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Environmental, Economic and Energy Impacts of Material Recovery Facilities

A MITE Program Evaluation

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ENVIRONMENTAL, ECONOMIC AND ENERGY IMPACTS OF MATERIAL RECOVERY FACILITIES A MITE PROGRAM EVALUATION

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DISCLAIMER

The information in this document has been funded by the United States Environmental Protection Agency (U.S. EPA) through Cooperative Agreement CR-818238 and the National Renewable Energy Laboratory (NREL) under Subcontract No. AB-2-1224Z with the Solid Waste Association of North America. It has been subject to the peer review and administrative review by both the U.S. EPA and NREL and has been approved for publication as a U.S. EPA and Department of Energy (DOE) document. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

This document contains numerous references to various methods and procedures for performing tests as part of the quality control and quality assurance process. The document references wherever possible consensus standards developed and approved by the U.S. EPA, the National Institute for Occupational Safety and Health, and the American Conference of Governmental and Industrial Hygienists. Other methods referenced in this document have been developed by individual parties and, therefore, do not necessarily represent consensus standards. The reference of non-consensus standards does not represent endorsement by the U.S. EPA or DOE.

FOREWORD

The United States Environmental Protection Agency (U.S. EPA) is charged by Congress with protecting the Nation's land, air, and water resources. Under a mandate of national environmental laws, the Agency strives to formulate and implement actions leading to a compatible balance between human activities and the ability of natural systems to support and nurture life. To meet this mandate, EPA's research program is providing data and technical support for solving environmental problems today and building a science knowledge base necessary to manage our ecological resources wisely, understand how pollutants affect our health, and prevent or reduce environmental risks in the future.

The National Risk Management Research Laboratory is the Agency's center for investigation of technological and management approaches for reducing risks from threats to human health and the environment. The focus of the Laboratory's research program is on methods for the prevention and control of pollution to air, land, water, and subsurface resources; protection of water quality in public water systems; remediation of contaminated sites and ground water; and prevention and control of indoor air pollution. The goal of this research effort is to catalyze development and implementation of innovative, cost-effective environmental technologies; develop scientific and engineering information needed by EPA to support regulatory and policy decisions; and provide technical support and information transfer to ensure effective implementation of environmental regulations and strategies.

This document is part of a series of publications for the Municipal Solid Waste Innovative Technology Evaluation (MITE) Program. The purpose of the MITE Program is to: 1) accelerate the commercialization and development of innovative technologies for solid waste management and recycling; and 2) provide objective information on developing technologies to solid waste managers, the public sector, and the waste management industry.

E. Timothy Oppelt, Director
National Risk Management Research Laboratory

ABSTRACT

This report documents an evaluation of the environmental, economic, and energy impacts of material recovery facilities (MRFs) conducted under the Municipal Solid Waste Innovative Technology Evaluation (MITE) Program. The MITE Program is sponsored by the U.S. Environmental Protection Agency to foster the demonstration and development of innovative technologies for the management of municipal solid waste (MSW). This project was also funded by the National Renewable Energy Laboratory (NREL).

Material recovery facilities are increasingly being used as one option for managing a significant portion of Municipal Solid Waste (MSW). The owners and operators of these facilities employ a combination of manual and mechanical techniques to separate and sort the recyclable fraction of MSW and to transport the separated materials to recycling facilities.

Despite the increasing use of these facilities, only limited data are available on the environmental, economic, and energy implications of MRFs. These data are necessary if solid waste managers are to make informed decisions on the design and operation of integrated municipal solid waste management (IMSWM) systems. To help close this data gap, a comprehensive evaluation was performed to determine the environmental, economic, and energy aspects of six operational MRFs. The participating MRFs are geographically distributed throughout the country, receive both commingled and source separated wastes, and employ a variety of techniques to recover recyclables. The facilities are located in the following jurisdictions: Islip, New York; Montgomery County, Maryland; Albuquerque, New Mexico; Hartford, Connecticut; Rice County, Minnesota; and Orange County, Florida.

The primary objective of the evaluation was to understand the effects of MRF operations on public health and the environment, as well as on occupational health and safety. The environmental evaluation conducted at the six MRFs considered the impacts on ambient air quality, receiving waters, and community noise levels, while the occupational health and safety evaluation addressed exposure to chemicals, biological aerosols, and occupational noise, as well as physical safety hazards and ergonomic stressors. The economic and energy aspects of MRFs must also be understood to fully appreciate these impacts in the context of the IMSWM system. The economic and energy evaluation was based on publicly available information or material provided by the owners or operators of the participating MRFs.

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The Appendices are not included in this report, since the majority of the field test results have been incorporated into the body of the document. To obtain a copy of the Appendices, make a request in writing to:

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FIGURES

TABLES

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This report was prepared under the coordination of Lynnann Hitchens, U.S. Environmental Protection Agency (U.S. EPA) Municipal Solid Waste Innovative Technology Evaluation (MITE) Program Manager, at the National Risk Management Research Laboratory, Cincinnati, Ohio and Philip B. Shepherd, Technical Monitor, at the National Renewable Energy Laboratory (NREL), Golden, Colorado. Contributors and reviewers of this report include Charlotte Frola and Dianne DeRoze of the Solid Waste Association of North America (SWANA).

This report was prepared for the U.S. EPA's MITE Program by Ian Thomson, James Walsh, Patrick Rafferty, and Jeffrey Benyo of Roy F. Weston, Inc. The air samples were analyzed by the Analytics Division of Roy F. Weston, Inc., Coast to Coast Labs, and MDS Labs. Bacteria and fungi samples were analyzed by PathCon Laboratories and Five Star Laboratories.

The authors would like to acknowledge the contribution of the municipal, county, and regional officials, as well as representatives of private operators, who assisted in the test program at the participating material recovery facilities (MRFs) and who also provided essential information on the MRFs and associated integrated municipal solid waste management (IMSWM) systems.

EXECUTIVE SUMMARY

Overview

The use of material recovery facilities (MRFs) is increasing by state, county and local governments as one option for managing municipal solid waste (MSW). The owners and operators of these facilities employ a combination of manual and mechanical techniques to separate and sort the recyclable fraction of MSW and then transport the separated materials to recycling facilities. Despite the increasing use of these facilities, only limited data are available on the environmental, economic, and energy impacts associated with MRF operation. These data are necessary if solid waste managers are to make informed decisions on the design and operation of integrated municipal solid waste management (IMSWM) systems which include collection, transport, processing and final disposition of solid waste and recycled materials.

The primary objective of the evaluation was to understand the effects of MRF operations on public health and the environment, as well as on occupational health and safety. To that end, the environmental evaluation conducted at the six MRFs considered the impacts on ambient air quality, receiving waters, and community noise levels, while the occupational health and safety evaluation addressed chemical exposure, biological aerosols, occupational noise, physical safety, and ergonomics. The economic and energy aspects of MRFs must also be understood to fully appreciate these impacts in the context of the IMSWM system.

Case Studies

Six MRFs considered representative of the systems currently operating or planned throughout the country were selected for this evaluation. The selected MRFs are geographically distributed throughout the country, receive both commingled or source separated wastes, and employ a variety of techniques to recover recyclables. The facilities serve the following jurisdictions:

- Islip, New York;
- Montgomery County, Maryland;
- Albuquerque, New Mexico;
- Hartford, Connecticut;
- Rice County, Minnesota; and
- Orange County, Florida.

Because of the limited sample of MRFs evaluated compared with the entire universe of facilities, the evaluations should be considered case studies of typical MRFs currently in operation or under development throughout the country.

Technical Approach

The field test programs conducted at the participating MRFs were intended to assess the direct impacts of MRF operations on public health and the environment, as well as occupational health and safety impacts of facility operations. To put these impacts in perspective, a field survey was conducted at the six MRFs prior to the field test program to evaluate the technical, economic, energy, and environmental issues related to the IMSWM system and its various components.

During the field test programs at the six MRFs, environmental sampling was conducted to determine the measurable impacts on ambient air quality, wastewater quality, and noise levels in the immediate vicinity of each of the facilities. Indoor and personnel sampling were conducted to evaluate worker exposure to chemicals, biological aerosols, and noise. A Certified Industrial Hygienist also reviewed available health and safety programs, conducted personnel interviews, and videotaped operations for a subsequent ergonomic hazard evaluation.

For the most part, the sampling and analysis was conducted in accordance with standard methods and procedures established by the U.S. EPA and the National Institute of Occupational Health and Safety (NIOSH). Table ES-1 summarizes the environmental and occupational health and safety sampling conducted at the facilities, the parameters measured in each sampling program, and the criteria established by regulatory agencies or professional associations.

An analysis of costs and revenues associated with the integrated solid waste management systems (ISWMS) and the material recovery facilities (MRF) was performed as part of this project. A questionnaire and data request list were sent to each of the six participating entities to collect preliminary information regarding costs and revenues associated with their operations. The completed questionnaires and data which were returned were evaluated to determine their usability for the analysis. The relevant information was input into a cost/revenue spreadsheet model which was developed to analyze the ISWMS/MRF costs and revenues. After input of information into the model, it was determined that a significant amount of additional information was required. Follow up written and telephone communications were undertaken to collect needed data. Four of the six participating entities were able to provide sufficient data to complete the analyses. Two were unable to provide sufficient data, and consequently, the analyses for these entities are incomplete. The results shown in this report are based on the spreadsheet analyses for the four entities from whom we obtained sufficient data.

Field Test Results

The environmental testing conducted at the MRFs measured the ambient concentrations of total suspended particulates (TSP), particulate less than 10 microns (PM10), carbon monoxide (CO), volatile organic compounds (VOCs), lead, and mercury vapor. Wastewater quality and community noise was also addressed in the field testing. Generally, TSP, PM10, and lead concentrations were well below the applicable State and National Ambient Air Quality Standards. Carbon monoxide and mercury concentrations were also well below the applicable NAAQS or OSHA's Permissible Exposure Limits (PELs). Detectable VOC concentrations were several orders of magnitude below applicable state guidelines. Wastewater quality and community noise levels met applicable Federal and state criteria.

Table ES-1

Summary of the Occupational Health and Safety Sampling Program

Critical Measurement	Matrix	Test Method	Regulatory Standard or Guideline
Total Suspended Particulate (TSP)	Air	40 CFR 60, Appendix B	260 $\mu g/m^3$
Particulate <10 Microns (PM10)	Air	40 CFR 60, Appendix J	150 $\mu g/m^3$
Particulate Lead	Air	40 CFR 60, Appendix G	1.5 $\mu g/m^3$ [a]
Volatile Organic Compounds	Air	EPA Method TO-14	Compound Dependent
Carbon Monoxide (CO)	Air	NIOSH 7601	35 ppm
Mercury Vapor		Jerome Analyzer	0.05 mg/m^3
Wastewater Parameters	Water	EPA Methods	Site-Specific
Community Noise	Noise	Sound Level Meter	Site-Specific
Nuisance Dust, Total	Air	NIOSH 0500	15 mg/m^3
Nuisance Dust, Respirable	Air	NIOSH 0600	5 mg/m^3
Silica, Crystalline	Air	NIOSH 7601	0.1 mg/m^3
Aluminum	Air	NIOSH 7300	15.0 mg/m^3
Arsenic	Air	NIOSH 7300	0.01 mg/m^3
Chromium	Air	NIOSH 7300	1.00 mg/m^3
Lead	Air	NIOSH 7300	0.05 mg/m^3
Nickel	Air	NIOSH 7300	1.00 mg/m^3
PCBs and Pesticides	Air	EPA TO-10	Compound Dependent
Bacteria and Fungi	Air	PathCon Protocol	None Established
Worker Noise	Noise	Personnel Dosimeter	90 dBA

[a]Reduction to 0.75 $\mu g/m^3$ pending.

The occupational health and safety testing conducted at the MRFs addressed worker exposure to total dust, respirable dust, crystalline silica, metals, CO, mercury vapor, polychlorinated biphenyls, pesticides, bacteria, fungi, and occupational noise. Physical safety hazards and ergonomic stressors were also evaluated during the field test program. Total dust, respirable dust, silica, and metal concentrations were one or more orders of magnitude below the applicable PELs. Carbon monoxide and mercury vapor concentrations were well below the applicable PELs, while PCB and pesticide levels were below the detection limits of the test method. Airborne bacteria and fungi concentrations measured inside the MRFs were roughly one order of magnitude higher than the levels found outside the facility. The airborne and surface samples of bacteria and fungi were relatively consistent from one location to another inside a facility.

For the most part, the six MRFs had implemented programs to protect worker health and safety in conformance with regulations promulgated by the Occupational Safety and Health Administration (OSHA). These programs address, among other issues, energy control, hazard communication, respiratory protection, hearing conservation, and bloodborne pathogens. The ergonomic issues identified at the MRFs include worker discomfort, fatigue, injury, and illness. The most common ergonomic risk factors is improper workstation design and excessive line speed that fails to accommodate workers or causes repetitive or awkward motions.

The forms of energy used to manage MSW include gasoline, diesel fuel, propane, number 2 fuel oil, and electricity. Estimates of the energy consumed by collection vehicles, processing facilities, including the MRF, composting facilities, and landfills are provided in this report. For the MRF's the energy consumption was determined from actual facility records, including monthly invoices. Telephone interviews were held with numerous private contractors to obtain actual or estimated energy consumption for their vehicles and operations. When data was not readily available, for example for collection vehicles, the average energy consumption was estimated using statistics from other communities.

Conclusions

The MRFs considered in this evaluation employed manual and mechanical techniques to recover materials from both commingled and source separated wastes. Considering the costs and revenues associated with material recovery, the six MRFs all provided a net cost to the respective IMSWM systems. Similarly, the energy consumption per ton of waste handled was typically an order of magnitude higher for recyclables compared with MSW, with MSW and recyclables collection dominating total energy consumption. Regardless of the economic or energy penalties associated with MRFs, most states mandate material recycling as part of the overall solid waste management plan for the responsible jurisdictions.

Based on the results of the environmental and occupational health and safety evaluation, MRFs do not appear to pose a significant threat to public health or the environment. Nuisance conditions, such as fugitive dust and excessive noise, can be readily mitigated through maintenance of roadways and equipment enclosure. Similarly, the health and safety hazards to which workers may be exposed can be controlled by design and implementation of OSHA-required worker protection programs. Because of rapidly developing knowledge and awareness of airborne microbiology and ergonomics, these areas may warrant additional evaluation.

SECTION 1

INTRODUCTION

Material recovery facilities (MRFs) are increasing in use by state, county and local governments as one option for managing municipal solid waste (MSW). The owners and operators of these facilities employ a combination of manual and mechanical techniques to separate and sort the recyclable fraction of MSW and then transport the separated materials to recycling facilities. Despite the increasing use of these facilities, only limited data are available on the environmental, economic, and energy impacts associated with MRF operation. These data are necessary if solid waste managers are to make informed decisions on the design and operation of integrated municipal solid waste management (IMSWM) systems. To help close this data gap, a comprehensive evaluation was performed to determine the environmental, economic, and energy impacts associated with six operational MRFs.

The primary objective of the evaluation was to understand the effects of MRF operations on public health and the environment, as well as on occupational health and safety. To that end, the environmental evaluation conducted at the six MRFs considered the impacts on ambient air quality, receiving waters, and community noise levels, while the occupational health and safety evaluation addressed exposure to chemicals, biological aerosols, and occupational noise, as well as physical safety hazards and ergonomic stressors. The economic and energy aspects of MRFs must also be understood to fully appreciate these impacts in the context of the IMSWM system. The economic and energy evaluation was based on publicly available information or material provided by the owners or operators of the participating MRFs.

Six MRFs considered representative of the systems currently operating or planned throughout the country were selected for participation in the evaluation. The selected MRFs are geographically distributed throughout the country, receive both commingled or source separated wastes, and employ a variety of techniques to recover recyclables. The facilities serve the following jurisdictions:

- Islip, New York;
- Montgomery County, Maryland;
- Albuquerque, New Mexico;
- Hartford, Connecticut;
- Rice County, Minnesota; and
- Orange County, Florida.

Because of the limited sample of MRFs evaluated compared with the universe of facilities, the evaluations should be considered case studies of typical MRFs currently in operation or under development throughout the country.

The field test programs conducted at the participating MRFs were intended to assess the direct impacts of MRF operations on public health and the environment, as well as occupational health and safety impacts of facility operations. A field survey was conducted at the six MRFs prior to the field test program to evaluate the technical, economic, energy, and environmental issues related to the IMSWM system and its various components. The forms of energy used to manage MSW include gasoline, diesel fuel, propane, number 2 fuel oil, and electricity. Estimates of the energy consumed by collection vehicles, processing facilities, including the MRF, composting facilities, and landfills are provided in this report. For the MRF's the energy consumption was determined from actual facility records, including monthly invoices. Telephone interviews were held with numerous private contractors to obtain actual or estimated energy consumption for their vehicles and operations. When data was not readily available, for example for collection vehicles, the average energy consumption was estimated using statistics from other communities. Based on this information, the total costs and energy use were allocated as appropriate to the MRF and IMSWM system. The environmental information was used to place the field test results into perspective.

The environmental evaluation addressed the impacts of MRF operations on ambient air quality, wastewater quality, and noise levels in the immediate vicinity of each facility. The occupational health and safety evaluation addressed worker exposure to chemicals, biological aerosols, and noise, as well as safety and ergonomic hazards. For the most part, the sampling and analysis was conducted in accordance with standard methods and procedures established by the U.S. Environmental Protection Agency (U.S. EPA) and National Institute of Occupational Health and Safety (NIOSH).

The environmental and occupational impacts of MRF operations were assessed by comparing measured concentrations with regulatory levels or other acceptable criteria. This identified those areas approaching or exceeding acceptable levels and determined the likely impacts on both the workers and the local community. For those releases without established criteria, the exposure or release was compared with other comparable sources, typical background levels, or measured background levels. This type of comparison was particularly useful for parameters such as airborne microbiological indicators.

SECTION 2

TEST PROGRAM DESCRIPTION

2.1 Case Studies

Six MRFs were selected for participation in a comprehensive environmental and occupational health and safety evaluation. The selected MRFs are located in various geographical areas, process source separated or commingled wastes, and employ a variety of techniques for separating and sorting recyclable material. The facilities evaluated serve the following jurisdictions:

- Islip, New York. The Multi-Purpose Recycling Facility, located in South Holbrook, Long Island, is owned and operated by the Islip Resource Recovery Agency. The facility was designed and built by the Agency. Private haulers collect paper and commingled recyclables in most of the districts within the Town of Islip, with the Agency providing collection services in the remaining districts. The facility receives newsprint and corrugated cardboard on Wednesday every other week, and commingled recyclables on the alternating Wednesdays. The recyclables are sorted in two processing lines by means of trommels, magnetic separators, and manual sorting. The recovered materials include newsprint, corrugated cardboard, ferrous cans, aluminum, plastics, and glass. The recovered materials are shipped to market by truck, with rejected material transported to the Agency's waste-to-energy facility.

- Montgomery County, Maryland. The Material Recovery Facility, located in Derwood, Maryland, is owned by Montgomery County. The facility was built and is currently operated by CRInc-Well under a subcontract with Maryland Environmental Services. Newsprint and commingled recyclables are collected separately by municipalities and private haulers; the County also provides collection services to a number of municipalities. At the facility, the newsprint and commingled recyclables are unloaded in separate areas on the tipping floor. The commingled recyclables are then processed in a sorting system developed by Bezner. The recovered materials include ferrous cans, aluminum, plastics, and color-sorted glass. The recovered material is baled, except for glass which is crushed into cullet, prior to shipment to market. Rejected material is currently transported to a private landfill.

- Albuquerque, New Mexico. The Intermediate Processing Facility is located adjacent to the City's landfill, approximately 20 miles from Albuquerque. The facility is owned and operated by the City. The City collects recyclables from residential and commercial customers in Albuquerque; private haulers also provide commercial collection services. At the facility, newsprint and corrugated cardboard are presorted on the tipping floor and baled for shipment to market. Commingled recyclables, that is ferrous metal, aluminum cans, plastic containers, and color-sorted glass, are recovered manually on a single sorting belt conveyor. The recovered material is delivered by truck to market, while rejects are disposed of in the adjacent landfill operated by the City.

- Hartford, Connecticut. The Mid-Connecticut Recycling Center, consisting of separate container and paper recycling operations, is located in Hartford. The Container Recycling Center is owned by the Connecticut Resources Recovery Authority and operated under contract by RRT Empire of Mid-Connecticut, Inc. The Paper Recycling Center is leased by the Authority and operated by Capital Recycling of Connecticut, Inc. The municipalities within the Mid-Connecticut Region collect paper and commingled recyclables in their jurisdictions and deliver them either directly to the facility or one of four transfer stations. The paper and corrugated cardboard is sorted into various grades of recyclable paper at the Paper Recycling Center, while commingled recyclables are sorted at the Container Recycling Center. Ferrous cans, aluminum, plastic containers, and color-sorted glass are separated from the waste stream and baled or crushed prior to shipment by truck and rail to market. Rejects are disposed of at the waste processing facility owned by the Authority.

- Rice County, Minnesota. The Recycling Facility, including a household hazardous waste center, is located adjacent to the County's landfill. The facility is owned and operated by the County. Private haulers collect recyclables separately from other wastes throughout the County. The source-separated recyclables include newsprint, corrugated cardboard, ferrous cans, aluminum, plastic containers, and glass bottles. The recyclable paper is shredded and baled in a separate building. The remaining separated material is processed individually throughout the day. Ferrous cans, aluminum, and plastics are baled for shipment to market, while glass is crushed into cullet prior to shipment. Rejects are disposed of at the adjacent landfill, owned and operated by the County. Household hazardous waste is also sorted in a separate building, and either made available to the public for reuse or transported by a licensed hauler to an off-site disposal site.

- Orange County, Florida. The Material Recovery Facility is located adjacent to the County's landfill east of Orlando. The facility is owned and operated by Recycle America of Orange County, a unit of Waste Management, Inc; however, the County has an option to purchase the facility at a future date. The recyclables are collected by municipalities or private haulers within franchise districts throughout the County. At the facility, paper and cardboard are presorted on the tipping floor, while mixed recyclables are mechanically and manually sorted into ferrous metals, aluminum, plastics, and color-sorted glass. The recovered material is shipped to market by truck. The rejects are disposed of at the adjacent landfill, owned and operated by the County.

It should be noted that the evaluation of only six MRFs cannot be expected to provide a high level of confidence (e.g., 95 to 98 percent confidence) in the representativeness of the samples collected compared with the entire universe of MRFs. Rather, these evaluations should be considered case studies of typical MRFs currently in operation or under development throughout the country.

2.2 Facility Surveys

The field survey identified the technical, economic, energy, and environmental issues related to each of the IMSWM systems and their various components. Based on this information, the portion of the total costs and energy use may be properly allocated to the MRF and IMSWM system. The environmental information obtained during the field survey was used to put the field test results into perspective. The methodologies used in the economic, energy, and environmental evaluation are discussed in the following sections.

2.2.1 Economic Implications

One of the objectives of the evaluation was to determine what portion of the overall costs of each IMSWM system may be properly allocated to its MRF. Accordingly, the capital and operating costs were determined for each of the system components to the extent the necessary information was available from the project participants. To this end, the field survey team requested the following information from each participant:

- a mass balance for the IMSWM system and its various components;
- operating costs and fees associated with the collection of solid waste and delivery to the appropriate component of the system;
- capital and operating costs for the MRF, transfer stations, drop-off centers, composting facility, waste-to-energy facility, and landfill;
- operating costs and fees for the transport of solid waste, rejects, and residues from these facilities to the waste-to-energy facility or landfill; and
- operating costs and fees for the transport of marketable commodities to market.

In any systems analysis problem, it is necessary to establish the boundaries of the system. For this evaluation, the system boundary has been set at the point of curbside pickup to the point of final delivery of products or rejects. This boundary included all of the IMSWM system components for which the municipal budget is normally responsible. If available, actual cost data for the calendar year 1992 were used in the evaluation. Alternatively, the jurisdiction's fiscal year was used instead of the calendar year.

At the participating MRFs, the responsible jurisdictions provided information required to complete a mass balance for the components of their IMSWM system. If available, the jurisdiction provided the records of revenues derived from the sale of marketable commodities or electrical power. Because waste collection services are often provided by private contractors, it was not always possible to ascertain the costs associated with the collection of MSW and recyclables and delivery of same to the appropriate component of the IMSWM system. In these cases, the costs were based on the actual fees charged to the jurisdiction. Once these data were compiled, the capital and operating costs were allocated to the appropriate components of the IMSWM system.

2.2.2 Energy Consumption

To determine the overall energy consumption of the IMSWM system and, in the case of a waste-to-energy facility, the energy production, the field survey team requested the following information from each participant:

- fuel used to collect solid waste and deliver it to the appropriate component of the system;

- fuels and electricity used to operate the MRF, transfer stations, drop-off centers, compost facility, waste-to-energy facility, and landfill;

- fuel used to transport solid waste, rejects, and residues from these facilities to the waste-to-energy facility or landfill;

- fuel used to transport marketable commodities to market; and

- sales of electricity and thermal energy to off-site markets.

The system boundaries extended from the point of curbside pickup to the point of final delivery of products or rejects. The time period was consistent with that used in the economic evaluation -- either the calendar year 1992 or corresponding fiscal year.

At the participating MRFs, the jurisdictions supplied records of fuel usage and electricity consumption allocated to the IMSWM system and the various components of the system. Where applicable, the jurisdiction provided the energy production records for the waste-to-energy facility. Because waste collection services are often provided by private contractors, it was not always possible to ascertain the fuel consumption associated with the collection of MSW and recyclables and delivery of same to the appropriate component of the IMSWM system. The available energy consumption or production values were then assigned to various system components.

2.2.3 Environmental Regulations

The field test programs conducted at the participating MRFs were intended to assess the direct impacts of MRF operations on public health and the environment, as well as occupational health and safety impacts on MRF employees. To put these impacts in perspective, information was obtained on federal and state regulations and approvals applicable to the various components of the IMSWM system. These regulations and approvals typically impose design and performance standards on solid waste management facilities. Any comparison of the environmental impacts associated with the participating MRFs must take these standards into consideration.

2.3 Field Test Program

The field test programs at the participating MRFs considered ambient air quality, wastewater effluent, and community noise, while the occupational health and safety assessment addressed exposure to chemicals, biological aerosols, and occupational noise, as well as physical safety hazards and ergonomic stressors. This section describes the technical approach used in the field test programs.

2.3.1 Regulatory Criteria

The field test results were compared to environmental and workplace standards established by the U.S. EPA, the Occupational Safety and Health Administration (OSHA), and the American Conference of Governmental Industrial Hygienists (ACGIH). Discussed below are the standards used in the assessment of the environmental and occupational health and safety impacts associated with the participating MRFs.

<u>National Ambient Air Quality Standards</u>

Pursuant to the Clean Air Act, the U.S. EPA has established National Ambient Air Quality Standards (NAAQS) for total suspended particulates (TSP), sulfur dioxide (SO_2), nitrogen dioxide (NO_x), carbon monoxide (CO), lead (Pb), non-methane hydrocarbons (NMHC), and photochemical oxidants measured as ozone (O_3). The NMHC standard was eventually changed to a guideline, and the O_3 standard was revised in subsequent regulations. Most recently, the U.S. EPA promulgated standards for respirable particulates with a mean diameter less than 10 microns (PM10). Based on an analysis of potential pollutant emissions from MRFs, the field test program was designed to measure ambient concentrations of TSP, PM10, and CO. The standards for these pollutants are presented in Table 2-1. Note that the primary standards are intended to protect public health, while the secondary standards protect public welfare.

Table 2-1
National Ambient Air Quality Standards
for TSP, PM10 and CO

Pollutant	Averaging Period	NAAQS ($\mu g/m^3$)	
		Primary Standard	Secondary Standard
TSP[a]	24-hour	260	150
PM10	24-hour	150	-
CO	1-hour	40,000	-
	8-hour	10,000	10,000

[a]PM10 standard has replaced TSP standard.

Permissible Exposure Limits

The OSHA has established mandatory concentration limits for over 400 workplace air contaminants under 29 CFR 1910.1000. A standard was also established for lead under 29 CFR 1910.1025. These standards, referred to as Permissible Exposure Limits (PELs), are usually expressed as an 8-hour, time-weighted average concentration of the contaminant measured in the worker's breathing zone. In some cases, PELs may be expressed as 15-minute average Short-term Exposure Limits (STELs) or as instantaneous Acceptable Ceiling Concentrations (Ceilings). In addition, the ACGIH has developed workplace criteria for air contaminants, known as Threshold Limit Values (TLVs). The pertinent PELs for the field test program are summarized in Table 2-2. To date, neither OSHA nor ACGIH has developed standards for bacteria and fungi.

Occupational Noise Exposure

The OSHA has established occupational noise exposure standards under 29 CFR 1910.95. According to these regulations, the maximum acceptable 8-hour worker exposure is 90 decibels on an A-weighted scale (dBA). Employers are required to institute a Hearing Conservation Program in cases where workers are exposed to noise levels in excess of 85 DBA.

Occupational Health

Additional standards have been established by OSHA to protect worker health and safety through work practices, engineering controls, training, protective equipment, reporting, and recordkeeping. These occupational health standards include:

- Occupational Injuries and Illnesses (29 CFR 1904.2),
- Respiratory Protection Standard (29 CFR 1910,134),
- Hazard Communication Standard (29 CFR 1910.1200),
- Lockout/Tagout Standard (29 CFR 1910.147), and

- Bloodborne Pathogen Program (29 CFR 1910.1030).

Although a number of these standards do not apply directly to MRFs, they can serve as a basis for employers to develop their own programs.

Table 2-2
Worker Exposure Limits

Contaminant	Units	Concentration PEL[a]
Total Dust	mg/m^3	15.0
Respirable Dust	mg/m^3	5.0
Respirable Silica	mg/m^3	0.1
CO	ppm	35
Mercury Vapor	mg/m^3	0.05
Arsenic	mg/m^3	0.01
Aluminum	mg/m^3	15.0
Chromium	mg/m^3	1.00
Lead	mg/m^3	0.05[b]
Nickel	mg/m^3	1.00

[a]Maximum 8-hour exposure established by OSHA (40 CFR 1910.1000)
[b]Maximum 8-hour exposure established by OSHA (40 CFR 1910.1025).

<u>Ergonomics</u>

The OSHA has proposed an ergonomics standard, focusing on the prevention of work-related cumulative trauma disorders. It is anticipated that the final standard will require all employers to perform an assessment to identify ergonomic risks in their workplace. Where employees experience cumulative trauma disorders, employers will be required to perform a more detailed assessment of jobs and tasks to develop a comprehensive ergonomics program to prevent future injury.

2.3.2 Sampling and Analysis Procedures

To completely define the environmental and occupational health and safety impacts of MRFs would require the collection of a large number of samples over the entire range of operating, production, seasonal, and meteorological conditions. Because such an approach was considered infeasible for this impact analysis, the sampling and analysis program was based on the collection and analysis of a wide variety of samples over a three-day period at each MRF under typical operating, production, and meteorological conditions.

The sampling and analysis were conducted in accordance with test procedures developed by the U.S. EPA and NIOSH. Discussed below are the sampling and analysis procedures used in the environmental and occupational exposure evaluation.

Public Health and the Environment

An environmental sampling program was conducted at the participating MRFs to assess the potential environmental impacts associated with their operation. The testing program addressed ambient air quality, wastewater quality, and noise levels in the immediate vicinity of each of the facilities. Table 2-3 summarizes the environmental tests that were conducted at the facilities, the parameters measured during the test programs, and the applicable criteria established by responsible agencies.

Air Quality

Air emissions from MRFs typically result from the following sources: general or local ventilation exhaust; fugitive emissions from process equipment; fugitive dust from materials handling; fugitive dust from vehicular traffic; vehicular exhaust emissions; and exhaust from combustion sources. Because MRFs rarely, if ever, use thermal processing systems, stack sampling was deemed unnecessary to quantify stack emissions. The only stack emissions anticipated are those from oil or gas combustion for general heating purposes, which may be readily estimated based on published emission factors and fuel consumption. Likewise, vehicular emission can be calculated using appropriate emission factors and either fuel consumption or miles traversed.

Table 2-3
Summary of the Environmental and Public Health Sampling Program

Critical Measurement	Matrix	Test Method	Regulatory Standard or Guideline
Particulate, Total	Air	40 CFR 50, Appendix B	260 $\mu g/m^3$
Particulate lead	Air	40 CFR 50, Appendix G	1.5 $\mu g/m^3$[a]
Particulate < 10 μm	Air	40 CFR 50, Appendix J	150 μ/m^3
Volatile Organic Compounds	Air	EPA TO-14	Compound-Specific
Mercury Vapor	Air	Manufacturer's Manual	50 $\mu g/m^3$
Pesticides	Air	EPA TO-10	Compound-Specific
BOD (colorimetric tests)	Water	Standard Method 405.4	Site-Specific
COD (colorimetric tests)	Water	Standard Method 410.4	Site-Specific
TOC (UV, persulfic oxide)	Water	Standard Method 415.2	Site-Specific
Oil and Grease (spectrophotometric)	Water	Standard Method 413.2	Site-Specific
Suspended Solids (gravimetric)	Water	Standard Method 160.2	Site-Specific
Total Dissolved Solids (gravimetric)	Water	Standard Method 160.1	Site-Specific
Ph (electrometric)	Water	Standard Method 150.1	Site-Specific
Conductivity (specific conductance)	Water	Standard Method 120.1	Site-Specific
Ammonia (colorimetric)	Water	Standard Method 350.1	Site-Specific
Total Nitrogen (colorimetric)	Water	Standard Method 351.2	Site-Specific
Total Phosphorous (colorimetric, ascorbic acid)	Water	Standard Method 365.1	Site-Specific
Coliform Bacteria	Water	Standard Method 909A	Site-Specific
Fecal Coliform Bacteria	Water	Standard Method 909C	Site-Specific
Metals (RCRA 8)	Water	CLP-TAL	Site-Specific

[a]Reduction to 0.75 $\mu g/m^3$ is pending.

The total emissions from each MRF were measured by means of ambient air quality sampling. At each of the participating MRFs, the test program consisted of property-line sampling using the following reference methods prescribed by the U.S. EPA:

- Total Suspended Particulate (TSP). U.S. EPA Method described in 40 CFR 50, Appendix B.

- Particulate Matter Less than 10 Microns (PM10). U.S. EPA Method described in 40 CFR 50, Appendix G.

- Lead and Lead Compounds. U.S. EPA Method described in 40 CFR 50, Appendix G.

- Volatile Organic Compounds (VOC). U.S. EPA Method TO-14.

- Pesticides and Polychlorinated Biphenyls (PCBs). U.S. EPA Method TO-10.

Because the U.S. EPA methods call for the 24-hour samples of TSP, PM10 and lead, three consecutive one-day samples were collected for each of these contaminants. One sample was collected upwind of the MRFs, while two were collected downwind (plus one collocated sample for quality assurance).

Carbon monoxide (CO) and mercury vapor measurements were made using the Drager 190 Datalogger and Jerome Mercury Vapor Analyzer, respectively. These instruments, which provide direct measurements of these contaminants, were used throughout the facility property (including selected upwind and downwind fence line locations) at three-hour intervals during the sampling period. Basic meteorological measurements were collected contemporaneously with the ambient sampling to determine temperature, wind speed, and wind direction. The meteorological data were used to determine the upwind and downwind sampling locations.

Water Quality

Wastewater effluent streams from MRFs are generally limited to housekeeping wash water, rinse water from process sources, and stormwater runoff. The process streams typically result from intermittent, rather than continuous washing operations. For this reason, wastewater sampling was limited to grab samples from floor drain and stormwater sumps during episodes of water-intensive housekeeping.

The wastewater samples were collected and analyzed at the MRFs in accordance with U.S. EPA methods or Standard Methods for the Analysis of Water and Wastewater. The grab samples were analyzed for the following parameters:

- 5-day biological demand (BOD_5),
- chemical oxygen demand (COD),
- total organic carbon (TOC),
- oil and grease,
- total suspended solids (TSS),
- total dissolved solids (TDS),
- pH,
- conductivity,

- total nitrogen ammonia,
- total Kjeldal nitrogen (TKN),
- total phosphorous,
- total coliform bacteria,
- fecal coliform bacteria, and
- eight RCRA metals.

A total of two water samples, along with quality assurance samples, were collected at each of the Islip and Montgomery County MRFs, and one sample was collected at the Rice County facility. No samples were collected at the remaining MRFs, either because the facilities did not provide for drainage or washing events did not occur during the test period.

Noise Levels

Community noise typically results from the operation and unloading of trucks, material separation activities, shredding and baling equipment, and operation of front-end loaders. The resulting noise levels are strongly dependent on the size of the "buffer zone" between the sources of noise and receptors within the community and the presence of noise attenuating structures such as walls, roofs, vegetation, and other barriers. The acceptability of noise depends on the historical land use around the facility, the proximity of other noise sources, the time of the day, and existing community noise ordinances.

At the six MRFs, community noise was measured using a sound level meter. The noise measurements were taken along the perimeter of the facility property. Measurements were taken during all hours of operation at one or two locations, depending on the layout of the facility and proximity of adjacent noise-generating sources. To establish background noise levels, measurements were also made during non-operating periods.

Occupational Health and Safety

Indoor and personnel sampling was conducted to evaluate the occupational health aspects of MRF operations. The sampling addressed chemical exposure, biological aerosols, and noise levels. A Certified Industrial Hygienist (CIH) reviewed available health and safety programs, conducted personnel interviews, and videotaped operations for subsequent ergonomics evaluation. Table 2-4 summarizes the occupational health and safety sampling conducted at each of the facilities, the parameters measured in each sampling program, and the criteria established by responsible agencies.

Chemical Exposures

Chemical exposures result from the same sources associated with air emissions described earlier, with the notable difference that workers are frequently much closer to the source for longer periods of time than the general public. Chemical exposure was determined using standard methods established by NIOSH.

Table 2-4
Summary of the Occupational Health and Safety Sampling Program

Critical Measurement	Matrix	Test Method	Regulatory Standard or Guideline[a]
Nuisance Dust, Total	Air	NIOSH 0500	15 mg/m^3
Nuisance Dust, Respirable	Air	NIOSH 0600	5 mg/m^3
Mercury Vapor	Air	Manufacturing Instrument Manual	0.05 mg/m^3[b]
Carbon Monoxide	Air	NIOSH S-340	35 ppm[b]
Silica, Crystalline	Air	NIOSH 7601	0.1 mg/m^3
Aluminum	Air	NIOSH 7300	15.0 mg/m^3
Arsenic	Air	NIOSH 7300	0.01 mg/m^3
Chromium	Air	NIOSH 7300	1.00 mg/m^3
Lead	Air	NIOSH 7300	0.05 mg/m^3
Nickel	Air	NIOSH 7300	1.00 mg/m^3
PCBs and Pesticides	Air	EPA TO-10	Compound-Specific
Bacteria	Air	PathCon Protocol	Not Established

[a]Eight-hour, time-weighted average concentration, unless otherwise noted.
[b]Ceiling concentration.

At each of the MRFs, the sampling program addressed organic and inorganic contaminants of potential concern from an occupational health perspective. These include the following contaminants:

- Total Nuisance Dust. NIOSH Method 0500.
- Respirable Nuisance Dust. NIOSH Method 0600.
- Crystalline Silica. NIOSH Method 7601.

- Carbon Monoxide (CO). Drager 190 Datalogger CO Dosimeter.

- Pesticides and Polychlorinated Biphenyls (PCBs). U.S. EPA Method TO-10.

- Trace Metals. NIOSH Method 7300 (arsenic, aluminum, chromium, lead and nickel).

At the six MRFs, sampling was conducted over the entire work-shift on personnel selected as representative of the range of exposures experienced by the entire work-force. Where possible, samples were collected from the breathing zone of sampled employees using personal sampling equipment. Samples were collected on one shift each day of the three-day sampling period at the facilities.

Biological Aerosols

Biological aerosols, or bioaerosols, represent an important and controversial aspect of occupational health in MRFs. Bioaerosols are important because they are ubiquitous in residential and commercial waste and can have health implications for the exposed worker. They are controversial in that, despite the public concern, reliable methods have yet to be developed for many bioaerosol components. The problem is exacerbated by the fact that safe or acceptable levels of microorganisms in the air have not yet been established as has been done for chemical compounds.

The procedures used in characterizing bioaerosols were developed by Path Con and Five Star Laboratories. The procedures call for six plates of microbiological media selected to allow for a wide range of organisms to be collected and cultured on the following growth media:

- R2A with cycloheximide (R2Ac),
- Rose Bengal Agar (RBA), and
- Tryptic Soy Agar (TSA).

For each of the three days, one sample set was collected at an upwind location, two at downwind locations, and from three to six at indoor locations. In addition, up to eight wipe or surface samples were collected at each facility to identify potential sources of contamination or skin contact.

The initial characterization was performed using standard biochemical techniques followed by speciation using gas chromatography (GC). The GC analysis allows for the isolation of the six most predominant colony types and characterization of bacteria by means of GC analysis of fatty acids identified with individual species. Fatty acid chromatograms are compared with a library of chromatograms of common environmental and pathogenic microorganisms, thus providing a greater degree of reliability in characterizing the organisms. With the ability to identify less predominant colonies, it is unnecessary to use specialized (inhibitory) media called for in other protocols.

Noise Levels

As with chemical exposures, occupational noise exposures result from the same sources as community noise, with the notable difference being the worker's proximity to the noise source. Based on a preliminary noise survey, personal noise dosimeters were placed in the hearing zone of employees to represent the range of exposures experienced by the entire work-force. Samples were collected on one shift each day of the three-day sampling period at the facilities.

Physical Safety

Physical safety encompasses job-related exposures that pose a risk of physical injury to the worker, including motor vehicle operation, electrical hazards, falling objects, explosions, mechanical equipment, and laceration or puncture by sharp objects. These potential hazards were evaluated subjectively by a CIH during the test program. The hazard posed by a particular process or operation was then evaluated against any patterns of injuries or illnesses noted in the OSHA 200 Form "Log of Occupational Injuries and Illnesses."

Occupational Health

Available information on existing occupational health and safety programs in the MRFs were reviewed to evaluate their status and effectiveness. The following programs and procedures were addressed in the review:

- respiratory protection program,
- hazard communication program,
- hearing conservation program,
- lockout/tagout procedures,
- chemical exposure program, and
- bloodborne pathogens program.

These programs or procedures may be required under standards established by the Occupational Safety and Health Administration (OSHA).

Ergonomics Review

During the site visit, employees were videotaped as they performed routine tasks. The videotapes were reviewed by a Certified Occupational Health Nurse (COHN), who evaluated the potential for back strain, repetitive motion trauma, overexertion, and other injuries. The COHN then identified potential ergonomic risk factors affecting MRF employees and recommended appropriate measures to minimize the potential risk.

2.3.3 Quality Assurance Procedures

Prior to implementation of the field test program, the U.S. EPA approved the Quality Assurance Project Plan (QAPjP) and site-specific Sampling and Analysis Plans (SAPs). The initial field test programs at the Islip and Montgomery County MRFs were conducted in accordance with the procedures described in the QAPjP and site-specific SAPs. In accordance with the original protocol, the initial two programs included individual tests for the following parameters:

- TSP, PM10, and particulate lead;
- CO and mercury vapor;
- VOCs;
- PCBs and pesticides;
- total and respirable dust, crystalline silica, and metals;
- airborne and surface fungi and bacteria;
- wastewater quality; and
- community and workplace noise levels.

Following the initial two test programs, the test results were evaluated to determine the effectiveness of the sampling and measurement strategy employed at the two sites and, as appropriate, to revise the test protocol to improve the overall effectiveness of the remaining field testing. The revised test protocol was reflected in the SAPs for the facilities in Albuquerque, New Mexico; Hartford, Connecticut; Rice County, Minnesota; and Orange County, Florida. A comparison of the original protocol for the initial two test programs and the revised protocol for the remaining sites is presented in Table 2-5. The scope of the individual tests and justification for revisions are discussed below.

- <u>TSP, PM10 and Lead</u>. The original protocol called for three 24-hour samples for TSP, PM10 and lead at one upwind and two downwind locations. This required four high volume samplers (TSP and lead) and four particle-size-specific samplers (PM10) -- three samplers for primary samples and a fourth collocated sampler for quality control. The revised protocol eliminated the need for the collocated sampler by using one downwind sampler for the collocated sample on the third day.

- <u>CO and Mercury</u>. The original protocol called for direct-reading instruments for CO and mercury measurements at 3-hour intervals over the three-day test period. The testing at the initial sites found extremely low levels of these contaminants, well below the applicable Threshold Limit Values (TLVs). These tests were continued at the remaining sites due to the high level of interest in the concentrations of these contaminants at operating MRFs.

- <u>VOC</u>. The original protocol called for three VOC samples collected using Summa® canisters at 24-hour intervals on each of the three days The initial testing found extremely low levels of VOCs (on the order of 1 ppb), several orders of magnitude below the applicable PELs. Consequently, this test was reduced from 3 days to 1 day at the remaining sites.

- PCBs and Pesticides. The original protocol required that PCB and pesticides samples be collected at four locations over the three days. Neither PCBs nor pesticides were detected at the initial two sites; therefore, the test was eliminated at the remaining sites.

- Dust, Silica and Metals. The original protocol called for the collection of personnel samples from up to three workers on each of the three days, requiring samples from up to nine workers per day. Total dust, respirable dust, and silica levels at the initial sites were well below the applicable PELs; arsenic, aluminum, chromium, lead, and nickel levels, for the most part, were below detection levels. Consequently, the revised protocol called for a reduction in the number of samples for total dust, respirable dust, and silica, and elimination of the personnel samples for metals entirely.

- Fungi and Bacteria. According to the original protocol, airborne fungi and bacteria samples were collected at one upwind, two downwind, and four indoor locations using the six-plate method described in Addendum No. 1 to the QAPjP. In addition, up to eight wipe samples were taken from worker skin or work surfaces. The test results from the initial sites demonstrated no significant variation in upwind and downwind samples nor the various indoor samples regardless of location. Consequently, the revised protocol reduced the airborne samples by eliminating one downwind location and several indoor locations based on the discretion of the CIH. The revised protocol maintained the same procedures for the wipe samples.

- Wastewater Quality. The original protocol called for two wastewater samples during intensive washing event. Based on the experience at the initial sites, such washing events are infrequent (e.g., once per week) and result in a minimal wastewater discharge (e.g., 5 gallons per event). Furthermore, the wastewater analyses found no significant contamination levels. The revised protocol, therefore, required that the test crew be prepared to collect a single sample in the event the operator washes the facility.

- Noise Levels. Community noise measurements were taken with a sound level meter at various onsite and fence line locations, while workplace noise levels were measured using personnel dosimeters over the three day period. The community and workplace noise levels were significant, either approaching or exceeding applicable criteria, at both of the initial two sites. In light of these findings, the noise measurements at the remaining sites were conducted in accordance with the original protocol.

Except as noted above, all testing was conducted in accordance with the quality assurance/quality control (QA/QC) procedures documented in the QAPjP.

Table 2-5
Comparison of the Original and Revised Protocols
for the Field Test Programs

Parameters	Sampling and Analytical Protocol	
	Initial Two Sites	**Remaining Four Sites**
TSP, PM10 & Lead	TSP and PM10 samplers at 1 upwind and 2 downwind locations for 3 days of testing with collocated samplers for duplicate analysis.	Eliminated the collocated samplers using 1 downwind sampler on the third day for duplicate analysis.
CO & Mercury	CO and mercury measurements using direct reading instruments at 3-hour intervals for 3 days of testing.	Same.
VOCs	VOC sampling with Summa® canisters for 3 days of testing.	Reduced VOC sampling from 3 days to 1 day.
PCBs & Pesticides	PCB and pesticides sampling using low-volume samplers at four locations for 3 days of testing.	Eliminated PCBs and pesticides sampling.
Dust, Silica & Metals	Dust, silica and metals samples with personnel sampling pumps from up to 9 personnel for the 3 days of testing.	Reduced the number of samples for dust and silica; eliminated metals sampling entirely.
Fungi & Bacteria	Airborne fungi and bacteria sampling using 6-plate method at 2 upwind and 4 indoor locations for 3 days of testing; up to 8 wipe samples from worker skin or work surfaces.	Reduced the number of samples for airborne fungi and bacteria; maintained wipe samples.
Wastewater Quality	Two wastewater samples during intensive washing event.	Reduced wastewater collection from 2 samples to 1 sample (if washings are routinely conducted at site).
Noise Levels	Community noise measurements with sound level meter at onsite and fence-line locations; workplace noise measurements using dosimeters for 3 days of testing.	Same.

2.4 Facility Effectiveness

The environmental and occupational impact of the releases from the MRFs were determined using several methods. The first method involved comparing measured concentrations with acceptable levels or other criteria. Acceptable levels or related criteria included:

- National Ambient Air Quality Standards (NAAQS),
- OSHA Permissible Exposure Limits (PELs),

- ACGIH Threshold Limit Values (TLVs),
- NIOSH Recommended Exposure Levels (RELs),
- State air toxics standards or guidelines,
- ACGIH bioaerosol guidelines,
- Federal and State effluent standards,
- OSHA occupational noise limits,
- community noise standards,
- OSHA safety regulations, and
- odor threshold values.

The comparison identified those areas approaching or exceeding acceptable levels and assessed likely impacts of such excursions on both the workers and the local community. For those releases without established criteria, the exposure or release was compared with other comparable sources and/or typical or measured background levels. This type of comparison may be particularly useful for such issues as environmental biological indicators.

SECTION 3

ISLIP, NEW YORK

3.1 Process Description

The Islip MRF, known as the Multi-Purpose Recycling Facility, is located in South Holbrook, Long Island. The facility is only one component of the IMSWM system serving the Town of Islip, New York. The process description presented in this section addresses the technical, economic, energy, and environmental aspects of both the MRF and IMSWM system.

3.1.1 Integrated Solid Waste Management System

The Islip Resource Recovery Agency (the Agency) provides disposal and limited collection services for MSW in the Town of Islip, New York. The components of the IMSWM system serving Islip include:

- Multi-Purpose Recycling Facility,
- Resource Recovery Facility,
- Composting Facility, and
- Hauppage Landfill.

Figure 3-1 presents a process flow diagram of the IMSWM system for Islip, showing the quantities of waste received and the residue produced by the various components of the system.

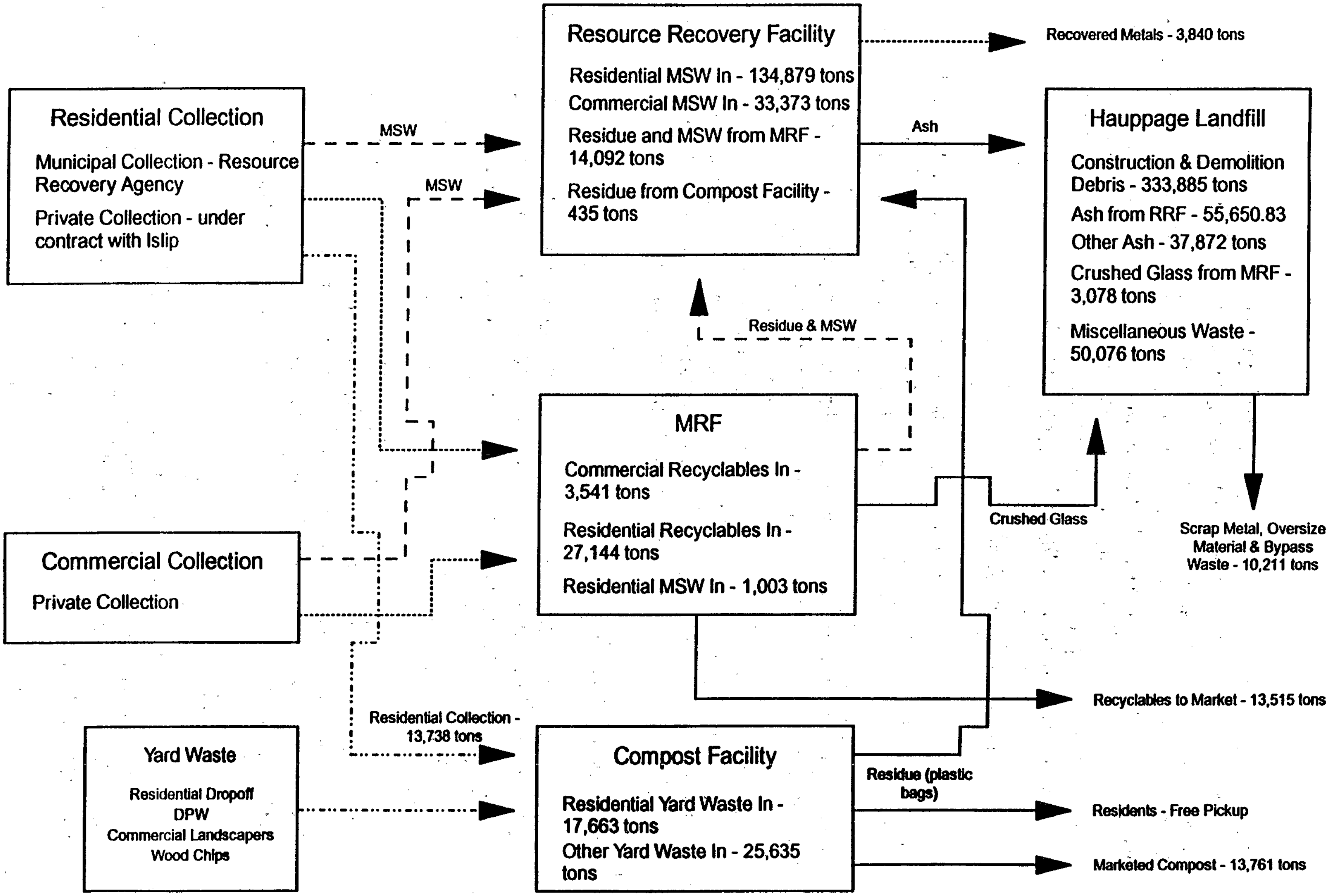
<u>Waste Collection</u>

Most of the MSW generated in Islip is collected by private haulers licensed by the Town. Licensed haulers are required to deliver waste to a site designated by the Town and pay the prevailing tipping fee charged at that facility. In addition, all one, two, and three-family dwellings within the Town are included in designated MSW collection districts. There are currently 70 districts within the Town. The Agency provides residential collection services in the remaining areas of the Town. In 1992, approximately 134,879 tons of residential waste and 33,373 tons of commercial waste were delivered to the Resource Recovery Facility. During this same period, the MRF received about 27,144 and 3,541 tons of residential and commercial recyclables, respectively.

<u>Multi-Purpose Recycling Facility</u>

The Multi-Purpose Recycling Facility is located at the Lincoln Avenue Complex in South Holbrook, New York. The facility is owned and operated by the Agency. The facility design includes two primary processing lines for backup redundancy and operational flexibility; each

Figure 3-1
Islip, New York Solid Waste System



processing line is capable of processing 120 tpd. The processing lines employ both mechanical and manual sorting to recover newsprint, corrugated cardboard, ferrous and aluminum cans, and color-sorted glass. Originally the facility received newsprint and mixed recyclables on every Wednesday and processed these materials over the next five days. Since November 1992, newsprint has been delivered to the facility on every other Wednesday, with mixed recyclables delivered on the alternating Wednesday. In 1992, the facility received approximately 30,685 tons of recyclables and shipped 13,515 tons of material to market. The rejects are transported either to the Resource Recovery Facility or Hauppage Landfill.

Resource Recovery Facility

The Resource Recovery Facility is located near MacArthur Field in Islip, New York. The facility is owned by the Agency and operated under contract by Montenay. The facility consists of two mass-burn, waterwall furnaces, each with a rated capacity of 100 tons per day (tpd). The furnaces employ the proprietary O'Connor rotary combustor. Following weighing at the scales, waste collection vehicles unload the MSW directly into a storage pit. Overhead cranes then transfer the waste to one of two feed hoppers serving the furnaces. The combustion process starts in the rotary combustor and continues on a grate system. The waste combustion produces superheated steam, which is then directed to a turbine generator for the generation of electricity. The electricity is sold to the Long Island Lighting Company. Approximately 168,252 tons of residential and commercial waste were burned at the facility in 1992. An additional 14,527 tons of solid waste were received from the MRF and Composting Facility.

Composting Facility

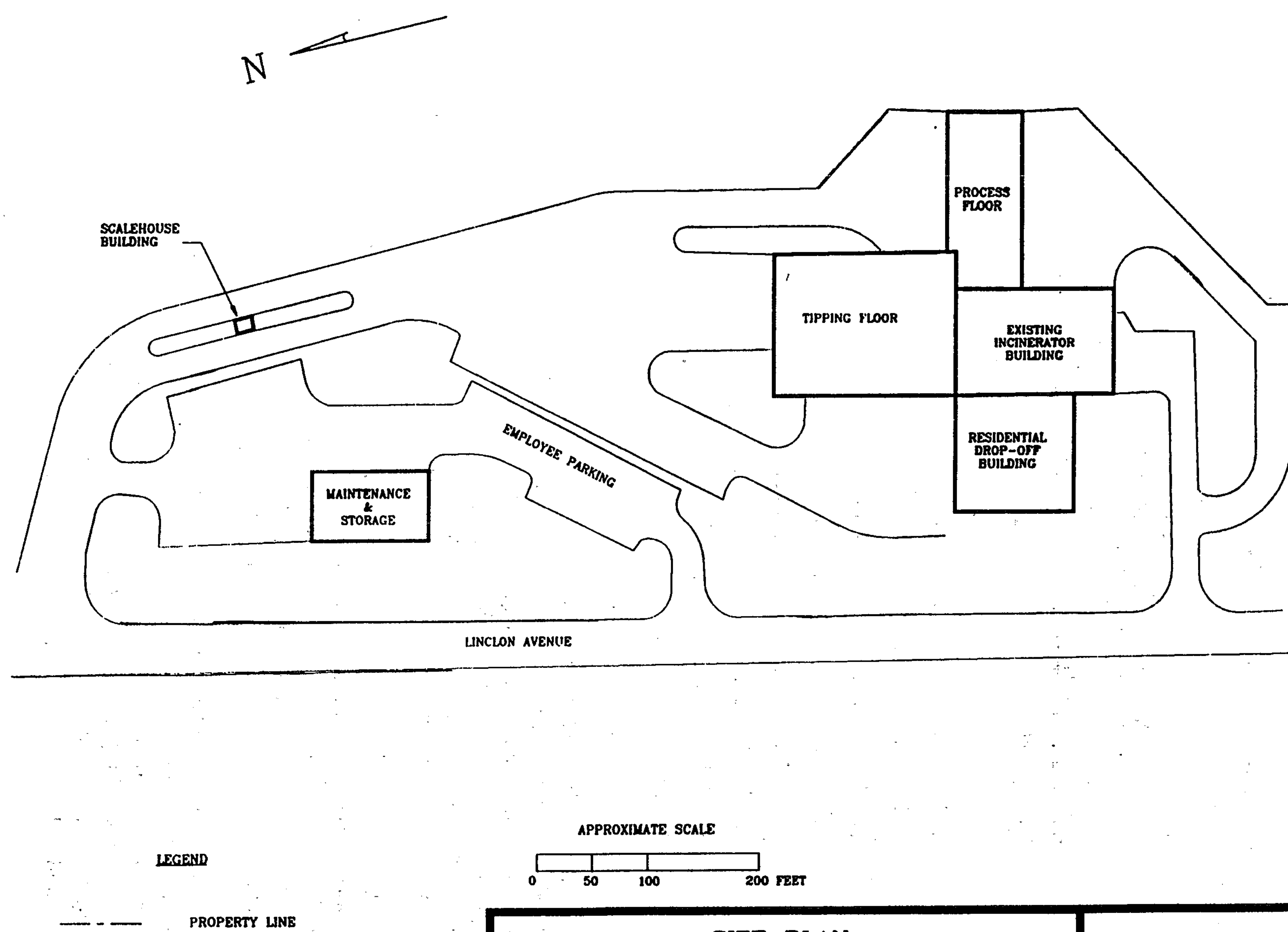
The Composting Facility is located at the Hauppage Landfill. Yard waste is brought to the facility by municipal and private haulers, commercial landscapers, and other Town agencies. The facility received approximately 43,298 tons of yard waste in 1992.

Landfill

The Hauppage Landfill is the ultimate disposal site for residue generated at the Resource Recovery Facility and Multi-Purpose Recycling Facility. Construction and demolition (C&D) debris is also disposed of at the landfill. In 1992, the landfill received approximately 55,650 tons of ash, 333,885 tons of C&D debris, and 3,078 tons of MRF residue. An additional 37,872 tons of ash were received from other resource recovery facilities on Long Island.

3.1.2 Material Recovery Facility

The Islip MRF, known as the Multi-Purpose Recycling Facility, is located on a 39.4-acre parcel of land at the Lincoln Avenue Complex in the unincorporated area of South Holbrook, New York. The facility itself occupies approximately 10.5 acres of the overall parcel. The MRF site plan is shown in Figure 3-2. Commencing operations in December 1990, the MRF is owned and



SITE PLAN
MULTI-PURPOSE RECYCLING FACILITY
ISLIP, NEW YORK

FIGURE 3-2

operated by the Islip Resource Recovery Agency. Table 3-1 summarizes the material received at the MRF in 1992.

Table 3-1
Material Received and Recovered in 1992

Material	Throughput (tons)	Percent of Total (%)
Newspaper	7,363	28.1
Corrugated Cardboard	2,095	8.0
Mixed Paper	1,355	5.2
Metals	1,320	5.0
Tin Cans	1,018	3.9
Plastics	167	0.6
Flint Glass	120	0.5
Green Glass	61	0.2
Aluminum	15	<0.1
Rejects	12,707	48.5
Total	26,222	100.0

The MRF includes a scalehouse, recyclables tipping area, processing floor building, residential drop-off center, administrative offices, and vehicle maintenance building. The facility design includes two primary processing lines for backup redundancy and operational flexibility. Each processing line is capable of handling between 15 and 18 tons per hour providing an installed processing capacity of 36 tons per hour. A single eight-hour shift, therefore, can process about 120 tons or, with both lines in operation, 240 tons.

Vehicles delivering either paper or commingled recyclables (on alternating Wednesdays) to the MRF immediately proceed to the scalehouse where the vehicle is identified, weighed, and logged into the computer system. The vehicles are then directed to the recyclables receiving building to discharge their load onto the tipping floor. After visual inspection, a payloader charges the material to one of two steel pan conveyor systems serving each processing line.

In each processing line, inclined transfer conveyors move the material from the steel pan conveyors to a variable-speed, hand-picking conveyor. The handpicking conveyor belt is 48 inches in width and 65 feet in length. The conveyors in each processing line are located in an enclosed primary sorting station where pickers remove corrugated cardboard, bulky wastes, and large metals. Three conveyors transfer the removed materials from the sorting station to three transfer trailers below the building.

The hand-picking conveyor discharges the remaining material into a primary trommel. Each trommel is 8 feet in diameter and 36 feet in length, with 9-inch holes in the trommel screens. Material expected to drop through the 9-inch holes include bottles, cullet, and cans (ferrous, tin, and aluminum). The rejects from the trommel pass onto another conveyor within a second enclosed picking station. The pickers here remove plastics and No. 2 paper (Mixed Paper-Grade No. 1), while cleaned No. 1 paper (Special News-Grade No. 7) passes through the picking station. The sorted materials are transferred by conveyor to transfer trailers.

The bottles, cullet, and cans passing through the 9-inch holes in the trommel are transferred by a series of conveyors to a third enclosed picking station. Steel cans are removed by a magnetic separator and discharged into a trailer below the building. The remaining material discharges onto a variable-speed conveyor within the picking station. In this picking station, aluminum is removed and glass is color-sorted and deposited into containers.

The rejects from the picking station are discharged to secondary trommels for removal of mixed broken glass. Each trommel, equipped with 3-inch diameter screens, is 4 feet in diameter and 18 feet in length. Rejects from this trommel are discharged onto a variable-speed conveyor within the final picking station. Plastic and No. 2 paper are removed from the conveyor in this picking station; the remaining No. 1 paper drops onto the same conveyor serving the primary sorting system.

3.1.3 Economic, Energy and Environmental Issues

This section addresses the economic, energy, and environmental impacts associated with the operation of the MRF and IMSWM system. These impacts are based on publicly available information or material provided by the Authority.

<u>Economic Implications</u>

In 1982, The Agency was authorized by the New York State Legislature and established through public referendum in the Town. The Agency is governed by a five-member board of directors comprised of the five members of the Town Board. Under a service agreement, the Agency agreed to develop a solid waste management system to process and dispose of all waste generated within the Town. The Town, in turn, is obligated to deliver all waste collected in the Town to the system and pay service charges collected from Town residents to the Agency. The system consists of the MRF, resource recovery facility, composting facility, and C&D landfill (Hauppage Landfill). The Agency is authorized to acquire land, develop facilities, contract services, sell bonds, and collect fees to pay all debt service and operating and maintenance expenses. Insufficient information was provided by the Agency to appropriately allocate costs to the IMSWM system and MRF. Estimates provided by the Agency, therefore, were used to assess the relative costs of the MRF in the context of the IMSWM system.

Tables 3-2 and Table 3-3 summarize the estimated costs and revenues for both the IMSWM system and MRF in 1992, respectively. The revenues were generated by tipping fees at the MRF, resource recovery facility, composting facility, and landfill, as well as sale of electricity produced at the resource recovery facility and material recovered at the MRF

and composting facility. The County also received state grants and levied a special assessment on all households in the County. The expenses included administration costs and operating and maintenance (O&M) costs for the waste management facilities. In 1992, the total revenues were approximately $25,395,000, while total expenses were $19,152,000. The MRF generated about $804,000 in revenues from tipping fees and recovered material sales, while the associated O&M expenses were $2,801,000. Based on these estimated costs and revenues, the net MRF costs represent over 10 percent of the total IMSWM system.

Energy Consumption

The Agency provided insufficient data to assess the energy consumption and production ofthe MRF and associated IMSWM system. Based on observations at the facilities, however, it can be deduced that the energy consumption of the vehicles and processing equipment at the MRF is insignificant, when compared with the energy consumption by the other disposal facilities within the system and net energy production from the resource recovery facility.

Environmental Regulations

The Islip facilities have received all necessary construction and operating permits from the New York State Department of Environmental Conservation (NYSDEC). Table 3-4 summarizes the status of all major permits and approvals for the resource recovery facility, composting facility, landfill, and MRF. Discussed below are the regulations governing solid waste management facilities in New York State.

Solid waste management facilities are regulated under 6 NYCRR 360 (Part 360) issued by the NYSDEC. The Part 360 regulations establish permitting requirements, design and operational constraints, financial assurance obligations, and monitoring, reporting, and recordkeeping requirements specific to resource recovery facilities, composting facilities, landfills, and MRFs. The regulations applicable to the Islip IMSWM system are summarized below:

- Landfills (6 NYCRR 360-2). Landfills must obtain permits prior to construction and operation from the NYSDEC. To obtain a permit, the operator must submit, amongst other material, an engineering report, plans and specifications, QA/QC plans, O&M manual, contingency plan, and hydrogeologic report. At a minimum, the permit imposes requirements for landfill liner system, leachate collection and treatment, groundwater monitoring landfill gas recovery, closure and post-closure activities, landfill reclamation, and financial assurance.

Table 3-2
Estimated Costs for the Islip IMSWM System

Cost Element	IMSWM System	MRF
Waste-to-energy operating expenses	5473000	
MRF operating expenses	2801000	2801000
Compost facility operating expenses	1821000	
C&D landfill operating expenses	1531000	
Administration	5295000	
Miscellaneous	2231000	
Total	19152000	2801000

Table 3-3
Estimated Revenues for the Islip IMSWM System[a]

Cost Element	IMSWM System	MRF
Resource recovery facility tip fees	15,829,000	
C&D landfill tip fees	4,232,000	
Yard waste tip fees	765,000	
MRF tip fees	559,000	559,000
Sale of electricity	2,814,000	
Sale of recovered material	245,000	245,000
Sale of compost	18,000	
Methane royalties	144,000	
Residue disposal fees	168,000	
Revenues received from grants	41,000	
Earnings on debt service	301,000	
Administration charged to collection	25,000	
Interest income	233,000	
Miscellaneous	21,000	
Total	25,395,000	804,000

[a] The retained earnings in the Waste Management Enterprise Fund has increased by approximately $553,000 in 1992. The remaining balance is to be used as reserve funds for future post closure needs.

- Incinerators (6 NYCRR 360-3). Resource recovery facilities must obtain permits prior to construction and operation from the NYSDEC. To obtain a permit, the operator must submit an engineering report, plans and specifications, comprehensive recycling plan, O&M manual, and waste control, contingency, closure and ash management plans. The permit establishes minimum requirements for facility operations, waste receipt and handling, and monitoring, reporting and recordkeeping.

- Composting (6 NYCRR 360-5). Composting facilities must obtain permit prior to from the NYSDEC. The facility must also comply with minimum design requirements and submit an annual report to the NYSDEC.

- Recycling (6 NYCRR 360-12). If a MRF accepts only source-separated, non-putrescible waste, it does not require a permit from the NYSDEC, but need only register with the agency prior to operation. The facility must also comply with minimum design requirements and submit an annual report to the NYSDEC.

If facilities discharge stormwater or process wastewaters to surface waters, they are also required to obtain a State Pollution Discharge Elimination System Permit and Water Quality Certification from the NYSDEC. A wastewater discharge permit is required for releases to a municipal treatment plant from the Suffolk County Department of Health Services.

Resource recovery facilities must also obtain permits for air emissions prior to construction and operation from the NYSDEC (6 NYCRR 200, et seq.). If classified as a major source, the facility also requires a Prevention of Significant Deterioration (PSD) Permit. To obtain a permit, the operator must demonstrate that the facility will comply with all applicable ambient air quality standards and that the facility incorporates Best Available Control technology (BACT). The permit will establish emission standards for all regulated pollutants, performance criteria for air pollution controls, and monitoring, testing, reporting, and recordkeeping requirements. In addition, the U.S. EPA proposed Section 111(d) emission guidelines for existing resource recovery facilities in September 1994. These guidelines require existing facilities to comply with more stringent emission standards and retrofit additional control technology than currently required by the NYSDEC.

Table 3-4
Major Environmental Permits and Approvals

Facility	Responsible Agency	Permit/Approval	Issuance Date
Resource Recovery Facility	New York State Department of Environmental Conservation (NYSDEC)	Permit to Construct/Certificate to Operate an Air Contaminant Source (including PSD Permit)	11/30/84
	NYSDEC	Permit to Construct/Permit to Operate a Solid Waste Management Facility (Part 360 Permit)	11/30/84
	NYSDEC	State Pollution Discharge Elimination System (SPDES Permit)	11/30/84
	NYSDEC	Long Island Well Permit	11/30/84
	Suffolk County Department of Health Services	Wastewater Discharge Permit	11/30/84
Hauppage Landfill	NYSDEC	Permit to Construct/Permit to Operate a Solid Waste Management Facility (Part 360 Permit)	N/A
Multi-Purpose Recycling Facility	NYSDEC	Permit to Construct/Permit to Operate a Solid Waste Management Facility (Part 360 Permit)	N/A

3.2 Field Test Results

The field test program addressed the environmental and occupational health and safety impacts associated with the operation of the Islip MRF. The sampling procedures and results are summarized in the following sections.

3.2.1 Test Procedures

The field test program at the Islip MRF was conducted over a three-day period from June 29 through July 2, 1993. At the time of the field test program, the Islip facility was operating five days per week on a single shift basis from 7:00 a.m. to 3:30 p.m. Operations were suspended during a one-half hour lunch break and two 15-minute coffee breaks. A total of 58 people were employed at the facility. The facility was operating on an alternating schedule of receiving and processing newsprint collected during one week and then mixed recyclables the next week. The changeover occurred on Wednesday.

During the field test program, the Islip facility completed processing of paper received the prior week, and received mixed recyclables on Wednesday. The operating schedule was as follows:

- Tuesday. Paper processing only.

- Wednesday. Paper processing for two hours, mixed recyclables for the remainder of the day.

- Thursday. Mixed recyclables processing only.

The schedule allowed ambient sampling to take place during the two operational modes of the MRF -- processing newsprint and corrugated cardboard received the prior week and receiving and processing commingled recyclables.

The field test program was conducted in accordance with the approved QAPjP and site-specific SAP, with the following exceptions:

- On June 29 and July 1, there were two upwind and one downwind sampling locations due to a change in the predominant wind direction after startup of the TSP and PM-10 samplers.

- A second downwind PM-10 location was not sampled on July 1. Because only three PM-10 samplers were available for the program, the third sampler was used for the downwind duplicate sample on the last day.

- An audiodosimeter duplicate was not taken due to an oversight on the part of the field team.

- A pesticide field spike was not performed due to an oversight on the part of the field team.

- The desired sample volume of 2,880 liters was not achieved for the pesticide samples. The sample volumes were as low as 2,350 liters. Two factors contributed to this problem: (1) the pesticide samplers could not be started until between 8:30 and 9:00 a.m. because of delays in initiating the personnel sampling; and (2) the sampling team was required to leave the building at 4:00 p.m. curtailing the final part of the sampling period.

- A respirable dust sample was not collected on the custodian as he was absent from work due to illness on July 1.

- A matrix spike and matrix spike duplicate wastewater sample could not be collected because of insufficient wastewater volume in the sump drain.

Figure 3-3 shows the approximate locations of the sampling sites. The upwind/downwind locations of the air sampling equipment relative to the facility for each of the three days of monitoring are summarized in Table 3-5.

A brief discussion of each of the sampling location is presented below, highlighting any limitations that should be considered in the evaluation of the reported data.

- Site 1. This site was located near the southwest fence line, downwind of the facility for all three sampling events. The location was suspected to be influenced by vehicular traffic from the adjacent public road, but could not be relocated due to limitations imposed by the fence line and electrical outlet access.

- Site 2. This site was located at the north fence line, upwind of the facility for all three sample events and generally considered to be representative of upwind conditions.

- Site 3. This site was located to the northeast of the facility. At the end of Day 1, meteorological forecasts indicated that wind directions were shifting and equipment was moved from this location to Site 4 to better characterize downwind conditions. No further samples were collected from this location after Day 1.

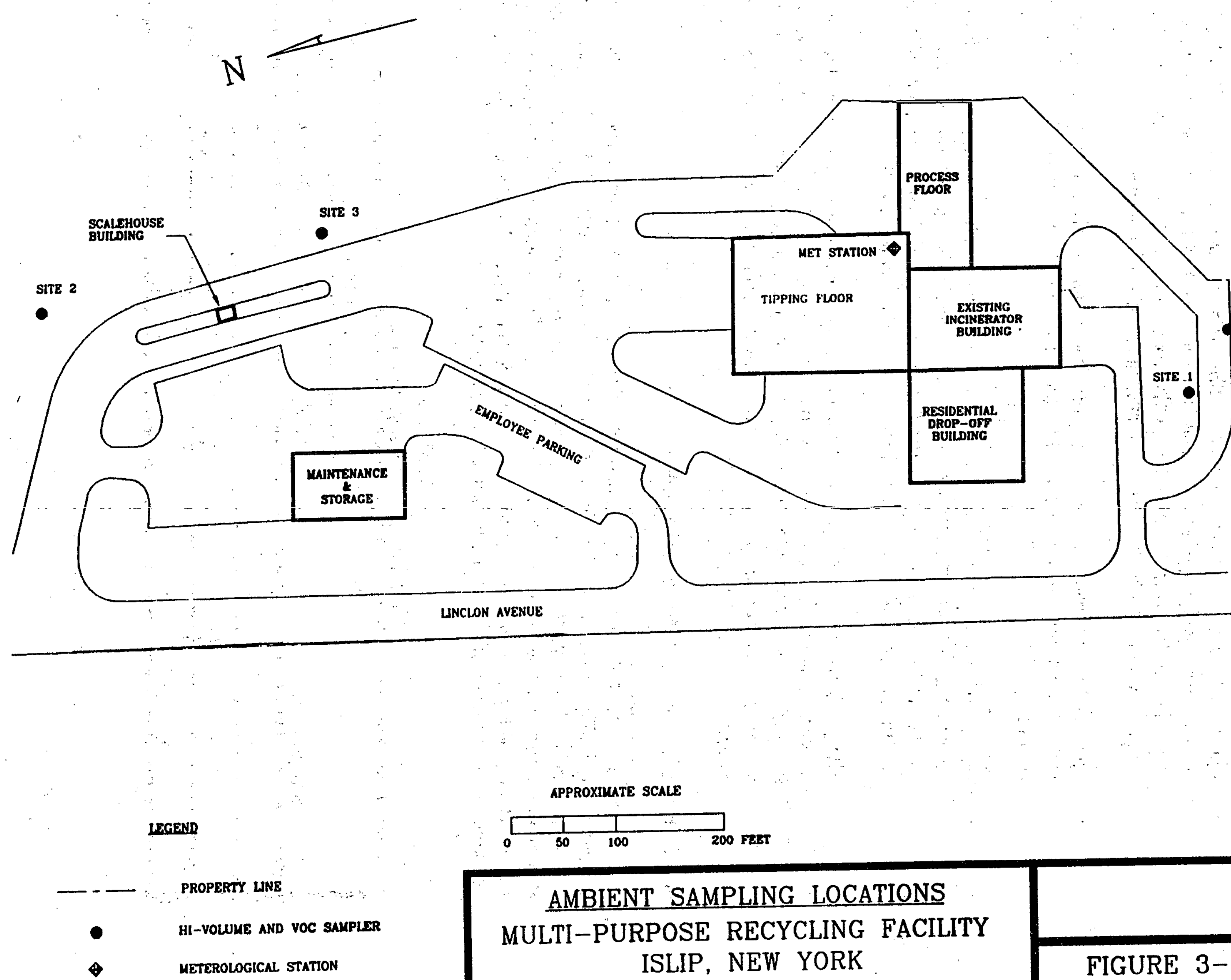
- Site 4. This site was located to the south of the facility and represents downwind conditions on Day 2 and upwind conditions on Day 4. The data from this location is suspected to be influenced by vehicular traffic from a nearby dirt access road between the MRF and the inactive landfill. To obtain a duplicate PM10 sample, the PM10 sampler was moved to Site 1 on Day 3.

3.2.2 Environment and the Public Health

The test program was conducted at the Islip MRF between June 29 and July 2, 1993. The air quality sampling measured the ambient concentrations of TSP, PM10, CO, VOC, lead, and mercury vapor. Measurements were also conducted to determine wastewater quality and community noise levels associated with MRF operations. The windrose data for the sampling period at Islip are presented in Appendix B. The test results are discussed in the following sections; the complete test results are presented in Appendix C.

Table 3-5
Sampling Locations at the Islip MRF

Sample Day	Locations	
	Upwind	Downwind
1	2,3	1
2	2	1,4
3	2,4	1



AMBIENT SAMPLING LOCATIONS
MULTI-PURPOSE RECYCLING FACILITY
ISLIP, NEW YORK

FIGURE 3-3

Total Suspended Particulate, PM10 and Lead

Samples for TSP, PM10, and lead were collected at three locations for approximately 24 hours on each of the three days of sampling. The TSP, PM10, and lead data are summarized in Table 3-6. The winds were variable during the three sampling events.

Table 3-6
Islip TSP, PM10 and Lead Sampling Results[a]

Day	Compound	Concentration ($\mu g/m^3$)			
		Upwind	Upwind	Downwind	Downwind
1	TSP	40.4	37.68	60.76	-
	PM10	24.71	27.57	36.93	-
	Lead	0.01	0.01	0.01	-
2	TSP	66.09	-	94.84	159.42
	PM10	33.22	-	46.22	75.50
	Lead	0.01	-	0.02	0.05
3	TSP	60.10	142.53	69.31	-
	PM10	27.01	NA	28.65	-
	Lead	0.01	0.03	0.01	-

[a] PM10 and lead standards are 150 and 1.5 $\mu g/m^3$, respectively.

On Day 1, TSP and PM10 levels measured at the upwind location were found to be lower than those at the downwind location. Two samplers were inadvertently operated at upwind locations due to a shift in the predominant wind direction after the sites were already set up and operational. Hourly wind speeds ranged from 1 to 7 miles per hour. Comparison of the two upwind locations show reasonable agreement for all three parameters. The TSP levels at the downwind location was approximately 50 percent higher than the levels at the two upwind locations. A negligible difference was noted when comparing the lead values for the three locations. The PM10 contribution to the total particulate ranged from 61 to 73 percent for all three locations.

The TSP and PM10 levels were measured at all sites on Day 2 were higher than that found on Day 1. Hourly wind speeds ranged from 2 to 10 miles per hour. Site 4 was determined to be downwind during testing on Day 2. The particulate results for Site 4 were 165 percent higher than that observed at the other downwind location (Site 1). Similarly, the lead levels at Site 4 were 200 percent higher than that observed at Site 1. This suggests that the Site 4 data may be elevated due to vehicular traffic in the vicinity of the sampler. The PM10 contribution to total particulate ranged from 47 to 51 percent for the three sites.

On Day 3, variable wind directions again resulted in two upwind and one downwind sampling locations. Hourly wind speeds ranged from 4 to 19 miles per hour. The higher wind speeds may have influenced the variability of the results. The upwind location (Site 2) showed little change in particulate concentration from Day 2, maintaining the 50-percent increase over levels measured on Day 1. At downwind Site 1, the particulate levels were similar to those observed on Day 1. Site 4 was considered upwind for Day 3, based on variable wind patterns noted throughout the day. The particulate concentrations at Site 4 were similar to those measured on Day 2, supporting the hypothesis that the higher particulate concentrations primarily result from vehicular traffic.

Excluding the Site 4 data, the TSP and PM10 downwind average concentrations were higher than the upwind concentrations by 37 and 28 percent, respectively. The higher downwind concentrations at Site 4 may be attributed to vehicular traffic on and off site, and the location of dirt roads near downwind sampling sites. There would appear to be a moderate contribution of the facility to fence line TSP and PM10 concentrations. There was negligible difference in upwind and downwind lead concentrations. The PM10 and lead levels were well below all applicable New York and National Ambient Air Quality Standards (NAAQS), which are 150 $\mu g/m^3$ and 1.5 $\mu g/m^3$, respectively. There is currently no ambient air quality standard for total suspended particulate.

The lead QC laboratory spike and spike duplicate analyses recoveries were both 85 percent. The lead matrix spike and matrix spike duplicate analyses recoveries were 49 and 68 percent, respectively. Based on the low lead recoveries, the test results should be assumed to be biased low. A sensitivity analysis of these recoveries shows, as a worst case, the adjusted results may be twice as high as the reported values, but are still considerably below the NAAQS.

<u>Carbon Monoxide and Mercury Vapor</u>

Carbon monoxide and mercury vapor levels were monitored with direct-reading instruments at upwind and downwind sites on each of the three days on-site. Instantaneous readings were generally taken at each sampling location once in the morning and once in the afternoon. The CO and mercury (Hg) results are summarized in Table 3-7. Carbon monoxide and mercury were not detected in concentrations higher than background levels. No difference between upwind and downwind concentrations were found. All results were considerably lower than the applicable OSHA and ACGIH exposure limits.

Table 3-7
Islip Ambient CO and Mercury Measurement Results[a]

Location	CO Level (ppm)	Hg Level (mg/m^3)
Fence Line (Trailer Park)	ND	ND-0.004
Fence Line (Coates Avenue)	ND-1	ND
Ambient Air Station #1	ND-1	ND-0.006
Ambient Air Station #2	ND-1	ND-0.006
Ambient Air Station #3	ND	ND-0.001
Ambient Air Station #4	1	ND

[a]The PELs for CO and Hg are 35 ppm and 0.05 mg/m^3, respectively.

Volatile Organic Compounds

Samples for VOC were collected at one upwind and two downwind locations for approximately 24 hours on one day, and two upwind and one downwind locations on two days of sampling. The samples were analyzed for "target compounds" consisting of VOC from EPA's Hazardous Substance List (HSL) and featured scans for over thirty-five compounds.

Table 3-8 compares the laboratory results with the applicable ambient guidelines issued by the New York State Department of Environmental Conservation (NYSDEC). Only those compounds that were found above their respective detection limits are presented in this table. Eleven VOCs were detected on Days 1 and 2, while five compounds were detected on Day 3. None of the compounds were measured at concentrations of greater than 10 $\mu g/m^3$, with the following exceptions:

- Three compounds (toluene, 1,3-butadiene, 2-butanone, and chloromethane) were detected in the range of 1 to 60 $\mu g/m^3$ range at the upwind Site 2.

- Acetone was detected in all samples in the range of 21 to 902 $\mu g/m^3$.

Table 3-8
Islip VOC Sampling Results

Day	Compound	Detection Limit ($\mu g/m^3$)	Concentration ($\mu g/m^3$)			State Guideline ($\mu g/m^3$)
			Site 1	Site 2	Site 3	
1	Acetone	2.4	98.7	902.0	76.0	NA
	Benzene	0.6	5.1	5.7	4.2	NA
	2-Butanone	0.6	7.1	9.4	ND	NA
	Carbon Tetrachloride	1.3	1.3	ND	ND	1,300
	Chloromethane	0.4	2.7	2.5	2.3	22,000
	Tetrachloroethene	0.7	ND	0.7	1.4	NA
	Toluene	0.8	15.1	15.8	10.9	NA
	1,1,1-Trichloroethane	1.1	6.5	8.2	8.7	NA
	Trichlorofluoromethane	1.1	5.6	6.2	2.8	NA
	Trichlorotrifluoroethane	1.5	ND	13.8	ND	NA
	Xylenes	0.9	7.4	6.5	4.3	100,000
2	Acetone	2.4	94.9	52.2	71.2	NA
	Benzene	0.6	4.2	5.1	4.2	NA
	1,3-Butadiene	1.1	ND	59.7	ND	2,200
	2-Butanone	0.6	12.1	44.2	10.9	NA
	Chloroethane	0.5	ND	7.9	ND	NA
	Chloromethane	0.4	2.5	56.3	ND	22,000
	Tetrachloroethene	0.7	5.4	6.8	8.8	NA
	Toluene	0.8	15.8	13.9	1.1	NA
	1,1,1-Trichloroethane	1.1	6.0	5.5	ND	NA
	Trichlorofluoromethane	1.1	5.1	3.4	ND	NA
	Xylenes	0.9	6.1	5.2	ND	100,000
3	Acetone	2.4	21.1	21.1	33.2	NA
	Benzene	0.6	ND	1.0	ND	NA
	2-Butanone	0.6	7.1	ND	1.2	NA
	Toluene	0.8	2.6	2.3	1.9	NA
	Trichlorofluoromethane	1.1	1.1	ND	ND	NA

Review of the data found no significant differences between upwind and downwind concentrations of VOCs. The levels of VOC reported can be considered representative of normal background levels in urban areas. All results were well below the limits found in the NYSDEC guidelines.

The duplicate analysis of a field sample demonstrated precision of 7 to 17 percent for all analytes, except acetone with a precision of 35 percent. Except for acetone, the RPD values for this set of samples met acceptance criteria of ± 20 percent. For the laboratory spike samples, the percent recoveries for 18 compounds spiked ranged from 74 to 120 percent, which slightly exceeds the QAPjP criteria of 75 to 115 percent. EPA Method TO-14 does not state specific acceptance ranges for surrogate and spike recoveries. Coast-to-Coast Analytical Service uses 70 to 130 percent as an acceptance criteria, based on guidance from EPA Region V. There were no VOCs detected in any of the field or instrument blanks.

Wastewater

Wastewater samples were collected from the drain at the rear of the building during the washing of a truck on July 2, 1993. This drain collects runoff from the area behind the building including runoff from stormwater and the washing of trucks. This runoff is pumped to a drainage field behind the facility. The soil is periodically removed and landfilled. Trucks and roll-off dumpsters are washed approximately once per week or as needed to keep them clean. The results of the wastewater sampling are presented in Table 3-9. The metals levels in the wastewater were found to be less than regulatory limits established under the Resource Conservation and Recovery Act (RCRA). Because the facility did not require a discharge permit, no limits have been established for the other parameters.

Community Noise

Community noise levels were measured at the four ambient air stations, the facility entrance, Lincoln Avenue, Coates Avenue, and the fence line by the trailer park. The results of the noise survey are presented in Table 3-10. The main source of noise is the dumping of glass and other recyclables on the tipping floor. The entrance to the tipping floor faces Lincoln Avenue and is shielded from the nearby mobile home park by the Residential Drop-off Building and the non-operational Incinerator Building. At the Lincoln Avenue property line, an instantaneous increase in noise levels of 6 and 13 dBA was measured during the dumping of recyclables. The impact of this increase should be minimal, because this activity is intermittent and Lincoln Avenue is a commercial and retail area. Measurements taken at the fence line next to the mobile home park ranged from 54 to 60 dBA, but reached instantaneous levels as high as 74 dBA when trucks passed through this area. The truck loading area also contributes to an increase in ambient noise levels. During operations, the noise levels at the nearest sampling point to a residential area (fence line by the trailer park) were below the 1-hour energy equivalent sound level of 62 dBA specified for a suburban area in the NYSDEC's Part 360 regulations [6 NYCRR 360-1.14(p)]. Instantaneous noise levels of 95 dBA were measured between the trucks during loading operations.

Table 3-9
Islip Wastewater Sampling Results[a]

Analyte	Units	Primary Sample	Duplicate Sample	Blank Sample
Chemical Oxygen Demand	mg/l	398	398	<5.0
Ammonia, as Nitrogen	mg/l	1.0	0.84	<0.10
Total Organic Nitrogen	mg/l	5.7	5.2	<0.10
Total Organic Carbon	mg/l	114	111	<0.50
Oil and Grease	mg/l	56.4	45.6	<5.0
Phosphate, as P-Total	mg/l	4.9	1.7	<0.050
Specific Conductance	umhos/cm	381	398	9.9
Total Dissolved Solids	mg/l	323	291	<5.0
Total Suspended Solids	mg/l	210	196	<5.0
BOD, 5-day	mg/l	83	630	<1
Silver, Total	μg/l	<10.0	<10.0	<10.0
Arsenic, Total	μg/l	<10.0	<10.0	<10.0
Barium, Total	μg/l	257	219	<200
Cadmium, Total	μg/l	24.5	22.0	<5.0
Chromium, Total	μg/l	13.6	12.3	<10.0
Mercury, Total	μg/l	<0.20	<0.20	<0.20
Lead, Total	μg/l	365	246	6.8
Selenium, Total	μg/l	<5.0	<5.0	<5.0
Total Coliform	mpn/100 ml	16,000	16,000	<2
Fecal Coliform	mpn/100 ml	16,000	16,000	<2

[a]Samples collected from wastewater sump on 07/02/93.

Table 3-10
Islip Community Noise Measurement Results

Location	Instantaneous Noise Level (dBA)
Fence Line (Trailer Park)	57.0-60.0
Fence Line (Coates Avenue)	46.0-70.0
Fence Line (Lincoln Avenue)	60.0-76.0
Fence Line (Facility Entrance)	55.0-58.0
Ambient Air Station #1	53.0-74.0
Ambient Air Station #2	54.0-56.0
Ambient Air Station #3	50.9-52.0
Ambient Air Station #4	58.0

3.2.3 Occupational Health and Safety

The occupational health and safety evaluation was conducted concurrently with the ambient sampling. Personnel sampling was conducted to measure worker exposure to nuisance dusts, silica, metals, fungi, bacteria, and noise. Indoor sampling was also conducted to detect levels of CO, mercury, PCBs, and pesticides. These sampling results are discussed in the following sections; the complete test results are presented in Appendix C.

<u>Dusts, Silica and Metals</u>

Worker exposures to total dust, respirable dust, silica, and metals were evaluated by collecting breathing zone samples from selected workers over the entire work shift (8 hours). Workers in the following job functions were sampled: maintenance worker, front end loader operator, residential drop-off attendant, roll-off driver, tipping floor attendant, truck loading laborer, custodian, and scale attendant. The personnel sampling results for total dust, respirable dust, and silica are summarized in Table 3-11; the metals sampling results are summarized in Table 3-12. As seen in these tables, all exposures levels were considerably lower than the applicable PELs. The highest total and respirable dust levels were found on the tipping floor attendant -- 3.39 mg/m^3 for total dust and 0.55 mg/m^3 for respirable dust. The only metal detected during the test program was aluminum. The highest concentration of 0.0105 mg/m^3 was several orders of magnitude below the TLV of 15 mg/m^3. The tipping floor attendant was observed to be wearing a dust mask approved for nuisance particulate.

Duplicate analysis found that all Relative Percent Difference (RPD) values were within the QAPjP limits, with the exception of one respirable and one total dust sample.

Table 3-11
Islip Total Dust, Respirable Dust and Silica Personnel Sampling Results[a]

Job Description	Concentration (mg/m^3)		
	Total Dust	Respirable Dust	Silica
Maintenance	0.4099	<0.1357	<0.0136
Front End Loader Operator	1.991	0.2586	<0.0001
Custodian	0.6533	-	-
Residential Drop Attendant	0.7581	0.2238	<0.1237
Roll-Off Driver	0.935	0.3359	0.039
Scale Attendant	<0.1275	<0.1512	<0.0151
Tipping Floor Attendant	3.081	0.5503	0.0144
Truck Loading Laborer	1.7592	0.439	<0.0122

[a] PELs are 15.0, 5.0, and 0.1 mg.m^3 for total dust, respirable dust, and silica, respectively.

Table 3-12
Islip Metals Personnel Sampling Results[a]

Job Description	Concentration (mg/m^3)				
	Arsenic	Aluminum	Chromium	Lead	Nickel
Front End Loader Operator	<0.0001	0.0055	<0.0011	<0.0011	<0.0011
Roll-Off Driver	<0.0001	0.0036	<0.0012	<0.0012	<0.0012
Tipping Floor Attendant	<0.0001	0.0081	<0.0014	<0.0014	<0.0014
Truck Loading Laborer	<0.0001	0.0023	<0.0011	<0.0011	<0.0011

[a] PELs are 0.01, 15.0, 1.00, 0.05, and 1.0 mg/M^3 for arsenic, aluminum, chromium, lead, and nickel, respectively.

Carbon Monoxide and Mercury Vapor

Direct reading measurements for carbon monoxide and mercury were made throughout the facility on the three days of the program generally once in the morning and once in the afternoon. The measurements found no levels above the typical instrument background, which is considerably lower than the applicable PELs.

PCBs and Pesticides

Indoor samples were collected for analysis of pesticides and PCBs on each of the three sampling days at the tipping floor and picking stations A and B. One sample each was collected from the lunch area, the large trommel, and outside the control room. All results were less than the detection limits for each compound, with the exception of the sample collected in the lunch area. This sample showed a concentration of 0.8306 $\mu g/m^3$ of PCB (Aroclor-1242). This concentration is slightly above the detection limit of 0.5106 $\mu g/m^3$, but is several orders of magnitude below the PEL and TLV of 1,000 $\mu g/m^3$. The PCB and pesticide detection levels are presented in Appendix C.

Bacteria and Fungi

Airborne and surface bacteria and fungi samples were collected inside the building. Samples were collected at the tipping floor and picking booths A and B on each of the three sampling days. One airborne sample was collected at each of the following locations: lunch area, large trommel, and the control room. One surface sample was collected at each of the following locations: tipping floor, picking booths, lunch area, large trommel, and control room. Airborne and surface sampling results are summarized in Tables 3-13 and 3-14, respectively. As shown in these tables, bacteria and fungi levels were relatively consistent from location to location inside the facility, with no specific area exhibiting unusually high or low levels. The OSHA has not yet established PELs or TLVs for either fungi and bacteria.

In addition, airborne bacteria and fungi levels were measured at the one upwind and two downwind locations outside the building on all three days. These bacteria and fungi results are also presented in Table 3-13. As shown in this table, the airborne fungi and bacteria levels measured outside the facility were approximately one order of magnitude lower than the levels inside the facility. The downwind sample results were not higher than those measured upwind, which may indicate that the airborne bacteria and fungi present inside the building are not being released in measurable quantities. There are currently no regulatory limits for bacteria and fungi levels in ambient air.

All fungi detected were common environmental fungi. None of the fungi detected are considered highly virulent in nature. The two most commonly associated with infections that were detected are *Aspergillus niger* and *Aspergillus flavus*. These organisms are considered opportunistic pathogens, in that they are most likely to infect individuals with compromised immune systems. Healthy people are not likely to be infected. However, it is possible that hypersensitive people, and people exposed to high levels of fungal spores, may

Table 3-13
Islip Airborne Fungi and Bacteria Sampling Results

Location	Sample (viable counts per cubic meter)		
	Fungi	Bacteria RT[a]	Bacteria 56[b]
Picking Booth A	3498-8774	2139-3660	23-61
Picking Booth B	2157-5856	350-2584	<12-23
Tipping Floor	1364-9795	1341-2782	12-110
Lunch Room	9513	1135	24
Large Trommel	6546	2093-2338	<12-94
Control Room Stairs	6530	2332	<12
Ambient Air Station #1	129-451	163-342	12-58
Ambient Air Station #2	187-2855	280-1574	23-35
Ambient Air Station #3	1440	793	37
Ambient Air Station #4	234-338	373-795	12-35

[a]Bacteria RT is incubated at room temperature.
[b]Bacteria 56 is incubated at 56 degrees F.

Table 3-14
Islip Surface Bacteria Sampling Results[a]

Location	Bacteria (units per gauze wipe)
Picking Booth A	8,400-63,000,000
Picking Booth B	9,200
Tipping Floor	1,000,000
Lunch Room	80,000,000
Large Trommel	40,000

[a]Fungi tests were not conducted on this sample

develop hypersensitivity reactions, such as allergies, asthma, and hypersensitivity pneumonitis. Little information is available describing the exposure levels required to initiate such reactions.

No highly virulent pathogenic bacteria were identified in any of the samples. The most common bacteria detected was *Bacillus*, which is commonly found in environmental samples and occur naturally in soil and water. *Curtobacterium* is a common plant pathogen which is commonly recovered from air samples. *Arthrobacter* is a common environmental organism often associated with soil. The species of *Acinetobacter*, *Flavobacterium*, and *Pseudomonas* detected likely originated from water or wet environments. *Staphylococcus* and *Micrococcus* are associated with human and/or animal skin, and are typically found in samples from occupied facilities. Several enteric organisms were detected. *Serratia* and *Enterobacter* are common in soil and water environments. *Proteus vulgaris* is often found in association with food, soil and sewage. *Klebsiella pneumoniae* is an environmental bacterium that is considered to be an opportunistic pathogen that has been related to incidence of pneumonia in immuno-compromised individuals.

General sanitation at the facility may be a contributing factor to the presence of fungi and bacteria. Equipment and conveyors are not cleaned on a regular basis. Floors and booths are swept at the end of the day to remove broken glass and debris, but this is unlikely to have any significant effect on bacteria or fungi levels found in the facility.

Duplicate samples were collected on each of the three sampling days and the results were evaluated for Relative Percent Difference (RPD). The RPD for fungi and thermophilic were not within the specified range of 20 percent on two of the three sampling days. This may be due to the significant and variable distribution of microorganisms in the air within the building.

Noise Exposure

Worker exposures to noise were evaluated using personal audiodosimeters over the entire 8-hour work shift. Workers in the following job functions were sampled: maintenance, tipping floor attendant, truck loading laborer, picking booth workers, and truck maintenance. In addition, instantaneous indoor noise measurements were made using a direct-reading sound level analyzer. Tables 3-15 and 3-16 summarize the audiodosimeter and indoor noise level results, respectively.

On June 29, when the facility was processing paper only, the average noise levels to which workers were exposed over the entire work shift ranged from 78.8 to 80.8 dBA. These levels are below the OSHA Action Level of 85 dBA and the PEL of 90 dBA (see Table C-11 and C-12 in Appendix C). On June 30 and July 1, when mixed recyclables were processed, the average noise levels to which workers were exposed over the entire shift ranged from 99.2 to 106.6 dBA. These levels are in excess of the OSHA PEL, and would require the implementation of a comprehensive hearing conservation program for workers in all of the tested job functions. Hearing protection was available and worn by several workers, but full compliance was not achieved with hearing protection requirements. Personal exposure levels in each of the four picking booths were in excess of 100 dBA. Direct reading measurement with

Table 3-15
Islip Audiodosimeter Results

Job Description	Average Noise Levels (dBA)
Tipping Attendant	80.6-113.9
Picking Booth A	82.2-108.2
Picking Booth B/C	106.6
Picking Booth C	82.7-113.8
Picking Booth D	81.0-109.7
Maintenance Worker	99.3-105.3
Tipping Attendant	113.9
Truck Loading/Maintenance	107.7-108.6

Table 3-16
Islip Indoor Noise Measurement Results

Location	Instantaneous Noise Level (dBA)
Picking Booth A	76.0-80.1
Picking Booth B	73.0-87.0
Picking Booth C	70.6-91.0
Picking Booth D	72.5-98.0
Lunch Room	65.0-74.0
Tipping Floor	82.6-111.0
Large Trommel	99.0-101.0
Foreman's Office Stairs	90.0-95.0
Ventilation Motor Area	84.0
Truck Loading Area	95.0
Main Floor	78.0-101.0
Maintenance Room	61.0
Truck Repair Area	74.0-93.0

a noise meter found that the highest noise levels were generated by the dumping of mixed recyclables on the tipping floor. Short-term levels reached as high as 111 dBA during this operation.

Health and Safety Programs

An evaluation was performed to determine the status of occupational health and safety programs in place at the facility with respect to OSHA Standards. Documentation was made available for several of the following programs:

- An Energy Control Program is in place at the facility, although no documentation of training or evaluation of program effectiveness was available. Each maintenance worker was issued a lock with instructions on how the program operates and lockout procedures are posted in the control room.

- Dust masks are the only form of respiratory protection used at the facility. Use of these respirators was reviewed during Hazard Communication Training, but no information or documentation was available on a Respiratory Protection Program. Medical monitoring is not performed on employees prior to their use of respirators.

- A Hazard Communication Program is in effect at the facility, although documentation of training was not available.

- A Hearing Conservation Program has been implemented. Documentation of training and evaluations of hearing protectors were not available. Hearing protectors were not always worn by exposed workers, nor were warnings posted in areas of high noise.

- There were no air contaminants identified present requiring specified control programs.

- There was no Bloodborne Pathogen Program in place. Workers did report that syringes and needles are sometimes found in plastic containers. There has been one unconfirmed needle stick injury.

Information on injury and illness rates were not provided during or subsequent to the field test program.

Ergonomics

Picking booth operations were videotaped during the on-site facility assessment. These videotapes were reviewed by a COHN to identify the general ergonomic conditions and potential ergonomic risk factors. For the purpose of this assessment, potential ergonomic risk factors are defined as workplace conditions or work practices that may contribute to, or result in, worker discomfort, fatigue, or injury. Five types of workstations were evaluated at the Islip MRF:

- Workstation 1. In the first type of workstation, workers were located on each side of a conveyor, with bins on either side for separating aluminum and plastic recyclables. The conveyor height was not adjustable to accommodate individual workers. The fixed height of the conveyor system appeared appropriate for the majority of workers, based on the observation of their upper extremities while performing work. No foot stools (platforms) appeared to be available in this area to accommodate one shorter worker. This shorter worker was noted to raise elbows and shoulders in order to accommodate the fixed workstation height.

  Workers were able to perform sorting tasks without bending or excessive reaching. Standard sized bins allow workers to discard recyclables with ease. One worker was observed twisting at the waist repeatedly when discarding into a smaller plastic disposal container. Two workers have developed a work practice of repetitively flexing/extending wrists to "flip" plastics over their forearm to discard into bins.

  The potential ergonomic risk factors associated with this workstation are: (1) the fixed workstation (conveyor) height did not accommodate shorter workers; (2) the bin height/placement caused one worker to repetitively twist at waist to discard recyclables; and (3) workers have developed the practice of repetitively flipping plastics over forearm to discard recyclables.

- Workstation 2. This type of workstation was found at the end of the picking line (Picking Booth B), with one worker assigned for sorting plastic/aluminum recyclables. The workstation height was not adjustable, but appeared appropriate for this particular worker. This worker repetitively reached across the full width of the conveyor, resulting in repetitive bending at waist. The worker performed the majority of his work from the end of the conveyor. The bin for discarding recyclables was placed at the opposite end of conveyor, which required the worker to throw plastics the length of the conveyor to reach the bin.

  The potential ergonomic risk factors associated with this type of workstation are: (1) the workstation width required workers to reach across the full width of conveyor; and (2) the bin placement resulted in repetitive, forceful throwing motion to discard recyclables at other end of conveyor.

- Workstation 3. At this workstation, the workers were located on one side of conveyor with the bins on the opposite side. The workstation (conveyor) height was non-adjustable and appeared too high for the majority of workers in this area, as noted by raised shoulders and elbows bent and away from body in performing tasks. The guard on the side of conveyor raised the workstation height two to three inches, resulting in workers tending to rest forearms on a blunt guard edge. Several workers used foot stools (platforms) to elevate themselves to accommodate workstation height. All foot stools (platforms) were of the same height, limiting fit to individual workers.

One tall worker using a foot stool had to continuously bend at the waist over the conveyor.

In performing picking tasks, workers reached the full width of the conveyor to sort, resulting in repetitive leaning and bending at the waist. The placement of bins on the opposite side of conveyor from workers required workers to throw recyclables from the conveyor to the bins, causing repetitive flexion/extension of elbows and wrists.

The resulting potential ergonomic risk factors are: (1) the attempt to accommodate workers may not be effective in alleviating problems associated with the fixed workstation (conveyor) height; (2) the workstation width requires workers to reaches across full width of conveyor to pick recyclables; and (3) the bin placement required repetitive throwing of recyclables into bins.

- Workstation 4. This type of workstation had workers on each side of conveyor with bins on either side for sorting paper. The workstation height was non-adjustable, appearing appropriate for a majority of workers. Workers were able to perform tasks without bending or excessive reaching. Workers were also able to place discarded paper into bins with minimal twisting motion of torso. No potential ergonomic risk factors were identified for this type of workstation.

- Workstation 5. This type of workstation had one worker assigned to the end of the paper picking/sorting line (outside Booth B). The guard on the side of the conveyor raised the workstation height two to three inches, but did not appear to be problematic for this particular worker. This worker performed repetitive reaches to the full width of conveyor, resulting in repetitive bending at the waist.

The only potential ergonomic risk factors is the workstation width, which required the one worker to reach across full width of conveyor for picking/sorting recyclables.

SECTION 4

MONTGOMERY COUNTY, MARYLAND

4.1 Process Description

The Montgomery County Council maintains several solid waste management facilities to serve the residents and businesses in Montgomery County, Maryland. The process description presented in this section addresses the technical, economic, energy, and environmental aspects of both the MRF and IMSWM system.

4.1.1 Integrated Solid Waste Management System

Montgomery County (the County) provides disposal and limited collection services for MSW generated in Montgomery County, Maryland. The components of the IMSWM system serving Montgomery County include:

- Materials Recovery Facility,
- Transfer Station,
- Leaf and Yard Waste Composting Facility, and
- Oaks Landfill.

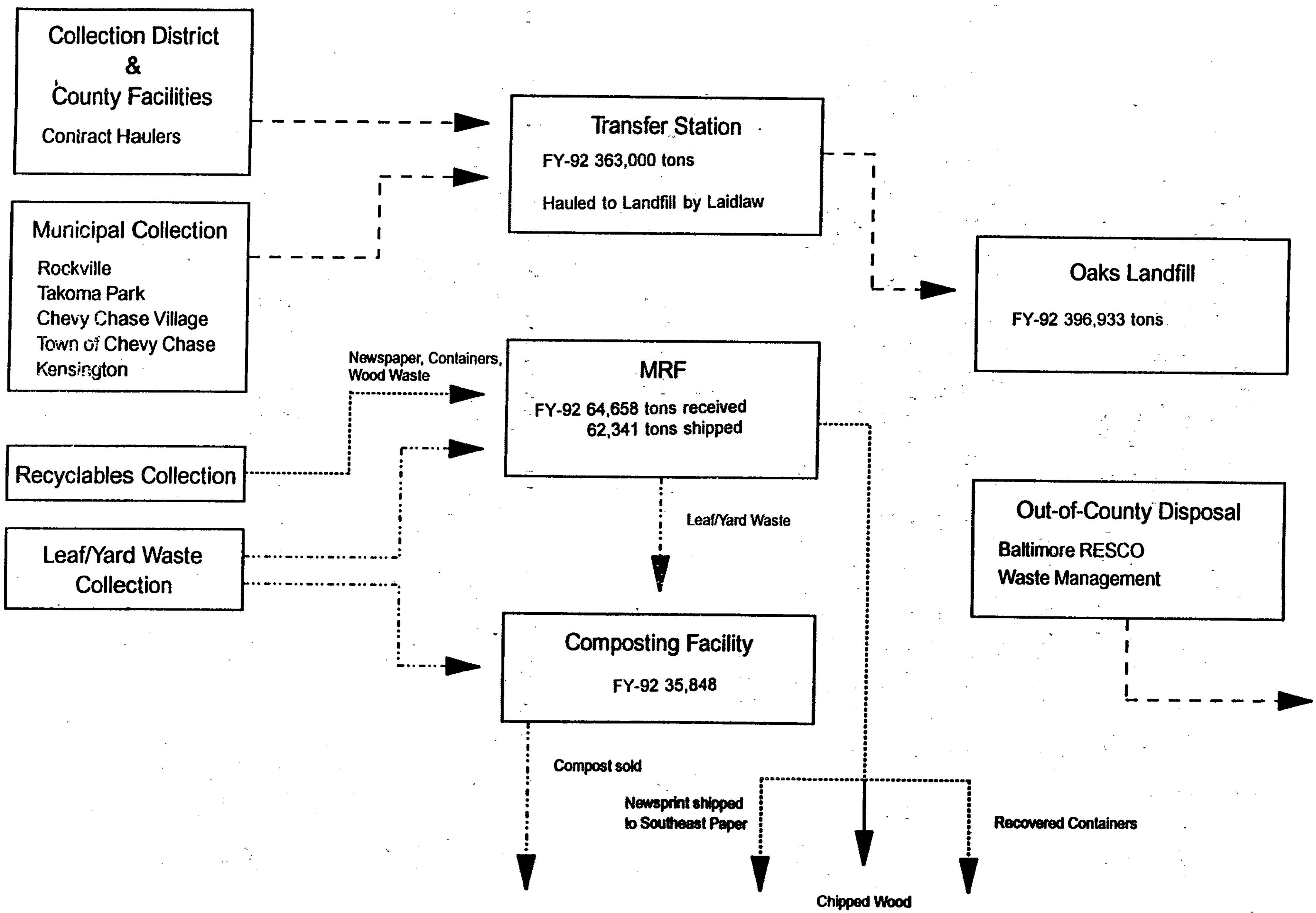
In addition, a Resource Recovery Facility will commence operations in the near future. Figure 4-1 presents a process flow diagram of the IMSWM system for Montgomery County, showing the quantities of waste received and the residue produced by the various components of the system.

<u>Waste Collection</u>

The County Collection District has 80,000 residences consisting of single family homes and multi-family homes with less than seven dwellings. The County sets routes and contracts with haulers. The Collection District was expanded in 1993 to cover all unincorporated areas of the County. The expansion of the Collection District added another 95,000 residences. In fiscal year (FY) 1992, 110,200 tons of MSW were collected from the 80,000 residences in the Collection District. In addition, County facilities contribute approximately 50,000 tons of MSW annually to the solid waste system.

Five municipalities in the County have municipal collection. These municipalities are Rockville, Takoma Park, Chevy Chase Village, Town of Chevy Chase, and Kensington. Approximately 50,000 tons of MSW are collected by the municipalities. Private haulers collect from residences outside of the Collection District and the five municipalities, residences with more than six dwellings within the Collection District, and commercial establishments. Private haulers collected approximately 500,000 tons of MSW in FY 1992.

Figure 4-1
Montgomery County Solid Waste System



Other collection consists of recyclables and leaf/yard waste. In FY 1992, approximately 53,000 tons of newspaper and commingled containers were collected in County-supported or sponsored programs. The collection of residential recyclables is offered to 205,000 residences. In FY 1992, approximately 24,000 tons of leaf and yard waste were collected from the approximately 147,000 residences. Recyclables collected from commercial establishments were estimated to amount to an additional 55,000 tons in FY 1992.

Material Recovery Facility

The Material Recovery Facility (MRF) is located next to the transfer station. The facility is owned by the County and operated by Maryland Environmental Services (MES). MES has subcontracted the operation to CRInc-Well. The MRF handled 64,658 tons of material in FY 1992. Operations at the MRF include the separation and baling of commingled containers, the shredding of brush and clean wood waste, and the baling of newspaper. Some leaf and yard waste is also brought to the MRF and then shipped to the composting facility. Newsprint is shipped to Southeast Paper in Silver Springs where it is further processed. The newsprint is then shipped to a pulp and paper mill in Georgia.

Transfer Station

The Transfer Station is located centrally in the County adjacent to the MRF. It is owned and operated by the County. In FY 1992, approximately 363,000 tons of MSW were received at the Transfer Station. The MSW is hauled to the landfill by Laidlaw.

Composting Facility

The Composting Facility is located in the western portion of the County. The facility is owned by the County and operated by MES. The composting area is approximately 35 acres in size. The leaf and yard waste is composted in windrows. The windrows are turned regularly with a mechanical turner. The compost product is marketed to landscapers, nurseries, retailers, and private citizens at $8.00 per cubic yard. In FY 1992, approximately 35,848 tons of yard waste were received at the Composting Facility.

Oaks Landfill

The Oaks Landfill is the northern portion of the County. The Oaks Landfill is owned by the County and operated by Browning-Ferris Industries (BFI). In FY 1992, 396,933 tons of MSW were disposed of at the landfill -- approximately 363,000 tons from the transfer station and 34,000 hauled directly to the landfill.

Out-of-County Disposal

An estimated 80,000 tons of MSW were disposed of out-of-County in FY 1992. Approximately half of that was hauled directly to the Baltimore RESCO waste-to-energy facility. The balance was hauled by Waste Management to distant landfills.

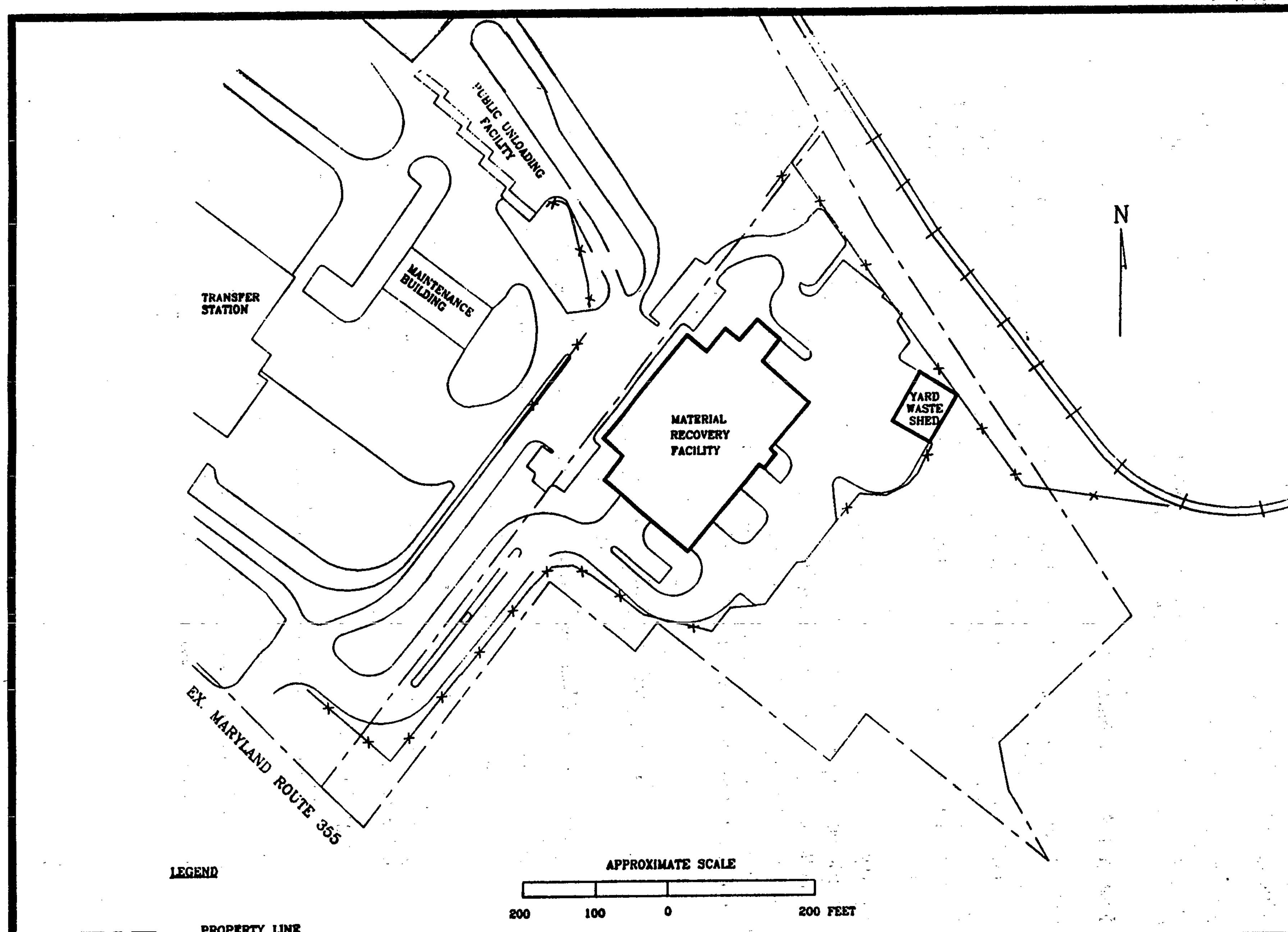
4.1.2 Material Recovery Facility

The Montgomery County MRF is situated on four acres of land immediately off of Interstate 270 south of the City of Gaitersburg, Maryland. The facility is located adjacent to the County's Solid Waste Transfer Station. The MRF is owned by the Montgomery County and, in a state and county partnership, managed by the Maryland Environmental Service. Under a subcontract with the MES, CRInc-Well constructed the facility and has operated it since startup in August 1991.

The MRF consists of a recyclables receiving area, processing room, administrative offices, and yard waste building (see Figure 4-2). The facility design includes a single processing line having a total throughput of 240 tons per eight-hour shift. This includes 140 tons of newspaper and 100 tons of commingled recyclables. The commingled recyclables consist of aluminum, ferrous materials, glass bottles, plastic bottles, and aluminum foil. Table 4-1 summarizes the material received and recovered at the MRF in 1992.

Table 4-1
Material Received and Recovered in 1992

Material	Throughput (tons)	Percent of Total (%)
Newspaper	41,557	64.3
Ferrous	2,006	3.1
Aluminum	829	1.3
Plastics	1,822	2.8
Flint Glass	6,426	9.9
Green Glass	3,444	5.3
Amber Glass	1,504	2.3
Mixed Glass	4,753	7.4
Residue	2,317	3.6
Total	64,658	100.0



SITE PLAN

MONTGOMERY COUNTY RECYCLING CENTER

DERWOOD, MARYLAND

FIGURE 4-2

Upon entering the site, the collection vehicles proceed immediately to the tipping floor. Because the County has negotiated a long-term contract for newspaper, the newspaper is simply dumped onto the floor and transferred by front-end loaders to open-top trailers for delivery to market. The commingled recyclables are dumped onto a separate portion of the floor and then pushed by a front-end loader into a pit serving the infeed conveyor.

The commingled materials are moved into the processing area by the infeed conveyor and then elevated by an inclined conveyor to an initial sorting station for the removal of nonrecyclables and aluminum foil products. The aluminum is deposited into portable storage bins, while nonrecyclables are conveyed to a roll-off. After initial sorting, the recyclables travel up another inclined conveyor to a magnetic separator that removes ferrous material (steel, tin, and bi-metal cans). The ferrous material is moved by conveyor to a self-tying baler for compaction into 1200-pound bales.

Following the magnetic separator, the remaining material drops onto a vibrating conveyor positioned at a right angle to the feed conveyor. As the material moves down this screen, broken glass and smaller contaminants fall through holes onto a mixed glass cullet conveyor. A triangular barrier at the end of the screen splits the stream into light and heavy fractions. The material is directed onto two inclined rotating tables designed to divide the heavy and light fractions. Rotating chain curtains divert the lightweight aluminum and plastic to each side of the table, while the heavier glass falls through the chains and brushes.

The plastic and aluminum drops off the side of the inclined table onto a two-stage vibrating screen. As the material moves down the vibrating screen, the aluminum cans and residue fall through the screen, while plastics continue onto the plastics sorting station. An eddy-current conveyor automatically separates aluminum cans from any remaining material. On the eddy-current conveyor, opposing magnetic fields cause the cans to jump off the conveyor onto a separate line that feeds a dedicated aluminum baler. The plastic containers remaining on the screen are sorted by type (PET and HDPE). The plastic bottles are directed to a baler for compaction into 900-pound bales.

The glass rolling off the inclined table is collected in a trough conveyor. The glass bottles are directed to another vibrating screen for removal of broken glass and then onto a conveyor that transports it to an enclosed sorting room. Sorters separate the amber and green glass, which is dropped through chutes to conveyors below the sorting room. The clear flint glass, which is negatively sorted, drops onto a conveyor outside the room. The three conveyors feed glass crushers on top of large enclosed storage bins. The crushed glass, along with the mixed cullet, are transferred to trucks for transport to market.

Vehicles deliver leaves, grass, brush, and other yard waste to the yard waste building. A tub grinder is provided to produce mulch from small diameter wood waste. Front-end loaders lift the yard waste into 45-foot, open-top trailers bound for the County's compost facility. The mulch is available to the public for pick-up.

4.1.3 Economic, Energy and Environmental Issues

This section addresses the economic, energy, and environmental impacts associated with the operation of the MRF and IMSWM system. These impacts are based on publicly available information or material provided by the Authority.

Economic Implications

The County is responsible under law for assuring that adequate facilities exist for disposal of the solid waste generated in the County. In 1976, the County established the Solid Waste Enterprise Fund to account for revenues and expenses of the IMSWM system. The system consists of a landfill, transfer station, composting facility, and MRF. In the near future, the resource recovery facility will commence operations and expand the disposal capacity available to the County. The Department of Environmental Protection (DEP), a part of the County's Executive branch, is responsible for planning, implementing, and managing the County's solid waste management program. The Division of Solid Waste Management, a division of the DEP, is responsible for the day-to-day operations of the IMSWM system. Insufficient information was provided by the County to appropriately allocate costs to the IMSWM system and MRF. To estimate the costs and revenues, the relative costs of the system components were estimated based on projections cited in the 1993 Official Statement for the Montgomery County IMSWM system.

Tables 4-2 and 4-3 summarize the estimated operating costs and expenses for both the IMSWM system and MRF in FY 1993, respectively. Revenues were generated by tipping fees at waste management facilities and the sale of material recovered at the MRF. Although not required in FY 1993, the County may also impose a System Benefit Charge on residents of the County. The expenses included administration costs, operating and maintenance (O&M) expenses and debt service for the waste management facilities. In FY 1993, the total system costs were estimated to be approximately $31,114,000. Settling the tipping fee to offset expenses, the total system revenues must equal system costs. The MRF generated about $990,000 in revenues from recovered material sales, while the O&M expenses were $12,350,000. Based on these estimated costs and revenues, the net MRF costs represent 36 percent of IMSWM system expenses (settling tipping fee to offset expenses).

Energy Consumption

An estimated 202 billion Btu of Energy was consumed to collect, transfer, haul, process, compost, and transport to market about 497,000 tons of MSW, yard waste, and recyclables. Of the 202 billion Btu consumed, approximately 65.8 percent was used to manage 397,000 tons of MSW, 9.4 percent was used to manage 35,800 tons of yard waste, and 24.8 percent was used to manage 64,700 tons of recyclables. Approximately 0.41 MMBtu of energy was consumed for each of the 497,000 tons of waste managed with 0.34, 0.53, and 0.77 MMBtu consumed for each of the 397,000 tons of MSW, 35,800 tons of yard waste, and 64,700 tons of recyclables, respectively.

Table 4-2
Estimated Costs for the Montgomery County IMSWM System[a]

Cost Element	IMSWM	MRF
Recycling Expenses	12,350,000	12,350,000
MRF Operating Expense	1,211,000	
Oaks Landfill Operating Expenses	4,131,000	
Gude Landfill Operating Expense	140,000	
Waste Reduction & Detoxification Expense	583,000	
Administrative & General Expenses	4,006,000	
Transportation System Expenses	1,400,000	
System Bonds Debt Service	4,294,000	
Existing County Debt Service[b]	3,000,000	
Total	31,114,000	12,350,000

Note: The above financial data are based on the information provided in 1993 Official Statement including the feasibility study. Because much of the financial information in the Official Statement are budget projections provided by the County, the above data should be considered "rough" estimations only.

[a]Information from the 1993 official statement including the feasibility study.

[b]No data provided on debt service prior to 1994.

Table 4-3
Estimated Revenues for the Montgomery County IMSWM System[a]

Cost Element	IMSWM	MRF
Tipping Fee Revenue[b]	27,525,000	
Yard Waste Tipping Fee Revenue	273,000	
Recycling Net Revenue	990,000	990,000
Gude Landfill Methane Sales	203,000	
Revenue from Citizen Drop-Off Center	753,000	
Interest Income	1,371,000	
Total	31,114,000	990,000

Note: The above financial data are based on the information provided in 1993 Official Statement including the feasibility study. Because much of the financial information in the Official Statement are budget projections provided by the County, the above data should be considered "rough" estimations only.

[a]Information from the 1993 official statement including the feasibility study.

[b]Tipping fee established to offset expenses.

Figure 4-3 and Table 4-4 show the energy consumed by function. For the entire IMSWM, almost 84 percent of the energy consumed was for transportation, that is, collection, transfer and haul, transporting recyclables to market, and hauling residue to the landfill. About 84, 78, and 85 percent of the energy consumed was for the transportation of MSW, yard waste, and recyclables, respectively.

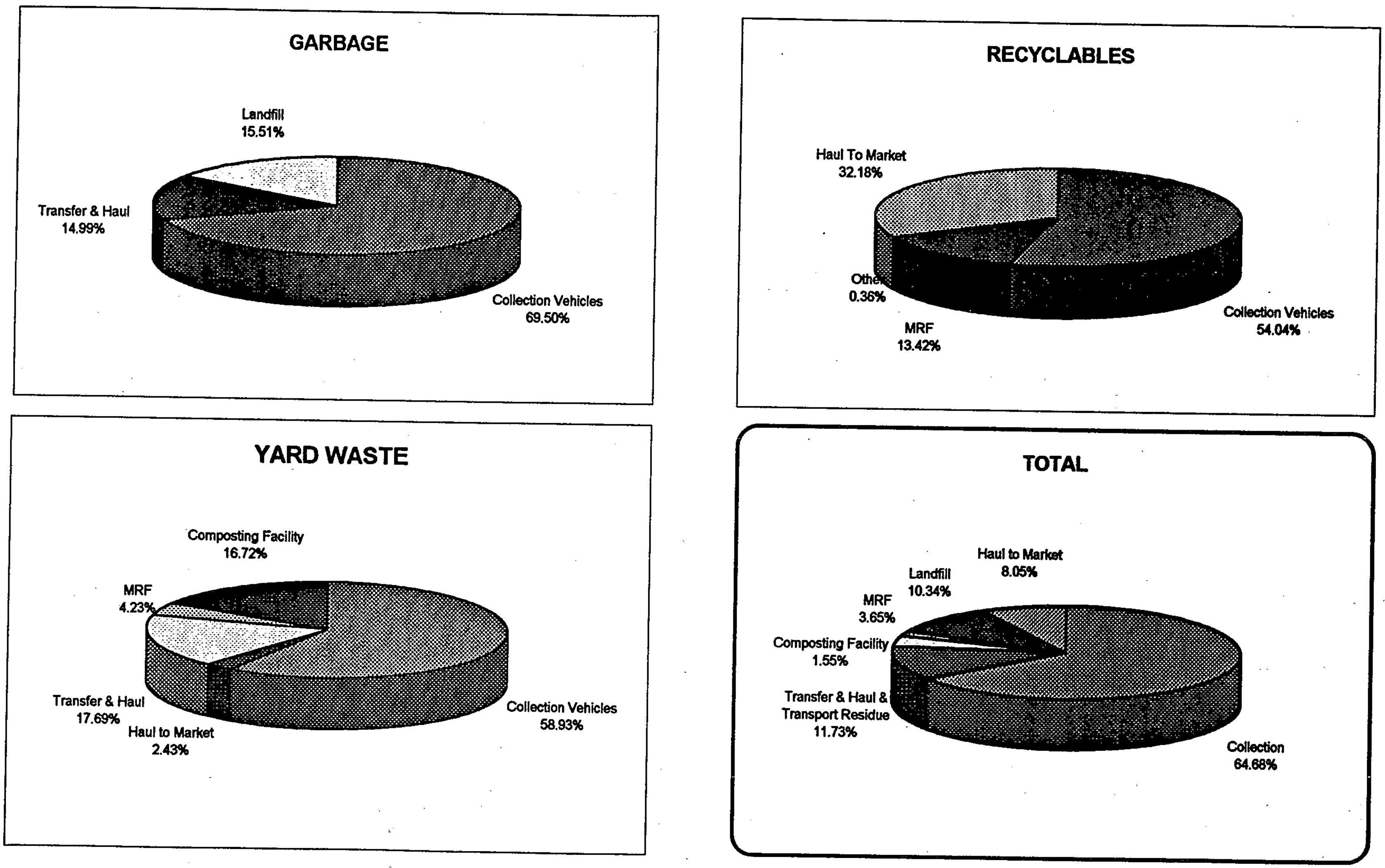
Table 4-4
Estimated Energy Consumption for the Montgomery County IMSWM System (MMBtu)[a]

Activity	MSW	Yard Waste	Curbside Recycling	Total
Collection Vehicles	92,970	11,020	26,502	130,494
Transfer & Haul (Inc. Maintenance Building)	20,048	3,309		23,357
MRF - Container/Paper Processing Facility			6,581	6,581
MRF - Yard Waste Grinding/Mulching Facility		792		792
Composting Facility		3,127		3,127
Transport Residue			57	57
Landfill Disposal	20,750		121	20,871
Subtotal	133,768	18,248	33,262	185,278
Haul to Market		454	15,781	16,235
Total Energy Consumption (MMBtu)	133,768	19,000	50,000	201,513
Tons Collected	396,933	35,848	64,658	497,439
Average Energy Consumption (MMBtu/ton)	0.34	0.53	0.77	0.41

[a]Excludes energy consumed by administration vehicles and energy consumed by some equipment used at the transfer station.

Except as discussed below, the energy consumption was obtained from data provided by the County, MES, and Browning-Ferris Industries (the operator of the Oaks Landfill). The fuel consumed to collect MSW, yard waste, and recyclables was estimated using collection vehicle data from Palm Beach County, Florida; Springfield, Massachusetts; Scottsdale, Arizona; Minneapolis,

Figure 4-3.
ENERGY CONSUMPTION FOR THE MONTGOMERY COUNTY ISWM SYSTEM
(Millions of British Thermal Units)



Minnesota; and Seattle, Washington. The energy consumed to haul recovered materials to market was estimated by multiplying the estimated ton-miles hauled by $0.024 per ton-mile, that is, the approximate fuel consumed by the MSW transfer vehicles used in Hartford, Connecticut; Palm Beach County, Florida; and Minneapolis, Minnesota.

Environmental Regulations

The Montgomery County facilities have received all necessary construction and operating permits from the Maryland Department of the Environment (MDE) and Maryland Department of Natural Resources (MDNR). Table 4-5 summarizes the status of all major permits and approvals for the transfer station, landfill, and resource recovery facility. Discussed below are the regulations applicable to solid waste management facilities in Maryland.

Table 4-5
Major Environmental Permits and Approvals

Facility	Responsible Agency	Permit/ Approval	Issuance Date
Resource Recovery Facility	Maryland Department of the Environment (MDE)	PSD Permit	04/26/90
	MDE	Permit to Construct	02/12/93
	MDE	Refuse Disposal Permit	02/12/93
	MDE	SPDES Permit	04/01/91
	Maryland Department of Natural Resources (MDNR)	Surface Water Appropriations Permit	01/01/91
	U.S. Army Corps of Engineers (COE)	Wetlands Permit	08/14/91
Transfer Station	MDE	Refuse Disposal Permit	04/22/91
Landfill	MDE	Refuse Disposal Permit	not available

Solid waste management facilities are regulated under COMAR 26.04.07 issued by the MDNR. These regulations establish permitting requirements, design and operational constraints, financial assurance obligations, and monitoring, reporting, and recordkeeping requirements applicable to landfills, composting facilities, transfer stations, and resource recovery facilities. The regulations applicable to the Montgomery County system are summarized below:

- <u>Landfills (COMAR 26.04.07.01-26.04.07.22)</u>. Landfills must obtain a refuse disposal permit prior to construction from the MDNR. To obtain a permit, the operator must submit, amongst other material, site information, geological and hydrogeological information, and detailed engineering plans and specifications. The refuse disposal permit imposes requirements for landfill liner system, leachate treatment, groundwater monitoring, landfill gas recovery, closure and post-closure activities, and financial assurance.

- Processing Facilities (COMAR 26.04.07.24). Composting facilities must obtain a refuse disposal permit prior to operations from the MDNR. The facility must also comply with minimum design requirements and submit an annual report to the MDNR.

- Incinerators (COMAR 26.04.07.25). Resource recovery facilities must obtain permits prior to construction and operation from the MDNR. To obtain a permit, the operator must submit engineering data, plans and specifications, O&M manual, waste control plan, and ash management plan. The permit establishes minimum requirements for facility operations, waste receipt and handling, and monitoring, reporting and recordkeeping.

If facilities discharge stormwater or process wastewaters to surface waters, they are also required to obtain a discharge permit from the MDNR. The MDNR must also issue a discharge permit for releases to a municipal wastewater treatment plant.

Resource recovery facilities must also obtain permits for air emissions prior to construction and operation from the MDE. If classified as a major source, the facility also requires a Prevention of Significant Deterioration (PSD) Permit. To obtain a permit, the operator must demonstrate that the facility will comply with all applicable ambient air quality standards and that the facility incorporates Best Available Control technology (BACT). The permit will establish emission standards for all regulated pollutants, performance criteria for air pollution controls, and monitoring, testing, reporting, and recordkeeping requirements. In addition, the U.S. EPA proposed Section 111(d) emission guidelines for existing resource recovery facilities in September 1994. These guidelines require existing facilities to comply with more stringent emission standards and retrofit additional control technology than currently required by the MDE.

4.2 Field Test Results

The field test program addressed the environmental and occupational health and safety impacts associated with the operation of the Montgomery County MRF. The sampling procedures and results are summarized in the following sections.

4.2.1 Test Procedures

The field test program at the Montgomery County MRF was conducted on July 20, 21, and 23, 1993. The Montgomery County facility operates five days per week on a 7:00 a.m. to

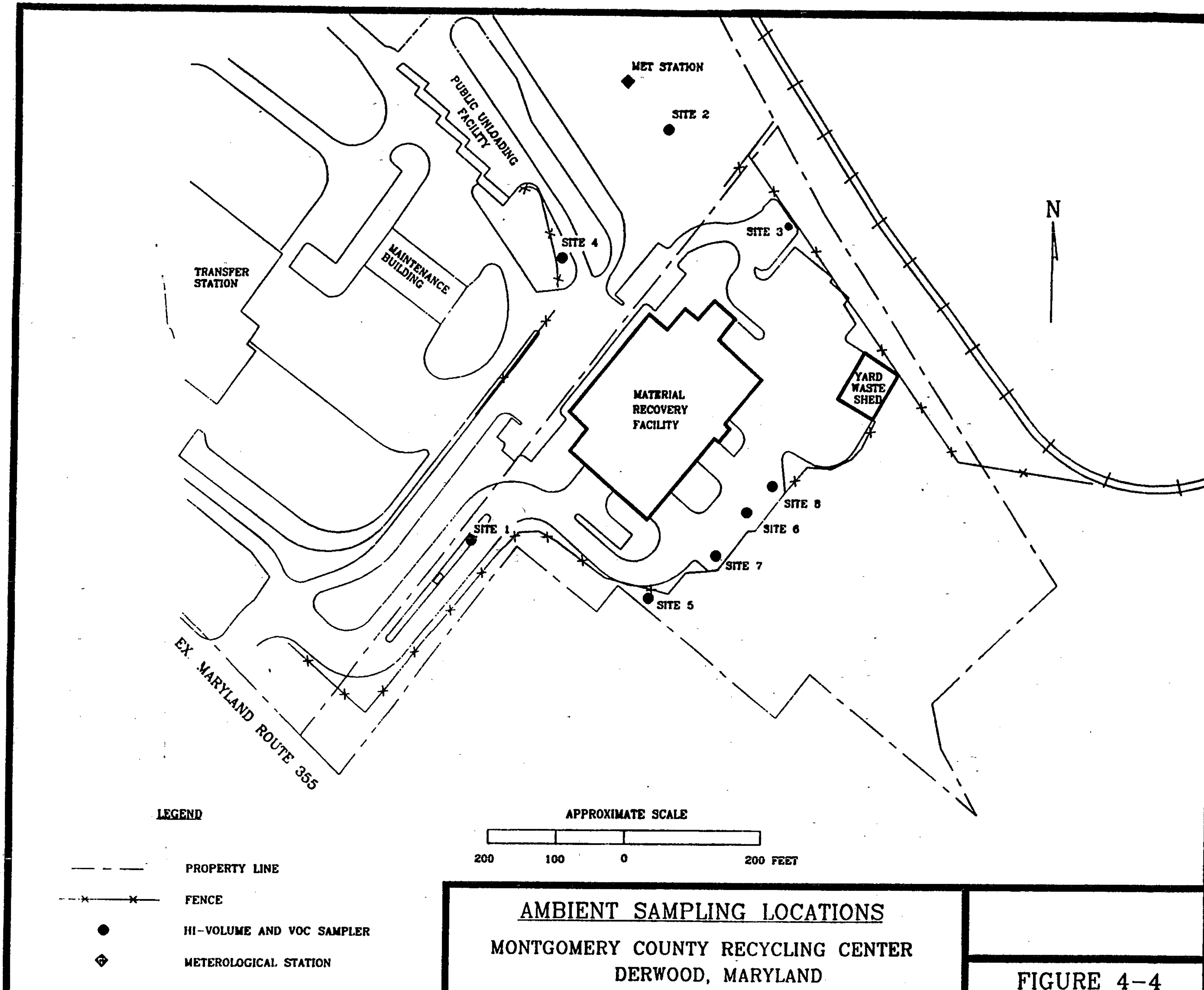
5:30 p.m. shift. There is a one-half hour lunch break and two 15-minute breaks throughout the day. The process line is stopped at 5:00 p.m. to clean the work areas. Approximately 20 operations personnel are employed at the facility. The sorting operations are conducted 10 hours per day -- Monday through Thursday. Mixed recyclables are shipped Monday through Thursday, and paper is shipped five days a week (10 hour shifts). Maintenance personnel work Monday through Friday on an 8-hour shift. Friday is designated as the primary day for maintenance of the processing line equipment. Materials are received Monday through Friday. Glass, aluminum, metal, and plastic are sorted by the main processing line; newspapers are collected in open-top trailers for shipment without being baled. The facility also maintains a tub grinder to process small diameter wood waste into mulch which is provided free to the public.

The field test program was conducted in accordance with the approved protocol in the QAPjP and site-specific SAP. The following deviations were noted from the QAPjP and site-specific field test protocol:

- A respirable dust/silica sample could not be collected on the traffic control person since this person was released from work.
- On July 20, the sampling time for the TSP and PM10 duplicate sample were less than 24 hours (12.6 hours sampled) due to a power outage.
- The relative percent difference (RPD) for the set of replicate lead samples exceeded 20 percent on July 20.
- On 20 July, two samplers were operated from what was later determined to be upwind locations due to a shift in the predominant wind direction after the sites were already set-up and operational.

Figure 4-4 shows the approximate locations of the sampling sites. The upwind and downwind locations of the air sampling equipment relative to the facility for each of the three days of monitoring are summarized in Table 4-6. The following discussion describes each sampling location and any limitation that should be considered in the evaluation of the reported data.

- <u>Site 1</u>. This site was located southwest of the facility. The location was suspected to be influenced by vehicular traffic, but could not be relocated due to limitations imposed by the fence line and electrical outlet access. On Day 1, this site was determined to be upwind of the facility. At the conclusion of testing, equipment from this location was moved to Site 5 due to shifting wind conditions.
- <u>Site 2</u>. This site was located north of the facility. The site was upwind on Day 1 and was considered to be a representative location. Shifting wind conditions, however, forced relocation of the equipment to Site 4 after completion of testing to better



AMBIENT SAMPLING LOCATIONS

MONTGOMERY COUNTY RECYCLING CENTER
DERWOOD, MARYLAND

FIGURE 4-4

Table 4-6
Sampling Locations at the Montgomery County MRF

Sample Day	Locations	
	Upwind	Downwind
1	1,2	3
2	4	5,6
3	4	7,8

characterize upwind concentrations. After Day 1, no further samples were collected from this location.

- Site 3. This site was located northeast of the facility. The site was located downwind on Day 1. After the first day of testing, the equipment from this location was moved to Site 6 to provide a better characterization of downwind concentrations. No further samples were collected from this location after Day 1.

- Site 4. This site was located northwest of the facility. The site was upwind on Days 2 and 3.

- Site 5. This site was located south of the facility. The site was downwind on Day 2. After the completion of testing, the equipment was moved to Site 7 to better characterize downwind concentrations.

- Site 6. This site was located southeast of the facility. The data from this location is suspected to be influenced by vehicular traffic from a nearby road and operation of a tub grinder used to grind yard wastes into mulch. On Day 2, the site was downwind of the facility and was moved to Site 8 after the conclusion of testing to better characterize downwind concentrations.

- Site 7. This site was located southeast of the facility. The data collected at this location is suspected to be influenced by vehicular traffic from a nearby road and operation of the tub grinder. The site was situated downwind on Day 3.

- Site 8. This site was located east-southeast of the facility. The data from this location is suspected to be influenced by vehicular traffic from a nearby road and operation of the tub grinder. The site was located downwind of the facility on Day 3.

4.2.2 Environment and the Public Health

The field test program at the Montgomery County MRF was conducted on July 20 through 23, 1994. The air quality sampling was conducted to measure ambient concentrations of TSP, PM10, CO, VOC, lead, and mercury. Measurements were also conducted to determine wastewater quality and community noise levels. The windrose data for the test period are provided in Appendix B. The field test results are discussed in the following sections; the complete test results are presented in Appendix D.

<u>Total Suspended Particulate, PM10 and Lead</u>

The TSP, PM10, and lead levels measured during the test program are summarized in Table 4-7. With the exception of the PM10 measurement at Site 2 on Day 1, the PM10 and lead levels were below the applicable Maryland and National Ambient Air Standards (NAAQS) despite possible bias from site locations in the vicinity of vehicular traffic and the

Table 4-7
Montgomery County TSP, PM10 and Lead Sampling Results[a]

Day	Compound	Concentration ($\mu g/m^3$) Upwind	Downwind	Downwind
1	TSP	66.80	70.68	68.79
	PM10	56.39	335.40	38.67
	Lead	0.02	0.04	0.01
2	TSP	2.30	85.55	146.25
	PM10	60.41	131.51	54.82
	Lead	0.01	0.03	0.02
3	TSP	64.05	134.43	322.75
	PM10	38.43	54.93	115.32
	Lead	0.01	0.01	0.01

[a]PM10 and lead standards are 150 and 1.5 $\mu g/m^3$, respectively.

tub grinder. The PM10 and lead standards are 150 and 1.5 $\mu g/m^3$, respectively. There is no stated standard for TSP.

On Day 1, there were two upwind and one downwind sites due to a shift in the predominant wind direction after the samples were setup and operational. Hourly wind speeds ranged from 3 to 10 miles per hour, slightly higher than the wind speeds occurring on either Day 2 or 3. At Site 2, a power outage resulted in TSP and PM10 sampling times of 12.6 hours instead of the desired 24 hour sample time. Review of the results for Day 1 show negligible differences in TSP concentrations at the upwind and downwind locations. For this sample event, the PM10 levels were 49 percent higher at the upwind location than measured at the downwind location.

On Day 2, the sampling equipment from Sites 1, 2, and 3 was relocated to new positions and identified as Sites 4, 5, and 6. Site 4 sampling equipment was located in the vicinity of automobile traffic. Wind speeds were 1 to 6 miles per hour. The TSP results for Site 4 (upwind) and PM10 results for Site 5 (downwind) are suspect and are not summarized in the report. The TSP concentrations measured downwind at Sites 5 and 6 were 24 and 113 percent higher than those measured downwind on Day 1, respectively. The TSP levels at Site 6 were about 71 percent higher than the levels measured at the other downwind location (Site 5). The higher concentrations measured at Site 6 are possibly attributable to truck traffic and the operation of a tub grinder in the vicinity of the sampler. These activities are associated with facility operations and therefore may indeed contribute to fence line concentrations. There was no appreciable difference in upwind and downwind PM10 concentrations measured at the site.

For Day 3, upwind TSP and PM10 concentrations are similar to Day 1 concentrations. Wind speeds were 2 to 7 miles per hour. The TSP and PM10 concentrations at site 7 are similar to the concentrations measured at Site 6 during Day 2. These two sites are in the same general vicinity and the concentrations are possibly affected by placement near the tub grinder. Site 8 equipment was located the closest to the tub grinder. The TSP and PM10 levels measured at this site were 240 and 209 percent higher than those measured at Site 7, respectively. Site 8 was approximately 30 feet closer to the tub grinder.

For Days 1 and 2, no clear conclusions on TSP and PM10 concentrations can be drawn from comparison of upwind and downwind data. The higher downwind concentrations on Day 3 may be attributed to vehicular traffic off site and the operation of the tub grinder. When the tub grinder was operating, a significant increase in fence line TSP and PM10 concentrations was observed; however, further study would be needed to determine the actual contribution of the tub grinder. Because of the negligible difference in the upwind and downwind lead levels, the facility does appear contribute to fence line lead concentrations. The PM10 and lead concentrations (including Site 8) are below the corresponding NAAQS.

The relative percent difference for the lead analysis exceeded 50 percent which was above the QA/QC guideline of ± 20 percent. The TSP duplicate sampler experienced a power outage which may have contributed to the variation. The lead QC spike and spike duplicate analyses recoveries were 75 and 80 percent, respectively. Even though the spikes did not meet laboratory acceptance criteria, the test results should be assumed to be biased low. In the worse case, the adjusted results would be approximately twice the reported values.

Carbon Monoxide and Mercury

Carbon monoxide and mercury vapor levels were monitored with direct-reading instruments at upwind and downwind sites on each of the three days on-site. Instantaneous readings were generally taken at each sampling location once in the morning and once in the afternoon. Carbon monoxide and mercury were not detected in concentrations higher than background levels. No difference between upwind and downwind concentrations were observed during the test program. The CO and mercury vapor test results are presented in Table 4-8. As shown in this table, all CO and mercury vapor concentrations were found to be less than OSHA and ACGIH exposure limits.

Table 4-8
Montgomery County
Ambient CO and Mercury Measurement Results[a]

Location	CO Level (ppm)	Hg Level (mg/m^3)
Fence Line (North)	ND	ND-0.003
Fence Line (East)	ND-1	ND-0.003
Fence Line (South)	ND	ND-0.003
Fence Line (West)	ND	ND-0.001
Ambient Air Station #6	ND	0.001

[a]The PELs for CO and Hg are 35 ppm and 0.05 mg/m^3, respectively.

Volatile Organic Compounds

The VOC test results are summarized in Table 4-9. The target compounds were from the hazardous substance list (HSL) and featured scans for over thirty-five compounds. Samples collected on Day 1 identified the presence of seven VOCs (i.e., acetone, benzene, 2-butanone, chloromethane, toluene, 1,1,1-trichloroethane, and xylenes). On Days 2 and 3, the sampling detected six (no chloromethane detected) and five (no chloromethane or xylenes detected) compounds, respectively. None of the compounds (excluding acetone) were reported at concentrations of greater than 4.4 $\mu g/m^3$. Acetone was detected in all samples in the 18 to 131 $\mu g/m^3$ range. For all compounds detected, there are no applicable Maryland Department of the Environment Air Administration Standards.

The VOC surrogate recovery values were well within acceptance limits at 97 to 100 percent except for one sample with a recovery of 111 percent. The duplicate analysis of a field sample demonstrated precision of 7 to 25 percent. Benzene and trichlorofluoromethane (F-11) were outside the acceptance criteria of RPD $\pm$20 percent. For all samples in which benzene and trichlorofluoromethane (F-11) were detected, the concentrations were less than two times the detection limit. For the VOC quality control spikes, the percent recoveries for 18 compounds spiked ranged from 71 to 124 percent, which slightly exceeds the QC criteria of 75 to 115 percent. EPA Method TO-14 does not state specific acceptance ranges for surrogate and spike recoveries. Coast-to-Coast Analytical Service uses 70 to 130 percent as an acceptance criteria.

With the exception of acetone, the measured VOC concentrations were below 5 $\mu g/m^3$), with no significant variation in upwind and downwind concentrations. The VOC data, as reported, can be considered representative of normal background levels in rural areas.

Table 4-9
Montgomery County VOC Sampling Results

Day	Compound	Detection Limit ($\mu g/m^3$)	Concentration ($\mu g/m^3$)			State Guideline ($\mu g/m^3$)
			Site 1	Site 2	Site 3	
1	Acetone	2.4	30.9	121.1	19.9	NA
	Benzene	0.6	1.3	1.0	1.0	NA
	2-Butanone	0.6	3.8	3.5	1.2	NA
	Chloromethane	0.4	1.3	ND	ND	NA
	Toluene	0.8	4.1	2.6	2.3	NA
	1,1,1-Trichloroethane	1.1	2.2	1.1	ND	NA
	Xylenes	0.9	1.7	ND	ND	NA
2	Acetone	2.4	19.9	26.1	22.1	NA
	Benzene	0.6	1.0	1.0	0.6	NA
	2-Butanone	0.6	2.7	2.1	1.5	NA
	Toluene	0.8	2.6	2.6	2.6	NA
	1,1,1-Trichloroethane	1.1	1.6	ND	2.2	NA
	Trichlorofluoromethane	1.1	1.7	1.7	ND	NA
3	Acetone	2.4	45.1	130.6	18.0	NA
	Benzene	0.6	0.6	0.6	ND	NA
	2-Butanone	0.6	ND	4.4	ND	NA
	Toluene	0.8	1.9	1.9	1.9	NA
	1,1,1-Trichloroethane	1.1	2.2	ND	2.2	NA

Wastewater

On July 23, 1993, wastewater samples were collected from the process floor using a shop vacuum, while the equipment was being washed with a high power sprayer. Equipment is washed approximately once per month. There were no floor drains present in the building. The wash water is swept to a pit below the materials feed belt and then pumped to a truck and taken to a treatment facility. The metals levels in the wastewater were found to be less than the regulatory limits established under RCRA. The wastewater effluent quality is summarized in Table 4-10.

Table 4-10
Montgomery County Wastewater Sampling Results[a]

Analyte	Units	Primary Sample	Duplicate Sample	Blank Sample
Chemical Oxygen Demand	mg/l	5290	11,000	<5.0
Ammonia, as Nitrogen	mg/l	2.7	2.8	<0.10
Total Organic Nitrogen	mg/l	123	206	<0.10
Total Organic Carbon	mg/l	1880	1940	1.1
Oil and Grease	mg/l	342	246	<5.0
Phosphate, as P-Total	mg/l	19.3	21.4	<0.050
Specific Conductance	umhos	2520	2500	1.0
Total Dissolved Solids	mg/l	4180	4320	7.0
Total Suspended Solids	mg/l	1120	1090	<5.0
BOD, 5-day	mg/l	1000	1000	<1
Silver, Total	μg/l	14.9	17.2	<10.0
Arsenic, Total	μg/l	256	290	<10.0
Barium, Total	μg/l	678	742	<200
Cadmium, Total	μg/l	21.8	22.4	<5.0
Chromium, Total	μg/l	225	258	<10.0
Mercury, Total	μg/l	4.9	5.7	<0.20
Lead, Total	μg/l	481	568	6.8
Selenium, Total	μg/l	<5.0	<5.0	<5.0
Total Coliform	mpn/100 ml	3.5×10^6	3.5×10^6	<18
Fecal Coliform	mpn/100 ml	2.2×10^6	3.3×10^6	<18

[a]Samples collected from wastewater sump on 07/23/93.

Community Noise

Community noise levels were measured at the fence lines to the north, south, east, and west. The results of this noise survey, which are expressed as a range of instantaneous noise measurements over the three-day period, are summarized in Table 4-11. The main sources of noise were the dumping of glass and other recyclables on the tipping floor, the process line, and the tub grinder. Measurements at the fence lines were in the range of 50 to 60 dBA when the process line was not operating, and 58 to 76 dBA when the process line and tub grinder were in operation. The tub grinder has the greatest effect on fence line noise levels, with 76 dBA measured at the east fence line. The community impact of this increase in noise during facility operation is minimal, since the facility is bordered by a rail repair yard, shopping center, and solid waste transfer station.

Table 4-11
Montgomery County
Community Noise Measurement Results

Location	Instantaneous Noise Level (dBA)
Fence Line (North)	53.0-62.0
Fence Line (East)	57.0-76.0
Fence Line (South)	67.0-76.0
Fence Line (West)	57.0-65.0
Ambient Air Station #6	74.0

4.2.3 Occupational Health and Safety

The personnel sampling was performed concurrently with the ambient sampling program at the Montgomery County MRF. Personnel sampling was conducted to measure worker exposure to dusts, silica, metals, fungi, bacteria, and noise. Indoor sampling was also conducted to detect levels of CO, mercury, PCBs, and pesticides. These results are discussed below; the complete testing results are presented in Appendix D.

Dusts, Silica and Metals

Worker exposures to total dust, respirable dust, silica, and metals were monitored over the entire work shift (10 hours). Workers in the following job functions were sampled: maintenance, fork truck operator, custodian, roll-off driver, scale attendant, presort attendant, tipping floor attendant, front end loader operator, traffic controller, mulch area front end loader operator, and the tub grinder operator. Table 4-12 summarizes the personnel sampling results for total dust, respirable dust, and silica, while the metal sampling results are summarized in Table 4-13. As shown in these tables, all exposure levels were less than the applicable PELs. The highest total and respirable dust levels were found on the custodian -- 2.05 and 0.40 mg/m^3 for total and respirable dust, respectively. Duplicate analysis did show variation beyond the RPD limit set in the QAPjP in a few cases. One respirable dust sample and two aluminum samples exceeded the 20-percent RPD limit.

Table 4-12
Montgomery County Total Dust, Respirable Dust and Silica Personnel Sampling Results[a]

Job Description	Concentration (mg/m^3)		
	Total Dust	Respirable Dust	Silica
Maintenance	0.6991	0.15	<0.0100
Front End Loader (Tipping Floor)	0.3332	0.18	<0.0010
Custodian	2.0554	0.4	<0.0100
Traffic Control	0.4712	NA	NA
Roll-Off Driver	0.4719	0.12	<0.0100
Scale Attendant	0.29	0.07	<0.0100
Presort Attendant	0.3341	0.33	<0.0100
Fork Truck Operator	1.5123	0.2122	<0.0100
Tub Grinder Operator	0.3903	0.24	<0.0100
Front End Loader (Mulch Area)	N/A	0.31	<0.0100

[a]PELs are 15.0, 5.0, and 0.1 mg/m^3 for total dust, respirable dust, and silica respectively.

Table 4-13
Montgomery County Metals Personnel Sampling Results[a]

Job Description	Concentration (mg/m^3)				
	Arsenic	Aluminum	Chromium	Lead	Nickel
Front End Loader (Tipping Floor)	<0.0001	0.0018	<0.0009	<0.0009	<0.0009
Custodian	<0.0001	0.0031	<0.0008	<0.0008	<0.0008
Traffic Control	<0.0001	0.0024	<0.0008	<0.0008	<0.0008
Roll-Off Driver	<0.0001	0.0049	<0.0010	<0.0010	<0.0010
Scale Attendant	<0.0001	0.0034	<0.0011	<0.0011	<0.0011
Presort Attendant	<0.0001	0.0115	<0.0008	<0.0008	<0.0008
Fork Truck Operator	<0.0001	0.0035	<0.0009	<0.0009	<0.0009

[a]PELs are 0.01, 15.0, 1.00, 0.05, and 1.00 mg/m^3 for arsenic, aluminum, chromium, lead, and nickel, respectively.

Carbon Monoxide and Mercury Vapor

Carbon monoxide and mercury measurements were taken with direct reading instruments at 13 locations throughout the facility, including the tub grinder and the mulch pile. The test results are presented in Table 4-14. Carbon monoxide levels in the range of 8 to 14 ppm were measured in the baler and roll-off areas, presumably resulting from the operation of fork trucks. These levels are well below the PEL of 50 ppm and the TLV of 25 ppm. All other areas were 5 ppm or less for CO. Mercury vapor was not detected in concentrations higher than background levels.

Table 4-14
Montgomery County
Indoor CO and Mercury Measurement Results[a]

Location	CO Level (ppm)	Hg Level (mg/m^3)
Tipping Floor	ND-2	ND
Maintenance Room	ND	ND
Plastic Sorting Booth	ND-3	ND-0.005
Glass Sorting Platform	ND-3	ND
Tub Grinder	ND	ND-0.004
General Floor Areas	ND-3	ND-0.001
Baler Areas	ND-14	ND-0.001
Roll-Off Area	ND-8	ND-0.002
Pre-Sort Platform	ND-5	ND-0.003
Lunch Room	ND	ND
Receptionist's Desk	ND	NA
Traffic Control	ND-1	ND
Mulch Pile	ND	ND-0.002
General Offices	ND	ND
Men's Locker Room	ND	NA
Process Floor Stairs	ND	NA
Mezzanine Outlook	3	NA
Front Door	ND	NA
Grinder Building	ND	ND

[a]PELs for CO and Hg are 35 ppm and 0.05 mg/m^3, respectively.

Pesticides/PCBs

Pesticide and PCB samples were collected at the tipping floor, pre-sort platform, tub grinder, and plastics sorting station on all three sampling days. One day of sampling was conducted in the facility's lunch area. All results were less than the detection limits (see Appendix D).

Bacteria and Fungi

Airborne and surface samples were collected for bacteria and fungi on the tipping floor, glass sorting platform, pre-sort platform, and plastic sorting station on all three days. One sample was collected in the lunch area. Ambient levels of airborne bacteria and fungi were also measured at the one upwind and two downwind locations on all three days. The airborne and surface sample results are presented in Tables 4-15 and 4-16, respectively.

Table 4-15
Montgomery County Airborne Fungi and Bacteria Sampling Results

Location	Sample (viable counts per cubic meter)		
	Fungi	Bacteria RT[a]	Bacteria 56[b]
Glass Sorting Platform	2494-9440	2483-9440	85-153
Plastics Sorting Platform	2553-9440	2096-9440	205-258
Tipping Floor	7026-9440	4508-9440	60-445
Lunch Room	1919	954	85
Pre-Sorting Platform	4620-9368	4345-9440	82-121
Ambient Air Station #1	7242	1195	48
Ambient Air Station #2	7242	893	36
Ambient Air Station #3	6639	712	121
Ambient Air Station #4	448-3677	363-6490	35-316
Ambient Air Station #5	1417	3513	304
Ambient Air Station #6	1792	1757	269
Ambient Air Station #7	2419-2525	1888-2596	59-142
Ambient Air Station #8	1322	1298	153

[a]Bacteria RT is incubated at room temperature.
[b]Bacteria 56 is incubated at 56 degrees F.

Table 4-16
Montgomery County Surface Fungi and Bacteria Results

Location	Sample (units per gauze wipe)	
	Fungi	Bacteria
Tipping Floor	500	4000
Glass Sorting Platform	400-1500	300-4600
Pre-Sort Platform	69,000	90,000
Mezzanine Outlook	1000	1000
Lunch Area	< 1000	3200

Airborne fungi levels inside the facility were generally two to three times higher than outdoor levels, except for the first sampling day when outdoor levels were approximately equivalent to indoor levels. The fungi levels were consistent from location to location inside the facility, although the fungi levels in the lunch area were about 25 percent of the levels in the remainder of the plant.

Wipe samples for bacteria/fungi were also collected at the tipping floor, glass sorting platform, pre-sort platform, mezzanine, and lunch area. The levels at the pre-sort platform were measurably higher than other areas. This may result from the workers agitating the materials by picking out nonrecyclables prior to the reaching the process line.

All fungi detected were common environmental fungi. None of the fungi detected are considered highly virulent in nature. The two fungi most commonly associated with infections that were detected are *Aspergillus fumigatus* and *Aspergillus niger*. *Aspergillus fumigatus* can cause pulmonary and/or eye infections, and is the dominant cause of aspergillosis. These organisms are considered opportunistic pathogens, in that they are most likely to infect individuals with compromised immune systems. Healthy people are not likely to be infected with *Aspergillus fumigatus* unless they are exposed to an unusually high dose. Infections due to *Aspergillus niger* are more rare -- it can cause infections in the ear. However, it is possible that hypersensitive people, and people exposed to high levels of fungal spores, may develop hypersensitivity reactions, such as allergies, asthma and hypersensitivity pneumonitis. Little information is available describing the exposure levels required to initiate such reactions.

No highly virulent pathogenic bacteria were identified in any of the samples submitted. The most common bacteria detected were *Bacillus*, which are commonly found in environmental samples and occur naturally in soil and water. *Curtobacterium* is a common plant pathogen which is commonly recovered from air samples. *Arthrobacter* and *streptomycetes* are common environmental organisms often associated with soil. The species of *Acinetobacter*, *Flavobacterium*, *Xanthomonas*, and *Pseudomonas* detected likely originated from water or wet environments. *Pseudomonas aeruginosa* is considered an opportunistic pathogen. Although it is common in the environment, it can cause skin, eye, ear and lung infections. *Staphylococcus*, *Brevibacterium*, and *Micrococcus* are associated with human and/or animal skin. Several enteric organisms were detected: *Serratia*, *Erwinia*, and *Enterobacter* are common in soil and water environments.

The RPD for duplicate samples collected at Site 7 on July 22 had exceeded the QAPjP limit of 20 percent, with RPD values of 32 and 83 percent for bacteria RT and thermophilic bacteria, respectively. In four cases, the RPD from duplicate samples exceeded the QAPjP limits.

Noise Exposure

Worker noise exposures were determined using audiodosimeters over the course of the entire shift. Workers in the following job functions were sampled: maintenance, fork truck operator, custodian, roll-off driver, plastic sorter, glass sorter, presort attendant, tipping floor front end loader, traffic controller, mulch area front end loader, and tub grinder operator. The personnel sampling results are presented in Table 4-17. The average noise levels for the entire 10-hour workshift ranged from 76.1 to 96.0 dBA. Employees working on the front-end loader, pre-sort platform, glass sorting platform, plastic sorting station, fork truck operation, tub grinder, and custodial operations experienced noise levels in excess of the PEL (adjusted to 88 dBA to account for the 10-hour shift). Consequently, these workers would require hearing protectors.

Table 4-17
Montgomery County Audiodosimeter Results

Job Description	Average Noise Levels (dBA)
Traffic Controller	87.1
Front End Loader Operator	84.4-88.1
Pre-sort Platform	89.3-90.2
Glass Sorting Platform	94.8-96.0
#11 Plastic Sorting	93.6
Fork Truck Operator	92.3
Maintenance	85.7
Roll-Off Driver	76.1
Tub Grinder Operator	88.3
Custodian	95.5

Direct reading measurements were also made with a sound level analyzer throughout the facility. The measurement results are summarized in Table 4-18. These results demonstrate that the highest noise levels were generated by the dumping of mixed recyclables on the tipping floor. Instantaneous noise levels reached as high as 107 dBA during this operation. Operation of the tub grinder increased noise levels by approximately 30 dBA -- from 70 to 100 dBA.

Table 4-18
Montgomery County Indoor Noise Measurement Results

Location	Instantaneous Noise Level (dBA)
Tipping Floor	82.0-107.0
Maintenance Room	72.0-97.0
Plastic Sorting Booth	95.0-97.0
Glass Sorting Platform	87.0-104.0
Tub Grinder	72.0-105.0
General Floor Areas	99.0-100.0
Baler Areas	86.0-100.0
Roll-Off Area	91.0-96.0
Pre-Sort Platform	88.0-101.0
Lunch Room	50.0-60.0
Receptionist's Desk	61.0-64.0
Traffic Control	72.0-88.0
Mulch Pile	63.0-71.0
General Offices	60.0
Men's locker Room	<50.0
Process Floor Stairs	65.0
Mezzanine Outlook	97.0
Front Door	57.0
Tub Grinder Building	69.0

Health and Safety Programs

The health and safety program evaluation was limited to information provided by on-site personnel. The facility had documentation available on-site to show compliance with each of the programs reviewed. The key findings from this evaluation include:

- An Energy Control Program is in place at the facility, and documentation of training was available. The facility SOP calls for annual evaluations of program effectiveness, although none had been conducted yet because the program had not been in effect for one year.

- A Hazard Communication Program is in effect at the facility and meets the standard established by OSHA.

- Dust masks are the only form of respiratory protection used at the facility. Use of these respirators had been covered in training, although no written respiratory protection plan had been developed. Air monitoring prior to this study showed airborne contaminant levels below PELs; therefore, respirators were not required. Medical monitoring of employees using dust masks has not been conducted.

- A Hearing Conservation Program has been implemented in accordance with OSHA requirements. Hearing protectors are provided to anyone entering a high noise area. Audiometric testing is conducted by the facility and also through a consultant. Consultants were used to conduct a noise survey in 1992. The only program deficiency was that a copy of the OSHA noise standard has not been posted at the facility.

- There were no air contaminants identified that required control programs under OSHA.

- There was a Bloodborne Pathogen Program in place that appeared to meet the requirements specified by OSHA. The facility provides gloves with liners, Kevlar sleeves, and plastic aprons to prevent cuts and contact with infectious materials.

- Information on injury and illness rates was provided for 1991, 1992, and 1993. Those rates, provided by the facility, are summarized in Table 4-19, along with BLS estimates of occupational injury and illness incidence rates for 1991 for Sanitary Services and Private Sector Industries. The operators did not provide specific information on the types of injuries or illnesses that have occurred at the facility.

Ergonomics

Picking booth operations were videotaped during the on-site facility assessment. These videotapes were reviewed to identify the general ergonomic conditions within this work area. For the purpose of this assessment, potential ergonomic risk factors identified can be defined as workplace conditions or work practices which may contribute to, or result in, worker discomfort, fatigue, or injury.

Three types of workstations at the Montgomery County facility were evaluated:

- Workstation 1. This type of workstation was used for separating aluminum and glass with workers located on each side of conveyor with bins on either side of workers. The workstation (conveyor) height was non-adjustable, but appeared appropriate for the majority of workers based on observation of arm motions while performing work. No foot stools (platforms) were available in this area to accommodate shorter workers. Shorter workers were seen raising elbows and shoulders in order to accommodate to workstation height.

  Workers were able to perform tasks without bending or excessive reaching and were able to place recyclables in bins without excessive twisting. One taller worker was observed to lean over conveyor repetitively to reach into work area of worker on the other side of conveyor. Work on this line involved extensive repetitive motion of upper extremities. Line speed in combination with volume of recyclables may have been a factor in the extent of repetitive motion required to complete tasks.

  The potential ergonomic risk factors are: (1) fixed workstation (conveyor) height did not accommodate shorter worker; (2) one worker repetitively bent over the conveyor into workspace of co-worker; and (3) the line speed and volume of recyclables caused extensive repetitive motion of upper extremities to complete sorting/picking tasks.

Table 4-19
Injury and Illness Rates
for 1991, 1992 and 1993

Year	Sector	Recordable Cases	Lost Workday Cases	Lost Workdays
1991	All Industry	8.4	3.9	86.5
1991	Sanitary Services	15.3	7.9	163.5
1991	MRF	12.6	12.6	37.9
1992	MRF	10.3	6.88	79.1
1993	MRF	18.8	6.26	25.0

- Workstation 2. At this type of workstation, workers sorting glass were located on each side of conveyor with bins on either side of workers. The workstation height was non-adjustable. Some workers would benefit from foot stools (platforms) to accommodate conveyor height, as noted by raised elbows in work performance. Workers used repetitive sweeping motions of upper extremities to push glass into bins. Extensive repetitive motion of upper extremities was required. the line speed and volume of recyclables appeared to be factors in the extent of repetitive motion required to complete tasks.

The potential ergonomic risk factors are: (1) the fixed workstation (conveyor) height failed to accommodate shorter workers; and (2) the line speed in combination with volume of recyclables resulted in extensive repetitive motion of upper extremities to complete sorting/picking tasks.

- Workstation 3. This type of workstation was employed for plastic sorting. Two workers were assigned to the line, one on each side of the conveyor. Workstation height was non-adjustable, but appeared appropriate for the individuals assigned to this task. The bin placement scheme required one worker to reach across the full conveyor width to discard paper. The worker on the opposite side of the conveyor had to reach across the full width of the conveyor to discard aluminum. The only potential ergonomic risk factor is that the bin placement required extensive reach across the full width of the conveyor.

SECTION 5

ALBUQUERQUE, NEW MEXICO

5.1 Process Description

The City of Albuquerque relies primarily on landfilling for managing residential and commercial solid waste under its jurisdiction. The City also maintains a MRF and drop-off centers. The process description presented in this section addresses the technical, economic, energy, and environmental aspects of the MRF and IMSWM system.

5.1.1 Integrated Solid Waste Management System

The City provides collection and disposal services for MSW generated within Albuquerque. The components of the IMSWM system serving Albuquerque include:

- Intermediate Processing Facility
- Two Drop-Off Centers, and
- Landfill.

Figure 5-1 presents a flow diagram for the IMSWM system, showing the quantities of waste received and residue disposed of by the various components of the system during the first six months of MRF operation (April 1 through September 30, 1992).

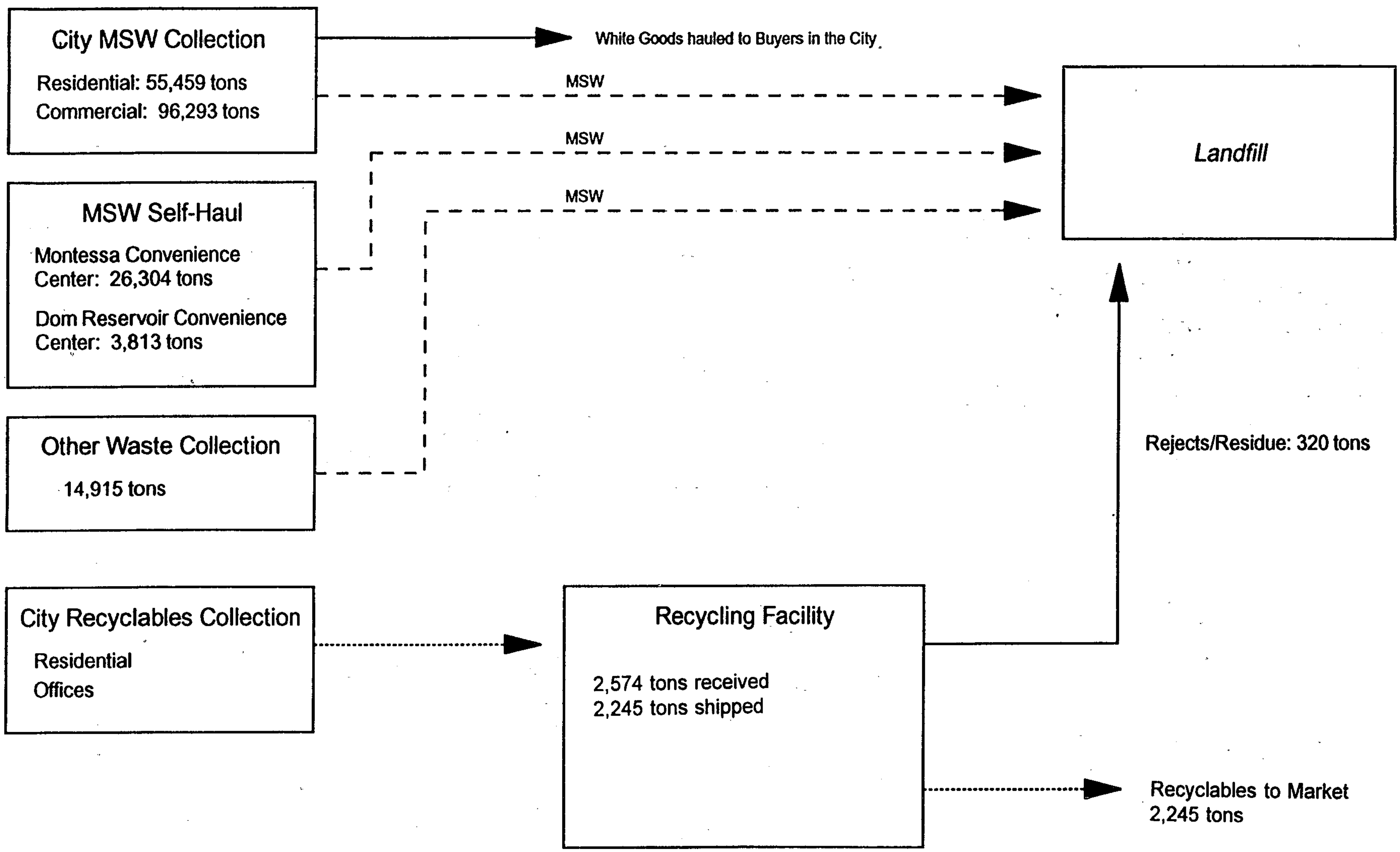
<u>Waste Collection</u>

The City provides collection services to residential and commercial customers in Albuquerque. During the six months since startup of the MRF, the City collected approximately 55,459 and 96,293 tons of residential and commercial waste, respectively. This represents 77 percent of the MSW delivered to the landfill during that period. Of the remaining waste received at the landfill, 14,915 tons were delivered by private haulers, and 30,117 tons were transferred from the drop-off centers over the six-month period.

<u>Intermediate Processing Facility</u>

The Intermediate Processing Facility is located on the site of the City's Landfill. Commencing operation April 1, 1993, the facility is owned and operated by the City of Albuquerque. During the first six months of operation, the facility processed about 2,574 tons of recyclable material. Newsprint and corrugated cardboard are presorted on the tipping floor and baled for shipment to market. The co-mingled recyclables, that is, plastic containers, ferrous metal, aluminum cans, and color-sorted glass, are recovered by mechanical and manual sorting.

Figure 5-1
Albuquerque Solid Waste System



Note: All quantities shown based on 6 month period -- April 1993 to September 1993.

Drop-Off Centers

Two Drop-Off Centers are located throughout in the City of Albuquerque. The centers are owned and operated by the City. Citizens may drop off white goods, yard waste, and other materials at these centers. The waste is delivered to the landfill by truck. Approximately 30.177 tons of waste were transferred from these centers to the landfill during the first six months of MRF operation.

City Landfill

The landfill is located approximately 20 miles outside of the City of Albuquerque. The landfill is owned and operated by the City. Yard waste is stored within a segregated area of the landfill. During the same six months since startup of the MRF, the landfill received approximately 196,784 tons of residential and commercial waste.

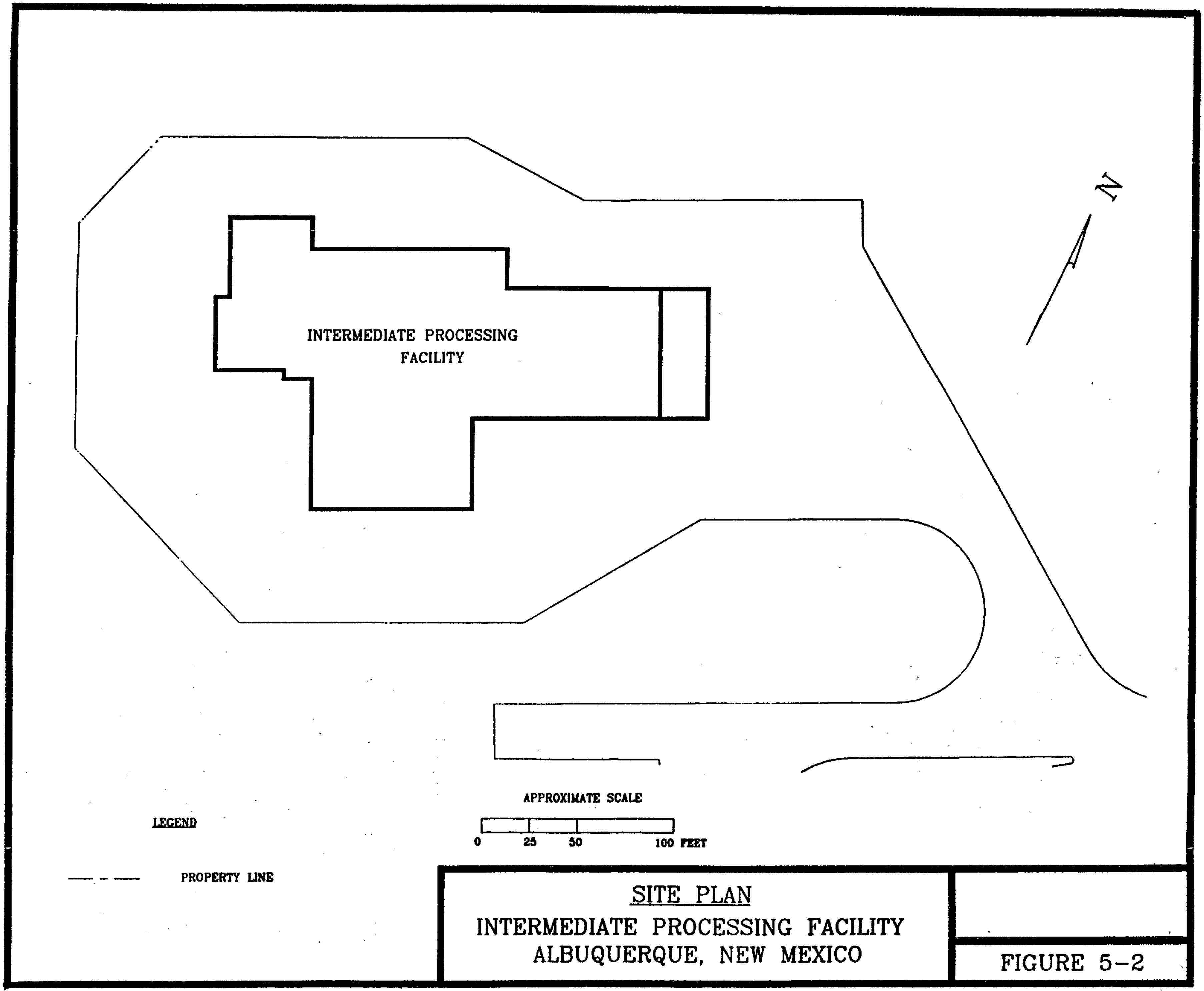
5.1.2 Material Recovery Facility

The Intermediate Processing Facility located at the site of the City Landfill approximately 20 miles west of Albuquerque, is owned and operated by the City. The facility has a single processing line designed to handle 125 tpd of recyclable material. The facility is staffed by six full-time employees, including the plant manager, truck driver, equipment operator, laborer, and two corrections officer. The material sorting is performed by 17 to 24 laborers supplied by the local correctional facility. Figure 5-2 presents a site plan for the Intermediate Processing Facility. Table 5-1 summarizes the material received and recovered at the MRF between April 1 and September 30, 1993.

Upon entering the building, the collection vehicles discharge their load on the tipping floor at the immediate entrance of the facility. Newsprint and corrugated cardboard are separated from the commingled recyclables on the tipping floor. The paper products are then manually transferred to a conveyor feeding the baler. The baled paper products are then stored in an area on the north side of the building (North Area). Plastic bags containing mixed recyclables are transferred to the sorting conveyor.

The plastic bags are ripped open and the contents dumped onto the feed conveyor. The recyclable materials move up the feed conveyor onto the sorting belt. An overhead magnetic separator removes ferrous material. Other recyclable material, that is, PET and HDPE plastic containers, aluminum cans, and glass containers are sorted by workers on each side of the belt. The workers drop the sorted material through chutes to storage areas below the sorting belt. Rejects drop off the end of the sorting conveyor. The plastic material is baled and stored in the North Area. Metal cans are crushed, baled, and then stored on-site.

The recovered material is transported off-site by private haulers to market. The rejects are transferred to the adjacent City landfill.



SITE PLAN
INTERMEDIATE PROCESSING FACILITY
ALBUQUERQUE, NEW MEXICO

FIGURE 5-2

Table 5-1
Material Received and Recovered
From April 1 to September 30, 1993

Material	Throughput (tons)	Percent of Total (%)
Newspaper	1,391	54.0
Ferrous Cans	44	1.7
Aluminum	28	1.1
Glass	191	7.4
Plastic	44	1.7
Cardboard	522	20.3
Mixed Paper	25	1.0
Rejects/Residue	320	12.4
Miscellaneous	9	0.4
Total	2,574	100.0

5.1.3 Economic, Energy and Environmental Issues

This section addresses the economic, energy, and environmental issues associated with the MRF and IMSWM system. These issues are based on publicly available information or material provided by the City.

<u>**Economic Implications**</u>

The Albuquerque Solid Waste Department is responsible for day-to-day operation of the IMSWM system. The system is operated as a self-supporting environmental unit under an enterprise fund managed by the Department. The data which was collected for this analysis was obtained from the City of Albuquerque. According to the City, the costs and revenues provided were based on actual results for FY 1992 and included all solid waste which was handled by the City.

In FY 1992, the total cost of waste transport, processing and disposal, material recovery and marketing, and administration was approximately $30.6 million. Approximately $13.7 million or 45 percent of costs was associated with labor/personnel. These costs included all labor associated with administration and operations related to the management of solid waste which for the City is responsible. Approximately $6.2 million or 20 percent of costs was associated with collection. Another $7 million was associated with materials and equipment maintenance, while the remaining $3.7 million was split between debt service, energy, and contractors.

The total cost of operating the MRF, including material collection, transport, processing, and product marketing, was approximately $4.4 million in FY 1992. Based on the City's allocation of costs, approximately $2.2 million or 50 percent of costs were associated with collection. Approximately 34 percent of MRF costs was for debt service, and 11 percent for personal services. The remaining 5 percent of MRF costs was associated with energy, contractors, supplies, and equipment maintenance. Table 5-2 summarizes the costs for the IMSWM system.

Table 5-2
Estimated Costs for the Albuquerque IMSWM System

Cost Element	IMSWM System	MRF
Labor/Personnel	$13,700,000	$478,000
Contractors	573,000	55,800
Materials/Supplies	2,600,000	15,710
Equipment	4,400,000	82,000
Energy	126,000	31,224
Collection Costs	6,200,000	2,211,000
Distribution Costs	N/A	N/A
Debt Service	2,970,000	1,500,000
Total	$30,569,000	$4,373,734

Based on the allocation of costs provided by the City, the operating costs of the MRF represent approximately 14.3 percent of total operating costs for the IMSWM system. It is important to note that, in the area of collection (the largest MRF expense category), the MRF accounts for one-third of total cost of the IMSWM system.

Based on an allocation performed by the City, the amount of total revenues from the MRF in FY 1992 was approximately $295,000. These revenues were earned through user charges (assessments), and the sale of recyclables. Table 5-3 summarizes the revenues generated by the IMSWM system and the MRF.

Table 5-3
Estimated Revenues for the City of Albuquerque

Revenue Element	IMSWM System	MRF
Tipping Fees	$6,570,000	$ 0
User Charges	45,000	45,000
Sales of Recyclables/Compost	250,000	250,000
Total Revenues	$6,865,000	$ 295,000

For clarification, *user charges (assessments)* are defined as annual fees which were charged to City residents for collection of recyclables.

Based on the allocation of costs provided by the City, the operating revenues of the MRF represent approximately 4.3 percent of total IMSWM system operating revenues. This is significantly less than the percentage contribution of the MRF to IMSWM system costs. These operating revenues recover approximately 6.7 percent of MRF costs.

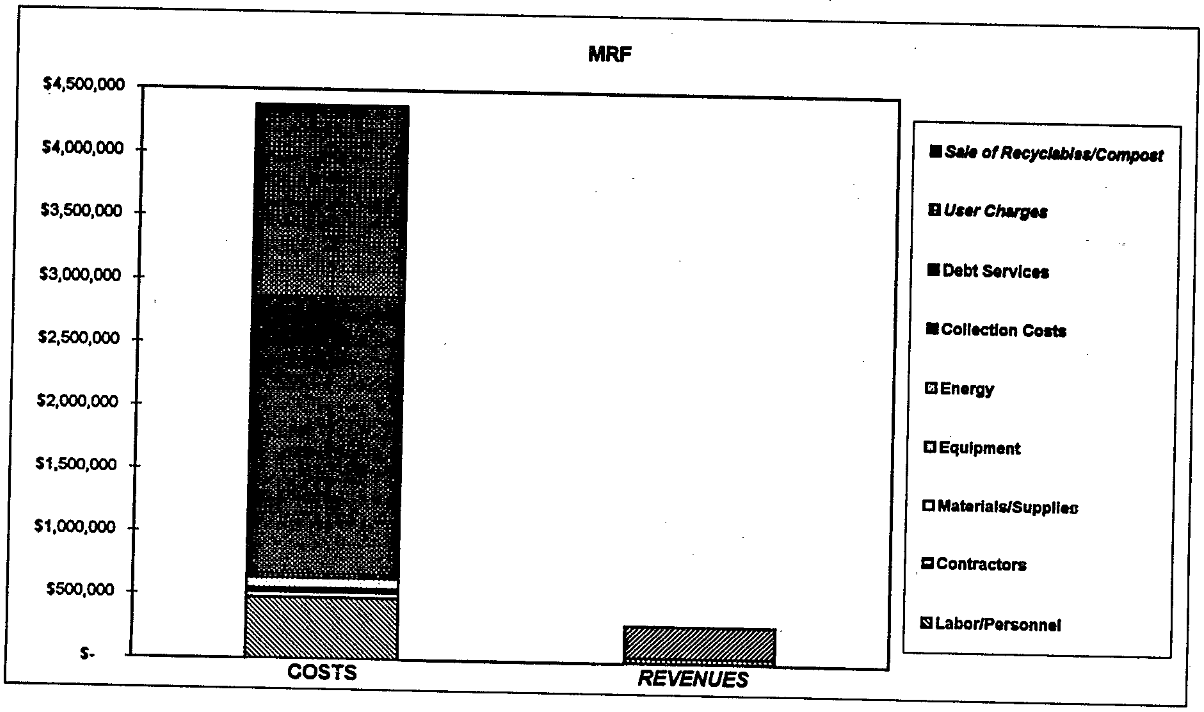
Figure 5-3 presents the costs and revenues for both the MRF and IMSWM system. Based on the analysis of operating costs and revenues for FY 1992 and the allocations provided by the City, it appears that the MRF provided a net cost to the IMSWM system in the amount of approximately $4,078,700 or 13.3 percent of total operating expenditures.

Energy Consumption

An estimated 74 billion Btu of energy was consumed to collect, transfer, haul, and process about 199,358 tons of MSW and recyclables. Of the 74 billion Btu consumed, approximately 98.7 percent was used to manage 196,784 tons of MSW, while 1.3 percent was used to manage 2,574 tons of recyclables. Approximately 0.37 MMBtu of energy were consumed for each of the 199,357 tons of waste managed, with 0.34 and 2.91 MMBtu consumed for each of the 196,784 tons of MSW and 2,574 tons of recyclables, respectively. The average energy consumption for the recyclables is almost three times higher than that found at the other facilities. This appears to be due to a higher per ton average for haul to market. Most likely, the values are inflated because they reflect only the first six months of operation of the MRF.

Table 5-4 and Figure 5-4 show the energy consumed by function. For the entire IMSWM system, almost 62 percent of the energy consumed was for transportation, that is, waste collection, transfer and haul, transporting recyclables to market, and hauling residue to the landfill. About 62 and 63 percent of the energy consumed was for the transportation of MSW and recyclables, respectively.

Figure 5-3.
TOTAL COSTS AND REVENUES FOR THE CITY OF ALBUQUERQUE ISWMS



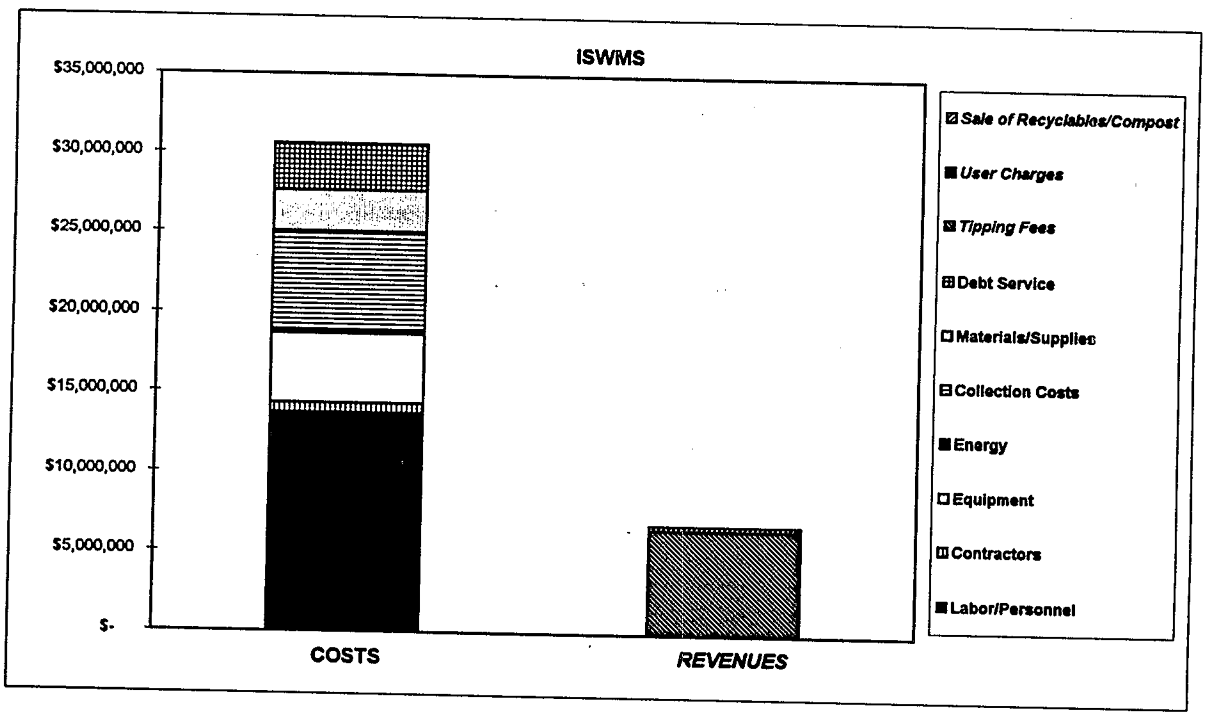


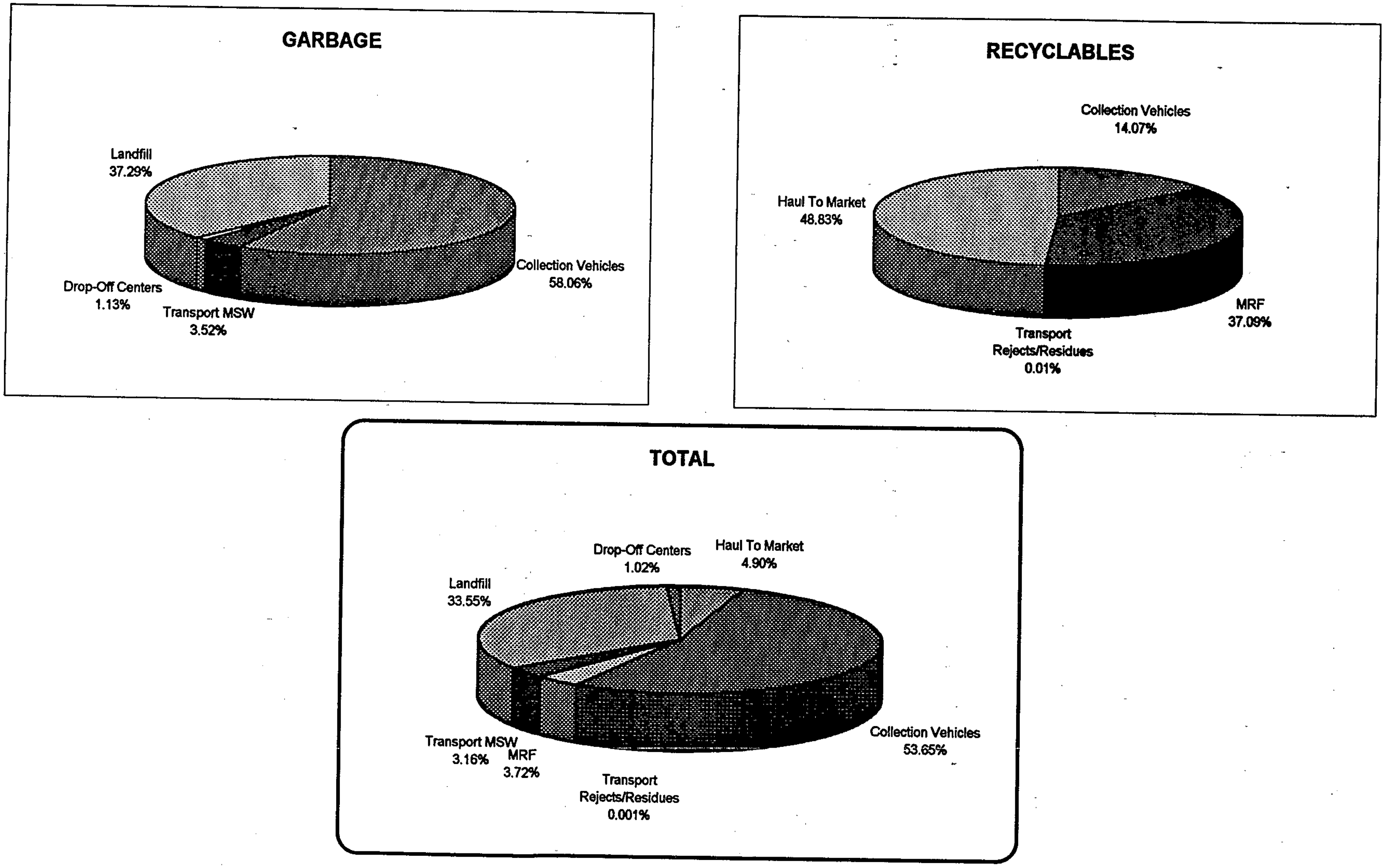
Table 5-4
Energy Consumption for Albuquerque IMSWM
(MMBtu)

Activity	Garbage	Curbside Recycling	Total
Collection Vehicles[a]	39,037	1,055	40,092
Transport MSW from Drop-off Centers[b]	2,364		2,364
Material Recovery Facility[c]		2,780	4,860
Drop-off Centers[c]	760		1,140
Transport Rejects/Residue		0.56	0.56
Landfill	25,070		25,070
Subtotal	66,471	3,836	72,386
Haul to Market[d]		3,660	3,660
Total Energy Consumption (MMBtu)	66,471	7,496	76,047
Tons Processed	196,784	2,574	199,357
Average Energy Consumption (MMBtu/ton)	0.34	2.91	0.38

[a]Collection consumption is based on an average of 1.6 gal/ton of garbage collected and 2.8 gal/ton of recyclables collected. These averages are based on a similar study.
[b]Transport fuel consumption is based on distances traveled and an average of 0.024 gal/ton mile for transfer trailers.
[c]Consumption for the MRF, Drop-off Centers, and the landfill was calculated based on cost expenditures and the following rates: Diesel, $0.70/gal (Fleet Management - suppliers); Natural Gas, $4.01/MMBtu (Gas Company of New Mexico); Electricity (Actual Consumption was provided by the City of Albuquerque).
[d]Haul to market consumption is based on distances for each type of recyclables to its appropriate processing facility and a haul average of 0.024 gal/ton-mile.

Except as discussed below, the energy consumption information was obtained from data provided by the City. The fuel consumed to collect garbage and recyclables was estimated using collection vehicle data from Palm Beach County, Florida; Springfield, Massachusetts; Scottsdale, Arizona; Minneapolis, Minnesota; and Seattle, Washington. The energy consumed to haul recovered materials to market was estimated by multiplying the estimated ton-miles hauled by 0.024 gallons per ton-mile, that is, the approximate fuel consumed by the MSW transfer vehicles used in Hartford, Connecticut; Palm Beach County, Florida; and Minneapolis, Minnesota.

Figure 5-4.
ENERGY CONSUMPTION FOR THE CITY OF ALBUQUERQUE ISWM SYSTEM
(Millions of British Thermal Units)



Environmental Regulations

The landfill and MRF have received solid waste management facility permits from the New Mexico Environment Department (NMED). The NMED regulations specify design and operational criteria, as well as monitoring, reporting and recordkeeping requirements, for these facilities.

5.2 Field Test Results

The field test program assessed the environmental and occupational health and safety impacts associated with the operation of the MRF. The sampling procedures and analytical results are summarized in this section.

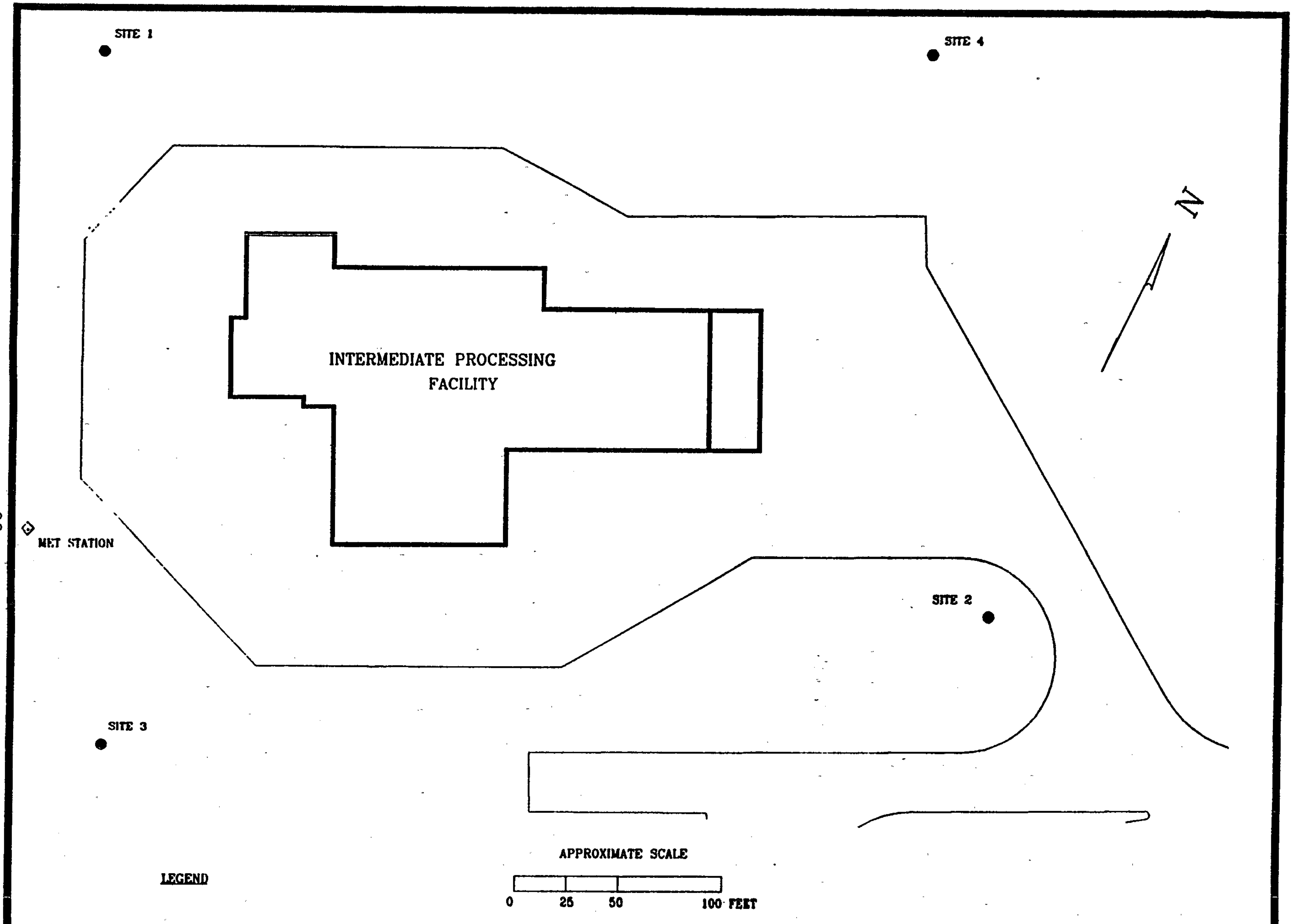
5.2.1 Test Procedures

The field test program at the Albuquerque MRF was conducted from September 14 through 16, 1993. The Albuquerque facility operates five days per week on a 7:00 a.m. to 3:30 p.m. shift. There are six full-time municipal employees including: the plant manager, a truck driver, an equipment operator, a laborer, and two corrections officers. The material sorting is performed by 17 to 24 laborers supplied by the local correctional facility. The laborers are given one hour for lunch, one 15-minute break in the morning, and one 15-minute break in the afternoon. The municipal employees start at 7:00 a.m. and clean the facility until 8:00 a.m. The laborers supplied by the correctional facility arrive at 8:00 a.m., and begin the processing of recyclables shortly after their arrival.

The facility is designed to process commingled recyclables. Newsprint and corrugated cardboard are separated on the tipping floor for baling. Plastic bags containing tin cans, aluminum, plastic containers, and glass bottles are pitched toward the sorting conveyor. These materials are then mechanically and manually separated and sorted on the conveyor.

The field test program was conducted in accordance with the approved test protocol in the QAPjP and site-specific SAPs. The only deviation from the protocol was that the relative percent difference (RPD) for the set of replicate lead samples exceeded 20 percent.

Figure 5-5 shows the approximate location of the ambient sampling sites. The upwind/downwind locations of the air sampling equipment relative to the MRF are summarized in Table 5-5. Provided below is a brief discussion of each sample location and any limitations that should be considered in the evaluation of the reported data.



AMBIENT SAMPLING LOCATIONS

INTERMEDIATE PROCESSING FACILITY
ALBUQUERQUE, NEW MEXICO

FIGURE 5-5

Table 5-5
Sampling Locations at the Albuquerque MRF

Sample Day	Locations	
	Upwind	Downwind
1	1	2,3
2	2	1,3
3	3	4

- Site 1. This site was located northwest of the facility. On Days 1 and 2, this site was located upwind of the facility on Day 1 and downsized on Day 2. Due to shifting wind conditions, the equipment from this location was moved to Site 4 at the conclusion of testing on Day 2. The samplers were used to obtain duplicate samples. No further samples were collected from Site 1 after Day 2.

- Site 2. This site was located east of the facility and was downwind on Day 1 and upwind on Day 2. The location was suspected to be influenced by off site (landfill) vehicular traffic, but could not be relocated due to limitations imposed by the fence line and electrical access. Shifting wind conditions required relocation of the equipment after completion of testing to Site 4 to better characterize downwind concentrations. After Day 2, no further samples were collected from this location.

- Site 3. This site was located southwest of the facility. This site was downwind on Days 1 and 2 and upwind of the facility on Day 3.

- Site 4. This site was located northeast and downwind of the facility. The site was the only downwind site on Day 3 and included TSP and PM10 duplicate samplers.

5.2.2 Environment and the Public Health

The ambient air quality sampling was conducted to measure the concentrations of TSP, PM10, CO, VOC, lead, and mercury vapor. Measurements were also made to determine community noise levels. The windrose data for the three days of sampling are presented in Appendix B. These ambient sampling results are summarized below; the complete results are presented in Appendix E.

Total Suspended Particulate, PM10 and Lead

Table 5-6 summarizes the sampling results for TSP, PM_{10}, and lead. The PM10 and lead levels were found to be well below all applicable New Mexico and National Ambient Air Quality

Standards (NAAQS) for all runs, despite concerns over possible bias from site locations in the vicinity of vehicular traffic. The New Mexico standard for TSP is 150 $\mu g/m^3$; the NAAQS for

Table 5-6
Albuquerque TSP, PM10 and Lead Sampling Results[a]

Day	Compound	Concentration ($\mu g/m^3$)		
		Upwind	Downwind	Downwind
1	TSP	17.51	63.41	16.36
	PM10	11.35	25.49	10.50
	Lead	0.02	0.03	0.03
2	TSP	301.06	25.74	41.07
	PM10	107.06	11.81	18.18
	Lead	0.004	0.006	0.006
3	TSP	65.38	91.98	-
	PM10	20.04	34.36	-
	Lead	0.002	0.003	-

[a] PM10 and lead standards are 150 and 1.5 ug/m^3, respectively.

PM10 and lead are 150 and 1.5 $\mu g/m^3$, respectively. The wind speeds were basically the same for all days and ranged from 1 to 11 miles per hour. It was visually noted by test personnel that dust generated by vehicular traffic to and from the landfill was impacting the Site 2 samplers on Days 1 and 2.

On Day 1, comparison of the Sites 1 (upwind) and 3 (downwind) show negligible differences in PM10 and TSP concentrations. The TSP and PM10 concentrations measured at Site 2 (downwind) were 143 and 288 percent higher than the concentrations found at Site 3, respectively. These results demonstrate that particulate concentration at Site 2 may be higher due to bias from truck traffic near the facility.

The Site 2 samplers were located upwind of the facility on Day 2. The TSP concentrations measured at Site 2 were five to ten times higher than the concentrations found at Sites 1 and 3, respectively. Similarly, the PM10 concentrations for Site 2 were four to eight times higher than Sites 1 and 3, respectively. This data is an indication that the Site 2 data may be biased high, possibly attributable to truck traffic in the vicinity of the sampler.

On Day 3, the sampling equipment from Sites 1 and 2 was relocated to a new position (Site 4) to better characterize downwind concentrations and obtain duplicate samples. Winds were variable on Day 3 and at times the samplers were not in ideal position to identify upwind and downwind concentrations. It was noted that Sites 3 (upwind) and 4 (downwind) did not appear to be impacted by vehicular traffic to the degree noted on Days 1 and 2. Also there was more dust generated by facility activities. A review of the sampling results indicates much higher particulate concentrations than on previous days. Since vehicular traffic may have biased results for Days 1 and 2 compared with Day 3, comparisons of all three days may not be appropriate. A comparison of upwind and downwind sites show an increase in downwind TSP and PM10 concentrations.

Due to possible bias from truck traffic on Days 1 and 2, it is inconclusive whether the facility contributes to fence line concentrations. For Day 3, there would appear to be a moderate contribution of the facility to fence line TSP and PM10 concentrations. All TSP and PM10 results (including Site 4) are below NAAQS. Except for Day 2, there was no difference in upwind and downwind lead concentrations. For Day 2, the upwind and downwind lead concentrations were 0.01 and 0.02 $\mu g/m^3$, respectively -- considered a negligible difference. The facility then does not appear to contribute to ambient lead concentrations at the property boundary.

The lead duplicate results demonstrated a RPD of 40 percent, above the QC criteria of ± 20 percent. The lead results are very low and close to the detection limits for lead analysis. Therefore, the RPD excursion should have no impact on the results. The lead QC spike and spike duplicate analyses recoveries were both 100 percent. The lead matrix spike and matrix spike duplicate analyses met the laboratory acceptance criteria.

Carbon Monoxide and Mercury

Carbon monoxide and mercury vapor levels were monitored with direct-reading instruments at upwind and downwind sites on each of the three days on-site. Instantaneous readings were generally taken at each sampling location once in the morning and once in the afternoon. Carbon monoxide and mercury were not detected in concentrations higher than background levels. No difference between upwind and downwind concentrations were found. The results are presented in Table 5-7. All results were less than OSHA exposure limits.

Table 5-7
Albuquerque Ambient CO and Mercury Monitoring Results

Location	CO Level (ppm)	Hg Level (mg/m^3)
Ambient Air Station #1	ND-1	ND-0.001
Ambient Air Station #2	ND-1	ND-0.002
Ambient Air Station #3	ND	ND-0.002
Ambient Air Station #4	ND	ND-0.002

[a]PELs for CO and Hg are 35 ppm and 0.05 mg/m^3, respectively.

Volatile Organic Compounds (VOC)

VOC data collected on Day 2 is presented in Table 5-8. The target compounds were from the hazardous substance list (HSL) and featured scans for over thirty-five compounds. Sampling was conducted at Sites 1, 2, and 3 and the presence of two VOCs was detected. Acetone was detected in all samples with the highest concentration of 35.6 $\mu g/m^3$ measured at the upwind location. Trichlorotrifluoroethane (F11), another suspected laboratory contaminant, was detected in one of the two duplicate samples collected at Site 2. Acetone levels were well below the guideline established by the New Mexico Health and Environment Department Environmental Improvement Division. Excluding common laboratory contaminants, the VOC results indicated that no VOCs were present at the upwind or downwind locations. The results can be considered representative of normal background levels in rural desert areas.

Table 5-8
Albuquerque VOC Sampling Results

Day	Compound	Detection Limit ($\mu g/m^3$)	Concentration ($\mu g/m^3$)			State Guideline ($\mu g/m^3$)
			Site 1	Site 2	Site 3	
2	Acetone	2.4	35.6	18.0	28.5	590,000
	Trichlorotrifluoroethane	1.5	ND	ND	ND	NA

For the VOC QC spikes, the bromomethane recovery of 124 percent exceeded the QC criteria of 75 to 115 percent. It should be noted that bromomethane was not detected in any of the samples. EPA Method TO-14 does not state specific acceptance ranges for surrogate or spike recoveries. Coast-to-Coast Analytical Service uses 70 to 130 percent as an acceptance criteria. This is based on guidance from EPA Region V. Therefore, the high recovery for bromomethane should have no impact on the results.

Wastewater

Equipment at this facility is not normally washed with water sprayers. Any water used at the facility evaporates quickly due to the low humidity. No wastewater samples, therefore, were collected at this facility.

Community Noise

Instantaneous noise levels were measured at locations inside the facility, at the ambient air stations, and at locations along the fence line of the facility property. Table 5-9 summarizes community noise levels measured around the MRF. The main source of noise outside the facility was produced by the glass crusher. Noise levels in the vicinity of the glass crusher while in operation ranged from 95 to 100 dBA. Noise levels increased from 59 to 74 dBA in the North

Table 5-9
Albuquerque Community Noise Measurement Results

Location	Instantaneous Noise Level (dBA)
Fence Line (North)	43.0-56.0
Fence Line (East)	46.0-65.0
Fence Line (South)	43.0-78.0
Fence Line (West)	43.0-45.0
Ambient Air Station #1	60.0-63.0
Ambient Air Station #2	63.0-65.0
Ambient Air Station #3	55.0-64.0
Ambient Air Station #4	65.0-70.0

Work Area when the glass crusher was started. Even 150 meters north of the facility, noise levels increased from 43 to 56 dBA.

Noise levels measured at ambient air station locations and fence line locations generally ranged from 43 to 70 dBA. Periodically, when trucks passed, noise levels along the south fence line reached as high as 78 dBA. Due to the remote location of this facility, the noise generated by the facility does not have a community noise impact.

5.2.3 Occupational Health and Safety

Personnel sampling was conducted to measure worker exposure to dusts, silica, bacteria, fungi, and noise. Indoor sampling was also conducted to determine levels of CO, mercury and noise. The personnel and indoor sampling results are summarized below; the complete results are presented in Appendix E.

<u>Dusts and Silica</u>

Worker exposures to total dust, respirable dust, and silica were monitored over the entire work shift (8 hours). Workers in the following job functions were sampled: sorting line worker, baler line worker, glass crusher operator, truck driver, tipping floor attendant, front end loader operator and truck driver. The personnel sampling results are summarized in Table 5-10. All sample results were less than the applicable PELs or TLVs. The highest total dust concentration was found on the glass crusher operator (1.45 mg/m^3), and the highest respirable dust concentration was found on a sorting line worker (0.57 mg/m^3). Sampling result for respirable silica indicated less than detectable for all samples.

Only two respirable dust and one total dust duplicate samples exceeded the RPD limit of 20 percent.

Table 5-10
Albuquerque Total Dust, Respirable Dust and Silica[a]
Personnel Sampling Results

Job Description	Concentration (mg/m^3)		
	Total Dust	Respirable Dust	Silica
Sorting Line Worker	0.5367	0.5711	<0.0117
Baler Line Worker	0.5767	0.2694	<0.0134
Glass Crusher Operator	1.4471	0.1734	<0.0124
Tipping Floor Attendant	0.8647	0.1291	<0.0129
Front End Loader Operator	0.4341	<0.1184	<0.0118
Truck Driver	0.3784	<0.1197	<0.0120

[a]PELs are 15.0, 5.0, and 0.1 mg/m^3 for total dust, respirable dust, and silica, respectively.

Carbon Monoxide and Mercury Vapor

Carbon monoxide and mercury measurements were taken with direct reading instruments at six locations throughout the facility. These measurement results are presented in Table 5-11. Carbon monoxide levels ranging from 3 to 11 ppm were measured on the sorting line. The CO levels on the tipping floor ranged from 8 to 12 ppm, although the 12 ppm measurement was the result of a small front end loader operating in the area. A CO level of 21 ppm was measured at the baler, again while the loader was in operation. These levels are below the PEL of 50 ppm and the TLV of 25 ppm. It is unlikely that personnel would be exposed to levels over the PEL or TLV, since the loader is not continually in the area. One measurement detected a CO level of 167 ppm in the area of a compressor being used to repair the front end loader. All other areas were 5 ppm or less for carbon monoxide.

Direct reading measurements for mercury vapor did not find any levels above the typical instrument background nor approaching the established exposure limits.

Bacteria and Fungi

The airborne bacteria and fungi levels were measured at the one upwind and two downwind locations on all three days. In addition, airborne bacteria and fungi samples were collected at the sorting line and tipping floor on all three sampling days. One sample was collected at the baler and in the lunch area. The airborne bacteria and fungi results for the Albuquerque facility are presented in Table 5-12. Levels of airborne bacteria and fungi outside the facility were generally one to two orders of magnitude lower than the levels inside the facility. The downwind sample results were found to be similar to upwind samples, indicating that the airborne bacteria and fungi present inside the building are not being released in measurable quantities. There are currently no regulatory limits for bacteria and fungi levels in ambient air.

Table 5-11
Albuquerque Indoor CO and Mercury Monitoring Results

Location	CO Level (ppm)	Hg Level (mg/m^3)
Sorting Line	ND-11	0.001-0.003
Baler Line	ND-21	ND-0.003
Aluminum Can Vacuum	1-3	ND-0.002
Glass Crusher	ND-1	ND-0.004
Tipping Floor	ND-12	ND-0.003
Lunch Room	ND-3	ND-0.003
North Work Area	ND-1	ND-0.003
Front End Loader	167	0.002

Table 5-12
Albuquerque Airborne Fungi and Bacteria Sampling Results

Location	Sample (viable counts per cubic meter)		
	Fungi	Bacteria RT[a]	Bacteria 56[b]
Lunch Room	35-70	305-551	23-59
Baler Line	4231-5607	3036->6936	58-231
North End Area	1855	>6828	68
Tipping Floor	5326-7618	3757->6828	35-445
Sorting Line	340-9248	715->6936	117-307
Ambient Air Station #1	88-451	231-1179	<12-35
Ambient Air Station #2	139-328	1360-3260	23-35
Ambient Air Station #3	35-139	624-938	12-45
Ambient Air Station #4	80-512	375-1013	23-34

[a]Bacteria RT is incubated at room temperature.
[b]Bacteria 56 is incubated at 56 degrees F.

Bacterial and fungi wipe samples were also collected on the surfaces inside the facility on September 16, 1993. However, because PathCon detected a contaminant in the diluent solution for these samples, a second set of wipe samples were collected October 28, 1994. The analytical results of the wipe samples indicated that they contained several organisms that were similar to those organisms found in air. Therefore, it is plausible that the organisms detected in the air samples may have originated from some of the surface sources. Table 5-13 summarizes the results of the bacterial and fungi wipe samples.

Table 5-13
Albuquerque Surface Fungi and Bacteria Results

Location	Sample (units per gauze wipe)	
	Fungi	Bacteria
Tipping Floor	20000	150000
Large Baler	11000	920000
Bag Breaking Area	25000	740000
Lunch Room	<260	570
Small Baler	800	50000
Sorting Line	72000-190000	1600000-1700000

All fungi detected were common environmental fungi. None of the fungi detected are considered highly virulent in nature. The two most commonly associated with infections that were detected are *Aspergillus niger* and *Aspergillus flavus*. These organisms are considered opportunistic pathogens, in that they are most likely to infect individuals with compromised immune systems. Healthy people are not likely to be infected. However, it is possible that hypersensitive people, and people exposed to high levels of fungal spores, may develop hypersensitivity reactions, such as allergies, asthma and hypersensitivity pneumonitis. Little information is available describing the exposure levels required to initiate such reactions.

No highly virulent pathogenic bacterial were identified in any of the samples submitted. The most common bacteria detected were Bacillus, which are commonly found in environmental samples, and occur naturally in soil and water. *Curtobacterium*, *Erwinia,* and *Clavibacter* are common plant pathogens which is commonly recovered from air samples. Arthrobacter is a common environmental organism often associated with soil. *Corynebacterium* and *Brevibacterium* may be found in human/animal or environmental sources. *Aureobacterium* has been found in soil and dairy products but is probably widely distributed in the environment. The species of *Acinetobacter, Flavobacterium, Pseudomonas, Alcaligenes, and Xanthomonas* detected likely originated from water or wet environments and soil. *Sphingobacterium multivorum* probably originates from water and soil sources. *Staphylococcus and Micrococcus* are associated with human and/or animal skin and mucus membranes. Three enteric organisms were detected: *Enterobacter cloacae, Hafnia alvei,* and *Klebsiella pneumoniae.* All three may be found in various environments including water, food, soil, and sewage. *Klebsiella pneumoniae* is an environmental bacterium that is considered to be an opportunistic pathogen that has been related to incidence of pneumonia in immune compromised individuals.

Duplicate fungi/bacteria samples were collected at Site 4 on September 16, 1993. The RPD for the fungi, environmental bacteria, and thermophilic bacteria were 146, 92 and 38 percent, respectively. These RPD values are not within the 20 percent limit in the QAPjP. Two duplicate samples were collected for indoor samples. The RPD values for both samples also exceeded the QAPjP limit of 20 percent.

Noise Exposure

Worker noise exposure levels were determined over the work shift through the use of audiodosimeters. Workers in the following job functions were monitored: sorting line worker, baler line worker, glass crusher operator, truck driver, tipping floor attendant, and front end loader operator. The audiodosimeter results are presented in Table 5-14. The average noise levels for the three days of sampling ranged from 79.3 dBA for the front end loader operator to 93.1 dBA for the glass crusher operator. In several cases, noise levels exceeded the OSHA Action Level of 85 dBA and the PEL of 90 dBA. The highest noise levels, above 90 dBA, were found on the glass crusher operator, sorting line worker, and tipping floor attendant. At these levels, workers would be required to use hearing protectors. Another major source of noise within the facility is the aluminum can vacuum. Noise levels ranged from 95 to 99 dBA when the vacuum was in operation.

Table 5-14
Albuquerque Audiodosimeter Results

Job Description	Average Noise Levels (dBA)
Truck Driver	84.9
Equipment Operator	79.3-80.5
Tipping Floor Attendant	83.4-91.2
Sorting Line Foreman	89.1-92.0
Glass Crusher Operator	91.7-93.1
Baler Line Operator	82.0-83.6

Instantaneous noise measurements were also made using a sound level meter throughout the facility. Table 5-15 presents the results of the indoor noise measurements. The indoor noise levels ranged from 57 dBA in the north work area to 102 dBA at the glass crusher outside the building.

Table 5-15
Albuquerque Indoor Noise Measurement Results

Location	Instantaneous Noise Level (dBA)
Sorting Line	82.0-94.0
Baler Line	80.0-86.0
Aluminum Can Vacuum	87.0-99.0
Glass Crusher	95.0-102.0
Tipping Floor	72.0-85.0
Lunch Room	57.0-70.0
North Work Area	56.0-74.0
Front End Loader	100.0

Health and Safety Programs

The health and safety program evaluation was limited to information provided by on-site personnel and the regional safety officer. Key findings from this evaluation include:

- An Energy Control Program is in place at the facility, although the energy control procedures do not meet OSHA standards. Documentation of training was available, although the training content does not meet OSHA's specifications. Documentation of periodic inspections of the lockout/tagout program effectiveness was not available.

- Dust masks are the only form of respiratory protection used at the facility. The facility does have a written respiratory protection program and medical examinations for municipal employees, but the examinations are for initial employment only and do not meet OSHA standards. Dust masks are stored in a clean area, the program is evaluated periodically, and the work area is surveyed for conditions which may contribute additional stress for respirator wearers. Training on the use of these respirators had not been conducted.

- A Hazard Communication Program is in effect at the facility which includes a written program, container labelling, material safety data sheets (MSDS), and training. The facility did not have a list of hazardous chemicals available, indicating that it was at the main office. MSDS were not readily available at all times, because the front office is sometimes locked.

- A Hearing Conservation Program has been implemented. Noise monitoring, audiometric testing, evaluations of hearing protectors, and training have been conducted. Employees have not been formally notified of exposures above 85 dBA and a copy of the OSHA noise standard has not been posted at the facility.

- There were no air contaminants present requiring specific control programs.

- There was no Bloodborne Pathogen Program in place. Workers are not required to have first aid or CPR training, although two to three people have been trained in CPR.

- Information on injury and illness rates were not available, because the facility had only been in operation seven months at the time of the study.

Ergonomics

Ergonomic conditions at the facility were evaluated by an occupational nurse who reviewed notes and drawings made by the on-site industrial hygienist. Video tape of the operations was not conducted at the request of the facility manager due to the presence of prison workers. Picking booth operations were observed during the on-site facility assessment. For the purpose of this assessment, the potential ergonomic risk factors identified can be defined as workplace conditions or work practices which may contribute to worker discomfort, fatigue or injury.

Two types of workstations were evaluated:

- Workstation 1. At this workstation, workers opened bags on a conveyor as they moved toward sorting line. The only significant ergonomic risk factor appeared to be associated with workers reaching across the entire width of conveyor.

- Workstation 2. At this workstation, workers on each side of the conveyor removed recyclables and placed them into the bins. This action required repetitive twisting of the upper torso.

SECTION 6

HARTFORD, CONNECTICUT

6.1 Process Description

The Connecticut Resources Recovery Authority (the Authority) maintains several solid waste management facilities to serve the communities in the Mid-Connecticut Region. The process description presented in this section addresses the technical, economic, energy, and environmental aspects of the MRF and IMSWM system.

6.1.1 Integrated Solid Waste Management System

The Authority provides disposal services for MSW generated in the 44 communities in the Mid-Connecticut Region. The components of the IMSWM system located in Hartford and several other communities include:

- Recycling Center,
- Four Transfer stations,
- Waste Processing Facility,
- Power Block Facility, and
- Hartford and Ellington Landfills.

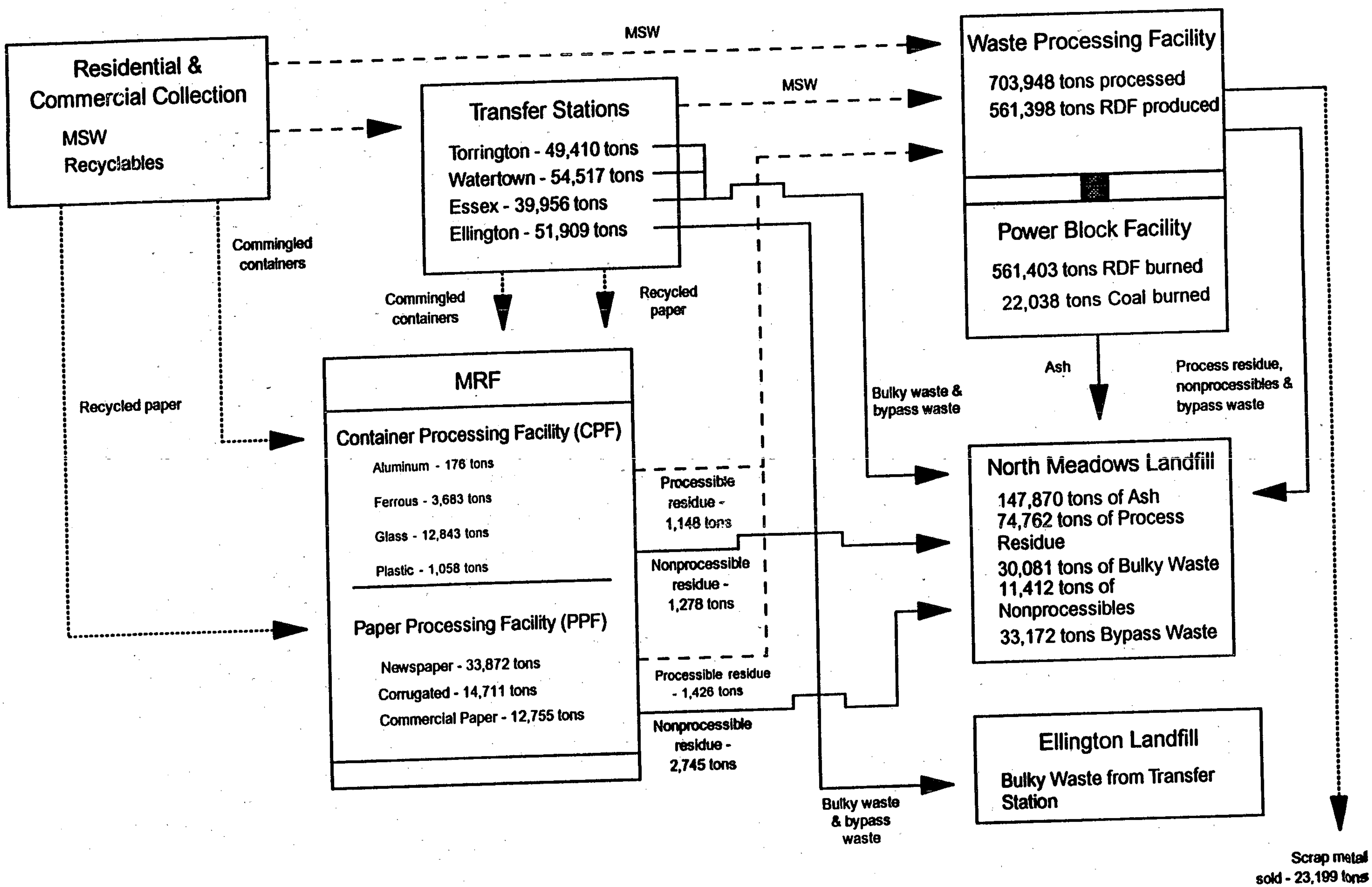
Figure 6-1 presents a flow diagram of the Authority's IMSWM system, showing the quantities of waste received and the residue disposed of by the various components of the system.

<u>Waste Collection</u>

Originally, 33 municipalities entered into service contracts with the Authority to deliver all municipal solid waste (MSW) generated within their boundaries to the system. Subsequently, an additional eleven municipalities entered into service contracts. Each service contract provides that payments be made by each municipality sufficient to cover the debt service and operating costs of the system. The payments are based on the greater of the actual tonnage of MSW delivered each year or the contractually committed minimum annual tonnage.

The municipalities provide collection services for MSW either directly or through private contractors. The MSW is then delivered by the municipal or private haulers to either the Waste Processing Facility or one of four Transfer Stations. Recyclables materials, collected by the municipal or private haulers, are delivered to the Recycling Center, the Watertown Transfer Station, or the Torrington Transfer Station. In FY 1992, approximately 508,156 and 195,792 tons of MSW were delivered directly to the Waste Processing Facility and Transfer Station system, respectively. Approximately 89,098 tons of residential and commercial recyclables were delivered to the Recycling Center.

Figure 6-1
Mid-Connecticut Solid Waste System



Recycling Center

The Recycling Center is located in Hartford, near the Waste Processing and Power Block Facilities. The Recycling Center consists of two separate recycling operations -- the Container Recycling Center and the Paper Recycling Center. The Container Recycling Center is owned by the Authority and operated under contract by RRT Empire of Mid-Connecticut, Inc. (RRT). The Paper Recycling Facility is leased by the Authority and operated by Capitol Recycling of Connecticut, Inc (CROC). The Metropolitan District Commission (the District) transports all residue generated the Recycling Center to either the Waste Processing Facility or Hartford Landfill. In FY 1992, approximately 17,760 tons of recyclable material was recovered at the container recycling facility and 61,338 tons of newsprint, commercial paper, and corrugated cardboard at the paper recycling facility.

Transfer Stations

The four transfer stations are located in outlying areas of the wasteshed in Ellington, Essex, Torrington, and Watertown. All four transfer stations are owned by the Authority and operated by the District. The Torrington transfer station receives both MSW and container recyclables; the other transfer stations receive only MSW. In FY 1992, approximately 195,792 tons of MSW were received at the four transfer stations. The MSW is transferred from the transfer stations to the waste processing facility by trailer trucks.

Waste Processing Facility

The Waste Processing Facility is centrally located in the wasteshed in Hartford. The facility is owned by the authority and operated by the District. Municipal solid waste is transported either from the transfer stations by trailer truck or directly from nearby participating municipalities by collection vehicles. In the facility, the MSW is first weighed, then deposited in a receiving area, and finally processed to separate combustible material, non-combustible residue, and recoverable ferrous metal. In FY 1992, 703,948 tons of MSW were delivered to the facility from the transfer stations and local communities. Approximately 561,398 tons of waste were used in the production of refuse-derived-fuel (RDF), 119,346 tons of residue, non-processibles, and bypass waste were transported to the Hartford Landfill, and 23,199 tons of ferrous metal were delivered to market.

Power Block Facility

The Power Block Facility, located adjacent to the Waste Processing Facility, is owned by the Authority and operated by Ogden Martin Systems of Hartford, Connecticut (Ogden). The pre-processed fuel is conveyed directly to one of three traveling-grate, waterwall furnaces fabricated by Combustion Engineering. The combustion process both reduces the volume of waste requiring landfill disposal and produces steam delivered to the electrical generating facility owned and operated by Connecticut Light & Power (CL&P). Coal, delivered to the facility by barge, may be fired in a parallel train to fully utilize the facility's electrical generating capacity. Approximately 561,403 tons of refuse-derived-fuel (RDF) and 22,038 tons of coal were burned in the facility in FY 1992. The approximately 147,870 tons of ash residue generated at the facility was transported to the Hartford Landfill for disposal in a dedicated ash monofill under lease to the Authority.

Hartford Landfill

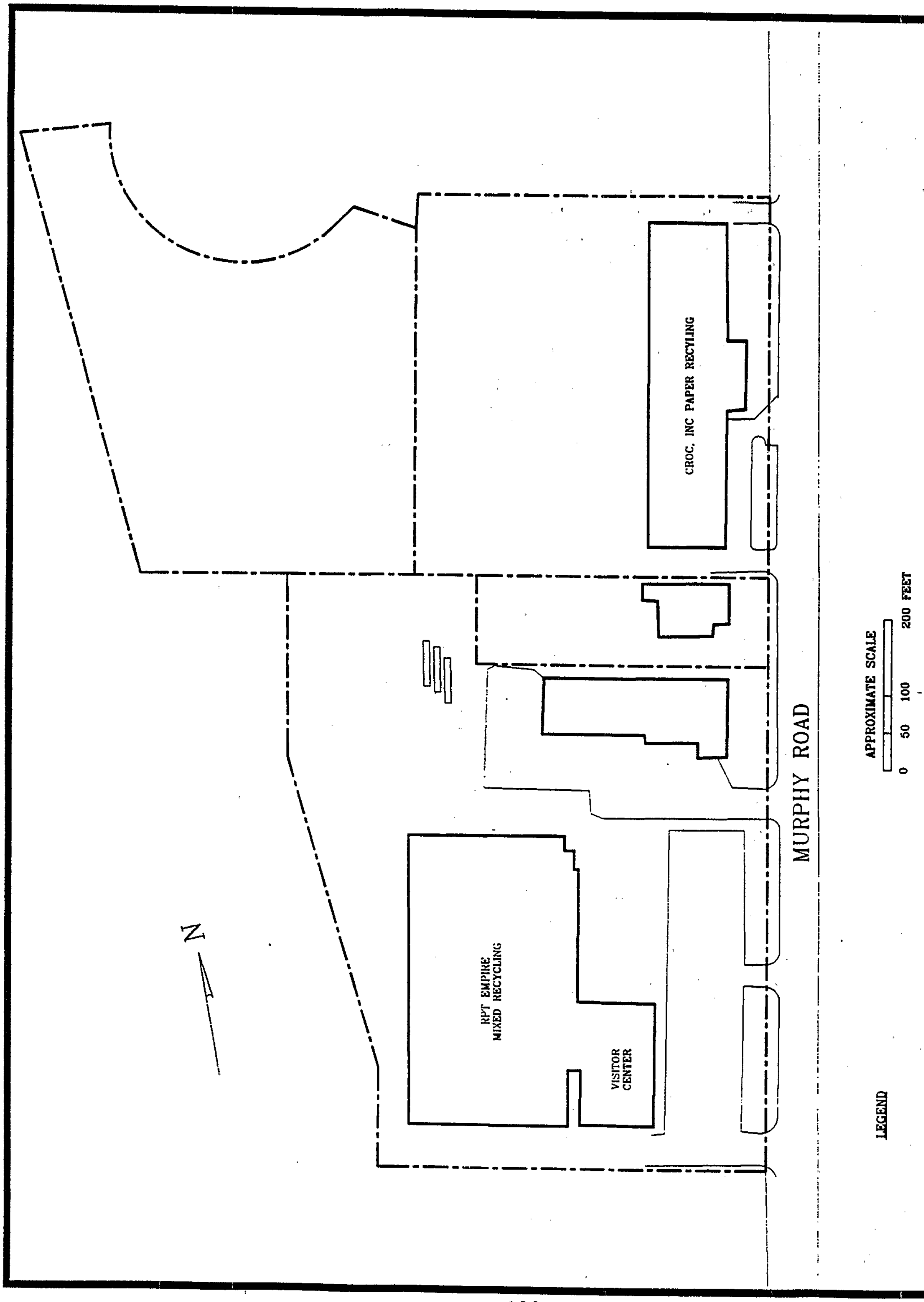
The Hartford North Meadows Landfill is located in northeast portion of the City adjacent to the Connecticut River. The Hartford Landfill is leased from the City by the Authority and is operated and maintained by the District. The approximately 87-acre landfill is augmented by a 36-acre parcel dedicated to the disposal of oversized bulky wastes (OBW), non-processible waste, bypass waste, and system residue. In FY 1992, about 301,320 tons of waste and residue were disposed of at the Hartford Landfill. In addition, OBW from the four communities using the Ellington Transfer Station is disposed of at the Ellington Landfill.

6.1.2 Material Recovery Facility

The Recycling Center is located on Murphy Road in Hartford, near the Authority's Waste Processing Facility and Power Block (see Figure 6-2). The facility consists of two separate recycling operations -- the Container Recycling Center and the Paper Recycling Center. The Container Recycling Center is owned by the Authority and operated under contract by RRT Empire of Mid-Connecticut, Inc. This facility is designed to process 200 tpd of recyclable material, including ferrous metal, aluminum, plastics, and color-sorted glass. The Paper Recycling Center is leased by the Authority and operated by Capitol Recycling of Connecticut, Inc. This facility is designed to process 380 tpd of newsprint, corrugated cardboard, and commercial paper goods. Table 6-1 summarizes the material received and recovered at the MRF in 1992.

At the Container Recycling Center, collection vehicles enter the building and discharge their load onto a tipping floor. A front end loader directs material into either of the receiving hoppers serving the two identical lines. The material is automatically transferred from the hopper by conveyor to a magnetic separator for removal of ferrous metal. The remaining waste then passes by an inspection station for removal of non-recyclables (i.e., ceramics, PVC, plastic film, etc.).

The material is then directed to a primary air classifier. The light fraction, consisting primarily of aluminum and plastic containers, is conveyed to a grizzly conveyor to separate large, plastic containers from the aluminum and plastic. The reduced stream is then fed to an eddy-current separator for separation of aluminum and plastic. The aluminum is fed directly to a storage bin and then to a baler, while the plastic is directed to a sorting conveyor. On the conveyor, the sorters positively sort PET and colored HDPE and negatively sort clear HDPE.



SITE PLAN
MID-CONNECTICUT RECYCLING CENTER
HARTFORD, CONNECTICUT

FIGURE 6-2

The heavy fraction from the primary air classifier is directed to a vibrating screen for removal of broken glass. The remaining oversized material is fed to a secondary air classifier removing additional aluminum and plastic. The material then continues into the glass sorting conveyor. Workers sort green and amber glass, negatively sorting flint glass. The color-sorted glass is then conveyed to a hammer crusher before being transferred to a beneficiation system. The mixed color, glass aggregate is conveyed to a beneficiation system producing a high-quality cullet for use in construction applications.

Table 6-1
Material Received and Recovered in 1992

Material	Throughput (tons)	Percent of Total (%)
Newspaper	33,852	65.6
Tin Cans	3,645	7.1
Aluminum	150	0.3
Aluminum Foil	26	<0.1
PET	47	0.1
HDPE Mixed	896	1.7
HDPE Natural	115	0.2
Flint Cullet	2,999	5.8
Green Cullet	1,436	2.8
Amber Cullet	366	0.7
Mixed Glass	8,043	15.6
Scrap Metal	38	<0.1
Total	51,611	100.0

At the Paper Recycling Center, the newsprint commercial paper, and corrugated cardboard are hand sorted on a series of conveyors. The facility is capable of producing high-quality grades of recyclable paper readily acceptable in the market place.

6.1.3 Economic, Energy and Environmental Issues

This section addresses the economic, energy, and environmental issues related to the operation of the MRF and IMSWM system. These impacts are based on publicly available information or material provided by the Authority.

Economic Implications

In 1973, the State of Connecticut created the Authority to implement the State's comprehensive plan for solid waste disposal, while conserving and preserving the environment. To that end, the Authority provides solid waste management facilities and services to participating municipalities and regional districts on a self-sustaining basis. It is empowered to site, own and operate waste management facilities either directly or under contract with private industry, and to provide waste management services through contracts with participating municipalities and regional districts. The Authority is quasi-public, non-profit entity governed by a board of fourteen directors appointed by the governor and state legislature.

The data collected for this analysis was obtained from the Authority. According to the Authority, the costs and revenues were based on actual results for FY 1992 and included all solid waste handled by the Mid-Connecticut project. In FY 1992, the total cost of waste collection, processing, combustion, and disposal, material recovery and marketing, and administration was approximately $80.9 million. Approximately $40.5 million or 51 percent of costs were associated with vendor operating fees. The total costs, including operating fees, are illustrated in detail in Table 6-2. Approximately $31.1 million or 38.5 percent were associated with debt service. The remaining $9.3 million was split between waste transport, administration, and other expenses.

Table 6-2
Estimated Costs for the Mid-Connecticut IMSWM System

Cost Element	IMSWM System	MRF
Waste Processing Facility	$13,260,000	
Power Block Facility	16,765,613	
Hartford and Ellington Landfills	3,329,482	
Electrical Generating Facility	1,833,500	
Transfer Stations	2,234,050	
Recycling Center	1,831,079	$1,831,079
Subtotal (Vendor Fees)	40,440,974	1,831,079
Administration	4,047,790	1,500,190
Debt Service	31,129,176	1,053,012
Waste Transport	5,205,200	204,457
Other	90,000	
Total	$80,913,140	$4,588,738

In FY 1992, the total cost of operating the MRF, including collection, processing, and marketing recyclables, was approximately \$4.4 million. Approximately \$1.8 million or 42 percent of costs was associated with vendor operating fees, while approximately 34 percent of MRF costs was associated with administration. The remaining \$1.05 million or 24 percent of MRF costs was for debt service. Based on the allocation of costs provided by the Authority, the operating costs of the MRF represent approximately 5.4 percent of total IMSWM system operating costs. It is important to note, however, that in the area of administration, the MRF accounts for 37 percent of total IMSWM system cost.

The amount of total revenues received by the IMSWM system was approximately \$80.9 million in FY 1992. Approximately \$37 million or 46 percent of revenues was associated with sale of energy generated by the EGF to Northeast Utilities. Approximately \$28.5 million or 35 percent was associated with general tipping fees. The remaining \$15.4 million was split between interest, use of prior year earnings, sale of recyclables, and service charges. The revenues are broken out in detail in Table 6-3.

Table 6-3
Estimated Revenues for the Mid-Connecticut IMSWM System

Cost Element	IMSWM System	MRF
Tipping Fees	\$28,560,000	
Metal Tipping Fees	46,300	
Spot Waste	5,102,100	
Hauler Fees	30,000	
Sale of Recyclables	1,434,240	1,392,640
Sale of Energy	37,000,000	
Interest	3,001,000	
Fines	10,000	
Bulky Waste	2,900,000	
Soil	240,000	
Use of Prior Year Earning	2,500,000	
Miscellaneous	90,000	
Total	\$80,913,640	\$1,392,640

For clarification, the definition of selected revenue sources is as follows:

- *Metal Tip Fees.* Tipping fees associated with white metal goods, such as refrigerators, stoves, etc. which were sent directly to the landfill.

- *Waste*. Disposal fees associated with waste which was received from out of state.

- *Sale of Energy*. Sale of electricity which was generated by the EGF to Northeast Utilities.

- *Interest*. Earnings on Authority investments.

- *Bulky Waste*. Fees associated with bulky items which could not be processed at the WPF and had to be directly landfilled (e.g. mattresses)

- *Soil*. Fees associated with the disposal of contaminated soil.

- *Use of Prior*. Operating surplus from prior year.

- *Year Earnings*. Based on an allocation performed by the Authority, the amount of total revenues from MRF in FY 1992-93 was approximately $1.4 million. All of these revenues were earned through the sale of recyclables.

The operating revenues of the MRF represent approximately 1.7 percent of total IMSWM system operating revenues based on the allocation of costs provided by the Authority. This is significantly less than the percentage contribution of the MRF to IMSWM system costs.

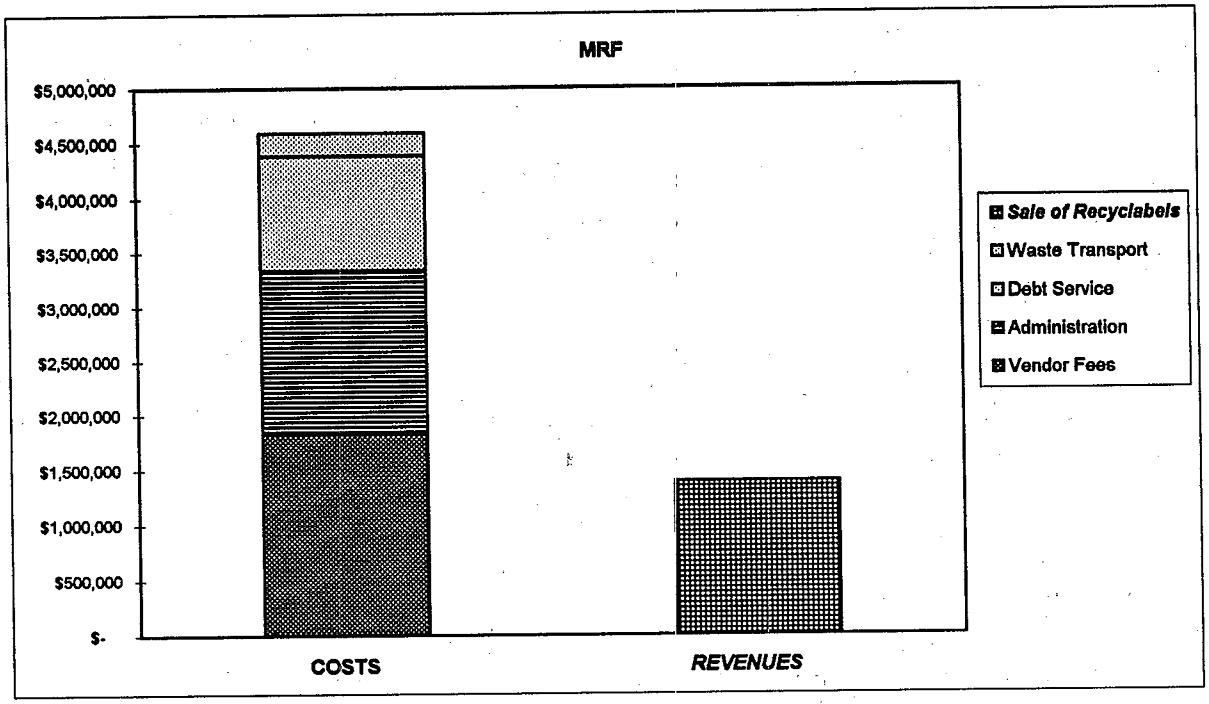
Figure 6-3 presents the costs and revenues for both the MRF and IMSWM system. Based on the analysis of operating expenses and revenues for FY 1992 and the allocation provided by the Authority, it appears that the MRF provided a negative incremental contribution to the IMSWM system in the amount of approximately $3 million or 4 percent of total operating expenditures.

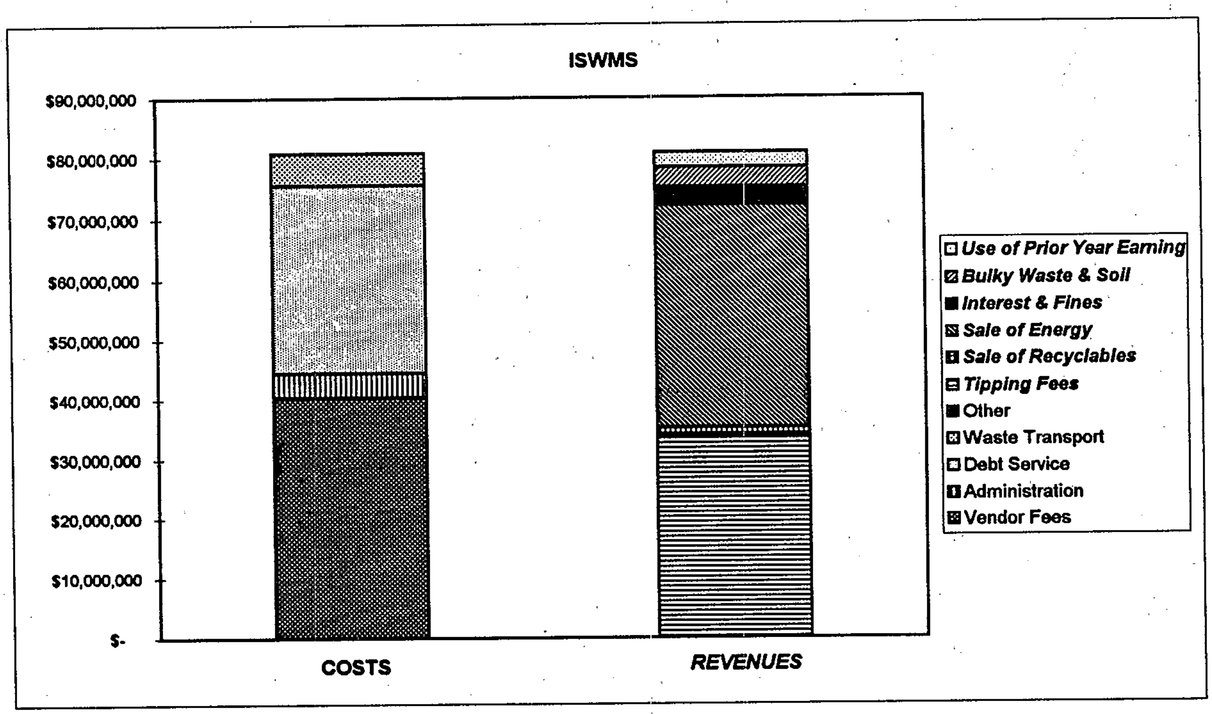
Energy Consumption

The energy conserved from the generation of about 395,000 MWh of net electrical power at the power block facility was an order of magnitude greater than the energy consumption of the entire system. Since this project only evaluates the energy consumption and production for the Mid-Connecticut IMSWM system, the energy consumed or conserved at the remanufacturing facilities that process recyclables is not included in this analysis. Specifically, an estimated 3,380 billion Btu of energy was conserved from the combustion of approximately 575,000 tons of refuse-derived fuel in FY 1992. Exclusive of the in-plant power consumed by the waste processing facility and the power block, an estimated 332 billion Btu of energy was consumed to collect, transfer, haul, process, combust, and transport to market about 734,000 tons of MSW and recyclables. The net energy conserved was 3,050 billion Btu.

The approximately 59,700 MWh (or about 203 billion Btu) of electrical energy was consumed to process and combust the MSW. This in-plant power consumption plus the 3,930

Figure 6-3.
TOTAL COSTS AND REVENUES FOR THE MID-CONNECTICUT ISWMS





MWh of purchased power was subtracted from the gross power generation to estimate the net energy conserved from the combustion of RDF and coal at the power block facility. The energy value of the coal was then subtracted from the gross energy conserved to estimate that portion of the energy conserved attributed to the combustion of RDF.

Of the 332 billion Btu consumed, approximately 76 percent was used to manage 674,000 tons of MSW and 24 percent was used to manage 59,700 tons of recyclables. Approximately 0.45 MMBtu was consumed for each of the 734,000 tons of MSW and recyclables managed. The management of the 674,000 tons of MSW consumed an average of 0.38 MMBtu per ton, while the management of the 59,700 tons of recyclables consumed an average of 1.33 MMBtu per ton. The energy consumed to manage the recyclables included the energy required at the waste-to-energy facility and landfill to process or dispose of residue from the MRF.

Table 6-4 shows the energy consumed by function. For the entire IMSWM System, almost 79 percent of the energy consumed was for transportation, that is, collection, transfer and haul, transporting recyclables to market, and hauling non-processible waste, residue, and ash to the landfill. The energy consumed for transportation of waste and materials constituted 74 and 87 percent of total energy consumption for MSW and recyclables, respectively. The energy consumption is graphically depicted in Figure 6-4.

Except as discussed below, the energy consumption information reported in this section was obtained from data provided by the Authority. The fuel consumed to collect garbage and recyclables was estimated using collection vehicle data from Palm Beach County, Florida; Springfield, Massachusetts; Scottsdale, Arizona; Minneapolis, Minnesota; and Seattle Washington. The energy consumed to haul recovered materials to market was estimated by multiplying the average ton-miles hauled by $0.024 per ton-mile. This was the average fuel consumed by the MSW transfer vehicles used in the Hartford area.

Environmental Regulations

The Mid-Connecticut facilities have received all necessary construction and operating permits from the U.S. EPA and Connecticut Department of Environmental Protection (CTDEP). Table 6-5 summarizes the status of all major permits and approvals for the power block facility, waste processing facility, container recycling center, paper recycling facility, four transfer station, and Hartford Landfill. Discussed below are the regulations applicable to solid waste management facilities in the State of Connecticut.

All of the facilities were required to obtain permits to construct and operate a solid waste management facility from the CTDEP. These permits established design and operational constraints, financial assurance obligations, and monitoring, reporting, and recordkeeping requirements. In addition, the power block facility had to obtain an State Pollution Discharge Elimination System (SPDES) permit and sewer discharge permits from the CTDEP. The four transfer stations also required SPDES permits.

The power block facility was required to obtain permits for air emissions prior to construction and operation from the CTDEP. Because the facility was classified as a major source, the facility also had to obtain a Prevention of Significant Deterioration (PSD) Permit from the U.S. EPA. To obtain these permits, the Authority demonstrated that it complied with all applicable ambient air quality standards and that the facility incorporated BACT.

Table 6-4
Estimated Energy Consumption for The Mid-Connecticut IMSWM System[a]
(MMBtu)

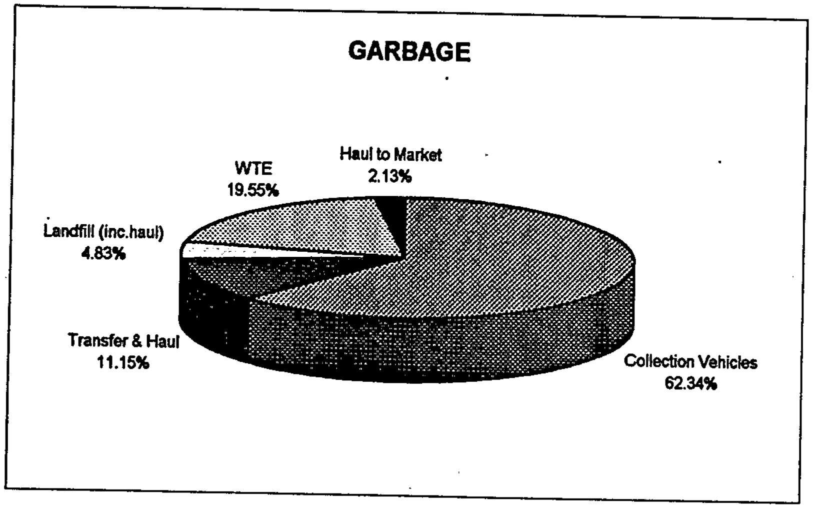
Activity	Garbage	Curbside Recycling	Total
Administration			146.5
Collection Vehicles	157,836	24,452	182,288
Transfer & Haul	28,237	1,154	29,392
MRF - Container Processing Facility		4,932	4,932
MRF - Paper Processing Facility		3,566	3,566
WTE - Waste Processing Facility	28,635	170	28,805
WTE - Power Block Facility	20,864	124	20,987
Transport Residue & Non-Processibles	1,809		1,809
Transport Ash	3,085	18	3,104
Landfill Disposal	7,333	153	7,486
Sub-Total	247,799	34,570	282,369
Haul to Market	5,396	44,783	50,180
Total Energy Consumption (MMBtu)	253,195	79,353	332,549
Tons Collected	673,867	59,665	733,522
Average Energy Consumption (MMBtu/ton)	0.38	1.33	0.45

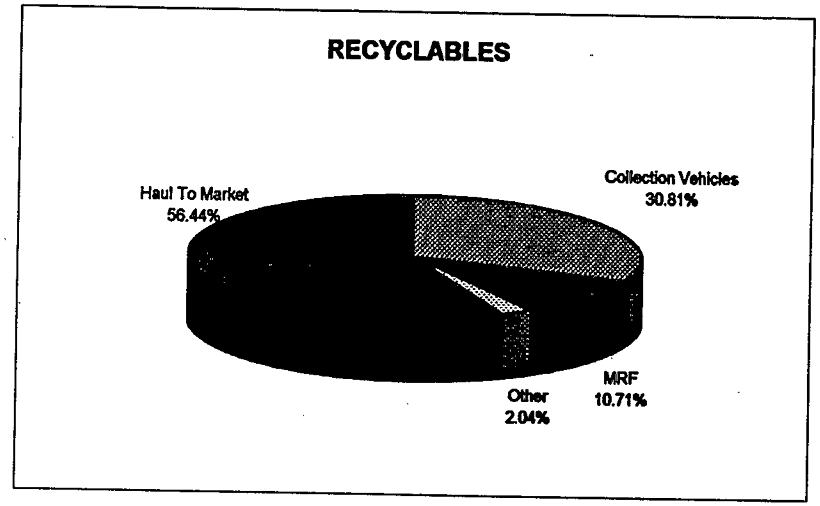
[a]Exclusive of waste-to-energy facility in-plant power usage.

The permits established emission standards for all regulated pollutants, performance criteria for air pollution controls, and monitoring, testing, reporting, and recordkeeping requirements.

The U.S. EPA proposed Section 111(d) emission guidelines for existing municipal waste combustors in September 1994. These guidelines will require that the power block facility comply with more stringent emission standards and retrofit additional control technology than currently required by the CTDEP.

Figure 6-4.
ENERGY CONSUMPTION FOR THE MID-CONNECTICUT ISWM SYSTEM
(Millions of British Thermal Units)





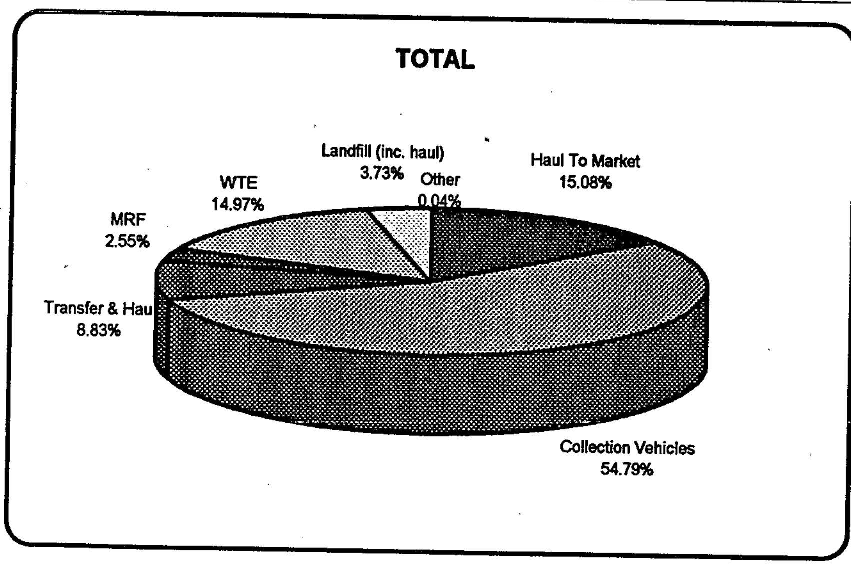


Table 6-5
Major Environmental Permits and Approvals

Facility	Responsible Agency	Permit/Approval	Issuance Date
Power Block Facility	U.S. EPA	PSD Permit	4/4/85
	Connecticut Department of Environmental Protection (CTDEP)	Air Permit to Contract	4/18/85
	CTDEP	Air Permit to Operate	8/27/85
	CTDEP	Solid Waste Facility Permit to Construct Facility	10/7/87
	CTDEP	SPDES Permit	6/16/87
	CTDEP	Sewer Permit	4/20/87
Waste Processing Facility	CTDEP	Solid Waste Facility Permit to Construct/Permit to Operate	01/28/86
Container Recycling Facility	CTDEP	Solid Waste Facility Permit to Construct	8/2/91
	CTDEP	Permit to Operate	3/13/92
Paper Recycling Facility	CTDEP	Solid Waste Facility Permit to Construct	6/15/91
	CTDEP	Permit to Operate	10/18/91
Hartford Landfill	CTDEP	Solid Waste Facility Permit to Operate	01/07/93
Essex Transfer Station	CTDEP	Solid Waste Facility Permit to Operate	12/11/87
	CTDEP	SPDES	1/12/88
Torrington Transfer Station	CTDEP	Solid Waste Facility Permit to Operate	8/19/93
	CTDEP	SPDES	2/18/88
Ellington Transfer Station	CTDEP	Solid Waste Facility Permit to Operate SPDES	6/26/90 6/9/90
Watertown Transfer Station	CTDEP	Solid Waste Facility Permit to Operate SPDES	12/27/90 11/27/90

6.2 Field Test Results

The field test program addressed the environmental and occupational health and safety impacts associated with operation of the Mid-Connecticut Recycling Center. The sampling procedures and results are summarized in this section.

6.2.1 Test Procedures

The field test program at the Hartford MRF was conducted from November 2 through 4, 1993. The Hartford MRF consists of two separate facilities on adjacent sites: the Container Recycling Center, which processes commingled recyclables, including plastics, glass, tin, and aluminum; and the Paper Recycling Facility, which processes paper products including cardboard and newspaper. The RRT facility operates during the day from 7:00 a.m. to 4:00 p.m. The CROC facility runs two shifts -- the first shift running from 7:00 a.m. to 4:00 p.m. and the second shift from 4:00 p.m. to 1:00 a.m. Approximately 15 to 20 full time employees work at the container recycling facility and 15 to 20 employees work at the paper recycling facility. At each facility, the workers are given a half-hour for lunch and two additional fifteen-minute breaks during the day.

The field test program was conducted in accordance with the approved test protocol in the QAPjP and site-specific SAP. The following deviations were noted from the field protocol:

- Only one set of duplicate respirable dust/silica samples was collected during the test program; the second duplicate was voided after sampling equipment was damaged during testing.

- No airborne bacteria samples were collected at the glass sorting station on Day 1, because operations were shut down before samples could be collected. To make up for the missed sample, two sets of samples were collected in the glass sorting station at different times on Day 2.

- Only one round of direct-reading instrument measurements were taken on Days 1 and 3 due to the effort needed to reposition the TSP and PM-10 samplers. An additional round of measurements was taken on Day 4.

- The VOC canister pressure readings exhibited wide variations suggesting that dust particles may have jammed the flow regulator and reduced the flow of air into the cylinder.

- On Day 3, the TSP, PM10, and lead samples collected downwind of the CROC facility ran for less than 24 hours (8.7 hours) due to a power outage. The run time did capture the operating time of the MRF.

- The relative percent difference (RPD) for the replicate samples for PM10, total dust, and respirable dust each exceeded the QAPjP limit of 20 percent.

Table 6-6 summarizes upwind/downwind location of the air sampling equipment in relation to the facility for each of the three days of monitoring. Figure 6-5 shows the approximate location of the sampling sites selected for the test program.

Table 6-6
Sampling Locations at the Hartford MRF

Sample Day	Locations	
	Upwind	Downwind
1	1	2,3
2	4	5
3	4	5,6

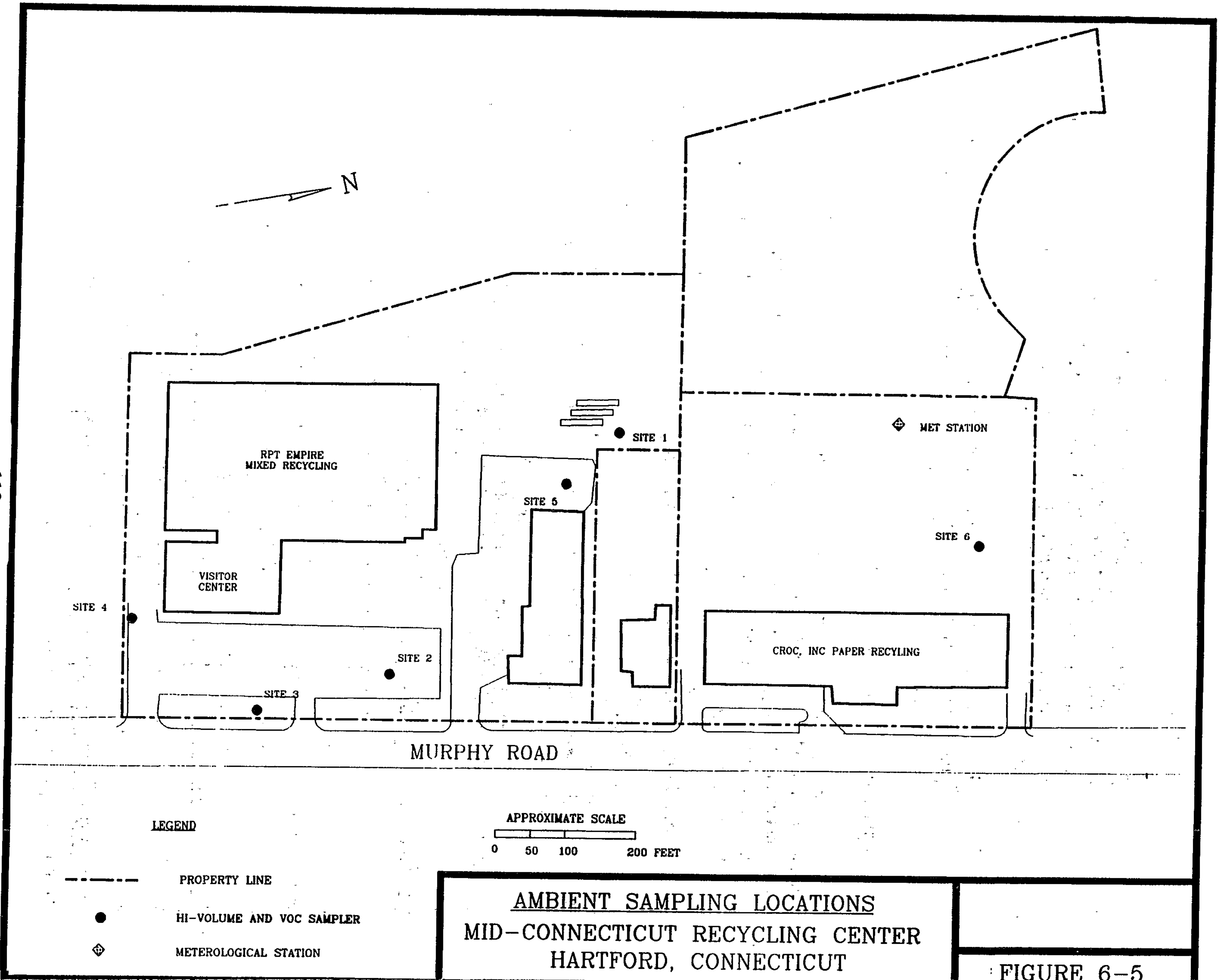
Provided below is a brief discussion of each sampling location and any limitations that should be considered in the evaluation of the reported data:

- Site 1. This site was at an upwind location north northeast of the RRT Empire facility and was suspected to be influenced by vehicular traffic. The sampling equipment at this site was moved to Site 5 for the last two sampling days in order to collect a downwind sample. Due to the lack of property space north-northeast of the CROC facility, an appropriate upwind sample location representing both facilities could not be identified. No further samples were collected at this site after Day 1.

- Site 2. This site was located east of the RRT paper facility. This site was downwind of the facility for the first sampling event and considered to be a representative sample location. The sampling equipment from this site was moved to Site 5 for the collection of duplicate TSP and PM10 samples on Day 2.

- Site 3. This site was located southeast of the RRT facility. This site was downwind for the first sampling event. Due to a shift in wind direction, the equipment from this site was moved to Site 4 in order to collect an appropriate upwind sample for the final two days of sampling. No further samples were collected from this source.

- Site 4. This site was located south of the RRT facility. This site represented a upwind sample location for both facilities for the final two sampling events.



AMBIENT SAMPLING LOCATIONS
MID-CONNECTICUT RECYCLING CENTER
HARTFORD, CONNECTICUT

FIGURE 6-5

- Site 5. This site was located between the two facilities, northeast of the RRT facility. This site was a representative downwind sample of the RRT facility for the last two sampling events. Duplicate TSP and PM10 samples were collected during the second sampling event at this site and moved to Site 6 for sampling event 3.

- Site 6. This site was located northwest of the CROC facility for the third sampling event. This site was the only site located downwind of the CROC facility during the sampling program.

6.2.2 Environment and the Public Health

Air quality sampling was conducted at the Hartford MRF to determine ambient concentrations of TSP, PM10, CO, VOC, lead, and mercury vapor. Measurements were also made to determine community noise levels. The windrose data for the test period are presented in Appendix B. The ambient sampling results are summarized below; the complete results are presented in Appendix F.

Total Suspended Particulate, PM10 and Lead

The TSP, PM10, and lead sampling results are summarized in Table 6-7. The PM10 and lead results were well below all applicable Connecticut and National Ambient Air Quality Standards (NAAQS) for all runs. The Connecticut standards for TSP, PM10, and lead are 260, 150, and 1.5 $\mu g/m^3$, respectively.

Table 6-7
Hartford TSP, PM10 and Lead Sampling Results[a]

Day	Compound	Concentration ($\mu g/m^3$)		
		Upwind	Downwind	Downwind
1	TSP	122.75	49.63	59.75
	PM10	48.66	27.01	32.46
	Lead	0.03	0.02	0.03
2	TSP	27.30	45.29	40.67
	PM10	25.79	43.94	24.15
	Lead	0.02	0.02	0.01
3	TSP	46.38	58.00	138.90[b]
	PM10	28.94	29.40	52.41[b]
	Lead	0.02	0.02	0.02[b]

[a]The Connecticut standards or TSP, PM10, and lead are 260, 150, and 1.5 $\mu g/m^3$, respectively.
[b]Samples collected over 8-hour period due to loss of power.

The sampling results for Day 1 show possible bias from truck traffic at the upwind location. The upwind TSP concentrations were higher than the downwind locations by 110 and 157 percent. The upwind PM10 concentrations were 48 and 80 percent higher than the downwind locations. Comparison of the two downwind locations show reasonable agreement for all three parameters of interest. A negligible difference was noted when comparing the lead levels measured at the three locations. The PM10 contribution to the total particulate was 39 and 55 percent for the upwind and downwind sites, respectively.

On Day 2, there was negligible difference in the PM10 concentrations measured at the upwind and downwind locations. The downwind PM10 concentrations were approximately 59 percent of the TSP concentrations, while the upwind TSP and PM10 concentrations were nearly equivalent. Excluding possible biased results for Day 1, the TSP and PM10 concentrations (except upwind TSP) were in the same range as measured on Days 1 and 3.

Compared with TSP levels measured on Day 2, the TSP concentrations measured downwind of the RRT facility (Site 5) were about 25 percent higher on Day 3. The PM10 concentrations, on the other hand, were essentially equivalent to the levels measured on Day 2. The samplers located downwind of the CROC facility (Site 6) experienced power failure resulting in a reduced sampling time of 8.7 hours. The samplers were running while the facility was operating. The Site 6 TSP and PM10 concentrations measured at Site 6 were 200 and 81 percent higher than the upwind location, respectively.

It can be concluded that there was negligible facility contribution to TSP and PM10 fence line concentrations for RRT. For CROC, there appears to be a moderate contribution to TSP and PM10 fence line concentrations during working hours. Since the samplers at the location downwind from CROC were only operating during facility operations, no conclusions can be made on a 24 hour basis. All TSP and PM10 concentrations were considerably less than the applicable standards. For all three days, there were insignificant differences in upwind and downwind lead concentrations. All measured lead concentrations were well below the applicable NAAQS.

The PM10 and lead duplicate results exceeded the QAPjP limit at 58.3 and 66.7 percent, respectively. Sampling and analytical problems were investigated, but no procedural errors were identified during the sampling program. Although the TSP duplicate samples had poor RPD, the results for Days 1 and 3 should be considered valid. The other TSP concentrations should be considered suspect due to the relatively poor RPD. Because lead concentrations were very low with negligible differences in upwind and downwind concentrations, the lead RPD excursion should have little impact on the results. All results for Day 2 should be considered suspect. The lead QC spike and spike duplicate analyses recoveries were both 80 percent. The lead matrix spike and matrix spike duplicate analyses were 82 and 62 percent, respectively. Although the lead spikes met laboratory acceptance criteria, the test results should be assumed to be biased low. In the worse case, the adjusted results would be approximately two thirds higher than the reported values. Even with this adjustment, the concentrations are considerably lower than the NAAQS.

Carbon Monoxide and Mercury Vapor

Carbon monoxide and mercury vapor levels were monitored with direct-reading instruments at upwind and downwind sites on four days on-site. Instantaneous readings were taken at each sampling location once on Tuesday, Thursday, and Friday, and twice on Wednesday. Carbon monoxide and mercury were not detected in concentrations higher than background levels. No difference between upwind and downwind concentrations were found. The ambient CO and mercury sampling results at the Container Recycling Center and Paper Recycling Center are presented in Tables 6-8 and 6-9, respectively. All results were less than OSHA exposure limits.

Table 6-8
Hartford Ambient CO and Mercury Measurement Results for the Container Recycling Facility[a]

Location	CO Level (ppm)	Hg Level (mg/m^3)
Fence Line (North)	ND	ND
Fence Line (East)	ND	ND-0.003
Fence Line (Southeast)	ND	ND
Fence Line (South)	ND	ND
Fence Line (West)	ND	ND
Fence Line (Northwest)	ND	ND

[a]PELs for CO and Hg are 35 ppm and 0.05 mg/m^3, respectively.

Table 6-9
Hartford Ambient CO and Mercury Measurement Results for the Paper Recycling Facility[a]

Location	CO Level (ppm)	Hg Level (mg/m^3)
Fence Line (North)	ND	ND
Fence Line (East)	ND	ND-0.002
Fence Line (South)	ND	ND
Fence Line (West)	ND	ND
Ambient Air Station #4	ND	ND
Ambient Air Station #5	ND	ND
Ambient Air Station #6	ND	ND

[a]PELs for CO and Hg are 35 ppm and 0.05 mg/m^3, respectively.

Volatile Organic Compounds (VOC)

The VOC sampling was conducted on Day 2 at Sites 4, 5, and 6. The sampling results are summarized in Table 6-10. The target compounds were from the hazardous substance list (HSL) and featured scans for over thirty-five compounds. The analysis detected the presence of six VOCs: acetone, toluene, 1,1,1-trichloroethane (TCA), trichlorofluoromethane (F-11), and xylenes. None of the compounds (excluding acetone and toluene) were reported at concentrations of greater than 6.9 $\mu g/m^3$. Acetone and toluene were detected in all samples at concentrations ranging from 9.4 to 41 $\mu g/m^3$.

Table 6-10
Hartford VOC Sampling Results

Day	Compound	Detection Limit ($\mu g/m^3$)	Concentration ($\mu g/m^3$)			State Guideline ($\mu g/m^3$)
			Upwind	Downwind	Downwind	
2	Acetone	2.4	23.0	33.2	30.9	11,800
	Benzene	0.6	1.9	ND	2.2	150
	Toluene	0.8	9.4	41.4	10.9	7,500
	1,1,1-Trichloroethane	1.1	ND	ND	1.1	38,000
	Trichlorofluoromethane	1.1	ND	ND	ND	NA
	Xylenes	0.9	ND	6.9	ND	8,650

All compounds detected were considerably less than the 8-hour hazard limit values (HLVs) established by the Connecticut Department of Environmental Protection (CTDEP). A review of the data suggested a slight increase in VOC concentrations from upwind to downwind locations. The VOC data, as reported, can be considered representative of normal background levels in urban areas.

Wastewater

Very little wastewater is generated at this facility. The small amount generated is allowed to evaporate. Consistent with the revised protocol, no wastewater samples were collected at this facility during the test program.

Community Noise

Community noise levels were measured at the ambient air stations and at locations along the fence line of each facilities property. Instantaneous noise levels measured at ambient air station locations and fence line locations outside the two facilities ranged from 57 to 73 dBA. The highest instantaneous levels were found west of the RRT facility (72 dBA) and south of the CROC facility (73 dBA). The community noise levels measured at the Container Recycling and Paper Recycling Center are summarized in Tables 6-11 and 6-12, respectively.

Table 6-11
Hartford Community Noise Measurement Results for the Container Recycling Facility

Location	Instantaneous Noise Level (dBA)
Fence Line (North)	58.0-67.0
Fence Line (East)	60.0
Fence Line (Southeast)	64.0
Fence Line (South)	58-60
Fence Line (West)	65.0-72.0
Fence Line (Northwest)	65.0

Table 6-12
Hartford Community Noise Measurement Results for the Paper Recycling Facility

Location	Instantaneous Noise Level (dBA)
Fence Line (North)	57.0-58.0
Fence Line (East)	60.0-67.0
Fence Line (South)	65.0-73.0
Fence Line (West)	60.0-67.0
Ambient Air Station #4	58.0
Ambient Air Station #5	62.0
Ambient Air Station #6	65.0

6.2.3 Occupational Health and Safety

Personnel sampling was conducted to measure worker exposure to dust, silica, bacteria, fungi, and noise. Indoor sampling was also conducted to measure the CO and mercury concentrations and noise levels. The personnel and indoor sampling results are summarized below; the complete sampling results are presented in Appendix F.

<u>Dusts and Silica</u>

Worker exposures to total dust, respirable dust, and silica were monitored over the entire work shift (8 hours). Workers in the following job functions were sampled; Glass Sorter, Baler Operator, Box Belt Operator, Plastic Sorter, Fork Truck Operator, Paper Sorter, Maintenance, and Front End Loader Operator. The results are presented in Table 6-13. All sample results were less than the applicable PEL. The highest total dust and respirable dust concentrations were found on a worker sorting glass -- 1.03 and 0.30 mg/m^3, respectively. Sample results for respirable silica indicated less than detectable for all samples. The results obtained in this evaluation are similar to the results of a voluntary survey conducted at the container recycling facility by the State OSHA in January 1993. This earlier survey found respirable dust levels ranging from 0.07 to 0.26 mg/m^3, which compares favorably with the respirable dust results from this evaluation ranging from <0.12 to 0.30 mg/m^3. The State OSHA survey also sampled for respirable quartz, cristobalite, and tridymite, and found levels at or below the method detection limits. Again, this agrees with results for silica sampling obtained in this evaluation.

Table 6-13
Hartford Total Dust, Respirable Dust and Silica
Personnel Sampling Results[a]

Job Description	Concentration (mg/m^3)		
	Total Dust	Respirable Dust	Silica
Baler Operator (Mixed Recyclables)	0.3006	0.164	<0.0117
Box Belt Operator (Mixed Recyclables)	0.6694	<0.1208	<0.0121
Glass Sorter (Mixed Recyclables)	1.0319	0.3048	<0.0117
Plastics Sorter (Mixed Recyclables)	0.5921	<0.1230	<0.0123
Maintenance (Mixed Recyclables)	0.8094	0.2751	<0.0120
Paper Sorter (Paper Building)	0.4151	0.5358	<0.0131
Fork Truck Operator (Paper Building)	0.4376	<0.1312	<0.0131
Maintenance (Paper Building)	0.443	<0.1315	<0.0132

[a]PELs are 15.0, 5.0, and 0.1 mg/m^3 for total dust, respirable dust, and silica, respectively.

The Authority also obtained the services of a consultant to collect dust and silica samples at the discharge of the broken glass trommel at the container recycling facility. The area sampled was representative of a "worst case" situation, as if a worker were standing next to the trommel for a full shift. The total dust level of 6.8 mg/m^3 was significantly higher than any of the personal sampling results obtained in this evaluation of 0.99 mg/m^3. Regardless, the results obtained in the earlier study were well below the PEL. It should be noted no silica was detected in that earlier study.

All QA samples were within the specified range, except that the RPD for one total dust sample duplicate and one respirable dust sample duplicate that exceeded the QAPjP limit of 20 percent. These RPD values were 32 percent and 110 percent, respectively.

Carbon Monoxide and Mercury

Carbon monoxide and mercury measurements were taken with direct reading instruments at six locations throughout the Mixed Recyclables Facility and 3 locations inside the Paper Facility. The indoor CO and mercury sampling results at the Container Recycling Center and Paper Recycling Center are presented in Tables 6-14 and 6-15, respectively. Carbon monoxide levels did not exceed 5 ppm, with the highest level measured in the Maintenance Area of the Container Recycling Facility. These levels are well below the PEL of 35 ppm and the TLV of 25 ppm. Direct reading measurements for mercury did not show any levels above the typical instrument background and did not approach established exposure limits.

Table 6-14
Hartford Indoor CO and Mercury Measurement Results for the Container Recycling Facility

Location	CO Level (ppm)	Hg Level (mg/m^3)
Glass Sorting Line	ND-4	ND-0.002
Plastics Sorting Line	ND-3	ND
Box Belt Line	ND-2	ND
Baler Area	ND-3	ND
Tipping Floor	ND-3	ND
Maintenance Area	ND-5	ND

[a]PEL for CO and Hg are 33 ppm and 0.05 mg/m^3, respectively.

Table 6-15
Hartford Indoor CO and Mercury Measurement Results for the Paper Recycling Facility

Location	CO Level (ppm)	Hg Level (mg/m^3)
Tipping Floor	ND	ND
Paper Sorting Lines	ND	ND
Fork Truck Operator	ND	ND
Baler Control Room	ND	ND

[a]PEL for CO and Hg are 33 ppm and 0.05 mg/m^3, respectively.

Bacteria and Fungi

Airborne and surface samples were collected for bacteria and fungi at several locations inside the operations building. Airborne samples were also taken at the one upwind and two downwind locations on all three days. The airborne bacteria and fungi sampling results are presented in Table 6-16; the surface sampling results are then presented in Table 6-17.

Table 6-16
Hartford Airborne Fungi and Bacteria Results

Location	Sample (viable counts per cubic meter)		
	Fungi	Bacteria RT[a]	Bacteria 56[b]
Tipping Floor	1082-6926	3798->9376	82-292
Plastics Sorting Line	2916-7559	4304->9376	94-246
Paper Sorting Line	926-5751	1517-2602	47-94
Glass Sorting Line	2705-8004	4222->9416	82-777
Ambient Air Station #1	398	609	<12
Ambient Air Station #2	246	785	23
Ambient Air Station #3	305	1195	4688
Ambient Air Station #4	188-212	353-1000	23-24
Ambient Air Station #5	200-459	400-506	12-71
Ambient Air Station #6	259	1282	24

[a]Bacteria RT is incubated at room temperature.
[b]Bacteria 56 is incubated at 56 degrees F.

Table 6-17
Hartford Surface Fungi and Bacteria Results

Location	Sample (units per gauze wipe)	
	Fungi	Bacteria
Tipping Floor (Mixed Recyclables)	1900	5000
Plastics Sorting (Mixed Recyclables)	4500-4700	100-1600
Lunch Room (Mixed Recyclables)	800	4700
Glass Sorting (Mixed Recyclables)	300	5200
Paper Sorting (Paper Building)	1300-3300	100-800

The levels of airborne bacteria and fungi inside the facility were generally one order of magnitude higher than the levels outside the facility, the only exception being the thermophilic bacteria level on Day 1 at Site 3 (downwind). The thermophilic bacteria level was 4688 cfu, compared to the 23 cfu at the other downwind location and <12 cfu at the upwind location. The level at Site 3 was one to two orders of magnitude higher than any of the levels measured inside the facility and was likely caused by another source. For the remaining sample days, the downwind sample results were not higher than the upwind, which may indicate that the airborne bacteria and fungi present inside the building are not being released in measurable quantities. There are currently no regulatory limits for bacteria and fungi levels in ambient air.

All fungi detected were common environmental fungi. None of the fungi detected are considered highly virulent in nature. The two most commonly associated with infections that were detected are *Aspergillus fumigatus, Aspergillus niger* and *Aspergillus flavus*. These organisms are considered opportunistic pathogens, in that they are most likely to infect individuals with compromised immune systems. Healthy people are not likely to be infected with Aspergillus unless they are exposed to an unusually high dose. Infections due to *Aspergillus flavus* and *Aspergillus niger* are rare. *Aspergillus fumigatus* is the dominant cause of *aspergillosis*. However, it is possible that hypersensitive people, and people exposed to high levels of fungal spores, may develop hypersensitivity reactions, such as allergies, asthma and hypersensitivity pneumonitis. Little information is available describing the exposure levels required to initiate such reactions.

No highly virulent pathogenic bacterial were identified in any of the samples submitted. The most common bacteria detected were *Bacillus*, which are commonly found in environmental samples, and occur naturally in soil and water. *Curtobacterium*, *Agrobacterium,* and *Clavibacter* are common plant pathogens which is commonly recovered from air samples. *Arthrobacter* is a common environmental organism often associated with soil. *Corynebacterium* is commonly associated with the soil but may also be of human or animal origin. The species of *Acinetobacter, Flavobacterium, Aeromonas, Pseudomonas, Alcaligenes, and Xanthomonas* are common in water or wet environments. *Staphylococcus, Brevibacterium and Micrococcus* are associated with human and/or animal skin. Several enteric organisms were detected: *Cedecea, Klebsiella, Hafnia, and Serratia* are frequently found in soil and/or water environments.

Both airborne duplicate samples collected inside the building exceeded the QAPjP RPD limit of 20 percent. The analytical results of the wipe samples indicated that they contained several organisms that were similar to those organisms found in air. Therefore, it is plausible that the organisms detected in the air samples may have originated from some of the surface sources. The duplicate sample for bacteria collected outside the building exceeded the RPD limit of 20 percent. The RPD for thermophilic bacteria of 67 percent, also exceeding the RPD limit.

<u>Noise</u>

Worker noise exposures were determined over the work shift through the use of audiodosimeters. Workers in the following job functions were monitored: glass sorter, baler operator, box belt operator, plastic sorter, fork truck operator, paper sorter, maintenance worker, and front end loader operator. The personnel audiodosimeter results are summarized in Table 6-18. The average noise levels found on workers in the Container Recycling Center over the three days of sampling ranged from 83.4 to 95.5 , with the highest noise level found on the belt box operator. Noise levels on six of the seven workers monitored in this facility exceeded the PEL of 90 dBA. At this level, workers are required by OSHA to wear hearing protection. All workers monitored were wearing hearing protection. The average noise levels observed on workers in the Paper facility ranged from 81.4 to 86.1 dBA. One paper sorter and baler operator exceeded the OSHA Action Level of 85 dBA, which requires the implementation of a hearing conservation program.

Table 6-18
Hartford Audiodosimeter Results

Job Description	Average Noise Levels (dBA)
Glass Sorter (Mixed Recyclables)	94.3
Plastic Sorter (Mixed Recyclables)	90.0
Equipment Operator (Mixed Recyclables)	83.4
Box Belt Operator (Mixed Recyclables)	94.5
Box Belt Operator (Mixed Recyclables)	95.5
Equipment Operator (Paper Building)	89.0
Paper Sorter (Paper Building)	85.4
Maintenance (Mixed Recyclables)	93.6
Baler Operator (Paper Building)	86.1
Paper Sorter (Paper Building)	83.7
Equipment Operator (Paper Building)	81.4
Baler Operator (Mixed Recyclables)	91.0
Maintenance (Paper Building)	84.1

These results are similar to those obtained during a voluntary survey conducted by the State OSHA in January 1993. This survey found noise levels ranging from 85.1 to 99.2 dBA.

The State OSHA measured noise levels at the glass sorting line two to four times higher than measured during this evaluation. The noise levels measured at the box belt line during this evaluation, however, were three times higher than those determined during the State OSHA survey. Too few sample results are available to determine the significance of these differences. The position with the lowest exposure, the front end loader operator, had similar results in both studies.

Instantaneous measurements taken with a sound level meter found noise levels inside the RRT facility ranged from 85 to 106 dBA. The main sources of noise inside the container recycling facility were the box belt line and the tipping floor. Instantaneous noise levels in the vicinity of the box belt line ranged from 94 to 106 dBA; noise levels on the tipping floor ranged from 95 to 97 dBA, with peaks up to 105 dBA during dumping of materials. Instantaneous noise levels in the glass sorting area ranged from 93 to 102 dBA. The results are slightly lower than the those obtained during the survey conducted by the State OSHA, which found noise levels ranging from 94 to 110 dBA in the processing areas. Measurements taken with a sound level meter found noise levels inside the CROC Paper facility ranged from 73 to 92 dBA. The highest noise levels were found on the tipping floor and baler control room, and during fork truck operations. Noise levels on the tipping floor ranged from 80 to 90 dBA, with the highest levels being measured when the bobcat loader was in operation. The indoor noise measurements at the Container Recycling Center and Paper Recycling Center are summarized in Tables 6-19 and 6-20, respectively.

Table 6-19
Hartford Indoor Noise Measurement Results for the Mixed Container Recycling Facility

Location	Instantaneous Noise Level (dBA)
Glass Sorting Line	93.0-102.0
Plastics Sorting Line	89.0-93.0
Box Belt Line	94.0-106.0
Baler Area	85.0-100.0
Tipping Floor	85.0-105.0
Maintenance Area	90.0-94.0

Table 6-20
Hartford Indoor Noise Measurement Results for the Paper Recycling Facility

Location	Instantaneous Noise Levels (dBA)
Tipping Floor	75.0-90.0
Paper Sorting Lines	73.8-85.0
Fork Truck Operator	92.0
Baler Control Room	78.0-90.0

Health and Safety Programs

Health and Safety Program evaluation was limited to information provided by on-site personnel. The key findings from this evaluation are presented below.

RRT Container Recycling Center

- An Energy Control Program is in place at the facility, including training and a written program.
- Dust masks are the only form of respiratory protection used at the facility. Dust masks are not required, but are given to workers to wear at their discretion. Use of these respirators was reviewed during Hazard Communication Training, but no information or documentation of a respiratory protection program was available.
- A Hazard Communication Program is in effect at the facility. A copy of the written hazard communication plan and MSDS were available in the plant processing area and the plant manager's office. Documentation of training was on file.
- A Hearing Conservation Program has been implemented according to the manager, although documentation of training was not available. A copy of the OSHA noise standard has not been posted at the facility.
- There were no air contaminants identified as requiring OSHA specified control programs.
- A Bloodborne Pathogen Program has been implemented. This program includes a written program located in the plant manager's office, training, protective equipment, and vaccinations.

- Information on injuries and illnesses for 1993 were provided, but rates could not calculated because workforce statistics were not made available for this review.

CROC Paper Recycling Center

- An Energy Control Program is in place at the facility, including training and a written program. The facility uses "breakaway locks" on equipment that is in use, and uses lockout/tagout procedures when equipment is being serviced.

- Dust masks are the only respirators used at the facility, and are only used at the discretion of the workers. If required, a respirator program will be implemented at the facility.

- A Hazard Communication Program is in effect at the facility. A copy of the hazard communication program is located in the lunch area and documentation of training was located in employee folders.

- A Hearing Protection Program has been implemented at the facility; however, past noise surveys have not warranted the use of hearing protection. Hearing protection is available to workers but not required. Two noise surveys have been conducted since the plant opened in 1991.

- There were no air contaminants identified as requiring specified control programs.

- A Bloodborne Pathogen Program has not been implemented for line personnel because of management's understanding that line personnel are not exposed to bloodborne pathogens. However, foremen and managers are trained on the bloodborne pathogen standard because they are certified in first aid.

- Information on injury and illness rates was provided for 1991, 1992, and 1993 (see Table 6-21). Those rates, provided by the facility, are summarized below, with BLS estimates of occupational injury and illness incidence rates for 1991 for Sanitary Services and Private Sector Industries.

The facility did not provide specific information on the types of injuries or illnesses that have occurred.

Ergonomics

Picking booth operations were videotaped during the on-site facility assessment. These videotapes were reviewed to identify the general ergonomic conditions within these work areas. For the purpose of this assessment, the potential ergonomic risk factors identified can be defined as workplace conditions or work practices which may contribute to, or result in worker discomfort, fatigue, or injury.

Table 6-21
Injuries and Illnesses 1991, 1992 and 1993

Year	Sector	Recordable Cases	Lost Workday Cases	Lost Workdays
1991	All Industry	8.4	3.9	86.5
1991	Sanitary Services	15.3	7.9	163.5
1991	MRF	5.13	0	0
1992	MRF	5.13	0	0
1993	MRF	2.56	2.56	5.13

Three types of workstations were evaluated:

- Workstation 1. At this type of workstation, workers on one side of conveyor sorted glass by removing the glass from the conveyor and placing on one of two parallel conveyor lines. The workstation height was non-adjustable, but appeared appropriate for most workers. No knee clearance was provided by this workstation design. The workers had to lean forward repetitively in order to throw sorted glass to the second or third conveyor line. The potential ergonomic risk factors include: (1) no knee clearance was provided by workstation design; and (2) workstation width/design required workers to repetitively lean forward to access conveyors for sorting recyclables.

- Workstation 2. At this workstation, workers separated paper on both sides of a conveyor with bins between them for sorting. Again the workstation height was not adjustable and appeared to be too high for one or more of the workers in the area. No foot stools (platforms) were seen in this area to accommodate workers to the level of the workstation. Bin placement allowed sorting with minimal twisting to access. Work performed in this area requires very repetitive upper extremity tasks, possibly related to line speed and volume of recyclables. Repetitive motion was intermittently interrupted to clear line jams. The potential ergonomic risk factors are: (1) the fixed workstation (conveyor) height; (2) the lack of accommodation of shorter workers; (3) line speed and volume of recyclables; and (4) extensive repetitive motion of upper extremities required to complete sorting/picking tasks.

- Workstation 3. Plastics sorting was accomplished at this type of workstation by workers on one side of conveyor pushing plastics off the conveyor into a large bin (chute). The workstation height was non-adjustable, but appeared suitable to workers in this area. Two workers leaned across full depth of conveyor to push plastic into bin, resulting in repetitive, forceful leaning and pushing. The potential ergonomic risk factors are: (1) the workstation width (depth) and current work practice; and (2) pushing plastic recyclables into bin/chute using repetitive forceful motion.

SECTION 7

RICE COUNTY, MINNESOTA

7.1 Process Description

Rice County maintains and operates the Material Recovery Facility and County Landfill located in Dundas, Minnesota. The process description addresses the technical, economic, energy, and environmental aspects of the MRF and IMSWM system.

7.1.1 Integrated Solid Waste Management System

Rice County provides disposal services for MSW generated in the County. The components of the integrated solid waste management system serving Rice County, Minnesota include:

- Recycling Facility,
- Household Hazardous Waste Facility, and
- Rice County Landfill.

Figure 7-1 presents a flow diagram for the Rice County System, showing waste processed and residue generated by the system components.

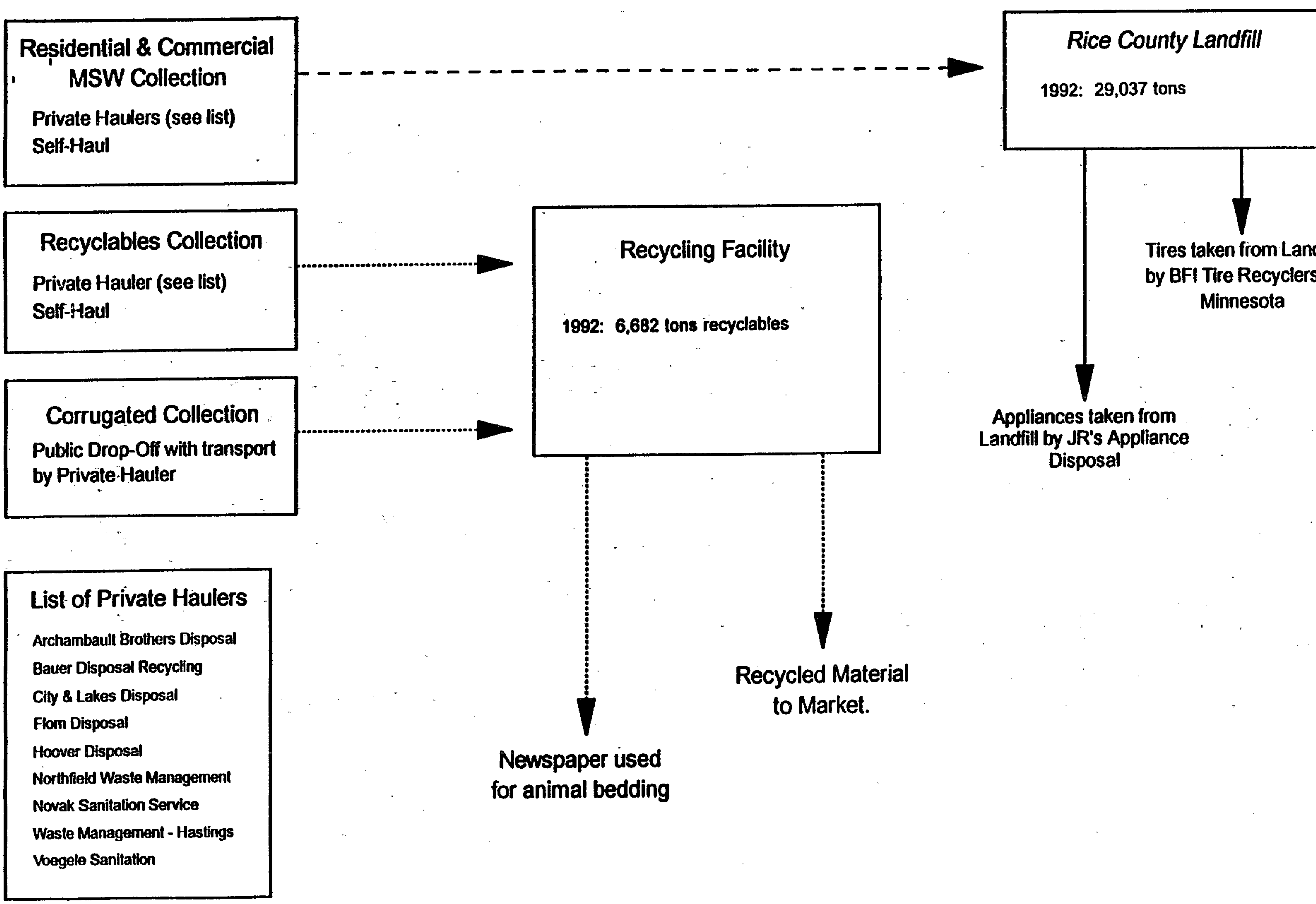
<u>**Waste Collection**</u>

Private haulers provide collection services for both urban and rural areas throughout the County. In urban areas, the municipalities contract with private haulers to collect both MSW and recyclables from residences and commercial establishments. Collection services are performed by private haulers contracted by individual homeowners in rural areas. In 1992, private haulers delivered 29,037 tons of MSW to the Rice County Landfill and 6,682 tons of recyclables to the Recycling Facility.

<u>**Recycling Facility**</u>

The Recycling Facility is located adjacent to the Rice County Landfill. The facility is owned and operated by the County. Residential recyclable material includes source-separated glass, plastic bottles, newspaper, and metal cans; commercial, industrial, and institutional recyclables consist primarily of corrugated cardboard and various grades of ledger paper. The source-separated recyclables are delivered by private haulers and deposited in designated areas within the recycling building. The containers are mechanically or manually sorted to separate tin and aluminum cans, PET and HDPE plastics, and color-sorted glass. Newsprint is chopped and baled into animal bedding used by local farmers. The corrugated cardboard and ledger paper are shipped directly to market. The facility processed 6,682 tons of recyclable material in 1992.

Figure 7-1
Rice County Solid Waste System



Household Hazardous Waste Facility

Household hazardous waste may be dropped off at a separate at the recycling center. The wastes are either given away to the citizens or shipped off-site for disposal. Approximately 17 tons of household hazardous waste was processed in 1992.

Rice County Landfill

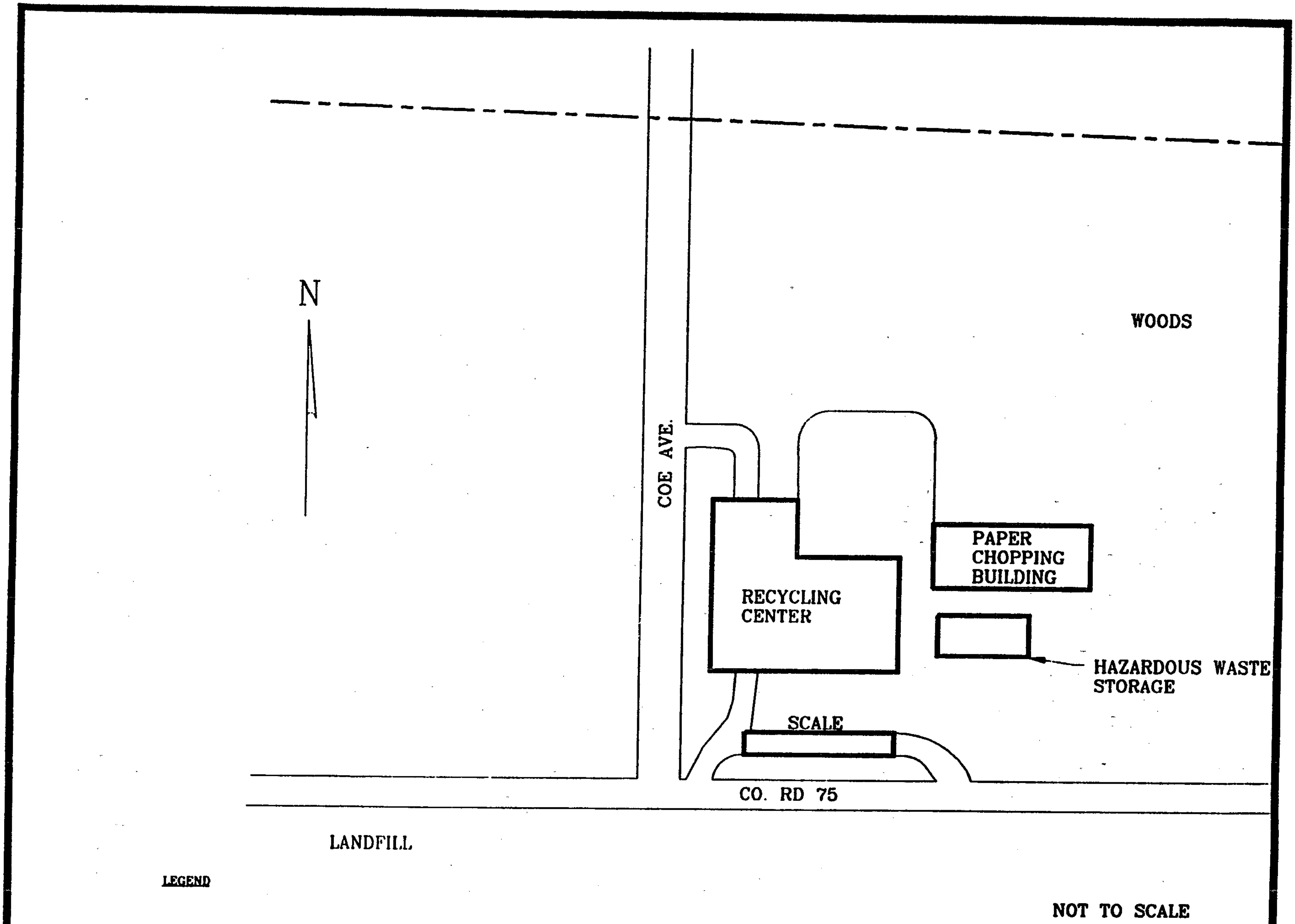
The Rice County Landfill has been in operation since 1975. The latest change in landfill operations occurred in 1992 with vertical expansion to increase the capacity and longevity of the landfill. Residential and commercial MSW is delivered to the landfill for disposal by private haulers serving both urban and rural areas in the County. In addition, citizens may drop off yard waste and scrap metal for a fee, while appliances and tires are accepted at no cost. The tires are removed from the landfill by BFI Recyclers of Minnesota, and appliances by JR's Appliance Disposal. In 1992, approximately 29,037 tons of MSW was delivered to the landfill by private haulers and self-haul.

7.1.2 Material Recovery Facility

The Recycling Facility, located adjacent to the County Landfill, is owned and operated by the County. The facility consists of three structures: the processing building, the paper chopper building, and the household hazardous waste center. The facility site plan is presented in Figure 7-2. Table 7-1 summarizes the material received and recovered at the facility in calendar year 1992.

Table 7-1
Material Received and Recovered in 1992

Material	Throughput (tons)	Percent of Total (%)
Mixed Recyclable	2,888	43.2
Cardboard	877	13.1
Paper	497	7.4
Glass	198	3.0
Metals	68	1.0
Plastic	3	<0.1
Newspapers	1,801	27.0
Rejects	350	5.2
Total	6,682	100.0



PLOT PLAN
RICE COUNTY RECYCLING CENTER
DUNDAS, MINNESOTA

FIGURE 7-2

The source-separated recyclable are delivered by private haulers and deposited in designated storage areas. The recyclable are source-separated into newsprint, high grade paper, corrugated cardboard, metal cans, plastics, and glass containers. The separated materials are then processed independently over the day. The ferrous and aluminum are fed via a hopper onto a conveyor. After removal of ferrous metal by a magnetic separator, sorters remove tramp material, negatively sorting the aluminum. The metal recyclables are temporarily stored in wagons. Plastic containers are also fed through a hopper onto a conveyor. The plastic is sorted into PET and HDPE, which is baled prior to shipment. Similarly, glass is sorted on a conveyor and stored in roll-off containers.

The newsprint, high grade paper, and cardboard are transferred by truck to the chopper building. The various paper grades are shredded in a chopper and the baled in this separate building. The shredded paper is provided free to local farmers for animal bedding.

The Recycling Center also includes a household hazardous waste center. Residents drop off household products that may be classified as hazardous waste. A chemist determines what material can be reused and offers them free to County residents. Other material is inventoried and deposited into drums for removal by a licensed hauler.

7.1.3 Economic, Energy and Environmental Issues

The economic, energy, and environmental impacts associated with the operation of the MRF and IMSWM system are addressed in this section. These impacts are based on publicly available information or material provided by the County.

Economic Implications

The IMSWM system is owned and operated by the Rice County Board of Commissioners (the Board). Reporting to the Board, the Department of Waste Management (Department) is responsible for the day-to-day operations of the IMSWM system. The IMSWM system is operated as a self-supporting governmental unit under an enterprise fund managed by the Board.

The data which was collected for this analysis was obtained from the Department. According to the Department, the costs and revenues were based on actual results for 1992 and included all solid waste which was handled by the Department.

In 1992, the total cost of waste collection, transport, processing, and disposal, material recovery and marketing, and administration was approximately $4.55 million. Approximately $3.7 million or 81 percent of costs were associated with collection. These collection costs included labor, transportation, equipment, and operational costs associated with the collection of all of the waste for which the Department is responsible. Approximately $460,000 or 10 percent of costs were associated with personal services. The remaining $250,000 was split between operations and maintenance, utilities, supplies, debt service, distribution, and other expenses.

The total cost of operating the MRF, including collecting, transporting, hauling, processing, and marketing recyclables, was approximately $2.7 million in 1992. Based on the Department's allocation of costs, approximately $2.2 million or 81.5 percent of costs were associated with collection. Approximately 10 percent of MRF costs were associated with personal services. The remaining 8.5 percent of MRF costs were associated with O&M, utilities, supplies, distribution, debt service, and waste transport. Table 7-2 shows costs for the IMSWM system and MRF.

Table 7-2
Estimated Costs for the Rice County IMSWM System

Cost Element	IMSWM System	MRF
Personal Services	$ 462,804	$ 286,104
O&M and Utilities	116,500	55,800
Supplies	22,310	15,710
Debt Service/Depreciation/Interest	82,000	82,000
Other	31,224	31,224
Collection Costs	3,711,000	2,211,000
Distribution Costs	120,000	50,000
Total Cost	$4,545,838	$2,731,838

Based on the allocation of costs provided by the Department, the operating costs of the MRF represent approximately 60.1 percent of total IMSWM system operating costs. It is important to note that in the areas of collection and personal services (the two largest expense categories) the MRF accounts for 60 percent of total IMSWM system cost.

The amount of total revenues received by the IMSWM system was approximately $2.12 million in 1992. Approximately $1.5 million or 69 percent of revenues was associated with tipping fees. Approximately $405,000 or 19 percent was associated with general tipping fees. The remaining $200,000 was generated through the sale of recyclables.

Based on an allocation performed by the Authority, the amount of total revenues from MRF was approximately $655,000 in 1992. These revenues were earned through assessments, the sale of recyclables, and revenue from landfill operations. Table 7-3 summarizes revenues for the IMSWM system and MRF.

Table 7-3
Estimated Revenues for the Rice County IMSWM System

Revenue Element	IMSWM System	MRF
Tipping Fees	$1,515,740	$ 0
Assessments	405,000	405,000
Revenue from Landfill Operations	0	0
Sale of Recyclables/Compost	200,000	200,000
Total Revenues	$2,120,740	$ 655,000
Net Income (Deficit)	($2,425,098)	($2,076,838)

For clarification, the definition of selected revenue sources is as follows:

- *Assessments:* Annual fees which were charged to County residents for collection of recyclables.

- *Revenue from Landfill Operations:* Revenue which was transferred from tipping fees received by the landfill to partially offset MRF costs.

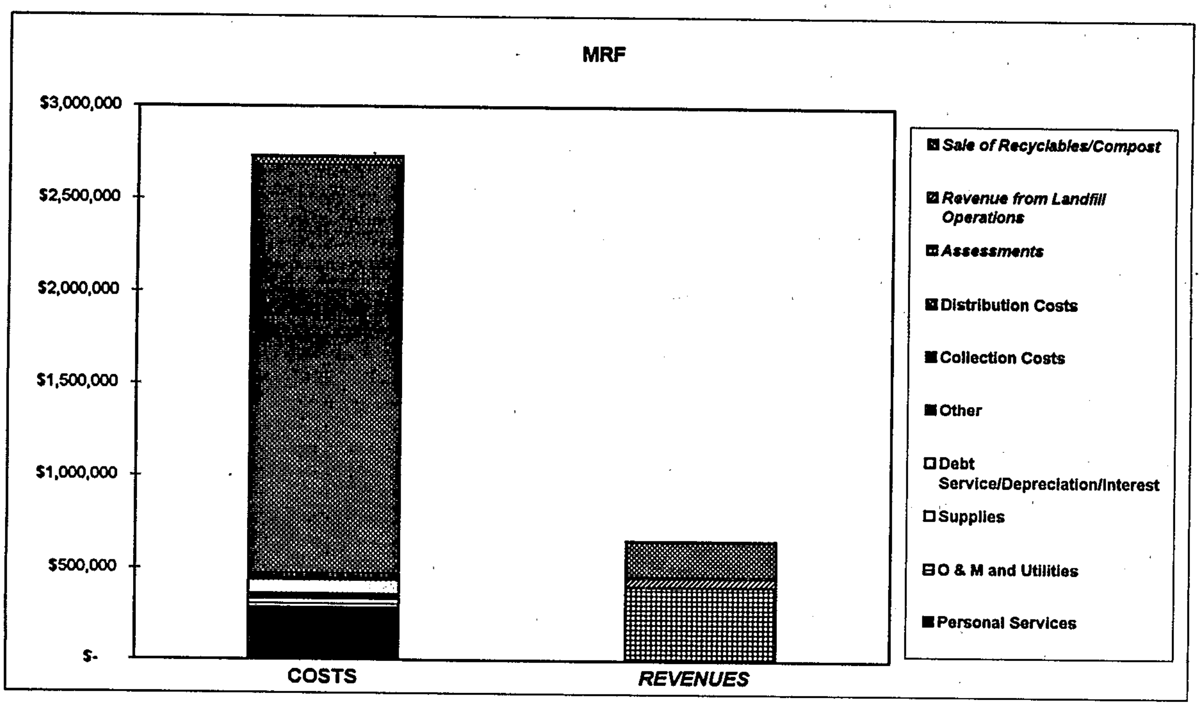
Based on the allocation of costs provided by the Department, the operating revenues of the MRF represent approximately 31 percent of total IMSWM system operating revenues. This is significantly less than the percentage contribution of the MRF to IMSWM system costs. These operating revenues recover approximately 24 percent of MRF costs.

The total costs and revenues for the IMSWM system and MRF are shown in Figure 7-3. Based on the analysis of operating expenses and revenues for 1992 and allocations provided by the Department, it appears that the MRF provided a net cost to the IMSWM system in the amount of approximately $2,077,000 or 46 percent of total operating expenditures.

Energy Consumption

An estimated 16 billion Btu of energy was consumed to collect, transfer, haul, process and transport to market about 35,736 tons of MSW, household hazardous waste, and recyclables. Of the 16 billion Btu consumed, approximately 59 percent was used to manage 29,037 tons of MSW, 0.42 percent was used to manage 17 tons of household hazardous waste, and 41 percent was used to manage 6,682 tons of recyclables. Approximately 0.46 MMBtu of energy were consumed for each of the 35,736 tons of waste managed, with 0.33, 4.07, and 1.0 MMBtu were consumed for each of the 29,037 tons of MSW, 17 tons of household hazardous waste, and 6,682 tons of recyclables, respectively.

Figure 7-3.
TOTAL COSTS AND REVENUES FOR THE RICE COUNTY ISWMS



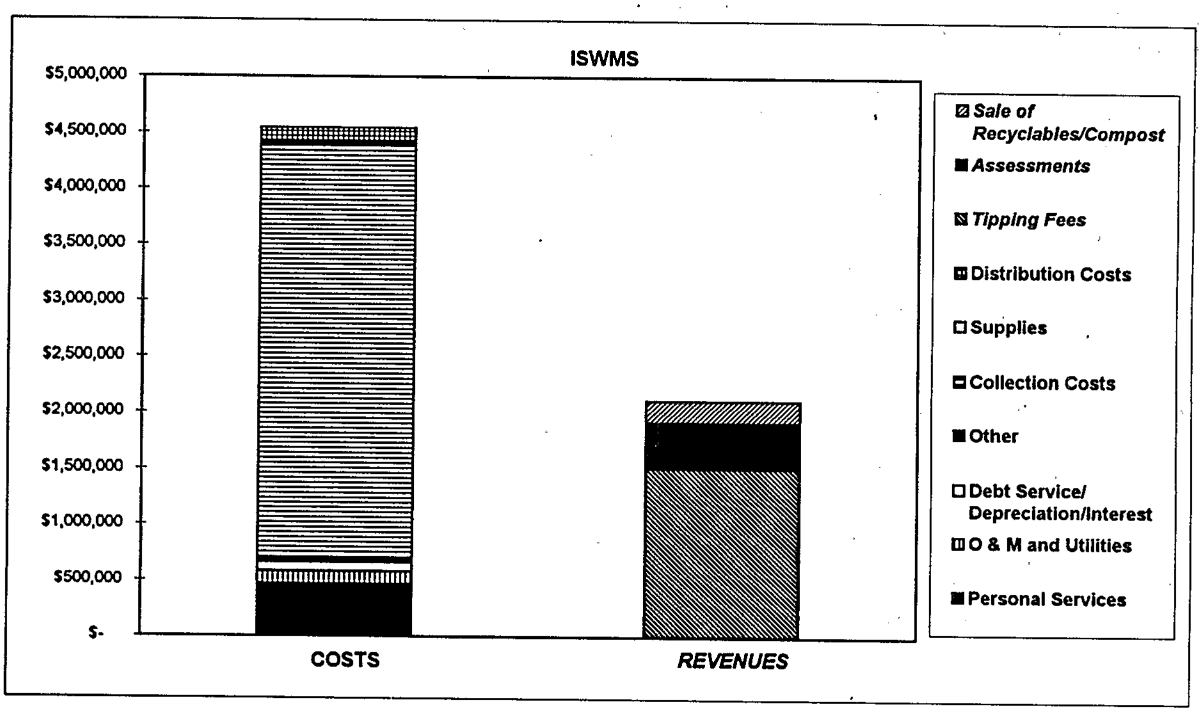


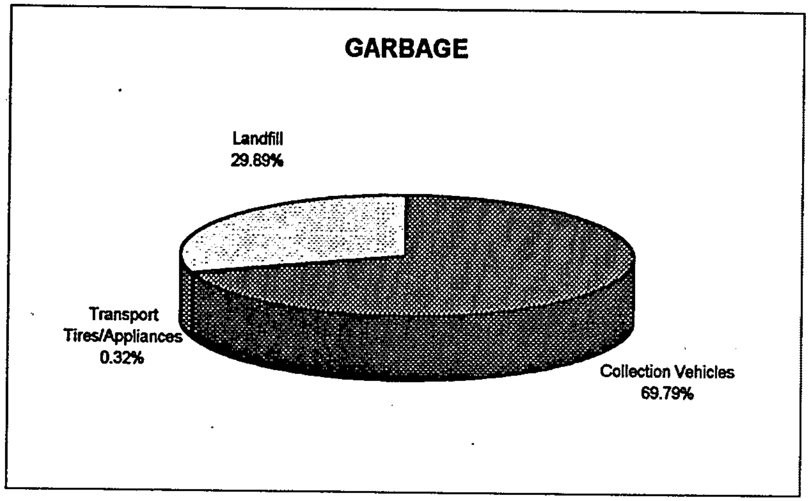
Table 7-4 summarizes the energy consumed by function. For the entire IMSWM system, almost 68 percent of the energy consumed was for transportation, that is, waste collection, transfer and haul, transporting recyclables to market, and hauling residue to the landfill. About 70 and 65.3 percent of the energy consumed was for the transportation of MSW and recyclables, respectively. Collection data was not available for household hazardous waste as the facility is maintained as a drop-off center. Figure 7-4 shows the energy consumption for both the IMSWM system and MRF.

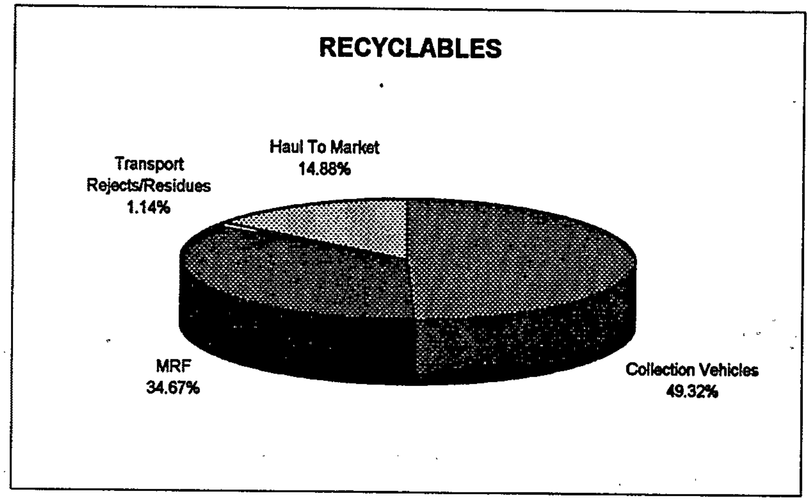
Table 7-4
Energy Consumption for the Rice County IMSWM System
(MMBtu)

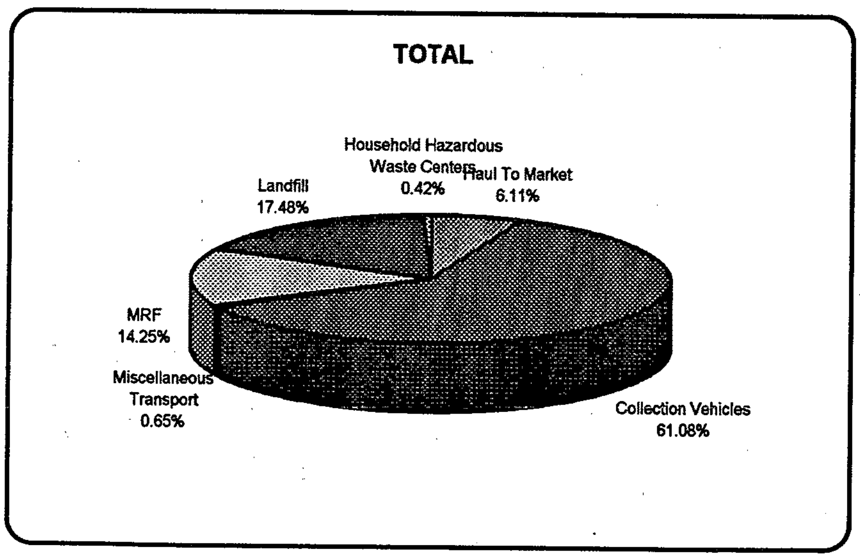
Activity	Garbage	Household Hazardous Waste	Curbside Recycling	Total
Collection Vehicles	6,644		3,299	9,943
MRF - Paper Chopping Facility			280	280
MRF - Processing Building			2,039	2,039
Subtotal			2,319	2,319
Household Hazardous Waste Center		69		69
Transport Rejects/Residue			76	76
Transport Tires/Appliances from Landfill	30			30
Landfill	2,846			2,846
Subtotal	9,520	69	5,694	15,283
Haul to Market			6,513	6,513
Total Energy Consumption (MMBtu)	9,520	69	6,689	16,278
Tons Collected/Tires & Appliances	29,037	17	6,682	35,736
Average Energy Consumption (MMBtu/ton)	0.33	4.07	1.00	0.46

Except as discussed below, the energy consumption information reported in this section was obtained from data provided by Rice County. The energy consumed to haul recovered materials to market was estimated by multiplying the estimated ton-miles hauled by 0.024 gallons per ton-mile, i.e., the approximate fuel consumed by the MSW transfer vehicles used in Hartford, Connecticut; Palm Beach County, Florida; and Minneapolis, Minnesota.

Figure 7-4.
ENERGY CONSUMPTION FOR THE RICE COUNTY ISWM SYSTEM
(Millions of British Thermal Units)







Environmental Regulations

The County landfill has been in operation since 1975 and thus was grandfathered under the regulations of the Minnesota Pollution Control Agency (MPCA). The most recent change in landfill operations was the vertical expansion of the existing landfill. This expansion was intended to prolong the useful life of the landfill and allowed for covering the landfill with a more impermeable layer to prevent water from control leaching through the existing landfill cells to subsurface water. The MPCA must approve the leachate control system and future landfill expansion.

For the MRF, construction and operation required only a Conditional Use Permit issued by the County. Pursuant to MPCA Solid Waste Management Regulations (Parts 7035.2845), the DWM submitted a letter of notification to the agency prior to starting operations at the MRF. The MRF also had to comply with design, operations, contingency plans, and closure requirements specified in the MPCA regulations.

7.2 Field Test Results

The field test program at the Rice County facility was conducted between November 16 and 18, 1993. The Rice County MRF is the smallest of the six facilities included in the evaluation. The field test procedures and results are discussed in detail in this section.

7.2.1 Test Procedures

In Rice County, the material is source-separated prior to being delivered to the facility. At the facility, the material is dumped into the appropriate storage area recycling building. Unlike the other facilities, the sorting line workers do not remove the material from commingled recyclables on a conveyor, but rather remove non-recyclables and sort the remaining recyclables in the source-separated material. The sorted recyclables are crushed and baled for delivery to market. Unique to this facility is that newsprint is first shredded in a paper chopper and then baled in a separate building.

There are approximately 10 to 12 full time employees at the facility. Two to three times a week, a group of mentally disabled adults assist with sorting activities. The facility is operated from 7:30 am. to 4:00 pm. The workers are given one half hour for lunch, two fifteen minute breaks during the day.

The field test program was conducted in accordance with the approved test protocol in the QAPjP and site-specific SAP. The following deviations from the field protocol and the QAPjP are discussed below:

- The BOD analysis could not be performed by the laboratory because of the large amount of oil present in the samples.

- The TSP and PM-10 samples were analyzed by Coast to Coast Analytical Laboratories, rather than by WESTON.

- One VOC sampler did not have an accurate vacuum reading after running overnight.

- Four to five hours of run time were lost on a set of TSP and PM-10 samplers when the timer switch inadvertently shut the samplers down early.

- The meteorological station did not collect data for a short period on the first sample day, and the temperature recorder did not operate throughout the study.

- Personnel noise monitoring on the paper chopper operator was limited to approximately 4 hours, because the operator was replaced.

- The oil and grease analysis of the wastewater sample could not be completed using the standard Freon extraction method due to the gelatinous nature of the sample. The sample was prepared using a Soxhlet distillation extraction procedure.

- Only one set of replicate respirable dust and silica samples was collected, because the second duplicate was voided due to damaged sampling equipment.

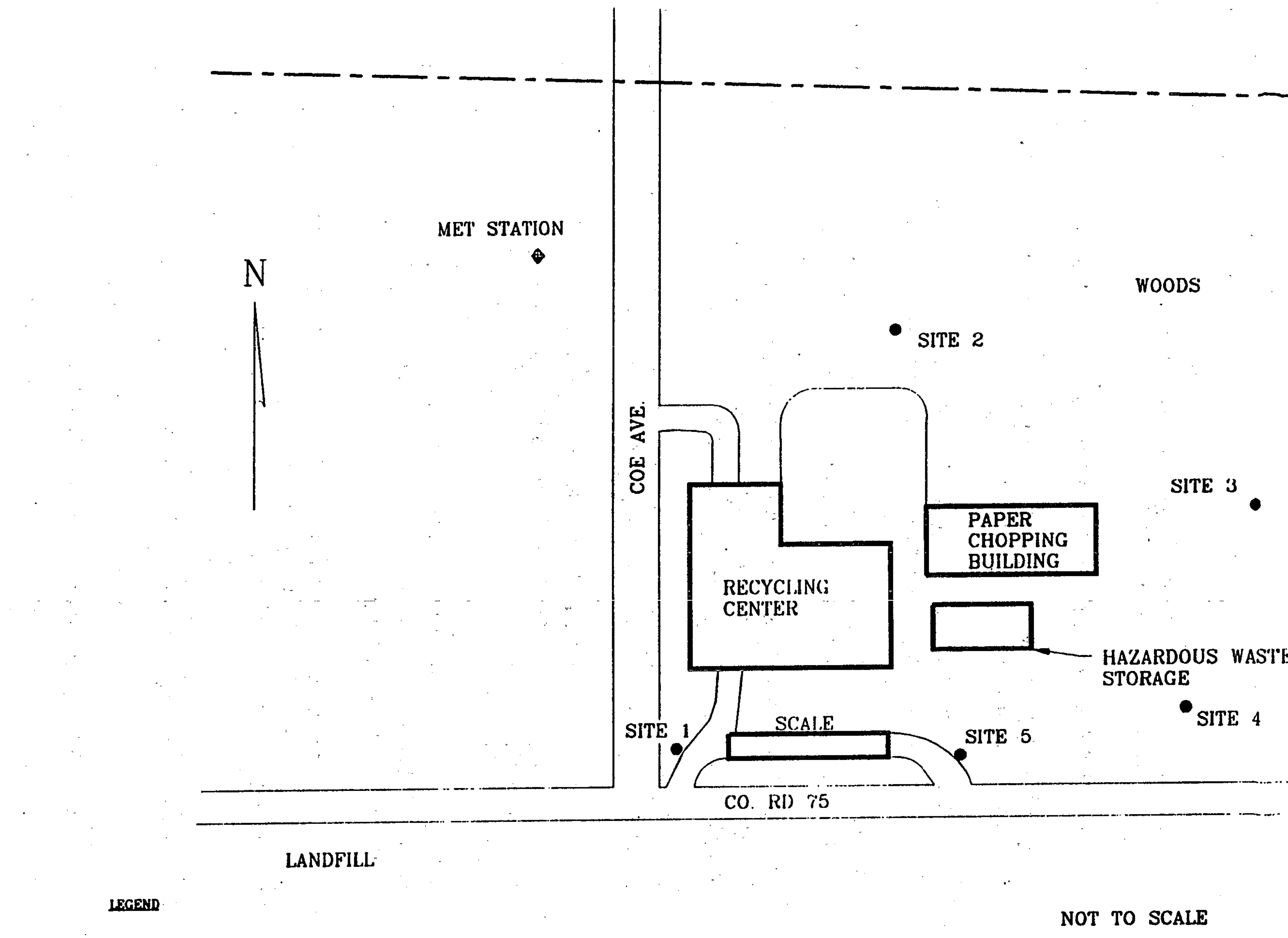
- No airborne bacteria samples were collected at the glass sorting station on Day 1, because operations were shut down before samples could be collected. To make up for this sample, two sets of samples were collected in the glass sorting station at different times on Day 2.

- The relative percent difference (RPD) for one set of replicate total dust samples exceeded 20 percent. The RPDs for the set of replicate respirable dust samples and replicate lead samples exceeded 20 percent.

Table 7-5 summarizes upwind/downwind location of the air sampling equipment in relation to the facility for each of the three days of monitoring. Figure 7-5 shows the location of the ambient sampling sites at the Rice County MRF.

Table 7-5
Sampling Locations at the Rice County MRF

Sample Day	Locations	
	Upwind	Downwind
1	1	2,3
2	2	4,5
3	5	2



AMBIENT SAMPLING LOCATIONS
RICE COUNTY RECYCLING CENTER
DUNDAS, MINNESOTA

FIGURE 7-5

Provided below is a brief discussion of each sample location and any limitations that should be considered in the evaluation of the reported data.

- Site 1. This site was located southwest of the facility. On Day 1, this site was located upwind of the facility and was suspected of being influenced by truck traffic on a nearby dirt road. Due to shifting wind conditions, the TSP and PM10 samplers from this location were moved to Site 5 at the conclusion of testing. No further samples were collected from this location after Day 1.

- Site 2. This site was located north of the facility. Samplers were located at this site for all three sample events and were downwind on Days 1 and 3 and upwind on Day 2. The site was considered to be a representative location. The site was the only downwind site on Day 3 and included TSP and PM_{10} duplicate samplers.

- Site 3. This downwind site was located east-northeast of the facility. Due to shifting wind conditions, the TSP and PM_{10} samplers from this location were moved to Site 4 at the conclusion of Day 1 testing. After Day 1, no further TSP and PM_{10} samples were collected from this location. On Day 3, VOC samples were collected at this location downwind of the facility.

- Site 4. This site was located southeast of the facility. This site was downwind of the facility for Day 2 and considered to be a representative location. For Day 3, the TSP and PM10 samplers were relocated to Site 2 and used to obtain duplicate samples. No further samples were collected from this location after Day 2.

- Site 5. This site was located southeast of the facility and was observed to be influenced by truck traffic in the vicinity. This site was located downwind on Day 2 and upwind on Day 3.

7.2.2 Environment and the Public Health

Ambient sampling was conducted at the Rice County facility for TSP, PM10, lead, CO, mercury vapor, and VOC. Measurements were also made for wastewater quality and community noise. The windrose data for each of the sampling days are provided in Appendix B. The ambient sampling results are summarized below; the detailed results are presented in Appendix G.

Total Suspended Particulate, PM10 and Lead

The TSP, PM10, and lead data are summarized in Table 7-6. The PM10 and lead levels were well below all applicable NAAQS for all runs. The PM10 and lead standards are 150 and 1.5 $\mu g/m^3$, respectively. There is no stated standard for TSP. There were periods when no meteorological data was collected possibly due to moisture in meteorological station. Wind speeds for Days 2 and 3 were approximately twice the speeds measured on Day 1.

Table 7-6
Rice County TSP, PM10 and Lead Sampling Results[a]

Day	Compound	Concentration ($\mu g/m^3$)		
		Upwind	Downwind	Downwind
1	TSP	30.19	17.92	18.50
	PM10	11.02	12.68	15.24
	Lead	0.003	0.003	0.001
2	TSP	9.66	16.47	27.17
	PM10	15.76	28.78	89.84
	Lead	0.002	0.002	0.003
3	TSP	99.75	49.69	-
	PM10	20.96	18.48	-
	Lead	0.007	0.004	-

[a]PM10 and lead standards are 150 and 1.5 $\mu g/m^3$, respectively.

For Day 1, the upwind location was noted as being possibly biased by vehicular traffic on the dirt road adjacent to the samplers. A review of the results reveals that the upwind TSP concentration is approximately one-third higher than the two downwind locations, while the upwind PM_{10} concentration is lower than the downwind locations. It is possible that dust generated from the dirt road was greater than 10 microns and thus would not affect the upwind PM_{10} results. The two downwind PM_0 concentrations were approximately 14 and 37 percent higher. At the downwind locations, the PM_{10} contribution to the total particulate was 54 and 64 percent. There was negligible difference in lead concentrations.

On Day 2, the downwind TSP concentrations were 62 and 465 percent higher than that measured upwind at Sites 4 and 5, respectively. The PM_{10} concentrations were 74 and 179 percent higher than those at Site 4 and 5, respectively. For Day 2, the TSP and PM_{10} levels at Site 2 and 4 were 7 and 21 percent higher than those at the downwind locations on Day 1, respectively.

On Day 3, the TSP and PM_{10} concentrations measured at the upwind location (Site 5) were 100 and 47 percent higher than those at the downwind location, respectively. For Days 2 and 3, the data indicates that Site 5 results may be biased high due to the truck traffic on a nearby dirt road and high wind speeds.

The lead duplicate RPD was 29 percent, which exceeded the criteria of ±20 percent. Since the lead results were at or near the detection limit, there should be little impact on the results. The lead spike and spike duplicate analyses recoveries were both 90 percent. The lead matrix spike and matrix spike duplicate analyses were both 72 percent. Although the spikes met the laboratory criteria, the test results should be assumed to be biased low. In the worse case, the adjusted results would be approximately 1/3 higher than the reported values. Even with this adjustment the concentrations are considerably lower than the NAAQS.

Carbon Monoxide and Mercury Vapor

Carbon monoxide and mercury vapor levels were monitored with direct-reading instruments at upwind and downwind sites, as well as at the fence line boundaries. The readings were taken once in the morning and once in the afternoon on each of the three sampling days. Carbon monoxide and mercury were not detected at any of the sites.

Volatile Organic Compounds

The VOC data collected on Day 2 are summarized in Table 7-7. The target compounds were from the hazardous substance list and featured scans for over thirty-five compounds and detected the presence of three VOCs. Acetone and toluene were detected in all samples ranging from 1.5 to 40 $\mu g/m^3$. Benzene was detected in one sample (downwind) at a concentration that was close to the detection limit and, therefore, should not be considered native to the source. The Minnesota Pollution Control Agency (MPCA) has not established air quality standards or guidelines for these pollutants. A review of the data demonstrated no significant difference between upwind and downwind concentrations of VOCs, with the possible exception of toluene. The VOC data, as reported, can be considered representative of normal background levels in rural areas.

Table 7-7
Rice County VOC Sampling Results

Date	Compound	Detection Limit ($\mu g/m^3$)	Concentration ($\mu g/m^3$)			State Guideline ($\mu g/m^3$)
			Upwind	Downwind	Downwind	
1	Acetone	2.4	21.4	7.1	9.5	NA
	Benzene	0.6	ND	1.0	ND	NA
	Toluene	0.8	1.5	21.1	10.2	NA

The trichlorofluoromethane (F11) recovery was 121 percent, which did not meet criteria of ±15 percent. F11 was not detected in any of the field samples and, therefore, did not affect the results. EPA Method TO-14 does not state specific acceptance ranges for surrogate and spike recoveries. Coast-to-Coast Analytical Service, however, uses ±70 to 130 percent as an acceptance criteria based on guidance from EPA Region V.

Wastewater

Wastewater samples were collected on Day 1 from a storage tank located beneath the floor at the back of the facility. The wastewater sampling results are summarized in Table 7-8. Drains on the processing floor emptied to this storage. Sources contributing to the tank include wash

Table 7-8
Rice County Wastewater Analysis Results[a]

Analyte	Units	Primary Sample	Duplicate Sample	Blank Sample
Chemical Oxygen Demand	mg/l	10,100	10,100	<5.0
Ammonia, as Nitrogen	mg/l	10.0	7.8	<0.10
Total Organic Nitrogen	mg/l	114	57.6	<0.10
Total Organic Carbon	mg/l	1,450,000	877,000	<0.50
Oil and Grease	mg/l	-	-	-
Phosphate, as P-Total	mg/l	6.5	9.0	0.090
Specific Conductance	umhos/cm	1.9	9.1	1.3
Total Dissolved Solids	mg/l	1,730	1,480	<5.0
Total Suspended Solids	mg/l	90,700	28,400	<5.0
BOD, 5-day	mg/l	N/A[b]	N/A[b]	2
Silver, Total	μg/l	16.4	12.8	<10.0
Arsenic, Total	μg/l	14.6	15.7	<10.0
Barium, Total	μg/l	1,040	967	<200
Cadmium, Total	μg/l	44.6	40.4	<5.0
Chromium, Total	μg/l	131	108	<10.0
Mercury, Total	μg/l	<0.20	<0.20	<0.20
Lead, Total	μg/l	42,800	84,400	<3.0
Selenium, Total	μg/l	<5.0	<5.0	<5.0
Total Coliform	mpn/100 ml	>1,600	>1,600	<1
Fecal Coliform	mpn/100 ml	300	300	<1

[a]Samples collected from wastewater sump on 11/16/93.
[b]Laboratory could not analyze because samples contained oil.

water from vehicles and equipment, fluids released during vehicle or equipment maintenance, and liquids released from the balers during the crushing of aluminum, plastic, and tin. Minor spillage was observed from the plastic oil container draining system. The oil draining system is a PVC pipe with holes drilled in the top to accept empty oil containers submitted for recycling. The tank had not been drained since the facility opened. If required, the County will contract a licensed hauler to dispose of the waste.

The contents of the tank had a layer of oil floating on top that was approximately 4 to 5 inches thick. This impacted the quality of the data presented in Table 7-8. The metals analysis found a lead concentration of 42.8 mg/l and 84.4 mg/l. These both exceed the RCRA limit of 5 mg/l. A potential source of lead in this wasteewater could have been used motor oil, leaded gasoline, and lead solder on tin cans processed in the baler. The remaining RCRA metals were below EPA limits.

Community Noise

Instantaneous noise levels were measured at locations inside the facilities, at the ambient air stations, and at locations along the fence line of the facility property. The community noise levels are summarized in Table 7-9. The instantaneous noise levels measured at ambient air station locations and fence line locations outside the facility ranged from 48 to 66 dBA. The MRF is located in a remote farming area and is unlikely to cause any noise impact on residences or the community.

Table 7-9
Rice County Community Noise Measurement Results

Location	Instantaneous Noise Level (dBA)
Fence Line (North)	51.0
Fence Line (East)	50.0-58.0
Fence Line (South)	52.0-58.0
Fence Line (West)	52.0-58.0
Ambient Air Station #1	55.0
Ambient Air Station #2	48.0-66.0
Ambient Air Station #3	53.0-55.0
Ambient Air Station #4	50.0-52.0
Ambient Air Station #5	57.0

7.2.3 Occupational Health and Safety

Personnel samples were collected for total dust, respirable dust, silica, and noise exposure. Indoor sampling was conducted for CO, mercury vapor, and noise levels. Airborne and surface samples were also collected for bacteria and fungi. The sampling results are summarized below; the detailed results are presented in Appendix G.

Dusts and Silica

Worker exposures to total dust, respirable dust, and silica were monitored over the entire work shift (8 hours). The sampling results are summarized in Table 7-10. The workers sampled included the paper chopper operator, Economy Baler operator, tipping floor attendant, light equipment operator, and hazardous waste coordinator. All sample results were less than the applicable PELs or TLVs. The highest total dust and respirable dust concentrations were found on the worker operating the paper chopper -- 2.50 and 0.36 mg/m^3, respectively. Sample results for respirable silica were less than the detectable levels for all samples.

Table 7-10
Rice County Total Dust, Respirable Dust and Silica Personnel Sampling Results[a]

Job Description	Concentration (mg/m^3)		
	Total Dust	Respirable Dust	Silica
Paper Chopper Operator	2.5036	0.3618	<0.0120
Economy Baler Operator	0.387	0.2372	<0.0119
Tipping Floor Attendant	0.2978	0.1276	<0.0116
Light Equipment Operator	0.3178	0.2064	<0.0121
Hazardous Waste Coordinator	0.1264	0.1328	<0.0133

[a]PELs are 15.0, 5.0, and 0.1 mg/m^3 for total dust, respirable dust, and silica, respectively.

The duplicate analyses for respirable dust and total dust found one respirable dust sample with an RPD of 22 percent and a total dust sample with an RPD of 42 percent. Both exceeded the QAPjP limit of $\pm$20 percent. The consideration of this variation does not change the conclusion that all results are less than the applicable PEL.

Carbon Monoxide and Mercury

Instantaneous CO and mercury vapor measurements were taken with direct reading instruments at the sorting lines, tipping floor, and cardboard baler in the processing building, and in the paper chopping building and hazardous waste building. The results are presented in Table 7-11. Carbon monoxide levels ranged from zero to 6 ppm, with the highest level measured on the main processing floor when the foreman was operating a fork truck. These levels are well below the PEL of 35 ppm and the TLV of 25 ppm. Direct reading measurements for mercury did not show any levels above the typical instrument background and did not approach established exposure limits.

Table 7-11
Rice County Indoor CO and Mercury Measurement Results

Location	CO Level (ppm)	Hg Level (mg/m^3)
Sorting Lines	ND-3	ND-0.005
Tipping Floor	ND-4	ND-0.002
Paper Chopper Building	ND	ND-0.002
Worker Foreman	ND-6	ND
Cardboard Baler	ND-4	ND-0.002
Main Floor	ND	ND
Light Equipment Operator	ND	ND
Can Compactor	ND	ND
Economy Baler	2	ND
Hazardous Materials Building	ND	ND-0.002

[a]PELs for CO and Hg are 35 ppm and 0.05 mg/m^3, respectively.

Bacteria and Fungi

Airborne bacteria and fungi concentrations were determined at several locations inside the facility. Samples were collected on each of the three sampling days at the tipping floor, sorting lines, and paper chopper. Airborne bacteria and fungi levels were also measured outside at the one upwind and two downwind locations on the first two days, and one upwind and one downwind on the third day. As shown in Table 7-12, the bacteria and fungi levels inside the facility were one to two orders of magnitude higher than the levels outside the facility. Day-to-day variability in fungi and environmental bacteria levels was evident.

The paper chopping operation showed lower fungi and environmental bacteria levels than the main processing area. This is most likely due to the presence of only newspaper in the chopping area, with no food containers or other containers providing a medium for microbial growth. Of the downwind samples, only Site 5 on the second day of sampling had a significantly higher (two times) level of fungi than the upwind location. The environmental bacteria showed higher levels upwind than downwind, which indicates the possible presence of a source other than the MRF. The thermophilic bacteria levels were relatively consistent from day to day and site to site indicating that the MRF is not likely to be contributing to ambient levels.

Table 7-12
Rice County Airborne Fungi and Bacteria Results

Location	Sample (viable counts per cubic meter)		
	Fungi	Bacteria RT*	Bacteria 56**
Tipping Floor	796->5661	507-1329	11-23
Sorting Lines	1764->9168	623-1637	<11-58
Paper Chopper	92-848	150-2693	<11-298
Ambient Air Station #1	323	415	<11
Ambient Air Station #2	92-665	81-550	<11-34
Ambient Air Station #3	357	81	<11
Ambient Air Station #4	35	150	<11
Ambient Air Station #5	207-458	207-1364	<11

[a]Bacteria RT is incubated at room temperature.
[b]Bacteria 56 is incubated at 56 degrees F.

Surface samples were collected from surfaces inside the MRF. Table 7-13 summarizes the surface bacteria and fungi samples inside the facility. These results indicated that they contained several organisms that were found in air.

Table 7-13
Rice County Surface Fungi and Bacteria Results

Location	Sample (units per gauze wipe)	
	Fungi	Bacteria
Tipping Floor	2600	400
Plastics Sorting Line	2600-56000	53000->70000
Economy Baler	10000	8000
Paper Chopper	2800	1200
Hazardous Materials Building	16000	4000

All fungi detected were common environmental fungi. None of the fungi detected are considered highly virulent in nature. The most commonly associated with infections that were detected is *Aspergillus niger*. This organism is considered opportunistic pathogens and is most likely to infect individuals with compromised immune systems. Healthy people are not likely to be infected with *Aspergillus* unless they are exposed to an unusually high dose. Infections due to Aspergillus niger are rare. It is possible that hypersensitive people, and people exposed to high levels of fungal spores, may develop hypersensitivity reactions, such as allergies, asthma and hypersensitivity pneumonitis. Little information is available describing the exposure levels required to initiate such reactions.

No highly virulent pathogenic bacterial were identified in any of the samples submitted. Many of the bacteria detected were various species of *Bacillus*. These bacteria are commonly found in environmental samples, and occur naturally in soil and water. *Curtobacterium* and *Agrobacterium* are common plant pathogens which is commonly recovered from air samples. *Arthrobacter* is a common environmental organism often associated with soil. *Corynebacterium* is commonly associated with the soil but may also be of human or animal origin. The species of *Flavobacterium, Pseudomonas, and Alcaligenes* are common in water or wet environments. *Aureobacterium* is commonly found in soil and dairy products. *Staphylococcus, Brevibacterium, and Micrococcus* are naturally associated with human and/or animal skin. *Genera* from the family of *Enterobacteriaceae* are frequently found in soil and/or water environments.

A duplicate sample taken at Ambient Air Station #2 found RPD values for environmental bacteria and thermophilic bacteria of 34 and 39 percent, respectively. Both are in excess of the QAPjP limit of $\pm$20 percent. This information does not affect the interpretation of the results.

Noise Exposure

Worker noise exposures were determined over the work shift through the use of audiodosimeters. The audiodosimeter results are presented in Table 7-14. Workers monitored included the paper chopper operator, foreman, sorting line worker, Economy Baler operator, tipping floor attendant, light equipment operator, and hazardous waste coordinator. The average noise levels ranged from 72.9 to 91.4 dBA. Results indicated that the paper chopper operator (91.4 dBA) was the only operation which exceeded the PEL of 90 dBA. However, several operations, such as the sorting line worker (87.7 to 89.1 dBA) and tipping floor attendant (88.0 to 89.6 dBA), showed noise levels exceeding the OSHA Action Level of 85 dBA and approaching the PEL of 90 dBA. At the PEL, workers are required by OSHA to wear hearing protection. The paper chopper operator and tipping floor attendant were the only workers observed to be wearing hearing protection.

These results are summarized in Table 7-15. The indoor noise levels ranged from 70 to 103 dBA, and noise levels inside the paper chopper building were as high as 98 dBA during operation. The main sources of noise inside the processing building appeared to be the can compactor and the sorting of glass and cans. Instantaneous noise levels in the vicinity of the can compactor reached as high as 103 dBA. Noise levels on the sorting line during the sorting of glass ranged from 75 to 88, with peaks up to 110 dBA during dumping of glass into carts. Noise levels on the sorting line during the sorting of aluminum and tin where as high as 103 dBA.

Table 7-14
Rice County Audiodosimeter Results

Job Description	Average Noise Levels (dBA)
Paper Chopper	86.6-91.4
Foreman	83.8
Sorting Line Worker	87.7-89.1
Tipping Floor Attendant	88.0-89.6
Economy Baler Operator	78.4
Light Equipment Operator	87.3
Hazardous Materials Worker	72.9

Table 7-15
Rice County Indoor Noise Measurement Results

Location	Instantaneous Noise Level (dBA)
Sorting Lines	70.0-110.0
Tipping Floor	63.0-95.0
Paper Chopper Building	67.0-98.0
Worker Foreman	75.0-80.0
Cardboard Baler	75.0-85.0
Main Floor	65.0
Light Equipment Operator	85.0
Can Compactor	103.0
Economy Baler	85.0-94.0
Hazardous Materials Building	50.0-62.0

Health and Safety Programs

Health and Safety Program evaluation was limited to information provided by on-site personnel. However, some questions could not be answered at the time of the on-site visit due to facility personnel scheduling, and the program evaluation forms were completed and received via mail. Key findings from this evaluation include:

- A Respiratory Protection Program has been implemented for the facility which includes a written program and training. Disposable dust masks are used in the Paper Chopping Operation and cartridge type air-purifying respirators are used in the Household Hazardous Waste Building. Dust masks are not required, but are available for workers to wear. Only the Household Hazardous Waste Coordinator has been evaluated.

- A Hazard Communication Program is in effect at the facility, however, documentation of training was found only for three workers.

- No Hearing Conservation Program has been implemented at the facility to protect employees routinely exposed to noise levels in excess of the OSHA Action Level of 85 dBA. Employees working in the paper chopping operation, sorting lines, tipping floor, and light equipment operation would be required to participate in a Hearing Conservation Program. Based on the measurement data, only the Paper chopper operator would be required to wear hearing protection, although several other job functions showed levels very close to the PEL.

- There were no air contaminants identified as requiring specific control programs.

- A Bloodborne Pathogen Program has been implemented which includes a written program, personal protective equipment, offering Hepatitis B vaccinations, and training.

- Information on injury and illness rates was provided for 1991, 1992, and 1993. Those rates, provided by the facility, are summarized in Table 7-16, along with BLS estimates of occupational injury and illness incidence rates for 1991 for Sanitary Services and Private Sector Industries. The most frequent injury over the three year period was crushed hands which occurred three times resulting in eight lost workdays. There were also two shoulder injuries, a strain and a dislocation, which did not result in any lost workdays.

Table 7-16
Injuries and Illnesses
1991, 1992 and 1993

Year	Sector	Recordable Cases	Lost Workday Cases	Lost Workdays
1991	All Industry	8.4	3.9	86.5
1991	Sanitary Services	15.3	7.9	163.5
1991	MRF	15.7	15.7	78.7
1992	MRF	63.0	15.7	47.2
1993	MRF	31.5	0	0

Ergonomics

Picking booth operations were videotaped during the on-site facility assessment. These videotapes were reviewed to identify the general ergonomic conditions within this work area. For the purposes of this assessment, potential ergonomic risk factors identified can be defined as workplace conditions or work practices which may contribute to or result in, worker discomfort, fatigue or injury.

Two types of workstations were evaluated:

- Workstation 1. At this type of workstation, workers on each side of a conveyor separated glass from paper and placed the glass into bins on each side of the conveyor. The workstation height was non-adjustable, but appeared appropriate for individuals assigned in this area. Workers were able to perform tasks without bending or excessive reaching. Bin placement allowed workers to place material in cans with minimal effort. No significant ergonomic risk factors were identified for this workstation.

- Workstation 2. This type of workstation required workers on each side of a conveyor to separate material and to transfer it to bins behind the workers. The workstation height was non-adjustable and appeared low for some workers as evidenced by workers leaning forward over conveyor. The workers were able to sort without excessive reaching. The placement of the bins behind the workers required repetitive twisting and turning. The potential ergonomic risk factors are: (1) the fixed workstation height may have been too low for a majority of assigned workers; and (2) the bin placement behind the workers required repetitive twisting and turning to discard recyclables.

SECTION 8

ORANGE COUNTY, FLORIDA

8.1 Process Description

Orange County provides disposal services to participating and unincorporated areas of the County. This section addresses the technical, economic, energy, and environmental impacts of the Orange County IMSWM system.

8.1.1 Integrated Solid Waste Management System

The Orange County Public Utilities Division is responsible for day-to-day operation of the IMSWM system. The components of the IMSWM system serving Orange County, Florida include:

- Material Recovery Facility,
- Two Transfer Stations,
- Household Hazardous Waste Station,
- Composting Facility, and
- Landfill.

Figure 8-1 presents a flow diagram of the IMSWM system, showing the solid waste received and residue generated at the various system components.

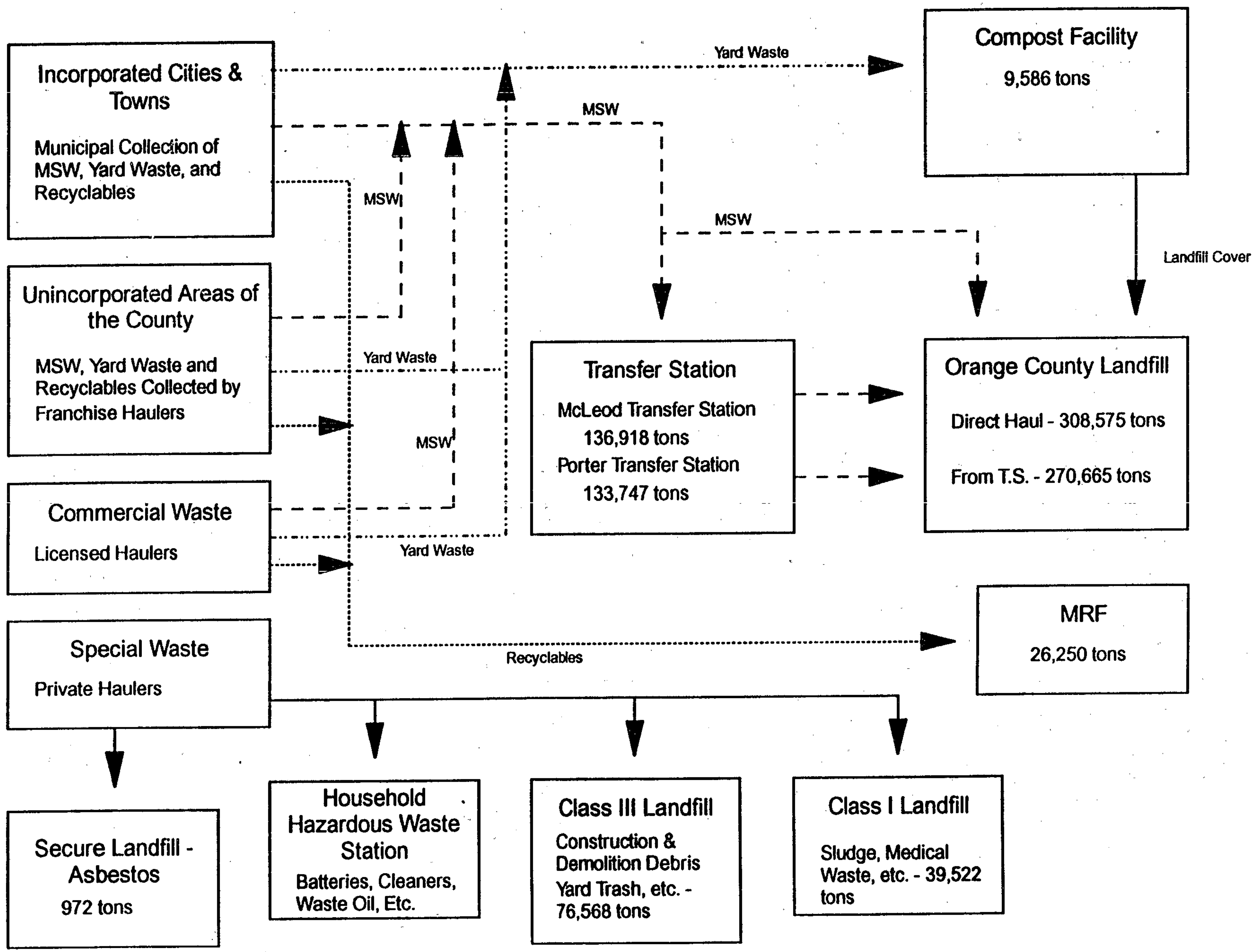
Waste Collection

Mandatory MSW collection has been in effect throughout the unincorporated area of the County since July 1987. Under County ordinance, residential waste must be collected and transported to designated disposal facilities by licensed franchised haulers. The franchise haulers are required to provide curbside pickup of MSW twice weekly and yard waste and recyclables once a week. Seven residential franchises and unlimited commercial licenses have been established to serve the unincorporated area of the County. In addition to providing solid waste disposal services in the unincorporated area, the County has entered into interlocal agreements with 11 of 13 municipalities within the County. Interlocal agreements have not been executed with Bay Lake and Lake Bueno Vista.

In FY 1992, approximately 579,240 tons of MSW were delivered to the Orange County Landfill. This included 136,918 tons from McLeod Transfer Station and 133,747 tons from the Porter Transfer Station. The County also received approximately 26,250 tons of recyclables, 9,586 tons of yard waste, 76,568 tons of construction and demolition debris, and 39,522 tons of sludge. Approximately 1,000 tons of special waste, including tires, batteries, asbestos, waste oil, and household hazardous waste, was also received by the County.

Figure 8-1

Orange County, Florida Solid Waste System



Material Recovery Facility

Opening in August 1990, the Material Recovery Facility (MRF) is located just south of Cells A through K at the County Landfill. The facility is owned and operated by Recycle America of Orange County, a unit of Waste Management, Inc. The County, however, has the option to purchase the facility in five or ten years. Newsprint and corrugated cardboard, handled separately from the commingled recyclables, is baled and shipped directly to market. The commingled recyclables are mechanically processed to separate ferrous metals, and manually processed to separate plastic containers, aluminum cans, and color-sorted glass. In FY 1992, the MRF received approximately 26,250 tons of recyclable material.

Transfer Station

The County operates two transfer stations in the City of Orlando. The McCleod Road Transfer Station, located just west of I-4, is operated under a lease from the City by the County. This transfer station has an average capacity of 600 tpd of residential and commercial waste. The Porter Transfer Station is located at the intersection of Good Homes Road and White Road north of State Road 50. This transfer station also has an average capacity of 600 tpd of residential and commercial wastes. The waste is delivered by transfer station from each station to the County Landfill. Approximately 270,665 tons of MSW were transferred to the landfill through the two transfer stations in FY 1992.

Household Hazardous Waste Station

The Household Hazardous Waste Station, located just south of Waste Station the MRF, opened in April 1990. The station includes two storage sheds -- one for containing corrosives and the other for flammable and poisonous materials. Waste oil received at the second shed is pumped to a holding tank at the site.

Composting Facility

The Composting Facility is located in the extreme northeast corner of the landfill site. The facility began receiving yard waste in March 1992. Finished compost was used as a soil amendment around the landfill, however, the County intends to market the compost once the process has stabilized. In FY 1992, the Composting Facility received approximately 9,586 tons of yard waste.

Landfill

The County owns and operates a 5,000-acre landfill located at the end of Young Pine Road east of Orlando. Of the 5,000 acres, approximately 650 acres are closed waste cells. Following weighing, waste haulers are directed to the appropriate area of the landfill depending on the waste and vehicle type. Franchise and other commercial haulers are sent directly to an active face, while private haulers are sent to a separate off-loading area. Transfer trailers are sent to a staging area where the trailer is disconnected and towed to the active face by landfill equipment. In FY 1992, the landfill received approximately 579,240 tons of MSW.

Special wastes delivered to the landfill include whole tires, asbestos, white goods, automotive batteries, waste oil, and household hazardous wastes. Used tires are stored and processed on the east side of the landfill, while asbestos is buried in sealed containers in the northern portion of the landfill. Automotive batteries, waste oil, and household hazardous waste are stored near the small vehicle unloading area at the Household Hazardous Waste Station.

Yard trash, land clearing debris, street sweepings, and construction and demolition debris are disposed of at a Class III landfill located adjacent to Composting Facility. Domestic wastewater sludges are also delivered to the landfill by various municipalities. The sludge is delivered in tanker trucks and deposited just east of the Class III disposal area. The sludges are stabilized on site and used as a solid amendment in landfill cover material.

8.1.2 Material Recovery Facility

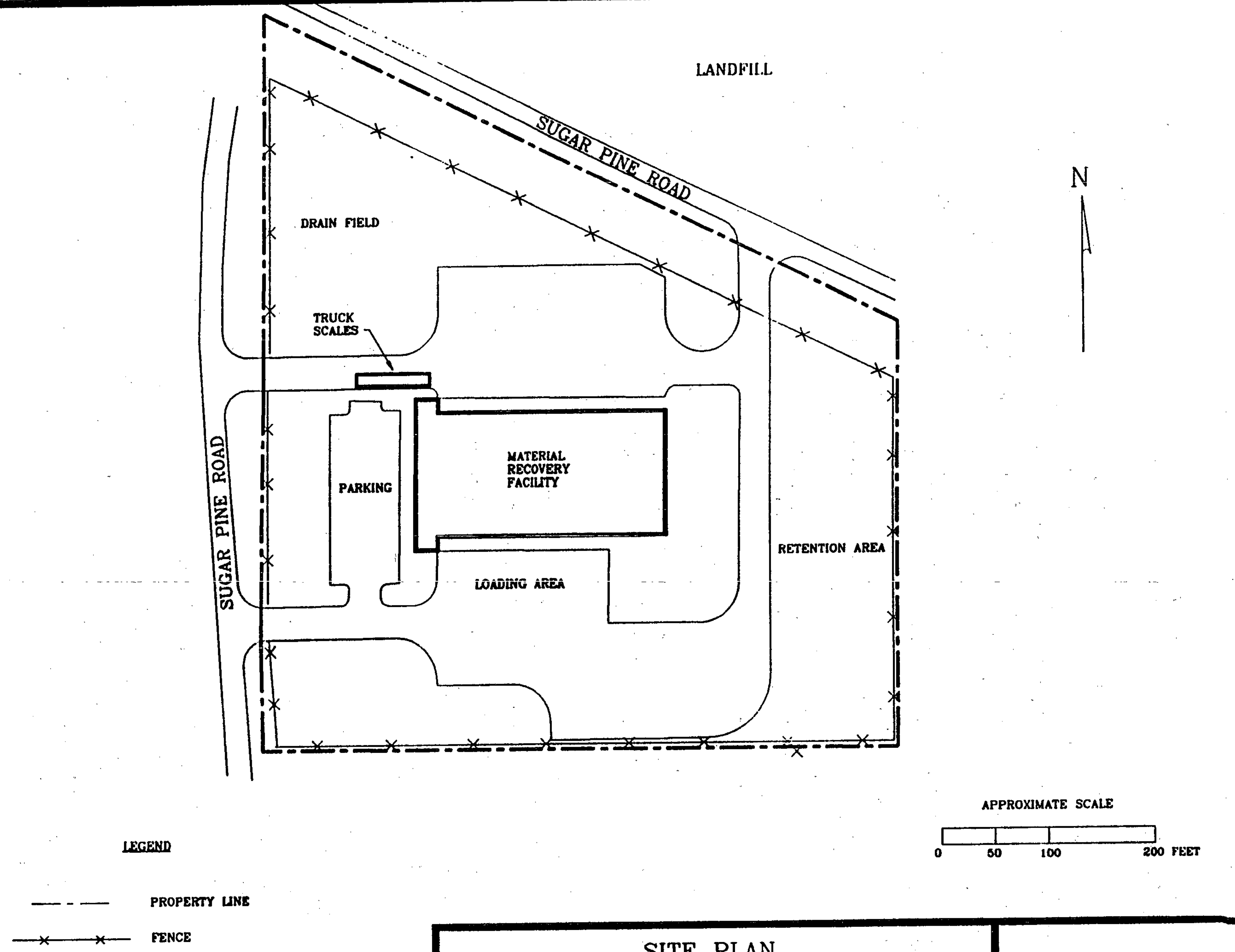
The MRF has a design capacity of 300 tpd based on two shift operators, but is currently operating only one shift at an average rate of 80 tpd. The facility processes newsprint, corrugated cardboard, ferrous metals, plastic containers, aluminum cans, and color-sorted glass. Table 8-1 summarizes the tonnage of material received and recovered between August 1, 1991 and July 31, 1992. Figure 8-2 presents a site plan for the Orange County MRF.

Upon arrival, collection vehicles enter the facility and discharge their loads onto the tipping floor. A front end loader moves the material to either a storage or pre-sort area. At the pre-sort area, a worker separates newsprint and corrugated cardboard from the recyclable waste stream. The paper products are loaded onto a conveyor belt where the newsprint is separated from the cardboard. The recyclable paper is baled and then stored inside the facility prior to shipment to market.

The commingled recyclables are transferred to a conveyor belt that feeds the sorting conveyor. The material first passes over screens to remove grit and broken glass, and then a magnetic separator for the recovery of ferrous metal. The remaining material is manually sorted on a conveyor belt for recovery of plastic containers, aluminum cans, and color-sorted glass. The recovered material is dropped down a chute to dedicated storage areas below the sorting belt. The recovered material is crushed and then baled for shipment. The recyclable material is transported to market by truck.

Table 8-1
Material Received and Recovered at the MRF
between August 1, 1991 and July 31, 1992

Material	Throughput (tons)	Percent of Total (%)
Newsprint	15,493	60.2
Aluminum	671	2.5
Plastic	1,275	4.9
Clear Glass	2,305	9.6
Amber Glass	700	2.7
Green Glass	822	3.3
Ferrous	1,288	4.9
Residue	1,909	7.0
Rejects	1,286	3.3
Unprocessed	9	<0.1
Phone Books	492	1.5
Total	26,250	100.0



SITE PLAN
MATERIAL RECOVERY FACILITY
ORANGE COUNTY, FLORIDA

FIGURE 8-2

8.1.3 Economic, Energy and Environmental Issues

The economic, energy, and environmental impacts associated with the operation of the MRF and IMSWM system are addressed in this section. These impacts are based on publicly available information or material provided by the County.

Economic Implications

The IMSWM system is owned and operated by an elected body -- the Orange County Board of County Commissioners (the Board). The Board has the authority to issue bonds, set rates and fees, and engage in other financial activities necessary to provide for the management of solid waste in the County. The County Chairman is a member of the Board and exercises direct authority over the day-to-day operations of County government under the jurisdiction of the Board. The County Administrator, appointed by the Chairman and confirmed by the Board, is employed on a full-time basis to assist in the daily management of the County.

The Public Utilities Division (PUD) is responsible for operating and maintaining the IMSWM system. The PUD reports directly to the County Chairman and County Administrator. The system is operated as a self-supporting governmental unit and is accounted for as an enterprise fund of the Board. Under an enterprise fund, the expenses associated with the delivery of services, as well as depreciation, amortization, and interest, are recovered primarily through user charges.

The data collected for this analysis was obtained from Orange County. According to the County, the costs and revenues were based on actual results for FY 1992 and included all solid waste handled by the County. It should be noted that processing of recyclables is performed by a subcontractor, and they were unwilling to provide detailed information regarding operating expenses.

In FY 1992, the total cost of waste collection, transport, processing, disposal, and combustion, material recovery and marketing, and administration was approximately $52.5 million. Approximately $17.6 million or 34 percent of costs was associated with collection. These costs included the labor, transportation, equipment, and operations associated with the collection of all of the waste for which the County has responsibility. Approximately $6.3 million or 12 percent of costs were associated with debt service and depreciation, and $4.3 million was associated with labor. The remaining $24.3 million was split between contractors, supplies, equipment, O&M, utilities, and other expenses.

The total cost of operating the MRF, including collecting, transporting, processing, and marketing recyclables, was estimated to be approximately $4.2 million in FY 1992. This amount was estimated based on an a fee of $1.02 million which was charged by the subcontractor to process the recyclables. Based on this estimate, approximately $1.9 million or 46 percent of costs was associated with O&M and debt service. The remaining 54 percent of MRF costs was associated with collection. Based on the estimated costs provided by the County, the operating costs of the MRF represent approximately 8.1 percent of total IMSWM system operating costs. Table 8-2 summarizes the costs for the IMSWM system and MRF.

Table 8-2
Estimated Costs for the Orange County IMSWM System

Cost Element	IMSWM System	MRF
Labor	$4,341,624	
Contractors	1,845,377	
Materials and Supplies	429,918	
Equipment O&M	685,882	
Utilities	88,669	
Other Expenses	3,809,559	
Debt Service/Depreciation	6,226,015	
MRF O&M plus Debt		$1,940,200
Subtotal (O&M plus Debt)	17,466,044	1,940,200
Collection Costs	17,600,000	2,300,000
Total	$52,532,088	$4,240,200

The amount of total revenues received by the IMSWM system was approximately $24.3 million in FY 1992. Approximately $18.2 million or 75 percent of revenues was associated with tipping fees, while approximately $2.1 million or 9 percent was associated as closure costs adjustment. The remaining $4 million was generated through the sale of recyclables, grants, interest revenue, and other revenues.

Based on an allocation performed by the Authority, the amount of total revenues from MRF was approximately $3 million in FY 1992. These revenues were earned through tipping fees, the sale of recyclables, and grants. Table 8-3 summarizes the revenues for the IMSWM system and MRF.

Table 8-3
Estimated Revenues for the Orange County IMSWM System

Cost Element	IMSWM System	MRF
Tipping Fees	$18,169,117	$1,050,000
Closure Cost Adjustments	2,128,700	
Sale of Recovered Materials	1,308,240	1,308,240
Grants and Subsidies	1,050,000	640,000
Interest Revenue	1,616,389	
Other Revenues	38,511	
Total	$24,310,957	$2,988,240

For clarification, the definition of selected revenue sources is as follows:

- *Closure Costs Adjustment*. Surplus funds which were originally allocated to a closure activity which were subsequently unused for that purpose.

- *Grants*. Funds received from the County and/or the State to partially offset MRF costs.

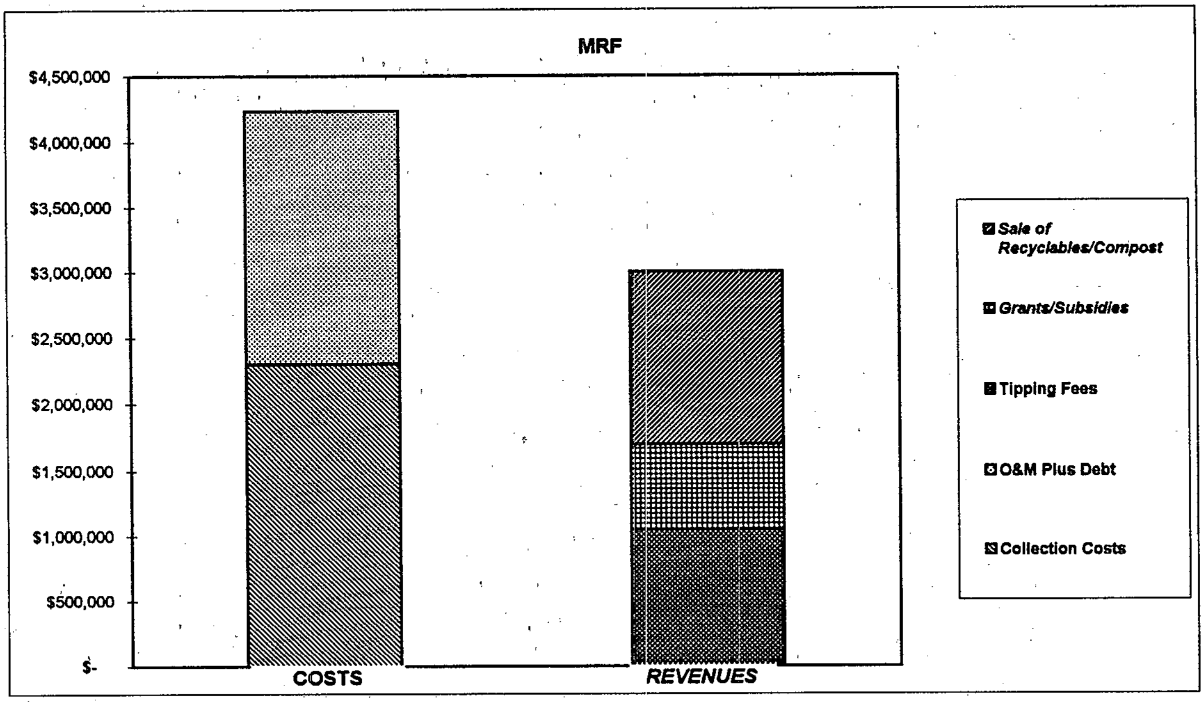
Based on the allocation of costs by the County, the operating revenues of the MRF represent approximately 12.5 percent of total IMSWM system operating revenues. This is somewhat more than the percentage contribution of the MRF to IMSWM system costs. These operating revenues recover approximately 71 percent of MRF costs.

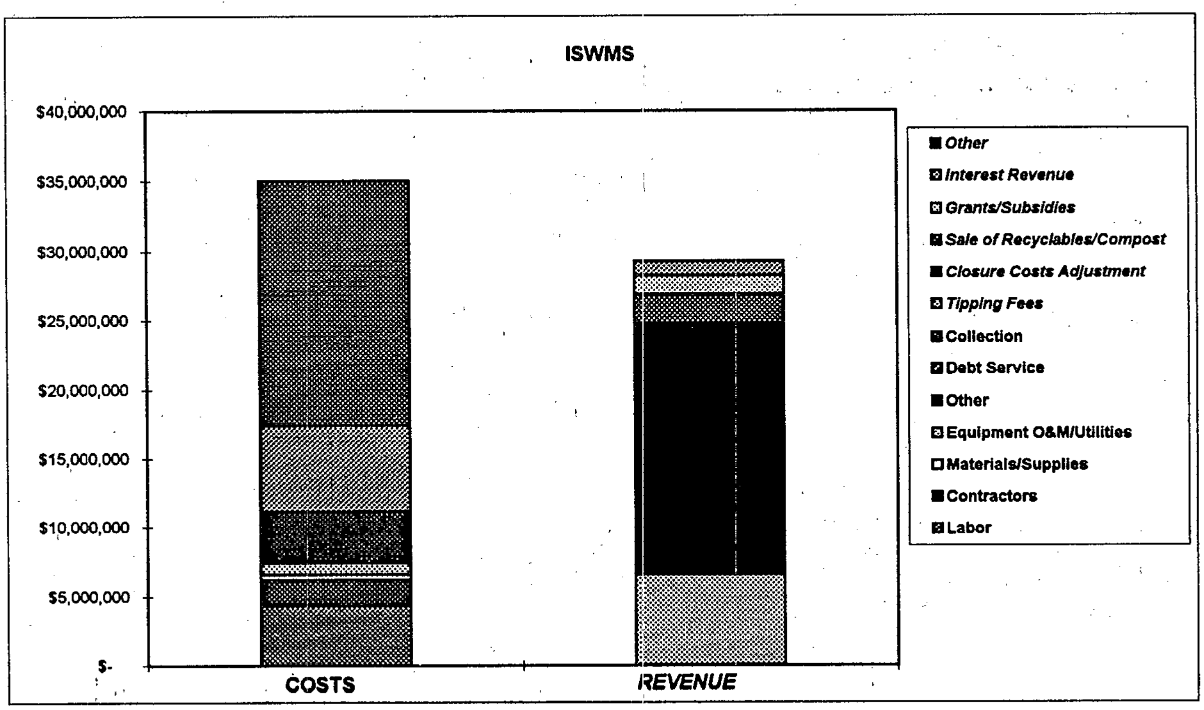
Figure 8-3 shows the total costs and revenues for the IMSWM system and MRF. Based on the analysis of operating expenses and revenues for FY 1992 and allocations provided by the County, it appears that the MRF provided a net cost to the IMSWM system in the amount of approximately $1.2 million or 2.5 percent of total operating expenditures.

Energy Consumption

An estimated 266 billion Btu of energy was consumed to collect, transfer, haul, process, compost, and transport to market about 733,138 tons of MSW, yard waste, and recyclables. Of the 266 billion Btu consumed, approximately 81.9 percent was used to manage 697,302 tons of MSW, 1.5 percent was used to manage 9,586 tons of yard waste, and 16.5 percent was used to manage 26,250 tons of recyclables. Approximately 0.36 MMBtu of energy was consumed for

Figure 8-3.
TOTAL COSTS AND REVENUES FOR THE ORANGE COUNTY ISWMS





each of the 733,138 tons of waste managed, with 0.31, 0.43, and 1.68 MMBtu consumed for each of the 697,302 tons of MSW, 9,586 tons of yard waste, and 26,250 tons of recyclables, respectively.

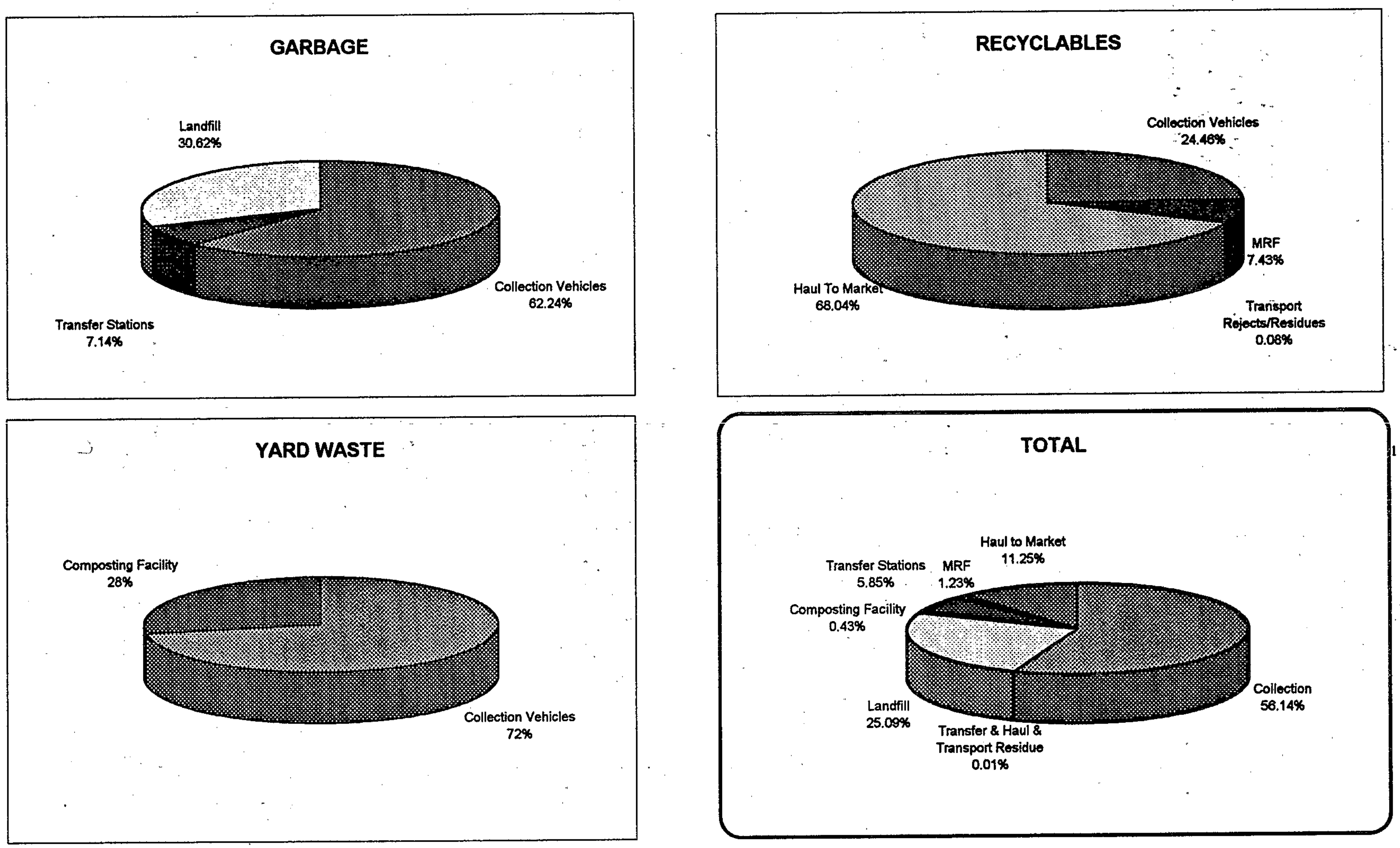
Table 8-4 and Figure 8-4 show the energy consumed by function. For the entire IMSWM system, almost 67 percent of the energy consumed was for transportation, that is, collecting recyclables, transporting recovered materials to market, and hauling residue to the landfill. Transportation constituted about 62, 72, and 93 percent of the energy consumed for MSW, yard waste, and recyclables, respectively.

Table 8-4
Energy Consumption for the Orange County IMSWM System
(MMBtu)

Activity	Garbage	Curbside Recycling	Yard Waste	Total
Collection Vehicles	135672	10760	2947	149378
Material Recovery Facility[a]		3270		3270
Transfer of Rejects to Landfill[b]		34		34
Transfer Stations[c]	15560			15560
Composting Facility[d]			1138	1138
Landfill[e]	66756			66756
Subtotal	217987	14063	4085	236136
Haul to Market		29935		29935
Total Energy Consumption (MMBtu)	217987	43998	4085	266071
Total Tons Collected	697302	26250	9586	733138
Average Energy Consumption (MMBtu/ton)	0.31	1.68	0.43	0.36

[a]Fuel and electricity consumption at the MRFs was provided by Recycle America who maintains and operates the facility.
[b]Fuel consumed to transfer rejects from the MRF to the landfill was calculated based on mileage and the average value of 0.024 gal/ton = mile for rejects and residues based on studies done in Springfield, Massachusetts; Scottsdale, Arizona; Palm Beach County, Florida; Minneapolis, Minnesota; and Seattle, Washington.
[c]Transfer station data was based on actual electric consumption and fuel consumption provided by Orange County.
[d]Total landfill electricity and fuel consumption were provided by Orange County. The operator of the composting facility estimated that the only energy consumption related to the composting facility was diesel fuel and it was conservatively estimated that 10% of the total diesel of the landfill was consumed for composting operations.
[e]Haul to market was calculated based on mileage from the MRF to the appropriate processing facility and the study value of 0.024 gal diesel/ton = mile for transport of recyclables.

Figure 8-4.
ENERGY CONSUMPTION FOR THE ORANGE COUNTY ISWM SYSTEM
(Millions of British Thermal Units)



Except as discussed below, the energy consumption information reported in this section was obtained from data provided by Orange County and Recycle America(the operator of the Material Recovery Facility). The fuel consumed to collect garbage, yard waste, and recyclables was estimated using collection vehicle data from Palm Beach County, Florida; Springfield, Massachusetts; Scottsdale, Arizona; Minneapolis, Minnesota; and Seattle, Washington. The energy consumed to haul recovered materials to market was estimated by multiplying the estimated ton-miles hauled by 0.024 gallons per ton-mile, i.e., the approximate fuel consumed by the MSW transfer vehicles used in Hartford, Connecticut; Palm Beach County, Florida; and Minneapolis, Minnesota.

Environmental Regulations

The County was required to obtain construction and operating permits for various components of the IMSWM system. The Florida Department of Environmental Regulation (FDER) has issued the required permits for the expansion, operation, and closure of the landfill, including the Construction, Operating, and Management and Storage of Surface Waters Permits. The National Pollutant Discharge Elimination System (NPDES) Permit required for the landfill was received from the U.S. EPA, and the Consumptive Use Permits from the St. Johns River Water Management District (SJWMD). The FDER also issued the Construction and Operating Permits for the transfer stations, composting facility, household hazardous waste facility, and other waste management facilities operated by the County. Table 8-4 summarizes the current status of the permits required for the components of the IMSWM system.

8.2 Field Test Results

The field test program at the Orange County MRF was conducted between January 18 and 21, 1994. The field test procedures and results are discussed in detail in the following sections.

8.2.1 Test Procedures

The material is brought to the facility in the trucks containing paper products separated from the rest of the remaining recyclables. At the facility, the paper products and mixed recyclables are dumped separately and sorted separately. There are approximately 20 full time employees at the facility. The facility operates from 7:00 am to 5:30 pm. The sorting lines start at approximately 7:30 am. Workers generally stop sorting at 5:00 pm to clean up their areas. The workers are given a half hour for lunch and two fifteen-minute breaks during the day. The MRF is located next to an active municipal landfill. The side facing the MRF has been covered and was in the process of having a cap installed.

The field test program was conducted in accordance with the approved test protocol contained in QAPjP and site-specific SAP. The following deviations were noted from the field protocol:

Table 8-5
Major Permits and Approvals

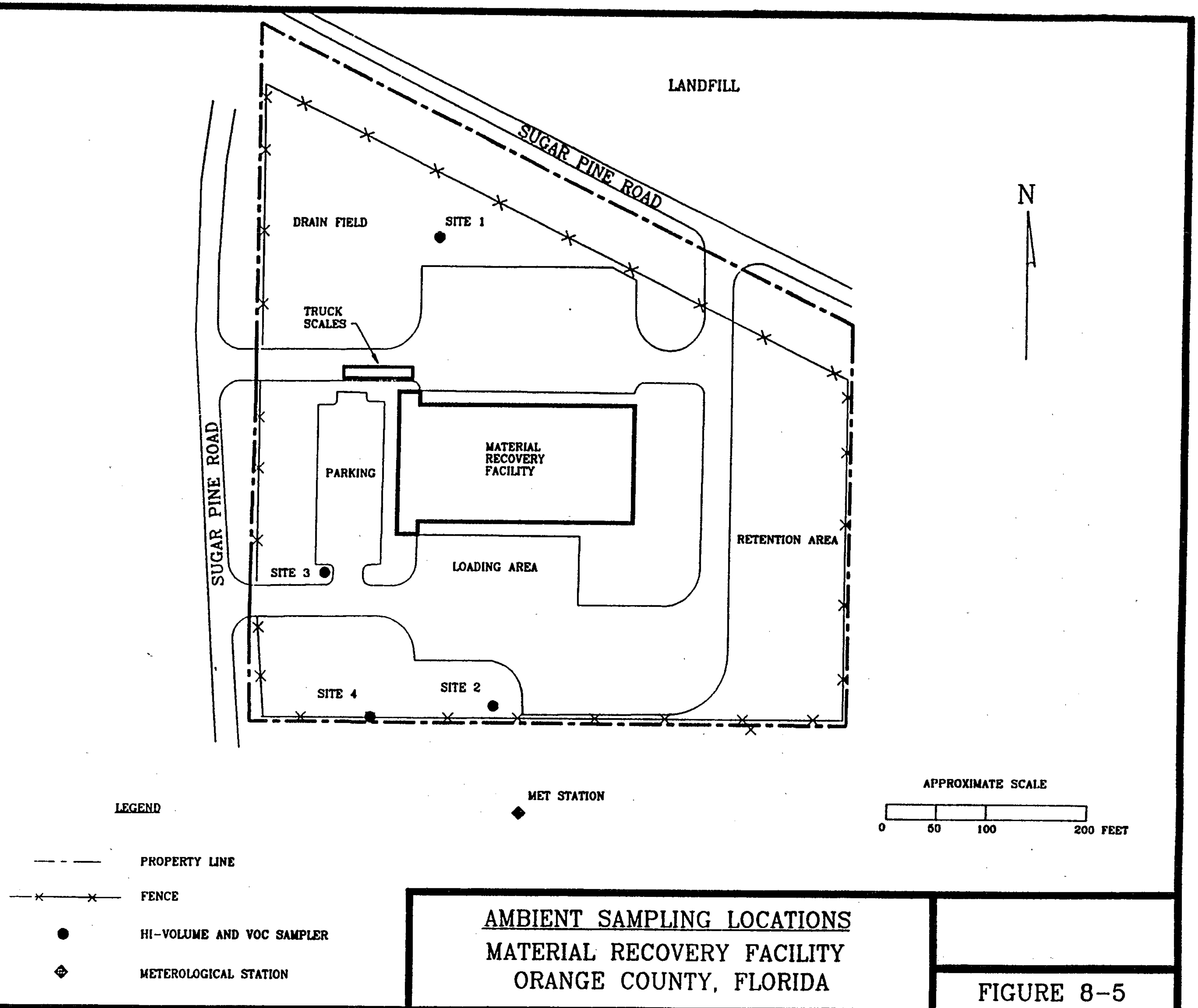
Facility	Responsible Agency	Permits/Approvals	Issuance Date
County Landfill	Florida Department of Environmental Regulation (FDER)	New Cell Construction Permit	03/22/88
	FDER	Management and Storage of Surfaces Water Permit	05/91
	FDER	Class III Expansion Construction Permit	02/06/92
	U.S. Environmental Protection Agency	NPDES Permit	05/01/88
	St. John's River Water Management District	Consumptive Use Permit	08/91
Tire Storage Area	FDER	Temporary Operating Permit	06/30/89
Household Hazardous Waste Facility	FDER	Temporary Operating Permit	11/29/89
McLeod Transfer Station	FDER	Operating Permit	10/29/85
Porter Transfer Station	FDER	Construction Permit	09/08/81
Landfill Yard Waste	FDER	Construction Permit	12/10/91
Compost Facility	FDER	Operating Permit	12/20/91

- Due to severe winter storm weather conditions, shipment and delivery of some of the sampling equipment was delayed. This resulted in only one downwind PM10 sample being collected on Day 1.

- On 14 January, a power outage resulted in TSP and PM10 sample times of less than 24 hours (10.6 hours duration).

- The RPD for the set of replicate respirable dust samples exceeded 20 percent.

Figure 8-5 shows the locations of the sampling equipment and meteorological station during the field test program at the Orange County MRF. The upwind/downwind location of the air sampling equipment in relation to the facility for each of the three days of monitoring are summarized in Table 8-6.



AMBIENT SAMPLING LOCATIONS
MATERIAL RECOVERY FACILITY
ORANGE COUNTY, FLORIDA

FIGURE 8-5

Table 8-6
Sampling Locations at the Orange County MRF[a]

Sample Day	Locations	
	Upwind	Downwind
1	1	2,3
2	1	2,4
3	1	2

[a]The PM10 and lead standards are 150 and 1.5 $\mu g/m^3$, respectively.

Provided below is a brief discussion of each sample location and any limitations that should be considered in the evaluation of the reported data.

- Site 1. This site was located north of the facility. The site was located upwind of the facility for all three sample events. It was noted that the results might be biased by nearby landfill activities.

- Site 2. This site was located south of the facility. Samplers were located downwind at this site for all three sample events. The site was considered to be representative location and included TSP and PM10 duplicate samplers.

- Site 3. This site was located southwest of the facility. Due to shifting wind conditions, the TSP sampler from this downwind location was moved to Site 4 at the conclusion of Day 1. After Day 1, no further samples were collected from this location.

- Site 4. This site was located south southwest of the facility. This site was downwind of the facility for Day 2 sample events and considered to be a representative location. The TSP and PM10 samplers were relocated on Day 3 to Site 2 and used to obtain duplicate samples. No further samples were collected from this location after Day 2.

8.2.2 Environment and the Public Health

The ambient air sampling program included measurements for TSP, PM10, lead, VOC, CO, mercury vapor, and VOC. Community noise measurements were also made along the fence line boundaries of the property. The wind rose data for the sampling period are presented in Appendix B. The sampling results are summarized below; the complete results are presented in Appendix H.

Total Suspended Particulate, PM10 and Lead

The TSP, PM10, and lead data are summarized in Table 8-7. Values for PM10 and lead were well below all applicable National Ambient Air Quality Standards (NAAQS) for all runs despite concerns over possible bias from site locations in the vicinity of the local landfill. The PM10 and lead standards are 150 and 1.5 g/m^3, respectively; there is no standard for total suspended particulate. Over the testing period, there were no major difference observed in the wind speeds which ranged from 1 to 12 miles per hour.

Table 8-7
Orange County TSP, PM10 and Lead Sampling Results[a]

Day	Compound	Concentration ($\mu g/m^3$) Upwind	Downwind	Downwind
1	TSP	38.36	70.74	61.79
	PM10	18.07	29.10	NA[b]
	Lead	0.004	0.005	0.004
2	TSP	43.44	110.99[c]	54.51
	PM10	21.33	47.39[c]	23.28
	Lead	0.006	0.005[c]	0.002
3	TSP	99.41	82.34	86.55[d]
	PM10	50.47	43.27	48.78[d]
	Lead	0.008	0.007	0.00[d]

[a]The TSP and lead standards are 150 and 1.5 $\mu g/m^3$, respectively.
[b]No PM10 sample collected.
[c]Samples collected over 10.6 hours due to loss of power.
[d]Duplicate sample.

A review of the results for Day 1 show the downwind TSP concentrations were 61 and 84 percent higher than the upwind location. An increase of approximately 41 percent was noted for PM10 at the downwind location, when compared to the upwind location. A negligible difference was noted when comparing the lead values for the three locations. The PM10 contribution to the total particulate ranged was 47 and 41 percent for upwind and downwind locations, respectively.

On Day 2, the TSP levels increased approximately 25 and 156 percent at the two downwind (Sites 2 and 4) over the levels measured on Day 1. The PM10 results increased approximately 9 and 122 percent at these downwind locations. The TSP and PM10 concentrations measured at Site 2 were twice as high as those measured at Site 4, while the TSP and PM10 concentration measured at Sites 1 and 2 are similar to concentrations measured during Day 1.

These data indicate that the data collected at Site 4 may be biased high, possibly attributed to a power outage that resulted in a reduced sample time (10.6 hours). This hypothesis is based on the significant difference observed between the data collected at Sites 2 and 4, along with the reproducibility of the results at the other locations on Days 1 and 2. The PM10 contribution to total particulate was 49 and 42 percent for the upwind and downwind locations, respectively.

Excluding Site 2, the TSP and PM10 sampling results for Day 3 increased at the upwind location when compared with the corresponding results for Days 1 and 2, while the downwind concentrations increased only moderately. The upwind TSP and PM10 concentrations were approximately 18 and 10 percent higher than the downwind concentrations, respectively. This is an indication that Site 1 results might be influenced from activities at the nearby landfill.

The TSP and PM10 levels measured at the fence line were highest on Days 1 and 2 (excluding Site 2). The results for Site 2 demonstrate a significant increase in downwind concentrations on Day 2. This could be attributable to the fact that the samplers only operated during facility operations (when activities tend to generate more dust), rather than over the entire 24-hour period. No conclusions can be drawn from the results collected on Day 3 due to possible bias of the results at the upwind locations. All TSP and PM10 results (including Site 4) are below the NAAQS. For all three sample events, there were no significant differences in upwind and downwind lead concentrations. The lead concentrations were well below the corresponding NAAQS.

The TSP, PM10, and lead duplicate results were 5.0, 11.9, and 33.0 percents, respectively. The RPD for the duplicate lead samples exceeded QAPjP criteria of ± 20 percent. Because the lead levels were extremely low, the RPD excursion has little impact on the results. The lead QC spike and spike duplicate analyses recoveries were both 105 percent. The lead matrix spike and matrix spike duplicate analyses were 72 and 77 percent, respectively, which do not meet QAPjP criteria. Based on the low lead recoveries, the test results should be assumed to be biased low. In the worse case, the adjusted results would be approximately 129 percent of the reported values. Even with this adjustment the concentrations are considerably lower than the NAAQS.

Carbon Monoxide and Mercury

Carbon monoxide and mercury vapor levels were monitored with direct-reading instruments at upwind and downwind sites, and at the fence line boundaries. The readings were taken once in the morning and once in the afternoon on each of the three sampling days. Neither CO nor mercury vapor were detected at any of the ambient sampling locations.

Volatile Organic Compounds

The VOC data collected on Day 3 at Sites 1, 2, and 4 are presented in Table 8-8. The target compounds were from the hazardous substance list and featured scans for over thirty-five compounds. The presence of two VOCs were detected in the samples. Acetone and toluene were detected in all samples in the range of 0.4 to 7 $\mu g/m^3$. Acetone and toluene concentrations were well below the "no-treat levels" established by the Florida Department of Environmental Regulation (FDER). Excluding common laboratory contaminants, the VOC data demonstrated no compounds present in upwind or downwind locations. The data can be considered representative of normal background levels in rural areas.

Table 8-8
Orange County VOC Sampling Results

Day	Compound	Detection Limit ($\mu g/m^3$)	Concentration ($\mu g/m^3$)			State Guideline ($\mu g/m^3$)
			Upwind	Downwind	Downwind	
2	Acetone	2.4	7.1	4.7	7.1	8,544
	Toluene	0.8	0.8	1.1	1.1	898

The VOC surrogate recovery values were 84 to 89 percent which exceeds the QC criteria of ±10 percent. For the QC spikes, the RPDs for 18 compounds spiked ranged from 74 to 124 percent, exceeding the QC criteria of ±15 percent. EPA Method TO-14 does not state specify acceptance ranges for surrogate or spike recoveries. Coast-to-Coast Analytical Service, however, uses ±30 percent as an acceptance criteria. This is based on guidance from EPA Region V.

Community Noise

Instantaneous noise levels were measured at locations along the fence line of the facility property. The community noise measurements are summarized in Table 8-9. Instantaneous noise levels measured at the fence line locations ranged from 55 to 74 dBA. The highest ambient noise levels were found along the north fence line, which is likely due to the facility having no wall on the north side. The noise levels encountered are unlikely to have any community impact due to the remote location of the facility.

Table 8-9
Orange County Community Noise Measurement Results

Location	Instantaneous Noise Levels (dBA)
Fence Line (North)	69.0-74.0
Fence Line (East)	59.0-66.0
Fence Line (Southeast)	61.0-66.0
Fence Line (South)	66.0-71.0
Fence Line (Southwest)	65.0-67.0
Fence Line (West)	55.0-65.0

8.2.3 Occupational Health and Safety

The occupational health and safety evaluation addressed chemical exposure, CO, mercury vapor, bacteria, fungi, and noise exposure. Both personnel sampling and indoor sampling were performed at the facility. The sampling results are summarized below; the detailed results are presented in Appendix H.

Dusts and Silica

Worker exposures to total dust, respirable dust, and silica were monitored over the entire work shift (8 hours). The personnel sampling results are presented in Table 8-10. Workers sampled included the plastic sorter, aluminum sorter, baler operator, tipping floor attendant, glass sorter, supervisor, front-end loader operator, and fork lift operator. All sampling results were less than the applicable PELs or TLVs. The highest total dust and respirable dust concentrations were found on the bobcat operator -- 0.32 and 0.16 mg/m^3, respectively. Sampling results for respirable silica indicated less than detectable levels for personnel.

Table 8-10
Orange County Total Dust, Respirable Dust and Silica Personnel Sampling Results

Job Description	Concentration (mg/m^3)		
	Total Dust	Respirable Dust	Silica
Tipping Floor Attendant	0.1426	0.1165	<0.0106
Baler Operator	0.1325	0.0993	-
Plastics Sorter	0.0844	-	-
Aluminum Sorter	0.125	0.1029	<0.0103
Glass Sorter	0.083	0.083	<0.0107
Supervisor	0.1359	-	-
Front-end Loader Operator	0.3179	0.1587	0.0099
Fork Lift Operator	0.3042	-	-

Duplicate analyses for respirable dust and total dust found that two total dust samples had RPDs of 37 and 33 percent, respectively. Both of these values exceed the QAPjP limit of $\pm$20 percent.

Carbon Monoxide and Mercury

Direct reading measurements for mercury and carbon monoxide were taken at the sorting lines, tipping floor, lunch area, baler area, front-end operations, and fork truck operations. These measurements did not detect any levels above instrument background over the sampling period, with the exception of one measurement of 0.001 mg/m^3 near one of the workers on the sorting line.

Bacteria and Fungi

Airborne and surface samples of bacteria and fungi concentrations were determined at locations inside and outside the facility. Indoor sample locations included the tipping floor, sorting lines, baler, bale storage, and lunch area. Outside, airborne bacteria and fungi levels were measured at the one upwind and two downwind locations on each of the three sampling days. The airborne and fungi results for the Orange County facility are presented in Table 8-11. As shown in this table, the levels of airborne bacteria and fungi inside the facility were generally one to two orders of magnitude higher than the levels outside the recyclables processing facility.

Table 8-11
Orange County Airborne Fungi and Bacteria Results

Location	Sample (viable counts per cubic meter)		
	Fungi	Bacteria RT[a]	Bacteria 56[b]
Tipping Floor	359-2707	580-2318	12-35
Sorting Lines	1843->9256	1147-2569	12-58
Baler Operator Station	522-3992	811-2742	<12-93
Bale Storage	324-683	243-694	<12-46
Lunch Room	278-1238	394-949	<12-12
Ambient Air Station #1	220-440	209-1136	<12-58
Ambient Air Station #2	348-3437	336-2730	<12-46
Ambient Air Station #3	162	533	23
Ambient Air Station #4	313	452	35

[a]Bacteria RT is incubated at room temperature.
[b]Bacteria 56 is incubated at 56 degrees F.

Fungi and environmental bacteria levels were highest on the third day of sampling at each of the indoor locations. Thermophilic bacteria levels were highest on the first sampling day. No conditions were observed that were likely to have contributed to the variation in levels. Outside the building, a significantly higher level of environmental fungi and bacteria (one order of magnitude) was observed at the downwind location (Site 2) than at the upwind location only on Day 3. The levels inside the facility were also measurably higher on Day 3. This indicates that the MRF may have been a contributing source to the ambient downwind concentrations of fungi and bacteria. The thermophilic bacteria levels were relatively consistent from day-to-day and site-to-site, indicating that the MRF is not likely to be contributing significantly to ambient levels of thermophilic bacteria.

The surface samples of bacteria and fungi are summarized in Table 8-12. The analytical results of the wipe samples indicated that they contained several organisms that were similar to those organisms found in air. Therefore, it is plausible that the organisms detected in the air samples may have originated from some of the surface sources. The surface of the baler area showed significantly higher levels of fungi than at any other sampling location.

Table 8-12
Orange County Surface Fungi and Bacteria Results

Location	Sample (units per gauze wipe)	
	Fungi	Bacteria
Sorting Line	2,800-9,800	8,800-17,000
Baler Area	1,600,000	5,800
Lunch Room	200	2,000

All fungi detected were common environmental fungi. None of the fungi detected are considered highly virulent in nature. The two fungi most commonly associated with infections that were detected are *Aspergillus niger* and *Aspergillus flavus*. These organisms are considered opportunistic pathogens and are most likely to infect individuals with compromised immune systems. Healthy people are not likely to be infected with Aspergillus unless they are exposed to an unusually high dose. Infections due to *Aspergillus niger* and *Aspergillus flavus* are rare. It is possible that hypersensitive people, and people exposed to high levels of fungal spores, may develop hypersensitivity reactions, such as allergies, asthma and hypersensitivity pneumonitis. Little information is available describing the exposure levels required to initiate such reactions.

No highly virulent pathogenic bacterial were identified in any of the samples submitted. Many of the bacteria detected were various species of *Bacillus*. These bacteria are commonly found in environmental samples, and occur naturally in soil and water. *Curtobacterium, Clavibacter* and *Agrobacterium* are common plant pathogens which is commonly recovered from air samples. *Arthrobacter* is a common environmental organism often associated with soil. *Corynebacterium* is commonly associated with the environment but may also be of human or animal origin. The species of *Acinetobacter, Xanthomonas, Hydrogenophaga, Flavobacterium, and Pseudomonas* and Gram negative non-fermenting bacteria are common in water or wet environments. *Aureobacterium* is commonly found in soil and dairy products. *Staphylococcus* and *Micrococcus* are naturally associated with human and/or animal skin. The genera *Enterobacter, Klebsiella, Hafnia,* other bacteria from the family *Enterobacteriaceae*, and Gram negative fermenting bacteria are frequently found in soil and/or water environments. *Flavimonas* and *Brochothrix* are widely distributed in the environment. Microbacterium is found in dairy products, sewage, and associated with insects. Gram positive bacteria are common in soil and other environmental sources.

Fungi and environmental bacteria air samples and wipes exceeded the RPD limit of 20 percent. A duplicate sample taken at Ambient Air Station #2 found RPD values for fungi and environmental bacteria of 62 and 27 percent, respectively. Both are in excess of the QAPjP limit of 20 percent.

Noise Exposure

Worker noise exposures were determined over the work shift through the use of audiodosimeters and are presented in Table 8-13. Workers monitored included the plastic sorter, aluminum sorter, baler operator, tipping floor attendant, glass sorter, bobcat operator, and fork lift operator. The average noise levels to which workers were exposed ranged from 87.0 to 98.6 dBA. Out of the 11 noise exposure samples, eight were above the PEL of 90 dBA. Personnel experiencing noise levels above the PEL were the plastics, aluminum, and glass sorters, fork lift operator, bobcat operator, and tipping floor attendant. The highest noise levels were found on the sorting line, ranging from 93.5 to 98.6 dBA. The only operation showing levels below the PEL was the baler operator; however, the levels on the baler operator were close to the PEL ranging from 87.0 to 88.5 dBA. At noise levels above the PEL, workers are required by OSHA to wear hearing protection. The majority of the workers in the facility were observed wearing hearing protection.

Table 8-13
Orange County Audiodosimeter Results

Job Description	Average Noise Levels (dBA)
Fork Lift Operator	90.2
Bobcat Operator	92.9
Plastics Sorter	95.8-98.6
Aluminum Sorter	93.5-95.1
Baler Operator	87.0-88.5
Tipping Floor Attendant	88.2-90.8
Glass Sorter	94.7

Instantaneous noise measurements collected within the facility are summarized in Table 8-14. These noise levels ranged from 82 to 99 dBA. The main sources of noise inside the facility was found on the sorting line and the tipping floor. Instantaneous noise levels on the sorting line ranged from 85 to 99 DBA, with the highest levels found at the picking stations located closest to the feed conveyor. Noise levels on the tipping floor ranged from 83 to 98 dBA, with peaks as high as 101 dBA during dumping of material.

Table 8-14
Orange County
Indoor Noise Measurement Results

Location	Instantaneous Noise Levels (dBA)
Sorting Lines	85.0-99.0
Tipping Floor	83.0-101.0
Lunch Room	43.0-53.0
Baler Area	82.0-89.0
Bobcat Operator	86.0-94.0
Fork Truck Operator	84.0-91.0

Health and Safety Programs

The health and safety program evaluation was limited to information provided by site personnel. The key findings from this evaluation include:

- A Respiratory Protection Program has not been written for the facility. Disposable dust masks are the only form of respiratory protection used at the facility. Dust masks are not required, but are given to workers to wear at their decision. Workers have not been trained on the use of these respirators.

- A written Hazard Communication Program was not available at the facility. A list of hazardous chemicals and MSDS were available. Documentation of training was not available.

- No air contaminants were identified as requiring specific control programs.

- A comprehensive Hearing Conservation Program has not been implemented at the facility, although employees have received training and audiometric tests. Monitoring has not been conducted prior to this study. Hearing protectors have not been evaluated and the OSHA noise standard was not posted at the facility.

- A Bloodborne Pathogen Program has been implemented. A worker had recently received a needle stick and was given a hepatitis vaccine. The facility does have a part-time nurse on-site. The facility has a biomedical incineration box which is used to transport needles to a medical incinerator.

- Information on injury and illness rates was provided for 1990, 1991, 1992, and 1993. Those rates, provided by the facility, are summarized in Table 8-15, along with BLS estimates of occupational injury and illness incidence rates for 1991 for Sanitary Services and Private Sector Industries.

Table 8-15
Injuries and Illnesses
1991, 1992 and 1993

Year	Sector	Recordable Cases	Lost Workday Cases	Lost Workdays
1991	All Industry	8.4	3.9	86.5
1991	Sanitary Services	15.3	7.9	163.5
1990	MRF	4.60	0	0
1991	MRF	4.60	2.30	2.30
1992	MRF	11.5	6.90	347
1993	MRF	9.20	4.60	66.7

The facility provided specific information on the types of injuries or illnesses that have occurred. Those injuries included:

1990: Elbow injury; leg laceration.

1991: Knee injury; finger laceration.

1992: Back injury; shoulder injury; hand-tendon injury; forearm-wrist injury; wrist fracture.

1993: Knee/back/neck injury from fall; neck pain; back pain; needle stick.

<u>Ergonomics</u>

Picking booth operations were videotaped during the on-site facility assessment. These videotapes were reviewed to identify the general ergonomic conditions within this work area. For the purpose of this assessment, the potential ergonomic risk factors identified can be defined as workplace conditions or work practices which may contribute to, or result in worker discomfort, fatigue or injury.

Two types of workstations were evaluated:

- <u>Workstation 1</u>. At this type of workstation, workers on both sides of conveyor separated material and place recyclables into bins on either side of worker. The workstation height was non-adjustable, but appeared appropriate for workers assigned to work in this area. Knee and foot clearance appeared adequate for worker comfort. No excessive reaching or bending was observed in performing the tasks. Bin placement allowed workers to sort without excessive twisting. One worker was observed lifting trash container to shoulder height to empty onto conveyor. The only ergonomic risk factor observed was the lifting of the plastic trash container to shoulder level to empty onto conveyor.

- Workstation 2. This workstation required workers on both sides of conveyor to perform general sorting placing recyclables into bins on each side of the workers. The workstation height was non-adjustable; no foot stools (platforms) were observed in the area to accommodate shorter workers. The guard on the side of the conveyor raised the workstation height two to three inches and may have contributed to poor accommodation of shorter workers to this workstation height. No excessive bending or reaching was observed in performing tasks in this area, nor excessive twisting or reaching to access the bins. The only potential ergonomic risk factors appears to be associated with the fixed workstation (conveyor) height and lack of accommodation for shorter workers.

SECTION 9

CONCLUSIONS

9.1 Economic, Energy and Environmental Issues

The MRFs considered in this evaluation employed manual and mechanical techniques to recover materials from both commingled and source separated wastes. A field survey was conducted at each of the MRFs to establish the economic, energy, and environmental issues associated with MRF operation. The field survey and subsequent analyses established the following:

- Economic Implications. The costs and revenues associated with material handling varied widely and were dependent on a number of variables, including collection practices (commingled or source separated materials), facility design (degree of mechanical and manual sorting), market availability (long-term vs. short-term markets), and contractual arrangements (full-service vs. operating contractor). Based on the four waste management entities for which costs and revenues were analyzed, the following conclusions could be drawn:

  - Material recovery facilities result in a net cost for waste management entities.

  - For the four participating entities that provided sufficient data, the ratio of MRF costs to IMSWM costs ranged from less than 3% to almost 50%.

  - The ratio of MRF costs to IMSWM costs has some correlation with (but is not directly dependent on) the quantity of MSW and recyclables handled within the system.

  - There do not appear to be any accounting standards for allocating costs and revenues associated with MRFs. There did not seem to be consistency in the way that overhead costs were allocated to the MRF by each study participant.

  - There appears to be some correlation between the size of the service area and the ratio of MRF costs to IMSWM costs; larger service areas incur a greater percentage of costs for MRF operations. This appears to be related to increased recyclable collection costs associated with the larger service areas.

  It should be noted that the ratio of reported MRF costs to IMSWM costs for these entities may have been based on varying methods of allocating costs and revenues within each entity, and the ratios of MRF to IMSWM costs could be impacted by differences in environmental laws between the states in which they operate.

- Energy Consumption. Generally, the participating MRFs do not consume a significant amount of electrical power or fossil fuels, especially when compared with other components of the IMSWM system. The fuel usage associated with the collection of recyclables and transport of materials to market, however, dominates the overall energy consumption of MRF operations. Whether collecting commingled or source separated recyclables, fuel usage ranges from 0.8 to over 4.0 MMBtu per ton of recyclables compared with an average of 0.34 MMBtu per ton of MSW. Depending on the quantities of MSW and recyclables handled, the fuel required for material recovery may have a significant impact on the overall energy consumption of the respective IMSWM systems.

- Environmental Regulations. The state environmental agencies having jurisdiction over the participating MRFs impose design standards and permitting requirements on the various components of the respective IMSWM systems. Typically, MRFs are subject to less stringent design and operational standards than other system components, especially waste-to-energy facilities governed by both state and, most recently, federal regulations. The state permitting requirements are also usually less stringent as state agencies are encouraging the development of MRFs. Indeed, most state agencies have promulgated regulations mandating that recycling be incorporated into the solid waste management plans for the respective IMSWM systems.

Considering the costs and revenues associated with material recovery, the MRFs all provided a net cost to the respective IMSWM systems -- the magnitude dependent on the quantity of MSW and recyclables handled within the system. Similarly, the energy consumption per ton of waste handled was typically an order of magnitude higher for recyclables compared with MSW, with MSW and recyclables collection dominating total energy consumption. Regardless of the economic or energy penalties associated with MRFs, most states mandate material recycling as part of the overall solid waste management plan for the responsible jurisdictions.

9.2 Public Health and the Environment

The environmental testing conducted at the MRFs considered ambient concentrations of TSP, PM10, CO, VOC, lead, and mercury vapor. Wastewater quality and community noise levels were also addressed during the field testing. The environmental evaluation demonstrated the following:

- TSP, PM10 and Lead. Generally, TSP, PM10, and lead concentrations were below the applicable State or National Ambient Air Quality Standards (NAAQS). The downwind concentrations of these pollutants were similar or slightly higher than the upwind concentrations, except where samplers appeared to be unduly influenced by fugitive dust generated by vehicular traffic or processing equipment. No significant changes were observed in upwind and downwind lead concentrations.

- CO and Mercury Vapor. Carbon monoxide concentrations were well below the applicable NAAQS, as well as the PEL. Mercury vapor concentrations were also well below the applicable PEL. In most instances, the CO and mercury readings were below the detection limits of the monitoring instruments.

- VOCs. Volatile organic compound concentrations were several orders of magnitude below applicable state guidelines. No significant changes were observed in upwind and downwind VOC concentrations.

- Wastewater. The wastewater metal concentrations were below the regulatory limits established under RCRA. Because no process wastewater was discharged to municipal sewer systems at any of the MRFs, no permit limits have been established for the other parameters.

- Community Noise. The community noise levels measured at the property boundaries were below applicable Federal or state criteria. The major noise sources included vehicular traffic and exterior processing equipment.

Based on the results of the environmental evaluation, MRFs do not pose a significant threat to public health or the environment. Nuisance conditions, such as fugitive dust and excessive noise, can be readily mitigated through maintenance of roadways, and enclosure of noise-generating equipment.

9.3 Occupational Health and Safety

The occupational health and safety testing conducted at the MRFs addressed worker exposure to total dust, respirable dust, crystalline silica, metals, CO, mercury vapor, PCBs, pesticides, bacteria, fungi, and occupational noise. Physical safety hazards and ergonomic stressors were also evaluated during the field test program. The occupational health and safety evaluation demonstrated the following:

- Dust, Silica and Metals. Generally, total dust, respirable dust, and silica concentrations were at least one order of magnitude below the applicable PELs. Metal concentrations were several orders of magnitude below the applicable PEL and, in most instances, below the detection limit of the test method.

- CO and Mercury Vapor. Indoor CO and mercury vapor concentrations were well below the applicable PELs. In most instances, the readings were below the detection limits of the monitoring instruments.

- PCBs and Pesticides. Indoor PCB and pesticide concentrations, for the most part, were below the detection limit of the test method.

- Bacteria and Fungi. Airborne and surface samples of bacteria and fungi were relatively consistent from one location to another inside a facility. Airborne bacteria and fungi concentrations measured inside the MRFs were roughly one order of magnitude higher than the levels found outside the facility. While a wide variety of pathogenic and nonpathogenic organisms were identified, no highly virulent pathogens were found in any of the airborne or surface samples.

- Noise Exposure. Noise levels throughout the MRFs often exceeded the PEL and OSHA Action Level. The main noise sources included truck unloading activities, trommels, glass crusher, can flattener, and other equipment operations.

- Physical Safety Hazards. Compliance with worker health and safety programs required by OSHA varied considerably among MRFs. Where they have been implemented these programs address energy control, hazard communication, respiratory protection, hearing conservation, and bloodborne pathogens.

- Ergonomic Stressors. The most common ergonomic risk factors at the MRFs are improper workstation designs that fail to accommodate workers and that causes repetitive or awkward motions.

Based on the test results, workers do not appear to be exposed to unusual health or safety hazards provided the appropriate worker protection programs are developed and implemented. Because of rapidly developing knowledge and awareness of airborne microbiology and ergonomics, these two areas may warrant additional evaluation to ensure the adequacy of protection programs.

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