BEST MANAGEMENT PRACTICES ANALYSIS FOR SOLID WASTE

VOLUME IV

EXECUTIVE SUMMARY

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A. PURPOSE OF ANALYSIS

Washington State, like the rest of the nation, faces a dilemma: what to do with its solid waste? Traditional methods, particularly landfilling, have created severe environmental problems. Recently, the siting of new facilities such as incinerators has met with overwhelming public opposition. Hauling waste to another community offers only a short-term solution to a long-term problem. All disposal methods are becoming increasingly expensive.

The Washington State Legislature, in order to prevent an impending crisis, enacted legislation to determine the "Best Management Practices" for solid waste. The State Legislature, in Substitute House Bill No. 1684, directed the Department of Ecology to undertake this comprehensive solid waste stream analysis.

This analysis was to be based on representative solid waste generation areas and was to provide the following information (source of this information is also cited):

- Solid waste generation rates.
  (Volume I and Section E of the Executive Summary)
- Recycling rates.
  (Volume I and Section E of the Executive Summary)
- Current and potential reduction efforts.
  (Volume II.A)
- A technological assessment of recycling methods.
  (Volume II.A and II.B)
- An assessment of the feasibility of separating solid waste.
  (Volume III)
- Methods to increase reduction.
  (Volume II.A and II.B and Section F of the Executive Summary)
- An assessment of new and existing solid waste management methods.
  (Volume II.B)

In addition, the Department was directed to:

- Determine which method had the least environmental impact.
  (Volume II.A and II.B and Section F of the Executive Summary)
- Evaluate the cost of various management methods.
  (Volume II.A and II.B and Section F of the Executive Summary)
- Review market availability and consider the economic impact on affected parties.
  (Volume II.C and Section G of the Executive Summary)
- Determine best management methods for each category of solid waste.
  (Volume II.A and Section F of the Executive Summary)

Policy Recommendations are listed in Section B of the Executive Summary. Section C documents the involvement of interested citizens and groups in this study. The methodology is presented in Section D. Waste generation disposal and recycling data are summarized in Section E. Barriers to implementing "Best Management Practices" for solid waste are outlined in Section F. Section G contains recommended methods or "Best Management Practices" for solid waste. Recommended methods for specific categories of solid waste are summarized in Section H. Current markets for recyclables and market development recommendations appear in Section I. Conclusions are presented in Section J.

B. POLICY RECOMMENDATIONS

Policy recommendations are intended to support the implementation of Best Management Practices for solid waste. They are based on four essential conditions:

- Awareness of the problem and of appropriate waste management methods.
- Financial and other incentives to encourage use of recommended methods.
- Institutional support for Best Management Practices.
- An opportunity for all Washington citizens and businesses to use these recommended methods.

Policy recommendations support seven objectives for the best management practices for solid waste:

Objective 1: Maximize cost-effective reduction

Objective 2: Plan for source-separated recycling

Objective 3: Strengthen institutional support for source-separated recycling

Objective 4: Provide funding and incentives for source-separated recycling

Objective 5: Increase opportunities for source-separated recycling

Objective 6: Use cost-effective and environmentally sound methods for separating recyclables after collection of solid waste

Objective 7: Provide opportunities for better disposal methods

Policy recommendations are listed below under each objective:

1. Objective 1: Maximize Cost-Effective Reduction

   a. Develop and implement a waste reduction and recycling promotion and education program as a required element of local solid waste management planning.

   b. Structure rates for regular garbage collection services that would encourage waste reduction and recycling.

   c. Investigate ways to encourage reduction and recyclability of packaging and disposable products.

d. Modify the State Environmental Policy Act (SEPA) process to include evaluation of the solid waste generated by a proposed project and methods to reduce those impacts.

e. Provide commercial/institutional waste audit programs to reduce and recycle waste.

f. Develop comprehensive programs to encourage on-site home and institutional composting of yard and garden waste, encourage environmentally sound practices and provide technical information.

g. Encourage the development of, and provide financial assistance for, regional/Statewide waste exchange programs.

2. Objective 2: Plan for Source-Separated Recycling

a. Require that local solid waste management plans treat on-site collection of residential and commercial source-separated recyclables as a best management practice, unless shown otherwise based on cost, feasibility, and environmental impact.

b. Rely on local governments to determine operating details for source-separated recycling programs.

c. Assess the financial impacts of source-separated collection on existing recycling and waste management industries, and public resources.

d. Develop and adopt a Waste Planning Code as a section of State and local building codes for new non-single-family structures, and require that these buildings provide facilities to collect and store recyclable materials.

3. Objective 3: Strengthen Institutional Support for Source-Separated Recycling

a. Undertake programs to develop markets focusing on new or expanded demand for secondary materials.

b. Establish lower, easily understood, and consistent intra-state tariffs for the transportation of recyclable commodities.

c. Provide authority to counties to establish source-separated recycling collection and drop-off systems.

d. Provide for cross-jurisdictional collection of source-separated materials.

e. Routinely collect and maintain data on waste generation, disposal and recycling.

f. Streamline permitting for new recycling projects.

g. Reduce the financial burden on waste handlers for funding liability.

4. Objective 4: Provide Funding and Incentives for Source-Separated Recycling

a. Impose a State tax on waste destined for disposal, and provide a mechanism for sharing these revenues among local jurisdictions to support waste reduction and recycling.

b. Recover the costs of on-site collection of source-separated recyclables through a regular municipal solid waste collection service charge.

c. Structure rates for regular garbage collection services so as to encourage waste reduction and recycling.

d. Provide local jurisdictions the authority to give diversion payments to recycling programs, using revenue from the state disposal tax.

5. Objective 5: Increase Opportunities for Source-Separated Recycling

a. Promote and provide support for expanding buy-back and drop-off operations.

b. Encourage and support centralized yard waste composting.

c. Provide clearly identified and accessible recycling facilities and promote their use at all drop-off, transfer and disposal sites and provide financial incentives to separate and recycle self-hauled waste.

d. Provide rate-based incentives or diversion payments to owners of multi-family and commercial properties and/or to haulers and recyclers for collection of source-separated recyclable materials from these generators.

e. Provide incentives to promote increased efficiency in the collection of source-separated materials.

f. Support the expansion of systems to reuse materials that might otherwise become wastes.

6. Objective 6: Use Cost-Effective and Environmentally Sound Methods for Separating Recyclables After Collection of Solid Waste

   a. Acknowledge mixed waste processing as a recycling method and evaluate before considering disposal methods.

   b. Require pre-processing of wastes in conjunction with (and upstream of) new mixed waste processing facilities, new incineration facilities, and new landfills; and remove potentially harmful materials from the solid waste stream prior to incineration or landfilling.

7. Objective 7: Provide Opportunities for Better Disposal Methods

   a. Resolve issues concerning the disposal of ash from municipal solid waste incinerators.

   b. Conduct a market analysis for refuse-derived fuel and identify ways to eliminate barriers to its use.

   c. Improve incinerator operations.

   d. Dispose of nonreusable construction and demolition waste at dedicated landfills. Compost the biodegradable fraction of land clearing waste with yard and garden wastes at centralized composting facilities.

   e. Base selection of disposal methods on global environmental impacts.

C. PARTICIPATION IN ANALYSIS

Several working groups and advisory committees participated in this analysis. The final form and content were shaped by these groups; the project could not have been undertaken without their involvement. These groups included:

- Washington Department of Ecology (WDOE) Statewide Advisory Committee
  - Provided guidance in policy recommendations.
- Waste Generation Area (WGA) Working Groups
  - Assisted in evaluating waste management methods for each of the WGA's.
- Washington State Recycling Association (WSRA) Commodity Groups
  - Helped assess markets for recyclable commodities.
- WSRA Technical Advisory Committee
  - Reviewed the market analysis and helped identify strategies for market development of recyclables.

Other organizations contributing to this study were:

- Washington Waste Management Association
- Governmental Refuse Collection and Disposal Association
- Environmental Health Directors Group
- Washington Citizens for Recycling
- Washington Association of Business
- Independent Business Association
- Washington Environmental Council
- Washington State Association of County Engineers
- Association of Washington Cities
- Washington State Association of County Officials
- League of Women Voters of Washington
- Washington Toxics Coalition
- Other representatives of private industry

Complete lists of participants appear in Volume II of the Best Management Practices Report.

D. METHODOLOGY

1. Volume I

a. Overview

Volume I of the Best Management Practices Analysis analyzes the quantity and composition of generated, recycled and disposed waste within the eight Waste Generation Areas (WGA's). This volume:

- Defines, for the purposes of this study, eight Waste Generation Areas (WGA's) reflecting variations in population, economic base, and waste generation.
- Estimates the quantity and composition of generated and disposed wastes in each WGA. All waste which enters or could potentially enter the municipal waste stream was considered in this analysis.
- Estimates current recycling levels in each of the Waste Generation Areas.

b. Approach

(1) Definition of Waste Generation Areas

WGA's are defined as "geographic areas which have similar economic, environmental, and social characteristics and which are dependent upon similar transport networks." Waste Generation Areas were demarcated using a computer analysis. This analysis focused on three criteria: (1) solid waste generation, (2) availability of recycling, and (3) disposal options.

In addition to analyzing data, four regional focus groups rank-ordered criteria, suggested how these criteria might vary across the State, and reviewed preliminary boundaries. Subsequent reviews by the Joint Select Committee for Preferred Solid Waste Management, the statewide focus groups, and the Department of Ecology resulted in the final establishment of eight WGA's. The following map, Figure 1, identifies the WGA boundaries and the counties they include.

(2) Quantity and Composition of Waste

Quantity estimates were compiled from two comprehensive telephone surveys. The first survey queried county public works departments, solid waste disposal facilities (public and private), and all incorporated cities and towns in Washington State. The second survey interviewed all solid waste haulers in the State, both public and private.

Field sampling to determine waste-stream composition was conducted from November 1987 through September 1988. Samples totaling over 150,000 lbs were taken from 25 locations throughout the State. Of the 429 total samples, 74 were from single-family residences, 256 were from loads hauled to disposal

Figure 1

WGA BOUNDARIES

facilities by private individuals ("self-haul loads") 12 were from unattended receptacles designed to collect recyclable materials ("self-haul drop boxes") and 87 were from commercially hauled loads coming from a single, homogeneous source ("commercial pure loads").

In addition, 156 randomly selected surveys were completed for manufacturing businesses within Washington. Sixty-one visual inspections were conducted to confirm survey results.

Residential and self-haul disposed tonnages, derived from the hauler survey, were each compared to statewide composition estimates obtained through sampling. Commercial and manufacturing waste generation tonnages were derived by applying generation rates and composition estimates from the surveys and sampling. The disposed quantities from these four substreams were added to quantities recycled to determine the total amount of waste generated.

(3) Current Recycling Levels

The analysis of recycling levels involved:

- Establishing a statewide network tracking the movement of recycled materials from recyclers to processors/end-users.
- Surveying approximately 450 recyclers and processors/end-users to determine the volume of recycled materials handled in 1987.

To eliminate double-counting, all participants who sent recycled materials out of their WGA's were asked to estimate how much of these materials was sold to other study participants.

2. Volume II

a. Overview

Volume II of the Best Management Practices Analysis evaluates potential solid waste management methods in each of eight Waste Generation Areas. This volume:

- Identifies existing waste management methods.
- Determines the current markets for recyclable commodities in Washington State and in each of the WGA's.
- Examines past and future market trends including an assessment of the effect of publicly initiated recycling programs on the existing private recycling industry.
- Identifies potential solid waste management methods for waste reduction, recycling and final disposal in each of the Waste Generation Areas.

- Evaluates potential waste management methods for each Waste Generation Area based on:

  - cost-effectiveness
  - environmental impact
  - technical feasibility

- Recommends the Best Management Practices for solid waste management in each of the eight Waste Generation Areas.

b. Approach

The evaluation of "best" solid waste management methods for each of the Waste Generation Areas incorporates rankings of potential methods by WGA working groups and by the consultant team. These rankings are based on costs, environmental impact and technical feasibility, which are further discussed below. The process is depicted in Figure 2. The WGA working groups also assisted in identifying regional environmental concerns and analyzing technical feasibility.

Waste Generation Area working groups were comprised primarily of representatives of local government and the solid waste and recycling industries. Citizens and business representatives also participated. These groups provided the consultant team with a local perspective critical to establishing "Best Management Practices" in distinctly different regions of the State.

3. Volume III

a. Overview

Volume III of the Best Management Practices Analysis provides statewide solid waste policy and program recommendations. This volume:

- Reviews barriers to best management practices.

- Recommends market development strategies for various state agencies.

- Provides recommendations for handling special wastes (problematic or potentially harmful categories of solid waste).

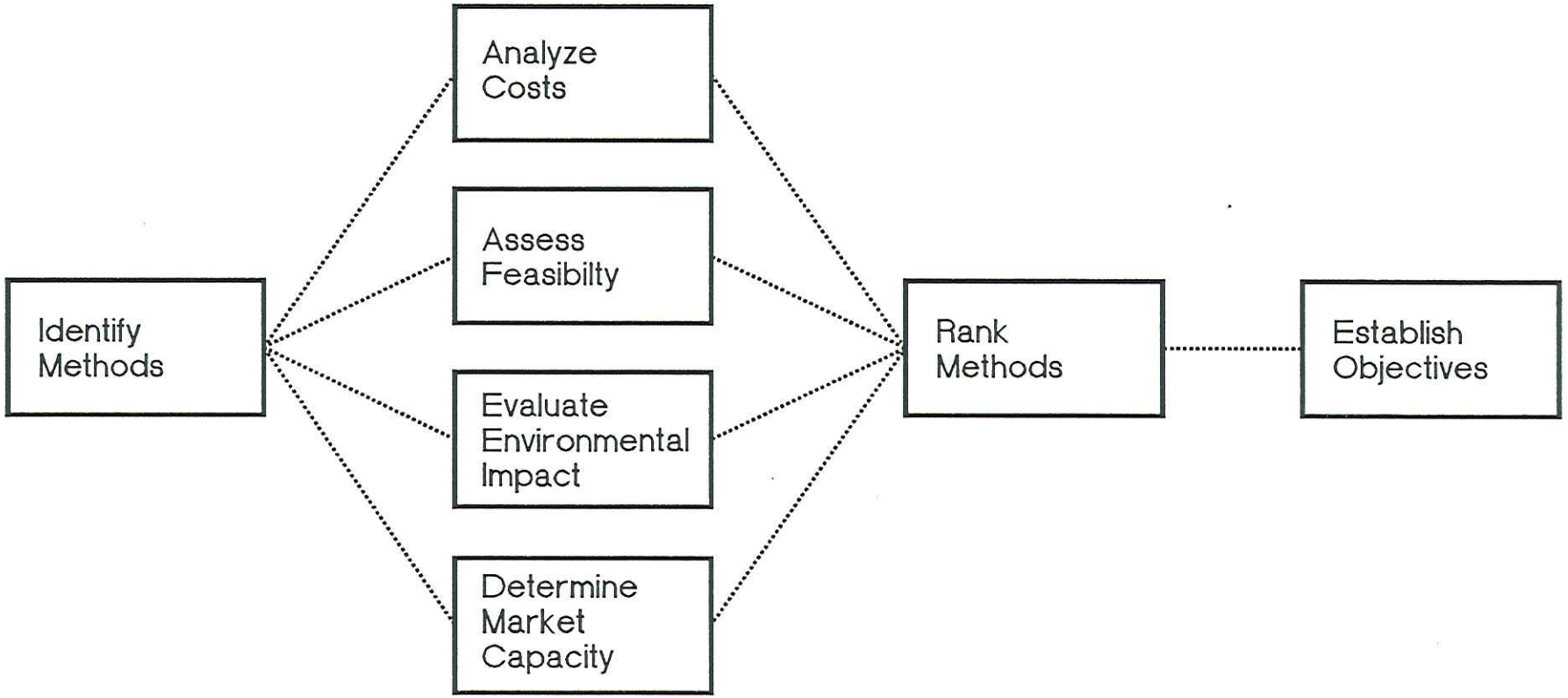
- Presents statewide policy recommendations to support the implementation of Best Management Practices for solid waste.

b. Approach

Barriers to effective solid waste management, recommended strategies for market development, recommendations for handling special waste and policy recommendations were developed through an interactive process involving representatives from the public sector, from business and from the waste management

Figure 2

WGA Recommendations



and recycling industry. Members of the Washington State Recycling Association Technical Advisory Committee and the WGA working groups were involved in identifying solid waste management barriers. These groups also helped guide the development of market development strategies and special waste recommendations. The WDOE Advisory Committee identified policy issues and helped shape final recommendations.

4. Cost-Effectiveness

An economic model was developed to determine solid waste management costs for each of the Waste Generation Areas. First, cost estimates were calculated for each of the potential waste management methods. These costs, as well as WGA-specific data for population, waste stream quantities and composition, were incorporated in the model to determine system costs. The selection of alternative waste management methods resulted in varying costs and levels of recycling. By looking at overall system costs, cost-effective methods were identified. These were defined as methods for which costs per ton were equal to or less than the overall system cost per ton. Costs were developed for new programs that meet the State's Minimum Functional Standards.

5. Technical Feasibility

Technical feasibility was defined as the potential exposure to loss or failures associated with the implementation and operation of each solid waste management method. An exposure to loss assessment was developed for the State as a whole. Factors taken into account included:

- Siting (potential public opposition, difficulty and cost of permitting)
- Waste supply (quantity and composition)
- Markets
- Vendors
- Technology (ability to construct, operate and maintain)
- Residue disposal (characteristics and site availability)
- Financing
- Other uncontrollable circumstances

The WGA working groups reviewed these assessments. Variances in WGA-specific assessments were documented. Based on the WGA reviews, the statewide technical feasibility assessment was revised and WGA-specific assessments were completed.

6. Environmental Impact

Environmental impacts associated with each of the potential solid waste management methods were first identified. WGA working group concerns were also documented. Two environmental impact assessments were conducted for each Waste Generation Area. The first, a "mitigated assessment" assumed facilities using the best available technology. It was also assumed that appropriate mitigation measures would be taken and that facilities would be operated by qualified personnel. The second, or "failure based assessment," assumed that potential failures could occur. These failures present potential

threats to the environment. Both of these assessments looked at all potential solid waste management methods and evaluated environmental elements including:

- Air quality
- Odor
- Water quality (surface and ground water)
- Noise
- Risk of explosion
- Public health risk
- Aesthetics
- Traffic

E. WASTE GENERATION AND RECYCLING IN WASHINGTON

Over five million tons of solid waste were generated in the State of Washington during 1987. This five million tons included both recycled materials and disposed waste. Disposed waste consists of four separate substreams: residential, commercial and manufacturing, and self-hauled waste. Residential, commercial, and manufacturing waste were hauled by firms in the business of transporting waste for profit, or by public entities. Self-hauled waste was taken to a drop box, transfer station, or disposal facility by individuals or businesses not normally engaged in waste hauling. The estimated tons and percentages of both recycled waste and disposed waste from each of the three major substreams appear in Figure 3.

Of the estimated 5,100,000 tons of waste generated in 1987, approximately 1,177,000 tons were recycled. This represents nearly 23% of all waste. Figure 4 shows the proportion of the waste stream which was recycled and its composition by weight. Ferrous metals, corrugated paper, and newsprint comprised almost 75% by weight of the recycled materials.

Almost four million tons of waste were disposed, approximately 77% of the total waste generated. Figure 5 depicts the composition of the waste disposed in Washington. Figures 6, 7, 8, and 9 estimate composition of residential, commercial, manufacturing, and self-haul disposed waste.

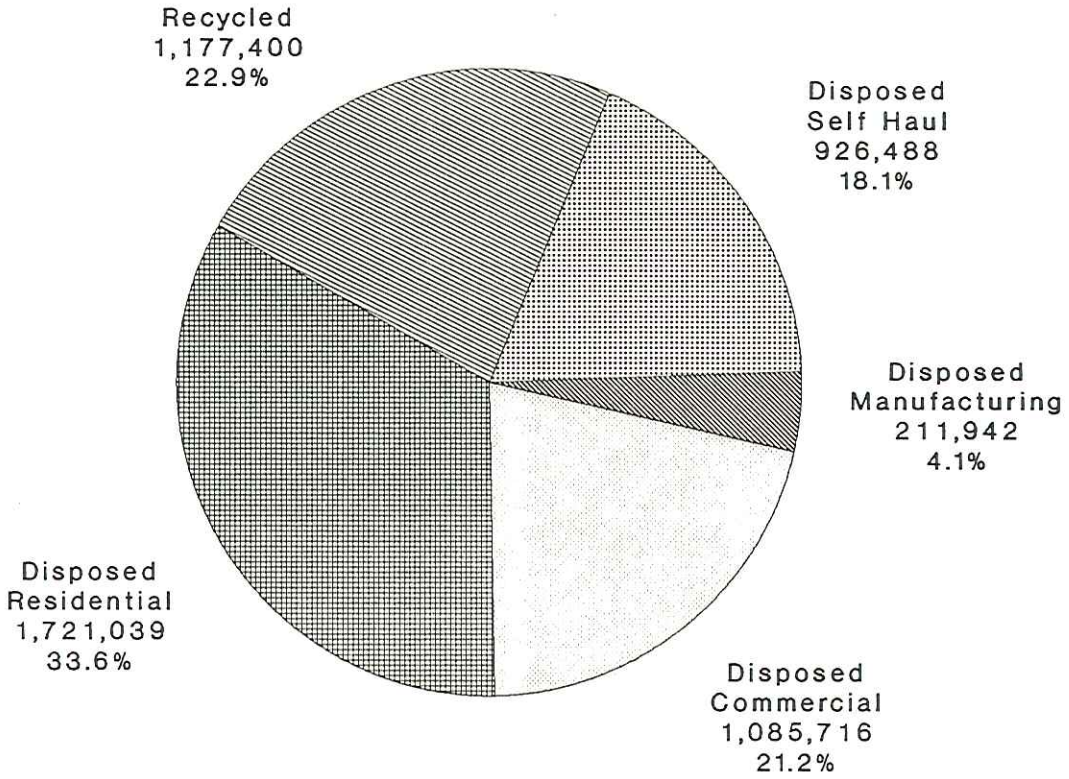
The proportion of disposed waste contributed by each of the major waste substreams--residential, commercial manufacturing, and self-haul--varies substantially among the Waste Generation Areas. The percentage contributed by each waste substream for each of the eight WGA's is presented in Volume I. Waste composition data for each WGA also appear in Volume I.

Overall, Washington residents dispose of approximately 2.1 pounds of waste each day. This does not include waste which is disposed by businesses or which is self-hauled to disposal sites, which amounts to another 2.7 pounds per person each day.

Recycling rates range from a low of 7.5% in the West WGA to a high of 26.8% in the Puget Sound WGA. Recycling rates for each of the WGA's are found in Figure 10.

Figure 3

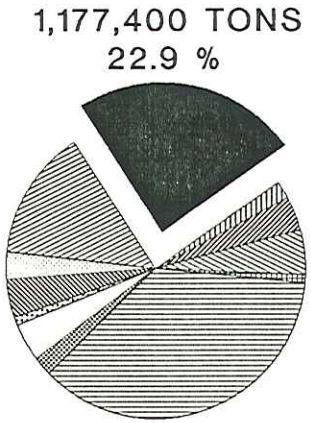
TOTAL GENERATED WASTE STREAM



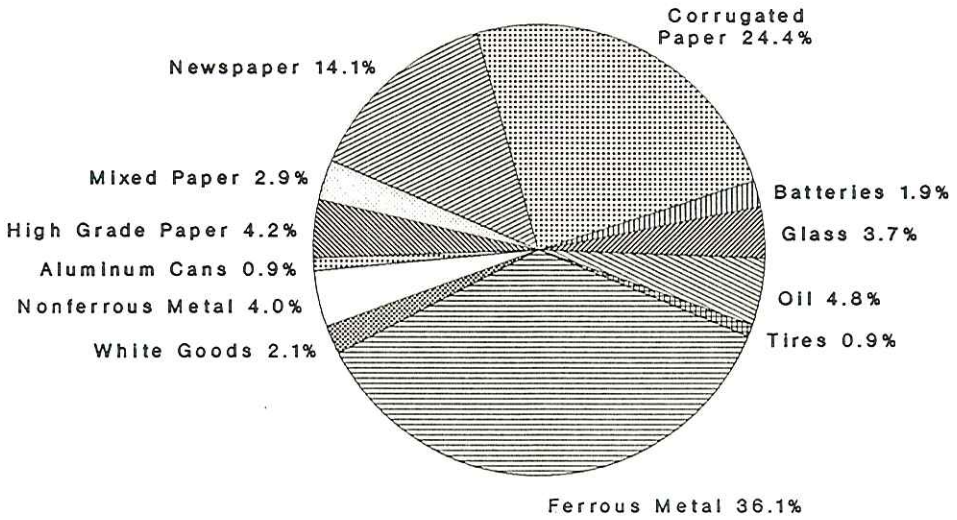
TONS AND PERCENTAGES
AS PORTIONS OF THE TOTAL
5,123,185 TONS GENERATED

Figure 4

RECYCLED WASTES



RECYCLED TONS
AS A PORTION OF THE TOTAL
5,123,185 TONS GENERATED

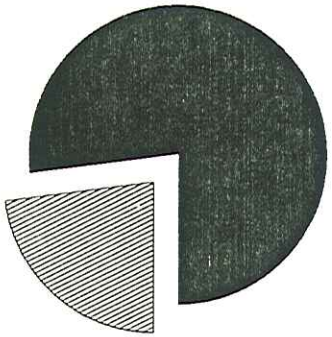


COMPOSITION BY WEIGHT
OF RECYCLED WASTES

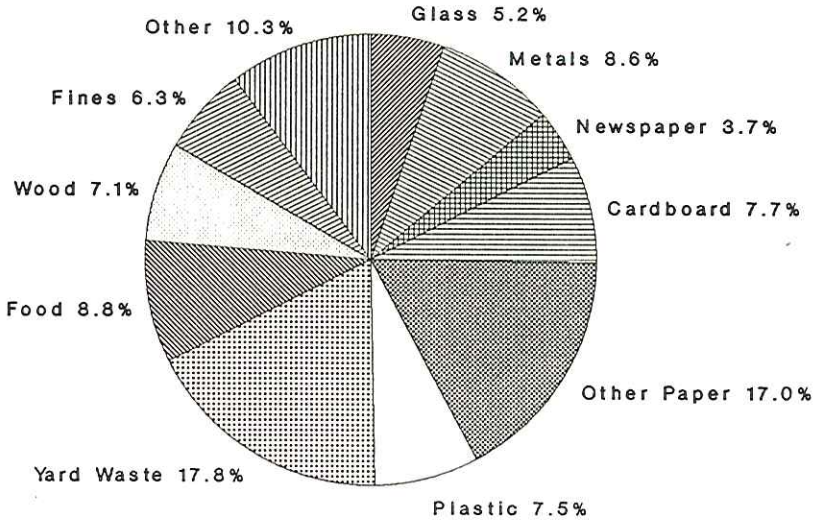
Figure 5

TOTAL DISPOSED WASTES

3,945,785 TONS
77.0 %



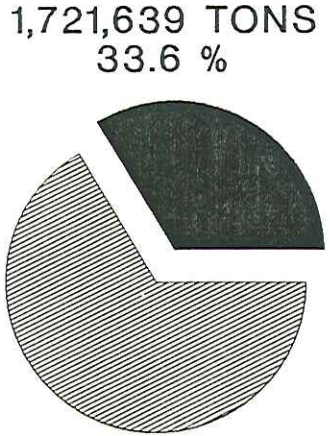
TOTAL DISPOSED TONS
AS A PORTION OF THE TOTAL
5,123,185 TONS GENERATED



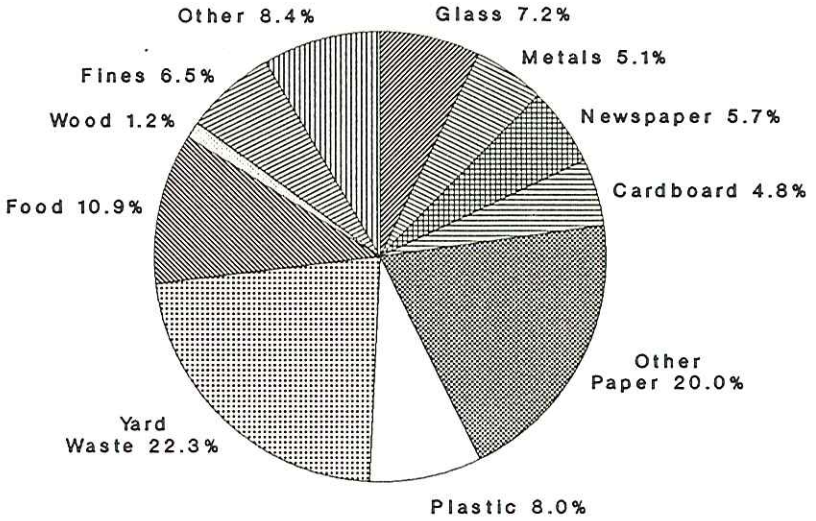
COMPOSITION BY WEIGHT
OF TOTAL DISPOSED WASTES

Figure 6

DISPOSED RESIDENTIAL WASTES



DISPOSED RESIDENTIAL TONS
AS A PORTION OF THE TOTAL
5,123,185 TONS GENERATED

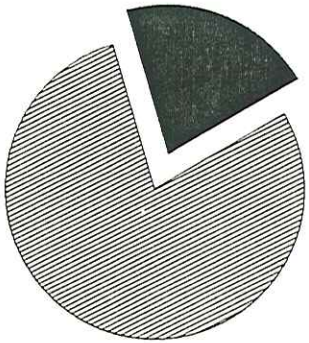


COMPOSITION BY WEIGHT OF
RESIDENTIAL DISPOSED WASTES

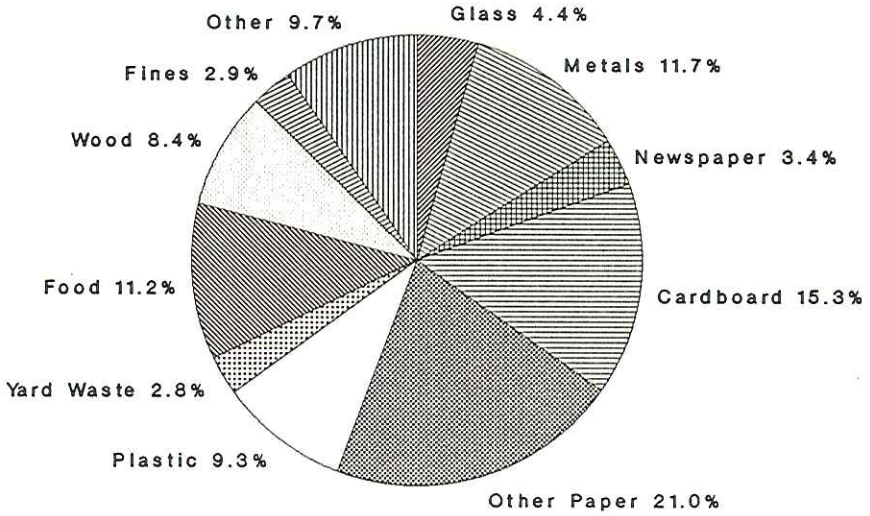
Figure 7

DISPOSED COMMERCIAL WASTES

1,085,716 TONS
21.2 %



DISPOSED COMMERCIAL TONS
AS A PORTION OF THE TOTAL
5,123,185 TONS GENERATED

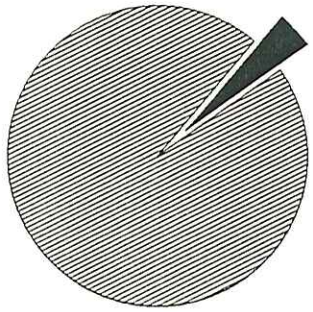


COMPOSITION BY WEIGHT OF
COMMERCIAL DISPOSED WASTES

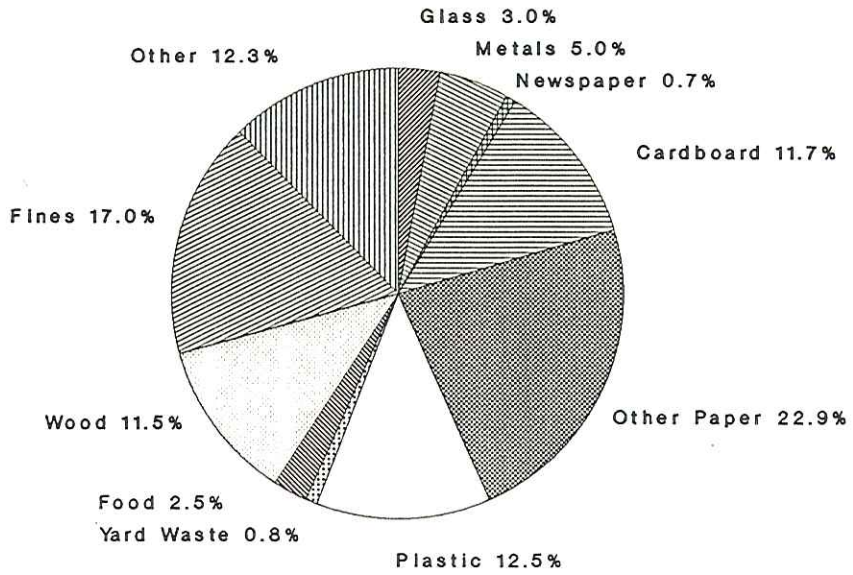
Figure 8

DISPOSED MANUFACTURING WASTES

211,942 TONS
4.1 %



DISPOSED SELF HAUL TONS
AS A PORTION OF THE TOTAL
5,123,185 TONS GENERATED

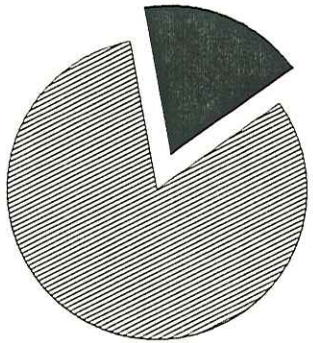


COMPOSITION BY WEIGHT OF
SELF HAUL DISPOSED WASTES

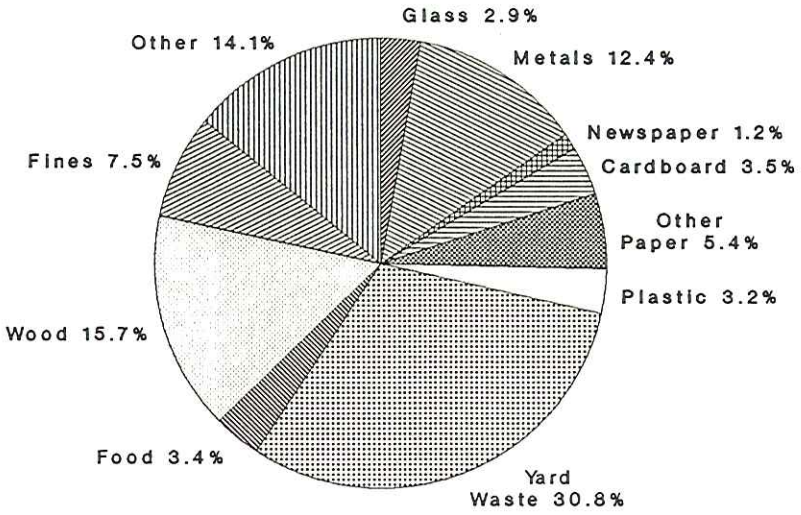
Figure 9

DISPOSED SELF HAUL WASTES

926,488 TONS
18.1 %



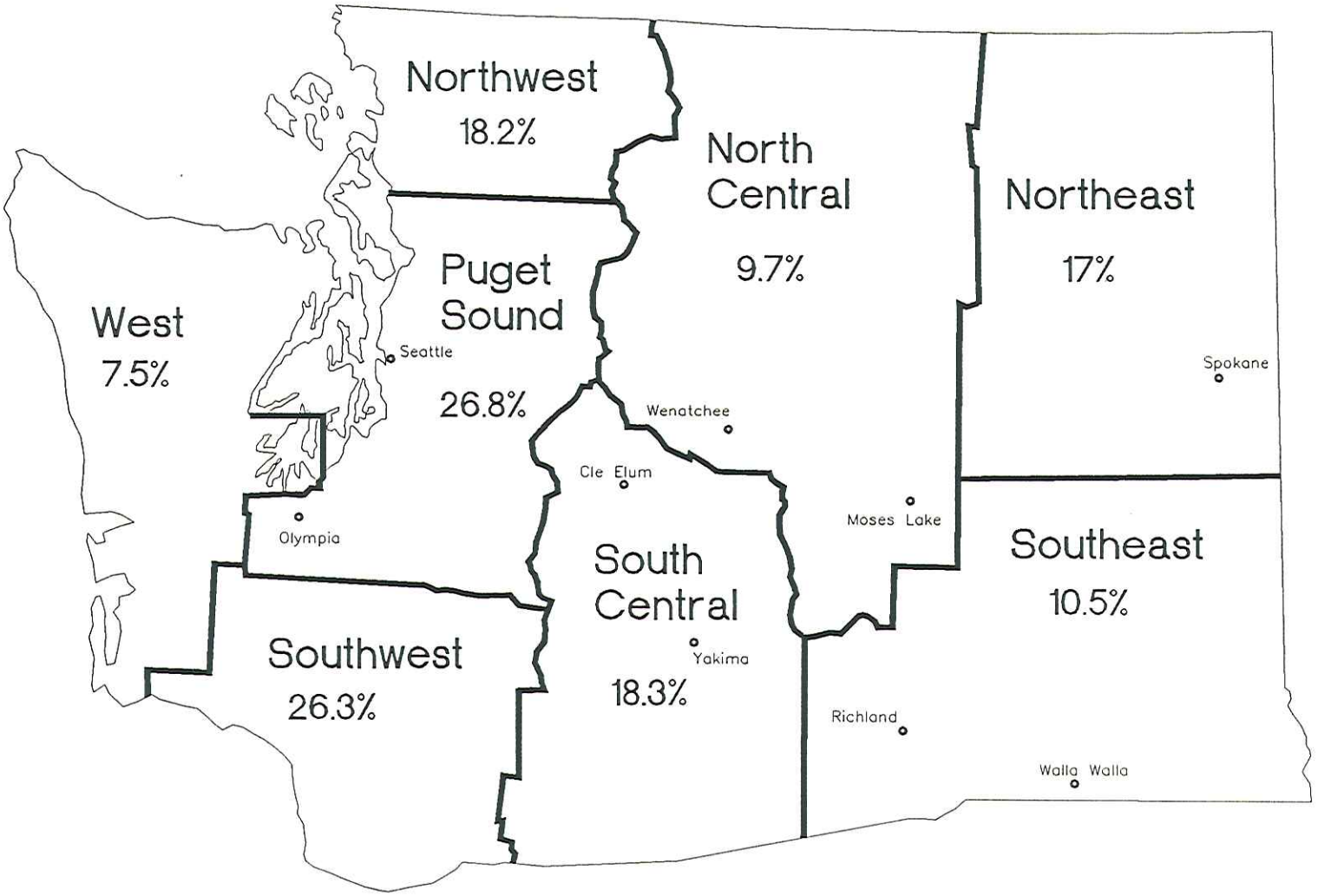
DISPOSED SELF HAUL TONS
AS A PORTION OF THE TOTAL
5,123,185 TONS GENERATED



COMPOSITION BY WEIGHT OF
SELF HAUL DISPOSED WASTES

Figure 10

WGA Recycling Rates



F. BARRIERS TO BEST MANAGEMENT PRACTICES FOR SOLID WASTE

Barriers to effective solid waste management are impediments to the implementation of Best Management Practices. They are obstacles surmountable by enacting new policies. As such, they were identified primarily to focus attention on those policies which would yield the greatest results and move the State toward implementation of Best Management Practices for solid waste. Barriers are presented here first by major program area: waste reduction, recycling and disposal and then by solid waste management method.

1. Program Barriers

The Best Management Practices Analysis identified the following major program barriers:

- Waste Reduction
  - Lack of awareness and motivation. (Both on the part of manufacturers and consumers)
  - Cultural bias, the wastefulness inherent in a "throw-away" society.
  - The cost of disposal not being reflected in products' prices.
- Recycling
  - Uncertain, undeveloped markets.
  - High transportation cost/tariffs.
  - Lack of county authority to establish collection programs.
  - Lack of coordination/communication among cities and counties.
- Disposal
  - Difficulty of siting facilities.
  - Public perception of high risk.

2. Method Barriers

Method-specific barriers and related policy recommendations appear in Table 1.

TABLE 1

BARRIERS TO RECOMMENDED METHODS

	Barriers	Recommendations
REDUCTION METHODS:		
Education/Awareness	o Minimal national influence on both consumers and producers	o Require education and promotion o Initiate packaging reduction and recycling
Incentives/Disincentives	o Lack of political acceptability o Administrative complexity o Uncertainty of predicted effects in marketplace	o Require education and promotion o Provide rate incentives
Special Governmental Programs	o Institutionalized wasteful practices o Inconsistent sense of priority	o Require waste plans for new development o Provide waste audits
Waste Exchange	o Difficulty in matching supply and demand	o Support waste exchange(s)
Home Yard Waste Composting	o Cheaper and easier to put out with the trash	o Encourage on-site composting of yard waste
RECYCLING METHODS:		
Curbside Collection	o State law regarding definition and ownership of solid waste	o Permit counties to establish collection/drop-off systems and direct flows o Provide for cross-jurisdictional collection
Multi-Family Housing Collection ...	o Lack of internal collection systems and space o Potential high costs	o Require waste plans for new construction
Commercial Source Separated ..... Collection	o Lack of efficient internal system and space o Lack of incentives for both haulers and building owners/ managers	o Require waste plans for new construction o Support commercial collection o Provide rate incentives o Establish diversion payments
Commercial High-Grade Collection ..	o Lack of incentives for haulers	o Support commercial collection o Provide rate incentives o Establish diversion payments

TABLE 1

BARRIERS TO RECOMMENDED METHODS
(continued)

	Barriers	Recommendations
RECYCLING METHODS: (cont.)		
Drop-Off/Buy-Back Centers	o Fluctuations in markets and recovery volumes o Lack of convenience	o Support drop-off/buy-back operations o Develop markets o Establish lower, simpler intra-state tariffs o Establish diversion payments o Provide facilities at all sites o Require education and promotion
Centralized Yard Waste Composting .	o Uncertain markets and lack of product standards o Little operating experience in Northwest	o Support centralized yard waste composting o Develop markets o Establish diversion payments o Provide facilities at all sites o Require education and promotion
Mixed Waste Processing	o Variable product quality and uncertain markets o Systems untried in Northwest	o Consider mixed waste processing o Develop markets o Establish diversion payments
MSW Composting	o Variable product quality and uncertain markets o Potential contaminants and liability	o Consider mixed waste processing o Develop markets o Establish diversion payments
Food Waste Processing	o Systems untried in Northwest	
DISPOSAL METHODS:		
Incineration/Energy Recovery	o Environmental concerns o Lack of RDF markets o Residue disposal/uncertainty of ash regulations	o Improve incineration operation o Conduct RDF market analysis/ eliminate barriers o Resolve ash disposal issues o Undertake global impact analysis
Landfills	o Environmental concerns	o Undertake global impact analysis

G. RECOMMENDED METHODS FOR MANAGING SOLID WASTE

1. Introduction

Solid waste management methods are processes for reducing, recycling, handling, processing, or disposing of solid waste. Table 2 lists solid waste management methods that could be implemented in Washington.

The methods are grouped under four program categories:

- Reduction
- Recycling
- Handling
- Disposal

Each of these methods was evaluated and ranked for each of the eight Waste Generation Areas.

TABLE 2

POTENTIAL METHODS FOR MANAGING SOLID WASTE IN WASHINGTON

Program	Method
Reduction	Education
	Incentives/Disincentives
	Special Governmental Programs
	On-site Composting of Yard Waste
	Waste Exchanges
Recycling	Reuse
	Education
	Incentives/Disincentives
	Special Governmental Programs
	Drop-off/Buy-back Centers
	Residential Curbside Collection
	Multi-family Housing Collection
	Commercial Source Separation/Collection
	Commercial High-Grade Collection
	Centralized Yard Waste Composting
	Mixed Municipal Solid Waste Processing
	Mixed Municipal Solid Waste Composting
	Food Waste Processing
	Special Waste Recycling and Reuse

TABLE 2
(Continued)

Program	Method
Handling	Transfer Long Haul
Disposal	Incineration/Energy Recovery Solid Waste Landfills Ashfills

2. Cost-Effectiveness

Cost-effectiveness of solid waste management methods varied dramatically among Waste Generation Areas. However, several general conclusions did emerge:

- The cost-effectiveness of reduction methods is difficult to measure. There is no data concerning the return (quantities reduced) on an investment in implementing reduction methods. While these strategies have the potential to significantly reduce the waste stream, the cost to achieve these reductions is not known. Based on a run of the economic model that considered conditions statewide, an across-the-board reduction of 5% in disposed waste yielded a savings of $8.7 million. Therefore, an investment up to this amount would be justified, if a 5% reduction were achieved.

- The cost-effectiveness of source-separated recycling collection methods ("curbside" collection from both residential and commercial generators) depends on the quantity of materials collected. Where larger volumes of recyclable materials are generated, primarily in urban areas, curbside collection is cost-effective. Where these volumes are smaller, primarily in rural areas, cost-effectiveness of curbside collection decreases. The factors that determine the cost-effectiveness of curbside methods include: waste quantity and composition, amount of self-hauled waste and distance to markets for recyclables.

- Separate collection of recyclable material from multi-family generators appears to be cost-effective only in those areas where there are concentrations of multi-family complexes having more than 5 or 6 units per site. This configuration of multi-family housing occurs primarily in larger urban areas.

- On-site collection and centralized composting of yard waste is usually cost-effective. The net cost per ton is slightly less than collection and disposal costs for mixed municipal solid waste. Composting self-hauled yard waste is less expensive than disposal. Where tipping fees exceed $30-per-ton composting is a best management practice.

- Drop-off and buy-back methods are highly cost-effective. In fact, they show a net revenue. This is not surprising since existing systems are for the most part privately operated for profit.

- Collecting commercially generated, source-separated recyclables and sorting targeted commercial high-grade loads are both cost-effective methods where there are sufficient quantities to justify one or more routes. Existing programs have proven to be profitable for private haulers and recyclers.

- Mixed waste processing is cost-effective where there are sufficient quantities of waste and markets. This method would be most cost-effective in urban areas or if operated regionally. The cost-effectiveness of this method, however, depends on the existence of markets for recovered recyclable materials as well as on a market for mixed solid waste compost. At this time, markets are limited or non-existent for mixed solid waste compost.

- The costs of final disposal methods, incineration and landfilling, are fairly comparable, particularly over the long run. The impacts of disposal methods extend beyond the solid waste management system and the region in which they are located. The effects include long-term global environmental impacts, such as the "greenhouse effect" and the depletion of virgin materials. These, more than relatively short-term system costs, should receive greater consideration in the evaluation of disposal alternatives.

- The preparation of refuse derived fuel (RDF) would be a cost-effective method if markets existed for refuse-derived fuels. Markets are limited due largely to regulatory concerns surrounding air emissions.

3. Technical Feasibility

General conclusions drawn from the technical feasibility assessments conducted for each of the eight WGA's include:

- Technical feasibility or potential exposure to loss varies significantly among methods.

  - Exposure to loss is greater with capital intensive methods.
  - Exposure to loss is also greater with less-proven methods such as pyrolysis and anaerobic decomposition.

- The factors which contribute most to exposure to loss are:

  - Siting problems
  - Availability of markets

- The results of technical feasibility analysis vary little among WGA's.

4. Environmental Impact

The Waste Generation Area environmental impact assessments lead to a number of general conclusions:

- Environmental impacts will vary with the specific site and the design of each facility.

- Environmental concerns vary dramatically among the WGA's.

- When best available technology is used under mitigated conditions--environmental impacts are minimal. Failure-based impacts caused, for example, by a leak in a landfill liner or by the inefficient operation of incinerator emission control equipment--vary among the Waste Generation Areas.

- Failure-based impacts also vary among methods:

  - Potential impacts are greater for failures in high technology methods, especially disposal methods.

  - Failure-based impacts are lower for recycling and waste processing methods.

- Air quality and ground water have the greatest susceptibility to degradation.

5. Recommendations

Potential solid waste management methods were ranked in order to identify "Best Management Practices" for each of the eight Waste Generation Areas. Methods were ranked by both WGA working groups and by the consultant team.

Reduction, recycling, and disposal methods were ranked separately. Individual rankings by both the WGA working groups and the consultants appear in Volume II for each of the WGA's. Recommended reduction methods include:

- Education

- Incentives and disincentives

- Special governmental programs

- On-site composting of yard waste
- Waste exchanges

Recommended recycling methods depend upon the waste substream (residential or commercial) and whether the service area is urban or rural.

There is little evidence to support the selection of one disposal method over another. Best management practices for disposal of waste should be based upon site-specific conditions and on local preferences.

Table 3 lists recommended methods by program and relative statewide rankings for cost-effectiveness, technical feasibility, and environmental impact.

TABLE 3

RECOMMENDED MANAGEMENT METHODS

	Cost-Effectiveness	Technical Feasibility	Environmental Impact
REDUCTION METHODS:			
Education	High	High	Low
Incentives/Disincentives	Moderate	Moderate	Low
Special Governmental Programs	High	High	Low
On-Site Composting of Yard Waste	High	Moderate	Low to Moderate
Waste Exchanges	Moderate	Moderate	Low to Moderate
RECYCLING METHODS:			
Education	High	High	Low
Drop-Off/Buy-Back	High	Moderate-High	Low to Moderate
Commercial Source-Separated Collection	Moderate to High[1/]	Moderate to High	Low
Curbside Collection	Varies[2/]	Moderate to High	Low
Centralized Yard Waste Composting	Moderate	Moderate to High	Low to Moderate
Incentives/Disincentives	Moderate	Low to Moderate	Low
Commercial High-Grade Collection	Moderate to High[1/]	Moderate to High	Low
Multi-Family Collection	Low	Moderate	Low
Mixed Waste Processing	Low to Moderate	Low to Moderate	Moderate to High
DISPOSAL METHODS:			
Incineration/Energy Recovery	Moderate	Moderate	Moderate to High
Long-Haul	Moderate	Moderate to High	Low to Moderate[3/]
Landfill	Moderate	Moderate	Moderate to High

1/ - Depends on existence of commercial waste stream.
2/ - Varies primarily based on quantity of available recyclables.
3/ - Does not consider impact at point of disposal.

H. RECOMMENDED METHODS FOR CATEGORIES OF SOLID WASTE

1. Major Categories

Substitute House Bill No. 1684 directed the Department to determine best management practices for categories of solid waste that "comprise a large volume of the solid waste stream or present a high potential of harm to human health." Recommendations for managing major categories of solid waste appear in Table 4. Recommendations for categories of special waste, potentially harmful materials, are presented below, in Subsection 2.

Table 4 lists major categories of solid waste that comprise a large volume of the waste stream. For each of these categories, recommended waste reduction methods, recycling methods, and disposal methods are provided.

2. Special Waste

The legislation mandating the Best Management Practices Analysis for Solid Waste specified the evaluation of certain "special wastes" that pose a potential threat to human health. A summary of recommendations concerning these special wastes appears below. Recommendations are provided for tires, batteries, disposable diapers, waste oil and expanded polystyrene.

a. Waste Tires

- Regulate collection and disposal.
- Develop markets.
- Increase contributions to tire fund.
- Assess feasibility of regional processing.

b. Batteries

- Regulate sales, collection, and disposal.
- Assess the effectiveness of incinerator emissions controls, separation methods, and product labeling.
- Support efforts to educate the public about recycling and environmentally sound disposal.
- Establish procurement preference for rechargeable batteries.

c. Disposable Diapers

- Consider standards for disposable diaper design which encourage recycling.

- Clarify existing regulations governing disposal of disposable diapers.
- Provide education about alternatives to disposable diapers.
- Consider encouraging diaper services to operate in unserved areas.
- Evaluate the effectiveness of privately supported disposable diaper recycling operations.
- Consider a product tax or charge.
- Develop a disposable diaper waste management plan.

d. Waste Oil

- Eliminate potential hazardous waste liability for collectors.
- Expand "Do It Yourself" collection network:
  - fund the acquisition of equipment
  - provide incentives
  - require collection by retailers
- Support promotion/education programs, such as Ecology's used oil program.
- Procure re-refined oil.

e. Expanded Polystyrene

- Ban the manufacture, sale, and use of products using chlorofluorocarbons (CFC's) as a blowing agent.
- Determine if degradability of certain products is an appropriate management strategy.
- Include in the State's effort to reduce and recycle packaging in the waste stream.

TABLE 4

RECOMMENDED METHODS
FOR
MAJOR CATEGORIES OF SOLID WASTE

Category of Waste	% of Waste Stream	Reduction Methods	Recycling Methods	Disposal Methods
Yard Waste:	18%	On-site composting of yard waste	o Centralized yard waste composting o Incentives/disincentives	None are appropriate
Recyclable Paper:	23%	All, except on-site composting: o Education o Incentives/disincentives o Special governmental programs o Waste exchanges	o Drop-off/buy-back o Curbside collection o Commercial source-separated collection o Commercial high-grade collection o Multi-family collection o Incentives/disincentives o Mixed waste processing	All (should be minimized)
Non-Recyclable Paper:	5%	All, except on-site composting	None	All
Food:	9%	All, except on-site composting and waste exchange	o Mixed waste processing	All
Wood:	7%	All, except on-site composting	o Drop-off/buy-back o Commercial high-grade collection o Mixed waste processing	o Dedicated construction/ demolition landfills o Incineration (should be minimized)
Glass:	5%	All except on-site composting	o Drop-off/buy-back o Curbside collection o Commercial source-separated collection o Commercial high-grade collection o Multi-family collection o Incentives/disincentives o Mixed waste processing	All (for non-recyclable items such as light bulbs and mirrors)

TABLE 4
(Continued)

Category of Waste	% of Waste Stream	Reduction Methods	Recycling Methods	Disposal Methods
Metals:	9%	All except on-site composting	o Drop-off/buy-back o Commercial source-separated collection o Mixed waste processing o Curbside collection	Landfills (should be minimized)
Plastics:	7%	All except on-site composting	o Drop-off/buy-back o Curbside collection o Commercial source-separated collection o Multi-family collection o Commercial high-grade collection o Incentives/disincentives o Mixed waste processing	All, for that which is not recyclable

I. MARKETS FOR RECYCLABLES

1. Major Findings

Without end-use markets, recyclable materials would end up back in the waste stream. Therefore, an assessment of markets for recyclable commodities was a major consideration in the study. The market assessment addressed two questions:

- Do current markets have the capacity to accommodate increased supplies of recyclable materials?
- What impact will publicly supported collection of recyclables have on the existing recycling industry?

Markets for recyclable commodities are driven by demand. Factors that impact demand and thus the price for recyclable commodities include:

- The availability and price of virgin materials.
- International market conditions as compared to more limited state or regional markets.
- The health of domestic and global economies.
- Currency exchange rates.
- Capacity of mills and smelters to use recyclable commodities.

Supply, unless it is expanded through publicly supported programs,is in turn a function of commodity prices as well as transportation and processing costs. These and other factors affecting markets change constantly.

To determine market capacity, these factors were analyzed by the consultants with assistance from the Washington State Recycling Association (WSRA) Technical Advisory Committee. Most of the WSRA participants were private industry experts who deal daily in recycling commodities markets. An economic analysis of historical data and an econometric model were used to predict future market conditions. These analyses lead to the following conclusions:

- Markets exist for all paper grades except mixed waste paper, all non-plastic food and beverage containers, and all ferrous and non-ferrous scrap metals. These markets have the capacity to accommodate gradually increasing quantities of these materials.
- Markets exist for mixed waste paper and for plastics only in those WGA's located near the Ports of Portland and Seattle. Current prices are insufficient to cover processing and transportation costs from more distant Waste Generation Areas.

- Markets exist for lawn and garden waste and for "white goods" (used appliances such as stoves and refrigerators) only if recyclers are compensated for avoided disposal costs; recyclers will have to be paid to handle these materials.

- Publicly supported recycling in Washington will not by itself decrease the prices private sector recyclers receive for materials which compete in an international marketplace. The aggregate demand in the world marketplace will not be significantly affected by an increase in the supply of recyclable commodities from Washington State. Regional markets can accommodate gradually increasing quantities of recyclable commodities.

- Publicly supported recycling will decrease the quantities of recyclables recovered by the private sector, thus private sector revenues will be adversely affected. Existing drop-off and buy-back services will likely be used less where collection programs provide a more convenient service.

- Increased collection of recyclables across the U.S. is likely to cause a decrease in prices, primarily for recycled paper. Without an increase in the demand for secondary paper fibers, the impact on the private recycling industry could be severe. Over the long term, lower prices should serve to increase demand for secondary paper fiber. This will not, however, alleviate the immediate threat to the existing recycling industry. This threat is aggravated by the potential loss of the refillable beer bottle market.

A general description of markets for recyclable commodities is described below. Market capacity is summarized in Table 5.

a. Waste Paper

Waste paper is sold on a global market. Supplies from Washington State are consumed by mills and other end-users in the Pacific Northwest, the rest of the nation and overseas. Markets for corrugated containers and high-grade waste paper continue to show a strong demand, though prices fluctuate. Demand for used newspaper has been consistent in the past, with some seasonal variations. Worldwide prices may decrease over the next few years as a result of rapidly increasing supplies, primarily from new East Coast recycling programs. This may reduce prices paid for newspaper from Washington. Demand for mixed waste paper is historically lower. This is reflected in an end-user price which does not currently cover transportation and handling costs for some Waste Generation Areas.

b. Glass

Container glass, or cullet, from Washington State is processed in Seattle and Portland plants. There appears to be sufficient capacity and demand to make use of recovered glass. Green glass is in less demand than

TABLE 5

MARKET CAPACITY

Commodity	Market	Special Conditions
Paper ..... (corrugated, newspaper, office and other high grades)	Yes	Under gradually expanding markets
Mixed Waste Paper	Yes, in some WGA's	Primarily in areas near Portland and Seattle
Glass	Yes	Markets for refillable bottles will no longer exist if use of these bottles is discontinued
Metals	Yes	Market for tin cans is marginal in WGA's, more distant from Seattle
Plastics	Limited	Developing markets in urban areas
Organics	Limited	Mainly lawn and garden compost products in western Washington

clear and brown glass. Consistent prices and freight allowances permit cost-effective recovery of glass from most communities in the State. Refillable glass containers have enjoyed a stable market; however, this trend will be reversed if local breweries discontinue refilling beer bottles.

c. Scrap Metals

The demand for used aluminum cans, ferrous metals, and non-ferrous metals is strong. Capacity for reprocessing these higher-value metals is more than adequate. Scrap tin cans from throughout the Northwest are processed in Seattle. The processing plant has enough capacity to more than double its current consumption of post-consumer supplies. Given tin cans' low value, costs of preparing and transporting them to market make their recycling marginal in some Waste Generation Areas.

White goods require handling and processing which together, cost more than they are worth under current prices. It is cheaper, however, in most areas of the State, to process and transport these materials rather than dispose of them. End-user prices and demand for white goods have weakened in the last two years, due to concerns over environmental liability.

d. Plastic

Post-consumer plastics recycling is in the developmental stages. Collection, processing, and marketing infrastructure is receiving attention in Washington. Limited supplies are currently recovered from the State. It is not possible to predict with any certainty the future demand for plastic. Recovery efforts currently focus on PET (polyethylene terephthalate) and HDPE (high-density polyethylene) as well as flexible plastic packaging and films. Some areas of the State may be able to market significant quantities of recovered plastics in the near future.

e. Organics

Yard waste is the organic component of the municipal waste stream with the greatest market potential. Limited collection, processing, and composting of yard wastes is occurring in western Washington. Compost markets for yard waste are generally localized.

Communities developing recovery programs for yard waste should be willing to pay a processing fee, since this is generally lower than disposal costs. The local ability to market compost products should be determined prior to implementation of a yard waste recovery program.

2. Market Development Recommendations

Market uncertainty is a primary barrier to recycling. Successful recycling depends on expanding demand as well as on increasing supply. New demand will strengthen the existing system. Existing drop-off and buy-back operations are threatened by increased publicly sponsored collection and the associated decline in world prices. The following market development strategies are organized according to which agency has primary responsibility for implementation of the strategy.

a. Washington State Legislature

- Develop a state policy supporting the recycling of plastics.
- Establish an ombudsman role to mediate regulatory conflicts hampering the recycling industry.

b. Department of Ecology

- Fully fund and implement previously authorized market development activities.
- Evaluate and modify market development activities and strategies now and in the future.
- Develop standard product specifications for compost and other organic materials.
- Initiate and support market development activities at the regional and federal levels.
- Establish a clearinghouse for market information.
- Assist potential yard waste processors in meeting regulatory requirements.
- Promote the use of recyclable materials and the purchase of recycled products.
- Promote organic products such as compost in areas where processing capacity is being developed.

c. Department of Trade and Economic Development

- Support recycling businesses and industries by:
  - Providing funding assistance for new ventures.
  - Encouraging new businesses to use secondary materials.
  - Promoting diversified uses of recoverable waste materials.
- Encouraging the expansion of export markets for recyclable materials.

d. Office of Procurement, Department of General Administration

- Increase procurement of products with recycled content and products which are recyclable:
  - Modify purchasing specifications.
  - Identify suppliers.

- Provide assessment of ability to use recycled products.
- Establish bid price preferences.
- Consolidate purchases of recycled products.
- Set goals for testing new recycled products.

e. Local Governments

- Develop recycling collection programs for materials such as plastics, wastepaper and yard waste which are flexible and which have the ability to respond to fluctuating market conditions.

- Procure recycled products.

- Coordinate establishing market cooperatives for recyclable commodities.

f. Washington Utilities and Transportation Commission

- Establish lower, simpler intra-state tariffs for transporting recyclable materials.

J. CONCLUSIONS

1. Waste Reduction

Limited reduction efforts are being undertaken in response to increased disposal costs. As garbage rates continue to climb, reduction efforts should also increase. The potential for effective waste reduction is significant. Depending on the method, these efforts can be highly cost-effective. Also, the environmental impacts of these methods are relatively low. Based on anticipated disposal costs, investments in effective waste reduction will pay. In addition to supporting private initiatives, local and state governments should promote waste reduction by providing information and assistance as well as by structuring garbage rates which encourage waste reduction.

2. Recycling

Washington State currently enjoys a high recycling rate, estimated at approximately 23%. However, levels of recycling vary from region to region, with the highest rates occurring in the Puget Sound area.

Source-separated recycling methods are preferred over methods where waste is sorted or processed after collection. Most recycling methods have relatively low environmental impact. Generally, cost-effective methods include drop-off and buy-back operations, collection and composting of yard waste, collection of commercial source-separated recyclables, and high-grade loads. Cost-effectiveness of residential curbside collection depends on the amount of recyclable materials which are available for collection as well as on distance to markets. The potential for increased recycling within the State of Washington is substantial. Much of what is currently disposed, both by residences and by businesses, is recyclable.

3. Disposal Methods

There are no truly preferred disposal methods. Best management practices depend on local conditions. Over the long term, costs are comparable. All methods pose potential environmental threats. An assessment of the global environmental impacts of disposal methods should be undertaken and used to guide future evaluations of disposal alternatives.