribution
- Develop direct mail and printed inserts
- Purchase billboard advertising space

Monitoring and Evaluation

- Monitor success of program elements and revise activities as warranted

Activity: <u>Program Identity</u>

Responsibility: Coordinator, Environment Committee, Task Force

Description: To help convey the message of recycling to county residents, a slogan should be developed and used consistently in all activities and materials to give the program an identity. The slogan should communicate the key theme of the program. Slogans such as "Recycle - Once is not enough" or "Let's Do It Again - Recycle" are examples of catchy phrases which impart the message of recycling.

Consideration should also be given to the development of a logo or symbol for the program. The logo should be simple but provide a strong visual identity. Widespread use of the slogan and logo will increase awareness of the program and serve as a reminder to residents to participate.

Timing: Prior to, or immediately upon, program implementation.

Cost: Approximately $500-$750 for development of slogan and logo by design consultant.

Activity: Data Base

Responsibility: Coordinator

Description: A data base should be developed identifying groups, businesses, institutions and individuals interested in recycling. Local public officials, business leaders, media, and environmental and recycling organizations (at the local, state and national levels) should also be included. These contacts can be used as communication links to transmit the recycling program message to the public.

Timing: Prior to, or immediately upon, program implementation.

Cost: No additional cost beyond coordinator's budget.

Activity: <u>Program Coordination</u>

Responsibility: Coordinator

Description: Overall coordination of all activities should be carried out by the recycling coordinator working with the Environment committee of the Board and any Task Forces appointed by the Board.

Scheduling and preparation of materials for public relations and promotional activities; coordination of advertising creative, production and placement activities; and program research, monitoring and evaluation activities should be done as part of this element.

Program activities should be coordinated and integrated with the recycling activities of municipalities, local recyclers, scouts, church groups, schools, businesses and the local waste management industry to increase awareness and participation in recycling.

The development of a strong and well-informed volunteer network can enhance efforts to promote recycling. A basic volunteer training program should be developed and offered to interested groups active in recycling.

Timing: Ongoing activity.

Cost: No additional cost beyond coordinator's budget.

Activity: <u>Clearinghouse</u>

Responsibility: Coordinator

Description: The recycling coordinator's office should serve as the clearinghouse for all inquiries concerning recycling and the program. The telephone number of the office should be publicized and the office manned during normal working hours. If the office is not staffed at all times, calls should be forwarded and answered at another appropriate county office.

Timing: Immediately upon program implementation.

Cost: No additional cost beyond coordinator's budget.

Activity: Speaker's Bureau

Responsibility: Coordinator

Description: Understanding and awareness of the recycling program will be enhanced by presentations made by informed speakers to meetings of local government, civic, and business organizations. The coordinator should enlist as speakers members of the Environment Committee of the County Board and members of any Task Force appointed by the County Board.
Speakers should be provided to groups requesting presentations and speaking engagements also should be solicited to provide the widest exposure of program information.

One person, Chairman of the County Board Environment Committee or the coordinator, should be designated the official spokesperson for the program.

Timing: Ongoing. Solicitation of engagements should be clustered immediately prior to program implementation and at major program milestones or events. The possibility for media coverage of these engagements enhances opportunity for publicity concerning the program.

Cost: No additional cost beyond coordinator's budget.

Activity: <u>News Releases</u>

Responsibility: Coordinator

Description: News releases should be written and distributed to inform the media of various milestones in the program or noteworthy events which could generate publicity. Releases should be sent to all area newspapers, radio and television stations.

In addition, releases should be sent to organizations, municipalities and individuals interested in recycling.

Timing: Ongoing activity.

Cost: No additional cost beyond coordinator's budget.

Activity: Press Conferences

Responsibility: Coordinator

Description: Press conferences should be held at milestones during the program and to inform the public of special events or promotions. Press conferences, while usually scheduled to issue statements, also should offer the media an opportunity to pose questions about the program.

Timing: Ongoing, as warranted.

Cost: No additional cost beyond coordinator's budget.

Activity: <u>Press Kit</u>

Responsibility: Coordinator

Description: A press kit should be developed and sent to local media contact to assist in the preparation of factual stories and feature articles. The press kit should include background information on the recycling program, a fact sheet in question/answer format, black and white photographs (as appropriate), promotional brochures, and copies of prior news releases all contained in a folder. The folder should display the program logo and slogan.

In addition to photos which may be included in the press kit, a photo and video library should be set up which could be accessed by local media when background photographs or film footage is needed to supplement news features.

Timing: Prior to program implementation, and updated as warranted by program changes.

Cost: Approximately $1,600 - $2,000 for creative and production associated with folder prepared by design firm.

Activity: <u>Newsletter</u>

Responsibility: Coordinator

Description: A regularly published (quarterly) program newsletter should be produced and distributed to municipalities, interested organizations, businesses and individuals. Updates on program implementation, pilot projects and successful recycling events should be included.

Newsletter format could be single double-sided sheet or four page layout. Contact should be made with local utilities, banks, stores and other companies which send out monthly bills to request that newsletter be included with billing.

Local companies, community groups, governmental units and politicians publishing in-house newsletters should be contacted about including articles on the recycling program.

Timing: Ongoing activity.

Cost: $700 - $1,000 per newsletter issue for production and postage costs.

Activity: Print Publicity

Responsibility: Coordinator

Description: News releases sent to local newspapers will generate straight news stories concerning special recycling activities or the implementation of new aspects of the program. However, it is important to keep the program "in the news" by generating additional publicity. Letters to the editor of newspapers from interested parties, participating groups or local public officials can serve to inform the public about the program. An effort also should be made to keep editorial boards and local assignment reporters informed and aware of the program. Short briefing papers on specific program aspects should be prepared and discussed with newspapers to generate feature articles.

Timing: Ongoing, as warranted by program activities.

Cost: No additional cost beyond acoordinator's budget.

Activity: <u>Radio and Television Public Service Announcements (PSA's) and Public Affairs Programming</u>

Responsibility: Coordinator

Description: Public affairs departments of radio and television stations will accept public service announcements (PSA's) to air free of charge. PSA's will need to be prepared according to each stations preferred format for audio or video tapes. The preparation of tapes most likely will require the assistance of a consultant for scripting and production. It is possible that some radio and television stations (particularly local cable stations) may be willing to donate studio, production facilities and assistance to produce PSA's for the program. Use of existing taped spots from the State of Illinois or federal Environmental Protection Agency can keep costs to a minimum. These stock PSA's can be tagged with the local program's logo (for video) and a short voice over identification of the program.

Airing of PSA's should be required with any radio or television paid advertising placement.

Contact with public affairs departments of radio and television stations should be made periodically to attempt to schedule shows featuring the recycling program.

Timing: Ongoing activity.

Cost: $1,000 - $3,500 for consultant scripting and production work, if required.

Activity: Workshops

Responsibility: Coordinator, Environment Committee, Task Force

Description: Organization and sponsorship (or co-sponsorship) of workshops can be effective in presenting basic information on recycling and the specifics of the program. Intended audiences might be local officials, businesses, the media and the general public. Local public officials, outside experts, local waste management industry representatives, the coordinator, and members of the Environment Committee and Task Force should be enlisted to participate.

Timing: Prior to, and immediately upon, program implementation. At various intervals after program implementation as an educational device.

Cost: Costs can be kept to a minimum by scheduling workshops in public facilities and using program materials already prepared (flyers, fact sheets, folders, souvenirs, materials available through the State of Illinois, federal programs and the waste management industry).

Activity: Tours

Responsibility: Coordinator

Description: To increase awareness of the recycling program, arrangements should be made for local officials, organizations, school groups, interested parties and the media to tour a local recycling facility. Tours also should be arranged to observe curbside collection operations, pilot program operations and composting operations.

Timing: Ongoing activity.

Cost: No additional cost beyond the coordinator's budget.

Activity: Special Outreach Programs

Responsibility: Coordinator

Description: Recycling "information days" at local shopping centers should be scheduled periodically to distribute information and promotional materials to the general public. Advance promotion of information days should be sought through media publicity and interested organizations.

Certain aspects of recycling municipal solid waste require special attention to insure program success. Multiple family dwellings can pose obstacles to successful program implementation. A special effort should be made to enlist apartment buildings in the recycling program. Building management and maintenance personnel should be contacted and arrangements for special collection and storage equipment made.

Office waste recycling programs also should be pursued. Individual corporations, municipal offices, hospitals, universities and managers of multi-tenant commercial facilities should be contacted regarding management of waste and recycling.

Timing: Immediately upon program implementation, ongoing.

Cost: Encouragement of local waste industry to provide collection and storage equipment could keep costs at a minimum.

Activity: <u>Special Ongoing Educational Programs</u>

Responsibility: Coordinator

Description: Education of school age children concerning recycling can increase awareness not only among the children but also among their parents. Contact with local school officials to arrange for the distribution of promotional materials should be made. The coordinator should offer to set up school assemblies or to address classes regarding the program.

Special promotions can be arranged which reward individual students, classes or schools for collection of recyclable items.

Means of integrating the recycling program into the curricula (science, math, political science, art) should be investigated with school officials.

Timing: Upon program implementation, and ongoing.

Cost: No additional cost beyond coordinator's budget.

Activity: <u>Contests</u>

Responsibility: Coordinator

Description: As a means of increasing awareness, contests could be an effective marketing tool. A contest might focus on developing suggestions for promoting recycling. A children's art contest could be held with the theme of recycling. Arrangements might be able to be made to display art on donated bus interior and exterior advertising space, increasing program visibility. Contests could be run to pick the best city, neighborhood, or organization for recycling participation.

Timing: Upon program implementation, ongoing.

Cost: Donated prizes and media publicity would keep costs down.
No additional cost beyond coordinator's budget.

Activity: <u>Community Drives</u>

Responsibility: Coordinator

Description: Recycling "days" (or weeks, or months) should be organized using as much community involvement as possible. Enlisting the aid of scouts, churches, senior citizen centers and other interested organizations can heighten the level of interest in community drive promotions. Goal setting for specific amounts of various materials is effective in getting everyone in the spirit of doing their part. Communities can have drives to collect special materials for recycling or pick-up such as used motor oil (residents can be given donated plastic milk bottles for collection by waste haulers), bulky goods, and so forth.

Timing: Ongoing activity.

Cost: No additional cost beyond coordinator's budget.

Activity: <u>Paid Media Advertising</u>

Responsibility: Coordinator

Description: Display advertising space in local newspapers may be purchased to promote specific events or aspects of the recycling program. A special pull out newspaper advertising section (tabloid format) is an effective attention getting advertising means. Program information such as schedules for special pick-ups, events and so forth included in the tabloid can then be conveniently saved by the reader.

Purchased radio and television time for program informational spots is included in this element and would require the services of a consultant for scripting, production and distribution. Purchase of television time is cost prohibitive and should only be undetaken if production could be completely borne by State and significant donated time is also made available by individual station. Local cable television is an alternative, however, exposure to the public is minimal. Any purchase of radio or television time should be accompanied by a guarantee of publicity and PSA time.

Timing: Ongoing activity.

Cost:

Newspaper (creative, production, placement)	
Tabloid per insertion	$12,000
Display Ads per campaign	$ 3,000
Radio (creative, production, placement)	
Paid Spots per flight	$ 4,000
Television (creative, production, placement)	
Paid Spots per campaign	$20,000

Activity: Brochures, Posters, Flyers

Responsibility: Coordinator

Description: Information about the the need for recycling, the recycling program itself and its benefits can be effectively presented in brochures, posters and flyers. Concise, well written pieces such as these can be used for press kits, outreach programs, events, speaking engagements, school programs, information days, direct mail and so forth.

Preparation of copy, design and production should be done by a consultant under the direction of the coordinator. All materials should be printed on recycled materials.

It is possible to keep costs at a minimum be using materials already prepared and available through the State of Illinois Department of Energy and Natural Resources, however, these materials would not be specific to the local program. It would be desirable to have at least one locally produced marketing piece supplemented by the more generic materials available through the State.

Timing: Prior to program implementation, ongoing.

Cost: $3,000 - $5,000 per piece (depending on quality and quantity)

Activity: Displays

Responsibility: Coordinator

Description: A portable, lighted display which could be set up at speaking engagements, events, shopping malls, supermarkets, local fairs and festivals and so forth should be fabricated. Panels with pictures, samples of recycled products and general visual presentation of the recycling program process is an effective educational tool. The display would not necessarily need to be manned, and could be loaned out for functions.

Timing: Upon implementation of program.

Cost: $3,000 - $4,500 for creative and production of display by consultant.

Activity: Slide Show

Responsibility: Coordinator

Description: A ten to fifteen minute slide show with taped narration should be prepared to present information about recycling in general and the County's recycling program specifically. General images and discussion should include:

- County setting, statistics on population and waste
- Landfill operations, capacity concerns
- Illinois Solid Waste Management Act
- Recycling requirements
- County recycling program, identity and slogan segue into brief explanation
- Benefits of program
- Close (possibly with testimonials)

Timing: Immediately upon program implementation.

Cost: $5,000 - $6,000 for creative and production by consultant.

Activity: <u>Souvenirs</u>

Responsibility: Coordinator

Description: Inexpensive advertising specialty items should be produced as recycling promotional "give-aways." Whenever possible, items should be fabricated out of recycled materials. Items which might be considered would include bumper stickers, shopping bags, sun visors, biodegradable trash bags, hats, T-shirts, and so forth. These items should bear the imprint of the program identity and slogan. Souvenirs should be freely given away at events, meetings, fairs, parades, workshops, press conferences, school programs, special outreach activities, during community drives, and at other activities attended by the coordinator.

Timing: Immediately upon program implementation.

Cost: \$6,000 - \$8,000 would be an adequate budget to begin program activities.

Activity: <u>Direct Mail and Printed Inserts</u>

Responsibility: Coordinator

Description: Community promotion for the recycling program can be conducted effectively by direct mail. In areas where pilot programs are put into place or where collection procedures are being changed, direct mail will be very desirable.

Contact can be made with companies and stores which send monthly billings to request that recycling program printed inserts are included in mailings. Substantial savings will be realized with insertions.

Timing: Upon implementation of program.

Cost: $2,000 per 10,000 pieces (preparation and postage) for direct mail.

$1,000 per 10,000 pieces (preparation for distribution) for inserts.

Activity: <u>Billboards</u>

Responsibility: Coordinator

Description: One or more billboards promoting the recycling program could be installed at high visibility locations along major roadway corridors. Billboard companies can prepare artwork and oversee production and installation.

Timing: Immediately upon program implementation.

Cost: $1,200 - $1,800 per month (depending upon location).

Activity: Monitoring and Evaluation

Responsibility: Coordinator

Description: The objective of the Public Education and Information element of the recycling program is to create understanding and acceptance of recycling. The measure of success of the element is the degree to which attitudes and behavior are changed.

Throughout the program, it will be necessary to continually monitor changes in those attitudes and behavior and discover what motivates change. Through this process, it will be possible to adjust the emphasis of the Education and Information element toward those activities which generate the most positive results.

Particular attention should be focused on measuring successful promotional techniques applied in pilot programs, since these programs will be carried out in small geographic areas where assessment is more easily carried out. Before and after program participation measurements and the application of various survey techniques should be employed.

Timing: Ongoing, as warranted.

Cost: Minimal, depending on measurement survey techniques employed.

Scheduling of Activities
Recycling Program Public Education and Information Element

Activity	Pre-Program	Start-Up	Ongoing
	Implementation Schedule		
Project Coordination			
Program Identity	<--------------	-------------->	
Data Base	<--------------	-------------->	
Coordination			<-------->
Public Relations			
Clearinghouse		<------------>	
Speakers Bureau			<-------->
News Releases			<-------->
Press Conferences			<-------->
Press Kit	<------------>		<-------->
Newsletter			<-------->
Print Publicity			<-------->
Radio and TV PSA's			<-------->
Workshops	<--------------	-------------->	<-------->
Tours			<-------->
Promotions			
Outreach		<------------>	<-------->
School Programs		<------------>	<-------->
Contests	<------------>		<-------->
Community Drives			<-------->
Advertising and Marketing			
Paid Media			<-------->
Brochures	<------------>		<-------->
Display		<------------>	
Slide Show		<------------>	
Souviners		<------------>	
Direct Mail		<------------>	
Billboards		<------------>	
Monitoring and Evaluation			<-------->

#624-02

RESOLUTION ADOPTING THE FIVE YEAR UPDATE OF THE SOLID WASTE MANAGEMENT PLAN

WHEREAS, the Illinois General Assembly has mandated that counties take the primary responsibility to plan for the management of municipal waste within their boundaries to ensure the timely development of needed waste management facilities and programs; and

WHEREAS, a Solid Waste Management plan was adopted by the St. Clair County Board on June 25, 1990, approved by the Illinois Environmental Protection Agency (the "Agency"), and readopted by the County Board on April 29, 1991; and, July 29, 1996; and

WHEREAS, the Solid Waste Plan was adopted in conjunction with Monroe and Madison Counties; and

WHEREAS, the Solid Waste Planning and Recycling Act (the "Act"), 415 ILCS 15/1 et. seq., requires that each Illinois county to prepare, adopt and implement a 20 year waste management plan and these plans be reviewed and updated every five years and any necessary or appropriate revisions shall be submitted to the "Agency" for review and comment; and

WHEREAS, an update of the Solid Waste Plan has been prepared in conformity with the "Act" and is proposed for adoption and submission to the "Agency"; and

WHEREAS, the Environmental Committee from St. Clair County recommends adoption of the plan update.

NOW, THREFORE, BE IT RESOLVED by the County Board of the County of St. Clair, Illinois that it hereby adopts the St. Clair County Solid Waste Plan Five Year Update and approve submission to the "Agency."

APPROVED AND ADOPTED by the County Board of St. Clair County this 28th day of January, 2002.

Alan Banmin

Chairman, St. Clair County Board

ATTEST:

Bob Delaney

Clerk of the Board

8-b-3

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RESOLUTION No. #624-02

Page 2

REVIEWED BY:

Robert B. Harda

State's Attorney

Director of Administration

SUBMITTED BY:

Dixie M. Seibert

Frank Boyce

C. David Tiedeman

Robert L. Heyrbich

Edward L. Lockwell

Joseph L. J. Hardy Jr.

ENVIRONMENT COMMITTEE

APPROVED BY:

X

Ed Anderson

Dixie M. Seibert

Richard Verner

Ralph Seaberry Sr.

F X Werty

JUDICIARY COMMITTEE

8-b-3

19

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

1021 NORTH GRAND AVENUE EAST, P.O. BOX 19276, SPRINGFIELD, ILLINOIS 62794-9276

RENEE CIPRIANO, DIRECTOR

FIVE YEAR MUNICIPAL WASTE MANAGEMENT PLAN UPDATE

The Agency has prepared this form to assist local governments with the five year updates of municipal waste (MW) plans. Although local governments may prepare and submit a more extensive document, the Agency will consider submission of this completed form to be the plan update required under the Solid Waste Planning and Recycling Act (SWPRA).

Attach additional labeled pages as necessary.

GENERAL INFORMATION

Local Government: St. Clair County

Contact Person: Barb Hohlt

Address: 19 Public Sq., ste. 150

Belleville, IL 62220

Telephone: 618-233-7769 Plan Adoption Date: June 20, 1990

Re-Adoption Date: April 29, 1996 Plan Update Due: 2001

---

1. **Recommendation and Implementation Schedule Contained in the Adopted Plan**

This information should be easily accessible in the plan's Executive Summary or Recommendations chapter. Briefly describe the recommendations and implementation schedule for each alternative in the adopted plan below.

a. Source Reduction

Education programs to schools, businesses and citizens continue. Special emphasis on businesses has been the target group, along with county-wide waste audit surveys.

b. Recycling and Reuse

The plan called for a 25% recycling rate by 1996. This has been accomplished and current data reflects a 44% recycling rate in 2000, and a 3 lbs/person of waste generated compared to the state average from 1999 of 6.9 lbs/person. Schools have a well established paper recycling program supported by businesses and citizens. We continue to support drop-off recycling and the latest directory is attached.

c. Combustion for Energy Recovery

~~There is no current plan to develop a waste-to-energy facility in St. Clair~~ County at this time.

d. Combustion for Volume Reduction

~~This is not recommended as part of the plan.~~

e. Disposal in Landfills

The plan anticipated the need for additional landfill space and this was implemented in Nov. 1999 with the operation of the Cottonwood Hills/Marissa Landfill which has an expected life of 35 years. The existing Milam/ESL landfill current life expectancy is 5-6 years , however, efforts are underway for possible expansion.

2. **Current Plan Implementation Efforts**

a. Which recommendations in the adopted plan have been implemented?

~~1. Source Reduction~~

2. Recycling and Reuse

3. Disposal in Landfills

Briefly describe which recommendations were not implemented and the reasons why these were not implemented.

At this time, the County has yet to determine the development of a waste-to-energ facility to be feasible. Low disposal costs, ample landfill space, increased recycling efforts and the lack of flow control authority are some of the reasons the county has not pursued this option.

8-63

b. Which recommendations in the adopted plan have been implemented according to the plan's schedule?

Source reduction, Recycling and Reuse and Disposal in Landfills have all been implemented, however, some modifications have been made to better reflect the need and practicability.

Briefly describe which recommendations were not implemented according to the adopted plan's schedule, and attach a revised implementation schedule.

Waste-to-energy has not been implemented (see reasons in #2). Continued evaluation of this option shall be done and made in joint effort of all 3 counties.

3. **Recycling Program Status**

Because the Agency's annual landfill capacity report includes data on each adopted plan's recycling status, information on your recycling percentages is not being requested on this form. This will avoid duplication of efforts.

a. Has the program been implemented throughout the county or planning area:
yes X no ____

b. Has a recycling coordinator been designated to administer the program?
yes X no ____ If yes, when? 11-6-89

c. Does the program provide for separate collection and composting of leaves?
yes X no ____

d. Does the recycling program provide for public education and notification to foster understanding of and encourage compliance with the program?
yes X no ____

e. Does the recycling program include provisions for compliance, including incentives and penalties?
yes ____ no X If yes, please describe.

f. Does the program include provisions for recycling the collected materials, identifying potential markets for at least three materials, and promoting the use of products made from recovered or recycled materials among businesses, newspapers, and local governments?
yes X no ____ If yes, please describe.

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An extensive educational program encouraging participation in recycling and the use of recycled content materials has been promoted and continues to be enhanced throughout the County to schools, businesses and citizens.

g. Provide any other pertinent details on the recycling program.

A Pollution Prevention Partnership (P2 Partnership) group has been established with apporximately 70 members from schools, businesses, government officials and citizens. The function of this group is to serve as a resource for ideas to enhance program activities, evaluate needs and support community efforts.

4. **Current Needs Assessment Information (optional)**

Depending upon the available resources, updated waste generation data, current municipal waste recycling and disposal information, and any other recent available data may be included; this information will not be required by the Agency.

a.	MW generated per year:	140,205	tons	462,676	cubic yards
b.	MW generation rate:	3	pcd	(lbs/capita/day)	
c.	MW recycled/year:	61,843	tons		
d.	MW incinerated/year:		tons		cubic yards
e.	MW landfilled/year:	78,362	tons		cubic yards

Time period for this information: 2000 ****This information is only estimated for County waste.

4. **New Recommendations and Implementation Schedule**

Due to political, fiscal, or technological changes, a local government may choose to recommend different waste management options for the review plan. It should be noted, however, that the recycling program requirements of the SWPRA must be followed. Discuss any new recommendations included in the revised plan, and the implementation schedule to be followed.

Continue to explore waste-t-energy options and monitor landfill capacity. This shall be done as a joint effort by the 3 counties. Future revisions to the plan will be a cooperative effort of all 3 counties.

8-b-3

#92-96-R

RESOLUTION ADOPTING THE FIVE YEAR UPDATE OF THE SOLID WASTE MANAGEMENT PLAN

WHEREAS, the Illinois General Assembly has mandated that counties take the primary responsibility to plan for the management of municipal waste within their boundaries to ensure the timely development of needed waste management facilities and programs; and

WHEREAS, a Solid Waste Management Plan was adopted by the St. Clair County Board on June 25, 1990, approved by the Illinois Environmental Protection Agency (the "Agency"), and readopted by the County Board on April 29, 1991; and,

WHEREAS, the Solid Waste Plan was adopted in uniformity with Monroe and Madison Counties; and

WHEREAS, the Solid Waste Planning and Recycling Act (the "Act"), 415 ILCS 15/1 et. seq., requires that solid waste plans be reviewed and updated every five years and any necessary or appropriate revisions shall be submitted to the "Agency" for review and comment; and

WHEREAS, an update of the Solid Waste Plan has been prepared in conformity with the "Act" and is proposed for adoption and submission to the "Agency"; and,

WHEREAS, an Executive Summary of the five year plan update has been prepared and is proposed in uniformity with Monroe and Madison Counties; and

WHEREAS, the Environmental Committees from Madison, Monroe, and St. Clair Counties are jointly recommending adoption of the plan update.

NOW, THEREFORE, BE IT RESOLVED by the County Board of the County of St. Clair, Illinois that it hereby adopts the St. Clair County Solid Waste Plan Five Year Update and approves submission to the "Agency".

APPROVED AND ADOPTED by the County Board of St. Clair County this 29th day of July, 1996.

Wade H. Brunsmann
Debra M. Seibert
Robert L. Gentsch
Frank Boyne
Joseph Kasky

Environmental Committee

Kenneth J. Slatz
[illegible]
Debra M. Seibert
Ed Anderson
Charles Powell

Judiciary Committee
(Approved 7/22/96 meeting)

John Baricevic

Chairman, St. Clair County Board

A. X. Heiligenstein

ATTEST:

Sam Flood

County Clerk

State of Illinois
ENVIRONMENTAL PROTECTION AGENCY

Mary A. Gade, Director

2200 Churchill Road, Springfield, IL 62794-9276

FIVE YEAR MUNICIPAL WASTE MANAGEMENT PLAN UPDATE

The Agency has prepared this form to assist local governments with the five year updates of municipal waste (MW) plans. Although local governments may prepare and submit a more extensive document, the Agency will consider submission of this completed form to be the plan update required under the Solid Waste Planning and Recycling Act (SWPRA).

Attach additional labelled pages as necessary.

GENERAL INFORMATION

Local Government: St. Clair County, Illinois

Contact Person: Barbara A. Hohlt

Address: 19 Public Square, Suite 150
Belleville, IL 62220-1624

Telephone: (618) 233-7769 Plan Adoption Date: June 25, 1990

Re-Adoption Date: April 29, 1991 Plan Update Due: April 29, 1996

1. Recommendations and Implementation Schedule Contained in the Adopted Plan

This information should be easily accessible in the plan's Executive Summary or Recommendations chapter. Briefly describe the recommendations and implementation schedule for each alternative in the adopted plan below.

a. Source Reduction

See Attachment "A"

b. Recycling and Reuse

See Attachment "B"

b. Which recommendations in the adopted plan have been implemented according to the plan's schedule?

See Attachment "3"

Briefly describe which recommendations were not implemented according to the adopted plan's schedule, and attach a revised implementation schedule.

See Attachment "3"

3. Recycling Program Status

Because the Agency's annual landfill capacity report includes data on each adopted plan's recycling status, information on your recycling percentages is not being requested on this form. This will avoid duplication of efforts.

a. Has the program been implemented throughout the county or planning area?
yes X no ____

b. Has a recycling coordinator been designated to administer the program?
yes X no ____ If yes, when? 11-6-89

c. Does the program provide for separate collection and composting of leaves?
yes X no ____

d. Does the recycling program provide for public education and notification to foster understanding of and encourage compliance with the program?
yes X no ____

e. Does the recycling program include provisions for compliance, including incentives and penalties?
yes ____ no X If yes, please describe.

f. Does the program include provisions for recycling the collected materials, identifying potential markets for at least three materials, and promoting the use of products made from recovered or recycled materials among businesses, newspapers, and local governments?
yes X no ____ If yes, please describe.

ATTACHMENT "A"

1. Recommendations and Implementation Schedule Contained in the Adopted Plan.

   a. Source Reduction

   Source reduction activities were planned and developed that promote the reduction of the amount of waste generated. The primary goal involves education activities targeted at the residential, institutional, and business sectors of our municipal waste generators. The implementation schedule called for the development of these activities immediately.

   b. Recycling and Reuse

   The plan outlined several recycling and reuse activities including the development of residential curbside recycling programs, commercial and institutional recycling, drop-off recycling, the development of a material recovery facility, and educational activities. The implementation schedule called for the development of these programs targeted at recycling 15% of the waste stream by the third year and 25% by the fifth year.

   c. Combustion for Energy Recovery

   The plan called for the development of a waste-to-energy facility. It was suggested that more than one facility could be developed. Each county was to be responsible for the evaluation of the need for waste-to-energy facilities to accommodate disposal of waste generated within its boundaries. If an acceptable agreement could be worked out, then a joint effort could be pursued. The implementation schedule was to begin within three years to determine the feasibility of developing such a facility. Once the feasibility was determined, a three year implementation schedule was to be followed to develop the facility.

   d. Combustion for Volume Reduction

   Combustion for volume reduction was not recommended as part of the plan.

   e. Disposal of Landfills

   The plan anticipated the need to develop new landfill capacity once existing capacity is depleted. The plan outlined the process and criteria for developing a landfill but did not commit the three counties to implementation. The need and time table for pursuing this will to be determined at a later date.

ATTACHMENT "B"

2. Current Plan Implementation Efforts

a. Which recommendations in the adopted plan have been implemented?

Source reduction and recycling recommendations of the plan have been implemented. Programs and activities promoting recycling and reduction in waste generated have been developed, such as annual presentations at every Senior Nutrition Site in the County. During the presentations ideas were exchanged regarding source reduction initiatives. Displays reinforcing source reduction were also provided annually at every school science fair, and several community functions. See Attachment "C" for additional information on recycling implementation.

The county has not participated in the development of new landfill capacity. This has occurred in the private sector, however, through the expansion of the Laidlaw Roxanna landfill in Madison County and the Waste Management Milam landfill in St. Clair County.

Briefly describe which recommendations were not implemented and the reasons why these were not implemented.

The waste to energy provision of the plan has not been implemented. The county has yet to determine the development of a facility to be feasible. Low disposal costs at local landfills, ample landfill space, the lack of viable energy markets, public concerns regarding health and safety, financial risks in developing a facility, and the lack of flow control authority are some of the reasons the county has not pursued this.

b. Which recommendations in the adopted plan have been implemented according to the plan's schedule?

The source reduction and recycling and reuse recommendations of the plan have generally been implemented according to the plan's schedule. Some of the recommendations have been modified and programs and activities changed to better reflect need and practicability. The overall intent of the recommendations, however, has been met according to the schedule through the development of a comprehensive source reduction and recycling/reuse program by the fifth year of implementation of the plan, by reaching the 25 percent recycling goal.

Briefly describe which recommendations were not implemented according to the adopted plan's schedule, and attach a revised implementation schedule.

The waste-to-energy recommendation of the plan was not implemented. The county continues to evaluate the feasibility of implementing this component of the plan and is concentrating on the remaining components at this time.

The development of a landfill has also been implemented. The original plan called for a possible joint development of a landfill by the three counties when it was determined that new landfill capacity was needed. Due to landfill expansions and proposed new landfill in Marissa, it has yet to be determined that the three counties need to engage in the development of a landfill.

A revised implementation schedule includes the following:

Continued exploration into waste-to-energy shall take place. Revisit the waste-to-energy recommendations from the original plan in the future when the development of such a facility becomes economical, technological, and feasible.

When it is determined that a need exists for the development of a waste-to-energy facility, consideration should be made for joint effort by the three counties.

Continue to monitor landfill capacity for St. Clair County to assure adequate capacity is available.

If it is determined that landfill capacity will soon be exhausted, a regional cooperative effort between Madison, Monroe, and St. Clair Counties will be considered to develop additional capacity.

ATTACHMENT "C"

RECYCLING PROGRAM STATUS

IMPLEMENTED ACTIVITIES

- Worked with haulers and municipalities to assist in developing source separated recycling programs that produce high recycling rates and are cost effective.

- Provided assistance and grants to units of local governments in managing their solid waste stream. A recycling coordinator was hired to work directly with units of local government. Over $230,000 of grants were provided by the county to assist schools and municipalities with their recycling efforts. Assistance was also provided to municipalities and private businesses in securing over $600,000 grants from outside agencies, which represents a total of nearly $1,000,000 in assistance.

- Assisted nine communities and two townships in the development of curbside recycling programs and assisted five communities and five townships with drop-off recycling programs.

- Provided assistance to businesses developing recycling programs. A Commercial Recycling Advisory Group and an Industrial/Manufacturer Environmental Advisory Group were established to aid in developing the commercial recycling programs. Over 300 businesses recycle office paper and cardboard.

- In March, 1996, the Belleville curbside recycling program and the Fairview Heights drop-off collection program will expanded to collect plastic.

- Promoted comprehensive adult recycling education on a continuing basis.

- Acted as a recycling information clearinghouse for residents, institutions, and businesses.

- Implemented a school recycling education program that includes a county sponsored school paper recycling program. Since 1991 nearly 350 tons of paper has been recycled by the school program.

- Assisted Belleville Recycling in expanding their Primary Processing Facility. Assisted other recycling collection programs.

- Assisted Waste Recovery Illinois in establishing a tire processing center in St. Clair County. The center has the capacity to process over 7.2 million tires each year at their two Illinois locations. Illinois Power is accepting the tires to use as a power source at the Baldwin Plant.

- Implemented tire and household hazardous waste collection programs.

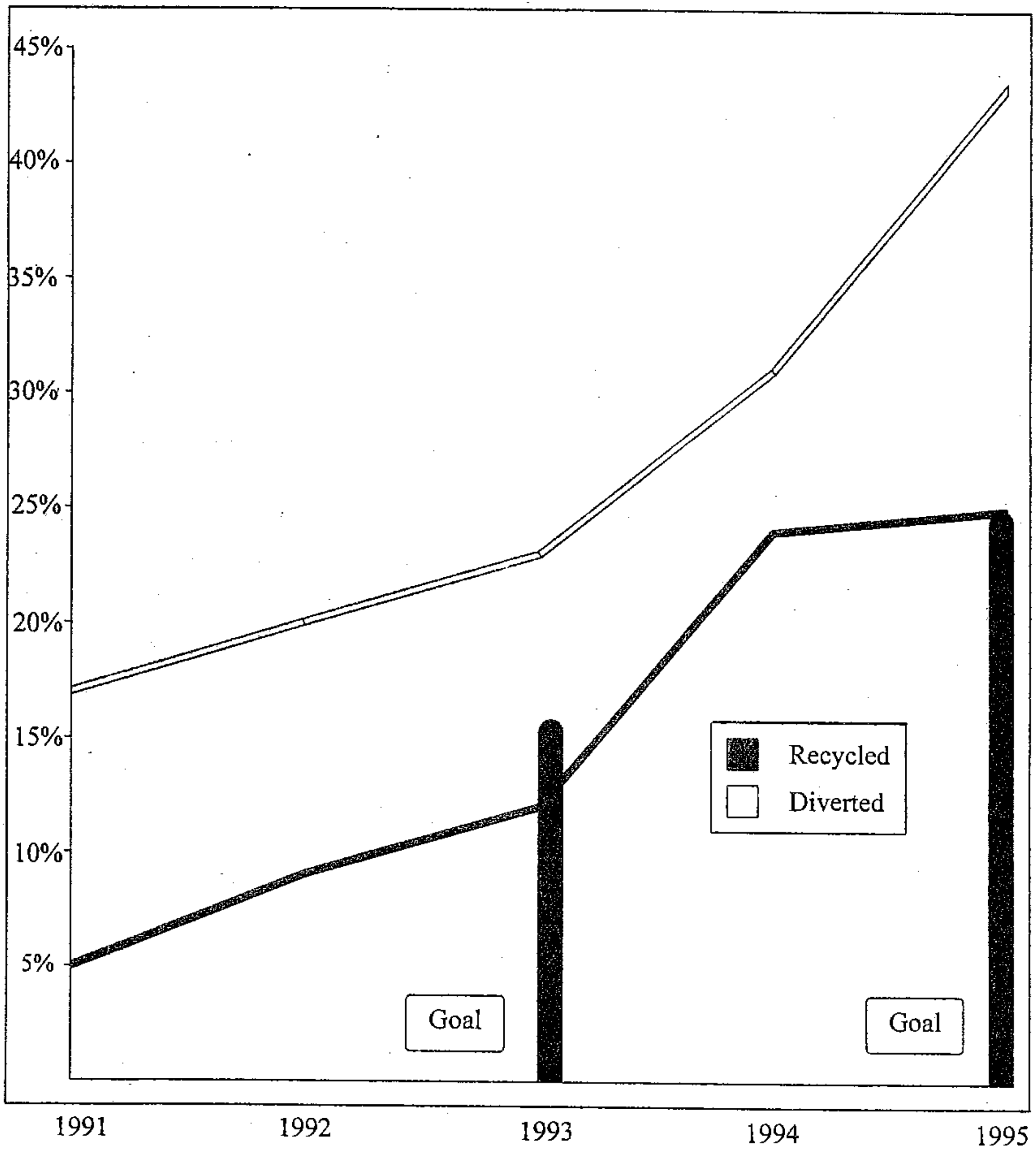
- Assisted units of local government in landscape waste management programs.
- A data base system was developed to record the haulers and processors recycling volume reports.

ST CLAIR COUNTY HEALTH DEPARTMENT RECOGNITIONS

- Received the 1995 National Association of City and County Health Official's "Excellence in Environmental Health" Award for Pollution Prevention Activities including leaf management and paper recycling.
- Received East West Gateway's Outstanding Achievement through Public-Private Partnerships Award.
- Received the American Forest and Paper Association's 1994 Best Paper Recycling Award for the County Office/School Paper Recycling Program.

Attachment "D"

St. Clair County
% Diverted vs % Recycled



Diverted: Recycling data, tires recycled, and landscape waste not included in recycling data.

Recycled: Aluminum, glass, metals, paper, plastic, construction/demolition and landscape waste processed for a secondary use.

Goal: In 1988, the State of Illinois enacted the Solid Waste Planning and Recycling Act, requiring counties to recycle 15% of the waste generated by the end of the third year and 25% by the end of the fifth year.

ATTACHMENT "E"

APPENDIX III
FIVE YEAR PLAN UPDATE
RECOMMENDATIONS AND IMPLEMENTATION

The following recommendations for adoption and implementation are as an amendment to the St. Clair County Solid Waste Plan, first adopted on June 25, 1990 and readopted on April 29, 1991. The update will be made part of the 1991 plan as an appendix. The objective of the update is to serve as a blueprint for managing solid waste in St. Clair County for the next five years. The original plan shall remain in effect as supporting documentation.

Source Reduction

Volume reduction at the source is at the top of the IEPA solid waste management hierarchy. Past volume reduction efforts have relied upon general education of the public. It may be necessary to develop specific waste reduction strategies to further expand efforts.

RECOMMENDATION: Existing waste reduction efforts should be expanded by establishing a percentile waste reduction goal and developing new programs and policies to help meet the goal.

Waste reduction efforts have been carried out in households, schools, institutions, and businesses. The effort should be expanded by first collecting data on existing waste reduction efforts, next developing potential activities to increase waste reduction, and then establish a realistic percentile goal for the amount of the waste stream reduced through these programs and activities.

RECOMMENDATION: Continue to provide source reduction education to the residential, institutional, and commercial sectors.

Education materials shall be updated for waste reduction activities in households, institutions, and businesses. Activities such as mailings, press releases, and electronic media public service announcements shall be targeted for all three sectors.

The school education program shall continue to promote waste reduction in both schools, and homes. Schools districts shall consider a 2-sided paper policy district wide. The use of individual slates and chalkboards shall be encouraged in lieu of using paper for drills and practice. Other practices such as the use of overhead projectors in lieu of handouts, Scantron testing sheets, and routing slips for memos shall be promoted. Business seminars and industry specific business waste reduction packets shall be used to promote waste reduction in the institutional and business sectors.

RECOMMENDATION: Develop waste reduction assessment procedures, such as waste audits, for all sectors contributing to the municipal waste stream.

Waste audits for institutions and businesses shall be used to assist in identifying methods for reducing waste. Businesses and institutions will be encouraged to conduct an analysis of waste reduction potential by including in the planning personnel who are integral in carrying out activities associated with generation and disposal of waste.

RECOMMENDATION: Encourage the establishment of volume based collection fees.

Establishing waste collection fees based on volume has been expanding across the country due to the effectiveness in increasing recycling rates and waste reduction. By creating an economic incentive (in lower monthly collection bills) to recycle and reduce waste, more households will engage in recycling and waste reduction activities. Communities shall continue to be encouraged to structure waste collection and payment based on volume. Several payment methods have been successful in Illinois municipalities. The county shall assist the municipalities in tailoring the type of payment methods that will work best in their community.

Recycling and Reuse

The second component of the Illinois hierarchy of solid waste management alternatives is recycling and reuse. The implementation of recycling programs have been the most involved of solid waste management efforts in the first five years. The efforts, in response to the state mandated 25% recycling rate by the fifth year, have resulted in a comprehensive approach to recycling all sectors responsible for generating the municipal solid waste stream.

There are currently nine municipalities and two townships in St. Clair County with curbside recycling. In addition, five municipalities and five township have drop-off recycling programs.

Commercial and institutional recycling continues to expand. Seventy-eight public and parochial schools in St. Clair County have recycling programs. Most large generators of fiber such as department stores, grocery stores, and fast food restaurants also have fiber recycling programs in place. Many medium and small generators of waste also have established recycling programs.

Reuse activities such as the commercial and industrial material exchange program continue to expand. The promotion of reuse retailers and education programs targeted at household and businesses shall be continued.

Further expansion of recycling and reuse activities are needed to exceed the state mandated 25% recycling rate and provide for a more comprehensive and effective solid waste management effort.

RECOMMENDATION: Continue to support the development of source separated recycling programs that produce high recycling rates and are cost effective.

The industry standard for recycling in the United States, Illinois, and the St. Louis metropolitan area is source separated recycling. Due to expanding markets for recyclable materials and low area disposal costs for waste, source separated recycling represents the most cost effective method of recycling for the residents of St. Clair County.

Recovered materials from source separated recycling programs are considered high quality by the markets due to low levels of contamination. The markets in return provide a higher payment for the material.

RECOMMENDATION: Monitor recycling activity in the residential sector through reporting to assure that a 25% recycling rate is being met. In units of local government which fall short of the 25% recycling rate, recycling enhancements such as additional education, volume based fee collection, and mandatory recycling shall be encouraged.

The state mandated 25% recycling rate is being implemented in the residential sector through voluntary residential recycling programs. Units of local government have the option of developing specific recycling programs tailored for their community, designed to maintain and exceed the 25% rate.

Units of local government who develop specific recycling programs will likely implement voluntary curbside recycling programs where all residents will be given the opportunity to recycle but the participation will not be mandatory. The program relies on education and the publics desire to "do their share" in achieving high enough participation rates to maintain and exceed the 25% rate. These programs are the most widely used type of curbside recycling programs in the country and have been effective with proper design and education.

If a local government program fails to maintain the mandated 25% recycling rate, then recycling enhancements such as additional public education, the use of volume based collection, and mandatory participation recycling shall be considered.

RECOMMENDATION: Encourage the development of a network of conveniently located containers to be used for drop-off recycling.

Mass recycling programs such as residential curbside and commercial on site collection are cost effective and easy to implement. These programs are capable of serving the majority of residences and businesses in the county. They may not, however, be practical to others such as rural households, small businesses with too little material or space to justify on site collection, or multiple family housing. In these cases, the expansion of a mobile recycling collection unit will be used for drop-off recycling to serve their needs.

The mobile unit is contracted through a private hauler and is placed on a regular basis at a consistent location to collect recyclables. This system assures appropriate use because it is staffed.

RECOMMENDATION: Expand assistance to businesses developing recycling programs with a goal to exceed a 25% recycling rate.

Commercial recycling should continue to be expanded. Publicity and education promoting the services that are available and the rewards of recycling will be part of an ongoing program. Brochures and packets will be developed and circulated.

Staff will continue to provide direct technical assistance to businesses developing new recycling programs. A support system comprised of representatives from the Chambers of Commerce, commercial associations, waste haulers, and local government groups will be used to explore further commercial recycling opportunities.

RECOMMENDATION: Monitor the development of recycling in the commercial sector. If voluntary recycling programs do not achieve a 25% recycling rate, then recycling enhancements such as additional education shall be considered.

The use of regulations to encourage recycling may need to be developed. Legislation could be adopted either by requiring recycling in businesses or creating an economic incentive to recycle by adopting state legislation that will charge a volume based penalty for those businesses not recycling.

RECOMMENDATION: Continue to expand the Material Exchange Program to increase the reuse of materials generated by business and industry.

A material exchange program has been developed that provides a catalog of participating businesses and the types of materials available. The materials may be a waste to the generator, but could be reused by others. The program should continue to be promoted and more participation solicited.

Instead of disposing of certain materials which a business may consider waste, it may list that material in the catalog. Another business may make contact and make arrangements to use the material which would have been discarded and disposed. The benefit of the material generator is lower disposal costs. The businesses accepting the material experiences the benefit of acquiring the material at a much lower cost (usually free) then acquiring new materials.

RECOMMENDATION: Expand recycling programs to include accepting additional materials as methods and markets become available.

Currently, recycling programs in the county include aluminum, tin cans, plastic milk jugs and soda bottles, glass food and beverage containers (all colors), newspaper, and corrugated cardboard. Effective upon the opening of the Laidlaw Material Recovery Facility in March of 1996, additional items of mixed office paper, chip board, junk mail, magazines and catalogs, telephone directories, and colored HDPE may be made part of curbside and drop-off recycling programs. These materials may also be collected in schools and businesses.

Other items shall be included in the future markets and efficient collection methods are developed. These materials may include aerosol cans, aseptic packaging, six pack rings, textiles, aggregate glass (ceramics/plate glass), scrap ferrous, PVC, and polystyrene.

Other materials may be identified later as technological changes occur both in the development of new materials and recyclability of materials. The county should continue to work with the markets, processors, and waste haulers to achieve further expansion of acceptable materials.

RECOMMENDATION: Promote comprehensive adult recycling education on a continuing basis.

A Recycling Educator will be hired to assist with the maintenance and expansion of educational programs. Ongoing adult education is an important component of the solid waste management plan.

Continued educational support to existing programs as well as the development of new programs are emphasized in this effort. Materials such as brochures to persuade residents to participate in recycling programs, explaining the correct preparation of materials, and describing the need for recycling shall be developed. These efforts should be ongoing in all areas of the County.

RECOMMENDATION: The implemented recycling school education program shall be maintained and expanded to include source reduction, recycling and reuse activities.

A comprehensive recycling school education program has been developed in St. Clair County. The program is important and effective in influencing young peoples behaviors and attitudes toward the environment. The program should continue to be maintained and expanded.

School districts that have not made recyclable collection as part of their standard waste hauling contract, will be encouraged to do so to further promote cost savings in recycling and waste disposal.

School districts will be encouraged to adopt procurement standards promoting the use of materials made with recycling content.

Other activities such as establishing annual teacher education workshops, coordinating recycling coordinator's meetings in each school district, continuing the earth flag and streamer program, the development of contests and special events, and student leadership programs will be undertaken to improve the level of waste reduction and recycling education provided to students.

RECOMMENDATION: Develop and promote recycling collection practices for private sector haulers that promote higher recycling levels and are cost effective. The proposed use of labor efficient two sort recycling vehicles with material processing facilities shall continued to be supported. The use of co-collection vehicles (waste and recyclables) shall be encouraged.

Major improvements have been made to recycling programs over the past five years. More convenient and cost effective recycling programs have been developed as the result of improved markets, more efficient handling methods by haulers, and processing technology.

Residents, businesses, and haulers no longer have to engage in the extensive separation practices at the source. This is performed in processing facilities. Residents only have to keep fiber separate from containers and only require one recycling bin to do it. Businesses can mix multiple types of fiber in one container.

Residential haulers only need vehicles equipped with two compartments in lieu of the old method of a separate compartment for each material. The capital costs for these vehicles are lower.

Smaller haulers have greater flexibility in modifying existing vehicles. Less time is also required at the curb since materials do not have to be sorted in separate compartments.

These types of changes have improved recycling and increased recycling rates. Further enhancements should continue as the recycling industry continues to mature. The use of dual collection vehicles (waste and recyclables) shall be explored to reduce collection costs. The benefit of having a material recovery facility for recyclables next to a landfill will make this more feasible. Other changes shall be encouraged to further improve and reduce costs for haulers.

RECOMMENDATION: Monitor the availability and operation of material recovery facilities to assure that adequate and competitive processing capacity is available. If it is determined that the county's needs are not being adequately met, then consider the development of a county sponsored material recovery facility.

With the existence of Belleville Recycling, Inc., a primary processing facility, the opening of the Laidlaw Material Recovery Facility, and the potential development of other processing facilities in the area, the county's processing needs will likely be met. It is the goal of the county to assure the processing capacity is available for its residents in a competitive and cost effective manner. Competition among the multiple processing facilities should help meet this goal.

RECOMMENDATION: Develop and implement a comprehensive multi-family dwelling recycling program.

Existing and future residential curbside recycling programs primarily target one and two family dwellings. Units of local government typically require the owners of multiple family dwellings to contract independently for waste removal. The characteristics of collection are also different for multiple family dwellings. Residents are usually asked to dispose of their trash in large trash dumpsters centrally located on the premises.

The development of multiple family recycling shall include encouraging apartment owners or managers to develop mini-drop off recycling sites.

These activities may be coordinated with private haulers. The use of legislation to require multiple family recycling shall be considered if voluntary program development is not effective.

RECOMMENDATION: Continue to collect recycling and municipal solid waste collection data and continue to improve reporting methods.

The reporting of municipal solid waste and recycling is necessary to assess solid waste management needs and the effectiveness of recycling programs. The information is needed to report to the state the county's performance in meeting state mandates. In addition, the data is essential in future planning activities.

RECOMMENDATION: Develop and implement a plan to allow the convenient and cost effective recycling of appliances, household batteries, household hazardous waste and construction and demolition debris.

Appliances, household batteries, household hazardous waste and construction and demolition debris have fewer recycling opportunities than other materials. While some of the materials have viable local markets, the convenient collection of the materials make them difficult to recycle.

The private sector has appeared to have adequately dealt with recycling opportunities for tires, used motor oil, and car batteries. New tire chipping operations at the Illinois Correctional Industries new East St. Louis facility and a processing facility in Dupo, which provides tire chips to Illinois Power for burning with coal, has provided outlets for tires. Scrap dealers are a viable market for appliances. Used car batteries and motor oil are accepted by most automobile parts and service retailers.

Fewer opportunities exist for household hazardous waste, household batteries and construction and demolition debris.

The office of Technology in the Bureau of Energy and Recycling in the Department of Commerce and Community Affairs continues to research methods to improve the recycling of these materials. The county will continue to monitor research findings and attempt to develop a plan to implement programs for the recycling of all materials. In addition, collection opportunities will be studied to provide for more convenient recycling of these materials. The use of the two existing landfills and the new material recovery facility shall be considered as potential drop-off sites for some of these materials.

RECOMMENDATION: Develop and implement a plan to provide an improved method of managing landscape waste. The plan should address both collection methods and composting operations.

Most of the residents in St. Clair County have access to curbside landscape waste collection. Some units of local government provide collection as a service to the residents. Other require residents to either contract directly or transport the waste to a centrally located drop-off site.

Currently, both of the landfills located in the County have compost facilities that are open to waste haulers and the general public. The landfill operators use the composed material for alternative daily cover and final vegetative layer. They also have provided the compost materials for reuse in residential, commercial, and agricultural applications.

The county should continue to explore new technology that could make landscape waste collection and composting operations more convenient and cost effective for residents. A detailed analysis should be performed and a plan developed to assist in doing this.

RECOMMENDATION: Continue to promote the development of business and industry that utilize recyclables in replacement of raw materials for products.

The development of new industry that utilizes recyclable materials is vital to both the success of recycling programs as well as the development of jobs and investment in St. Clair County. The county shall continue to promote locating these types of industries in industrial areas of the county.

Combustion for Energy Recovery

The original solid waste plan called for the development of incineration with energy recovery as long term strategy. The proposed used of waste-to-energy continues to be included as part of the plan. Since 1990 when the current solid waste plan was developed, significant changes have occurred locally and at the state and national level that will impact the county's ability to develop such a facility.

Issues that effect the development of a facility includes: availability of viable energy markets; high operating costs and high tipping fees charged at facilities as compared to landfills where space presently is ample and inexpensive; and the lack of "flow-control" authority.

These issues make the development of such a facility difficult and risky. The facilities can not compete with landfills due to cost. Present landfill disposal costs are approximately $25 per ton. Waste-to-energy disposal costs would likely be two to three times this amount. Local government cannot force waste to the facility due to flow-control restrictions. The result of this would likely be that facilities would need to be subsidized from other sources of revenues to lower the tipping fee to a range which is competitive with landfill disposal. In addition, local government would likely be required to back financing with general tax revenues.

RECOMMENDATION: Continued exploration into waste-to-energy shall take place. Revisit the waste to energy recommendations from the original plan in the future.

If a shortage in landfill space is projected, flow control legislation passes, energy markets become viable, financial risks for local government are minimal, and waste-to-energy is determined to be acceptable, then waste-to-energy as a disposal option will be explored by the county.

RECOMMENDATION: When it is determined that a need exists for the development of a waste-to-energy facility, the effort shall be undertaken by the three counties as a regional cooperative effort.

Due to the cost of developing a facility, and the large amount of waste needed to operate it, the three counties should join together in developing a facility that will service the needs of the three counties.

RECOMMENDATION: Review any privately developed waste-to-energy facilities to assure the primary beneficiary of the facility is Madison, Monroe and St. Clair Counties. Facilities proposed where the primary source of waste is from outside of three county area shall be considered inconsistent with the solid waste plan.

The intent of the Solid Waste Plan is to provide for the planning and implementation for the management of solid waste for residents of the three counties. The potential exists for waste-to-energy facilities to be developed whose primary purpose is to burn waste generated outside of the three county area. The development of such a facility which does not have a significant impact on the three counties solid waste stream, should be considered inconsistent with this plan.

<u>Disposal in Landfill</u>

The solid waste plan established criteria for the development of a landfill for the three county area replacing landfill capacity projected to be depleted. The effort was to be carried out jointly by three counties. Since the plan has been developed, new landfill capacity has been added to the area. At this point, the county has not determined a need to directly engage in the development of a new landfill.

It is estimated that St. Clair County has a remaining landfill capacity of between ten and twenty years. Life spans of landfills are affected by changes in disposal patterns in the area and the closing and expansions of other landfills. Hauling distance to landfills play a major part in decisions where waste is disposed of. Waste is usually diverted to a location where the combination of tipping fees and transportation time determines where waste is disposed of. The actual landfill capacity for the three county area, as shown in the tables below, is 38 years. Present disposal practices, however, place the life at 11 years. As also shown below, the impact of a landfill expansion such as the pending Marissa Landfill, will extend the life of the region's landfill capacity. Based on the below analysis, the regions landfills would have an expected life of 19 years if the Marissa Landfill is developed.

Landfill Capacity in Madison, Monroe, and St. Clair Counties:

<u>Three County Waste Only</u>

Remaining Capacity: 52,518,844 Cubic Yards
Annual Waste Disposal of: 1,382,484 Cubic Yards
Years of Capacity Remaining: 38

All Waste Disposal Including Out-of-State

Remaining Capacity: 52,518,844 Cubic Yards
Annual Waste Disposed of: 4,912,309 Cubic Yards
Years of Capacity Remaining: 11

Marissa Waste Management Expansion

Projected Additional Capacity: 39,500,000 Cubic Yards
Years of Additional Capacity (Three County): 28
Years of Additional Capacity Including Out-of-State: 8 years

Projected Total Landfill Capacity including Marissa: 19 years

Future landfill expansions in St. Clair County will depend on economics and environmental acceptability. The two existing Madison County Landfills both have room for expansion. The Waste Management Chain of Rocks Landfill has room to expand vertically and the Laidlaw Roxanna Landfill has room for expansion both vertically and horizontally. New stringent landfill regulations, increasing opposition of citizens and environmental groups, and the high cost of developing landfills make new landfills and expansions difficult to develop.

RECOMMENDATION: Continue to monitor landfill capacity for St. Clair County to assure adequate capacity is available.

St. Clair County shall continue to monitor the remaining landfill capacity. At the point when projections determine that additional capacity needs to be developed, then the county should engage in an analysis to determine the best method of increasing disposal capacity.

RECOMMENDATION: If it is determined that landfill capacity will soon be exhausted, then a regional cooperative effort with Madison, Monroe, and St. Clair County shall take place to develop additional capacity.

Due to the cost of developing a facility, and the large amount of waste needed to operate it economically, the three counties should join together in developing a facility that will service the needs of the three counties.

RECOMMENDATION: Any future landfill developments or expansions should include a provision of a "Host Agreement" being negotiated with the developer for an annual assessment to be used for solid waste management activities for the residents of St. Clair County.

The use of a "Host Agreement" is a widely used tool to generate revenues for waste management activities. It is particular beneficial in areas such as St. Clair County where it is estimated over 50% of the waste disposal in our landfills is from out-of-state sources.

Revenues generated from such agreement may be used to improve waste management programs. Activities may include providing more expanded services, reducing costs for existing waste management services, or to create a savings to be used to replace mature landfill capacity with new disposal capacity and assure proper closure of depleted landfills. Additionally, legislation needs to be enacted to provide financial assistance to monitor and assure public health and safety at waste transfer stations.

RECOMMENDATION: Support changes in federal legislation that give counties more control over out-of-state waste and flow control.

Supreme Court rulings in the 1990's have dramatically affected local governments ability to develop facilities and restrict usage of landfills. Out-of-state waste continues to fill up local landfills without restriction. New facilities are difficult to develop without the ability to secure long term commitments from waste generators.

Legislation should be supported giving states and local government greater control over the amount of out-of-state waste coming into our disposal facilities and allowing the use of flow control for developing new facilities.

RECOMMENDATION: Continue to review solid waste practices and technology.

Continued research into alternative disposal options is necessary in order for St. Clair County to be prepared in the event new capacity is required or new technology is developed which provides greater benefit.

IMPLEMENTATION SCHEDULE

Implementation of recommendations in the St. Clair County Solid Waste Plan have been ongoing since the plan's adoption.

The waste reduction and recycling and reuse programs and activities will continue to be developed and expanded. It is anticipated that most of the activities will be implemented within the next five year planning horizon.

The waste-to-energy provision of the plan will be pursued when it is determined that the disposal costs at a waste-to-energy facility are competitive with other area disposal facilities, a shortage of existing disposal capacity is projected within a few years, viable energy markets are available, and it is determined that financial risks for the county are minimal.

The development of additional landfill capacity will not be pursued until it is determine that existing capacity will be depleted within a few years.