BEST MANAGEMENT PRACTICES ANALYSIS FOR SOLID WASTE

VOLUME TWO

Eight Waste Generation Area Findings

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TABLE OF CONTENTS

Section Number	Section and Subsection Title	Page Number
A.	INTRODUCTION, PURPOSE AND OVERVIEWS	
	1. Purpose	A-1
	2. Approach	A-2
	3. Definitions	A-2
B.	POTENTIAL SOLID WASTE MANAGEMENT METHODS	
	1. Introduction	B-1
	a. General	B-1
	b. Organization	B-1
	2. Environmental Impact Procedures Common to Program Methods	B-2
	a. Methodology	B-2
	b. Screening Evaluation	B-3
	c. Environmental Impacts Common to Several Methods	B-6
	d. Global Environmental Impacts	B-11
	3. Reduction Program Methods	B-11
	a. Introduction	B-11
	b. Education	B-13
	c. Incentives/Disincentives	B-15
	d. Special Government Programs	B-17
	e. Waste Exchange	B-18
	f. Home Yard Composting	B-18
	g. Environmental Impacts	B-20
	4. Recycling Program Methods	B-20
	a. Introduction	B-20
	b. Reuse	B-21
	c. Recycling Support Programs	B-21
	d. Drop-Off/Buy-Back Depots	B-23
	e. Curbside Collection	B-27
	f. Multi-Family Housing Collection	B-35
	g. Commercial Source Separation/Collection	B-37
	h. High-Grade Commercial Collection	B-41
	i. Yard Waste Composting	B-42
	j. Mixed Municipal Solid Waste Processing	B-47
	k. Mixed Municipal Solid Waste Composting	B-51
	l. Food Waste Composting	B-57
	m. Special Waste Recycling and Reuse	B-59
	5. Solid Waste Handling Program Methods	B-65
	a. Introduction	B-65
	b. Transfer	B-66
	c. Long Haul	B-67
	6. Disposal Program Methods	B-69
	a. Introduction	B-69
	b. Incineration/Energy Recovery Method Technologies	B-69
	c. Solid Waste Landfills	B-79
	d. Ashfills	B-86

TABLE OF CONTENTS
(Continued)

Section Number	Section and Subsection Title	Page Number
C.	MARKET CAPACITY	
	1. Introduction and Summary	C-1
	2. Methodology	C-4
	3. Existing and Near-Term Future Conditions	C-4
	a. Paper	C-4
	b. Glass	C-16
	c. Metals	C-21
	d. Plastics	C-33
	e. Organics	C-40
	f. Summary of Existing and Near-Term Future Market Conditions	C-44
	4. Analytical Framework	C-45
	a. The Conventional Wisdom	C-46
	b. A More Comprehensive Theory	C-46
	c. Two Important Caveats	C-48
	5. U.S. Production, Domestic Recovery, Export and Price Data for the Major Recyclable Commodities	C-49
	a. The Recycled Paper Fibers Industry	C-49
	b. The Scrap Aluminum Industry	C-50
	c. Tin and Ferrous Recycling	C-51
	d. Glass Containers Recycling	C-51
	e. Plastics Recycling	C-52
	f. Washington State Recovery Compared with National and International Recovery	C-52
	g. Past Versus Potential Future Growth Rates in Material Recovery	C-52
	6. Empirical Estimates for Price Elasticities	C-54
	a. WGA Demographic, Economic, and Recyclables Price-Quantity Data	C-54
	b. Estimated Supply Curves and Shift Factors	C-55
	c. Concluding Note on WGA Supply Price Elasticities	C-59
	7. Impact on Publicly Sponsored Recycling on Existing Recyclers	C-60
	a. Effects of WGA Level Public Recycling on the WGA's Existing Recyclers	C-60
	b. Effect of State Level Public Recycling	C-62
	c. Effect of Expanded National Recovery on Washington State's Existing Private Recycling Industry	C-62

TABLE OF CONTENTS
(Continued)

Section Number	Section and Subsection Title	Page Number
D.	ECONOMIC ANALYSIS	
	1. Introduction	D-1
	2. Objective	D-1
	3. Global Impacts	D-1
	4. Qualitative Economic Analysis	D-2
	a. Methodology	D-2
	b. Limitations	D-9
E.	EVALUATION OF BEST MANAGEMENT PRACTICES FOR EACH WGA	
	1. Introduction	E-1
	2. Methodology	E-3
	a. Introduction to Existing Methods	E-3
	b. Introduction to Market Capacity	E-4
	c. Evaluation of Methods	E-7
	d. Introduction to Ranking of Methods and Recommendations	E-14
	3. West WGA	E-16
	a. Introduction to West WGA	E-16
	b. Existing Solid Waste Management Methods	E-16
	c. Market Capacity	E-20
	d. Evaluation of Methods	E-20
	e. Ranking of Methods and Recommendations	E-22
	4. Northwest WGA	E-28
	a. Introduction to Northwest WGA	E-28
	b. Existing Solid Waste Management Methods	E-28
	c. Market Capacity	E-31
	d. Evaluation of Methods	E-31
	e. Ranking of Methods and Recommendations	E-33
	5. Puget Sound WGA	E-39
	a. Introduction to Puget Sound WGA	E-39
	b. Existing Solid Waste Management Methods	E-39
	c. Market Capacity	E-44
	d. Evaluation of Methods	E-44
	e. Ranking of Methods and Recommendations	E-46
	6. Southwest WGA	E-53
	a. Introduction to Southwest WGA	E-53
	b. Existing Solid Waste Management Methods	E-53
	c. Market Capacity	E-56
	d. Evaluation of Methods	E-57
	e. Ranking of Methods and Recommendations	E-61
	7. North Central WGA	E-68
	a. Introduction to North Central WGA	E-68
	b. Existing Solid Waste Management Methods	E-68
	c. Market Capacity	E-70
	d. Evaluation of Methods	E-71
	e. Ranking of Methods and Recommendations	E-73

TABLE OF CONTENTS
(Continued)

Section Number	Section and Subsection Title	Page Number
E.	EVALUATION OF BEST MANAGEMENT PRACTICES FOR EACH WGA (cont.)	
	8. South Central WGA	E-78
	a. Introduction to South Central WGA	E-78
	b. Existing Solid Waste Management Methods	E-78
	c. Market Capacity	E-80
	d. Evaluation of Methods	E-81
	e. Ranking of Methods and Recommendations	E-83
	9. Northeast WGA	E-89
	a. Introduction to Northeast WGA	E-89
	b. Existing Solid Waste Management Methods	E-89
	c. Market Capacity	E-92
	d. Evaluation of Methods	E-92
	e. Ranking of Methods and Recommendations	E-95
	10. Southeast WGA	E-101
	a. Introduction to Southeast WGA	E-101
	b. Existing Solid Waste Management Methods	E-102
	c. Market Capacity	E-104
	d. Evaluation of Methods	E-105
	e. Ranking of Methods and Recommendations	E-108

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SECTION A

INTRODUCTION AND OVERVIEW

1. PURPOSE

Volume II satisfies in part the requirements of Substitute House Bill 1684. This legislation states:

> "The Department of Ecology shall determine the best management practices for categories of solid waste in accordance with the priority solid waste management methods established in RCW 70.95.010. In order to make this determination, the Department shall conduct a comprehensive solid waste stream analysis and evaluation."

Section 2 of this bill states that the comprehensive solid waste stream analysis is to be based on representative solid waste generation areas. This volume contains an analysis of the Best Management Practices for eight proposed waste generation areas (WGA's) within the State of Washington.

Volume II of the Best Management Practices evaluates potential solid waste management methods in each of eight waste generation areas. (See Figure A-1.) The objectives of this volume are to:

(1) Identify existing waste management methods.

(2) Determine current market capacity for recyclable commodities.

(3) Examine past and future market trends including an assessment of the effects of publicly initiated recycling programs on the existing private recycling industry.

(4) Identify potential solid waste management methods for waste reduction, recycling and final disposal in each of the waste generation areas.

(5) Evaluate cost-effectiveness, environmental impacts and technical feasibility of potential solid waste management methods for each waste generation area.

(6) Recommend the Best Management Practices for solid waste management in each of the eight waste generation areas.

Section B of this volume provides an overview of potential solid waste management methods and assesses environmental impact, technical feasibility and exposure to loss for each method. Section C discusses existing and future market capacity for recyclable materials. This analysis addresses the impact of publicly initiated recycling programs on the recycling industry in Washington. Section D presents the economic analysis conducted to determine the relative costs of the potential waste management methods.

Figure A-1

WGA BOUNDARIES



Section E evaluates potential waste management methods and recommends the Best Management Practices for each of the State's waste generation areas. Percentages of each waste stream category to be handled by each method are also established.

2. APPROACH

The evaluation of appropriate 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, among other criteria. The WGA working groups assisted in identifying regional environmental concerns, and brought a local perspective to the technical feasibility analysis.

Waste generation area working groups were comprised primarily of representatives of local government and the solid waste and recycling industries. Citizens and representatives of business also participated. These working groups were not, nor were they intended to be, representative of the entire population of the waste generation area. Therefore, the rankings, assessments, and references expressed by these groups do not necessarily reflect the opinion of all citizens within each waste generation area. These groups provided the consultant team with the local perspectives critical to establishing Best Management Practices in distinctly different regions of the State. The assessments and rankings of methods by each of these groups and the consultant team are shown in Section 5.

3. DEFINITIONS

For purposes of the Best Management Practices Analysis of solid waste, the following definitions apply:

- WASTE STREAM CATEGORIES--Separate materials found in the waste stream. (See Table A-1.)
- WASTE SUBSTREAMS--Portions of the waste stream defined by generator type or method of collection.
- SINGLE-FAMILY RESIDENTIAL--Waste primarily from single-family residences which is collected by a public or private hauler.
- COMMERCIAL--Waste from all non-residential generators which is collected by a private or public hauler.
- SELF-HAUL--All waste transported to a drop box, transfer station, landfill or incinerator by a private individual or commercial enterprise not in the business of hauling or transporting solid waste.
- PROGRAM--The various methods constituting the total reduction, recycling, or disposal effort in a Waste Generation Area.

- METHOD--A general process for reducing, recycling or disposing of waste such as source separation recycling, composting, landfilling or incineration. A list of methods appears in Table B-1 in Section B.

- METHOD COSTS--Cost of all the activities required to implement a reduction, recycling or disposal method, from generation to final disposal.

- COLLECTION--The pick-up of waste and recyclables from point of generation and delivery to a processing facility or final disposal site.

- PROCESSING--Any activity performed with waste or recyclables after collection and prior to final disposal.

- TRANSFER AND TRANSPORT--Pick-up of waste or recyclables from a processing facility such as a transfer station (after collection has occurred) and delivery to another processing point or to a final disposal site.

- FINAL DISPOSAL--Ultimate disposition of waste materials.

- DROP BOX--Facility used to collect self-hauled waste from individuals and businesses.

- TRANSFER STATION--A permanent collection facility used by individuals and private/municipal haulers to transfer solid waste into a larger transfer vehicle for transport to another solid waste handling facility or to an ultimate disposal site.

- LONG-HAUL--Transport of waste out of a waste generation area.

TABLE A-1

WASHINGTON DEPARTMENT OF ECOLOGY
Recycling and Waste Stream Survey-1987
WASTE STREAM CATEGORY DEFINITIONS

- NEWSPRINT: Printed groundwood newsprint, including advertising "slicks" (glossy paper), unless found separately.
- CORRUGATED CONTAINERS: Unwaxed kraft paper corrugated containers and boxes, unless laminated with other paper such as glossy stock. Includes also brown kraft paper bags.
- HIGH-GRADE PAPER: Continuous-feed computer printouts and forms of all types, except multiple-copy carbonless paper. High-grade white or light colored bond and copy machine papers and envelopes.
- MIXED WASTE PAPER: Low grade potentially recyclable papers, including magazines, colored papers, non-corrugated paperboard, and paperback books.
- REFILLABLE GLASS CONTAINERS: Brown glass bottles from western breweries, such as Rainier, Olympia, or Lucky. Soft drink bottles, of any color, marked by the manufacturer as refillable or returnable for redemption of a deposit.
- OTHER RECYCLABLE GLASS (CONTAINERS): All glass food containers, wine and wine cooler bottles, and other glass containers of any color.
- ALUMINUM BEVERAGE CONTAINERS: Aluminum beverage cans.
- TIN FOOD AND BEVERAGE CANS: Tin-coated steel food containers.
- FERROUS METALS: Ferrous and alloyed ferrous scrap metals (metals to which a magnet adheres), which are not significantly contaminated by other metals or materials.
- NON-FERROUS METALS: Metals not derived from iron (metals to which a magnet will not adhere), which are not significantly contaminated by other metals or materials.
- WHITE GOODS: Large household appliances or parts thereof.
- PET BOTTLES: Polyethylene teraphthalate 2-liter pop bottles, with or without base, and PET liquor bottles.
- HDPE BOTTLES: High-density polyethylene milk and juice containers.
- PLASTIC PACKAGING/FILM: All plastic packaging films, shipping materials and other plastic items which are not themselves finished consumer products, including thermoplastics and thermosetting plastics used as packaging.

TABLE A-1
(Continued)

- EXPANDED POLYSTYRENE: Packaging and finished products made of expanded polystyrene.
- OTHER PLASTIC PRODUCTS: Finished plastic products such as toys, toothbrushes, vinyl hose and shower curtains. Fiberglass resin products and materials.
- TIRES: Vehicle tires of all types.
- OTHER RUBBER PRODUCTS: Finished products and scrap materials made of rubber, such as bath mats, inner tubes, rubber hose, and foam rubber.
- FOOD: Food wastes and scraps, including bone, rinds, etc., including the food container when the container weight is not appreciable compared to the food inside.
- LAWN AND GARDEN WASTE: Grass clippings, leaves and weeds, prunings 6 inches or less in diameter.
- WOOD WASTE: Finished lumber, products made of wood, and prunings or stumps 6 inches or greater in diameter.
- DISPOSABLE DIAPERS: Disposable baby diapers and protective undergarments.
- OIL: Motor oil, diesel oil, and fuel oils.
- BATTERIES: Batteries of all types.
- OTHER HOUSEHOLD HAZARDOUS WASTE: Adhesives, paints, caustic cleaners, pesticides, gasoline or kerosene, asbestos, explosives and other chemicals, excluding spent or empty hazardous waste containers.
- CONSTRUCTION/DEMOLITION DEBRIS: Construction debris, other than wood, which could not be classified into other component categories, e.g., asphalt shingles, mixed fine material scraps. Includes gypsum wallboard and fiberglass insulation.
- OTHER ORGANIC WASTE: Nonrecyclable paper, textiles, leather, and ash.
- OTHER INORGANIC WASTE: Nonrecyclable glass, bi-metal cans, and inert material and nondistinct fines.

SECTION B

POTENTIAL SOLID WASTE MANAGEMENT METHODS

1. INTRODUCTION

a. General

Solid waste management methods are procedures or processes for achieving the reduction, recycling, reclamation, handling, processing, or disposal of solid waste in a manner that preserves both management options and environmental quality for future generations. Table B-1 lists solid waste management methods evaluated for this study of best management practices.

The methods are grouped into four types of programs: Reduction, Recycling, Handling, and Disposal. A general description of the process and physical features is provided for each method, followed by discussion of the technology background, implementation factors, technical feasibility, and potential environmental impacts.

b. Organization

Environmental impact assessment methodology and screening of environmental issues common to solid waste management methods are discussed initially. Solid waste management program methods are then presented and evaluated considering general issues that are likely common to all waste generation areas (WGA's).

TABLE B-1

STATE OF WASHINGTON
BEST MANAGEMENT PRACTICES FOR SOLID WASTE

PROGRAM METHODS

Program	Method
Reduction	Education
	Incentives
	Disincentives
	Governmental Programs
	Waste Exchange
	Home Yard Waste Composting

TABLE B-1
(Continued)

Program	Method
Recycling	Reuse
	Education
	Incentives
	Disincentives
	Government Programs
	Drop-Off/Buy-Back Depots
	Curbside Collection
	Multi-Family Housing Collection
	Commercial Source Separation/Collection
	High-Grade Commercial Collection
	Yard Waste Composting
	Mixed Municipal Solid Waste Processing
	Mixed Municipal Solid Waste Composting
	Food Waste Processing
	Special Waste Recycling and Reuse
Handling	Transfer
	Long Haul
Disposal	Incineration/Energy Recovery
	Anaerobic Decomposition
	Pyrolysis/Gasification
	Mass Burn Incineration
	Refuse-Derived Fuel
	Solid Waste Landfills
	Ashfills

2. ENVIRONMENTAL IMPACT PROCEDURES COMMON TO PROGRAM METHODS

a. Methodology

The environmental impact evaluation begins with a screening of the elements of the environment as defined by State Environmental Policy Act procedures (WAC 197-11-444). In this screening process, key elements or combinations of elements likely to be significantly impacted by implementation of waste management methods are identified.

Once the most sensitive elements are identified, the potential impacts common to many of the waste management methods are described in detail. By describing these impacts and appropriate mitigation methods in this section, repetition is avoided in the environmental impacts section of each method evaluation.

The environmental impacts of each potential waste management method selected for detailed technical feasibility evaluation are assessed in a narrative discussion. This discussion addresses the expected impact on each element of the environment identified in the screening evaluation. Where appropriate, discussion of measures available to mitigate potential impacts is included. These discussions of impacts are specific to the method being evaluated. Many of the methods address only a portion of the overall process of mixed municipal solid waste (MMSW) disposal; in such cases, only the impacts of that portion are identified.

Overall impacts depend on the combination of methods used in a particular solid waste management system. For example, MMSW processing results in residue materials that cannot be recycled directly; these residual materials may be incinerated, placed in a landfill, or processed further in some other manner. Disposal impacts of such residual materials are not discussed in the evaluation of MMSW processing.

In both the discussion of impacts common to methods and that of method-specific impacts, it is assumed that "state-of-the-art" technology is employed, that all applicable standards are met, that facilities are appropriately sited, and that facilities and equipment incorporate appropriate mitigation techniques.

b. Screening Evaluation

All elements of the environment are screened to identify key elements that could be significantly affected by waste management methods and impacts that differ among WGA's or methods. Site-specific impacts and appropriate mitigation measures are identified and discussed in this evaluation. Elements of the environment are considered in the order listed in WAC 197-11-444.

Earth-related elements include geology, soils, topography, unique physical features, and erosion. Impacts to these elements could include topographic changes caused by excavation and addition of fill material, or soil disturbance and increased erosion from operation or construction of a MSW facility. Such impacts are highly site-specific and their importance depends on details of the facility proposed. Increases in erosion can be readily mitigated by use of standard erosion control methods, especially during construction. For these reasons, the earth elements are not considered to be key issues for this analysis.

Air-related elements include air quality, odor, and climate. Although impacts on air quality and odor are definitely influenced by site-specific factors, such as ambient air quality and surrounding land use, such impacts are generally recognized as significant.[1] In addition, impacts from various methods differ considerably in the extent and nature. Air quality and odor are therefore key elements that will be the subject of more detailed analysis.

Water-related elements include surface water movement and quality, and the quantity of runoff/absorption; floods; ground water movement, quality,

and quantity; and public water supplies. Flood-related impacts are site-specific; as long as a facility is located outside the 100-year flood plain, likelihood of any impact is small. Some types of facilities consume significant amounts of water (as discussed under public services and utilities-related elements later in this section); however, the quantities are generally relatively small. Therefore, neither public water supplies nor quantity of ground water or surface water is likely to be significantly affected. Similarly, although minor changes in the runoff patterns may be produced by measures to control stormwater runoff, none of the waste management methods is likely to have a significant impact on water movement or runoff/absorption. In contrast, potential impacts on surface or ground water quality are of major concern for many methods, and are widely recognized as significant issues.[1][2] Therefore, surface water quality and ground water quality will be key elements for detailed analysis.

Elements related to plants and animals include: habitat and/or number and diversity of species of plants, fish, or other wildlife; unique species; and fish or wildlife migration routes. Impacts on these elements are likely to involve loss of habitat where facilities are located. Impacts on threatened or endangered species are of particular concern. Such impacts are highly site-specific, since they depend not only on the amount of area that would be effected but also on the quality of the habitat present in the vicinity of the facility. For this reason these elements will not be considered to be key elements for further analysis. Impacts to these elements would necessarily be evaluated as part of the siting process for any specific project.

Energy- and natural resources-related impacts include: amount required/rate of use/efficiency, source/availability, non-renewable resources, conservation and renewable resources, and scenic resources. None of the waste management methods under consideration would use enough energy to create a significant impact on any of the energy-related elements. Several methods would produce more energy then they use; however, this issue will be considered in more detail in the economic analysis and is not considered to be a significant environmental impact. Impacts on the natural resources-related elements are site-specific, and apply only to facilities requiring a large amount of land. If properly sited to avoid agricultural or forest lands and to avoid interfering with active mines or quarries, potentially significant impacts on natural resources can be largely avoided. For these reasons these elements are not considered to be key elements.

Environmental health elements include: noise, risk of explosion, and releases or potential releases to the environment affecting public health, such as toxic or hazardous materials (public health risk). Each of these elements is widely recognized to be of concern in solid waste management.[3] Impacts on these elements will likely vary among methods. For these reasons each of these elements will be considered key in the analysis.

Land and shoreline use-related elements include: relationship to existing land use plans and to estimated population; housing; light and glare; aesthetics; recreation; historic and cultural preservation; and agricultural crops. All of these elements are highly site-specific and would be considered in detail during a siting study. For example, disturbance of historic or prehistoric archaeological material could occur during construction of a facility;

however, potential for such impact can be reduced to low levels by selecting a site where such materials are unlikely to be present. Impacts on aesthetics, however, are likely to be of particular concern to the public and to vary among disposal methods. For this reason, aesthetics will be considered a key element in the environmental analysis.

Transportation elements include transportation systems, vehicular traffic; water-borne, rail, and air traffic; parking; movement/circulation of people or goods; and traffic hazards. One potential impact to these elements would be increased hazards to aircraft due to birds attracted by a waste disposal facility. This is very site-specific issue, which can be mitigated through careful siting. The most significant potential impact would be generation of additional vehicular traffic. The significance of this impact will, of course, vary depending on siting; however, major differences between waste management methods are likely and community opposition frequently focuses on this aspect of a proposal. For these reasons traffic will be considered a key element.

Public services and utilities-related elements include fire, police, schools, parks or other recreational facilities, maintenance, communications, water/stormwater, and sewer/solid waste, and other governmental services or utilities. For example, some energy/resource recovery methods that generate electricity would use significant amounts of water. Such water use could adversely affect water supply in areas without sufficient existing capacity. Waste-to-energy facilities would discharge to the sewer, which could adversely impact the local sewer district, if at or near sewage handling capacity. Similarly, landfills could also impact utility systems, particularly wastewater treatment facilities. In both cases the impacts would be highly site-specific and should be addressed during the siting process for a proposed facility. Appropriate mitigation measures are available.

Waste-to-energy plants also generate electricity for distribution and sale. Potential adverse impacts due to such generation could arise if high-voltage lines must be extended to a facility. Such impacts and their mitigation would be highly site-specific. Impacts on solid waste utilities will be considered in the institutional barriers evaluation in Section V and are not considered in detail in the environmental analysis. None of the utilities- and public services-related elements have been selected as key elements.

In summary, the elements of the environment that have been selected as key elements reflecting significant issues include the following:

- Air Quality
- Odor
- Surface Water Quality
- Ground Water Quality
- Noise
- Risk of Explosion
- Public Health Risks
- Aesthetics
- Traffic

By discussing impacts on these key elements, the environmental evaluation is focused on the most significant issues to facilitate comparative evaluation of the various WGA's.

c. Environmental Impacts Common to Several Methods

This section describes a number of impacts on key environmental elements that are common to several of the methods assessed in the feasibility evaluation. Available effective mitigation methods are also described here.

(1) Air Quality - Incineration Emissions

Combustion of solid waste generates a number of gaseous byproducts. The principal gases generated are carbon dioxide and water vapor. Such air pollutants as particulates, carbon monoxide, nitrogen oxide, sulphur dioxide, and other acidic gases such as hydrofluoric acid and hydrochloric acid (HCl) are also generated.

Federal, state, and local agencies have established ambient air quality standards which specify maximum allowable concentrations as well as maximum allowable exposure time for the air pollutants. The governmental regulations require that all significant new sources of emissions meet stringent prevention of significant deterioration (PSD) standards which stipulate allowable incremental increases of specified air pollutants.

To comply with these stringent emission regulations, plants are now designed to include a variety of pollution control devices, such as bag houses or electrostatic precipitators for particulate removal, wet and dry scrubber systems for acid gas control, and combustion/operational controls. Because emissions are generally released through a tall stack, the impact on ambient concentrations depends on dispersion within the atmosphere.

To estimate ground-level concentrations at points of public exposure, computerized air quality models are developed for each planned facility. These models use information on topographic conditions around the proposed facility and existing air quality and climatic conditions to predict concentrations. Thus, to determine whether a given facility would significantly affect air quality, the results of site-specific air quality models must be compared with applicable ambient air quality standards and the allowable incremental increases under the PSD regulations.

Mitigation measures necessary to comply with the strict standards should be sufficient to minimize any potential air quality impacts due to these major contaminants. No significant impacts are expected, if the facility operates in compliance with its permits.

Water vapor is produced by combustion processes. Stack emissions could include a visible water vapor plume under some climatological conditions. The water vapor plume would normally evaporate and disperse with downwind travel, and it would not be a significant effect. Water vapor could also be produced by a mechanical draft cooling tower used to dispose of waste heat. Such water vapor plumes can, under adverse meteorological conditions (moderate

winds, high humidities) cause ground-level fogging and icing; however, the effect would occur only within 100 to 200 meters of the cooling tower on the site.

If a more detailed evaluation of site-specific considerations regarding the cooling tower indicated that such impacts would be a problem and could not be sufficiently reduced by varying the location of the tower, a dry or wet/dry cooling system could be incorporated into the design. Therefore, water vapor plumes from any of the waste management methods are not expected to cause significant impacts.

(2) Air Quality - Dust Generation from Ash Handling

The handling and disposal of ash generated by solid waste combustion can cause release of particulate matter in the form of dust. Dust emissions from ash can create significant problems during moderate to high wind conditions. Wetting the ash and transporting it in covered vehicles can circumvent potential ash dust formation. At the final disposal site, usually a landfill or ashfill, covering the ash after disposal may be required to prevent wind erosion. With proper handling and management, little or no emission of fugitive ash dust should occur.

(3) Air Quality - Vehicle Emissions

Vehicles hauling waste to a processing or disposal facility and removing byproducts and residuals will generate particulates and emissions of gaseous air pollutants. The quantity of pollutants generated will vary with the level of traffic to and from the facility; however, the impact is generally expected to be minor. Similar vehicular emissions will be generated by heavy equipment used on site, such as bulldozers, front-end loaders, and graders.

(4) Odor

Decomposition of organic matter in waste creates compounds with unpleasant odors. Odors are a concern at all refuse handling facilities. A variety of control methods can be used. During facility siting, an area less sensitive to odors can be selected. For landfills, installing bottom liners can prevent underground migration of landfill gas. Capping the completed landfill and installing gas collection/treatment systems should minimize landfill gas and odor emissions. Liners, caps, and gas control systems are required by the Minimum Functional Standards (MFS) established by Washington State.

Whenever wastes are stored before or during processing (e.g., composting), odor can be minimized by preventing anaerobic conditions. Facilities that incinerate refuse can draw combustion air for the boiler in through the tipping area so that malodorous compounds from the refuse are incinerated prior to being vented to the atmosphere. Ventilation systems for the incineration facilities can be designed with an organic soil filter on the exhaust side of the aeration equipment to minimize off-site odors.

(5) Water Quality - Leachate Generation

Leachate is highly contaminated water formed as water passes through waste. The composition of leachate is highly dependent on the nature and stage of decomposition of waste materials. It is also influenced by the period of time required for the water to pass through the waste. Contaminants frequently present in leachate include heavy metals, organic materials that can reduce oxygen levels in receiving waters, nutrients that encourage plant growth, toxic organic compounds, and pathogens. The escape of leachate into either surface or ground water systems can significantly degrade their quality.

The primary means of preventing leachate formation is to prevent water from contacting the waste. Sources of potential leachate include water falling directly onto the waste during operations, runoff draining into the waste, and water contained within the solid waste. Measures to minimize potential surface and ground water contamination by leachate and to detect such contamination promptly should it occur, are required as part of the standards for both sanitary landfills and ashfills. Required measures include liner systems, leachate collection and treatment, and ground water monitoring to assure continued compliance with water quality standards.

Site-specific issues, such as soil conditions and geological characteristics of the site, and proximity to sensitive surface waters and to ground water aquifers used as drinking water supplies, are critical to evaluating the potential impacts of a specific facility. Such conditions should be evaluated as part of the siting process for any facility.

(6) Water Quality - Discharge of Wastewater from Combustion Processes

Processes involving combustion of wastes usually generate wastewater. State regulations for special incinerator ash management require that such wastewater be discharged to surface waters under a National Pollutant Discharge Elimination System (NPDES) permit or to ground water or municipal sewer system under a State discharge permit. Such discharges must meet stringent water quality requirements, including pretreatment in most cases.

Discharges vary considerably in both quantity and quality according to size and design of the facility. Some plants are designed to have zero discharge. As long as a plant's discharges meet permit conditions, adverse impacts on water quality would be minimal.

(7) Noise - Vehicular Traffic

Truck traffic associated with solid waste facilities would cause some increase in noise levels along the haul route. The noise impact would depend on the type and number of vehicles used to transport the material, as well as by the ambient noise levels and land use in affected areas. Collection vehicles serving facilities would produce lower individual noise levels than large transfer trucks, but a greater number of total trips would be generated. Noise effects due to truck traffic can be mitigated by avoiding routes near sensitive areas such as hospitals and through residential areas.

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(8) Noise - Processing Machinery

Processing of waste material can require mechanical equipment that produces very high noise levels which could potentially disturb adjacent activities. Noise impacts can be reduced by locating the facility in a remote, rural location or in an industrial/commercial location, or by using buffer zones around the facility when processing occurs in the open rather than within enclosed buildings. Physical screening and other design considerations can also reduce noise levels for both open and enclosed facilities.

All operations at new waste processing facilities would be required to meet noise standards set by the State and local authorities. Thus, since off-site noise impacts from waste handling and disposal facilities can be controlled by appropriate facility design and siting, increased noise levels should not be a significant concern.

(9) Public Health Risks - Pathogens

Dust generated during the processing of refuse may contain microorganisms that act as pathogens. Survival, growth, and transmittal of pathogenic organisms in waste material that leaves the site in processed form is another potential health concern. Such organisms include intestinal bacteria such as coliform streptococcus, fungi, viruses, and parasites. Pathogens may therefore be released with leachate, materials produced as a byproduct of waste processing such as compost, or on dust emitted in the vicinity of a facility.

Releases of spores of Aspergillus fumigatus, a fungus, were observed at a composting facility for leaves and other types of waste. Exposure to these spores is hypothesized to produce allergic reactions or infections in susceptible individuals.

Release of pathogens in leachate can be controlled by minimizing leachate generation and by the leachate handling methods described above under (5) Water Quality Leachate Generation. Dust control systems can reduce or eliminate the release of pathogens with fugitive dust emissions. Potential health impacts from pathogens that may be present in compost can be diminished by marketing the material appropriately. Soil application of mature compost contributes to killing pathogens through drying and exposure to ultraviolet radiation.

Evidence of a relationship between disease and infectious materials in solid waste and their byproducts is weak. Even for workers who are directly exposed to solid waste, epidemiological information does not provide conclusive evidence of a relationship.

(10) Public Health Risks - Release of Toxic Substances

Release of toxic substances from a facility can include emissions of heavy metals and volatile organic compounds formed during incineration, release in the form of leachate, or release in a byproduct such as compost. Concentration and nature of the toxic substances that may be present in such

releases vary tremendously depending on the source of the waste and the treatment employed. For these reasons, quantitative estimates can only be made for specific projects.

The concentrations of heavy metals and toxic organic compounds (such as dioxin and furans), in air emissions can be controlled by appropriate design and operation of the incinerator and, for control of air pollutants as required to meet air quality and PSD regulations (described under (1) Air Quality--Incinerator Emissions). This type of control will also minimize deposition of toxic material on crops and reduce the risk of direct inhalation.

Public health risks associated with solid waste facilities result from the exposure of individuals to potentially harmful substances through several possible pathways including inhalation, ingestion, and dermal absorption. To fully assess potential health risks for any given emission for the various exposure pathways requires specific details regarding the location of the affected population and typical activities of that population, specific data on emission levels, climatic data, and other factors. These factors are extremely dependent on the specific technology and site identified and must be assessed on a site-specific basis.

Release of toxic materials can also be reduced through control of the waste stream by removing sources of heavy metals such as lead acid batteries. This mitigative measure is discussed further under Recycling Program Method - Special Waste Recycling and Reuse in Section B.4.m. Health risks from toxic substances that may be present on compost materials can be controlled by marketing the materials for applications other than landscaping or use on food crops.

(11) Aesthetics - Impacts from Waste Handling Facilities

Significant adverse aesthetic impacts from waste handling facilities may occur if the facilities contrast visually with the surrounding or can be seen by people in residential, recreational, and natural areas, and travelers on scenic routes. Litter in the vicinity of a facility, untidy storage areas, working areas that are visible to those outside the site, and buildings that significantly contrast with the surroundings can all create adverse aesthetic effects.

These impacts can be minimized by appropriate siting, landscaping, vegetative buffers, adequate maintenance measures, use of trucks with covers, and appropriate architectural treatment of large facilities to minimize contrast. As always, siting is a particular concern; aesthetic impacts will vary depending on the location and surrounding land use.

(12) Traffic Impacts

Traffic on roads used by the haul vehicles would be increased; however, the significance of the increase would depend on the existing traffic volume, capacity of the roads in question, and the haul vehicle traffic volume. The major means of mitigating the impacts are appropriate considerations of potential traffic impacts and access during facility siting studies.

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d. Global Environmental Impacts

Development of solid waste management systems may have impacts which extend beyond the immediate jurisdiction to affect global environmental conditions. The individual effect of a given project may be relatively small; however, when combined with the impacts from many other similar activities worldwide, the impact could be significant. Examples of potential global impacts are warming of the earth's atmosphere due to air emissions from incineration facilities and landfills, and depletion of virgin materials due to use of non-renewable resources rather than recyclable materials. At the present time, there is insufficient data to make a meaningful comparison of alternatives with respect to global effects and, therefore, they are not included in this analysis.

3. REDUCTION PROGRAM METHODS

a. Introduction

The prevention or elimination of waste at the point of generation, to reduce or eliminate the need for collection or disposal is referred to as source reduction. Source reduction is an increasingly important element of solid waste management, because it reduces the amount of waste that must be managed, conserves energy, and removes a source of negative environmental impact. Reduction at the source involves making changes in the production of goods, in packaging design, and in consumer buying and disposal practices and behaviors.

Some forms of recycling, such as using refillable or deposit bottles, result in reducing the wastes to be managed through collection, processing, and disposal methods. The forms can, therefore, be considered waste reduction. As a result, the two programs overlap some and distinctions between waste reduction and recycling methods may not always be clear.

Reduction of waste at the source can be achieved through:

- Reducing the resource intensiveness of products (e.g., smaller automobiles)
- Increasing product life
- Reducing the amount of consumption associated with product marketing (e.g., reducing the amount of packaging)
- Replacing disposable products with reusable items (e.g., using cloth diapers in place of disposable diapers)
- Appropriately disposing of certain wastes on-site (such as home composting of yard waste)
- Reusing products (such as refillable bottles)

Waste reduction efforts should be directed toward residential as well as commercial and industrial waste streams. Waste reduction activities and actions can occur on national, state and local levels. Promoting waste reduction increases general awareness of and concern for all waste disposal and resource depletion issues. It can, therefore, contribute to recycling and other solid waste management programs.

Source reduction techniques are somewhat different than other waste management methods since they often do not involve programs or processes that have definable technological aspects. Appropriate efforts in waste reduction are not tied to geographic areas of the State as much as to the ability of different governmental levels to bring about change.

Five general approaches to promoting reduction of waste at the source are discussed below:

- An educational approach, aimed at consumers' purchasing habits and or manufacturers' production methods
- The incentive/disincentive approach, which utilizes economics through a regulatory or legislative context to influence producer or consumer preference in the purchase of targeted materials
- The approach of special government programs designed to facilitate source reduction
- The waste exchange approach
- The home yard waste composting approach

Each of these approaches or methods involves a number of different techniques or strategies. Other conceptual approaches for reviewing waste reduction could be taken (for example how consumers, manufacturers, or government agencies could each reduce their wastes). These would normally include the same techniques which are described here.

Efforts and programs directed towards waste reduction are often given minimal emphasis in a total solid waste management approach. When given first priority, as under State law, waste reduction programs can produce benefits for many elements of the waste recycling, collection, processing, and disposal methods.

In the past, it has been particularly difficult to quantitatively judge the short-term success and effectiveness of each of these approaches. Ideally, the introduction of a program to educate consumers about the importance of purchasing more durable goods will have a positive effect in reducing the amount of waste which must be managed. However, the immediate percentage impact on the disposed waste stream is often difficult to determine because of the multitude of dynamic demographic and economic factors which also influence waste volumes and composition.

If more than one waste reduction effort is undertaken, which is often the case, it may not be possible to attribute waste flow reductions to a particular effort. It is important that all new waste reduction efforts provide for some form of short-term and long-term effectiveness evaluation so that future efforts can be undertaken with more predictability.

Some source reduction programs, such as home yard waste composting, disposable diaper bans, and bottle deposit/redemption legislation, may quickly result in measurable reductions in the waste stream (depending on the amount of these materials within a particular waste generation area). Other source reduction efforts such as education may not produce distinguishable or immediate reductions in disposal waste volumes. However, these less direct methods should result in long-term and voluntary behavioral changes which do impact the disposal volumes. The success of these "soft" efforts may more appropriately be evaluated on the basis of observed changes in individuals' attitudes and behaviors.

A fundamental precept of source reduction programs is that if a state, county, or city is to convince the private sector and the public to voluntarily and conscientiously practice waste reduction and recycling, then it must implement source reduction measures in its own offices and yards. Government personnel should lead the way so that the private and residential sectors are encouraged to act similarly.

b. Education

The primary mechanism for eliciting voluntary waste reduction is through education, advertising, or promotional efforts. Education or promotion/information approaches developed by the public sector can be the most effective in addressing two key reduction issues that influence consumer behavior: product durability and packaging.

(1) Product Durability

One of the shifts in consumption behavior that could reduce the municipal waste stream is for buyers to select goods based on their durability (for example, an estimated 2% of the waste stream is composed of items designed to be thrown away immediately after a single use). Technological obsolescence and the continual introduction of newer and "better" items, also contributes to increases in disposal volumes.

Product durability is defined by various factors, including the functional lifetime of the product and the need for maintenance. Durable goods may have higher purchase costs, but their purchase reduces the cost of replacement and of disposal. It must be recognized that increased durability may in some cases lead to decreased recyclability--for example, steel and fiberglass belts in automobile tires have allowed them to be utilized longer; however, new difficulties with recycling or retreading these tires have resulted.

(2) Packaging

An additional desirable change in consumption behavior is for individuals and businesses to increasingly select products consciously that use less waste in packaging. A high percentage of the waste stream is packaging materials. Some of that material is used only for marketing purposes and adds little or no actual value to the product. Consumers should be encouraged through education programs to select their purchases considering elimination of unnecessary packaging and the recyclability of the packaging materials used.

To address these issues, a local or state governmental agency can establish a public education campaign that gives clear signals to consumers regarding the types of products that should be preferred. Staff can design, print, and distribute educational materials. Some of the materials can emphasize awareness-in-purchasing, while others can be directed at broader educational concepts pertaining to the State's solid waste crisis. This approach helps ensure that consumers will understand the importance of their choices.

Promotional materials can be presented in various ways. Direct mailings to the public and private business sectors are relatively costly, but reach the most people. Presentations to community groups often involve significant time commitments, but often pay off in terms of increased individual understanding and action. Involvement by the local media is important in appealing to a large number of people. In this regard, public service announcements or televised forums involving local officials or personalities may be particularly useful.

Governmental bodies can also cooperate with local community organizations in stressing the importance of consumer preference for products that are durable. For example, the West Michigan Environmental Action Foundation recently published a citizens' handbook which addresses four basic criteria for product preference:

- Minimization of natural resource consumption in product manufacture;
- Maximization of functional lifetime of the product;
- Reusability/recyclability of the product; and
- Reduction in overall consumption orientation.

Another way to distribute program information is via the school system. Materials can be incorporated into school curricula and in-service training for teachers. It may also include workshops and seminars presented at schools by State, county, or city staff.

The education programs discussed above present very little risk for the implementing entity, since they can be broken into small, controllable units. These programs can be highly feasible reduction methods.

c. Incentives/Disincentives

The regulatory or legislative approach to source reduction provides either economic rewards or penalties in order to change consumer behavior. This approach may incorporate either financial incentives such as payment of deposits and cost savings for purchasing less packaging; or disincentives such as bans or taxes on specific types of products. Product design or product labeling regulations can also be an incentive or disincentive for manufacturers to accomplish waste reduction objectives.

It is believed that large increases in the costs of disposal or tipping fees will provide an incentive for individuals or businesses to reduce wastes or to increase the amounts they recycle (this incentive can also be looked at as a disincentive to disposal). This would work best where waste generators pay for disposal in direct proportion to the amount of wastes they produce and where generators have the ability to cost-effectively modify waste generation or product purchasing patterns. As a management method, the approach of simply raising fees for the sole purpose of reducing wastes is rarely used.

Often, incentives or disincentives can be used to accomplish the same goal. The two methods are often implemented together through legislative and regulatory means. Product packaging or containers are the most frequent targets of such regulatory action. Several criteria are commonly used for determining the appropriateness of product regulatory action:

- Volume of product in the waste stream
- Potential environmental impacts
- Energy-intensiveness of product manufacture
- Availability of substitute products

The particular incentive or disincentive approach must also be tailored to the appropriate consumer or manufacturing group which has the ability to affect the desired change.

One method of creating a financial incentive (or disincentive) is to place a tax or surcharge on the undesirable product, making the favored product more economically attractive. Though this type of incentive has rarely been applied for waste reduction purposes, it is commonly used to encourage the purchase of those products manufactured domestically over those imported from a foreign country. A deposit or redemption value on beverage containers provides an incentive to return containers so that these items are kept out of the waste stream.

Beverage container legislation has effectively been established in 10 states including California, Connecticut, Delaware, Iowa, Maine, Massachusetts, New York, Oregon, Vermont, and Minnesota. Essentially, this type of legislation requires a deposit or refund on certain containers, typically all carbonated beverage containers including glass, aluminum, and plastic. The container either has a per unit surcharge (deposit) at the point of purchase which is refundable upon return, or no deposit, but a refund available through a redemption system.

Examples of products that have been the targets of proposed regulatory action through product banning or through regulation that forces product redesign or labeling include:

- Non-refillable beverage containers
- Non-recyclable packaging
- Disposable diapers
- Assorted plastic products

Plastic products are most commonly targeted because they are difficult to recycle and they tend to persist in the environment after disposal.

Because local markets are strongly affected by national and international forces, the effectiveness of local regulation to provide incentives or disincentives is limited. However, cities and counties make important statements to industries and to the general public by enacting, or even considering, such ordinances. They send a clear signal of the government's sincerity in its source reduction efforts and about the need to better manage solid wastes.

Product bans that have been implemented on the state or national level include:

- Bans on non-refillable beverage containers (Denmark, Saskatchewan)
- Bans on non-degradable plastic shopping bags (Italy)
- Bans on non-degradable six-pack carrier rings (Alaska, California, Connecticut, Delaware, Maine, Massachusetts, New York, Oregon, Rhode Island, and Vermont)
- Bans on polystyrene foam products in eating facilities of government buildings (Vermont)

At the local level, the City of Berkeley, California, has become the first city in the U.S. to ban plastic containers that are made with chlorofluorocarbons because of their effects on atmospheric ozone. That ban went into effect September 1, 1988.

Another local ban is that of Suffolk County, New York, which targets various plastic products sold at retail establishments. The law prohibits establishments such as supermarkets and fast-food restaurants from providing customers with plastic bags, sacks, or containers. The law requires that biodegradable packaging be used for food sold at retail establishments, and that eating utensils and food containers provided to customers at such establishments not contain polystyrene or polyvinyl-chloride. The City of Portland, Oregon, is currently considering a styrofoam ban.

Some industries have filed lawsuits in response to legislation which they feel unfairly obstruct their right to conduct business. An example is the case of Cloverleaf Creamery Company versus Minnesota, in which the

Minnesota Supreme Court ruled that banning non-refillable plastic containers, while preserving paper non-refillables, violated the equal protection clause of the 14th Amendment. But, in 1981, this ruling was reversed by the U.S. Supreme Court, which stated that the ban had a reasonable relation to the State's goal of developing environmentally sound waste disposal alternatives.

Similar litigation involved a grocer and the City of Berkeley, California. The Appeals Court found that a City ordinance encouraging the purchase of refillable containers did not violate the grocer's right of due process. It was ruled that the ordinance was rationally related to the City's waste reduction efforts.

Other incentives besides economic ones, such as good feelings about doing one's civic duty or having a part in protecting the environment, can be offered, but they generally are considered as educational or promotional approaches. When state or local governments consider the adoption of incentive or disincentive approaches, a very clear rationale must be developed and thoroughly assessed ahead of time to assure that the regulatory action will have the intended effect and to minimize unintended and undesirable consequences (such as displacement of businesses, switches to less desirable alternatives, or failure to accomplish the objective).

Incentive and disincentive programs discussed above present governmental jurisdictions with special problems of enactment and enforcement. The possibility of such programs resulting in outcomes other than those desired and the corresponding exposure to loss on the part of the implementing jurisdiction is judged to be moderate. The programs are judged to be highly feasible reduction methods.

d. Special Government Programs

A key promotional tool in the area of source reduction is the government's ability to set an example. For example, government offices can purchase reusable glasses, plates, and cutlery, instead of disposable plastic products. The State of Massachusetts has recently adopted legislation to do this.

Government purchasing agents can revise procurement specifications for items such as office furniture, equipment, vehicles and parts to give preference to the most durable products. These items can at times be reused, or their useful life extended, and thereby reduce the waste flow from government. Agencies can take internal actions to reduce the amount of paper and other waste materials that are discarded.

Another example of government involvement in promoting waste reduction is the recent proposal in Canada to develop national rating guidelines for designating products according to their overall "environmental friendliness," which includes their minimization of packaging and maximization of durability.

e. Waste Exchange

Government can also provide a service to private businesses to facilitate the reality that one person's waste can become another person's gain. In particular, industry often produces wastes that can be used as a feedstock for another industry. In many instances, generators of commercial and industrial waste have already established networks to utilize potential waste products in other applications. A primary barrier to this happening more frequently and to including smaller scale operations, is that information about these materials is often not generally available.

A government can sponsor or promote waste exchange by providing a clearinghouse of information for industry clients about potentially reusable waste materials. During the late 1970's, Washington State operated a waste exchange for hazardous wastes (through WETA), but this is no longer funded.

A number of private, state, and regional waste exchanges already exist for waste products such as: acids, alkalis, inorganic chemicals, solvents, oils and waxes, plastics, rubber, textiles, wood, paper, metals, sludges, and other materials. Many of these operations have been in business for a number of years or have consolidated from smaller operations. The private operations are generally able to make a profit because they deal in higher-value wastes. Lower-valued wastes could be exchanged in the same fashion with public financial assistance. Less commonly practiced, a waste exchange can actually receive and store materials while potential users are identified.

Governments have also been involved in a technical assistance role of performing waste audits for certain commercial or industrial waste generators with the potential for reducing their wastes or finding alternative disposal and reuse options.

Waste exchanges are judged to be feasible if implemented on a large scale or regional basis by a number of governmental units.

f. Home Yard Composting

Home yard waste composting is considered a source reduction strategy, since it effectively removes yard waste from the waste stream before it is collected. The advantages of a municipally sponsored backyard composting program are the low cost to the municipality, the potential for greatly reducing the waste stream (depending upon the proportion of yard waste which can be managed on-site), and the opportunity for hands-on citizen participation.

Composting is a biological process which stabilizes organic matter and makes available the bound nutrients. Backyard composting is very flexible and can be carried out in a piles, rows, or bins.

Several municipalities have experimented with home yard waste composting demonstration programs. The City of Seattle is recognized as a leader in this area and continues to expand its backyard composting demonstration site program. Seattle has also implemented a volunteer "master composter"

program, where citizen volunteers are trained by a municipal consultant to become backyard composting instructors. The instructors then staff the city-owned demonstration sites, accompany portable displays to shopping malls where they answer questions, and take slide shows out to service clubs and similar forums. To date, some 80 instructors have been trained, and significant program expansion is expected in 1989.

"Backyard" composting can be viewed as a stand-alone composting method for a portion of a community yard debris or it can be encouraged as a complementary part of an overall municipal yard waste management program that includes base centralized facilities for composting leaf and yard waste. Such a program is discussed in Subsection B.4.i.

Pierce County has initiated a program providing backyard composting bins to individuals for a pilot study. King County is currently providing publicity to encourage composting and other solid waste citizen involvement projects through a publication called "The Waste Paper" and informative brochures. "How to compost at home" information is sent to interested citizens free and includes basic composting practices, "build it yourself" composting bins, plans, and instructions.

Yard debris is estimated to compose approximately 18% of the State's disposed waste. Depending on collection methods, educational efforts, and other incentives, yard debris composting systems are capable of diverting up to 75% of the yard debris waste stream. The highest levels of diversion are made possible by accompanying the actual composting system with appropriate rates incentives, convenient curbside collection, disposal ban at landfills, and educational efforts.

Participation rates vary widely between rural and urban areas. Participation levels for backyard composting in urban areas are thought to range from 5-8%, and with aggressive educational programs, a participation rate of 10% or more may be achievable. The City of Seattle Yard Debris Composting Program Design estimates that 18-20% (17,000 tons per year) of all yard debris disposed of in 10 years could be handled by backyard composting/mulching.(4)

Costs to a municipality for collection, processing, and distribution are avoided for yard wastes that are composted by individuals. Generally, the extent to which individuals are engaged in home horticultural activities will influence the level of participation in backyard composting. Any home gardener even minimally familiar with horticultural pursuits, knows the value of compost. Municipalities can make use of this awareness and can add a sense of civic responsibility by pointing out the savings realized by the community when residents compost their own yard wastes.

While data on the quantity of yard wastes being composted by individual gardeners are limited, they certainly contribute significantly to the reduction of waste going to landfills in many communities. In addition, by reducing the volume of organic material in a landfill, composting reduces the production of methane gas, a primary problem in landfills. Through public education programs, the level of awareness of the role of composting in extending landfill life and of benefits of the product can be raised.

However, backyard composting is not a substitute for a municipal program. The home yard waste composting program discussed above requires very little on the part of local jurisdictions. The major responsibility of initiating and continuing the operation of the yard compost system rests with local homeowners. The risk to those who implement such systems and their neighbors is low to moderate. The program is judged to be a highly feasible reduction method.

g. Environmental Impacts

No direct adverse environmental impacts are associated with the waste reduction methods identified. Particular policies that are implemented through these methods may potentially produce some impacts. Incremental impacts of various waste management or disposal methods can be reduced if there is less waste, and impacts of manufacturing new articles can be lessened. Thus, positive impacts can potentially be achieved through waste reduction.

4. RECYCLING PROGRAM METHODS

a. Introduction

The practice of separating recoverable materials from other wastes so they can be reprocessed into a resource for new products is known as recycling. Recycling includes steps of separation, collection, processing, transportation to markets, and remanufacture, as well as purchase and utilization of materials in a new form. Recycling does not occur until all steps have been completed.

Recycling can be looked at as one approach for waste reduction; the two programs have many areas of overlap. One way to distinguish between recycling and waste reduction is that recycling encompasses those methods directed at managing and recovering wastes once they have been generated while reduction is directed at not generating wastes in the first place.

There are two basic approaches for recycling systems:

- Front-end separation
- Back-end separation

The front-end systems for source separating and collecting recyclable materials before they are mixed in with putrescible and other garbage are considered first in the following discussion. Mixed waste processing (back-end) systems deal with removing recyclables from the residential or commercial waste stream after they have been incorporated in a homogeneous mix of typical garbage. These systems are described in the latter portion of this subsection. Criteria for designating appropriate levels of recycling service within a given waste generation area are discussed in Subsection 4.m.

The key differences between various types of source separation recycling methods relate primarily to the techniques used to separate and collect recyclable material and make them available to brokers, processors, and markets.

b. Reuse

Waste reuse provides mechanisms by which individual items or products can be reused in their original form, by someone besides the first user. Reuse of items before they enter the waste stream is a key strategy for waste reduction, discussed in the previous subsection; it also provides an alternative to disposal when items can be salvaged from the waste stream.

In the State solid waste management strategies, reuse is given the same priority as recycling programs. Reuse, as discussed in the context of recycling, applies to items which can be salvaged from material presented for disposal.

For example, if an old tricycle or washing machine can be pulled from a load of material being landfilled, then repaired and reused rather than discarded, the waste stream will be reduced. Also fewer resources will be needed in the production of new tricycles and washing machines.

Not-for-profit organizations such as Goodwill, St. Vincent de Paul or the Salvation Army commonly play key roles in waste reuse programs. These programs have community support because they encourage tax deductible donations and often provide jobs to disadvantaged individuals. In addition, private secondhand stores or building material reuse centers also provide this service.

Government agencies can encourage and expand private or non-profit efforts in reuse activities by providing technical or financial assistance to support recovery of increasing amounts of reusable items. Some local governments have granted reduced disposal fees at landfills or transfer stations or provided other incentives to reuse operators. These incentives allow operators to perform more effectively.

In some cases, such as in Berkeley, California, the tipping area at the transfer station is used to pull items from the discarded waste stream, especially from self-haul waste, and a nearby site is used to resell the items. In some locations, salvaging for reusable or other recyclable materials occurs at the landfill, either before items are dumped or afterwards. Health and safety concerns should be considered if these sorts of activities are contemplated.

The reuse activities described above present relative low risk for the organizations and jurisdictions involved. These activities are judged to be highly feasible recycling methods.

c. Recycling Support Programs

Recycling collection programs require adequate promotional and educational or regulatory support to encourage effective use and recovery of the maximum amount of materials. In many ways, recycling programs parallel those discussed for waste reduction. Education, regulatory incentives or disincentives, and government programs are possible approaches to implementing both methods. The preceding waste reduction section covers methods that are

described in greater detail than those provided here. The primary objectives of implementation efforts are to:

- Encourage more people to recycle
- Encourage those who recycle to recycle more
- Inform people how and why to recycle
- Make it easier and more convenient to recycle

(1) Education

Recycling education informs the community why and how to recycle. This function can be performed by either government agencies, private sector recyclers, or both. Recycling hotlines (such as Washington's 1-800-RECYCLE) or information referral services are a common method of answering specific questions for those who need help in knowing how, when, or where to recycle. Brochures, school curricula, and advertising are other frequent methods of providing ongoing promotion and information on recycling. Arranging for presentations to groups, promoting special recycling events and preparing media presentations help heighten public awareness on recycling issues.

(2) Incentives/Disincentives

Governments have taken a wide range of actions through their regulatory authority to encourage and increase public and business participation in recycling efforts. Typical incentives include: reduced garbage rates for recycling (or producing less garbage), payments or credits for recycling, container deposits, and non-monetary rewards such as a feeling of civic pride and accomplishment. Disincentives may involve: disposal bans on recyclable materials or mandatory recycling regulations and associated penalties. Again, incentives and disincentives are often two different approaches to accomplishing the same goals.

(3) Government Programs and Actions

Efforts by governments to demonstrate the value and ease of recycling or to encourage recycling by citizens and businesses help support recycling systems. Government agencies can establish office paper collection systems and inform private businesses about their effectiveness. Efforts to develop markets and improve demand for recycled items is also a key activity for government involvement. Waste audits or other technical assistance and data services provided to private businesses can help these businesses identify potential new recycling strategies.

Consistent collection of waste composition and materials recovery data is an essential element in supporting public and private recycling efforts. Development of community recycling plans and the establishment of recycling goals by agencies can further recycling efforts.

Government can also amend planning and building requirements to accommodate recycling into new structures. In designing new multi-family dwellings or commercial buildings, centralized space can be provided to store recyclables and procedures for in-building transport of recyclables to these areas can be developed.

(4) Feasibility

The recycling support programs described above generally present relatively low risk for those organizations and jurisdictions involved. These programs are judged to be highly feasible recycling methods.

d. Drop-off/Buy-Back Depots

(1) General Description

Before the widespread implementation of curbside collection systems, communities intent upon recycling established drop-off depots. These centers, which are usually unstaffed, are places where residents can deposit recyclables. Privately operated buy-back depots operated also require residents to bring materials to a generally staffed site, where they are paid for delivering certain materials. The primary difference between drop-off and buy-back operations is the payments which are made for materials.

Many facilities or operations are a combination of drop-off and buy-back approaches. For example, a buy-back facility may pay for some materials, such as aluminum cans, refillable bottles, cardboard, and newspaper, but not for other materials, such as cullet or mixed waste paper. Often a buy-back center serves as a storage and processing facility for materials collected at numerous drop-off sites. For these reasons, the two methods are discussed together. A chart at the end of this subsection contrasts advantages and disadvantages of the two methods.

(2) Process and Physical Features

Drop-off centers are often operated as a fund-raising service by charitable or civic organizations; they also may be operated by for-profit recycling companies or by solid waste utilities. Often private sector firms will operate a drop-off facility on behalf of a charity and contribute a portion of the proceeds to the organization. Drop-off and buy-back depots generally receive recyclables recovered from the residential waste stream. Buy-back centers rely to a greater extent upon commercially generated recyclables. Both drop-off and buy-back operations are valuable components of urban or rural recycling programs.

These depots may be located at one particular site or may be based on the back of a truck which makes scheduled stops throughout an area. The fixed depots are often associated with solid waste operations such as transfer stations, materials processing centers, or landfills.

(3) Technology Background and Evaluation

Some drop-off sites accept only one type of material (i.e, the newspaper collection bins at numerous convenience stores and schools). Or they may collect any or all of a whole range of materials including: newspaper, cardboard, mixed waste paper, tin cans, metals, aluminum cans, glass, refillable bottles, plastics, yard waste, and waste oil. Drop-off centers may be either staffed or unstaffed; staffed centers tend to accept more materials and to process them on-site.

Buy-back depots must be staffed in order to measure and make payment on delivered materials. Buy-back operations generally focus their recovery on a few high-value or high-volume materials such as corrugated containers, aluminum cans, refillable bottles, and newspaper. Some buy-back sites will accept other materials without payment or will serve as a drop-off site during hours when they are not staffed. Reverse vending machines, operated in some areas of Washington State, are unstaffed buy-back depots which provide payment for particular materials, such as aluminum cans.

Unstaffed recycling facilities come in a variety of shapes and sizes. They are particularly popular in Europe. They have recently become more common in the U.S., including several communities in Washington State.

Fiberglass domes, or "igloos," are currently being used by some communities for unstaffed drop-off depots. These containers have a distinctive beehive shape. Igloos are approximately five feet high with a capacity of three cubic yards. Materials must be separated by users when they are put into the containers. These types of depots are serviced by a roll-off truck fitted with a hydraulic crane. The crane picks up the igloo and the contents are emptied into the collection vehicle by releasing a trap door. Trips must be made to each site on a regular basis to collect the variety of materials which are deposited. The distinctive look of these bins serves a promotional purpose that increases public awareness of recycling.

Recently, drop boxes with four or more sections have been used successfully in several U.S. drop-off programs. They can be loaded onto regular roll-off vehicles and transported to a processing or storage facility in a single trip.

Bins or individual drop boxes are also used for material storage. These may have to be unloaded by hand or with special equipment, such as knuckle cranes, side or front load packers, or rotating head fork lifts. Security and protection from wind and rain are factors to consider in designing drop-off facilities.

Depots are usually located in a central or easily accessible part of town. Residents are asked to bring their recyclables to the depot and deposit them in the openings. However, depots can also be of use in a rural situation where there is no curbside pick up. Highly frequented public areas such as supermarkets, shopping malls and amusement parks are ideal spots for depots to catch, in particular, discarded glass or metal beverage containers. Small drop-off depots are also used for multi-family residences.

Staffed buy-back centers can provide the public with a financial incentive to recycle. The cash incentive often attracts supplies from people who need money--pensioners, low-income residents, youth, and charitable or civic groups. Deliveries to a buy-back center are often larger and come from farther away than those delivered to drop-off centers, since buy-back customers collect from numerous sources and will travel some distance to generate cash from sales. Surveys in Oregon and California show that the typical drop-off center patron lives within five miles of the site.

(4) Implementation Factors and Feasibility

The use of drop-off centers may decline in urban areas offering curbside collection. Curbside collection is far more convenient than using drop-off facilities. However, drop-off sites afford an opportunity, particularly in rural areas where curbside service is not provided, for the public to fully participate in recycling. (Participation in drop-off recycling exceeds 90% in several communities where self haul is the only disposal method and recyclables are banned from the landfill).

The buy-back center strategy has been very effective nationally at recovering aluminum cans and newspapers from the residential waste stream and cardboard from the commercial sector. In Washington State, they have also contributed greatly to the recovery of refillable beer bottles. Buy-back operations are very successful for specific high-value materials. Only a small percentage of the general population utilizes buy-back centers.

Service levels of drop-off depots are normally found in the range of one site for every 5,000 to 25,000 residents. Multi-material drop-off centers can handle from 10 to 100 or more tons of material per month. Buy-back depots generally require a somewhat higher population base to support them, and they usually handle a higher volume of material (up to 1,500 tons per month).

Recovery levels at recycling depots can be increased with effective advertising and promotion. Often these centers will become involved in supporting paper drives or other outreach efforts. For example, in Tacoma, local schools are involved in collecting recyclables. The frequent use of volunteers by drop-off programs, such as in paper drives, can produce significant benefits but may not be a dependable source of consistent operational support.

Costs associated with drop-off or buy-back programs depend on the specific strategies and program objectives. Sites for locating collection bins may be donated or associated with other operations. The bins themselves can be either very inexpensive or relatively costly. The sites may sometimes include processing equipment for preparing materials for market. The costs of collecting and transporting materials from small convenient depots or bins to a centralized facility may be significant, but will not be a factor for a centralized depot. Changing or volatile markets for recyclable materials are not a factor in participation at drop-off sites but can have a major impact on deliveries to buy-back centers and on the economics of operating either type of program.

Convenience of using these centers is a critical factor in their effectiveness. They must be visible, accessible, and user-friendly. Residents tend to use the most convenient method of recyclables collection, whether curbside, drop-off or buy-back. Drop-off centers are well-suited for rural areas where curbside and buy-back collection is not feasible; drop-off centers also complement urban programs that may not collect all recyclable materials at the curbside and that often do not serve multi-family dwellings or commercial establishments.

One innovative method being tried in some areas is to provide collection bins for certain "away from home" recyclables in areas where they are generated. For example, shopping malls or parks are often areas where people will put recyclable containers in trash bins rather than cart them home or to a recycling center.

Government agencies often operate drop-off depots in conjunction with other solid waste facilities but seldom run buy-back centers, which may conflict with potentially profitable private sector activities. Also government is not suited to the tempo and types of business decisions that need to be made frequently and quickly in a buy-back business. Agencies have been involved in providing technical or financial assistance to private operators of both types of facilities -- often in the form of operating sites, low-interest loans/grants, in-kind services or promotion.

The following table compares the advantages and disadvantages of drop-off and buy-back operations:

TABLE B-2

DROP-OFF AND BUY-BACK OPERATIONS
ADVANTAGES AND DISADVANTAGES

DROP-OFF	BUY-BACK
ADVANTAGES	
o Least costly method of collection	o Provides economic incentive for participation
o Profit or non-profit income or fund raising source	o Effectively recovers high-value materials such as beer bottles and aluminum cans
o Cost-effective way to recover infrequently generated wastes, such as used oil, batteries, white goods	o Provides employment opportunity
	o Serves as a base for drop-off programs
o Promotes recycling through visual presence	o Helps to educate public
DISADVANTAGES	
o May not accept all materials	o May be inconvenient due to distance and travel time
o May be inconvenient due to distance and travel time	o Limited effectiveness in recovering items with little or no market value
o May have low participation and low diversion quantities	o Participation can be affected by fluctuating market prices
o May experience contamination of bins with garbage if unstaffed	
o If not properly maintained, can become unsightly or vandalized	

The drop-off and buy-back depots described above generally present low risk for those organizations and jurisdictions involved. As noted, buy-back centers are usually run as private enterprises. The burden of capitalization for what are often small businesses represents a potentially high risk. Drop-off and buy-back depot operations are judged to be feasible recycling methods.

(5) Environmental Impacts

Potentially adverse impacts of drop-off centers include increased traffic, noise and aesthetic impacts. Similar impacts may be caused by operation of buy-back facilities, although the presence of staff during daytime hours of collection reduces problems with noise from bottle collection and with litter. Potential benefits of these methods include reduced impacts through various processing and disposal methods as a result of lower tonnages.

e. Curbside Collection

(1) General Description

Curbside collection is recognized as an effective means of recovering recyclable materials from the residential waste stream. As a large-scale approach to collecting recyclables, curbside programs are relatively new, yet they have proven very successful where implemented. More than 500 communities in the U.S. now operate multi-family material curbside programs; this compares with fewer than 100 programs in 1980. Curbside collection programs also include awareness and promote recycling throughout the general service area, a significant benefit.

In this approach, collection vehicles pick up specified items at each single-family residence on a scheduled basis. Recyclable materials are taken either directly to buyers or to storage and processing facilities from which they are later shipped to market.

Curbside collection can be operationally complex and more costly than other established methods of collecting recyclables from residential waste. The decision to implement this method must be evaluated on a community-by-community basis. Generally, curbside collection will be more feasible in urban rather than rural communities. Key factors to consider in evaluating curbside collection for particular communities include:

- Demographics
- Waste composition
- Markets
- Community support and commitment
- Existing management systems and facilities

(2) Process and Physical Features

Based on experience elsewhere, successful recycling programs depend on a number of factors. Convenience is of special concern, since consistent and reliable participation by the public is critical. A recycling program

that provides curbside service makes recycling just as convenient as regular garbage set-out.

Designing a curbside recycling collection service is a complex task that requires consideration of many interrelated factors. Several issues, in addition to convenience that must be addressed during the planning stage, are:

- Will the recycling program be operated by the municipality or by one or more private contractors?
- Will recycling be combined with garbage collection or done separately?
- What type of collection vehicle will be most efficient?
- Should a household collection container be distributed?
- What materials will be collected?
- What household types will be serviced?
- Should the program be mandatory or voluntary?
- How frequently will material be collected?
- What amounts of material segregation will be done by the residents and by the collector?

The answers to several of these questions are driven by demographic factors, waste composition, local issues and parties that control solid waste, and by preferences of the policy makers. These can vary between WGA's and among communities within the WGA.

(3) Technology Background and Evaluation

As described below, a wide range of curbside collection services can be provided which will affect cost and participation. A number of parameters must be considered in designing and in projecting program cost and participation.

(a) Public versus Private Operation and Ownership

One of the most important decisions is whether a municipality should operate the curbside program or contract/franchise the operation to private collectors.

Most municipalities in North America now contract out recycling operations since the private sector usually performs the service more efficiently and at a lower cost. Contracting out the recycling program releases the city or county from the administrative burden of purchasing, operating and maintaining collection, and processing equipment.

If private operation is selected, financial arrangements need to be worked out on the sharing of economic risk and benefit from marketing of recyclable commodities. Curbside program costs are not normally fully offset by revenues from the sale of collected materials.

(b) Separate Recycling Collection vs. Combined Recycling/Waste Collection Vehicles

Recycling can either be done with a separate vehicle or combined with existing garbage collection trucks and service. Combining recycling with an existing waste collection system is usually done by adding bins for particular materials, such as newspaper, to the vehicle or by attaching a trailer for recyclables behind the regular garbage truck. Combining services obviously saves costs since the same personnel and trucks are sufficient to perform both collection functions. It is especially cost-effective in more rural areas, where quantities of material do not require dedicated recycling vehicles.

A number of problems, however, arise with regard to the use of trailers with regular garbage collection vehicles:

- Unless the truck is a side-loader, there is a safety concern about personnel being caught between the truck and the trailer.
- In an urban setting, the occurrence of dead-end and/or narrow streets can make maneuvering a packer truck-trailer tandem difficult.
- The trailer must be properly sized for maximum collection inefficiencies by assuring the driver has no need to unload at the processing center before the garbage truck is full, or to unload at a disposal facility before the recycling bins are full.

For these reasons, most urban multi-family material curbside recycling programs have opted for the separate collection of recyclables using vehicles and crews other than those used for garbage collection.

(c) Collection Vehicle Type

State-of-the-art recycling programs tend toward the use of dedicated collection vehicles. These specially designed vehicles are capable of collecting several recyclables at once--usually with newspaper in one compartment and container materials in another compartment, or containers may be segregated into two or more compartments (often steel and aluminum cans, clear and colored glass). The compartments on a recycling truck can generally be emptied hydraulically and independently. Many of these vehicles have a right-side, stand-up drive to allow the use of one-person collection crews, which significantly reduces the cost of the recycling program.

(d) Collection Frequency

To achieve maximum participation and materials recovery in curbside collection, frequency of collection is critical. Curbside collection service is typically offered on a monthly, bi-weekly, or weekly basis. The greatest recovery effectiveness occurs when recyclables collection is done on a weekly basis on the same day as regular garbage collection. This is perceived as a more convenient service, even though it may be more costly. People are also more likely to remember to set out recyclables. Results from 34 curbside programs in North America show the importance of collection frequency on participation rates in Table B-3. It should be noted that Seattle is experiencing much higher participation rates for both its weekly and monthly collection programs.

TABLE B-3

CURBSIDE COLLECTION FREQUENCY AND PARTICIPATION

COLLECTION FREQUENCY	REQUIREMENT	AVERAGE PARTICIPATION (percent)
Weekly	Mandatory	75
	Voluntary	48
Biweekly	Mandatory	51
	Voluntary	39
Monthly	Mandatory	34
	Voluntary	17

(e) Household Recycling Collection Containers

It is becoming increasingly clear that provision of special in-home containers results in increased participation levels and increased recovery rates. The container facilitates material storage and set-out at the curb, acts as a constant program reminder to neighbors, and improves collection efficiency. Depending on the recyclable segregation strategy employed, residents are provided with one to three containers.

(f) Materials Collected

It is possible to recover a broad range of materials from the residential waste stream through curbside collection including newspaper, high-grade paper, corrugated containers, mixed paper, glass containers, ferrous and bi-metal cans, aluminum cans, plastic containers, plastic film, and used motor oil. Other special materials, such as household or car batteries, can potentially be collected for recycling by curbside service, although this is not currently the practice. Yard waste is collected through some curbside programs; however, this material is not collected with other commodities and is discussed separately because of its different requirements.

The three most commonly collected materials in multi-family material programs are newspaper, glass containers, and metal cans. Each has well-established markets, exists in large quantities in the residential waste stream, and is relatively economical to collect (i.e., high weight-to-volume ratio and easy source separation).

A rapidly expanding component of the residential waste stream is plastic packaging. Relatively few recycling programs include plastics on their list of curbside recyclables due to the low weight-to-volume ratio of these materials and problems with segregating resin types. Some programs have begun collecting certain types of plastic containers; namely, HDPE (high-density polyethylene) dairy jugs and PET (polyethylene terephthalate) soft drink bottles. Curbside programs that collect plastics receive a high proportion of undesired plastics, which take up room and must be sorted out at additional cost. Markets for plastics collected curbside are often difficult to find and revenues fall far short of collection and handling costs.

The recovery technology for plastics is still in the embryonic stages. Methods for reducing the volume that plastics occupy on a collection vehicle are being developed, but the necessary systems are not yet available. The Plastics Institute of America is supportive of many recent efforts to provide for post-consumer plastics recycling.

Another material being collected with greater frequency is mixed waste paper. This includes white and colored writing papers, junk mail and paper board such as cereal boxes. The quantities collected can be as great as newspaper, thus having a substantial impact on the waste stream. However, additional vehicles are required to handle this bulk of material, and mixed waste paper markets and market prices are often unreliable.

(g) Source Segregated vs. Comingled Collection

Both containers and paper can be collected either segregated (each marketable material is set out in a separate household container), or mixed together (glass and metal containers may be in a single container, with newspapers often kept separate). Segregated collection can be facilitated by waste generators who have been instructed to place each material into a separate container, or by the collector who can sort at the truck.

Commingled (mixed) recyclables collection requires processing or sorting of the material after collection into its marketable components. Processing is accomplished at an intermediate processing center. This type of facility must be tailored to the collection strategy. A discussion of intermediate processing centers follows.

The commingled system is generally more convenient for the generator and is likely to increase participation rates. It also requires less time at each stop, which increases the number of households that a recycling truck can service each day by as much as 10 to 15%. It, therefore, reduces collection costs. Fewer bins are generally required on the truck and this allows the collection vehicle to add materials and/or volumes over time in response to program modifications.

The primary disadvantage of a commingled collection strategy is that it requires additional processing to separate the collected materials before they can be taken to market. This may involve time and expense and is accomplished at an intermediate processing facility. A secondary disadvantage is that materials may become contaminated (paper) or broken, in the case of glass.

(h) Intermediate Processing Center

At the intermediate processing center (IPC), materials collected in a commingled form are segregated. The IPC is not a method in itself, but is rather one technique that supports a particular method(s) of recyclables collection. New facilities recently developed in Seattle for Recycle America and Recycle Seattle curbside programs are examples of new intermediate processing center operations. The IPC can be used to process material collected through commingled curbside programs or commingled multi-family programs. These facilities are different in function from mixed waste processing operations, discussed later, in that they are intended not to produce any residual or non-recyclable fractions (though this is not generally realized in practice).

Segregated collection systems may also require some processing to prepare the materials for shipment to market--for example, sorting colors of glass or aluminum cans from steel cans, if this has not been done before they are stored in the collection truck. Materials may be baled, crushed, flattened, pelletized, perforated, or otherwise densified to reduce costs of shipping and to meet buyer specifications. This more minimal form of processing is not normally referred to as "intermediate processing," although it also is often performed at an IPC.

Intermediate processing centers differ from mixed waste processing facilities (discussed later) in that residuals from the processing line at an IPC are normally less. Residuals result when residents put inappropriate items in their containers; a cost is associated with disposing of the residuals. With source-segregated collection, residuals are negligible.

In intermediate processing systems, glass containers are separated from metal containers, and glass containers are separated into different colors. This is normally performed manually on picking belts. Aluminum, tin, and bi-metal cans can be separated, often by use of magnets and air classifiers.

Paper may be separated or high-graded, depending on market prices. If newspaper is mixed with other grades of paper, a lower market value results. However, the increased labor cost required to separate newspaper from other paper may not be warranted if the market prices for clean newspaper are not much greater than those of mixed paper.

Processing facilities may also play a role in other recycling systems, as will be discussed below. These facilities can be designed to receive materials collected from a variety of sources (residential, commercial, etc.) by various collection systems. IPC's may be developed in conjunction with buy-back operations, transfer stations or other disposal facilities.

A public agency can use several strategies to construct an IPC that meets the needs of the recycling programs. Generally, private companies play a significant role in construction and/or operation. The local government can use a standard service procurement process to solicit private proposals for such a facility. However, terms of a contract may involve performance standards that recognize the government's responsibility to share the risks involved in revenues, variable collection tonnages, and compliance issues. If the government collects the materials, it may have to pay penalties for low volumes that harm IPC economics.

To properly size the IPC, it is necessary to estimate the quantity of recyclable material that will be recovered by whatever collection programs are implemented in the service area. Based on experience in other municipalities and other factors mentioned, it is possible to determine approximate tonnages that will be collected. Due to economies of scale, it may make sense to service all or a large portion of the more rural WGA's with a single IPC.

(i) Households Served

Curbside collection service is usually only offered to households that already receive regular garbage collection. In some areas, households not subscribing to garbage collection service may participate in curbside programs if they are located along curbside routes. The maximum size of multifamily buildings serviced by curbside programs is typically six units. Smaller commercial businesses without significant waste volumes may also take part in curbside programs.

(j) Mandatory vs. Voluntary

There has been considerable debate recently whether public participation in residential recycling programs should be mandatory or left to the discretion of residents. Mandatory programs require that recyclables be kept out of regular garbage. Most typically, enforcement involves notification of non-compliance. Non-collection of refuse is another option after repeated offenses. In some areas, "mandatory curbside programs" mean that the curbside service has to be offered by local governments or waste haulers. Rhode Island and New Jersey are two states that have legislated mandatory curbside collection programs.

While there are many voluntary programs that are successful, mandatory programs that are properly designed, promoted, and operated tend to achieve higher participation rates and higher recovery volumes than their equivalent voluntary programs. [See table presented above in Subsection B.4.e.(3)(d) for collection frequency.] Often, mandatory ordinances are put in place after a voluntary program has operated for a while. The publicity associated with new mandatory programs may be as effective as the penalty in encouraging involvement, and even long-time participants segregate a higher percentage of their recyclables.

(4) Implementation Factors and Feasibility

Since a special collection vehicle is normally used to perform the curbside service, there should be enough households on a route to justify this capital expenditure. Generally, a collection truck operating in a typical suburban area can drive by 4,000 to 6,000 households per week. The overall expense of the residential curbside method varies depending on many factors including the equipment used, labor costs, citizen participation, recyclable market conditions, and so on.

Successful curbside collection programs require a continuing commitment to funding and promotional and educational support. Implementation of mandatory curbside programs can result in reduced participation in drop-off and/or buy-back operations. This, in turn, may adversely affect existing businesses and non-profit groups involved in recycling. These impacts can be anticipated and mitigated by involving existing recycling program operators in new curbside programs and in the marketing of materials. Promotional aspects of curbside programs can also help to increase participation in drop-off and buy-back operations.

For all recycling collection programs, the chief indicators of success are the recovery rates for the targeted materials. The recovery rate is the percentage of the material diverted from the waste substream. This rate is the product of the participation rate and the efficiency rate for that material:

RECOVERY RATE = PARTICIPATION RATE X EFFICIENCY RATE

For example, if 60% of a community participates in a curbside program and there is an efficiency rate of 50% for the capture of glass from those participating households, then the recovery rate for glass from the single-family residential waste stream will be 30% (0.6 x 0.5).

Well-run curbside programs generally have participation rates of between 50 and 75%, although higher and lower rates have been observed. This means that between 50 and 75% of the households serviced will set out at least some materials one or more times each month. Efficiency rates account for the fact that those who are participating do not set out all of their newspapers or containers. For the most frequently collected materials, curbside service generally results in the following efficiency rates (also called capture rates):

Newspaper	85%
Glass Containers	50%
Metal Containers	40%

These efficiencies can vary greatly from program-to-program and will be different for other materials that may be collected. For example, efficiency rates for collection of mixed waste paper may range from 30 to 75%, depending in part on how mixed waste paper is defined (whether it is all waste paper or only that portion which is marketable) and how the convenience of recycling the material is promoted and provided.

In some communities, scavenging of the more valuable materials that are set out for curbside collection has been a problem. This has been dealt with through ordinances designed to assure that only a designated collector may pick up material from specified routes.

Curbside collection, as described above presents many complex development issues. However, many private companies and governmental jurisdictions have implemented curbside collection and have shown risk to be relatively low if proper attention is directed at marketing the recovered materials. Curbside collection is judged to be a feasible recycling method.

(5) Environmental Impacts

Adverse environmental impacts from curbside collection include the minor increase in truck traffic in residential areas, with the associated local noise increase. Noise impacts can be minimized by avoiding early morning collection in residential areas. Curbside programs also create a minor adverse aesthetic impact on collection days, when streets are lined with recycling containers. Potential beneficial impacts of curbside collection are increased tonnages of recovered material which reduces impacts that may result from other waste processing or disposal methods.

If an intermediate processing center is developed in conjunction with a curbside collection or other program, adverse impacts could include effects of haul vehicle traffic on air quality, noise, and traffic. The facility may affect noise levels and aesthetics. Potential odor generation should be much less than for a facility handling the full range of solid wastes. These impacts are described in Subsection B.2.c.

f. Multi-Family Housing Collection

(1) General Description

Since apartment buildings contain a high number of households and contribute a significant volume of the residential waste stream in many areas, they should be included in a municipal recycling program. For residential buildings with greater than six dwelling units, special recycling collection programs must be developed. This recycling program component is often initiated after the basic curbside program is in place.

Apartment building recycling programs have not been implemented on a wide scale because of various real or perceived barriers. There have been recent efforts to develop innovative collection programs that specifically serve apartments and condominiums.

(2) Process and Physical Features

Efforts to develop recycling programs at multi-family facilities have been few because of important difficulties which must be overcome:

- Lack of efficient internal collection systems
- Storage space limitations
- Lack of convenience for residents
- High densities and diversities of multi-family dwellings in some areas
- Difficulty in motivating residents to participate
- Increased work time for building maintenance staff in moving recyclables or cleaning storage areas
- Lack of a municipal responsibility for refuse collection from apartment buildings

These difficulties must be managed in developing a collection program to serve multi-family units. The structure of a system to serve diverse building designs at each multi-family location must provide for addressing these issues.

(3) Technology Background and Evaluation

A number of effective multi-family collection systems have been developed. These systems are most effective when containers, storage facilities, and internal collection programs are standardized for all sites in the program area.

It can be very expensive to custom-fit collection equipment for serving a wide range of site situations. Assuring uniformity among targeted facilities entails numerous site visits to explain the system to the building superintendents or owners, to plan internal collection, and to provide promotional materials to be distributed to tenants. The launch stage of an apartment recycling program is staff-intensive and has to be conducted over several months before collection can begin.

Multi-family systems typically use common area bins in which residents place their recyclables. Often, building staff bring recycling barrels down from each floor to a pick up area in the basement or outside the building. One effective system consists of 90-gallon wheeled collection carts (one for newspaper and one for commingled glass and cans) and a semi-automated collection vehicle that hydraulically lifts and dumps the carts. Another system provides special bins with multiple compartments for various materials that can be mechanically emptied, all at one time, in a special truck. Other programs have been more labor-intensive, sometimes requiring manual transfer of recyclables from apartment house bins to bins on a collection truck adapted for the purpose.

Generally the materials collected from multi-family dwellings will be commingled; that is, the glass and metal containers will be mixed together. An intermediate processing center or additional crew time at each location is required to separate the materials into their marketable form.

(4) Implementation Factors and Feasibility

Many of the same factors affecting implementation of residential curbside programs, such as market availability, cost, and population also apply to multi-family programs. Since multi-family programs are more likely to be handled by the private sector, government agencies may have a different role in their implementation.

Provisions for technical assistance, promotion and education, or incentives are ways in which local governments can help private collectors initiate and sustain multi-family collection efforts. For example, in January 1989, the City of Seattle is offering disposal credits of $30 per ton for operators who collect recyclable material from multi-family dwellings. Requirements placed in municipal contracts or franchises can also help assure that multi-family programs are successful.

Participation rates in multi-family programs are not normally as high as those of curbside programs; however, they can be greatly improved with well-thought-out promotion efforts. Targeted materials collected may be different than those collected from single-family residents and should be identified after examining the waste substream composition. For example, yard debris and waste oil may not be as plentiful in multi-family residential wastes as in single-family residential wastes.

Multi-family housing collection represents a relatively low risk for those engaged in such services. As for curbside collection, market availability and population density will control the degree to which this feasible recycling method can be implemented.

(5) Environmental Impacts

Adverse environmental impacts from multi-family collection include a minor increase in truck traffic in residential areas, with an associated local noise increase. Noise impacts can be minimized by avoiding early morning collection in residential areas. Potential benefits from curbside collection are increased tonnages of recovered material which reduces impacts that may result from other waste processing or disposal methods.

g. Commercial Source Separation/Collection

(1) General Description

The commercial sector could potentially contribute a significant level of recycling. Large volumes of commercial waste materials from retailers, manufactures, offices, and restaurants are disposed of each year, many of which are recyclable. More than 30% of Washington's waste is generated by commercial businesses and manufacturing operations. A significant percentage of this waste stream could be diverted from landfills by implementing effective recycling programs targeted at specific high volume, easily recyclable materials. These programs can employ either source separation or processing after collection.

(2) Process and Physical Features

There are three recyclable materials which are fairly abundant in different segments of the commercial waste stream that can be targeted for source separation. The design of collection systems for each of these materials must be tailored to specific types of businesses where those wastes are principally generated.

(3) Technology Background and Evaluation

The technological background and evaluation of commercial source-separated collection is discussed for each of the commonly available materials.

(a) Office Paper

Office complexes generate large quantities of easily accessible waste paper and computer printout (CPO) paper. These papers are normally the highest valued papers found in the post-consumer waste stream (prices paid by end-users can range from $75 to $220 per ton).

The primary obstacle to office paper recycling has been the difficulty in setting up efficient and convenient in-building collection systems. However, in the urban areas where waste collection and disposal costs have skyrocketed in recent years, building owners have begun to implement paper collection systems in order to reduce their overall waste management costs. In addition, the current markets for high-grade paper are strong, resulting in considerable interest among private sector paper recycling operations in collecting this material from office buildings.

A typical office paper recycling system consists of three components:

- At-desk separation
- Internal collection and storage
- Pick up and transfer to market

Most office paper systems require employees to separate the paper at their desks (often into colored papers, white paper, and computer printouts; depending on the market or processing requirements other contaminants such as paper clips or address labels may need to be removed). Often employees are given a small desk top container to hold paper. When the desk top containers are full they are emptied into larger central containers located on each floor of the building, either by the employees or by maintenance staff. This larger container is usually on wheels to enable it to be moved onto a freight elevator and brought to a storage area at ground level. If there is a concern with confidentiality, the container is also secured.

At ground level, the containers are loaded into a roll-off container for subsequent pick up or are unloaded directly onto a collection truck. In the case of confidential records, the secured containers are loaded onto the collection truck and transported directly to a shredding operation.

An effective ongoing education and promotion campaign is essential to the success of an office paper recycling program. The campaign must be three-pronged (aimed at building owners, maintenance staff, and office employees), and must clearly explain the purpose of the program and the roles of each target audience.

High-grade paper-recovery programs should also be implemented in government buildings and banks. Office paper collection programs have a long history, and in some cases have become quite successful.

(b) Corrugated Containers

It is not uncommon for over 50% of the waste generated by large retail stores to be old corrugated containers (OCC or cardboard boxes). As with office paper, strong markets exist for OCC. As a result, it is likely that many large generators already have recycling systems in place.

Large generators, such as shopping malls, manufacturing plants, warehouses and department stores often have a stationary or roll-off compactor dedicated to handling OCC. The compactor is usually supplied by the waste hauler who transports it to a processor or end user when it is full. Depending on local market conditions the hauler either pays the generator for the OCC or simply removes it at no charge.

Collection from smaller establishments is more difficult because of the limited volumes per stop and the large number of potential sources. Various companies have experimented with using old packer trucks and small cube trucks to collect OCC from urban areas with a large concentration of retail stores. Waste haulers can potentially reduce the number of regular waste pickups at certain sites when source-separated cardboard is separately collected.

For example, Golden Gate Disposal of San Francisco offers free OCC collection to its waste customers, using a retired packer truck. The truck is able to collect about 7,500 lbs per load. Golden Gate used to operate three trucks dedicated to OCC pick up, but increased scavenger activity due to the current high prices for OCC has reduced collection volumes substantially.

(c) Glass Containers and Cans

Opportunities for glass and can recycling are available in the larger urban areas of the State. Recyclable glass and metals, i.e., food and beverage containers, account for a major portion of the waste stream generated by some bars and restaurants. This amounts to a significant tonnage of material that is currently landfilled and could be recycled.

Container collection systems are not generally expected to be as favorable economically as paper recovery. Few programs have been implemented and neither costs nor effectiveness of these efforts can yet be evaluated. Where high costs of disposal or the desire to keep non-combustibles out of the waste stream exist, however, this program may be economically feasible.

Waste glass containers and cans may be collected using municipal personnel and equipment, or may be contracted out to the private sector. The source-separated material can be sold directly to glass and metal markets, or processed at an intermediate processing center prior to shipment. Processing will result in higher revenues because contaminants such as food wastes, dishes, cups, straws, and other non-recyclable materials are removed.

Regardless of whether the municipality or a private contractor is responsible for collection, specialized collection containers for storage of recyclables, as well as specialized collection vehicles, will be necessary.

Lack of storage space is one of the most common problems restricting recycling in commercial establishments. For this reason, several sizes of containers for glass and can storage must be available to suit the needs of generators. Containers for both outdoor and indoor storage are necessary to suit individual space availability. Mobile containers that can be serviced by hydraulic lift mechanisms, especially for glass, are preferable.

In San Francisco, Golden Gate Disposal is providing a glass collection service to its bar and restaurant customers. Each of the company's 300 customers is furnished with a specially marked ("glass only") container, available in various sizes for either indoor or outdoor storage. Only regular customers may participate, and each participant is required to source-separate its glass. Golden Gate Disposal uses a modified tallow collection truck with a 22 cubic-yard open top box for collection.

(4) Implementation Factors and Feasibility

As with other collection programs, availability of markets and cost impacts are factors which should be examined prior to program design. Because of the generally higher values associated particularly with office paper and OCC materials, commercial source separation programs are more likely to be self-sufficient. Risk on the part of implementing organizations is generally quite low. Participation and efficiency rates for these programs may vary a great deal because of the diversity of commercial businesses within each WGA and the types of collection services which might be provided. Commercial source separation/collection is judged to be a feasible recycling method, if sufficient quantities and commercial recyclables are available.

(5) Environmental Impacts

The potential adverse impacts of commercial collection programs would be those associated with a minor increase in truck traffic for commercial sources located in residential areas. The degree of impact would vary depending on surrounding land use, and would be negligible in industrial or commercial areas. Potential benefits are reduced tonnages and impacts through various processing and disposal methods.

h. High-Grade Commercial Collection

(1) General Description

The majority of material recycled in North America is recovered through the source separation techniques described previously. Success has been achieved, however, in recovering recyclable materials from mixed waste loads in the commercial and industrial waste stream. High-grade or targeted-load recycling collection is a fairly recent and innovative technique for recovering materials from the commercial/industrial sector.

A high-grade collection and processing program involves:

- Rerouting commercial collection vehicles to pickup targeted loads at locations having a significant proportion of recoverable OCC or other waste paper incorporated into regular garbage; where source separation is not feasible because of limited space or internal processes

- Utilizing a facility specifically designed to handle loads with a high percentage of recyclables in a materials recovery process

(2) Process and Physical Features

Wastes generated by individual industries are highly specific to the production processes in the plant or business, but in many cases are highly concentrated with one or more recyclable materials. As discussed earlier, office complexes and retail establishments generate large quantities of paper and corrugated cardboard which can often be separated for recycling at the source. However, it may not always be feasible to source separate these materials from the rest of the waste stream. Where this is true, a mixed waste sorting facility can provide an opportunity for additional expansion of recycling in the commercial and industrial sectors. Some contamination of recyclable materials will occur using this approach.

(3) Technology Background and Evaluation

Commercial customers who have higher than 50 to 60% recyclables in their wastes are potential targets for high-grade collection routes (the exact proportion of necessary recoverable materials in high-grade loads is variable and depends on market economics for each material considered). Examples of businesses which might be included on high-grade routes include hardware stores, some offices, and small department stores.

High-grade wastes can normally be collected using the same truck used to pickup regular garbage, often a front end loading compactor truck. No new capital expenditures are normally required to do collection. Waste haulers can create specific collection routes to service only those generators with relatively clean loads of waste paper, OCC, plastics, metals, or other recyclable materials.

The processing facility must be capable of receiving mixed waste loads from refuse collection trucks, and should be situated close to existing waste collection/transfer routes. Generally, a facility of this type will have a combination of mechanized and manual separation systems, such as trommel screens, magnetic separators, picking line conveyors, and balers to prepare material for market. (Technology and factors associated with mixed waste processing are discussed in a following section.) Most often, the function of high-grade processing is combined with the function of regular mixed municipal waste processing at a single facility.

(4) Implementation Factors and Feasibility

Capital costs associated with the high-grade (mixed waste) processing facility require that a sufficient volume of high-grade material be available to operate efficiently. This requirement is typically met in urbanized areas. Often a high-grade processing facility can be combined with other functions such as an intermediate processing center, buy-back depot, transfer station, or mixed waste processing facility.

Recovery efficiency of high-grade collection and processing systems normally have to be greater than 50% to make them viable unless the residuals can also be processed in conjunction with compost, RDF, or incineration technologies. Participation with this method often depends on the motivation of private sector collectors to modify their collection routes and coordinate with commercial customers in evaluating the types of wastes they generate. Government agencies may provide technical assistance or help develop the processing facility. A differential or reduced tipping fee at the facility can provide an incentive for haulers to deliver predominantly clean loads to the facility rather than to a landfill.

High-grade commercial collection presents relatively low risk to private enterprise, which has been chiefly responsible for this method of successful waste management. High-grade commercial collection is judged to be a highly feasible recycling method.

(5) Environmental Impacts

The potentially adverse impacts of commercial collection programs would be those associated with a minor increase in truck traffic for commercial sources located in residential areas. The degree of impact would vary depending on surrounding land use, and would be negligible in industrial or commercial areas. Potential benefits are reduced tonnages and impacts through various processing and disposal methods.

i. Yard Waste Composting

(1) General Description

Yard waste consists of leaves, brush, tree trimmings, grass, garden waste, shrubs and materials generated by nurseries, landscapers, and individual citizens. Generation of these wastes is seasonal, with spring and fall the heaviest periods, and winter the lightest season.

Composting is a biological process which stabilizes the organic matter in solid waste through a managed decomposition process to produce a soil amendment product. It is a form of recycling since it returns nutrients to the soil to be used again. Yard waste composting is becoming more widespread as public agencies recognize the large quantity of biodegradable materials being placed in landfills, and as the general public becomes aware of the value of the stabilized end product. Although volume reduction estimates are highly site-specific, the composting process can reduce the initial volume of leaves by 60% to 80%, depending on the initial and final physical characteristics of the leaves and finished compost product.

There are primarily two methods used to perform the composting of yard wastes. The method discussed herein relies primarily on a centralized collecting and composting system. The other method, which relies on backyard composting by individuals, is called home yard waste composting and is discussed in Subsection B.3.f.

A centralized leaf and yard waste collection and composting system generally complements a backyard composting program, since not all householders will attempt to compost the large volume of leaves and prunings which they may generate on site. In some areas, as much as 25% of the residential waste stream can be composed of yard waste including: grass, leaves, brush, and shrub and tree trimmings as well as other garden wastes (for Washington State as a whole, in 1987, 18% of waste material consisted of lawn and garden waste).

Similar wastes are also produced by commercial landscaping and land-clearing operations. Normally, only single-family residences or smaller multi-family facilities are served in a curbside yard waste collection program, since larger multi-family units are serviced by professional landscapers.

Properly designed and supported curbside programs can recover between 75 and 90% of the annually generated yard waste. Drop-off site strategies will likely capture less of the available yard waste; possibly around 20%. Neighborhood clean-up programs will recover around 5% of the available material.

(2) Process and Physical Features

The methods employed for collecting yard waste from the waste stream will generally involve either curbside collection from residents or centralized/intermediate sites to which residents and commercial disposers may deliver yard wastes. Often these services are offered seasonally to assure maximum availability during the high growing and gardening periods.

Most urban areas already have existing private landscape-oriented businesses which provide a mobile chipper service for residents with occasional large amounts of prunings; however, these aren't able to fully service the large number of residents who periodically generate smaller volumes.

There are several options for collecting yard wastes at the curb on a community-wide basis, including using packer trucks or the combination of a

front end loader and a dump truck. Alternatively, residents can be requested to deliver their material to a drop-off site, although this approach results in lower collection levels.

For curbside service, bagging, bundling or placing yard waste in a can is considered to be the most efficient collection method, because existing collection equipment can be used. However, opening individual plastic bags at the compost site is a time-consuming and expensive process. One option being explored by some communities is the use of biodegradable paper bags instead of plastic bags. The paper bags can simply be collected and unloaded at the compost site and composted together with the yard waste, streamlining the process considerably.

Bagging of yard wastes may, however, not always be considered the most convenient method for residents. The City of Davis, California, and others have developed popular yard waste collection programs in which residents are asked to make compact piles of debris in the street. Specially designed loaders and compactor trucks are employed to pick-up the material. Leaves are also commonly collected from loose piles at the curb, using a vacuum truck or front-end loader.

As with curbside collection of other recyclable materials, a variety of factors must be considered in designing a program: waste composition, frequency and seasonality of collection, equipment selection, containers, contract versus municipal operation, funding, supporting incentives, and adequacy of promotion efforts.

Regularly scheduled, on-route collection of source-separated yard waste provides the most convenient method for many households; however, some situations may require other sorts of service. The mobile chipper service has already been mentioned as one alternative frequently used by residents with occasionally large volumes. Other residents may have a means of transporting yard waste and can be best served through a convenient collection site which allows them to dispose of yard waste during hours when they are most likely to be doing yard work. Often yard waste disposal sites can be associated with other solid waste systems such as transfer stations or landfills. Some areas have had success with neighborhood cleanups at which conveniently located drop boxes are made available for brief periods of time during peak yard waste generation seasons. In rural areas, unique programs may need to be developed, if yard waste is a significant waste stream component (which it often is not).

At a centralized facility, incoming yard waste is delivered to the facility through one or a combination of the methods listed above. The incoming vehicle may be weighed at the entrance to the facility. The yard waste is dumped in the receiving/holding area where it is separated by debris type, and non-processible material such as plastic, glass, metals, etc., is removed. If a shredder or grinder is used, materials such as brush and tree clippings will be moved to the shredding or grinding area. Grass and leaves will bypass this process and go directly to the holding area.

After the debris exits the shredder/grinder it is transported to the holding area. From the holding area materials are moved to the appropriate active compost area by a front-end loader.

The active compost area consists of a series of concrete pads, which may be under cover. "Windrows" of yard debris piles are placed 20 to 25 feet wide and up to 10 to 12 feet high on these pads, with the windrow as long as the site will allow. The piles are aerated, moisture is added as necessary, and the piles are turned periodically as determined by the rate of decomposition. The windrow process typically creates a usable end product in 18 to 24 weeks; accelerated decomposition can be accomplished to reduce the retention time to as little as six to eight weeks, depending on the moisture control, frequency of turning, method of aeration, degree of shredding, and addition of nitrogen during the decomposition the process.

Centralized yard waste compost facilities require some site preparation. The site must have controlled access, area for vehicles to maneuver, and a level, well-drained topsoil. Other site requirements are a perimeter security fence and gate, no vegetation or trees located in the active areas, grading and compaction plus the use of gravelfill as needed, and a two-lane access road. If possible, the access road and receiving area(s) should be paved. Some facilities have covered process areas for moisture control.

(3) Technology Background and Evaluation

The technology of yard debris composting has a proven record of high reliability with little technological risk. A rough approximation sets the number of existing centralized municipal composting facilities at over 150 throughout the nation. Facilities can be designed to handle a range of capacities with options for various marketable compost output.

(4) Implementation Factors and Feasibility

Implementation strategies will vary, depending on the yard waste composting program selected. Yard debris composting methods are extremely flexible. A facility would be designed to meet the specific needs of a community. A program can be designed which is capable of handling variable operating schedules. For instance, a facility could be operated seasonally or year-round and the length of the operating day could range from one-shift to multiple-shifts. The ultimate design will depend on local needs and goals for the yard debris composting program.

The rates of diverting yard debris from landfill disposal will depend largely on two factors: capacity of the composting system and support programs for yard debris composting. The latter includes maximum convenience for the user (such as drop-off opportunities and/or curbside collection), disposal fee incentives, and education programs. Achievable rates for diversion of yard debris from landfill disposal through a composting program range from 30-60% and up to 75% of that portion of the waste stream. Use of yard waste compost will likely displace other mulching material, such as composted sawdust, which is currently in use in some areas of the State.

Some concern has been expressed over potential contamination of yard debris with pesticides, chemicals, and other potentially hazardous materials which could affect the marketability of the yard waste compost. There are a variety of markets for compost including nurseries, landscape contractors, recreational facilities such as golf courses, and so on. A good use of

this compost product is in the final closure of landfills. Finished compost is also used by municipal parks departments and local nurseries, or is simply offered to the public for home and garden use.

Although compost is a valuable resource for certain applications, it may be necessary to sell it at lower prices or give it away under certain conditions. An important consideration is the benefit of returning these resources to the environment from which they came.

Acreage requirements can vary depending on the particular composting process used and need for buffer zones. The Grimm Fuel commercial composting facility in Sherwood, Oregon, has an 11-acre site and plans to process 40,000 tons of yard debris in 1988.(5) The suggested site plan to process 22,000 tons of yard debris for the City of Seattle, Washington uses 21 acres per site or 17 acres plus buffer zones.(4)

Costs of collecting yard waste and implementing yard waste recovery programs vary with local conditions and market or end-use arrangements. Programs may be funded through either general public funds or through user fees applied to all garbage customers or just to those who subscribe to the service. Generally, the value of the material recovered from the composting of yard waste is not adequate to cover all costs associated with collection and processing.

If this method is selected, a city or county will need to approve land use permits for a composting facility. The start-up time from permitting a centralized composting site to completion of an operating facility can range from one to two years.

Ordinances relating to incentives through fees and mandatory household separation may be considered. A comprehensive educational program to complement the yard debris composting program will be critical to its success.

Personnel required to operate the yard waste composting program itself would depend on facility design, length of operating day, operating period, and collection method. Support programs such as yard debris collection systems from curbside, drop boxes, and landfill diversion if implemented, would also require staffing.

The yard waste collection and composting operation described above presents the implementing entity with low-to-moderate risk. Yard waste collection and composting is judged to be a highly feasible recycling method. Composting could also be implemented cooperatively by multiple communities or counties.

(5) Environmental Impacts

Adverse environmental impacts from yard waste collection include the minor increase in truck traffic in residential areas, with the associated local noise increase. Noise impacts can be minimized by avoiding early morning collection in residential areas. Yard waste collection programs also create a minor adverse aesthetic impact on collection days, when streets are

lined with yard waste bundles or containers. Potential benefits of yard waste collection are increased tonnages of recovered material which reduce impacts that may result from other waste processing or disposal methods.

Potential impacts of a yard waste composting facility include all of the impacts described in Subsection B.2.c. with the exception of those associated with waste incineration. The impacts associated with the vehicular traffic will include both haul vehicles bringing waste to the facility and truck traffic associated with removal of compost.

Project design to control public health risks, as discussed in Subsection B.2.c.(9), is of particular importance for composting. Several composting techniques, including windrows and static piles, may generate leachate under heavy precipitation conditions if the piles are out in the open. This potential impact can be controlled by developing a collection and recirculation system, since the piles are net consumers of water.

Leachate from yard debris is likely to contain fewer potentially hazardous compounds, and the concern about release of toxic substances would focus on pesticides rather than heavy metals. In addition, these facilities probably would operate only seasonally, thus avoiding impacts during the season when the facility is not in operation. The facility would be out-of-doors; the noise reduction measures described for outdoor facilities would apply.

No other significant adverse impacts are expected to be produced by yard waste composting facilities.

By reducing the volume of wastes that must be placed in a landfill, yard waste composting has the beneficial effect of reducing the amount of land used for and the environmental impacts of landfills.

j. Mixed Municipal Solid Waste Processing

(1) General Description

The purpose of a MMSW processing facility is to receive unsorted mixed municipal solid waste, subject the waste to a variety of manual and mechanical processing elements, and produce materials and products that can be recycled, reclaimed, or used in other waste management processes. Since recyclables will be contaminated when commingled with other wastes, the marketability and prices for recyclable commodities will be lower than if source separated.

MMSW processing facilities receive waste directly from residential collection vehicles and commercial waste vehicles that collect certain recyclable safe commercial waste. MMSW processing facilities can produce recyclable materials, compost feedstock, and refuse-derived fuel (RDF), depending on the end-product market conditions and the desired level of landfill disposal avoidance.

Recyclable material products include paper, cardboard, metals, glass, plastics, etc. Although the material remaining after recyclable materials separation has occurred can be directed to a mass burn incinerator or to

a landfill, it is more common to produce compost feedstock and/or RDF. In all cases the unmarketable and unusable residual materials are disposed in a landfill.

(2) Process and Physical Features

For any MMSW facility the haul vehicle would enter by a controlled access road and proceed directly to a scale where the load would be recorded. The vehicle would proceed to the tipping area, generally an enclosed concrete pad, and the load would be dumped for processing. Some facilities, however, have a pit storage system in which the waste is dumped directly into a pit, then fed into a mechanical processing system.

Ranges of capacity for these facilities vary with the type of processing method employed. These are discussed in more detail below. Types of equipment used in these facilities also vary from simple dump and pick (manual) materials separation techniques to more automated processes used in preparation of RDF and composting feedstock. Discussions of equipment types and sizes are included for the techniques presented. No advance preparation of the MMSW is required. The end product specifications are an integral part of the facility design, especially when facility output is destined for further processing as in a compost feedstock or RDF. Possible emission streams generally include noise and odor from the facility, and litter and traffic on access routes to and from the facility.

(3) Technology Background and Evaluation

Several communities in the U.S. (Wilmington, Delaware; Madison, Wisconsin) use some form of mixed waste processing. Performance track record and availability of vendors and technologies are discussed for each technique. A typical MMSW processing facility is described below. Specific equipment manufacturers and project developers may alter the sequence and number of units in a facility, but the steps outlined below will usually occur.

The first major stage in the facility is mixing and screening waste. A large rotary drum screen is commonly used for bag opening and mixing; bags are broken open, bulky items are set aside, and hazardous materials are removed (inspection and removal of hazardous materials also precedes the screening step). Next, the waste is manually picked for identifiable recyclable items such as paper, cardboard, cans, glass, and plastic. Multiple pick stations are often used especially in large facilities.

Size reduction is achieved in the following step by use of a shredder or hammermill. This unit produces the greatest risk of explosion or fire within the facility. Use of slow-speed equipment and segregated rooms with explosion venting systems can significantly reduce risk of injury. Effective screening of potentially explosive materials is the best insurance against explosion. Magnetic separation for removal of ferrous metals can be located ahead and after the size reduction step.

Following size reduction, the waste is separated by screens, drums, and classifiers into a light fraction and heavy fraction, depending on the mix

and quality specifications for compost end-product and RDF. The light fraction consists mainly of paper and plastics, which become RDF; the heavy fraction contains most of the food, moisture and mineral inerts, and is used as compost feedstock. At several points, oversize particles and fines are removed from the system as rejected residue to be sent to a landfill for disposal.

The basic system is flexible with regard to the quality (inclusiveness of materials) of the compost feedstock and RDF products as well as the relative split between the two. Production of either RDF or compost can be maximized while the quantity of the other is reduced. Production of a high-quality compost or RDF will generally result in greater amounts of reject material being sent to the landfill. The determining factor is the end-product specification based on market requirements.

In addition to the equipment described, a typical MMSW processing facility will include a substantial number of conveyors, bins, alarms, controls, and motors for transporting and storing intermediate and final products. This technology has evolved both in the U.S. and in Europe, and is largely based on experience gained in handling materials in other fields, such as mining, food processing, pulp and paper, and wood products. Interest in mixed solid waste processing in the U.S. and in Europe is growing. Pioneering development was conducted in the U.S. in the early 1970's, but equipment complexity and market acceptance for recovered materials limited expansion of this technique.

Systems producing RDF have gained relatively wide use in the U.S. while systems producing compost feedstock are used more frequently in Europe. Equipment per se has not been the limiting factor in the implementation of this technology. In the mid to late 70's, when plant economics were based mainly on the value of recovered materials, several MMSW processing facilities were closed because they were viewed as uneconomical. As a result, operating experience in the U.S. has been limited. In recent years, full-service vendors have emerged who will accept the risk of technology efficiency and will share or reduce the product market risks. These product market risks remain a primary obstacle in MMSW processing implementation. Finding a vendor and other development participants with operating experience in successful MMSW processing systems will reduce operation performance risk.

A special MMSW processing technique is being marketed by the ORFA Corporation. The initial steps (up to shredding and magnetic separation) of this process are similar to the typical process described above. However, instead of producing compost feedstock and RDF the process employs drum dryers, ozonation, and screening to produce a "granulate" product containing plastics, glass, dust, grit, "congealed plastic film," and "ORFA Fiber" which is described as a "sanitized, stabilized fiber, mostly cellulose." The granulate is said to be a potential additive to building materials. The ORFA Fiber is advertised as a high-quality feedstock for the pulp and paper industry.

A special technique of MMSW processing is wet processing. This technology, adapted from the pulp and paper field, has been employed in three facilities in the U.S. Waste is first reduced in size using shredders and grinders and then introduced with water into a hydropulper. Using high-speed

cutting blades the pulpable and friable materials are converted into a slurry. Metals and other heavy particles (heavies) are rejected out of the slurry and either recovered or landfilled. The process employs numerous separation and washing steps using flotation and cyclone units. End-products are recoverable metals, a dewatered RDF pulp, and rejects.

One of the three facilities employing wet processing was a pilot or demonstration facility, which closed after research was complete. Another facility was closed due to odor and air pollution concerns. The third facility, while still in commercial operation, is in the process of being converted to a dry processing technique. No new MMSW wet processing facilities have been constructed in the U.S. This technique is not considered proven or reliable.

(4) Implementation Factors and Feasibility

Mixed solid waste processing facilities are complex technologically and although their processes have been used previously in other industries, municipal solid waste is a less homogeneous material than that encountered in most other types of materials handling and processing applications. Mixed solid waste processing equipment is somewhat less complex than waste incineration equipment, and since the emissions from a MMSW processing facility are less than for an incineration facility, municipalities may be tempted to "jump" at the chance to employ such a relatively clean and potentially popular technology. Successful implementation hinges, in part, on selecting a vendor/operator who has demonstrated experience with successful MMSW processing facilities. However, the single greatest implementation issue is still product market availability and whether materials can meet required product specifications.

In general, MMSW processing facilities are flexible in that various product mixes and specifications can be achieved, but compatibility and flexibility depends on defining the specific product market early in implementation. Some municipalities have built material resource recovery facilities without first assuring a market for the material produced. This has resulted in plants which produce products that cannot be marketed and, therefore, must be landfilled.

MMSW processing facilities are available in a wide range of sizes. Facilities in the range of 150,000 to 250,000 tons per year are likely to be most attractive to vendor/developers and to municipalities. Very small facilities will likely be uneconomical; extremely large facilities will be composed of numerous process trains and will likely be unattractive.

Implementation timelines can vary from 2 to 8 or more years depending on local conditions. Other associated facilities such as composting and/or RDF preparation and incineration facilities can add substantially to this timeline. Identifying and obtaining market assurances will also require substantial development time.

MMSW processing facilities represent a large capital investment for a community and are usually financed by issuance of debt. To provide the

financial backers (bond holders) of a project with assurance that dept will be repaid, a municipality will need to assure the existence of a dedicated revenue stream or waste stream to the MMSW processing facility depending on whether general obligation or project-based financing is used.

Permitting of a MMSW processing facility is usually fairly straightforward. Since the overall project depends on the viability of other facilities, such as compost or RDF plants, permitting of these more complex facilities could delay final permits and approvals for the MMSW processing facility.

MMSW processing presents implementing agencies with moderate-to-high risk, principally because of the complex nature of these facilities and the substantial capital and operating investment required. These facilities are judged to be a feasible recycling/recovery method.

(5) Environmental Impacts

The major impacts of a MMSW processing facility would be air quality, noise, and traffic impacts caused by haul vehicle traffic (residential collection vehicles and commercial waste haulers). The facility itself would have some aesthetic impacts and processing activity would create noise. Potential odor generation is also possible. All of these environmental impacts and appropriate mitigating measures are described in Section B.2. A wet process facility would have potential to generate contaminated discharge water unless such water was recycled, avoiding discharge. Discharges to surface water would be made under a NPDES permit or to ground water or a sewer system under a State discharge permit. If permit conditions are met, discharges should not create significant adverse environmental impact. No other significant adverse impacts are expected.

k. Mixed Municipal Solid Waste Composting

(1) General Description

The composting process involves the biological decomposition of part or all of the organic components of the waste stream, thereby producing a stable end-product, which has value as a soil conditioner, organic fertilizer base, or landfill cover material. MMSW composting is aimed at the organic fraction of the waste stream. Overall, it can divert as much as 30%-60% from landfill disposal, depending on the type of process used.

The composting systems are most commonly comprised of three distinct activities:(6)

- Municipal solid waste preprocessing
- Composting
- Post-compost processing

(2) Process and Physical Features

Municipal solid waste composting systems are often operated in conjunction with a centralized materials processing facility where various usable materials may be removed from the waste stream. (MMSW processing facilities are discussed in Subsection B.4.j.) The level of material recovery is specific to the waste stream, equipment, and labor factors incorporated in the processing facility and may include, in addition to compost feedstock, RDF. Metals, glass, and non-biodegradable plastics are not amenable to biodegradation and are generally separated out for resale. Some inert materials, such as glass and plastic, may be included in the compost feedstock product. While these materials do not severely affect the use of the product, they may affect its marketability. Rejects such as metals, heavy plastics, and bulky wastes, which are not compostable, need to be disposed of by recycling, incineration, or landfilling.

The degree of processing depends on how the compost will be used. Compost used for landscaping may require extensive preprocessing to remove as much non-biodegradable material as possible. On the other hand, if the compost is to be used for landfill cover where the appearance of the compost is not a major concern, only minimal processing -- such as using a single trommel screen before the composting operation -- is required.

Before preprocessing, car batteries, large appliances and other noxious, large, or undesirable materials must be removed from the waste.

The generalized process discussed below is typical of solid waste composting systems. Other techniques which differ from the typical process will be discussed separately.

(a) Pre-Processing

Pre-processing of the waste is required to prepare the municipal solid waste for maximum decomposition and biological activity, which is essential to the composting process. Three major aspects are involved:

- Particle size reduction
- Materials classification or separation
- Mixing

The first two steps in the compost pre-processing phase are essentially what is accomplished in MMSW processing. (Described with MMSW processing, Subsection B.4.j.)

Prior to particle size reduction, screening and removal of undesirable materials, which could contaminate the compost or cause explosions, takes place. In addition, some materials recovery can be accomplished at this stage, usually through manual separation.

Particle size reduction is achieved by shredding or grinding. The better the process of particle size reduction, the more efficient the composting process will be. The equipment used to achieve particle size reduction consists of vertical and horizontal shredders, hammermills, and drum shredders.

Following size reduction, most systems conduct some materials classification or separation. The principal piece of equipment used is a trommel or rotary screen. Two or more product streams may be produced. One stream consists of rejects such as metals, plastics, cardboard, etc.; a second stream of organic materials and glass is transferred to the composting process. Some systems remove the glass after composting. In many cases, especially where the daily tonnage exceeds several hundred tons per day, a RDF process precedes composting and constitutes the pre-processing step. In this case, the bulky and heavy wastes, such as paper, light plastics, and ferrous metals are removed from the waste stream before the compost process. Glass may also be removed at this time.

The final step of pre-processing is mixing. During this phase, moisture is added to the shredded MSW fraction to be composted to create optimum composting conditions. These components are then blended mechanically to produce a homogeneous feed material for the composting process. In some systems active bacteria or partially composted materials are introduced at the first composting or final preprocessing stage to accelerate initiation of the composting process and reduce the composting cycle time. This is called inoculation or biological amendment.

(b) Mixed Waste Composting

Following the pre-processing step, the organic fraction of the waste stream is composted. Usually the composting process takes from 14 to 28 days. There are four basic types of composting systems available: windrow, dynamic bin, static pile, and in-vessel reactors.

The most common method of solid waste composting utilizes windrows, long, narrow piles typically 20 to 25 feet wide and 10 to 12 feet high. The compost material is piled onto paved areas into windrows, either out in the open or under a roofed area, and is usually piled over aeration trenches in the pavement which supply forced aeration to the windrow pile. Large windrow machines (or in small facilities front-end loaders) are used to turn the windrow piles periodically during this process. The windrows can be as long as practicable or allowed by the site.

Another type of compost system is referred to as the static pile method. In this system, the solid waste is placed on a paved surface over an aeration duct and air is forced through the pile during composting. No mechanical agitation or turning is performed during the composting process.

In-vessel reactor systems consist of enclosed silos or reactors which feed compostable material through the reactor in a plug-flow fashion. These may be designed with different physical orientations such as a vertical tower, a digester tank with paddle agitators/conveyors, and other conveyance or mixing/agitation configurations.

Dynamic bin systems utilize some type of compost containers or bins where the processing equipment straddles the compost bins and turns the composting material in the bins. These systems are usually covered.

(c) Post-Composting Process

Following composting, the material is ready for the post-processing step. This step may consist of several components including:

- Curing
- Separation
- Grinding

Curing, or stabilization, extends the composting process and allows any uncomposted organic material to further decompose. This results in a stable, humus-like material which will not produce or contain obnoxious odors. The composted product is a dark, earth-like material. Typically, curing periods of from 30 to 90 days are required depending on the composting technique utilized.

Either before or after curing, additional refinement of the product is usually desired. Compost product size separation through screening along and pneumatic glass and stone removal are the principal refinement methods. Grinding of the product, with or without separation, can reduce the size of glass, plastic, and other particles so that they are not objectionable.

(d) Other Composting Techniques

A well-demonstrated variation to the typical process described above is the DANO system. This system uses a special mixing drum as the primary preprocess element. Composted waste is screened and some materials are removed prior to marketing the final product. This process can result in a lower quality product than that produced after more extensive pre-processing. A facility of this type is being planned in Portland, Oregon.

A somewhat different process of MMSW composting uses the entire waste stream which is shredded twice, exclusive of batteries and other toxics and building debris. The shredded MMSW then is brought up to the proper moisture content by the application of a water/bacteria mixture. The bacteria are very aggressive and reportedly finish decomposition in a controlled indoor facility in 21 days. After decomposition, the compost is shredded again and screened. Oversize material is sent back through the process. A facility of this type is being planned in Dade County, Florida.

(3) Technology Background and Evaluation

While relatively uncommon in the United States, composting of mixed municipal solid waste is widely used for solid waste stabilization in many parts of the world. In the United States, the majority of composting programs use sewage sludge or yard waste or a combination of the two as feedstock material for the composting process. However, a large number of facilities in Europe and elsewhere throughout the world also compost the organic portion of MMSW. MMSW components, such as food waste, yard waste, paper, and other miscellaneous organics are decomposed by microorganisms under controlled conditions.

The MMSW composting process was used in the 1950's in Pennsylvania and in the '60's and early '70's in Jamaica. There are no facilities of this type currently in operation in the United States. Other separated waste composting systems in use in the U.S. have been operated since the late '70's. Some of these have European origins and have significant track records in Europe where composting of mixed solid waste is common.

There is growing interest in MMSW composting technology in the U.S. MMSW systems can be configured to provide for various levels of materials recovery, quality of fuels for incinerators, and total capacity. MMSW composting in the U.S. to date has had mixed success. Consequently, a cautious approach to this type of facility is warranted. A low level of technological risk is involved with using the composting process itself; the risk is due to mechanical problems with preprocessing equipment and markets for MMSW compost.

As with other complex mechanical processing facilities, finding a vendor and other facility development participants with successful operating MMSW composting systems will reduce the operating performance risk. MMSW composting projects have failed in the U.S., but more ambitious projects are being considered and built as U.S. experience with the technology and the costs of waste disposal increase.

Facility development and continued operation have at times been hindered or shut down due to various problems, including undercapitalization (St. Cloud, MN); unrealistic expectations of compost material markets which includes marketability of compost material not allowed to be used in conjunction with food crops (Wilmington, Delaware); jurisdictional, political problems (McKeesport, Pennsylvania); and pre-composting handling requirements. The equipment and processes used in MMSW composting are becoming more reliable as more experience is gained. Some modifications to common industrial machinery and processes are required to accommodate the abrasive and heterogeneous nature of MMSW.

(4) Implementation Factors and Feasibility

Markets for the compost product are not guaranteed or necessarily stable over time. The marketability of compost is dependent on its quality and potential uses in addition to demand for soil conditioners in general. Methods to reduce the risk of a lack of market demand over time include long-term purchase contracts; however, these are very difficult to obtain. Additionally, if the financial planning for a composting facility assumes no market price paid for the compost product, the market variations in price would not affect the financial viability of the project.

In the event the composted product cannot be sold or given away for a secondary use, it may have to be landfilled. Because composting pre-processing reduces the waste size and increases the density (pounds per cubic yard), the MSW volume is reduced even before the composting begins and additional decomposition in the composting process further reduces the volume.

Justification for the components of the post-processing steps depend on the potential use of the final products. Compost to be used in a

potting mix for greenhouses will require more refinement than compost to be used for revegetation of mined areas or public works projects.

Although European compost facilities have been proven technically over a period of several years with the ability to produce a highly refined compost product, recent concerns regarding the health risks and emerging regulations have slowed implementation of MSW compost. At Dendermonde, Belgium, a highly agricultural area, marketing efforts began slowly with lawn and garden compost, then mixed (refined) compost, then eventually straight MSW compost was accepted although in a lesser demand. However, extensive dilution of MSW compost with manure, peat moss, and/or bark is required to meet new regulated levels of inerts. At Dendermonde, 22,000 metric tons of MSW compost is blended with 28,000 metric tons of manure, peat moss, and/or bark, which is purchased for this process to make a marketable compost. MSW compost is not marketable without such a refining process in that location. In France, use of MSW compost is limited with the primary market being vineyards.

Because of seasonal or poor market conditions, some composting facilities in Europe are developing incineration facilities for alternative volume reduction. Other compost facilities already include incineration as part of the integrated system. Combined incineration-composting facilities are also operating in the U.S.

Policies that a local government could develop in support of a composting facility could include market support for the composted product and a guaranteed disposal site if no use can be found for the compost. If composted materials were required to be specified for all municipal road and street landscaping, non-food crop soil amendment for municipal facilities, and possibly landfill cover materials, the local demand for the compost product would be substantially increased. The use of compost as a non-nursery material would allow a larger fraction of the waste stream to be composted and potentially diverted from landfilling; however, this compost would be of a lower grade than a nursery could use and would be restricted in its marketability.

MSW composting presents implementing agencies with moderate-to-high risk. This level of risk is due principally to the potential difficulty in marketing or otherwise finding acceptable uses for the compost product. MSW composting is judged to be a feasible recycling method.

(5) Environmental Impacts

Potential impacts of an MSW composting facility include all of the impacts described in Subsection B.2.c., with the exception of those associated with waste incineration. It should be noted that the impacts associated with the vehicular traffic will include both collection vehicles bringing waste to the facility and truck traffic associated with removal of compost. Project design features to control public health risks, as discussed in Subsection B.2.c.(9), are of particular importance for composting. The facility should be designed to ensure it does not attract vermin, such as rats, that might spread disease.

Several composting techniques, including windrows and static piles, may generate leachate under heavy storm conditions if the piles are out in the open. This potential impact can be controlled by developing a collection and recirculation system, since the piles are net consumers of water.

A risk of explosion may exist during the pre-processing stage if flammable materials, such as cans of paint thinner or fuel, are present in the waste stream. Measures should be taken to ensure the safe removal of these items. No other significant adverse impacts are expected from the MSW composting facilities.

By reducing the volume of wastes that must be placed in a landfill, MMSW composting has the beneficial effect of reducing the amount of land used for, and the environmental impacts of, landfills.

1. Food Waste Composting

(1) General Description

In food waste composting, food wastes are collected and then biodegraded into a compost material. Another related reuse for segregated food wastes is as an animal food. U.S. Department of Agriculture regulations require that the food containing meat wastes must be heat sterilized before it is used as animal feed. This practice was relatively common 40-50 years ago, but is now quite rare. Interest in food waste reuse for animal feed has revived especially in Norway and Denmark since the mid-1970's.

Readily biodegradable food wastes are a significant portion of the waste stream, about 11% in the State. However, the amount of food waste that can feasibly be recovered is not known at this time. Composting food wastes requires the addition of a bulking agent to reduce the moisture content of the compost mixture to about 55%. This provides optimal composting moisture conditions. The moisture content for food waste may be 70% or more.

(2) Process and Physical Features

Food waste composting is similar to other composting methods in that it is a technology which encourages and controls the biodegradation of organic materials. It is different in that only organic food waste materials are separated from the waste stream to be composted. Because its primary feedstock is free from inerts, food waste has the potential to produce a high-quality compost.

No large-scale programs for recycling food waste are operating in the U.S. Currently, one recycler in Portland batch composts 1 to 2 tons of food per month from household collections. In addition, a program of household collection of food waste is operating in parts of Philadelphia. This food waste is cooked and fed to pigs. In 1987, 30,000 tons of food waste was collected and processed in Philadelphia. A similar collection program is operating in New Jersey.

(3) Technology Background and Evaluation

In England during World War II, food waste was recovered for use as animal feed to conserve resources. Since the war, this process diminished in England and elsewhere until recently. Norway and Denmark have become interested in food waste reuse as an animal feedstock. These countries have on-going experiments and full-scale operations and have evaluated the advantages and disadvantages of food waste reuse.

When wastes are source-separated in households, the quality of the waste relative to levels of heavy metals is better than when the waste segregation is performed at a centralized facility. In Denmark it has been estimated that approximately 50% of the food waste can be practically recovered from residential separation and collection techniques. For institutions, like hospitals and nursing homes, nearly 100% food waste reuse may be achievable.

In Europe, collection systems have been implemented in which each resident has two or three color-coded containers. One container is for wet or putrescible garbage including yard waste; one for dry recyclables, cardboard, glass, metal and plastic; and one for other waste. Collection equipment and frequencies vary for each of the different containers. The material, collected at curbside, may be taken to a single facility or several facilities to be composted, processed, incinerated or landfilled.

Because a large-scale system has not been implemented in the U.S., the policies, personnel needs, and facilities required are difficult to determine. However, based on the U.S examples above, it appears that a system analogous to curbside collection of recyclables would be a reasonable starting point for resource requirements, even though the waste quantities collected would be of a different nature than recyclables.

The major obstacle to such a system is that households generate relatively small amounts of food waste at dispersed locations, which can make collection expensive. A potential advantage of food waste collection could be reduced collection frequency for non-putrescible waste without the usual increased risk to public health and sanitary conditions normally associated with less frequent waste collection systems.

It may be possible to integrate a food waste collection system into existing collection systems. This is done in the small-scale Portland, Oregon, system mentioned above. Such an integration may raise the collection costs and require some modification of equipment and facilities to handle and process the food wastes. For composting food wastes aerobically, a dry organic material (bulking agent), such as sawdust, is needed to absorb excess liquids.

(4) Implementation Factors and Feasibility

This technique may be best suited for local implementation because of the putrescible nature of food waste. This waste requires timely collection and processing before noxious odors are created from the anaerobic decomposition process. Whether the food waste is composted or reused as animal

feed, food waste composting could be implemented with a low level of technology relative to incineration or sophisticated mixed-waste processing facilities.

Because a large fraction of the organics would be removed by this technique, a reduction in landfill gas generation and organic chemicals in the leachate would be expected. In combination with incineration, the heating value of the remainder of the waste stream would be enhanced if food wastes are processed separately because of the high moisture content of food waste.

This technique could easily be implemented by the private sector, but may require financial and/or educational participation by local governments to become successful. The more densely populated areas and close locations of animal feed markets or compost markets would enhance the likelihood of successful implementation. Food waste collection and processing is judged to be a marginally feasible recycling method at this time.

(5) Environmental Impacts

Food waste composting and reuse would have essentially the same impacts as the other composting programs. The major differences would be that little, if any, toxic contaminants should be present if the wastes are source-separated, and some heat sterilization may be needed to control pathogenic organisms, particularly if meat wastes are included. In addition, odor generation may be a greater problem since the material is very readily putrescible. Another factor that must be considered is the attractiveness of the material to vermin that could spread disease. Because the facility would be indoors, there would be no potential for leachate generation.

m. Special Waste Recycling and Reuse

(1) General Description

Special wastes in the recycling program of solid waste management include tires, batteries and oil. Each of these waste types are recycled in different ways and have been recycled for many years. The techniques applied to the reuse and recycling of these wastes are discussed separately below.

(2) Tires

(a) Process and Physical Features

Tires can be reused on vehicles after being retreaded, or recapped, or they can be processed to become feedstock material for other products. Tires that are reused as retreads must first pass an inspection to assure that the structural integrity of the tire is intact. Passenger tires are usually retreaded once whereas some commercial truck tires can be regrooved and retreaded multiple times. The reuse of tires in this process uses about 30% of the energy needed in new tire production.

Tires not reused as retreads can sometimes be sold as used tires, or can be used in other whole-tire, non-vehicle applications.

Whole tires can be used as artificial reefs that support sports fishing. This has been done in Florida since the late 60's. Millions of tires have been slashed to prevent air trapping, compressed and bound before being placed at designated locations as artificial reefs. Whole tires have also been used for erosion control, small floating breakwaters, highway guard and dock bumpers, driveway borders, concrete base forms for poles or fences, and garden solar collectors/plant pest protectors.

Tires can be processed mechanically or chemically into useful products. Tires can be chipped, granulated, or shredded and for use as feedstock in producing floor mats, athletic mats and running surfaces, gaskets, asphalt rubber for crack sealers or roofing materials, molded rubber products, and rubber-asphalt concrete. These processes are typically performed by the private sector and many of the products are made from crumb rubber, ground used tire materials.

Chemical processing techniques generally include reclamation of the rubber in the tire and pyrolysis techniques. Rubber reclamation, or devulcanization, involves a process of grinding, digesting, heating, and mechanical processing. The end-product does not have similar characteristics to the virgin material after this process.

In tire pyrolysis, also called destructive distillation, the complex compounds in tires are thermally decomposed to less complex and lighter components. The resulting components include gases used to heat the tires, fuel oil and a solid char material containing titanium dioxide, zinc oxide, carbon black and steel. The process can be performed in many types of specialized pyrolysis facilities including fluidized bed, moving grates, rotary kiln, retorts, and others. A wide range of temperatures and pyrolysis conditions have been experimented with to achieve the best production and quality of the product streams. (See the discussion of Pyrolysis/Gasification in Subsection B.6.b.(3).)

Tires are also incinerated for their energy value in dedicated facilities. See the discussion of Mass Burn Incineration and Refuse Derived Fuel in Subsections B.6.b.(4) and (5).

If one of the above reuse or recycling techniques is not used, tires are often stockpiled. An estimated 15 to 20 million used tires are now stockpiled in Washington State. Tires tend to rise to the surface of landfills and, therefore, are not desired or allowed at most landfill locations.

(b) Technology Background/Evaluation

Tire reuse and recycling has been performed nationwide for many years. The retreading of tires has been a reliable technology since the quality of the fabric ply materials in the tire casing has been made of durable synthetic materials. Although retreading is a reuse technique, its popularity is waning because of lower cost new tires and the proliferation of different tire specifications requiring increased inventories of retread vendors. This tire reuse technology has been proven over time and retreaded tires are widely available at many retail stores across the State.

The process and market for crumb rubber is well established and new uses incorporating this material into products is ongoing. Playground mats and running tracks are example of ways in which tire material has been recently recycled into other products.

The pyrolysis processes are becoming more reliable and can process large quantities of tires. Similarly, specialized tire fuel incineration is an emerging technique for recovering the energy value in tires. A facility near Modesto, California, incinerates 4.5 million tires per year (up to 700 whole tires per hour) and generates 14.4 MW of electricity. Both the pyrolysis and tire incinerators have been developed in Europe and the U.S.

(c) Implementation Factors and Feasibility

The potential quantity of waste passenger tires that could be reused as whole tire retreads is high, but is held to a low level because of limited market demand. The use of waste tires as artificial reefs is also potentially significant. This option would be most practical for locations near the ocean. Environmental studies and coordination among agencies would be required before a tire reef could be installed.

The private sector has been involved primarily in the development of the crumb rubber, pyrolysis, and incineration of tires. Each of these techniques diverts part or all of the tire resource away from landfilling.

The success of pyrolysis of tires is controlled by the price of petroleum. Products and fuels derived from discarded tires often compete in price with products and fuels derived from virgin petroleum. Low petroleum prices in recent years have forced many in the recycling/recovery industry to charge a tipping fee for each tire collected.

Nonetheless, the pyrolysis and incineration techniques are becoming more common as the technology becomes more reliable over time and the tire disposal issue is addressed more thoroughly by governmental agencies and the public.

The incineration of tires in a dedicated facility may receive more favorable public acceptance than a MSW incinerator for a number of reasons. Perhaps the most important is related to the technology and waste stream. Because the waste stream is of a known composition, the facility can be built to maximize the benefits, like energy generation, and minimize air emissions, which is difficult to do with MSW or RDF because of its heterogeneous composition. The emissions and byproducts of a MSW incineration are likely to contain the heavy metals and other compounds of public concern that are not contained in tires.

To site a facility that processes large quantities of tires, a supply of used tires should be available nearby. Consequently, businesses tend to locate facilities near population centers, where larger quantities of waste tires are generated.

For less populated areas remote drop boxes for tires at landfills or tire stores may provide for reasonable collection before transporting to a processing facility. A 30-cubic yard drop box can be used to transport approximately 300 passenger car tires. At landfills a nominal charge per tire could be levied to recover the cost of transportation to the processing facility. A 1985 Minnesota study found that regional rural collection centers using local haulers who hauled tires up to 50 miles for initial collection and then from the rural collection centers to a tire processor would cost between 15¢ to 88¢ per tire plus any tipping fee per tire at the processing facility.(7)

By encouraging public and business involvement and reducing the number of local collection routes the transportation costs per tire can be minimized. As more tire-processing facilities are built in various geographic areas of the State, the transportation distance will decrease and make recycling tires more feasible in the rural areas of the State.

Tire recovery processes present participating businesses and industry with moderate risk because of the vast number of tires present and the relatively limited current market potential for reclaimed tire products. Tire recovery is judged to be a feasible method of recycling.

(d) Environmental Impacts

Environmental impacts of tire disposal, recycling, or reuse depend on the technology selected. Impacts of retreading or mechanical or chemical processing would be the same as those of a MMSW processing facility, described above, except that odor problems would be unlikely. Reuse would save energy used in manufacturing tires from virgin material, and other reuse techniques would save fossil fuels.

Pyrolysis and incineration in dedicated facilities would have impacts similar to those for pyrolysis and incineration of MMSW. The only significant difference is that specialized facilities can be designed to have lower emissions of pollutants and some of the precursors of toxic emissions present in MMSW are not present in tires. Substantial energy savings and conservation of petroleum could be accomplished by such reuse.

Environmental impacts of creation of artificial reefs would be highly site-specific and would have to be addressed in siting studies.

(3) Batteries

(a) Process and Physical Features

There are two types of commonly used batteries: primary and secondary batteries. Primary batteries cannot be recharged because the chemical processes within the battery are not easily reversible. These types include the traditional flashlight varieties and are categorized as alkaline, silver oxide, mercury oxide, carbon zinc, and carbon zinc chloride. Secondary batteries are rechargeable and include lead acid (such as in vehicles), nickel cadmium, nickel zinc, silver cadmium, and zinc cadmium.

Lead acid batteries can be reprocessed. The batteries are specially packed and placed in containers for shipment to reprocessing centers in California, the Midwest, or overseas. The acid and lead is recovered for reuse at the reprocessing centers.

Batteries are of special concern because of corrosives and heavy metals, which may result in poorer quality ash characteristics if batteries are incinerated and may similarly degrade landfill leachate.

Button batteries, used in cameras, watches, hearing aids and other small battery powered products, as well as other non-lead acid type batteries are recyclable in some instances. Some metals refining companies are interested in the button batteries that contain mercury or silver. Also some scrap metal dealers would be interested in the metal casings that surround most batteries.

Because most non-lead acid batteries are small, they are most easily separated from the waste stream for recycling at the source by individuals who use them. Collection of the batteries could be made convenient by integrating collection receptacles for batteries into an on-going recycling collection program. Collection mail-in kits that allow generators to mail used non-lead acid batteries to an agency or recycler, and battery drop sites at local shopping centers, camera shops, jewelers, and apartment buildings would also promote recycling.

(b) Technology Background and Evaluation

Except for lead acid batteries the development of recycling markets and technologies for batteries has not been well developed in the U.S. This is undergoing change as the problems of incinerating batteries is becoming evident through testing of leachate and incinerator air emissions ash residue.

The batteries which contain significant quantities of mercury or silver can be recycled to recover these valuable metals. Batteries made with less valuable materials are not generally economically recyclable because of the amount of effort required to separate the composite of materials.

In Japan, over 70% of municipalities have programs to collect cylinder shaped batteries. This is a relatively new program that is only recovering about 9% of these batteries and most municipalities are storing the batteries until a safe and economical reprocessing becomes available. The button shaped batteries, many of which contain mercury, are collected through retail stores by the battery manufacturers; approximately 27% of these batteries are recovered from the waste stream.

European countries are also collecting and reprocessing their batteries. In some places batteries containing cadmium are restricted or banned because of environmental concerns. On-going research is investigating economic methods to reclaim the resources contained in currently stockpiled batteries.

The Environmental Action Coalition in New York City has begun a household battery collection program at retail stores and apartment buildings. In the apartment buildings, the battery collection will complement the existing multi-material recycling programs.

(c) Implementation Factors and Feasibility

Lead acid batteries are calculated through established private sector reprocessing networks; no other organized battery collection activity exists in Washington. To implement a collection system, a metal refining firm willing to accept the batteries would need to be found. Also the types of batteries to be sent to the processor would need to be established as well as transportation and payment for the batteries. The collection system could parallel existing recycling programs in the educational and collection areas. It may also involve retail stores and asking individuals to mail batteries in or take them to collection centers.

The largest problem may be the disposal or reuse of the batteries that have no technological or economic market. Local governments could store the unprocessible batteries until the technology or markets develop. Alternatively, the batteries may be landfilled in concrete blocks as done at some locations in Japan. The advantage of storing the batteries is that when the technology for recovering the materials in batteries becomes available, they could then be processed; however, storage space may be expensive and the technology development timeline long.

Metals recovery from batteries presents reclamation industries with moderate risk, primarily because of the highly polluting nature of metals which may escape during the reclamation process. Recovery of metals from vehicle batteries is highly feasible. Recovery of metal from other types of batteries is judged to be marginally feasible at this time.

(d) Environmental Impacts

Potential adverse impacts of battery recycling would depend on the practices of the reprocessing facility. Benefits would include recovery of the heavy metals present in the batteries and reducing releases of these toxic substance into the environment through ash, leachate, or gaseous emissions.

(4) Oil

(a) Process and Physical Features

Waste oil is typically generated by cars and trucks and other machines after it has become contaminated by water, dirt particles, and the byproducts of combustion engines. Waste oil can be reused again for most common applications after the contaminants are removed and any needed additives are replaced. In many areas, used oil is reused in road surfacing or for dust control on low traffic roads. It is also used as a fuel in firing commercial boilers and furnaces.

Waste oil is collected for reuse statewide by gas stations, garages, and other businesses. Oil collection has been encouraged by the DOE to reduce the waste of this resource and to prevent inappropriate disposal on land or water.

Heavier contaminants in the oil will settle out; however, many oils contain additives that encourage the suspension of contaminants in the oil. Filtering and sometimes additional physical or chemical processes can clean the oil to the point where it has characteristics of unused oil. Less pure oils can be consumed in commercial oil burners. At present, most reclaimed oil is burned in such facilities.

(b) Technology Background and Evaluation

Used oil reuse and recycling techniques have been tested over time and are typically reliable and widely used in all parts of the U.S. The technology is proven, and markets have been developed to use the oil recovered from the waste stream.

(c) Implementation Factors and Feasibility

Used oil reuse and recycling is already implemented in all regions of the State. Used oil is a resource that can be adapted to the most appropriate use for the community in which it is generated. The various reuse and recycling techniques for waste oil are well established and reliable. However, there is some resistance to the continued use of oil on dirt roads due to its environmental impacts. Its use for this purpose may be declining. Ongoing education to encourage citizens and businesses to recycle their waste oils will divert these wastes from entering the landfill.

Oil reuse activities present moderate risk to those businesses and governmental jurisdictions involved, primarily because of the high pollution potential of oil. Oil reuse and recycling is judged to be highly feasible.

(d) Environmental Impacts

Recycling or reuse of oil has the beneficial effects of reducing waste of the fossil fuel resource and avoiding inappropriate disposal on land or in water. Potential adverse environmental impacts of waste oil reuse or recycling vary on a case-by-case basis. Reuse of waste oil for dust control

on dirt roads could cause pollution of surface or ground water by heavy metals and toxic organic compounds not present in clean oil. This impact could be avoided by applying waste oil only in situations where movement to surface or ground waters is unlikely.

5. SOLID WASTE HANDLING PROGRAM METHODS

a. Introduction

Handling program methods do not result in the reduction, recycling, or disposal of solid waste. These are necessary elements of solid waste

management systems in that they provide for consolidation, compaction, and transportation of solid waste between other management steps. Recycling methods can be coupled or co-located with handling program methods.

b. Transfer

(1) General Description

Transfer systems are fixed facilities consisting of drop boxes and/or transfer stations to which waste is delivered by the public, commercial collection vehicles or both. At transfer facilities, waste loads of numerous smaller vehicles are consolidated and, in many cases, compacted into loads appropriate for larger transportation haul vehicles. Transfer stations provide "disposal" service to the community, reduce traffic impacts of collection vehicles, and reduce the cost of solid waste management by using more efficient haul vehicles in place of small collection trucks or vehicles used by the general citizenry.

A transfer system is used for an area that cannot support its own waste disposal facility environmentally, economically, or politically. As disposal facilities become more difficult to site, transfer systems that make transporting waste to a distant facility more efficient become more common.

(2) Process and Physical Features

Drop box facilities range from simple, unstaffed, coin-operated boxes with minimal site improvements to staffed facilities with direct tipping into covered drop boxes. The detachable roll-off drop boxes are hauled when full or at least weekly, to the disposal facility.

At a transfer station, vehicles normally enter the facility through controlled access and are weighed or tallied at a tollbooth. Depending on the extent of waste recycling and processing on-site, the scale attendant directs each load to the appropriate tipping area. Waste to be transferred for disposal is often compacted either before or after loading into large transfer trailers for haul to the disposal facility.

Waste transfer is normally not economical for haul distances less than 15 to 30 miles. However, many factors, in addition to haul costs, enter into the decision of whether to utilize a transfer facility. In some cases transfer facilities are located at the disposal facility for access control and public safety. In other cases direct haul distances may be greater than 30 miles.

(3) Technology Background and Evaluation

The need for and development of solid waste transfer facilities resulted generally from the centralization and regionalization of disposal facilities. Prior to the enforcement of strict environmental regulations it was common for counties and cities to operate numerous small landfills distributed throughout the service area. This practice existed because collection

and transportation of solid waste was much more costly than disposal, and economics dictated locating landfills near the waste generators. As environmental laws changed to require strict environmental control systems many of these landfills were closed. Transfer stations became necessary to limit the travel distances required for collection vehicles, if waste was to be transported to a more distant regional landfill or other type of waste processing facility.

Solid waste transfer facilities are a fully developed technology with proven reliability and relatively low performance risk.

(4) Implementation Factors and Feasibility

Implementing transfer facilities is often a key element in regionalization of solid waste management systems. Transfer systems, technical feasibility and performance are well documented as well as their ability to provide lower cost waste disposal. Transfer stations are, however, subject to the siting and permitting requirements and public opposition typical of other solid waste facilities. The public opposition is lessened in certain cases by the fact that transfer facilities are generally built to serve the geographic area in which they are placed and, therefore, are not perceived to be an outside intrusion. This is not the case when transfer facilities are constructed in an outside jurisdiction as part of a long haul system.

Solid waste transfer facilities present implementing businesses and jurisdictions with generally low-to-moderate levels of exposure to loss. Transfer is judged to be a high feasible solid waste handling method.

(5) Environmental Impacts

Potential adverse environmental impacts of waste transfer facilities include increases in noise, emission of air pollutants, and traffic along the haul routes resulting from transportation of solid waste to and from the facility. Visual, noise, and other impacts result from operation of transfer stations themselves. In addition to visual and noise impacts of transfer facilities, potential odor problems, litter and attraction of vectors such as birds or rats could occur. These impacts and methods to mitigate them are described in Subsection B.2.c.

c. Long Haul

(1) General Description

Long haul at one time referred to the direct haul of waste by collection vehicles to a disposal site rather than a transfer station. Generally if the haul distance was greater than 15 miles it was considered a long haul. However, with the evolving concept of regionalized disposal facilities, agencies now consider long haul in terms of hundreds of miles to out-of-county or out-of-state facilities. With this concept, a transfer system is required to allow use of large truck trailer, rail, or barge transportation depending on the economics of these techniques. In some cases waste is transferred several times before disposal.

(2) Process and Physical Features

Long haul transportation options include truck, rail, or barge depending on location and distance. Virtually all long haul options require one or more transfer steps. For rail long haul, a possible scenario would call for collection vehicle waste to be transferred to a transport trailer/box. The trailer/box would be hauled to a rail load area by truck, the trailer/box loaded on to a rail car, the rail car pulled by train to a subsequent offload site from which the trailer/box would be pulled by transport truck to the disposal facility. The most economical option will depend on the effort made to compact the material, minimize the number of transfers required, and maximize the efficiency of each transfer.

A long haul transfer facility should be located so that direct transfer from collection vehicle to rail car or barge is accomplished; containerized transfer is possible. The potential for economical rail or barge transport increases with volume and distance. For distances of 75 miles or greater rail or barge should be seriously considered depending on available facilities.

Union Pacific and Oregon Waste Systems, operators of the Arlington, Oregon landfill have proposed a method of moving compacted solid waste by rail. Waste would be moved in 40-foot containers stacked on rail cars. Each car would carry 10 containers stacked two high (twin stack). Each of the 10 containers would contain 16 tons. For example, moving 1,500 tons per day from King County to eastern Oregon would require transporting one 10-car train load every day with a total of three trains dedicated to the system. With containerized loads, the transfer from truck to rail and back to truck is relatively simple with overhead cranes. Waste is completely enclosed and would not be visible from the time it entered the first transfer station until the containers were emptied at the landfill.(8)

(3) Technology Background and Evaluation

In the past, long haul of waste to out-of-county or out-of-state disposal sites has been practiced on only a very limited basis. New political and regulatory issues and siting difficulties for solid waste facilities has greatly increased the interest in this option. Public controversy over siting of municipal landfills and solid waste resource recovery facilities and the differences in construction and operation requirements between landfills in arid and non-arid areas are causing solid waste jurisdictions to investigate possibilities of solid waste disposal some distance from the community of origin. Disposal in such cases involves extremely long travel distances and would rely on long haul methods.

(4) Implementation Factors and Feasibility

Implementation of long haul systems present difficult permitting and contractual issues which result from transporting and disposing of waste outside of the jurisdiction in which it was generated. The host community, the waste generator, and the provider of the waste hauling and disposal service each have somewhat conflicting interests which must be met through contractual performance requirements and guarantees. Often the host community

and waste generator are not geographically adjoining; therefore, waste hauling may impact other communities. The potential exists for significant public opposition in the host community if waste is brought in from another jurisdiction. This can be offset by perceived economic benefits derived from waste disposal fees.

Long haul of solid waste presents implementing jurisdictions with moderate levels of exposure to loss. This exposure is due mainly to the significant commitment in equipment required to efficiently transport waste long distances. Long haul is judged to be a feasible handling method.

(5) Environmental Impacts

Since virtually any long haul scheme will involve solid waste transfer elements, potential adverse environmental impacts of long haul operations are essentially the same as those for solid waste transfer. Due to the long distances and travel times, the potential for odor is greater. Containerized shipment can mitigate this substantially. With increased handling, spills become a possibility. An emergency spill preparedness plan can help mitigate impacts of such an occurrence.

Potential environmental impacts at a disposal or processing site to which waste is being hauled must also be considered. These impacts are discussed in the appropriate sections.

6. DISPOSAL PROGRAM METHODS

a. Introduction

The disposal program methods include incineration/energy recovery and landfilling. Whereas incineration converts the majority of waste into gaseous and particulate products that are discharged to the air, landfilling buries the majority of waste in earthen cells. Each disposal method consists of numerous potential technology variations that can be used separately or in conjunction.

b. Incineration/Energy Recovery Method Technologies

(1) Introduction

Technologies involving combustion of solid waste or other methods to produce or recover energy from waste include:

- Anaerobic Decomposition
- Pyrolysis/Gasification
- Refuse-Derived Fuel Preparation and Use
- Mass Burn Incineration

(2) Anaerobic Decomposition

(a) General Description

Anaerobic decomposition is characterized by the microbial decomposition of waste to produce carbon dioxide and methane in the absence of oxygen. Anaerobic decomposition is also called anaerobic fermentation. It is referred to as decomposition because it involves breaking down complex organic molecules into simpler compounds.

The anaerobic decomposition process occurs naturally in landfills and creates landfill gas that can be problematic because of its potentially explosive nature. This gas can be recovered as an energy resource. The anaerobic decomposition technology is designed to encourage and control the production of methane during decomposition.

Composting is a microbial decomposition process, but it requires an oxygenated (aerobic) environment and does not result in methane as a byproduct.

(b) Process and Physical Features

In a controlled system of anaerobic decomposition, solid waste is first prepared for decomposition. This typically includes sorting out the non-organic fraction of the waste stream, which cannot be biologically decomposed, and size reduction. Moisture and nutrients added, and the pH adjusted to maximize the speed of decomposition.

The actions are often supplemented by mixing sewage sludge into the wastes. This results in a slurry type material which is heated to 55°C to 60°C and continuously mixed for 5 to 10 days. The decomposition process consumes moisture and nutrients and typically takes place in a continuous flow reactor where methane and CO_2 are continuously extracted as moisture and nutrients are added.

Equipment needs for an anaerobic decomposition facility would be similar to the required for mixed waste processing for the separation of organics. In addition, a decomposition reactor with associated moisture and nutrient injection and gas recovery equipment would be required. When in operation, these systems produce about 7 cubic feet of gases per pound of sorted, prepared wastes entering the reactor. The gases contain up to 50-60% methane. The methane can be used as a substitute for natural gas after it is dried and upgraded to a Btu content suitable for commercial use.

(c) Technology Background and Evaluation

Anaerobic decomposition of municipal solid waste has been developed only on an experimental basis and is not a commercially proven technology. On the other hand, anaerobic decomposition (digestion) of sewage sludge is very common in the wastewater treatment industry. The conversion of the carbon fraction of the waste to methane is low. Disposal of the residue may require dewatering and may result in higher levels of heavy metals if the solid waste is supplemented with sludges.

(d) Implementation Factors and Feasibility

Because this is not a proven technology, this method is only appropriate to consider for small-scale (pilot) use where the high risk associated with developing technologies is acceptable. This method could be used in association with mixed waste processing and recycling methods that concentrate on the non-organic recyclable fraction, but is not compatible with incineration or composting.

Anaerobic decomposition presents implementing jurisdictions with generally low-to-moderate levels of exposure to loss. For selected components of the solid waste stream, anaerobic decomposition is a feasible energy recovery disposal method.

(e) Environmental Impacts

Potential environmental impacts associated with anaerobic decomposition differ little from those produced by composting methods. All of the impacts associated with collection vehicle traffic, as described in Subsection B.2.c.(7), would occur. Odor should not be a problem, except during upset conditions; because of the nature of the anaerobic nature of the process involved, the potential for generation of particularly obnoxious odors under upset conditions is high. Aesthetic considerations and noise from processing machinery are the same as for other indoor facilities described in Subsection B.2.c.(8). Public health risks would be limited to toxic materials, especially heavy metals present in the residue. If the residual material must be dewatered, there would be a potential for release of heavy metals in the dewatering discharge. This discharge would probably be to the sewer system, and would need to meet applicable standards, possibly including pretreatment.

(3) Pyrolysis/Gasification

(a) General Description

A significant number of processes have been conceived which pyrolyze or gasify solid waste to produce gaseous or liquid fuels. Some concepts require production of a RDF-type product as the first step while others propose to use unprocessed solid waste. In either case, the waste is fed into a reactor in which partial combustion takes place with a controlled amount of air, thus producing a low-Btu gas. The gas can either be burned directly as a low-grade fuel or processed to remove condensables and tars, after which the fuel can be burned in an internal combustion engine.

(b) Process and Physical Features

Pyrolysis technology has been used for many years for production of charcoal, methanol, and turpentine from wood and coke from coal or heavy petroleum oils. Its use with municipal solid waste involves basically the same concept; however, additional fuel processing may be required. A pyrolysis facility will typically consist of waste shredding/processing equipment, pressure vessels or reactors where the process and gas storage takes place, and generating equipment.

Through various operating parameters such as temperature, pressure, feed rate, and particle size the process can be controlled to produce either primarily gaseous products such as hydrogen, methane, and carbon dioxide or primarily liquid fuel products such as oils, acetone, and methanol. The pyrolysis process also results in a char residue consisting of sulphur, metals, glass, and ash which requires disposal.

(c) Technology Background and Evaluation

Pyrolysis has been successfully used in preparation of fuels from many types of feedstock; however, the application to solid waste has been limited. Solid waste pyrolysis facilities have operated in the U.S., France, Japan, and other countries. These plants have met with only limited success, and all have experienced problems related to poor control of the quality of the fuel product and corrosion.

(d) Implementation Factors/Feasibility

The overriding consideration when evaluating the implementation and feasibility of solid waste pyrolysis is that technical and economic feasibility on a commercial scale has yet to be proven. Problems resulting from use of municipal solid waste in pyrolysis systems have resulted in plant shutdown and closures. Several companies continue to investigate this process, and it may prove to be a viable solid waste processing option in the future.

Pyrolysis/gasification presents implementing jurisdictions with moderate-to-high levels of risk. This is due primarily to the relatively unproven nature of this technology. As an incineration/energy recovery disposal method applied to mixed municipal solid waste, pyrolysis/gasification is considered infeasible at this time.

(e) Environmental Impacts

A pyrolysis plant would result in the same impacts from collection vehicles, potential for odor generation, noise from processing machinery, and aesthetic considerations as other facilities. These are described in detail in Subsection B.2.c. Pyrolysis plant technology is not sufficiently developed to allow detailed characterization of other substantial impacts. Disposal of the char residual would have to take into account the potential for release of hazardous materials such as heavy metals and organic compounds.

(4) Mass Burn Incineration

(a) General Description

As the name implies, mass-burn systems receive municipal solid waste (MSW) and incinerate it in the "as-received" condition. Minimal preprocessing is normally completed except for the removal of non-processible items such as tree stumps, large appliances, etc.

There are basically two forms of mass burn incinerators: small modular plants and larger field-erected facilities. Although features of

these two types of facilities differ in many ways, the two types of incinerators use fundamentally the same technology.

(b) Process and Physical Features

Modular incinerator technology is used in small- to medium-size facilities. Units are primarily factory-assembled with only minimal field erection required. These incinerators can have capacities from a few pounds per hour for use in hospitals to over 100 tons per day. Larger facilities (greater than 300 tons per day) are typically field-erected.

After weighing at the scale facility waste is dumped either onto a tipping floor or into a storage pit within the receiving area. Storage capacities range from room for a few to several days' waste depending somewhat on bypass capabilities of the overall solid waste system. Waste is delivered by front-end loaders or overhead cranes to incinerator hoppers which lead to the furnace. The loader or cranes are used to mix the waste to provide a uniform fuel mixture.

Waste is normally fed into incinerators through large charging hoppers. From the hoppers, the waste is pushed into the furnace by means of hydraulic rams. These rams regulate feed of waste to the furnace and allow the waste to form an air-tight seal or "plug" in the hopper above the rams, which helps control the amount of air entering the furnace for combustion.

The furnace is the chamber in which the incineration of the waste takes place. In some modular designs, slow and incomplete combustion takes place at a relatively low temperature (starved air combustion) in the furnace, and the combustion of unburned gases is completed in a second chamber or after-burner at a higher temperature (approximately 1,800°F). This design minimizes the carryover of ash particulates to the stack and damage to the refractory in the furnace. Large field-erected designs accomplish the combustion process in a single chamber (excess air combustion). The furnace may be completely lined with refractory or it may be lined with water-filled tubes which reduce temperatures and contribute to the ultimate steam generation efficiency.

A major requirement for good combustion of MSW is the tumbling or mixing of wastes in the furnace. In modular designs, this is usually achieved by a series of two or three rams at the bottom of the furnace. These rams push the burning waste and tumble it through two or three stepped stages and advance it toward the ash pit at the end of the furnace.

The bottom or floors of the furnace of this design are usually constructed of high-temperature refractory. In some field-erected designs, the furnace floor consists of reciprocating grates constructed of high chromium alloys which tumble and advance the MSW toward the ash pit.

Other designs consist of large rotary drum furnaces in an inclined position. The drums are lined throughout either with refractory or with water-filled tubes. The drums rotate slowly, tumbling the burning MSW which works its way to the ash pit at the lower end of the drum. This type of design is normally used in combination with other heat-recovery equipment.

The air required for combustion is supplied through small openings in the furnace floor (underfire air) and through openings in the furnace walls (overfire air) by means of fans or blowers. The underfire air also serves to cool the furnace floor or grate. In modular designs with afterburners, air is also supplied directly to these secondary chambers for the completion of combustion.

The residue ash is normally removed from the furnace bottom through a water-sprayed or water-quenched conveyor system and discharged into transport trailers either directly or via intermediate storage facilities. The flue gases from combustion are conducted through air pollution control equipment to remove ash and pollutants from the gases. The fly ash-laden flue gas, which also contains acid gases (SOx, NOx, and HCl) are first passed through an acid gas scrubber where a reagent (lime) is thoroughly mixed and contacted with the gases to capture the SOx and HCl. The gas next passes through a set of high-density woven fabric filters, commonly referred to as a "baghouse" where particulate matter is removed along with more acid gas.

Steam is generated in boilers which are either an integral part of, or an appendage to, the furnace. In the former case, the furnace walls are lined with boiler water tubes in which water is heated to the boiling point by the heat radiated from the furnace fire. The hot combustion gases travel further through the rest of the boiler, giving up heat for steam generation on their way to the stack. In the latter case the furnace is lined with refractory, and steam is generated in an attached heat recovery boiler by the hot combustion gases which leave the furnace. A conventional wet cooling tower is normally utilized for heat rejection.

The steam produced in the boiler can be used to generate electricity or can be sold directly to a steam customer. Sometimes both steam and electricity are generated by the facility, a practice which is referred to as cogeneration.

Mass burn systems will reduce the volume of the incoming waste by approximately 80% to 90% and the weight of the incoming waste by 65% to 75% on a dry basis.

(c) Technology Background and Evaluation

Early waste incineration methods, which were used for the purpose of volume reduction only, were expanded and developed into plants that used the heat from incineration to raise steam in boilers for heating and industrial process, and for the generation of electricity.

As is often the case with developing technologies, difficulties were initially encountered, and certain mistakes were made in the design and implementation of the new technologies. Such design errors were often coupled with attendant capital and operating cost overruns. Mass burn technology has been undergoing technological development in the United States for a number of years. Currently the technology has been developed to the extent where a mass burn facility can be operated with a low degree of performance risk. A large number of units are currently operating successfully. On-line availability of mass burn facilities is typically 75% to 85%.

As with any other complex technology, proposals by process equipment vendors should be evaluated on the basis of proven successful operating results of similar existing plants. Numerous manufacturers have provided the equipment to successfully operating plants, representing a range of capital and operation and maintenance costs.

(d) Implementation Factors and Feasibility

Incinerators may be designed for volume reduction only or for reduction and energy recovery. Energy recovery systems may produce steam only, electricity only, or both steam and electricity. The preferred size of an incinerator project depends on: (1) meeting the steam and/or electrical requirements of the potential customers; (2) the projected annual solid waste generation; (3) complementary programs for reuse or recycling; (4) solid waste generation fluctuations; (5) the proven incinerator unit sizes commercially available; (6) plant redundancy and availability; and (7) technical limitations of the equipment.

Another significant implementation issue is ash quality. The ash/residue from an incinerator is composed of two components, fly ash and bottom ash. These two components are typically collected and disposed of together. However, Washington State law may require separate handling and disposal of fly ash, since fly ash is more likely to contain significant levels of certain heavy metals (especially lead and cadmium) as well as dioxin and furan compounds. The fly ash also may contain some amount of unreacted lime from the stack gas scrubber.

Incinerators are complex and costly to build and to operate. Incinerators are viewed as a disposal option or as an alternative to landfills. Although waste is stabilized and reduced in volume and weight through incineration, this process produces significant ash residue. Siting, waste flow dedication/sizing, financing, and general concern for recycling, economics, and environmental protection have slowed the development of mass burn incinerator systems.

Mass burn incineration presents implementing jurisdictions with moderate-to-high levels of exposure to loss. This is due to the high costs involved and the complex nature of many implementation issues such as waste stream control and air emissions and ash disposal standards. Mass burn incineration is judged to be a feasible incineration disposal method.

(e) Environmental Impacts

Potential environmental impacts from mass burn/energy recovery facilities include all of the impacts described in Subsection B.2.c. except potential release of pathogenic organisms. In particular, the transportation related impacts of incineration include trucks bringing the waste to the facility as well as those removing both nonprocessible items such as large appliances and ash. Another source of traffic-related impacts is employee vehicles. Odor is also a potential concern because of the presence of several days' storage of waste for the facility. This can be mitigated by drawing combustion air from the storage pit.

Although such a facility itself generates no leachate, it does generate substantial quantities of ash which must be disposed of. Generally ash is disposed of in a landfill, where leachate is a major concern.

As described in Subsections B.6.c. and d. methodology to mitigate potential environmental impacts from this leachate is well developed. Although most of the processing occurs within enclosed facilities and therefore can be controlled by building design, noise produced by the cooling tower equipment is controllable only through location of the tower away from sensitive receptors. A major concern of the public with mass burn facilities is the perceived potential for human health risk due to releases of toxic substances especially heavy metals and dioxins in the emissions. These potential impacts are discussed in Subsection B.2.c.(10).

A significant environmental benefit that occurs with many energy recovery incineration plants such as mass burn facilities is the saving of fossil fuels due to substitution of electrical energy or steam for fossil fuel-derived energy or steam. In addition, incineration substantially reduces the volume of waste that must be landfilled, thus reducing the amount of land that must be withdrawn from productive use and the associated environmental impacts.

(5) Refuse-Derived Fuel

(a) General Description

RDF technology processes solid waste into a prepared fuel prior to introducing it into an incinerator. The range of processing options vary from very simple to complex. In a very simple process the solid waste is shredded, some ferrous metal is removed and the resulting product is fed directly to the incinerator without further processing. The most complex system involves multiple shredding and classification steps which in some cases include densifying or pelletizing the fuel. In general, the processing objectives are to produce a homogeneous fuel product of uniform particle size with a defined moisture and inerts content suitable for an RDF incinerator.

RDF incinerators vary from on-site units dedicated to burning a slightly altered solid waste fuel to those of business, industry and utilities that may burn a highly prepared RDF alone or in conjunction with other fuels. Such incinerators are usually located apart from the fuel preparation facility.

(b) Process and Physical Features

A typical RDF plant consists of fuel preparation and fuel incinerator units. At the fuel preparation facility, solid waste is discharged onto a tipping floor which is sized to hold an amount of solid waste equal to several days of plant throughput capacity. Conveyors feed the solid waste to an assemblage of equipment such as shredders, magnetic separators, trommels, disc screens, and air classifiers.

Products from the system can include RDF, compost feed stock, ferrous and non-ferrous metal products, and an inert fraction consisting primarily of glass, grit, and heavy organics. The composting feedstock goes to the

composting process, recovered metal products are normally sold, the inerts and residue fractions are disposed of at a solid waste landfill, and the RDF is sent to intermediate storage for delivery to the incinerator. The fuel preparation element of an RDF facility is essentially mixed waste process operation which is discussed in Subsection B.d.8.

The incinerator unit of the RDF technology shares many of the features of the mass burn incinerator discussed in Subsection B.6.b.(4) above. Simpler charging and firing systems can be used in the RDF facility because of the more homogeneous nature of RDF. RDF charging and firing systems can consist of a spreader and stoker and suspension or traveling grate burnout systems. Ash handling systems are generally simpler since usually most of the metals and other inerts were removed in the fuel preparation stage. The boiler and appurtenant steam and electrical generation equipment as well as air cleaning equipment are essentially the same as those discussed for mass burn incinerators.

A variation of the RDF incineration unit is the fluidized bed boiler. With this technology, finely processed refuse is burned in a turbulent bed with a fluidizing medium of inert particles. The inert particles are kept in a state of agitation and fluidity by a flow of high velocity combustion air introduced into the bottom of the combustor through a series of nozzles. The boiler section is located above the combustion process. The bed media may be sand or, alternatively, limestone. The latter provides a flue gas cleaning advantage with regard to acid gases.

These units require a very high quality RDF product with removal of most ferrous materials, glass, and aluminum.

RDF plants are normally designed for the plant to operate 24 hours a day, 7 days a week while the RDF processing equipment operates approximately 16 hours a day, 6 days a week. The shorter schedule for RDF processing equipment is designed to accommodate the high maintenance requirements of the processing side of the operation.

(c) Technical Background and Evaluation

More than half a dozen RDF plants with dedicated boilers are operating successfully including facilities at Akron, Ohio; Ames, Iowa; Columbus, Ohio; Niagara Falls, N.Y.; and Albany, N.Y. RDF is co-fired at Union Electric Company, Madison Gas & Electric, Baltimore Gas & Electric, and the City of Lakeland, Florida. The principal advantage of the RDF technology is that it permits a combustion of a more homogeneous feed, thereby facilitating control of the incineration process, potentially reducing emissions, and allowing use of less complex boiler and feed equipment.

Several fluidized bed units are operating successfully in Europe and Japan with loose and pelletized RDF as well as other fuels. Two commercial installations exists in the United States; one in Duluth, Minnesota which co-fires RDF with sewage sludge, and one in La Crosse, Wisconsin. In addition, a fluidized bed facility that will use a combination of coal and municipal solid waste as fuel is currently under construction in Tacoma, Washington.

A principal advantage to fluidized bed combustion is the ability to burn a wide variety of fuels. Fuels such as coal, petroleum, wood waste and a variety of waste products are being successfully burned in fluidized bed combustors. A second reported advantage is the ability to remove acid gases in the bed. While this is true for SOx, the removal of HCl is difficult at the resident bed temperatures; thus, a separate scrubber may be required if at least 90% HCl removal is required.

Nevertheless, nearly every RDF-based plant has experienced major difficulties during startup, and plants coming on-line today seem to be continuing this trend. The primary operating problems with RDF facilities have been related to waste processing equipment and feeding of RDF into the combustion system which require modifications for commercial operation. Thus, while the technology is clearly "commercial," the performance risk is considered to be somewhat higher than for mass burn units. RDF plants can be designed to handle 400 to 2,000 or more tons of solid waste per day.

RDF plants have the potential for reducing the volume and weight of the incoming solid waste stream by approximately the same ratios as mass burn plants. RDF-based plants have difficulty in processing certain types of materials frequently found in commercial/light industrial waste, such as carpet wastes, wire, and computer tape. RDF incinerators often use a modified grate system in the combustion chamber based on the type of RDF anticipated to be used.

(d) Implementation Factors and Feasibility

RDF is a proven technology that is in use throughout the U.S., Europe, and Japan. Where market conditions are favorable, it allows for preparation of a fuel product tailored to the needs of a commercial, industrial, or utility customer. This technology combines most of the aspects of mixed waste processing and mass burn incineration and is more complicated mechanically than either. In return for added complexity it responds to three of the most common public criticisms of mass burn incineration: greater level of materials recovery, greater degree of operational control, and lessened air and ash emissions.

RDF facilities remain difficult to site due to public opposition of traffic and air impacts. The exception to this may be the RDF preparation facility that sells to pre-existing industrial incinerator facilities.

Refuse-derived fuel presents implementing jurisdictions with moderate-to-high levels of exposure to loss. This is due to the high costs involved and the complex nature of many implementation issues such as waste stream control and air and ash emissions standards. Refuse-derived fuel is judged to be a feasible incineration disposal method.

(e) Environmental Impacts

The environmental impacts for refuse-derived fuel incineration are essentially the same as those for mass burn/energy recovery facilities. The major difference is that RDF alternatives with dedicated boilers can have

lower emissions of certain pollutants. The amount of reduction of pollutants in an RDF as opposed to a mass burn facility depends on the particular details of design of each of the facilities and varies from one pollutant to the next. Pollutant emissions are generally 40 to 75% lower. Especially significant are changes in heavy metal emissions, especially beryllium, where reductions of over 95% have been observed.

Impacts from RDF/fluidized bed combustion are the same as for the general case of refuse-derived fuel combustion, described above. The only exception is that emission of air pollutants, especially nitrogen oxides, is substantially lower.

c. Solid Waste Landfills

Landfilling has been addressed in detail in the Washington State Department of Ecology's solid waste landfill design manual.(9) The information presented here will be in summary form. More in-depth discussions of the various aspects of Solid Waste Landfill Design and Operation can be found in the manual.

(1) General Description

Among the currently available methods for solid waste disposal is burial in landfills. Landfilling of solid wastes was originally promoted as a method for both disposing of solid wastes and reclaiming unusable lands. As more scientific and operational data were collected and evaluated, the regulatory agencies, design professionals, solid waste industry, and general public have become aware of the significant short- and long-term impacts associated with landfills. Although landfilling is the lowest priority disposal method, there will always be a need for solid waste landfills, regardless of other solid waste disposal alternatives.

(2) Process and Physical Features

(a) General

Landfills categorized as mixed municipal solid waste sites receive predominantly household and commercial refuse. This waste stream is typically delivered to the landfill by commercial collection and/or transfer vehicles. Where public access to the site is allowed, residential self-hauled MMSW may also be received.

While scavenging, or the uncontrolled removal of materials from the landfill, is prohibited by law, salvage or recycle operations are required by WAC 173-304-460, unless an equivalent method of encouraging the public to recycle is provided. Containers should be provided for recycled materials and a designated area should be included in the site development plan. Access to the recycling area should be controlled by fencing to prevent unauthorized removal of salvaged materials.

Landfills can usually be adapted to various types of terrain, but certain topographical features are better suited than others. Landfills can be constructed in swales and ravines or on side hills with minimum excavation;

the finished landfill can be designed to blend in with the surrounding topography. Landfills on flat terrain generally require more excavation, at least initially, and it may be difficult to blend the completed landfill into surrounding topography.

Recent environmental controls over solid waste landfill development have had a marked effect on landfill operation options available to site operators. Traditional goals of on-site soil balance and effective topographic use are still important in determining the optimum landfill configuration; however, leachate collection systems and bottom liner requirements have somewhat limited options.

(b) Area Fill

An area fill includes a fairly large working face for waste disposal. Refuse is off-loaded either on undisturbed ground or on a prepared tipping pad where it is pushed onto the working face in lifts from 16 to 30 inches in thickness and then compacted. Each layer is compacted as the filling progresses over the course of the day, or until the thickness of compacted wastes reaches a height of 6 to 15 feet. At that time, and at the end of each day's operation, a 6- to 12-inch layer of cover material is placed over the completed fill.

The area fill technique should be applied under moderate and rolling topographic conditions, where cover material sources are readily available, and at large-volume MMSW or demolition sites with high traffic volumes. High in-place densities greater than 1,200 lb/cy are possible. The large overall area-to-volume ratio results in higher leachate production and higher capital costs, higher daily cover requirements, and higher litter problems.

(c) Trench Fill

In the trench method of landfilling, waste is spread and compacted in an excavated trench. To begin operation, the first part of the trench is excavated to the desired depth and the soils are stockpiled. Wastes are placed in one end of the trench and compacted until the desired height is reached. The daily cover material is obtained from stockpiled soil, continuing the trench, or borrowed from adjacent trenches.

The size of the individual trenches is generally governed by topography, constructibility, and refuse volume. A recommended trench width is generally 100 feet wide or less to provide a manageable trench and orderly construction of cells.

As one trench is filled, a subsequent trench is excavated adjacent to it. Because the two trenches are independent, there is a loss of landfill volume between the trenches. Landfill cell depth may vary from 5 feet or less to 30 feet or more depending on site constraints. The trench method may offer some cost savings over the area method, since material excavated from the trenches will be used as daily cover, eliminating imported cover costs.

Applications for this technique include small volume, low traffic facilities; moderate topography; areas with a low ground water table; lower area/volume ratio resulting in less gas and leachate production; below grade landfill; and specialized waste (sludge, wood wastes, demolition).

Limitations of this method include lower efficiency of land use (ton/acre) and difficulty in cost effectively implementing leachate management systems (liner and collection system).

(d) Modified Area Fill

The modified area method is probably more typical of current landfilling practices in Washington for medium to large facilities (less than 200 tons/day) than either the area or trench method. The system is flexible and can resemble either of the previously described techniques with very little alteration of the operating plan. In fact, many facilities begin early operations resembling a trench landfill altered by the modified area method, later changing to an area method to complete the landfill.

The modified area method of landfilling requires a fairly large working face similar to the area method. Depending on ground water levels and the required operation size, one or a number of cells may be excavated prior to operation and the material stockpiled for use as daily cover. This tends to create a more cost-effective landfill than the area method. Once deposited on the tipping pad, waste is pushed to a working face which is actually constructed on an incline. Waste is compacted in an uphill fashion and the lift is expanded laterally in proportion to the daily quantities delivered.

The modified fill area technique can be applied under moderate and rolling topographic conditions; large volume MMSW or high traffic demolition sites; areas with a low-grade water table. Moderate in-place densities of 1,000 lb/cy to 1,200 lb/cy are possible.

The larger overall area-to-volume ratio results in high leachate and gas production and higher capital costs.

(e) Volume Reduction Techniques

Shredding and baling are two volume reduction techniques involving preparation of refuse prior to landfilling that are applicable to Washington. Both have been employed at sites in Washington in an attempt to reduce landfill operations expense, to increase in place density (thereby prolonging site life), and to reduce environmental impacts. The techniques have had mixed success in meeting the objectives. Future applications should be carefully evaluated considering cost-effectiveness and benefits to the landfill operation.

Shredding. Shredded waste has been reduced to particles of less than 2 to 6 inches by mechanical processes such as cutting, tearing, ripping, and impact shattering. The most common method is hammermilling, an impact shattering process. Shredded waste disposal is similar to the landfilling methods discussed above for unprocessed wastes, with the following advantages:

- Operation of the landfill is simplified when the waste is shredded. Successful operations have shown that very little daily cover may be necessary to prevent vectors access to the waste because compaction is highly efficient. Blowing paper and debris is reduced since large pieces that may catch the wind are eliminated by the shredder. Spreading and compaction can be accomplished in significantly less time. Traffic routing and other operations during foul weather are also simplified.

- Because the shredded waste can be compressed to a greater density than unprocessed solid waste by up to 25%, the life of the landfill may be increased proportionately.

- Decomposition will proceed faster in a shredded waste landfill. This may be an advantage, particularly if methane gas or other by-products are to be recovered from the landfill, or if an ultimate land use plan for the site must be met.

Disadvantages for shredding operations include:

- Initial cost of equipment and ongoing cost of operation and maintenance can be higher.

- Leachate may be of higher strength due to more rapid decomposition and potentially longer retention time.

- Higher methane production may be a disadvantage if not collected and recovered.

Baling. Waste is baled by compression into large, rectangular blocks with densities up to 1,700 lbs/cy. The advantages are similar to the advantages for shredded waste:

- Improved aesthetics over unprocessed waste

- Cover costs are reduced because the bales create fairly uniform surfaces, thus minimizing the volume of cover material required. The bales can be maneuvered with a front-end loader or forklift, thus the only compaction equipment required is for the daily cover. Hauling costs can also be reduced if the waste is processed at transfer stations or more central locations.

- The life of the landfill is prolonged due to the greater density achieved with baled wastes compared to unprocessed wastes.

Disadvantages to baling waste are also similar to those for shredded waste:

- Cost of equipment, operation and maintenance.

- Increased strength of leachate and higher methane production due to higher waste density.

(f) Leachate, Gas, and Soil Issues

The Minimum Functional Standards (MFS) require that for all solid waste landfills regulated under WAC 173-304-460, with the exception of those using the arid liner design, a leachate collection system sized according to water balance calculations or other accepted methods be installed. The collection system ensures that no more than 2 feet of leachate develops at the topographical low point of the active area. The 2 feet are measured from the top of the bottom liner.

A leachate collection system is installed directly over the bottom liner. Typically, a layer of very permeable sand or gravel is installed on top of the liner. Within this layer is a network of perforated pipes to which the leachate flows. After entering one of the perforated pipes, the leachate flows into the transmission pipe for further transfer to the leachate treatment and disposal system.

Placement of solid waste under the anaerobic conditions of modern solid waste landfills has virtually eliminated many of the nuisances and health hazards associated with open dumps. However, the method has, at the same time, introduced a new environmental problem, methane gas generation and migration.

Methane gas production is a common and unavoidable microbiological phenomenon which occurs following the landfilling of organic solid wastes. Typically, the rate of generation is highly variable, depending on the solid waste characteristics and environmental conditions within the landfill, and is also time dependent.

Methods for controlling the migration of landfill gas may include blocking liners, gas vent gravel seams, interior gas venting, negative pressure systems, and gas flaring.

Early in the landfill design process, the quantity of different types of soil materials needed for construction of the various landfill design elements must be determined so that maximum use can be made of on-site soils. Differing soil types are needed for liners, intermediate and final cover systems, drainage layers, and gas venting. Few sites will have adequate quantities of all the types of required soils and the import of certain soils or the use of geosynthetics may be necessary.

Geosynthetics are manmade products that can substitute for soils in some applications. They can be used for liners, covers, erosion control, slope reinforcement, and protection of subsurface drainage pipe.

(3) Technology Background and Evaluation

Landfilling or dumping of solid waste dates back to the earliest period of recorded history. Much of what we know about some cultures we have

devined from our study of their dumps. American landfill technology evolved with little input from government regulation until the mid-1970's enactment of the Resource Conservation and Recovery Act (RCRA). However, long after RCRA set forth landfill design standards, old landfills continued to operate.

The leachate, gas migration, and buffer problems of these older landfills have created significant public and legislative support for tougher standards. In Washington State, these tougher standards have taken the form of the 1986 update of the State's Minimum Functional Standards for landfill design and operation. These technology standards if applied should prevent the problems associated with the older, pre-RCRA landfills. The standards, however, are no guarantee that the problems will not arise in building and operating these more complex landfills. The standards also do not ensure that landfills meeting these standards can be sited in all areas of the State.

(4) Implementation Factors and Feasibility

A solid waste landfill is like a long-term construction project. Most aspects of conventional construction activity are undertaken, including clearing, earthwork, road construction, building design and erection, drainage control, and installation of utilities. In addition, special attention must be given to the design of features unique to the landfill operation. These include provisions of odor, gas, and leachate control; subsidence and differential settlement control; construction of temporary facilities; phased construction of solid waste cells; final grading of the site following cessation of filling activity; and landscaping. All of these considerations should be a part of the site development plan.

The site development plan must include a zone around the perimeter of the landfill site to buffer adjacent property, to limit access by unauthorized persons, and to prevent litter, dust, and noise from escaping the site. The working area of the landfill should be visually separated from adjacent property by natural vegetation or by the use of plantings and berms. Public access to the working area of the landfill should be minimized to avoid conflicts with landfill equipment and large hauling vehicles which could create unsafe conditions. When these conditions could exist, consideration should be given to providing a drop box container or transfer station near the entrance of the landfill. This will allow for wastes delivered by individuals to be deposited properly, while keeping traffic away from the working area.

Although landfilling can be considered a familiar and often disliked technology, sanitary landfills meeting the current standards are new and have not had time to demonstrate a proven track record. Often, the public does not perceive there to be any difference between new and old landfilling prac- tices. This lack of experience with successful landfill technology will likely lead to protracted and unsuccessful siting efforts. The ability to successfully site new landfills is the single most important implementation factor facing use of this technology.

To the jurisdictions in which they are located, solid waste landfills present moderate-to-high exposure to loss. This is due in large part to

the rapidly evolving regulatory standards for landfill disposal, the difficulty in finding satisfactory sites and tremendous public opposition to such facilities. Solid waste landfills are judged to be a feasible disposal method.

(5) Environmental Impacts

The potential environmental impacts of MMSW landfills include many of the impacts described in Subsection B.2. These include the impacts related to haul vehicles, operational noise, odors, and aesthetic impacts.

Decomposition within the landfill generates a variety of gases. The principal components of landfill gas are carbon dioxide and methane, which can reach concentrations of 50% to 60%. Minor constituents, such as hydrogen sulfide and organic acids, are also of concern as they have obnoxious odors. Emission of volatile organic chemicals may adversely affect air quality; however, few data are available regarding amounts of impacts of such emissions. Methane gas is of concern because it increases the risk of explosions when the concentration in confined spaces is between 5% and 15%. Furthermore, methane gas in excess of 15% can create an asphyxiation hazard for personnel in confined spaces, and methane gas also can kill vegetation by asphyxiation of the roots as it passes through the soil. A variety of systems incorporating barriers, liners, and both active and passive venting systems, have been developed to prevent subsurface migrations of landfill gas and protect on-site personnel, as well as to recover the methane for economic use. An active method of gas withdrawal from surrounding formations can be used to recover the methane for use as fuel or to direct it to specially designed flares where it is burned to minimize odor. Performance of such control systems is monitored using specially designed gas detection probes positioned in appropriate locations around the landfill boundaries. Federal regulations include strict limits for landfill gas concentrations at the site boundaries and within on-site structures.

Water quality impacts are another major concern. Movement of water into the landfill from either the surface or from the ground water can produce substantial quantities of leachate. Impacts due to such leachate generation are described in Subsection B.2. Another type of water quality impact from landfill development is the increased potential for sedimentation in streams as a result of erosion of soil covers, exposed slopes, or other unprotected areas. Mitigation measures to reduce erosion impacts include standard engineering techniques such as construction of berms, dikes, and ditches to control the flow of water, and use of sedimentation ponds to remove particles from the water before it is discharged from the site. Even where sedimentation ponds are used, it is possible that the runoff may have increased concentrations of finer particles that are not efficiently removed within the settling time possible. Another concern for landfills are the public health risks due to the attraction of birds, rats, and similar animals that can serve as vectors of disease. Although placement of cover on a daily basis reduces the attractiveness of the landfills to such vectors, it does not eliminate it.

Potential environmental impacts of various ash pretreatment techniques and ways to mitigate these impacts are described in the preceding section on implementation factors/feasibility.

d. Ashfills

(1) General

The Washington State Department of Ecology is currently developing regulations for ash management under WAC 173-306, "Special Incinerator Ash Management Standards." The regulations have not yet been adopted and will undergo further review. The following is based on published draft regulations. The final regulations which are expected to be adopted in late 1988 or early 1989 are likely to reflect many of the issues put forth.

Under the new regulations WAC 173-306 would apply to special incinerator ash defined as follows:

> "...ash residues resulting from the operation of incinerator or energy facilities managing municipal solid waste, including solid waste from residential, commercial, and industrial establishments, if the ash residues (a) would otherwise be regulated as hazardous wastes under Chapter 70.105 RCW; and (b) are not regulated as a hazardous waste under the Federal Resource Conservation and Recovery Act, 42 U.S.C. Sec. 6901 et seq."

Under this definition, ash would fall into one of three categories:

- Solid Waste - Ash generated from wastes separated to the point that the resulting ash exhibits no dangerous or hazardous waste characteristics. This ash would be regulated as a solid waste and could be co-disposed of with solid waste in MSW landfills.

- Hazardous Waste - Ash regularly failing the EPA EP toxicity test would be regulated under RCRA, Subtitle C as a hazardous waste, requiring disposal in a hazardous waste disposal site. This would likely apply to fly ash and some combined bottom and fly ash.

- Special Incinerator Ash - Ash which passes the EP toxicity test but does not pass Washington State dangerous and hazardous waste standards would be regulated as special waste under WAC 173-306. This would apply to some combined bottom and fly ash and bottom ash. Disposal would be by monofill a dedicated landfill for ash residue.

The extent to which these regulations apply in the future may depend on final incinerator ash disposal regulations adopted by the U.S. EPA. Under the 1984 RCRA, incinerators burning only household waste are exempt from Subtitle C hazardous waste requirements.

The status of those facilities which do accept commercial or industrial wastes, in addition to household wastes, and which recover energy is being reviewed by the EPA at this time. In July 1985, the agency issued a statement that the ash resulting from these plants would still be subject to

Subtitle C if it failed the EP toxicity test. The agency is now expected to revise this interpretation to state that those facilities accepting household, commercial, and industrial wastes (not hazardous wastes) which recover energy would not be subject to RCRA Subtitle C disposal requirements for ash. However, those facilities not recovering energy would still be required to manage ash as a hazardous waste if the ash exhibits "hazardous characteristics."

It appears likely that the EPA will list incinerator ash as a "special waste," allowing it to draw up management guidelines specific to the ash. There is some possibility that EPA will regulate incinerator ash under Subtitle D. Such guidelines would likely require disposal in either a monofill or a segregated portion of a lined MSW landfill. Some question has been raised regarding the use of the EP toxicity test in relation to ash disposed in monofills. Further study of ash field behavior by the EPA indicates that the EP toxicity test and other leaching tests overestimate the amount of metals that may leach if ash were to be landfilled without mixing with other wastes.

The implications of EPA's actions regarding regulation of incinerator ash under Subtitle D and the replacement of the EP toxicity test by a different testing method on ash management are significant. As the laws stand now, some ash requires expensive handling and disposal procedures. New EPA regulations could reclassify incinerator ash as a special waste and Subtitle C regulations would not apply. In this case, WDOE would be likely to revise State regulations to conform with Federal requirements if reclassification occurs.(8) This action would broaden the range of ash to be disposed under WAC 173-306.

Ash disposal facilities under the draft WDOE regulations include only monofills. Monofills may be constructed on new sites, or on existing sites adjacent to, but separate from solid waste landfills. Monofills are subject to locational standards.

Two different liner designs are included in the draft regulations. The single liner system is used with the primary location standards for solidified fly ash and bottom ash, or for bottom ash only. The single liner is alternatively used with the enhanced location standards for combined bottom and fly ash and fly ash alone.

The double liner system is used with the primary location standards for combined fly and bottom ash, and fly ash alone. The primary standards are essentially the MFS solid waste locational standards with some deletions and additions. The 10 foot distance to ground water and the 100/250 foot buffer for non-residential/residential use are the same.

The enhanced standards are significantly more severe and require a 50-foot depth to ground water. A 10- to 50-foot distance may be used where unsaturated zone monitoring is installed. A buffer of 250 feet is required for land zoned as non-residential and a 2,500 foot buffer is required for adjacent residential land use. Other standards for distances of surface water, wells, intakes, etc. are included.

Ground water monitoring requirements are the same; however, gas control systems are not required for ash monofills. Leachate collection systems for monofills are technically the same as those for municipal solid waste landfills.

However, a quality assurance plan must be submitted prior to construction or modification of the site, and employment of an independent third party to inspect the liner during and immediately after construction is required. The new regulations do not prohibit combined storage and treatment of MSW ash leachates.

(2) Ash Pretreatment

Ash which may fail the EP toxicity test in an untreated state may in some cases be successfully treated resulting in acceptable leaching rates for toxic metals. Treatment techniques include vitrification, fixation, and chemical stabilization.

Vitrification is a process whereby ash is added to other glass-making products, heated in excess of 2,000 degrees for several hours and then cooled to form a glossy, black, glass compound that can be made into various products. The vitrification technique has been successful in destroying the inorganic compounds and entrapping the toxic metals within the glass structure. This is primarily due to the high temperatures used in the process. According to a process vendor, large quantities of glass can be made from incinerator ash with little or no modification of existing glass-making technology.

One environmental consideration of the vitrification process is that the gases produced in the process may contain hazardous chemicals. To solve this problem, a system to evacuate the exhaust gases to a scrubber unit is required. The amount of this gas produced is a function of the amount of incompletely combusted material remaining in the ash residue. The proper operation of incineration units should minimize the amount of this gas produced.

Fixation is a chemical process whereby the hazardous constituents of the ash are essentially encapsulated in a tightly bound chemical matrix or converted to compounds that are bound together in a matrix. Of particular interest is a technology in which ash is used in place of aggregate in concrete cement to form blocks that can be used as construction material.

Studies have shown that leaching rates of toxic metals and organic compounds from bottom ash-produced blocks are within the EPA requirements; however, concrete made with fly ash has had mixed results, depending on the original quality of the fly ash. In some cases vitrification or chemical stabilization may be a preferred alternative for fly ash disposal.

Chemical stabilization is a process in which a hazardous waste is treated with chemical reagents to produce an inert material that can be safely used as a cover or fill material. Chemical stabilization would be classified and regulated as treatment under WAC 173-306. In general, this process

results in an increase in volume and a decrease in toxicity of the material. The process typically produces no by-products. Fly ash is an excellent candidate for this type of treatment.

There are many processes available on the market to bring fly ash within EPA requirements for a non-hazardous waste. Chemical treatment could be performed at the incinerator site to avoid problems associated with transporting a hazardous waste. Most chemical stabilization processes work in three ways in which first, a chemical reaction occurs between the added reagent and the toxic metals within the ash. The reaction forms metal hydroxides and metal-silicate-hydroxide complexes having the effect of changing the chemical property of the toxic metals rendering them stable and insoluble. Second; hydrolysis, hydration, and neutralization reactions occur between the reagents, toxic compounds in the ash, and water producing non-toxic or less toxic compounds. The last principle involved in chemical stabilization is the formation of a tightly woven chemical matrix structure of silicates that acts as a trap for toxic metals and compounds that are not involved in the initial reactions. This matrix holds these constituents tightly within their web and prevents their leaching out into the environment.

(3) Feasibility

Ash landfills present moderate-to-high levels of exposure to loss to those jurisdictions operating such facilities. This is due primarily to the continuing development of regulations governing this practice. Ashfills are judged to be a feasible disposal method for incinerated solid waste.

(4) Environmental Impacts

The potential impacts from ashfills include most of the impacts described for MMSW landfills with the exception that gas odor and bird/rodent impacts would be slight to nonexistent. Ashfills are potential sources of blowing dust. Proper operating procedures in conformance with the required ash disposal plan can be expected to eliminate fugitive ash dust. Although there is concern regarding the ability of incinerator ash to pass the Federal Extraction Procedure (EP) toxicity test, ashfill leachate can be expected to be substantially better in quality than leachate from mixed waste landfills due to the very low levels of organics present and the reduced area and reduced opportunity for leachate generation.

SECTION C

MARKET CAPACITY

1. INTRODUCTION AND SUMMARY

Effective solid waste management requires a thorough analysis of markets for recyclable materials. Without end-use markets, recyclable materials end up back in the waste stream. This section of the Best Waste Management Practices Report analyzes market capacity for recyclables generated in Washington State, and addresses two principal questions:

- Do existing and developing markets for recyclable materials have the capacity to accommodate increased supplies of recyclables from each waste generation area (WGA) individually and from Washington State as a whole?
- What economic impact would publicly funded collection of recyclables have on the existing private sector recycling industry in each WGA?

Information provided to answer these two questions includes:

- An analysis of current market conditions for specific recyclable commodities and a projection of near-term future capacity for increasing quantities of recovered material.
- A theoretical economic analysis of the structure of recyclable materials markets at both the WGA and aggregate market levels.
- An historical review of prices and quantities traded for domestic recovery and export.
- An analysis of aggregate market supply and demand based on these historical data augmented by some secondary source analyses.
- An econometric estimation of recyclable commodity supply curves within the State's eight WGA's.

Based on these analyses, our conclusions are:

(1) Existing markets for all paper grades except mixed waste paper, all non-plastic food and beverage containers, and all ferrous and non-ferrous scrap metals have adequate capacity to accommodate gradually increasing quantities of recovered materials.

(2) Mixed waste paper and the newly emerging markets for recycled post-consumer plastic wastes are adequate for WGA's located near the Ports of Portland and Seattle, but may bring prices insufficient to cover preparation and transportation costs from WGA's more distant from the two ports.

(3) Lawn and garden waste and white goods markets have prices and demand that will allow private recyclers to profitably handle increased quantities only if compensated for avoided disposal costs.

(4) Public sector recycling at the WGA or State level will not by itself significantly decrease the prices private sector recyclers receive for recovered materials.

(5) Public sector recycling will decrease the quantities of recyclables recovered by private sector recyclers whose drop box, buy-back or collection services are less convenient or more costly than public collection services.

(6) Widespread publicly sponsored collection of recyclables by communities across the U.S. is likely to cause a decrease in prices, mainly for recycled paper fibers. In the absence of a compensating increase in the demand for recycled paper fibers by end-user paper and paperboard mills, the resulting impact on private sector recovery levels could be severe.

Subsection C.3 describes existing markets for major recyclable commodities. Subsections C.4 through C.6 analyze future market trends using historical and econometric approaches. These subsections address the impact of new public-initiated recycling programs on existing recyclers. Conclusions of the existing market analysis appear in Subsection C.3.f. The impact and new publicly supported recycling programs is summarized in Subsection C.7.

Markets take materials generated through recycling programs and convert them into new products. Markets are composed of end-users, those who purchase recyclable materials and transform them into new products; processors, who clean, classify and prepare materials for shipment to end-users; shippers, who transport material; and dealers or brokers, who arrange transactions between buyers and sellers. A particular business may play a number of roles in the market, often at more than one location.

Distinct markets exist for particular materials and often for particular grades of material. Grade and quality of material are principal determinants of price. Markets may be local, regional, national, international or a combination. Quantity bought and sold on a market is normally a function of:

- A material's price
- Costs of preparing the material to meet end-users' specifications
- Transportation costs to get recovered materials from household and business generators to point of final consumption by an end-user
- The price of primary materials that compete with the recycled materials (also called secondary materials) as inputs to the end-users' production processes

- The degree and location of demand for products produced from the recycled material

Markets are seldom static and demand may increase or decrease quickly and unpredictably. Changes in demand are generally reflected in the price end-users will pay for material, and in the quantity bought and sold over time. Market capacity, the quantity of a recycled material that can be sold at a profit to end-users, is thus a function of a number of interdependent short- and long-term factors. This analysis of market capacity examines the ability of markets to consume growing volumes of material from Washington State recycling efforts. Projections of increased market capacity are based on past stability and growth, current consumption and known potential for expansion.

Price for a recyclable material is a function of the quantity of material being bought and sold, its quality (the degree to which it meets end-users' specifications), its location and the buyer and seller's relationship. Not every community or recycling operation can expect to be paid the same price for the same material on any given day. Further, prices for some materials fluctuate dramatically (e.g., recycled paper), while prices for others such as tin remain more stable. Prices for some materials, for example non-ferrous metals, closely follow world market values, while prices for others, for example, Northwest Newsprint, are more influenced by regional factors.

Price and commodity value (total transactions revenue) figures presented in this chapter are based on estimates and are intended to be used only for planning. Reported end-user price figures have been judged by those most knowledgeable with the commodities to be representative for the time period. The complexities of end-user pricing strategies, and the varying levels of middleman brokering made a statistically based survey to identify average actual transaction prices impractical given the scope of the Best Waste Management Practices Project.

Further, this analysis is restricted to an examination of markets for those post-consumer materials normally found in the municipal solid waste stream. These materials are recyclable because of the existence of, or potential for, end-user markets. This means that there must be a practical means of removing them from the waste stream and furnishing them to end-users in a condition of value to those users.

Recycled materials have value to end-users or manufacturers because these producers can mix primary (virgin) and secondary (previously used/recycled) materials as inputs in their production processes. Some facilities may be restricted to using one or the other. Such limitations determine the ease with which new volumes of recovered materials can be substituted for primary resources.

The category of "secondary materials" needs further definition. Waste from industrial processes is often recycled as a secondary material. For example, paper trimmings from printers are normally sent back to a paper mill to be incorporated into new pulp and do not become part of the municipal waste stream. Other items outside of the municipal waste stream currently

recycled by end-users are car hulks, railroad ties, and forest products industry waste. These are not considered as post-consumer materials within the scope of this study, although data on recovery volumes will often include such items.

2. METHODOLOGY

Information for the Market Capacity study was gathered from a number of sources:

- End-users for various commodities were identified through the consultants' files, industry associations, published sources and phone contacts. End-user surveys supplied information on the current use of post-consumer secondary material and on the end-users' capacities and plans for future use of recycled material. These surveys were also helpful in identifying market trends, transportation requirements, and current as well as past prices for recyclable waste materials.

- Recently published reports on markets for key recyclable commodities prepared for Northwest communities were reviewed.

- Current recycling data obtained by The Gilmore Research Group for a concurrent Washington Department of Ecology study were evaluated.

- Commodity focus groups for glass, paper, metals, plastics, and organic materials were formed by the Washington State Recycling Association (WSRA) to provide important information on current market conditions and to review preliminary market data. These groups were composed of industry executives, end-users, and others knowledgeable about the particular commodities. A WSRA Technical Advisory Group also was called on to provide insight into market functioning.

- Historical data on end-user transactions in the U.S. were analyzed.

- WGA-recovered material quantities and prices were analyzed econometrically.

The information obtained through these investigations is discussed below.

3. EXISTING AND NEAR-TERM FUTURE CONDITIONS

a. Paper

Paper and metal dominate the volume of material currently recovered through recycling. Some recycled paper is commercial or industrial scrap such as mill trimmings, cardboard clippings from box manufacturers, overrun newspapers and scrap from printing operations--all materials with ready markets

because of their consistent quality and availability. As previously mentioned, these industrial scrap materials will not generally be dealt with in this analysis; although consumption and volume estimates may of necessity include some of these materials.

There are four categories of paper fiber which account for the great majority of post-consumer recyclable paper. The Paper Stock Institute of America has established grades for more than forty types of secondary paper; however, most of the post-consumer paper supplies will fit within one of the four grades to be discussed.

In 1987 approximately 17.2 million tons of these four grades were consumed by U.S. mills (end-users). This included:

4.2 million tons of newspaper	24%
9.2 million tons of corrugated containers	53%
1.7 million tons of high-grade office paper	10%
2.1 million tons of mixed waste paper	12%

These totals include some industrial scrap.

In the same year, the United States exported 4.2 million tons of these same grades with the majority going to the Far East and smaller percentages going to Mexico and Canada (22% news, 45% corrugated, 13% high-grade and 20% mixed grades).

These figures indicate that, nationally, 80% of U.S. recycled waste paper is consumed by domestic mills. Domestic consumption of all waste paper has increased steadily over the last 5 years at the rate of 4 or 5% per year. In addition, national export volumes have doubled in the last 5 years. In the Northwest, domestic consumption of these combined paper grades accounts for about 75% of recovered paper fiber; with more export than domestic consumption of both mixed waste paper and high-grade office paper. Clearly, the export market is important in the consumption of waste paper.

Of the approximately 700 paper mills in the United States, about 200 use scrap paper exclusively and another 300 use a mixture of scrap paper and virgin pulp. These end-users are supplied by over 2,000 waste paper dealers who purchase paper from innumerable paper drives, curbside collection programs, waste haulers, independent collectors, waste processing plants, and commercial businesses.

(1) Newsprint

(a) Material Description

Post-Consumer recyclable newspaper typically includes old newspapers as well as some glossy paper used in advertisements. Over 91% of the recovered newspaper in the Northwest is used in the manufacture of new newsprint. About 2% is used in the manufacture of paper board and another 2% in the manufacture of cellulose building insulation. The remaining 5% is used for making specialty products such as fruit packing trays or molded flower pots.

(b) Major End-Users, and Export Shipment Points

The major domestic end-users of old newspapers from the State of Washington are:

- Keyes Fiber in Wenatchee
- Michelson Packaging in Yakima
- Sonoco in Sumner
- Smurfit Newsprint Corporation in Newberg and Oregon City, Oregon

The Oregon plants produce new newsprint, while the Sumner plant makes linerboard, paperboard, and box board. Some paperboard and linerboard is also manufactured from old Washington newspaper by the Paperboard Industries Corporation in Vancouver, British Columbia. Keyes Fiber and Michelson produce insulation and specialty products as do plants in Spokane and Seattle.

Northwest end-users also receive some of their old newspaper supplies from as far away as Montana, Colorado and Southern California. In addition to supplying the regional market, a significant amount--about 30%--of Northwest old newspaper is currently being exported.

Exports of old newspaper from Puget Sound are significant; about 49,000 tons per year. Another 17,000 tons per year are exported out of the Columbia and Snake River Export District (primarily Portland, Oregon). These figures, reported by the U.S. Department of Commerce, do not include old newspaper which is exported under three paper categories such as mixed waste paper. They do include newspaper exported from Puget Sound but coming from other regions of the U.S.

(c) Transportation and Handling

Newspapers collected through recycling efforts are often sorted and baled by a local processor and then shipped to an end-user. If an end-user is located near the point of collection, less effort and expense may be involved in preparing material for shipping, depending on the requirements of the particular end-user. Paper dealers or brokers often coordinate shipments and purchases for end-users.

To receive the highest price for old newspaper at a mill, the papers generally must be sorted and baled. This may not be true if the material is going to an insulation or specialty manufacturer. But before being accepted for de-inking, contaminants have to be sorted out; this generally occurs at a processor near the area in which the material is collected. Sorting and baling of old newspapers costs as much as $25 per ton, depending on the type of machine used and the volume handled.

If this processing step does not occur, the material may still be marketed, but at a lower price. A decision must often be made for each lot as

to whether there is an adequate concentration of recoverable newspaper to warrant the costs of sorting. One option increasingly considered for newspaper, as well as other categories of waste paper, is that of exporting "super" mixed grades overseas where they can be sorted at a reduced labor cost.

Transporting old newspaper to the major mills is usually paid for by the end-user. For many areas of the State, transportation costs, therefore, will not reduce the price recycling programs can expect to receive for their material. Transportation costs do affect the marketing costs for supplies of newspaper which are exported or which come from areas of the State without sufficient volumes to produce full-sized loads for shipment.

(d) Material Consumption, Price, and Value

Approximately 167,000 tons of newspaper were recovered from Washington State in 1987, and 49,000 tons were exported. These figures are estimates because some end-users get their supplies from a number of states besides Washington and are unable to give precise figures for each state. Also, a portion of the export volume originates outside of Washington State.

In the fourth quarter of 1987, end-users were paying $80 to $90 per ton for old newspapers. Current Northwest prices (fourth quarter 1988) are between $40 and $50 per ton. Recent increases in old newspaper supplies on the East Coast, as a result of new mandatory recycling programs, as well as demand side factors, have resulted in these major price drops. The newspaper market will probably remain soft in the near-term future. Prices in the next year or two could potentially be lower than at present. At $45 per ton, the value to end-users of recycled newspapers from the State, given 1987 recovery volumes, is $7.5 million. The value of newspaper to recycling programs after adjusting for sorting and baling costs is roughly $2.8 million.

(e) Market Barriers and Constraints

Recently, Smurfit Newsprint Corporation announced plans to switch a portion of its process from using old newspaper as feedstock to using old magazines (mixed waste paper). This change is believed to be in response to consumer demands for a brighter, stronger product (the fiber in magazines is a higher-quality, longer fiber than that found in old newspapers).

It is too early to determine whether this may signal a trend among other newsprint producers. Although such a change would mean reduced demand, it is expected that local mills would reduce their consumption of old newspapers from outside the region in preference to Northwest supplies. Currently, mills are using the maximum amount possible of old newspaper, given their existing processes and equipment. Some plants are considering expanding their capacities to use old newspapers.

A number of constraints affect the demand for old newspapers to be recycled as insulation:

- Cellulose insulation is used as a blown-in insulation in older houses of which there are a limited number.

- Other types of insulation, such as fiberglass or foam, compete with cellulose insulation.

- Energy prices and supplies also affect the decisions of consumers to purchase insulation.

Repeated recycling of cellulose fibers may, by shortening fiber length, reduce the value of recycled materials for some uses, such as paper products. Currently, however, this is not a concern in the U.S. The increasing export demand for all waste paper is caused in part by the need in foreign countries to replenish the existing fiber stock with previously unrecycled materials.

(f) Market Capacity and Demand Projections

The market price for old newspaper in the 4th quarter of 1988, is weaker than it was a year ago. A number of market observers are attributing recent price decreases to an increased domestic supply of newspaper created by anticipated seasonally high collections and a temporary reduction in foreign exports, as well as newly implemented mandatory recycling programs in the eastern U.S. The market impacts of the first two factors will be short lived, but uncertainties remain over the impact of the new recycling volumes on national and international markets and the ability of existing facilities to consume potentially rapidly increasing supplies. Within the next 4 years, a new plant capacity in Georgia as well as increased capacity in Japan, Korea, Taiwan and Hong Kong will allow for an increased annual newspaper consumption of 600,000 tons per year. Depending on the rate of increase, there may be a lag before new capacity is able to consume larger volumes of waste newspaper.

Regional mill capacity for old newspapers collected in Washington State appears stable and adequate if supplies from outside the region are displaced. The increasing export market has recently served to stabilize regional prices. However, export demand may be reduced by the marketing of new tonnages from the East Coast. Currently, demand throughout the State is stable and should accommodate increases in supply resulting from new recycling efforts. Price impacts of increased national supplies are discussed later.

(g) Waste Generation Area Considerations

- Although some of the smaller end-users, such as those making cellulose insulation or other specialty products, have limited regional influence on old newspaper consumption; they may be the major consumer of old newspaper for particular WGA's. Prices paid and handling requirements may be different in these areas.

- Areas with lower population may receive a lower net price because of the additional transportation costs incurred by trading in smaller volumes.

- Areas with better access to export markets may have more flexibility in marketing old newspaper.

(2) Corrugated Containers

(a) Material Description

Corrugated containers (or OCC - for old corrugated containers) include Kraft linerboard or containerboard cartons and shipping boxes with corrugated paper medium. Kraft (brown) paper bags are commonly included in this material because they can be recycled with corrugated containers. Cardboard boxes with waxed coatings are not recyclable by end-users serving the Northwest. Products manufactured from old corrugated containers include corrugating medium and linerboard (the inside and outside parts of corrugated boxes) as well as new Kraft bags.

(b) Major End-Users and Export Shipment Points

There are six major end-users for old corrugated containers in the Northwest. The Container Corporation of America in Tacoma and Sonoco Products in Sumner each utilize old corrugated containers in the manufacture of boxboard, linerboard, and paperboard. In Oregon, Georgia Pacific in Toledo, Weyerhaeuser in North Bend, and Willamette Industries in Albany produce corrugating medium, Kraft paper, and linerboard. Paperboard Industries Corporation in Vancouver, British Columbia produces linerboard and corrugating medium.

Consumption of corrugated containers at paper product mills within Washington State is currently 76,000 tons per year. Oregon consumption is approximately 370,000 tons per year. Both states anticipate some growth in plant capacities to use OCC during the next two years.

The majority of corrugated material exported from the Northwest goes through Puget Sound (96%) with the remainder exported from the Columbia-Snake River Export District. Fifteen to thirty percent of the old corrugated containers collected by Northwest recyclers are exported. As with newspaper, the uncertain origins of some of the recycled OCC make it difficult to pinpoint the exact amount coming from Washington State. Some supplies utilized by Northwest end-users come from as far away as 1,000 miles. It is likely that some material coming from that distance also is exported from here.

(c) Transportation and Handling

As with newspaper, costs for shipping old corrugated containers to a regional mill are paid for by the end-user (through a freight allowance), when sufficient quantities of acceptable material are supplied. It may be necessary to consolidate supplies from a number of programs or communities in order to collect sufficient quantities. As a result, an additional transportation cost is incurred in some areas of the State. It is important to note that the mill freight allowances, which are provided for most types of the higher value papers coming from as far away as the Rocky Mountain states, could change if supplies closer to the mills, in Washington State for example, increase or if the market price of the material decreases.

Supplies destined for export do not receive a freight allowance and the cost of moving this material to market is paid by the seller. As a

result, supplies most likely to be exported are those collected closer to export shipping points.

Generally, source separated corrugated containers do not require any sorting or processing other than baling. Within recycling operations, Kraft bags are often kept separate from other types of corrugated containers since they can be sold at a higher price. Standard baling costs for paper products are between $20 and $30 per ton. It is critical to the value of the material that it be kept dry and free of contaminants.

(d) Material Consumption, Price, and Value

Estimated recovery of post-consumer corrugated paper products from Washington State in 1987 was 288,000 tons, including exports. At a current end-user price of around $65 per ton, the value of the 1987 recovery volume for corrugated containers to end-users and exporters is approximately $18.7 million. Deducting the costs for baling, which most recycling programs or buy back operations must pay, the value of material collected from recycling programs, prior to processing and handling is roughly $11.5 million. Over the last 5 years, prices paid for OCC by end-users have steadily increased; ranging from $40 per ton to $115 per ton. However, as with other grades of waste paper, current prices have fallen from the high prices paid in the last quarter of 1987.

(e) Market Barriers and Constraints

Markets for corrugated paper products are strong. Consumption capacity has been a barrier. Most mills are currently using all of the old corrugated containers they are able to obtain. Development of new regional capacity in 1989 to consume OCC will increase the demand for this material, and it is likely that supplies will have to be obtained from outside the region. The Washington State Use Tax was identified as one stumbling block to the corrugated container market.

(f) Market Capacity and Demand Projections

The outlook for the corrugated container market in the Northwest is generally bright. The opening of a new facility in Longview, Washington in 1989 by Longview Fibres will increase the regional capacity for consuming corrugated containers by 10 to 15%. New OCC consumption capacity will soon be available in British Columbia, Montana, and Arizona, as well.

The export market for the material seems also to be growing, providing additional capacity, and stabilizing prices. Increasing worldwide demand for corrugated containers and expansion of plant capacity in other countries also contribute to near-term optimism regarding this material.

(g) Waste Generation Area Considerations

- Areas with lower population may receive a lower price because of additional transportation costs for trading in smaller volumes.

- Areas with better access to export markets may have more flexibility in marketing old corrugated containers.

(3) High-Grade Paper

(a) Material Description

High-grade paper includes a variety of grades of printing, writing and computer papers. White ledger, colored ledger, computer printouts, computer paper, computer tab cards, bond and copy machine paper are all types of high-grade paper. "High-grade" refers to a wide variety of papers with a range of prices from moderate to high in comparison with other grades of recycled paper.

For the purposes of end-users, there are two major categories of high-grade papers: pulp substitutes and de-inking grades. Pulp substitutes, such as unprinted groundwood papers, have a higher value than printed groundwood papers, and can be used, with limited preparation, by almost any paper mill. New recycling programs rarely increase the recovery of pulp substitute because where these supplies exist in sufficient quantity, they are already being collected. Many of the pulp substitute grades are produced from plant scrap material rather than papers from the post-consumer waste stream. De-inking grades of office paper, such as used photocopy paper, are highly valuable but require specialized treatment to remove ink and other contaminants prior to use as a feedstock. Different mills have varying capabilities for dealing with the grades and types of de-ink office papers.

High-grade paper is primarily used in the manufacture of sanitary paper or tissue products. Some high-grade paper fiber is also used in the manufacture of new printing and writing paper, linerboard and paperboard.

(b) Major End-Users and Export Shipment Points

There are a limited number of Northwest end-users for the majority of high-grade paper recovered in the Northwest. In fact, the majority of Washington's high-grade paper is consumed in the Midwest or overseas. The Container Corporation of America in Tacoma and the Scott Paper Company in Everett use some high-grade paper for producing, in decreasing quantity, boxboard, linerboard or paperboard and tissue paper. In Oregon, the Springfield Weyerhaeuser mill uses some high-grade paper for producing linerboard, as does the Paperboard Industries Corporation plant in Vancouver, British Columbia.

The major U.S. end-user of Washington high-grade paper is the Weyerhaeuser Company, which purchases a large volume of high-grade office paper to be sent to mills it operates in other regions of the U.S. The company conducts a large-scale office paper recycling program serving large generators of the material, specifically major office buildings. The program sets up desk-top source separation systems and collection routes for white ledger and computer paper.

An estimated 72,000 tons of secondary office paper are exported from the Northwest each year. Slightly over 70% of this leaves through Puget Sound. These export figures include some proportion of waste recovered outside of the Northwest as well as some paper which is not post-consumer. Office paper consumption from the Northwest is dominated by exports and shipments to other regions of the U.S. In the last 5 years, exports of recyclable office paper from the Northwest have more than doubled.

(c) Transportation and Handling

As with other paper products, transportation costs from the area of collection to a domestic mill are generally paid by the end-user of high-grade paper, if sufficient quantity is available and material standards are met. This is especially true for the higher grades of paper since they have more value. Shipment of high-grade paper by land to other areas of the nation is economically feasible because of the material's high value relative to other types of waste paper.

Because there are many distinct grades into which high-grade paper might be sorted to take advantage of higher prices, sorting high-grade papers can be very expensive, possibly as much as $20 to $40 per ton. If sorting or source separation is not done, a load of paper is likely to be priced at the value of the lowest grade of paper contained in the shipment. Baling adds an additional cost of $20 to $30 per ton for recycling programs.

(d) Material Consumption, Price, and Value

The best estimate available on volumes of post-consumer high-grade paper recovered from Washington State in 1987 is about 49,000 tons. (This figure comes from a survey of both brokers and end-users.) This total includes a portion only of the Washington volumes shipped to other areas of the nation. Consumption of high-grade paper fiber material by Washington and Oregon mills is about 114,000 tons per year. Exports from Puget Sound are about 53,000 tons per year. Both of these totals include major portions originating outside of the region as well as some plant scrap waste paper which is not considered post-consumer for the purposes of this report.

Depending on the specific composition of high-grade waste papers, end-user prices range from $75 to $220 per ton. For the most typical post-consumer high-grade paper, such as white ledger paper, a price range of $80 to $120 per ton is most representative and a $100 per ton is a reasonable estimate of what end-users will pay. At the current market prices, the value to end-users of high-grade paper recovered from Washington State in 1987 was approximately $4.9 million. The value to recycling collection programs before handling and market preparation expenditures was about $2.2 million.

(e) Market Barriers and Constraints

Mills in the Northwest have reported plans to decrease their use of high-grade paper by as much as 6,000 tons per year between now and 1990. However, since there is an increasing national and international market for the material, this should not be a problem for Northwest supplies.

When wood pulp prices are close to high-grade prices, as they were in the 4th quarter of 1987, there are less significant operational savings to mills that use recycled office papers rather than virgin pulp. However, when a mill needs to add capacity, the capital cost of doing so to accommodate recycled fiber (pulp substitute grade) is approximately one-tenth the cost of adding virgin pulp capacity.

A primary market barrier to recovering more office paper is seen at the processing level; the cost of removing contaminants and sorting is very high.

The expanded use of laser printing and other new technologies have reduced the recyclability of some office paper, such as computer printouts, because the different inks and toners used may not be removed through existing de-inking processes. This obstacle can probably be overcome through increased sorting or modification of de-inking capabilities.

(f) Market Capacity and Demand Projections

As noted, the high-grade paper market is national and international in scope and both domestic and foreign demand are increasing. Overall, the market for this material is excellent and there should be no difficulty in using increased supplies resulting from new recycling efforts in Washington State.

(g) Waste Generation Area Considerations

- The primary end-user, Weyerhaeuser, has developed an effective source-separation and collection network in larger urban areas. This system will probably not expand into areas with relatively few office-type businesses.

- The efficient generation of high-grade waste paper is a function of population density. Some areas of the State may not enerate quantities of this material sufficient to make large-scale recycling efforts profitable. Potentially, a number of smaller communities could cooperate to develop the necessary processing capability.

(4) Mixed Waste Paper

(a) Material Description

Mixed waste paper includes low grade paper such as magazines, books, scrap paper, non-corrugated paperboard (boxboard/chipboard) and construction paper. Occasionally, shipments of higher-grade paper, such as old newspaper, may be classified as mixed waste paper if significant amounts of lower-grade paper are incorporated.

Special subcategories of waste paper, such as used phone books or blue prints, are also included in this designation. If sufficient quantities of special papers can be collected, end-users will often use them, if arrangements on delivery specifications and schedules can be made.

Lower grades of paper such as carbon paper, tissue, contaminated paper food cartons, wax paper and waxed cardboard are not presently considered recyclable in the region, and are considered contaminants in shipments of mixed waste paper. There may be some end-users elsewhere in the country who accept some of these materials. Mixed waste paper is used in the production of boxboard, construction paper and paperboard products.

(b) Major End-Users and Export Shipment Points

Sonoco Products in Sumner, the Container Corporation of America in Tacoma, and the Paperboard Industries Corporation in Vancouver, British Columbia both use some mixed waste paper in the production of paperboard and related products. The material is also used by cellulose insulation manufacturers in Spokane and Seattle.

Exports by various brokers currently dominate the Northwest market for mixed waste paper (about 68,000 tons per year with 78% leaving from Puget Sound). The majority of these supplies reportedly are destined for South Korea and Taiwan. Some export buyers do additional hand sorting, using inexpensive overseas labor, so that some higher-grade paper fiber can be recovered.

As mentioned in the discussion of newspaper markets, the Smurfit Newsprint Corporation plant in Newberg, Oregon anticipates substituting magazines (a mixed waste paper) for waste newspaper as a major feedstock in its newsprint production during 1989. This could provide a significant increase in the regional mixed waste paper demand--up to 77,000 tons per year.

(c) Transportation and Handling

Because of the low value of this material in relation to other types of waste paper, and because of the absence of mills in the region which use large amounts of mixed waste paper, freight allowances are unlikely to be paid by buyers of this material. Transportation tariffs for in-state shipment of mixed waste paper are between $.07 and $.18 per ton per mile, depending on shipping points.

Mixed waste paper received from recycling programs must generally be sorted before being baled and shipped to remove contaminants. As with other waste paper, sorting and baling costs $20 to $30 per ton. For domestic shipments, careful sorting is especially important to ensure that loads are not rejected.

(d) Material Consumption, Price, and Value

An estimated 34,000 tons of mixed waste paper were recovered from Washington State in 1987. About 7,500 tons per year of mixed paper are consumed by Washington mills. Reported exports of mixed waste paper from Puget

Sound are 53,000 tons per year. It is likely that some mixed waste paper enters the State from elsewhere to be used by mills or exported, and that some exported materials are recorded as mixed waste paper when they may consist of other grades as well.

End-user prices for mixed waste paper fluctuated during the last few years, ranging from $10 to $45 per ton. During the past year, mixed waste paper prices fell from a high of $45 per ton in the fourth quarter of 1987 to the present average of about $25 per ton. At $25 per ton, the estimated value to end-users and exporters of mixed waste paper at 1987 recovery volumes is about $0.9 million. After deducting sorting, baling, and other handling costs, the profit potential of mixed waste paper is probably now around $0; that is at current market prices, mixed waste paper recycling is a break-even proposition.

(e) Market Barriers and Constraints

Because of contaminants, it is often difficult to process post-consumer mixed waste paper economically and still meet market specifications. A few operations which formerly extracted mixed waste paper from the waste stream have discontinued their efforts because of recent low prices. Some mills consider it impractical to invest in lines for dealing with mixed waste paper when prices are volatile and long-term supplies are not assured.

To increase domestic demand for mixed waste paper, new uses must be considered, such as the Smurfit plan to substitute magazines for old newspaper in the production of newsprint. The cellulose fibers in mixed waste paper generally have less strength than those of higher-grade papers. However, the material has attributes which may make it useful in other applications.

Increased disposal costs have prompted East Coast processors to begin selling their mixed waste paper on the West Coast or in the Far East. This is considered practical for East Coast supplies even with increased transportation costs, which may exceed the market price of the material, since the cost of disposal is avoided. Competition with these supplies on foreign markets may mean less demand or lower prices for Washington mixed waste paper.

(f) Market Capacity and Demand Projections

The current market for mixed waste paper is poor. Most of the increased demand in recent years has been in the export market but this demand has not been consistent or predictable. Some new demand may develop in domestic markets, but it remains to be seen whether this development will warrant expanded recovery efforts.

Increased recovery of mixed waste paper must be accompanied by a marketing strategy that stresses alternatives. This may involve securing long-term orders, developing new markets or using the material as a fuel. Disposal cost avoidance may become a primary motive for some regions; this could affect the economics of mixed paper recycling for those currently recovering the material for its positive value.

(g) Waste Generation Area Considerations

- Urban areas with ready access to export markets have better opportunities to sell greater volumes of mixed waste paper.

- The goal of diverting material from a landfill and avoiding disposal costs may make recovery of mixed waste paper particularly appropriate in some areas of the State.

b. Glass

Post-consumer glass consists of three types: container glass, refillable glass containers and non-container glass, much of which is currently not recycled. All glass is originally produced using some of the earth's most common materials: silica sand in combination with soda ash and limestone. In making glass containers, these materials are mixed and melted in a furnace. The glass then flows to molding machines which form the containers. Glass bottles are then annealed for strength, inspected and shipped.

When broken for recycling, container glass and refillable glass pieces are called cullet, cullet can be melted to form new glass containers, glass beads or glass fibers. In the Northwest, only new glass containers are made from cullet. Refillable glass containers may contain a bit more glass per bottle than non-refillable containers and receive a special treatment to handle repeated capping and reuse. Glass cullet comes in three colors: green, brown (amber) and clear (flint). The marketing of cullet requires that the glass colors be separated since new clear bottles cannot be made using any significant amounts of brown or green cullet in the mix.

In the United States, there are more than 100 glass container plants in 31 states and most of these use some cullet. Cullet can be substituted for a high percentage of the raw material used in manufacturing new containers. Typically, container manufacturers use a 10% to 30% cullet content in their mix; however, cullet can be used in proportions of 50% to 60% or higher for certain colors of glass. Some plants in Europe use up to 90% cullet, but this affects product quality and durability.

Because of several factors--the presence of glass container plants throughout the nation, a low value-to-weight ratio for cullet as well as the ready availability of raw materials--little cullet is shipped beyond the region of origin. Although most of the cullet used in Northwest plants comes from Washington, Oregon and Idaho; some users obtain materials from Montana, Alaska and British Columbia.

The production of flat, pressed, or blown glass products--such as light bulbs, window glass, auto glass and ceramics--incorporate other materials or require different production processes and temperatures. These differences in composition do not allow these types of glass to be recycled in the same way as container glass. The new Fibres International facility in Seattle (described below) may undertake a program to recycle some of this

glass by marketing it out of state to be converted into fiberglass insulation or air filters. This operation would probably focus on commercially generated glass, and would likely charge a disposal fee.

(1) Container Glass - Cullet

(a) Material Description

This category includes recyclable food and beverage containers such as pop, beer, juice and wine bottles as well as pickle jars, baby food jars, medicine bottles, ketchup bottles, and similar containers. In the Northwest, cullet is used in the production of new clear, brown or green glass containers.

(b) Major End-Users and Export Shipment Points

Ball-Incon in Seattle and Owens-Brockway in Portland, Oregon are the two Northwest end-users of cullet generated in the region. Generally, cullet from the Puget Sound and northwest Washington regions goes to Ball-Incon, while cullet from eastern Washington and southwest Washington goes to the Portland plant. In the past, both plants have received the majority of their cullet directly from post-consumer sources including recycling programs, drop-off and buy-back centers, beverage deposit systems, and buy-back operations at the plant.

Ball-Incon recently arranged to have Fibres International operate a mechanical cleaning system and supply all its cullet. Both facilities will now have the ability to remove lids and labels which have presented problems in the past for the Seattle plant.

There is currently no significant export market for cullet. There have been attempts at shipping cullet overseas and some suggestions that future export markets could develop. An occasional shipment of excess green glass from the Northwest to California may occur due to a weaker regional demand for that color of container, but this is not usually economically attractive.

(c) Transportation and Handling

The segregation of cullet colors is of primary importance to end-users. There is minimal demand for glass which has not been color separated. Crushing or breaking of glass containers is normally done as a means of achieving greater density before shipment. If consistent color separation cannot be maintained, then glass containers collected for recycling are better left unbroken so as to facilitate hand separation later. End-users require that no window panes, ceramics, rocks or other contaminants be included in cullet shipments. This means that recycling programs must be set-up to handle three separate colors and prevent contamination. End-users can deal with labels left on glass containers.

Both end-users provide partial freight assistance for shipments from outside of their local areas. Transportation is often by rail or self-unloading trucks. Because of the low value-to-weight ratio of glass, it is best to ship color-sorted crushed or broken cullet rather than whole jars.

The cost of handling, storing and crushing color-separated glass in preparation for shipment is about $20 per ton. Shipping glass within the State costs between $.07 and $.31 per ton per mile, and it can be assumed that the end-user will assume about half of this cost if the material is clean and in sufficient volume.

(d) Material Consumption, Price, and Value

About 22,000 tons of cullet were recovered from Washington State in 1987. Recovery levels have been growing somewhat since the mid-1980's. Potential regional cullet consumption capacity provided by the two plants is about 70,000 tons per year, including supplies which may come from outside Oregon and Washington.

The current price paid by end-users is about $40 per ton. This price has held fairly steady for the last five years. Smaller shipments (less than one or two tons) may receive a lower price. No dramatic changes are expected in this price, although it could improve slightly as the consistency and quality of the supply increase.

The value to end-users of the cullet recovered from Washington State in 1987 is estimated at $.9 million at current market prices. Deducting handling and processing costs prior to shipment, the value of the 1987 recovery volume of cullet to recycling programs was approximately $.4 million.

(e) Market Barriers and Constraints

The need to remove contamination from cullet supplies has been a barrier in the past for the Seattle end-user. However, this situation should improve with the opening of the Fibres International processing facility in early 1989. A consistent supply of quality cullet should allow both plants to utilize increasing amounts of the material.

There is more green cullet available in the Northwest region than is needed to manufacture new green containers. Increased interest on the part of the Northwest wine industry in green bottles could help the market.

Both Northwest end-users, and the glass industry in general, have an interest in using greater proportions of cullet. Their ability to do so is somewhat limited by the electric furnaces used for a portion of their production. Gas furnaces can use greater percentages of cullet but are expensive to install.

In the market for new containers, glass must compete with alternatives such as aluminum, steel and plastic. If the glass container market were to decline through a displacement by other material containers in the consumer market, the demand for cullet would also decrease, other demand-side factors remaining constant.

(f) Market Capacity and Demand Projections

Continuing market demand is probably not a limiting factor in allowing increased recovery of glass cullet. Existing end-users appear willing and able to consume twice their current amount of cullet by increasing the

proportion of secondary materials in their mixes (currently between 30% and 45% depending on color), especially if the supply is consistent. Beyond this, investments in new furnaces could provide for even greater cullet consumption capacity.

(g) Waste Generation Area Considerations

- Freight assistance currently provides most WGA's with reasonably equal access to end-users.
- Areas with lower population may receive a lower price because of additional transportation costs and generally lower prices paid for smaller volumes.

(2) Refillable Glass Containers

(a) Material Description

Refillable glass containers in Washington State are now primarily beer bottles. Refillable soft drink bottles have all but disappeared, there were less than 2,000 tons of them recovered in Washington State in 1987. There are two types of refillable beer bottles: "consumer bottles," which are sold through retail outlets; and "deposit bottles" (long necks) which are utilized in taverns.

Deposit bottles are generally kept out of the waste stream because tavern owners pay distributors a refundable deposit of $.02 per bottle. These bottles must be returned to the brewery from which they came by distributors or wholesalers. Some deposit bottles are sent back to California or even the Midwest to be refilled a number of times. For greater durability, deposit bottles are normally constructed of heavier glass than consumer bottles or non-refillable bottles.

Consumer beer bottles sold through grocery and other stores do not carry a deposit but generally have value for those consumers who return them to a buy back center or the brewery from which they came. The consumer refillable bottle first appeared in the early 1970's and has been a key material, along with aluminum cans, in the viability of many buy back operations. These consumer bottles are more durable than non-refillable glass containers and are refilled an average of six times.

(b) Major End-Users and Export Shipment Points

The bottles handled by the many distributors who participate in the deposit bottle system will not be considered here. These bottles generally do not enter the municipal solid waste stream and do not affect Northwest recyclable materials markets except in their supply side impact on the container market.

The Rainier Brewing Company, Olympia, and Pabst are currently the major producers and users of consumer bottles in Washington. Other Washington

State breweries have had consumer bottle programs in the past. Rainier indicates that the program has been popular, but that it does not mean that it is less expensive than non-refillable bottle production. Refillable bottles are more costly to manufacture and must be stored and cleaned after being returned to the plant. Approximately 50% of consumer bottles are returned.

(c) Transportation and Handling

Transporting refillable consumer bottles to the Seattle plant can be a constraint for recyclers, especially if they are further than 50 miles away. Storage and handling of refillable bottles also presents some problems since they cannot be handled as bulk commodities but must be managed in individual cases or on pallets. Beer sales and returns of bottles to buy-back centers both tend to be somewhat seasonal in nature requiring more storage space at certain times of the year than at other times.

Transportation and handling costs range between $.20 and $.50 per case or about $50/ton (assuming 146 cases per ton). Due to the difficulty in handling refillable bottles, some bottles are recycled as cullet rather than returned for reuse. Some refillable bottles are collected through curbside recycling programs to be recovered as brown cullet. Recycling refillables as cullet reduces the value to recyclers by about 30%; however, handling costs are also reduced. As cullet, a refillable container may be worth about one cent rather than the one and a half cents it would be worth if taken to a buy-back center.

(d) Material Consumption, Price, and Value

It is estimated that the 1987 recovery of refillable bottles in Washington State was about 21,000 tons. This includes deposit bottles and consumer bottles. About 5,000 tons of these were deposit or tavern bottles.

The value to end-users of these bottles is estimated at $.80 per case or $116 per ton. The annual value of these returned bottles would be no more than $2.4 million if they were all consumer bottles. Deducting handling costs, the value of refillable bottles to recycling programs would be no more than $1.4 million at 1987 recovery volumes.

Consumers taking refillable bottles to buy-back centers are usually paid $.30 to $.40 per case or around one and one half cents per container. This price varies with location since the buy-back operator must pay the costs of transporting the bottles to Seattle.

(e) Market Barriers and Constraints

There has been a shift in the last few years away from the consumer refillable bottle. The brewery industry in some cases has moved to aluminum cans or other sizes and types of bottles. Consumer acceptance of the container is a major consideration in a bottler's decisions about the type of bottle to use.

As has been mentioned, transportation and handling problems present some barriers to the reuse of refillable beer bottles. Deposit or tavern bottles seem to have a stable niche because of distributor and wholesaler collection networks.

(f) Market Capacity and Demand Projections

Refillable consumer bottles have, for the last 15 years, been one of the key contributors to the viability of small buy-back recycling facilities around the State. These bottles may gradually become less of a mainstay in the industry, however, since there is a shift by bottlers towards producing mostly non-refillable containers. Therefore, the market may disappear. Refillable bottles, of course, may be recovered as amber cullet for which there is a healthy market.

(g) Waste Generation Area Considerations

- For areas of the State more than 50 miles from Seattle, transportation costs can make the handling of refillable consumer bottles a marginal proposition. These bottles are generally, therefore, currently being recovered in areas where buy-back operations are feasible. In 1987, at least some quantity of refillable bottles was recovered from each WGA.

- Areas of the State considering curbside collection programs, should assess the impact of such a program on the refillable bottle market, since residents may be more likely to put these bottles at the curb than to deliver them to the buy-back network. Typically, handling of curbside-collected materials does not allow for the sorting out of refillable bottles from other container glass recovered as cullet.

c. Metals

The municipal solid waste stream includes several grades of ferrous and non-ferrous metals. However, the recycling of metals is dominated by the processing of industrial scrap, material which traditionally is not part of the municipal waste stream. Though the scrap metal business does not internally distinguish between post-consumer and industrial scrap metals, industry representatives report that much less post-consumer material is handled than industrial. In contrast to paper recycling, where paper grades conform fairly closely to the distinction between post-consumer and industrial scrap, grades of metal do not conform to this distinction.

Post-consumer scrap metals include household items such as appliances, pop cans, tin cans, fixtures, bike frames, old window frames, plumbing parts, aluminum lawn chairs and certain automotive parts such as batteries and wheel rims. Post-consumer scrap metal does not include scrap from industrial or manufacturing processes or auto bodies.

The main types of scrap metals recoverable from the municipal waste stream include:

Ferrous Metals (Iron or Steel based)
- tin cans
- white goods (appliances)
- other ferrous scrap

Non-Ferrous Metals
- aluminum beverage containers
- aluminum, copper, brass, lead, zinc, and other miscellaneous metals

In 1986, over 65 million tons of ferrous scrap (the most abundant scrap metal) were consumed domestically in the U.S. while almost 12 million tons were exported. This material is supplied by approximately 1,000 scrap processing yards which receive material from industrial as well as commercial and residential sources.

Metals generally have a much higher price to weight ratio than other recyclable items and their price is usually given as dollars per pound rather than dollars per ton. It is very difficult to quantify volumes of the various metals recovered from post-consumer sources. As has been mentioned, end-users may not know exactly what proportion of their supplies are made up of items which could be considered post-consumer. Also, the metals market is very competitive and operators express a need to keep confidential information which could possibly be of value to other metals brokers or end-users with whom they compete.

(1) Aluminum (Used) Beverage Containers

(a) Material Description

Used aluminum beverage containers (UBC) include soft drink, juice and beer cans which are composed of a consistent and predictable alloy mix. Most used aluminum beverage containers from Washington State are purchased by primary aluminum producers and resmelted at a limited number of plants in the Midwest, South and Eastern United States. The material is reformed into stock for use by beverage producers in making new cans. In the recycling of UBC, new stock can be made using nearly 100% secondary material. Nationally, approximately 50% of the aluminum beverage containers produced are recovered. This amounts to 1.25 billion pounds per year.

(b) Major End-Users and Export Shipment Points

Major end-users of UBC from the Northwest include Alcoa Aluminum with resmeltering/delacquering plants in Indiana and Tennessee, Reynolds Aluminum with a plant in Alabama, and Kaiser Aluminum with a plant in California. As with secondary paper and paper/paperboard mills, not every aluminum smelter (there are some within Washington State) can use UBC as a feedstock because of the paint and lacquer which must be removed. Kaiser Aluminum recently reported that it would contract with International Mill Service to

resmelt UBC and painted aluminum at a sizable plant expected to open in the spring of 1989 in Idaho.

Some UBC is exported through Puget Sound and may account for as much as 20% of the regional end-use market. Official U.S. Department of Commerce records indicate that 123 tons of aluminum cans were shipped from Puget Sound in 1986. Some UBC which was shipped may have been recorded as aluminum scrap.

Existing collection systems within Washington State for UBC are well developed. Buy-back centers, recycling depots, scrap metal dealers, and the aluminum companies themselves are all involved in collecting UBC throughout the State. Consolidation of supplies to form railcar loads of UBC bales usually occurs in Seattle, Spokane, or Longview. The three major end-users each have operations within the State to collect materials or purchase lots from scrap dealers and brokers.

(c) Transportation and Handling

Because of its high value, transporting UBC across the country is very feasible once it is densified. The smelters generally pay freight costs once they take delivery in Longview, Spokane, Seattle, or some other location at which a railcar can be filled. In-state transportation can significantly increase costs for those who must take the material to one of these points unless they first densify it.

Baling is currently the method of densification used throughout the State. In the past, some shredding and blowing of cans into railcars was done but this is no longer practiced. The cost of producing the 600-1,000 pound bales depends on the baler and the throughput of cans, but is normally about $150 per ton.

End-users request that aluminum foil, aluminum bottle caps and other types of recyclable aluminum should not be included in supplies of UBC since they have a different alloy mix and are considered contaminants. (These lower value aluminum materials can be recycled as non-ferrous metals.) These materials don't generally affect the quality of the resmelting process, but the buyer would rather not pay for weight which does not contribute to the output volume.

The combination PET plastic and aluminum can which has been test marketed in some regions with a variety of products also presents a contamination problem for UBC end-users and shippers.

(d) Material Consumption, Price, and Value

Estimated recovery of UBC in Washington State was 11,000 tons in 1987. The current price paid by end-users at the point of shipment (Spokane, Longview, or Seattle) is around $.50 per pound. At this price, the estimated value of Washington UBC to end-users is $11 million at 1987 recovery volumes. Deducting a handling cost of $150 per ton, the value to recycling programs and buy-back centers of UBC prior to handling was around $9 million.

The price paid to those who deliver small quantities of used aluminum cans to a buy-back center is usually around $.30 to $.50 per pound. The difference between the end-user price and the street price is an indication of the extensive collection, handling and brokering system which has developed for this valued material.

The price of aluminum in real dollars has increased substantially in the last 20 years, although there have been periods of sharp price decrease. The most recent decline occurred during the fourth quarter of 1988, apparently as the result of end-users being oversupplied. The long-term real price increase has been due to greater demand from the increasingly industrialized markets overseas and the increasing cost of the energy needed to produce aluminum from primary ores. Significant price increases are not likely to occur in the next few years.

(e) Market Barriers and Constraints

If aluminum prices increase unacceptably, packagers of soft drinks and beer can modify their production lines to accommodate containers made from other materials such as steel, glass, or plastic. The demand for UBC could be affected if a major bottler made this switch and significantly reduced aluminum's share of the container market. At the same time, new uses for UBC product, such as liter-size containers and aluminum food cans, are being considered and even test marketed in other parts of the nation.

Aluminum UBC prices generally reflect the world demand for primary aluminum. Some third-world countries are implementing plans to increase their production of primary aluminum by 25%. This could drive down the price of UBC.

(f) Market Capacity and Demand Projections

Long-term supply appears to be the only constraint on additional consumption of used aluminum beverage containers. For the foreseeable future, indicators show that the UBC market will continue to be healthy, although prices may not continue as good as they were in mid-1988 (above $.70 per pound). As with refillable glass containers, used aluminum beverage cans have been a mainstay supporting the operation of many buy-back centers around the State.

(g) Waste Generation Area Considerations

UBC is marketable regardless of where it comes from in the State. Transportation costs may be greater from some areas to shipping points; however, this is normally a minor factor in relation to the material's price.

(2) Tin Food and Beverage Cans

(a) Material Description

Tin-plated food and beverage cans include soup cans, vegetable cans, juice cans, meat and fish cans and other cans made of ferrous or alloyed materials coated on the inside with tin. The tin plating, useful in protecting

the flavor and quality of the packaged food or beverage, is what makes this predominantly ferrous material worthy of special treatment and collection from the waste stream.

Tin cans collected through recycling programs are shipped to a processor who removes the tin plating by washing the cans in a caustic solution. This solution is then treated in an electrolytic process to recover pure tin. About six pounds of tin are recovered from a ton of scrap cans. The high-quality ferrous scrap recovered from the process can be reclaimed as well and represents about 80% of the value in every ton of recyclable tin cans.

(b) Major End-Users and Export Shipment Points

One processor, MRI Corporation, located in Seattle, processes all tin cans recovered in the Northwest. Though not strictly-speaking an end-user, MRI is the last point at which tin cans remain tin cans. Besides post-consumer tin cans, MRI also processes a significant volume of industrial scrap from canned food manufacturers or suppliers of can stock.

There are no exports of tin cans from the Northwest, though both tin and steel are exported. Some tins cans from overseas and from other parts of the U.S. are processed here because few other detinning operations serve this part of the globe.

(c) Transportation and Handling

Materials are transported to MRI by either railcar or truck. Given the large volume required to fill a rail car--30 tons minimum, most tin cans from recycling programs or buy-back centers arrive by truck. Rates for transporting flattened cans within the State vary from $.07 to $.31 per ton per mile. For supplies coming from more distant areas, a freight allowance is sometimes provided to develop and stabilize consistent supplies. Flattening and loose baling of the cans reduce the transportation cost, for this otherwise low value material, and also improve the detinning process. Unflattened cans can be handled, but receive a lower price. The cost of flattening and baling tin cans is about $20 per ton.

(d) Material Consumption, Price, and Value

Recovery of tinned cans from Washington State was estimated at 1,000 tons in 1987. This volume has been steadily increasing due to the implementation of new recycling operations. The price paid by end-users for tin cans, currently $49 per ton, has remained fairly constant over the last several years and is partially tied to the value of steel and tin on world markets.

The estimated value of tin cans recovered from Washington State to end-users was $49,000 in 1987 at current market prices. The annual value of tin cans to recycling programs in 1987 after deducting handling costs was $29,000 at current 1988 prices.

(e) Market Barriers and Constraints

The small volume and circumscribed value of tin cans currently being recovered make their processing dependent on maintaining stable operating costs. These processing costs could potentially be affected by regulatory changes (such as environmental controls or liability). Tin cans have a lower value than other recyclable commodities and buy-back centers often do not pay for them. They are not always perceived as recyclable, and this may limit the number of cans captured by those who do recycle.

(f) Market Capacity and Demand Projections

MRI indicates that, by increasing throughput, it can easily handle an additional 1,000 to 2,000 tons of tin cans per year without displacing any of its industrial scrap processing. This capacity should prove adequate to consume more tin cans than will be available in the foreseeable future from existing and planned Northwest recycling programs. However, the plant's size is inadequate to detin all tin food and beverage cans currently in the waste stream.

(g) Waste Generation Area Considerations

The costs of transporting tin cans from different areas of the State to Seattle is a primary consideration affecting the recoverability of this material. Generation of sufficient volumes to make transport economical is a related concern.

(3) Ferrous Metals

(a) Material Description

Ferrous metals include iron and steel (those metals to which a magnet will adhere). Typical post-consumer ferrous items are cast iron fixtures, toasters, bike frames and wheel rims. The majority of ferrous metals, such as car bodies, rail road track, materials from bridge demolition and iron scrap from industrial processes and manufacturing, have not traditionally entered the municipal waste stream to be landfilled because of scrap metal networks readily available to recycle these items. "White goods," old appliances, are basically a ferrous metal source; however, are considered separately given the special processing they require.

The miscellaneous ferrous material collected from the residential waste stream is normally self-hauled by residents to a recycling bin at a disposal facility or to a scrap yard or buy-back center. There are also a number of scrap collectors who pick up items from homes and businesses and deliver them to a scrap metal yard or broker.

Ferrous metals recycled in the Northwest are used in the production of reinforcing bar, light structural steel, railway track, plate steel, and cast iron or steel products.

(b) Major End-Users and Export Shipment Points

General Metals of Tacoma and Seattle Steel and Salmon Bay Steel, both in Seattle, are the primary end-users of post-consumer ferrous metals in Washington State. Oregon Steel in Portland also receives some ferrous material from Washington State. General Metals in Tacoma and Schnitzer Steel in Portland, Oregon are major Northwest exporters of ferrous scrap. In addition to these, there are other metals processors, foundries, and mills in the region which handle mostly or exclusively industrial scrap or car bodies. Car bodies account for the single largest source of ferrous scrap. All of the Northwest mills use electric furnaces.

The export market plays a major role in ferrous scrap markets all along the West Coast. In 1986, about 300,000 tons of ferrous metal were exported from Puget Sound. This total represents over 35% of the combined ferrous metals consumption and exports reported for Washington State. This recovery is primarily from industrial sources and does not account for interstate shipments. Korea, Taiwan and Japan are major buyers of Northwest scrap ferrous.

(c) Transportation and Handling

Each mill and scrap metal dealer has specific requirements for the type and condition of the material they accept. The scrap yard and metals broker network collects and delivers scrap metal to end-users and export markets. Handling costs vary widely depending on the type of facility receiving, storing, processing, or shipping the material and the volume of material managed. The cost of handling scrap ferrous is approximately $15 per ton.

Many post-consumer items contain a fair amount of ferrous metal in combination with small amounts of wood, cloth, plastic, glass, or other contaminants. Separating and breaking down many of these products (e.g., furniture, televisions and typewriters) is very labor-intensive and does not normally yield sufficient value. Some end-users will purchase scrap steel bundles containing up to about 20% non-recoverable material. However, purchase is at a lower price than is paid for clean material.

(d) Material Consumption, Price, and Value

It is difficult to obtain accurate post-consumer recovery volumes for ferrous metal. Annual consumption of all ferrous scrap in Washington State is 800,000 tons per year. Annual exports of all ferrous metals from Puget Sound is 299,000 tons, and from the Columbia-Snake Export District, 231,000 tons. Some Washington ferrous scrap goes to Oregon to be remelted.

It is not possible to get good estimates of the amount of this material recovered from the municipal waste stream. The 1987 volume of ferrous metals recovered from Washington State, apart from internal plant scrap was 424,000 tons. This figure does not include white goods, but does include car hulks and similar items not normally found in the municipal waste stream. Of this amount, probably only 10% or less is really post-consumer scrap as has been defined in this report. (Nevertheless, the 424,000-ton figure will be used to estimate the annual value of recovered ferrous scrap.)

Prices for ferrous scrap fluctuate since it is a widely traded commodity on the world market. Generally, metals prices reflect the health of the economy and whether or not automobiles are selling well in the current year. In addition, there are a number of grades, location factors and other influences affecting price. Sometimes export markets pay more than domestic markets and other times less. Nationwide, steel scrap prices during the last year have risen greatly above average prices for the previous 2 years. This study's estimate of the annual value of ferrous scrap assumes a current end-user or export price for post-consumer grades of $65 per ton.

On this basis, the annual value to end-users of recovered Washington scrap ferrous (including car hulks) is $28 million. After deducting the estimated handling costs, the annual value of ferrous scrap is $21 million. If municipal sources of post-consumer scrap could be measured, its value to recycling programs would probably be less than $2 million per year.

(e) Market Barriers and Constraints

As indicated, one problem with recovering ferrous scrap is that it is often difficult and expensive to separate from the consumer items of which it is a part. Fluctuation in price discourages operators from attempting some of this processing. Other items composed primarily of ferrous metal, such as aerosol and paint cans, present special difficulties in recycling because of their contents.

The use of electric arc to replace or expand existing blast furnace capacity has increased world demand for post-consumer ferrous supplies. Fifteen years ago, electric furnaces accounted for less than 20% of domestic steel production. Today they account for 35%. Blast furnaces generate more scrap metals then do electric furnaces. Recovered industrial or post-consumer ferrous scrap is compensating for this decrease in plant scrap. The more economical electric arc furnaces have also allowed both primary and secondary steel industries to rapidly develop throughout the world. This increased capacity will increase the demand for scrap, but may also lower the price paid on international markets because of increased steel availability. The Northwest is competing for export markets with California and other major ferrous generators.

(f) Market Capacity and Demand Projections

Ferrous scrap has a strong market with strong demand for the foreseeable future, although prices and economics of recovery may periodically weaken.

(g) Waste Generation Area Considerations

Transportation to markets and collection of quantities sufficient to allow efficient handling are key considerations. Most areas of the State currently either have operators involved in ferrous recovery or scrap yards to provide intermediate markets.

(4) White Goods

(a) Material Description

White goods include household appliances such as stoves, refrigerators, freezers, dishwashers, clothes washers and dryers. In the past, these items were generally purchased by major mills and shredded to recover ferrous metals. Insulation, electrical components, glass and plastic are a heterogeneous waste product, or "fluff" resulting from the process. Currently, concern about liability issues surrounding disposal of the fluff is having a nationwide effect on the processing and price of white goods.

(b) Major End-Users, Exporters, and Shippers

White goods are shredded at the Seattle Iron and Metals plant in Seattle, the General Metals plant in Tacoma, the Pacific Hide and Fur Depot in Spokane and at Schnitzer Steel in Portland, Oregon. In late 1986, most of these operators began to require that appliances be stripped of all electrical components before purchase. This requirement stemmed from concern about environmental liability. Over the last two years the question has been raised to whether or not these businesses would continue to accept white goods.

The U.S. EPA regulations of concern pertain particularly to older stoves, refrigerators, washers and dryers which occasionally contain polychlorinated biphenyls (PCB's) in certain electrical parts or motors. If the fluff from white good shredding contains excessive levels of PCB's, it is subject to regulation as a hazardous waste. Other concerns about white goods have surfaced regarding heavy metal toxicity of the paints, the freon contained in refrigeration systems and potentially responsible party (PRP) liability under RCRA for processors who do strip appliances and dispose of the electrical parts at an approved site.

Export of white goods prior to processing is not feasible given their bulk and low value.

(c) Transportation and Handling

White goods cannot be economically transported great distances because of their bulk. There are a number of mobile compactors that regularly travel to sites around the State, such as municipal landfills, where appliances have accumulated, in order to prepare and compress loads of stripped white goods for shipment to one of the shredders mentioned above. Some processors have adequate volume to support a fixed appliance crusher. Transporting white goods more than 50 to 100 miles from their source for processing is generally not practical unless they have been compacted.

Stripping electrical components from white goods costs from $2 to $5 per appliance or between $20 and $50 per ton. Removal of the components can be done either by end-users, processors, recyclers or consumers. Operating costs for appliance compactors approximate $30 per ton and have been included in the end-user prices given below since these operators act as brokers for end-users. Total transportation and handling costs for white goods can vary anywhere from $10 to $70 per ton depending on the arrangements for stripping, compacting, and transporting.

(d) Material Consumption, Price, and Value

In 1987, an estimated 25,000 tons of white goods were reported recovered in Washington State. This number is less than actual recovery volume given some under-reporting by those surveyed, and because some supplies remain stockpiled waiting to be stripped of electrical components.

Prices paid for white goods vary widely depending on point of purchase and whether they have been stripped of all electrical components. End-user concern over environmental liability is a major factor in establishing prices. The average price paid by end-users for stripped and compacted or noncompacted appliances is about $20 per ton. One end-user pays $50 to $70 per ton and receives most of the white goods prepared by the mobile compacting services. Another processor accepts unstripped items without payment. In mid-1986, before hazardous waste issues became of concern, end-users were more typically paying around $40 per ton.

The estimated value to end-users of white goods recovered from Washington State in 1987 is $.5 million at current market prices. To estimate the value of white goods to recyclers, an assumption must be made about representative handling requirements and costs. Given that recyclers break even on the handling of white goods, which generally is reported to be the case (although some sites charge a disposal fee for appliances), then the typical handling costs must approximate the end-users' price. The resulting annual value of white goods to recycling operations can thus be placed at $0.

(e) Market Barriers and Constraints

The environmental, hazardous waste and financial concerns already discussed above are the major barriers facing the white goods market. The items themselves have good value as scrap steel; however, uncertainties about regulation have reduced this value.

Some localities have banned landfill disposal of white goods and this would impact the market if it were to occur in Washington State.

(f) Market Capacity and Demand Projections

At present, the market for white goods from Washington State is tenuous. Some end-users are unwilling to take white goods and this decrease in demand has resulted in lower market prices. The value of white goods to recycling operations, due to stripping and preparation requirements, is currently minimal or perhaps even negative. The Institute of Recycling Industries is currently working with EPA to find a solution to hazardous waste concerns. When a solution is found, it is likely that regional demand for white goods will return to the normal levels of the past.

(g) Waste Generation Area Considerations

Transportation costs for white goods are expected to be a consideration affecting the value of these items in each WGA. In many cases, inclusion of transportation costs could result in a net negative value for recycling operations dealing in white goods.

(5) Non-Ferrous Metals

(a) Material Description

Recycled non-ferrous metals include: aluminum (other than UBC), copper, zinc, nickel, stainless steel, brass and lead. Post-consumer scrap is composed of such items as old gutters, siding, window frames, plumbing pipes and fixtures, electrical wire, aluminum foil, batteries and lawn chair frames. Again, much of the recycled non-ferrous scrap comes from industrial sources outside the municipal waste stream. Processors in the region generally bale or press these metals into briquettes for domestic shipment out of the Northwest region or for export. As with ferrous metals, market structure and supply routes through scrap yards, brokers, processors, end-users and exporters are well-established. Batteries, a source of recoverable lead, are discussed in a separate section of this document.

(b) Major End-Users and Export Shipment Points

Five Washington and three Oregon businesses play major roles in the processing and exporting of non-ferrous metals. Tacoma Metals, Inc., General Metals of Tacoma, and Joseph Simon & Sons, Inc. are located in Tacoma. Seattle Iron and Metal Corp. and Pacific Iron and Metal Co. are located in Seattle. Calbag Metals, Acme Trading and Supply and Schnitzer Industries are located in Portland, Oregon. These businesses primarily process scrap non-ferrous metals for shipment out of state or for export. A large number of scavengers, scrap dealers, buy-back centers and brokers contribute to the system that collects and markets non-ferrous scrap. Some of these processors receive metal supplies from as far away as Alaska.

More than 50% of the West Coast's recovered non-ferrous metals are exported. Annual non-ferrous scrap exports from Puget Sound are about 96,000 tons; primarily scrap aluminum, copper and lead.

(c) Transportation and Handling

High prices for most non-ferrous metals allow Northwest suppliers to compete on the world market even though smelters for most metals are quite distant. A reasonable limit on the distance non-ferrous metals can be transported before processing is 300 miles, although 50 miles is a typical distance. Recyclers in the region must generally pay the cost of moving materials to one of the locations or plants specified above.

Typically processors prefer that supplies be segregated by metal types and that they not be contaminated with other material. Shipments not up to specifications for a particular type of metal will normally be accepted at a reduced price. Storing and brokering material incur the major expense, besides transportation, for recycling programs dealing in non-ferrous metals. Storing and brokering cost is about $150 per ton.

(d) Material Consumption, Price, and Value

As with ferrous metals, it is very difficult to obtain precise figures on the volume of non-ferrous material recovered from post-consumer

sources. Some processors indicate that 50% of their volume comes from buy-back operations while others estimate that less than 10% of their material is pulled from the municipal waste stream. In 1987 more than 47,000 tons of non-ferrous metals were recovered from Washington State. This includes some amount not attributable to municipal post-consumer sources.

Non-ferrous metal prices vary a great deal depending on the type and grade of metal. For example, the October 25, 1988 nickel prices were listed as $.80 to $3.75 per pound, depending on type and market location, while copper prices were between $.27 and $1.18 per pound. Typical post-consumer grades are normally on the low side of these published prices and the prices are those paid for delivery in Los Angeles, San Francisco, or locations in the Midwest, Eastern, or Southern U.S. Export prices are not published but of necessity must be somewhat indexed or related to domestic prices. Northwest processors pay approximately $800 per ton ($.40/lb). At this price, the derived annual value to Northwest processors of the non-ferrous metals from Washington State in 1987 was $38 million. The annual value to recycling centers and buy-back operations was about $31 million if all of the materials were post-consumer.

In the past, prices for non-ferrous metals have fluctuated widely above and below levels that generally follow world production and inflationary trends. The last two years have shown major increases resulting from expansion of the market, due to the revitalization of auto manufacturing and other industries as well as a weaker dollar abroad.

(e) Market Barriers and Constraints

Since the export market plays a major role in the trading of non-ferrous metals, foreign trade policy, government regulations, and economic conditions in foreign countries are of major importance.

(f) Market Capacity and Demand Projections

Brokers and processors say they can handle a much higher volume of post-consumer non-ferrous metals than they currently receive. Since the demand for this material is a world demand, the Northwest has an unlimited capacity to market non-ferrous metals, even though prices may fluctuate.

(g) Waste Generation Area Considerations

- The major processors of non-ferrous metals are located near Puget Sound or the Columbia River. Areas of the State distant from these shipping points have reduced access to markets due to higher transportation costs.

- Non-ferrous metals are usually traded in substantial volumes which may be difficult to obtain in less populated areas of the State.

d. Plastics

Plastics are displacing other materials in the consumer market and taking up increasing space in the municipal waste stream. By the end of the century, plastics resin manufacturing is expected to grow 58%. Packaging is one of the areas of greatest growth for the use of plastic. Plastic packaging increased about 25% between 1980 and 1985 and now uses about 30% of all plastic resin. Plastics are replacing traditional recyclables such as glass, tin cans, aluminum and paper.

The plastics industry is large and diversified, with much product manufacturing by small businesses. Nationally, nearly 25,000 companies consume about 45 billion pounds of plastic resin each year. Plastic packaging accounts for about 4% of the nation's waste stream, half of this amount being containers.

Most plastics, the thermoplastics, can be recycled without great technical difficulty by reheating and reforming. Much of the plastic scrap produced in manufacturing processes is now being recycled, either in-plant or through granulation and sale to other users.

However, difficulties do arise with post-consumer recycling of plastics. Due to the diversity of plastic resins, it is difficult to distinguish types of plastics and to produce a grade of scrap that is pure enough for manufacturing. Plastic's light weight and the difficulty of removing contaminants, make recycling it more marginal than recovering the other materials discussed in this study.

When looking at recycling markets, there are five categories of plastics to consider: polyethylene terephthalate (PET) soft drink bottles, high-density polyethylene (HDPE) milk bottles, flexible plastic films (primarily low-density polyethylene, LDPE) and other flexible plastic packaging or bags, expanded polystyrene (styrofoam) and other mixed thermal plastics. These five categories are not the only framework for examining post-consumer plastics, but they provide a useful context for discussing current plastics recycling. PET is recovered primarily in states with deposits on soft drink bottles. A few drop-off centers, less than 100 in the country, now accept clean, separated PET, HDPE, LDPE and other mixed plastics. Some curbside programs have begun to collect PET and HDPE on-route.

Approximately 25 firms in the United States specialize in the processing of post-consumer plastics. Most of these also handle industrial scrap for which there is a larger base of processors. Nationally, 130 million pounds (6,500 tons) of PET were recycled in 1987. This represents 18 percent of the 740 million pounds of PET produced in 1987. HDPE recycling for the same period was 55 million pounds (27,500 tons) and accounted for about 1% of the 7.8 billion pounds of HDPE produced. Recycling rates for other post-consumer plastics were not reported and are likely insignificant.

The recovery of and markets for post-consumer plastics in Washington State are currently minor or non-existent. Recovery of plastics and associated markets could, however, develop rapidly in the next five years. The

plastics industry is strongly promoting the recyclability of its products and appears supportive of efforts to develop technology and systems for recovery. Large national corporations have recently joined smaller entrepreneurial businesses in their commitment to recycling post-consumer plastic.

(1) PET Bottles

(a) Material Description

PET (polyethylene terephthalate) is the formulation used in the manufacture of clear plastic soft drink bottles. PET accounts for about 20% of the currently recovered post-consumer plastics. Recycled PET is primarily made into polyester fibrefill (for sleeping bags and ski jackets), strapping and fabrics such as geotextiles. The fuzzy covering on tennis balls and carpeting is also being made from recycled PET. PET can also be broken down chemically into compounds used for manufacturing other plastics.

(b) Major End-Users and Export Shipment Points

Domestic end-users of PET are located in the South and East U.S. With implementation of the California redemption law, West Coast supplies may be adequate to justify construction of a processing facility in the West in the near future. New facilities are reportedly being developed in the Midwest to process PET. The main supply of PET for these facilities will be states with bottle deposit legislation. These end-users will generally take delivery of PET shipments anywhere in the U.S. or Canada if volumes are sufficiently large.

A number of Washington businesses are now involved in pilot scale recycling, processing or exporting of post-consumer plastics. Some of these handle small amounts of PET, although they have, thus far, focused primarily on HDPE and LDPE or films. The following are examples of some Washington businesses involved in plastics recycling. The list is not all-inclusive. Many others are entering the field through developing brokering and collection networks:

Pilot Scale Plastics Recycling/Processing:

Partek	-	Vancouver
Rainier Plastics	-	Yakima

Plastics Exporting:

First Line Plastics	-	Seattle
Allied Plastics	-	Seattle
Wastec	-	Portland

Plastics Collection:

Bowen	-	Seattle
Rabanco Recycling	-	Seattle
Fibres International	-	Seattle

The international demand for PET is fairly strong due to a shortage of virgin resins in Asia and elsewhere. The export market can likely absorb a

great deal of PET, although there is also concern that some countries may currently be speculating in PET and other plastics and that significant price drops may result.

(c) Transportation and Handling

Because PET is a low density material, transportation costs are a major consideration. Prior to shipment, PET bottles must be perforated (unless a high-density baler is used) and then baled. Balers must be adequately sized to achieve bale weights of 1,000 to 2,000 pounds. Baling and preparing PET for shipment costs approximately $.05 per pound. A system to move PET from consumers to a location where it can be baled is $.08 to $.12 per pound. Transporting baled PET to a processor is more expensive than for other materials because of lower bale densities.

To be recycled, PET or any other plastic must be clean and free of contamination. Two approaches achieve this. Either consumers must thoroughly clean and separate plastics prior to collection, or they must be separated and cleaned mechanically after collection. Both of these methods are being tested in different parts of the country.

(d) Material Consumption, Price, and Value

Currently, no significant volumes of PET are being recovered from Washington State. Washington State consumes about 6 million pounds of PET per year. Prices currently paid by end-users or exporters are approximately $.08 per pound ($160 per ton). This price should follow future changes in the price of virgin resin, currently at about $.60 per pound.

(e) Market Barriers and Constraints

The major barrier to PET as well as other recycled plastics markets is the lack of a system for collecting and processing it. For end-users, there is no consistent and dependable supply. The absence of venture capital and government-supported research supporting plastics recycling are additional barriers.

Another problem for all plastics is that they are not generally perceived by the public as recyclable materials. In the United States, food and drug regulations make it difficult to use recycled plastics for food packaging; this is not the case in most other countries. Plastics have a high-heat content and are, therefore, a desirable component of waste material destined for incineration. This also may be a barrier to the collection of the material from the waste stream for recycling.

(f) Market Capacity and Demand Projections

There are adequate markets beyond the Northwest and overseas to absorb volumes from experimental plastics recycling programs; however, it is too soon to say whether markets will be available in the future. Development of new products using PET could improve future markets. Demand for recycled plastics is also a function of world petrochemical supply.

(g) Waste Generation Area Considerations

As with many other materials, distance to markets or shipping points as well as the adequacy of a sufficient population base to generate large quantities of PET would be factors in the recycling of this material.

(2) HDPE Bottles

(a) Material Description

HDPE (high-density polyethylene) plastic bottles are the rigid translucent, or colorless containers used for milk, juice, water, detergent, shampoo, syrup, and cooking oil. Nationally, HDPE accounts for approximately 60% to 65% of the currently recovered post-consumer plastics. Recycled HDPE is used in the manufacture of flower pots, drainage pipe, mud flaps and mats, among other items.

(b) Major End-Users and Export Shipment Points

There are currently a number of end-users in the region for clean reground HDPE. However, the only "regrind" which is currently being produced in the region comes from industrial scrap sources. If post-consumer plastic processors develop within the region to clean and prepare consistent quality regrind for these manufacturers, there should be an adequate market to absorb HDPE, even for use in applications other than food packaging. Partek, a firm operating in Vancouver, Washington is currently developing such a cleaning and separation system.

Pacific Rim Nations constitute the primary market for HDPE currently recovered in Washington State. There is currently a very high demand throughout the world for HDPE, both for virgin resins and for clean regrind. Some U.S. manufacturers are importing virgin resin from as far away as Hungary. World prices for resins increased recently after a primary resin producing plant in Saudi Arabia was destroyed.

Of the Washington businesses involved in pilot scale recycling, processing or exporting of post-consumer plastics, it is believed that only First Line Plastics is currently involved in the exporting of HDPE on an other than experimental basis. Industry representatives agree that for plastics recovery to flourish, domestic processing and consumption must develop. The domestic market may pay more for HDPE (up to $.35 or $.50 per pound for some processed resins). However, U.S. end-user cleanliness and sorting standards are much higher than those of export markets where inexpensive labor cleans and sorts the material to meet these standards.

(c) Transportation and Handling

As with other types of plastics, HDPE's transportation and handling costs are critical factors. HDPE's low density makes transportation of the material to a processor or shipping point uneconomical unless it is first densified through baling or grinding. If a processor is nearby to clean the material, it can be reground at the same time it is prepared for shipment.

Otherwise, the HDPE should be compacted and baled. This cost is estimated at $.05 per pound. Once baled, the material can be transported by truck to other areas of the State at a cost which may be twice that of hauling other materials because of the typically low density of HDPE bales.

Storage, sorting of various resin types, and cleaning of the material may affect cost. Lids must be removed from HDPE bottles. It is reported that the plastics industry is developing a coding system to facilitate recycling by marking each item to identify its resin type.

(d) Material Consumption, Price, and Value

Estimated recovery for all post-consumer plastics in the State of Washington was about 1,700 tons in 1987. This volume seems to be increasing rapidly, with a reported recovery of only 350 tons in 1986. Assuming that around 75% of the plastics recovered are HDPE with the remainder being LDPE or mixed plastics, then the 1987 volume of recycled HDPE was about 1,300 tons.

Reported prices paid by end-users for HDPE vary from $.08 to $.20 per pound depending on the type of resin, cleanliness and the amount of sorting which has been done as well as on who pays shipping. As with PET, the price paid for regrind will generally remain below the cost for virgin resin. Prices have recently increased dramatically; however, it is likely that they are now leveling off.

Assuming the typical price paid by end-users for HDPE delivered to Puget Sound for export is $.10 per pound ($200 per ton), then the estimated annual value of the material to end-users is $260,000 at 1987 recovery volumes. After deducting baling costs, the value for recycling programs is around $130,000 per year.

(e) Market Barriers and Constraints

Many of the same barriers listed for PET also apply to HDPE. Supplies of HDPE provided through collection programs are not yet dependable or consistent and a collection system similar to that for UBC aluminum or other recyclables needs to be developed. Improved processing and cleaning technology for post-consumer HDPE are needed. Techniques to reduce high handling and transportation costs also need to be found.

(f) Market Capacity and Demand Projections

There has been significant growth in worldwide demand for HDPE, but reprocessing capacity is still very limited. Those in the State currently developing cleaning and marketing facilities or networks will be able to recover 2,500 to 30,000 tons per year of HDPE in the next 1 to 5 years. If recovery of HDPE from the municipal solid waste stream begins to gradually increase, it is expected that, for at least the near term, processing and marketing system development will be able to keep pace.

In addition, there are now adequate markets beyond the Northwest to absorb volumes from experimental programs in plastics recycling. However, it

is uncertain whether or not these markets will continue to develop as plastics are recovered from municipal solid waste in increasing volumes.

(g) Waste Generation Area Considerations

Distance to markets or shipping points as well as a population sufficient to generate adequate quantities for efficient marketing affect the recycling of this material.

(3) Plastic Packaging and Film, LDPE

(a) Material Description

Low-density polyethylene (LDPE) and other flexible plastics or film stock include: plastic grocery bags, ice bags, poly sheeting, stretch wrap, plastic shipping film, garbage bags, and all other types of flexible plastic packaging that do not return to their previous shape after pressure is applied. This material can be recycled into garbage bags, pipe, and geotextiles.

(b) Major End-Users and Export Shipment Points

End-use for these types of plastics in the Northwest is currently very limited. Some businesses, such as Rainier Plastics in Yakima, are recovering film plastics from industrial sources and might use post-consumer films if cleaning systems are developed to provide a consistent supply. Material currently being recovered is exported, primarily by First Line Plastics through Seattle. Foreign buyers of these plastics currently arrange for hand laborers to meticulously clean and sort each piece of material so that it can be reprocessed.

(c) Transportation and Handling

This type of plastic has a very low density; however, baling can compress the material so that it has a density comparable to other materials such as waste paper. Some commercial businesses who must dispose of plastic film received in shipping manage it with low-density balers to save plant space and reduce landfill disposal costs. Because HDPE bales are denser than PET or HDPE bales, LDPE is cheaper to ship, with transportation costs similar to those for other recyclable commodities. Baling costs and other handling factors are similar to those for PET and HDPE: about $100 per ton.

(d) Material Consumption, Price, and Value

As indicated in the discussion of HDPE, approximately 25% of the plastics exported from Washington State are low-density films. This equates to a recovery level of about 400 tons for 1987. Prices paid by export shippers are around $.08 per pound ($160 per ton). The price outlook is unclear because costs for domestic processing and cleaning of the materials are not yet known.

The estimated value to exporters of the material currently being shipped from Washington is about $64,000 per year. After deducting baling

costs, the estimated value of plastic film to recyclers (without deducting the cost of transportation to a shipping point) is about $24,000 per year.

(e) Market Barriers and Constraints

There is a risk of destroying the recoverability of these types. The introduction of photo-degradable and biodegradable plastic film materials may destroy the recyclability of products made from LDPE and other plastic films. The diversity of resin types used in these materials, sometimes even in laminate form, as well as the need to remove inks and other contaminants, present technological challenges.

It is currently cheaper to produce plastic products from virgin resin than from recycled films. Other countries have greater demand for recycled films because lower labor costs permit cleaning post-consumer plastics at a lower cost. Other uses for recycled film which do not require intensive cleaning and sorting are being investigated in the U.S. For example films can be combined with mixed thermal plastics to make "plastic lumber".

(f) Market Capacity and Demand Projections

Potential new uses for this material may stimulate a greater demand for recycled plastics of this kind, particularly if proper collection, sorting and cleaning processes can be developed. Although markets for LDPE and other plastic films may not be as far developed as for HDPE and PET, they have equal potential for future expansion. A foreign market for the material does allow for some experimental recycling in areas near exporting facilities.

(g) Waste Generation Area Considerations

Distance to markets or shipping points as well as a population sufficient to generate sizable quantities influence the recycling of this material.

(4) Expanded Polystyrene

Expanded polystyrene (i.e., "styrofoam") items are not currently recycled in any significant volumes in Washington State or other areas. Processes to recycle this material are just developing and, until recently, polystyrene foam was not even considered to be recyclable. Research is currently being done on technologies for polystyrene recycling. However, implementation of any large-scale system for recovering polystyrene foam is not expected in the near future. Some of the attributes of polystyrene which make it an effective packaging material, light weight and non-compressibility, also make it difficult to collect and process for recycling. A separate discussion of the management of expanded polystyrene as a special waste is presented in Volume III of this report.

(5) Other (Mixed Thermal) Plastics

Mixed thermal plastics include plastics used in toys, foam pads, plastic shells, trash cans, and automotive products. Many non-expanded polystyrene products such as plastic forks, cottage cheese containers and drinking

straws are included in this category. These items are composed of a wide variety of resins and it is currently believed that in most cases, large scale sorting and regrinding of this material to produce pure resin types is impractical. Also, included in the mixed plastics category are some special grades of plastic, such as PVC pipe, which have high value and are being recovered in small quantities.

Some hand sorting of these plastic types is being done in Asia; and a limited quantity of mixed plastics from Washington have been sent there for recycling. Systems used in Europe to recover mixed plastics are being experimented with in this country. One technology, which extrudes dimensional products such as sign and fence posts or "plastic lumber," is being tested. This process can also use film plastics or the higher value PET and HDPE plastics.

Most of the conditions governing the recycling of HDPE and PET also apply to mixed thermal plastics. Generally, mixed plastics (except for the special plastics) have a lower value than either of HDPE or PET, $.01 to $.02 per pound.

It is too early in the development of recycling systems--both the technologies of end-use and the techniques of collection and processing--to predict how successful plastics recycling will be. Much of the success of plastics recycling will depend on the future price and availability of competing raw materials such as virgin resin which is manufactured from crude oil. Thus, the long-term success of plastics recycling may be tied to the future of worldwide oil markets. Some new technologies may be economically feasible if an adequate supply of recyclable material can be provided. However, few economically viable systems for collecting and processing large amounts of material have been instituted.

e. Organics

In considering markets for organic wastes, five key waste streams or waste stream components must be considered. These are: agricultural and forest products industry waste, sludge, food waste, wood waste (including slash and demolition waste), and lawn and garden debris. Other special sorts of organic wastes such as dead animals can be considered in this category.

Agricultural (including crop and animal by-products) and forest products industry waste are not considered post-consumer materials and are generally dealt with outside of the municipal solid waste stream, although uses for or disposal of these wastes may compete with those for post-consumer wastes. Generally, agricultural wastes are disposed of by land application, though some manure is used in making compost. Forest products wastes are used in the production of paper, wood products or energy (as hogged fuel). Other uses include barkdust ground cover or sawdust used in compost. Markets for these materials will not be discussed except at the point where there is potential displacement of post-consumer material markets.

Sludge is also normally managed outside of the municipal waste stream, with material either being placed in special landfills, incinerated, or made into compost. Although markets for sludge compost in some cases overlap those for yard waste compost, sludge product markets will not be discussed.

Little attention has been paid to the issue of markets for food waste, and only limited projects have focused on recovering this material. A discussion of food waste recycling is presented elsewhere in the report.

Wood waste, which includes old pallets, stumps, slash, and demolition materials, can be recycled by incorporating uncontaminated ground-up wood material with ground-up lawn and garden debris to produce compost or ground cover. This treatment is not always appropriate or all types of wood waste or compost. This report discusses demolition waste disposal elsewhere, and provides no separate discussion of wood waste markets except those cases where wood waste can be managed with yard and garden waste.

The municipal waste stream organic material with a significant existing and potentially expanding market is lawn and garden debris. The organics market capacity section itself focuses on lawn and garden debris. Markets for yard debris will be discussed, rather than markets for the compost or other products produced from yard debris. A survey of potential markets for compost products in the Seattle area has recently been completed for the City of Seattle. This study found that sufficient markets for compost products can be developed in the Seattle area.

(1) Lawn and Garden Waste

(a) Material Description

Lawn and garden debris includes naturally occurring woody and vegetative material (including trimmings) from trees, plants and shrubs as well as leaves and grass from parks, and commercial or residential lawn and garden maintenance. These materials can often be composted where they are generated, and this is normally a preferred method of source reduction.

Managed off-site, yard waste can be processed into three primary products: first, compost used as a soil amendment, growing medium and ground cover; second, hogged fuel for incineration in industrial boilers; and third, compressed fire logs for residential wood stoves and fireplaces. The most feasible of these three is yard waste composting. In each of the other two uses, waste generated by the wood products industry already dominates the market with prices lower than for yard waste feedstocks.

Yard waste compost is a good plant growing medium though it often may require the addition of nitrogen. Compost enhances soil quality. Though not inhibiting weeds, it also can serve as a ground cover. In some applications, compost competes directly with materials produced by the forest products industry, such as barkdust and sawdust. Potential outlets for the product are landscapers, nurseries, the general public, and institutional or public groundskeepers. Compost produced from yard waste may also be useful as an organic component for covering reclaimed landfills or strip mines.

Yard waste comes into the waste stream from several sources, including commercial landscapers, parks, utility and public facility maintenance operations, residential yard maintenance and curbside collection of

either source-segregated yard waste or yard waste combined with regular residential waste. Yard waste from most of these sources can potentially be contaminated with material which is incompatible with the composting process, e.g., herbicides, pesticides, plastics, and stones.

A major challenge in producing a marketable product is establishing methods to deliver large quantities of uncontaminated yard waste. The supply of yard waste is highly seasonal, being greatest during the peak growing months. Throughout the country, unprocessed yard debris delivered to a processing center is generally charged a fee so the operation can compete with producers of compost from other sources.

(b) Major End-Users and Export Shipment Points

Because of high transportation costs, markets for unprocessed yard waste must be within 30 or 40 miles of the point of generation. Two processors of yard waste who produce compost are: Pacific Topsoils in Woodinville, and the Skamania County Department of Public Works in Stevenson. The large number of other businesses around the State currently involved in topsoil production potentially could develop new yard waste composting operations.

A number of operators are either currently experimentally composting yard waste, or are scheduled to begin full scale operation within the next year: Gro Co. in Kent, Clean Acres (Rabanco) at Maple Valley in King County, Land Recovery Inc. in Puyallup, Bassett Western in Woodinville, Valley Topsoils in Auburn, Island County Landfill in Oak Harbor, and the Clark County Solid Waste Department in Vancouver.

The Clean Acres facility, scheduled to begin processing 30,000 tons per year of yard waste in 1989, will also grind wood pallets as might some of the other facilities. If pallets or other types of wood or demolition wastes are accepted, magnetic separators or other equipment must be used to keep nails and other contaminants out of the compost. Northwest Wood Recyclers, in Woodinville, currently accepts large stumps from commercial land clearing operations but has not yet done any composting. The chips from this operation are used as ground cover or as road and trail bases.

The Woodland Park Zoo, the Seattle Parks Department, the University of Washington Arboretum, the Seattle Children's Orthopedic Hospital, and Long Acres race track all have in-house composting programs for portions of their organic wastes. The Washington Association of Landscape Professionals and the Nurseryman's Association have also gotten involved, in the Seattle area, in promoting the recovery of tree trimming chips from the waste stream.

The City of Seattle has operated pilot projects during the past two years at its solid waste transfer stations to divert clean yard waste to processing centers. Beginning in 1989, the city will contract for source segregated curbside collection of yard waste and centralized processing which could result in a total recovery of 30,000 tons per year by 1991, a total that includes the amount already handled at transfer stations.

(c) Transportation and Handling

The cost of delivering yard waste from the area in which it is generated to an end-user limits a yard waste processing market. A 30- to 60-mile round trip is probably the maximum distance that yard waste can be economically hauled to a processor. Economics would change if landfill disposal charges increased. Hauling yard waste costs about $.20 to $.45 per ton per mile. (The higher cost assumes that the collection vehicle is empty on the back haul.)

Costs of handling yard waste at the source are dependent on the type of collection, equipment and facility used. Curbside collection programs, drop boxes, transfer station reloading and self-haul are all means to supply end-users. Loading and unloading time, spotting for contamination and collecting fees are other critical handling factors.

Processors require supplies of yard waste to be as free of contaminants as is possible. Wood that has been treated with preservatives or herbicides is harmful to the composting process. Other wastes may also disrupt the composting process.

(d) Material Consumption, Price, and Value

Estimated annual recovery of yard waste at Washington State processing centers is about 10,000 tons per year. most of this in the Puget Sound area. This amount of yard debris should produce about 2,000 to 5,000 tons of compost.

Processors of yard waste in Washington State, and elsewhere, charge a disposal fee for each cubic yard of compost delivered. This fee ranges from $3 to $10 per cubic yard. Depending on the processing operation's size and assuming a density of 200 to 500 pounds per cubic yard, an average fee for disposal of yard waste will be $20 per ton delivered to the end-user. These assumptions yield an estimated annual value of yard waste compost to end-users of ($200,000). In other words, this is the amount processors must be paid to accept it. For recyclers supplying the material, this equates to an annual cost of $300,000 (assuming an average of $10 per ton for short-haul transportation).

(e) Market Barriers and Constraints

One of the principal barriers for yard waste processors is uncertainty in the marketing of the composted product. The ability to market the compost is a key factor in the amount of the tipping fee charged for disposing of yard waste. Yard debris compost must compete with similar products already on the market including: bark, sawdust, lava rock, peat moss, steer manure, chicken manure and sewage sludge-based products. Displacement of these other materials is a concern. Yard waste compost does unique applications, and this may allow it to occupy a distinct market niche.

Since yard debris compost has a higher value and greater density than fresh non-composted yard waste, it can be transported further. This one area's yard waste compost product might compete with another area's yard waste

compost even though the two areas are too far apart to share a single yard waste processor. Transportation costs limit the extent of markets for compost products.

Potential users of yard waste compost such as nurseries and landscapers, may be reluctant to try a new product. This is especially true if there are concerns about the material's toxicity or consistency. Knowledge about these issues is improving and there is also an increasing understanding of the unique qualities and applications of yard debris compost.

Processors indicate a potential difficulty with State regulations in that a yard debris compost operation might be required to meet Minimum Functional Standards for disposal sites if time limits for stockpiling are exceeded. New rules prohibiting the burning of demolition waste and land clearing slash in the Puget Sound area may result in an over-supply of stumps which would compete with yard waste for processing capacity.

(f) Market Capacity and Demand Projections

King County has the estimated capacity to process 100,000 to 150,000 tons of yard waste per year. In Pierce County there should soon be adequate capacity to process between 5,000 and 15,000 tons per year. This signals a healthy and growing market in these areas.

The market for yard waste compost is not necessarily driven by supply and demand. Composting avoids disposal costs, and processing capacity will likely be available until either the product cannot be given away and has to be landfilled or until the costs of processing become higher than the cost of landfilling. This means that processing of yard waste may be appropriate in areas with high landfilling costs.

Government programs may provide outlets for compost. For example, yard debris compost could be specified for use in government projects such as covering landfills, strip mines, and enhancing parks and highways.

(g) Waste Generation Area Considerations

Yard waste composting has thus far been considered mostly in the Northwest, Puget Sound, and Southwest WGA's. (Spokane may also be looking at yard waste processing). This is due to higher concentrations of the material in the waste stream and to increasing landfill disposal costs in these areas. These are the two key considerations which need to be considered when evaluating yard waste recovery options.

f. Summary of Existing and Near-Term Future Market Conditions

This market capacity study provided a detailed analysis of 15 key commodities. For each of the key commodities, descriptions were given for:

the material	major end-users
shippers/exporters	transportation factors
handling factors	consumption

price
market barriers
market capacity
variations between WGA's
annual value
market constraints
market demand projections

Table C-1 provides a summary of the estimated annual volume, annual value and average prices for the 15 key commodities. The table indicates the current relative significance of these recyclable commodities.

Table C-2 indicates variations in value among the State's waste generation areas due to transportation, processing and handling costs. Separate discussions in Section E of report Volume II provide a market capacity summary for each Waste Generation Area.

Table C-3 presents the conclusions of the existing and near-term future conditions study, summarizing the capacities of the 15 principal commodity markets to accommodate gradually increasing recycling levels. These conclusions refer primarily to the capacity of the markets to simultaneously absorb increased volumes and offer a price sufficient to cover handling and transportation costs. No attempt has been made to account for moderate changes in price which may reduce or increase profits.

Subsections C.4, C.5, and C.6 provide a framework for analyzing markets, historic/market data and estimates of market sensitivity to price. The discussions and data provide the background for conclusions concerning the impact of publicly supported recycling on existing, private sector recyclers in Subsection C.7. These conclusions are also summarized in the above Introduction.

4. ANALYTICAL FRAMEWORK

Market price for a recyclable material and the quantity bought and sold during a particular period result from many separate, but interacting decisions. Supply and demand curves of the type shown in Figure C-1 summarize the economics of these market place interactions.

With markets for recyclables, the supply curve (labeled SS on Figure C-1) represents the behavior of private and public organizations who collect materials from households and businesses and prepare them for sale to end-users. The demand curve (labeled DD on Figure C-1) represents the behavior of end-users (e.g., a paper mill) who purchase recyclable materials for use in production processes. Each point on a supply curve represents the quantity offered for sale by recyclers at the given price. At higher prices recyclers want to sell greater quantities. Each point on a demand curve represents the quantity that end-users desire to purchase at the given price. At higher prices end-users are willing to buy less secondary material. The intersection of the two curves is that typically unique price which clears the market, that is the price at which supply is equal to demand. This intersection point is called the market equilibrium, and the associated price and quantity pair (labeled P_0 and Q_0 respectively on Figure C-1) are called the equilibrium price and equilibrium quantity.

TABLE C-1

Summary of Current Estimated Recyclable Commodity Market Volume, Price and Value

Commodities	1987 Washington Recovery (tons)	1986 Puget Sound Exports(1) (tons)	Market Value: 1988 Price(3) ($/ton)	Market Value: Historic Price ($/ton) 3-5 Years	Market Value: 1988 Est. Value ($/year)	Value to Recyclers Before Transportation Costs(4): 1988 Net Price(3) ($/ton)	Value to Recyclers Before Transportation Costs(4): 1988 Est. Value ($/year)
Newsprint	167,000	49,000	$45	$25-75	$ 7,515,000	16	$ 2,839,000
Corrugated	288,000	97,000	65	40-115	18,720,000	40	11,520,000
High Grade Paper	49,000	74,000	100	75-200	4,900,000	45	2,205,000
Mixed Waste Paper	34,000	53,000	25	10-45	850,000	0	0
Glass - Cullet	22,000	0	40	30-40	880,000	20	440,000
Refillable Glass	21,000	0	116	100-120	2,436,000	66	1,386,000
Aluminum (UBC)	11,000	0	1000	600-1500	11,000,000	850	9,350,000
Tin Cans	1,000	0	49	40-55	49,000	29	29,000
Ferrous Metals	424,000	300,000	65	40-90	27,560,000	50	21,200,000
White Goods	25,000	0	20	0-40	500,000	0	0
Non-Ferrous	47,000	96,000	800	200-800	37,600,000	650	30,550,000
PET Bottles	0	0	160	100-300	0	60	0
HDPE Bottles	1,300	1,300 (2)	200	200-250	260,000	100	130,000
Plastic pack/film	400	400 (2)	160	100-200	64,000	60	24,000
Yard Wastes	10,000	0	(20)	(10)-(50)	(200,000)	(30)	(300,000)

Notes:

(1) Figures for export shipments from Puget Sound ports, as provided by the U.S. Department of Commerce (unpublished table). These figures should only be considered approximate measures of the extent of exports of recycled materials from Washington, because not all of the tonnages originated in Washington and because the categories of commodities are not necessarily comparable to recycled categories (for example, old newsprint may be classified as mixed waste paper for export purposes). U.S. Department of Commerce data does not include plastics (see note 2).

(2) Figures for exports of plastics based on information from local processors.

(3) Prices shown are estimates based on end user surveys. They are for planning purposes only, and are not intended to represent actual or future prices paid by end users, brokers, or buy-back centers.

(4) "Value to Recyclers" = Market Price - Processing/Handling Costs. This is the theoretical value to a recycler if there were no transport costs to an end user/exporter.

TABLE C-2

Estimated 1988 Net Value of Recyclables by Waste Generation Area

Commodities	Estimated 1988 Avg Price(1) ($/ton)	Estimated Handling & Processing Cost(2) ($/ton)	Theoretical Value(3) to Recycling Programs							
			WGA 1 West	WGA 2 North West	WGA 3 Puget Sound	WGA 4 South West	WGA 5 North Central	WGA 6 South Central	WGA 7 North East	WGA 8 South East
Newsprint	$45	$29	11	11	16	15	16	16	16	16
Corrugated	65	25	36	36	40	39	40	40	40	40
High Grade Paper	100	55	32	33	45	43	45	45	45	45
Mixed Waste Paper	25	25	-17	-16	0	-3	-18	-11	-21	-12
Glass - Cullet	40	20	4	9	20	19	11	15	10	14
Refillable Glass	116	50	33	44	66	39	26	49	46	44
Aluminum (UBC)	1000	150	817	836	850	849	834	833	850	837
Tin Cans	49	20	12	22	29	21	19	21	19	18
Ferrous Metals	65	15	17	36	50	47	31	33	30	28
White Goods	20	20	-33	-14	0	-3	-19	-17	0	-13
Non-Ferrous	800	150	617	636	650	647	631	633	630	628
PET Bottles	160	100	-6	15	60	54	-351	21	19	16
HDPE Bottles	200	100	34	55	100	94	-311	61	59	56
Plastic pack/film	160	100	27	38	60	57	-146	40	40	38
Yard Wastes	-20	10	-30	-30	-30	-30	-30	-30	-30	-30

Notes:

(1) 1988 average prices have been estimated based on end user surveys.

(2) Estimated processing costs provided by WSRA Commodity and Technical Advisory Groups. Yard waste processing cost is handling/transport to central site.

(3) Theoretical Values = End User Price - Processing Cost - Transportation Cost

TABLE C-3

SUMMARY OF MARKET CAPACITIES *
(Within categories, commodities are not ranked)

Markets With Sufficient Stability and Capacity Statewide to Accommodate Consistent "Gradual" Expansion of Recycling Efforts:

Newsprint
Corrugated Containers
High-Grade Paper
Tin Food and Beverage Cans
Ferrous Metals
Non-Ferrous Metals
Aluminum Beverage Containers
Container Glass
Refillable Glass

WGA's: All

Markets With Significant Potential Capacity For Certain WGA's to Accommodate Consistent "Gradual" Expansion of Recycling Efforts:

Mixed Waste Paper
PET Plastic Bottles
HDPE Plastic Bottles
Plastic Packaging/Film (LDPE)

WGA's: Northwest, Puget Sound, Southwest

Depending on the future of commodity prices and market developments, these materials may have potential in other WGA's as well.

Markets With Potential Capacity For Minimizing/Avoiding Disposal Costs for Recoverable Items:

Lawn and Garden Waste
White Goods

WGA's: All
Particularly - Northwest, Puget Sound, and Southwest for Lawn and Garden Debris

* For a summary of market capacity in each WGA, refer to Section E of Volume II.

It is important to understand that the relationship between price and quantity depicted by a supply or demand curve assumes all other factors affecting the market interaction are constant. When one of these other variables--such as the price of wood pulp in the case of a recycled paper fibers market--changes, then one can expect the curve it affects to shift. Shifts in supply or demand curves cause changes in market equilibrium. For example, as will be explained below, one would expect the entrance of public organizations into the business of collecting recyclables to shift the supply curve, resulting in a change in equilibrium price and quantity.

a. The Conventional Wisdom

One common thread running through many editorials about recycling is the idea that too much recycling by too many organizations, especially governments, will lead to market saturation or gluts, lower prices and resulting economic difficulties for all recyclers. The supply and demand curves of Figure C-2 characterize the economics of this possibility.

Here the supply curve labeled S_0S_0 represents the supply of a recyclable commodity forthcoming at various prices from the existing recycling industry in some local community or WGA. The demand curve labeled DD represents the fixed capacity of existing end-users who want to fill up their existing capacity no matter what price they must pay for the recyclable commodity in question.

Along comes a program initiated by the public sector in the local community to collect the recyclable commodity. The resultant increased supply causes an outward shift in the supply curve to S_1S_1, because at any given price the existing recyclers still want to sell the same quantities they did before. But now the public sector collections must also be marketed at that price.

What is the effect on market equilibrium? The vertical demand curve, called a "perfectly inelastic" demand because quantity demanded does not change when prices rise or fall, indicates that the end-users will take advantage of increased competition on the sellers side of the market. Equilibrium price will fall from P_0 to P_1. At price P_1 the existing recycling industry will only want to sell the quantity Q_1.

The effect on existing recyclers of public collection is in this scenario given by the decrease in quantity sold from Q_0 to Q_1, the decrease in price received per ton from P_0 to P_1, and the decrease in total sales revenue of $P_0Q_0 - P_1Q_1$. The revenue generated from public sector collection is $P_1(Q_0 - Q_1)$.

b. A More Comprehensive Theory

There are a number of difficulties with using Figure C-2 to analyze the impact of expanded recycling on equilibrium price, on quantity traded, and on existing private recyclers:

- "Perfectly inelastic" demand is an atypical, extreme case in the theoretical supply/demand model.

Figure C-1

Market Supply and Demand Curves

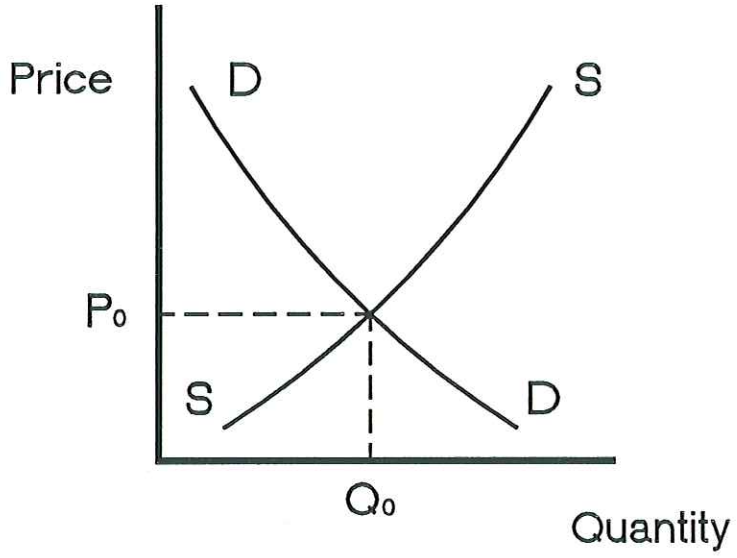
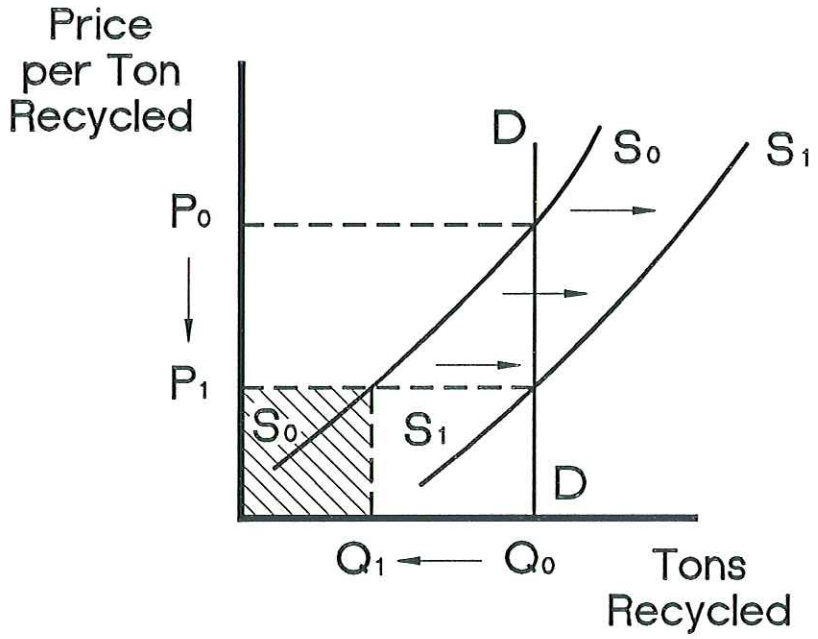


Figure C-2

Impact of Expanded Recycling: Conventional View



Note: Arrows Show Direction of Changes.

- No WGA market could be found in which quantity purchased by end-users was independent of price, even in the short run.

- Empirical studies of market demand seldom have yielded "perfectly inelastic" demand curves.

- Most recyclable materials in the WGA's are sold outside the WGA on national or international markets, and market structure in this case is not adequately represented by Figure C-2.

To give some examples of non-vertical demand curves: if prices for secondary materials fall relative to primary materials prices, end-users can increase their plant processing capacities by adding shifts, shifting input factor combinations toward more expensive and productive mixes (for example, hiring more talented workers or buying better quality intermediate goods), running machinery faster, or by bringing previously idle capacity into production, to name a few of the possibilities. Over a longer period of time, end-users can increase capacity by building more plant space and filling it with more equipment. A more elastic demand curve representing such a situation is shown on the right-hand side of Figure C-3. This more typical demand curve slopes downward to the right, indicating that end-users will buy more of the recycled material as its price drops.

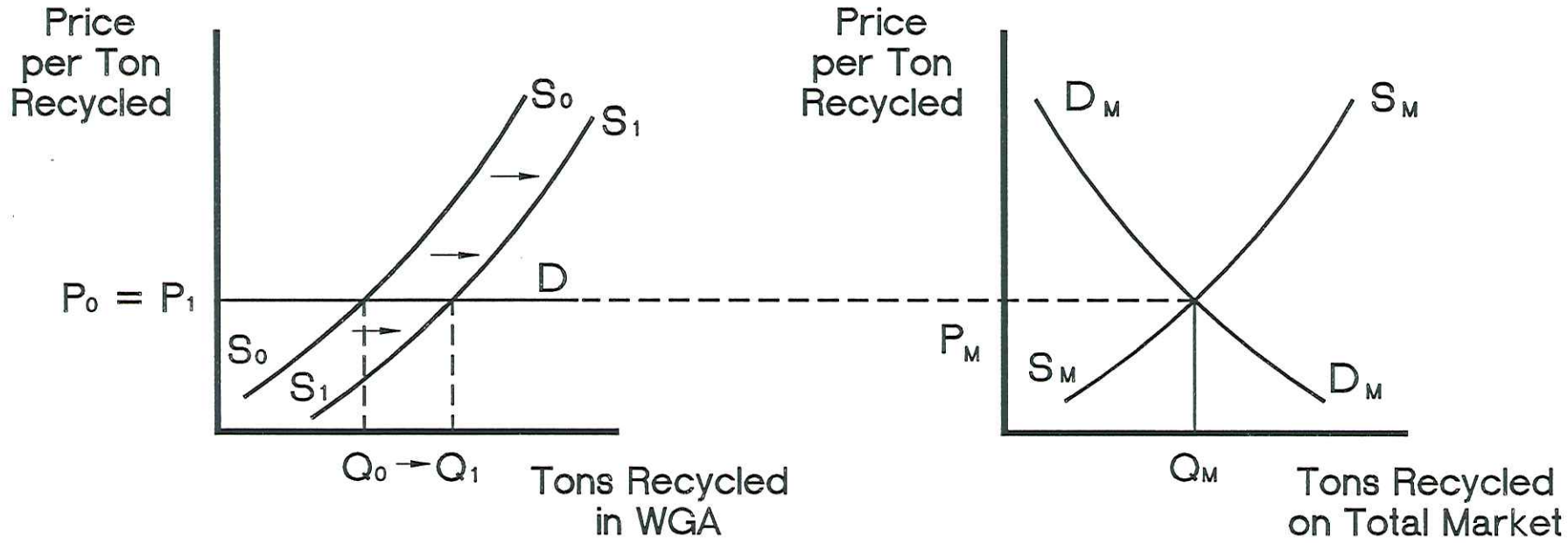
A previously ignored distinction becomes important here, and is the reason for showing two markets on Figure C-3. This is the distinction between the national or international market for a recycled commodity, and the local or WGA market for the same commodity. The graph on the right represents total supply and demand in the broad market with the supply curve for all recyclers who sell on that market aggregated into one total supply curve S_mS_m. The many end-users buying the recycled commodity have their aggregate demands represented by the total market demand curve D_mD_m. Equilibrium price and quantity recycled are represented by P_m and Q_m, respectively.

If total market tons recycled are large relative to recycling in a local community or WGA, then the WGA is like an individual producer operating in a competitive industry. That is, recyclers in the WGA can sell all they wish on the aggregate market at the overall market equilibrium price P_m. This situation is portrayed by the left-hand set of supply and demand curves on Figure C-3. Rather than being perfectly inelastic, demand in the local WGA is perfectly elastic, that is, the demand curve is horizontal. In this case, local recyclers have no influence over the price they get for their recycled commodity. When supply shifts outward to S_1S_1 because of local public sector initiated recycling, there is no impact on the price that existing recyclers receive for recycled tonnage.

To verify the latter assertion, observe that the shift in supply from S_0S_0 to S_1S_1 when public sector recycling starts does not reduce the price that existing recyclers get for their goods. Nor does it reduce the amount Q_0 they wish to sell and can sell. No impact on the existing recycling industry results from local public sector recycling programs in the case portrayed by Figure C-3.

Figure C-3

Impact of Expanded Recycling: Extended View



Note: Arrows Show Direction of Changes.

WGA Market

Total Market

VAA00047

c. Two Important Caveats

However, two important and likely scenarios need to be addressed. The first, if public sector involvement in recycling makes the collection by existing recyclers of recyclables from households and businesses more expensive, existing recyclers would be affected. The amount that private recyclers wish or can afford to sell for any given price now would be reduced because they must spend more to extract recyclables from households and businesses.

On Figure C-4, this situation is represented by a shift to the left of existing recyclers' supply curve S_0S_0 to $S_0'S_0'$. Public sector recycling in this case would be greater than the amount $Q_1 - Q_0$, in fact it would be $Q_1 - Q_0'$. The extra amount $(Q_0 - Q_0')$ would be the portion of previous private recycling given up by existing recyclers because of increased collection costs. Some of the recycling accruing to the public sector would then be a substitution for recycling previously done by existing private recyclers. Only the quantity $Q_1 - Q_0$ could be termed "new" recycling. Private recyclers would experience a loss of revenues. The loss to private recyclers would be the value of $(Q_0 - Q_0')$.

The second important consideration is that this analysis says nothing about the effect of an increase in aggregate market supply caused by new public recycling in the rest of the U.S. In this situation, other factors remaining constant, the aggregate supply curve S_mS_m would shift to $S_m'S_m'$ and equilibrium price would fall to P_m as portrayed on Figure C-5.

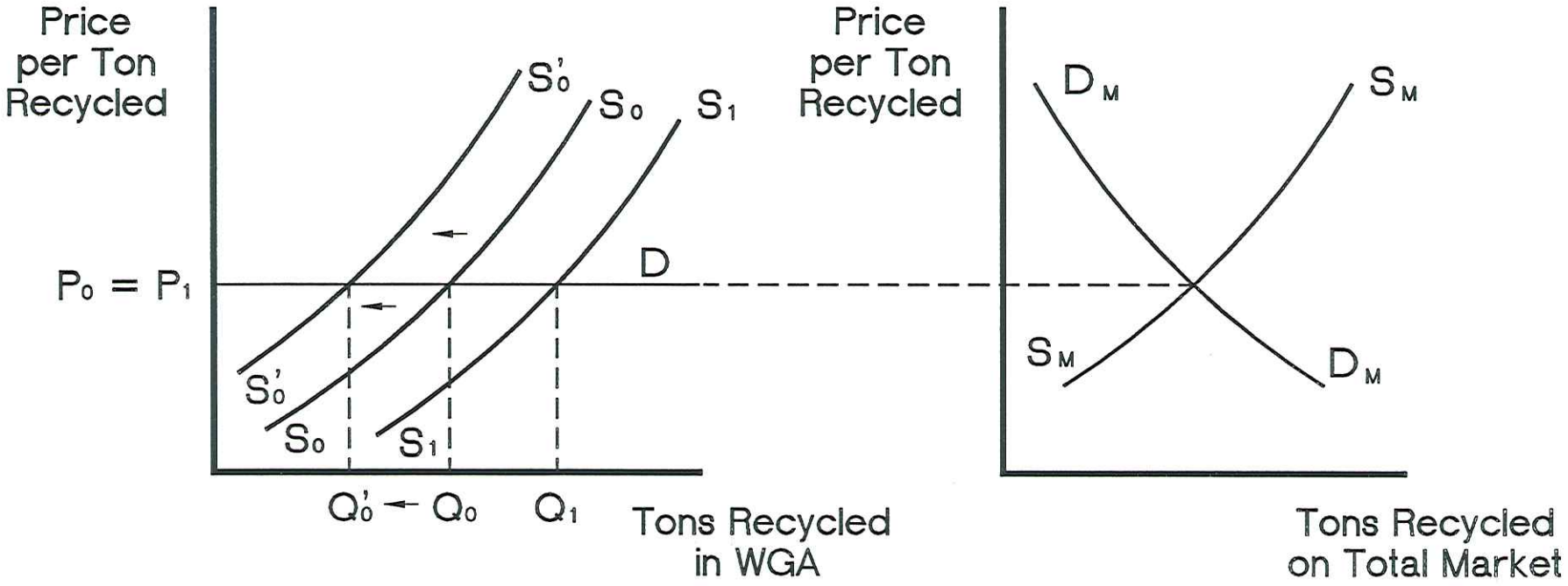
The existing private recyclers would supply only Q_0' at the new lower equilibrium price $P'=P_m'$. Their total revenue would fall from PQ_0 to $P'Q_0'$. Local public sector recycling which would have added $Q_1 - Q_0$ to recovery in the WGA, would now only add $Q_1' - Q_0$. Further, the public sector would be collecting an amount $Q_0 - Q_0'$ previously collected by existing private recyclers. Thus, private recyclers would collect fewer materials and receive a lower price for those which they do collect.

There are many forces at work in the aggregate market over the course of five or ten years. In contrast to new entrants on the supply side, causing aggregate supply to shift out (or increase), aggregate supply could shift the opposite way or decrease because of waste reduction or new costs for pollution controls on the processing of recyclables. Public sector education about recycling and tax subsidies to recyclables processors would tend to increase aggregate supply. This could offset some of the indirect impact of increased competition from the public sector in the collection of recyclables.

Aggregate demand could be increased by: (1) increased prices for primary materials that compete with secondary materials as inputs to end-user production processes; (2) government procurement policies favoring goods made from recycled materials; (3) technological developments that increase the efficiency of secondary versus primary material use (e.g., the electric arc furnace for making steel); (4) increased energy costs (there are typically lower energy requirements for using secondary materials); (5) increased costs of pollution controls on end-user production processes; (6) new end-users or new plant capacity brought on line by existing end-users; (7) U.S. dollar exchange rate declines that reduce recyclables prices for foreign buyers; and (8) decreased tax and transportation subsidies on use of primary materials.

Figure C-4

Indirect Impact of Public Sector Recycling



Note: Arrows Show Direction of Changes from Figure C-3.

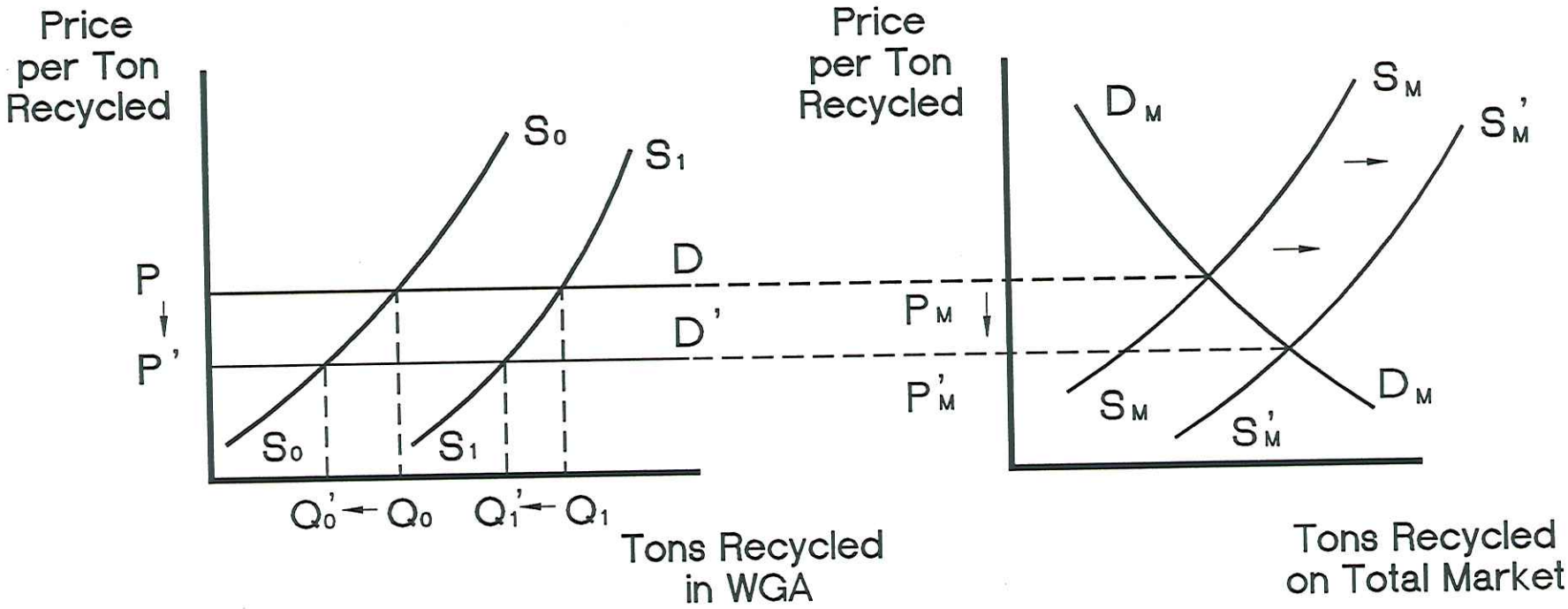
WGA Market

Total Market

VAA00055

Figure C-5

Impact of Increased Aggregate Market Supply



Note: Arrows Show Direction of Changes from Figure C-3.

WGA Market

Total Market

VAA00054

Predicting the cumulative effect on future prices for recyclables of such a large number of forces is difficult at best. The empirical and historical data provided below, give broad indications about future prices for recycled materials.

5. U.S. PRODUCTION, DOMESTIC RECOVERY, EXPORT AND PRICE DATA FOR THE MAJOR RECYCLABLE COMMODITIES

The graphical data presented in this section provide a perspective for U.S. markets on new production, domestic recycling, export of recycled materials, and price variations for major commodities. These data are useful for determining the major trends and fluctuations in markets for recyclable materials. Past growth rates in consumption of secondary materials by domestic end-users are compared with growth required to achieve various recovery rates. This comparison provides an indication of the level of increased recovery at which supply could exceed demand.

Of particular interest are trends in export markets. Washington State's access to Asian markets for recycled paper fibers, ferrous metals, and plastics will play an important role in determining recycling's future in the State.

This analysis evaluates the period 1969-1987. Some pre-1969 data are unavailable. Fortunately, a 19-year period provides a valuable perspective on the potential for market growth through the year 2000.

As Subsection C.3 indicates, recyclable paper fibers and metals are routinely exported from Washington State to end-users in other parts of the U.S., in Canada and Mexico, and overseas in Asian countries. These export transactions tie local markets to national and international markets, so that trends and fluctuations in the larger aggregate markets will typically be mirrored in Washington State. To analyze potential market capacity for Washington State's recovered materials thus requires examination of these aggregate markets.

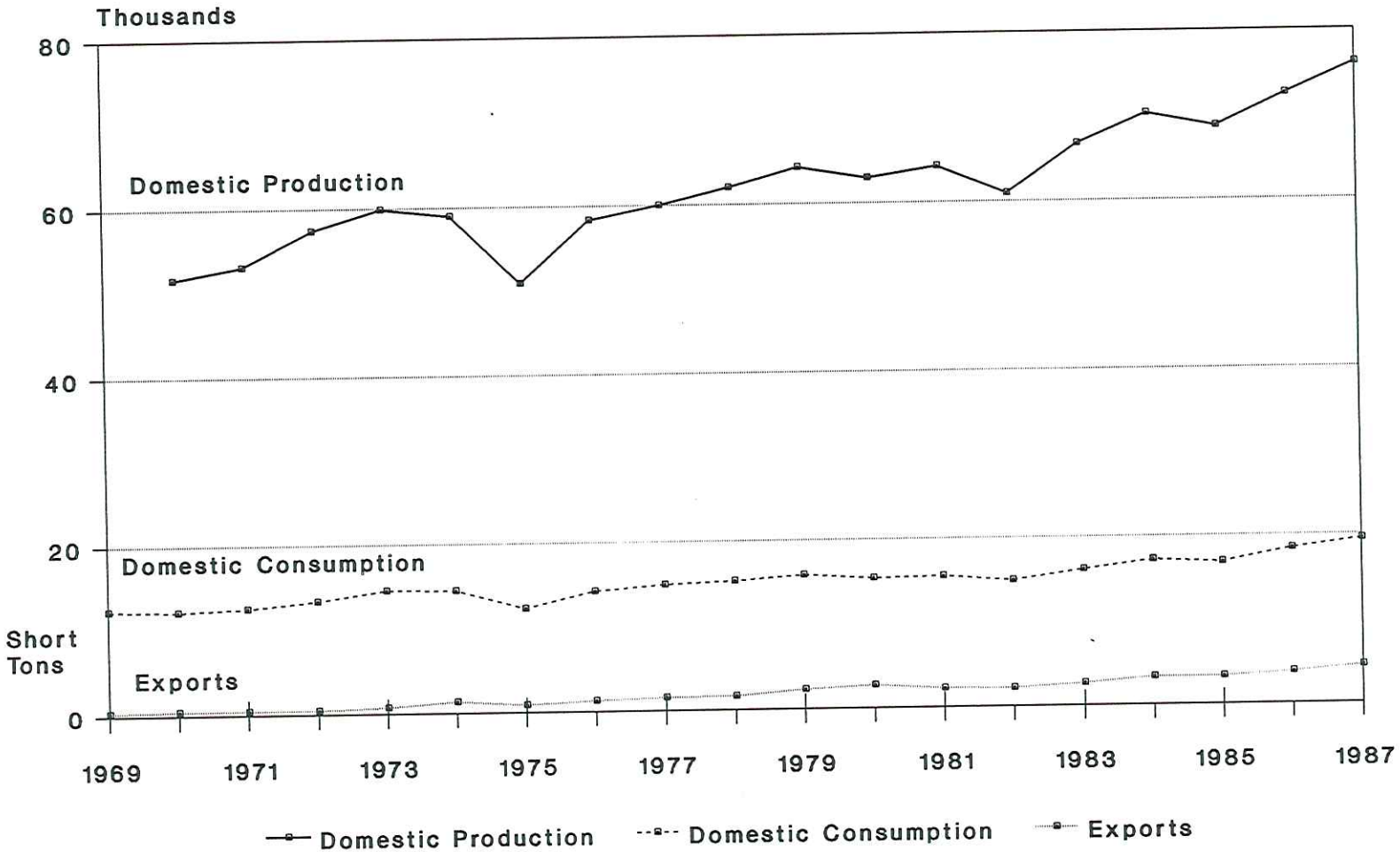
Given the scope and budget of this Best Waste Management Practices study, a graphical analysis of aggregate U.S. market data over time seemed the most cost-effective way to incorporate total market information into the study. To determine local shares of larger markets, 1987 levels of international recovery of recyclables were compared to U.S., Washington State, and WGA materials recovery quantities.

a. The Recycled Paper Fibers Industry

Figure C-6 shows U.S. production of new paper and paperboard for 1970 through 1987. For 1969-1987, the figure also shows domestic consumption of recycled paper fibers by mills in the domestic paper industry, as well as by producers of molded pulp products, insulation, mailing bags and other end-products. Exports of paper fibers are shown at the bottom of the figure.

Figure C-6

U. S. Paper/Paperboard Production
Recycled Paper Consumption & Exports



Source: American Paper Institute, Paper Recycling Committee, "1987 Annual Statistical Summary, Waste Paper Utilization," (New York: American Paper Institute, July 1988)

Domestic consumption plus exports less any imports of paper fibers indicate the extent to which new production is being recycled as opposed to being disposed in sewage or municipal solid waste. Imports of paper fibers are quite small. The ratio of domestic paper fibers recycled to new production has trended slowly upward from 22.4% in 1970 to 28.5% in 1987.

Figure C-7 exhibits national price indices for paper and paperboard mill output, for recycled paper fibers and for wood pulp. Wood pulp is the primary material competing with recycled paper as an input in the production of new paper and paperboard products. As the figure indicates, the price of wood pulp increased between 1969 and 1987 to a greater extent than did the price paid for recycled paper, although the price for recycled paper fibers fluctuated much more dramatically. The relative price advantage of using recycled paper rather than wood pulp in paper production thus rose gradually during the time frame, although the wider fluctuations in waste paper prices are likely to have countered this favorable trend to some extent.

The price for paper and paperboard also increased at a faster rate than did the price paid for recycled paper. Between 1969 and 1987, price trends in the paper industry generally have been favorable for paper recycling.

Figure C-8 shows the relationship between paper recycled in the U.S. for both domestic end-user consumption and export between 1969 and 1987, and the price index of market price paid for recycled paper fibers. The quantity of paper recycled increased during the period while prices fluctuated widely throughout a fairly flat trend. However, during the 1974-1975, 1980-1982, and 1984-1985 periods the quantity of paper recycled decreased in response to a rapid price decrease. In the 1974-1975 period, real prices paid for recycled paper fibers fell 62%, while quantity recycled fell 16.7%. During the 1980-1982 period, real prices fell 47.9% and quantity recycled decreased 5.6%. During 1984-1985, real prices fell 37.7% and quantity recycled fell 1.4%.

b. The Scrap Aluminum Industry

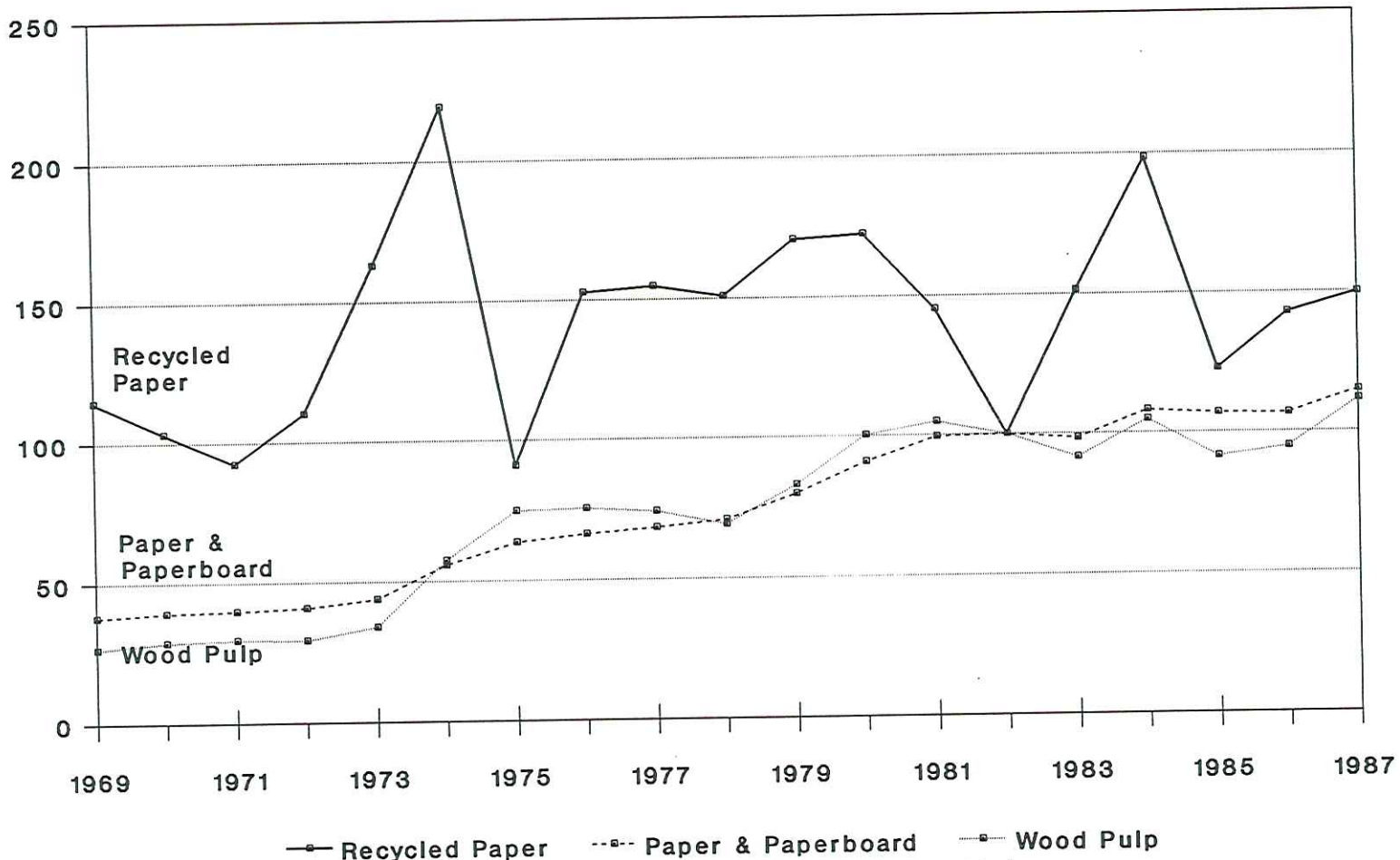
Figure C-9 indicates domestic U.S. production of primary aluminum and recovery from scrap for the time period 1969 through 1987. The latter series measures the metallic aluminum content recovered from recycled aluminum products. The recovery rate rose steadily from 30.3% in 1969 to 55.3% in 1987.

Figure C-10 shows that prices for primary aluminum and aluminum scrap have moved closely together throughout 1969 to 1987. Both series exhibit an upward trend in nominal--that is, not corrected for inflation--price level.

Figure C-11 shows that the upward trend in scrap aluminum price has been associated with an increase in aluminum recycling. As in the paper recycling industry, there have been three periods of sharp price decreases. The 1974-75 real price decrease of 43.3% was associated with 3.6% less aluminum recycling. During 1980-82, real prices for aluminum scrap fell 51.2%. After a one-year lag, aluminum recycled fell 10.6% in 1982 from its level in 1981. During 1984-85, real prices fell 25.7% and aluminum recovery declined 1.8%.

Figure C-7

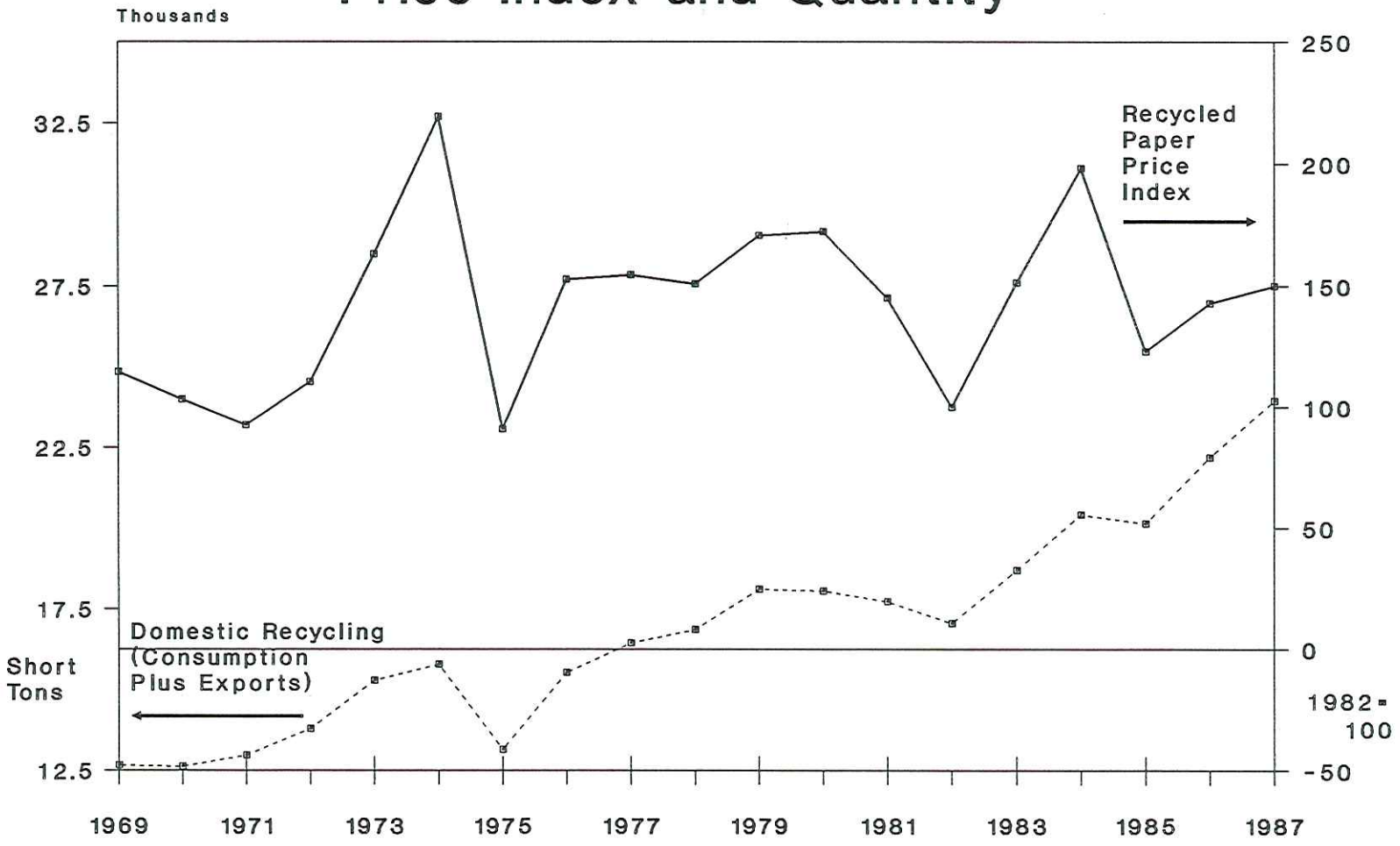
Domestic Paper Industry Price Indices
(1982 = 100)



Source: U. S. Department of Labor, Bureau of Labor Statistics, Supplement to Producer Price Indices, (Washington, D. C., U. S. Government Printing Office), Data for Various Years.

Figure C-8

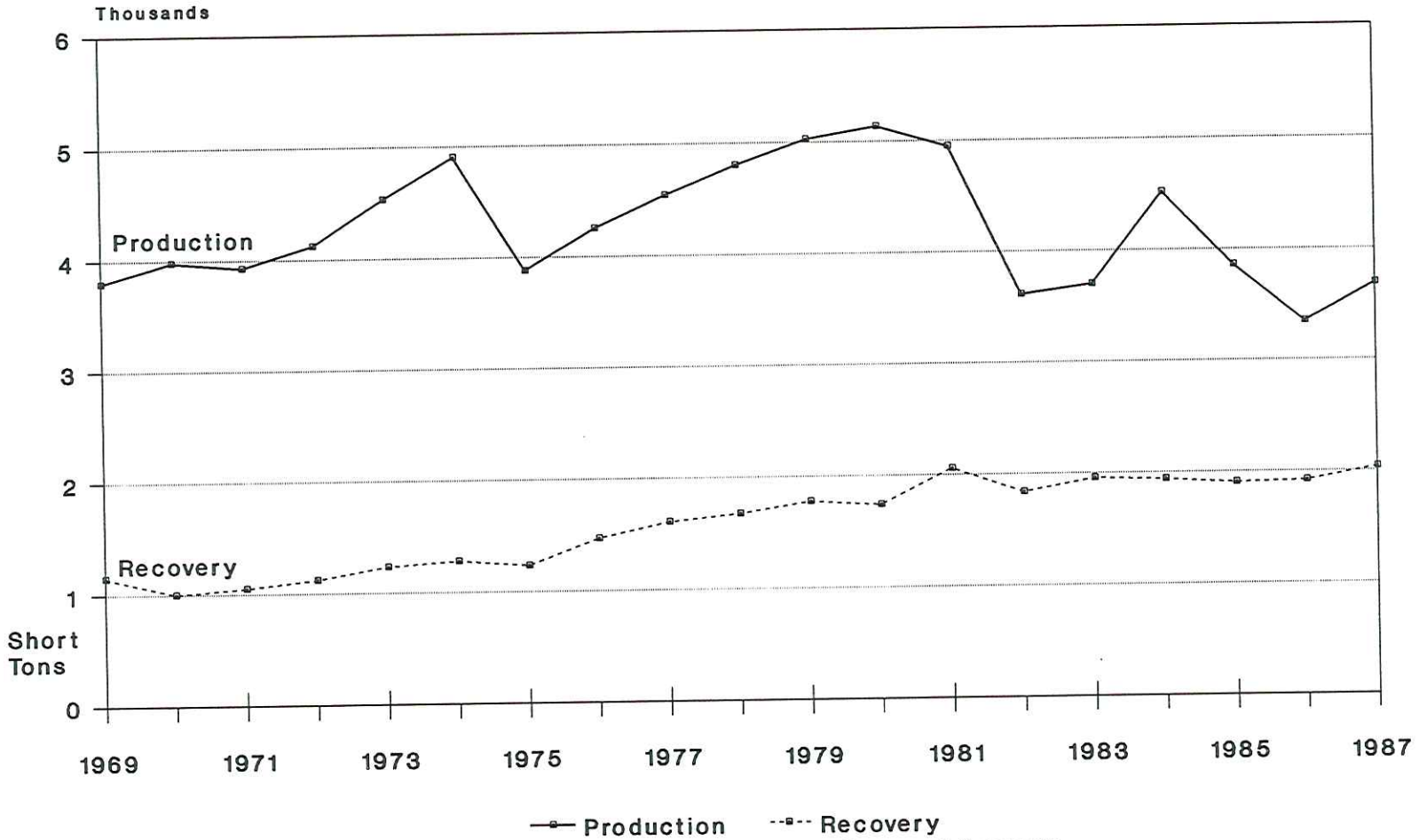
Recycled Paper (U. S. Consumption Plus Exports) Price Index and Quantity



Sources: American Paper Institute, Paper Recycling Committee "1987 Annual Statistical Summary, Waste Paper Utilization" (New York: American Paper Institute, July 1988), and Supplement to Producer Price Indices.

Figure C-9

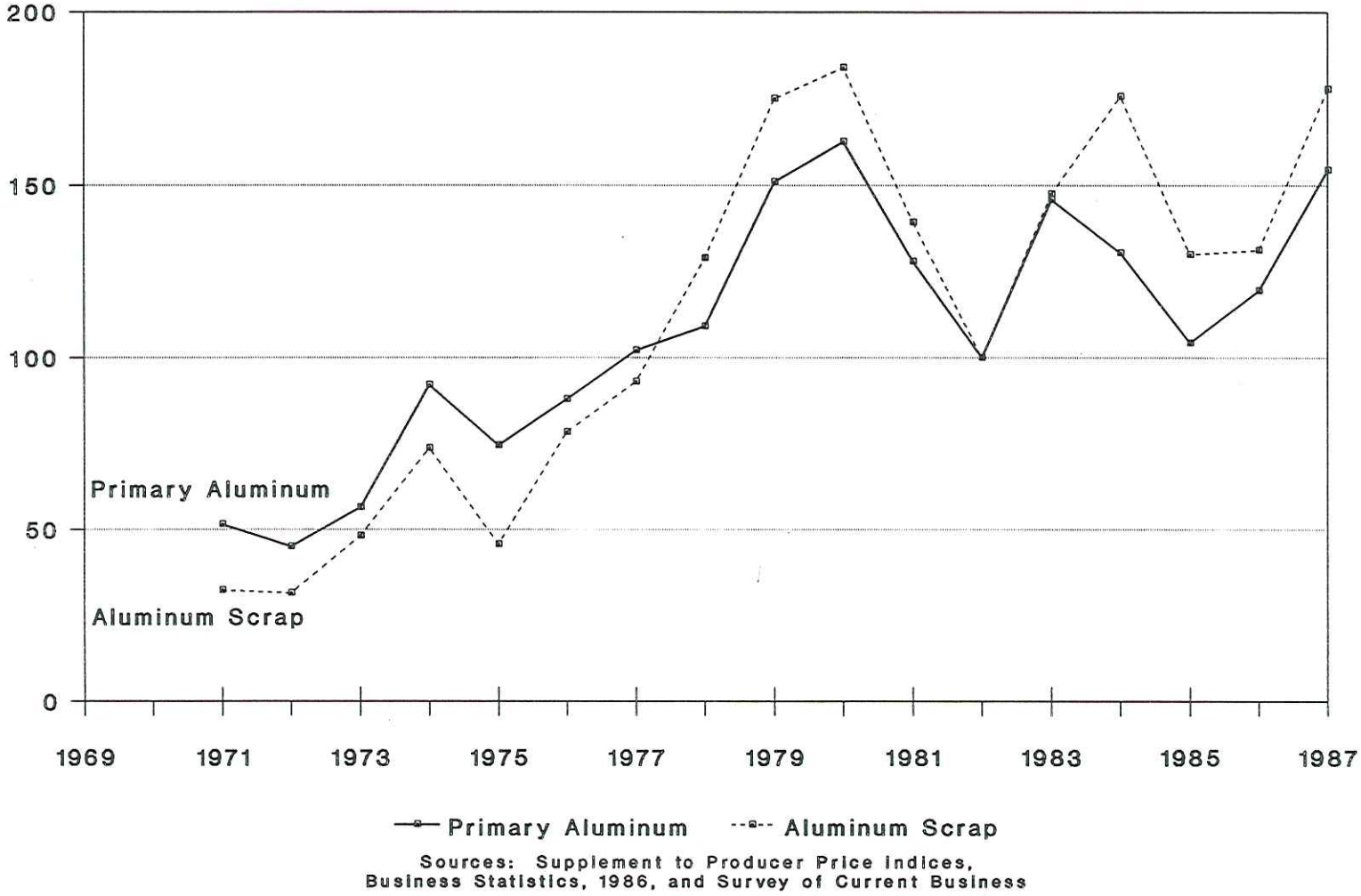
U. S. Primary Aluminum Production and Recovery from Scrap



Source: U. S. Department of Commerce, Bureau of Economic Analysis, Business Statistics, 1986, a Supplement to the Survey of Current Business, (Washington, D.C., U.S. Government Printing Office)

Figure C-10

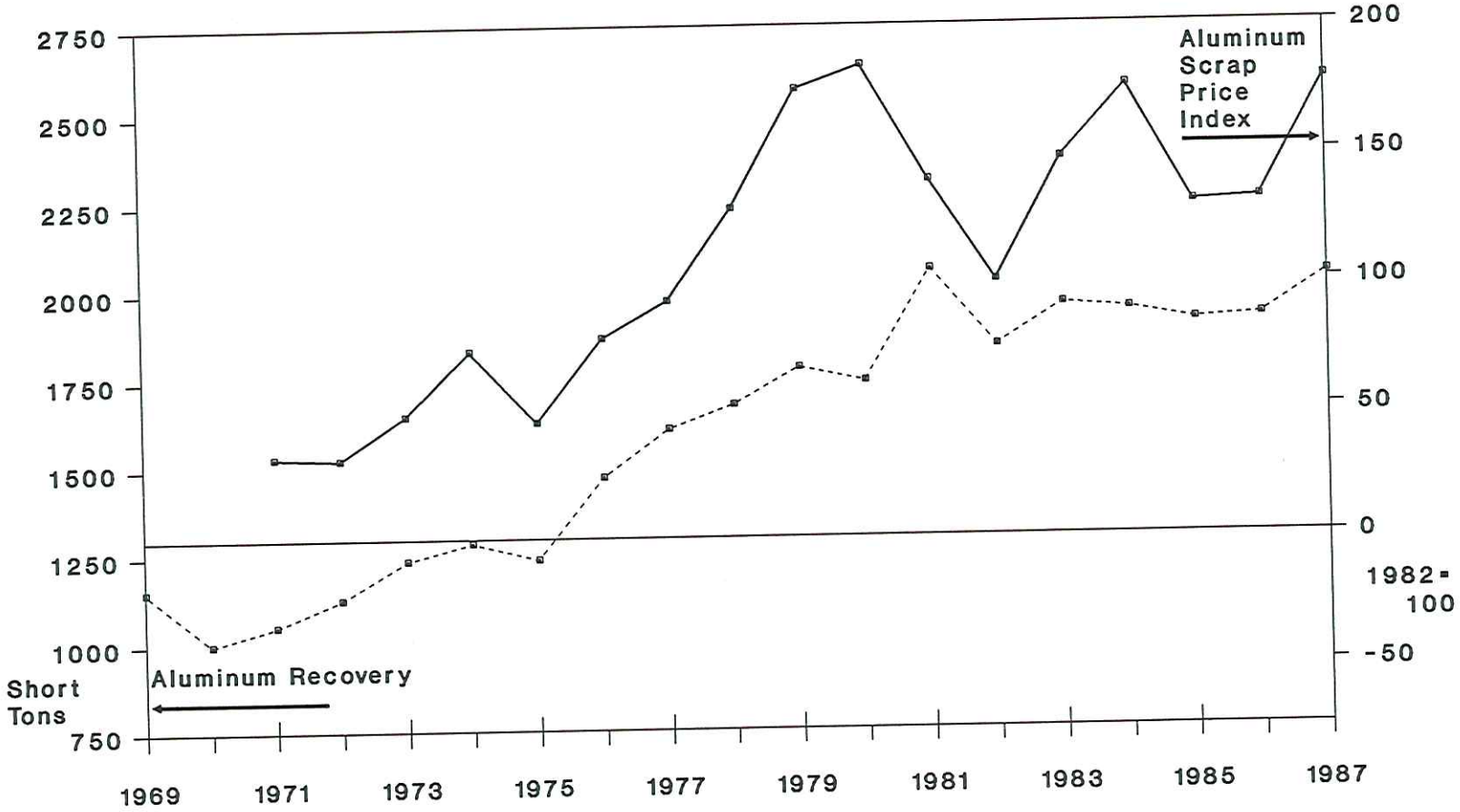
U. S. Aluminum Industry Price Indices
(1982 = 100)



Sources: Supplement to Producer Price Indices, Business Statistics, 1986, and Survey of Current Business

Figure C-11

U. S. Recycled Aluminum Price Index and Quantity



Sources: U. S. Department of Commerce, Bureau of Economic Analysis, Business Statistics, 1986, A Supplement to the Survey of Current Business, (Washington, D.C.: U. S. Government Printing Office)

c. Tin and Ferrous Recycling

Figure C-12 exhibits domestic raw steel production, iron and steel scrap consumption and scrap exports for the period 1969 through 1987. The industry was declining until about 1982 when the effects of proliferating electric arc furnaces began to be significant. According to Cynthia Pollock, "By 1983, the industrial market economies produced 30% of their raw steel in electric arc furnaces, or minimills, that rely exclusively on scrap for their feedstock." [Pollock, Cynthia, "Realizing Recycling's Potential," in Lester R. Brown, et al., State of the World 1987, (New York: W. W. Norton & Company, 1987).] Since 1982, raw steel production, domestic ferrous scrap consumption, and ferrous scrap exports have gradually increased.

Figure C-13 shows domestic tin consumption and recovery of tin from scrap for 1969 to 1987. The tin recovery rate has decreased in recent years from its levels in earlier periods--for example, 28.2% in 1969. In 1987 the tin recovery rate was 22.6%. In addition, the domestic tin industry declined substantially over the period 1969 through 1986, although there are now some signs of revival.

Figure C-14 depicts price movements for ferrous scrap, tin and steel mill products during the years 1969 to 1987. Ferrous scrap prices have fluctuated widely throughout a generally increasing trend. Steel mill products prices have trended upward. Tin prices have increased during 1969-1987 with a substantial spike in 1980.

Figure C-15 compares price and quantity for ferrous scrap. The price index is for Number 1 heavy melting iron and steel scrap, a composite of prices for scrap delivered at Chicago, Pittsburgh, or Philadelphia. The relationship between ferrous recycling and ferrous scrap prices over the 1969 to 1987 period is not as strong as the quantity-price relationship for aluminum recycling.

During the 1974-1975 period real prices for ferrous scrap fell 38.9% while the quantity of ferrous recycled dropped 22%. During 1980 through 1982 prices again dropped substantially, this time by 39%, and quantity recycled fell 32.6%. During 1984-85 real prices for ferrous scrap fell 12% but recovery actually increased. During 1974-75 and 1980-82, the drop in ferrous recycling associated with decreased real prices was greater in proportion to the price decline than were the decreases in recovery in the paper and aluminum recycling industries.

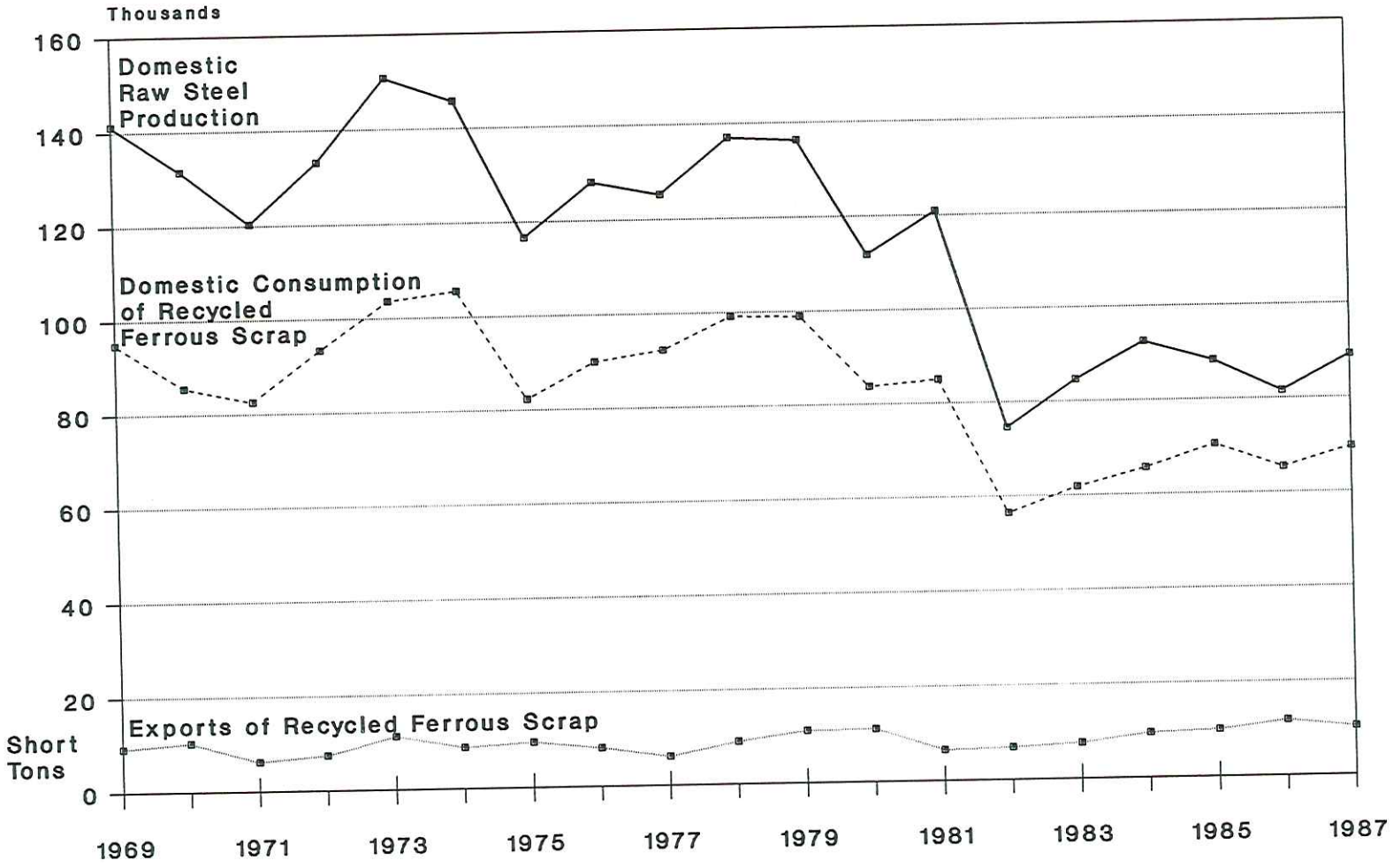
d. Glass Containers Recycling

Figure C-16 shows the production of glass containers and their price index over the 1969 to 1987 time period. Since 1978, glass containers production has trended downward. Prices for glass containers on the other hand have continued to rise, at least before correcting for changes in the value of the dollar.

Figure C-17 exhibits glass container shipments and recovery in thousand of short tons for 1969 through 1986. The recovery rate for glass has

Figure C-12

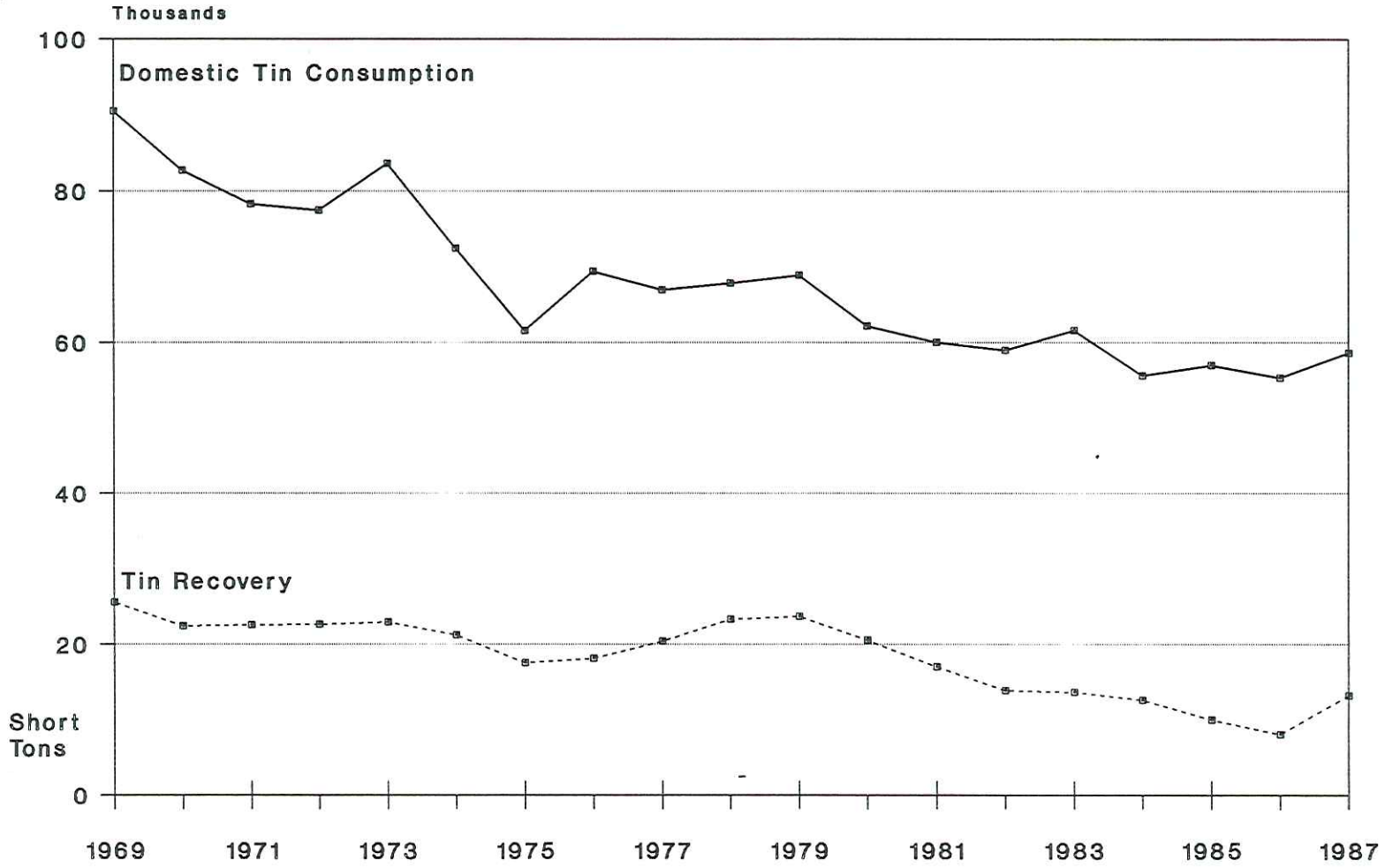
U. S. Raw Steel Production
Recycled Ferrous Consumption & Exports



Source: Business Statistics, 1986 and Survey of Current Business

Figure C-13

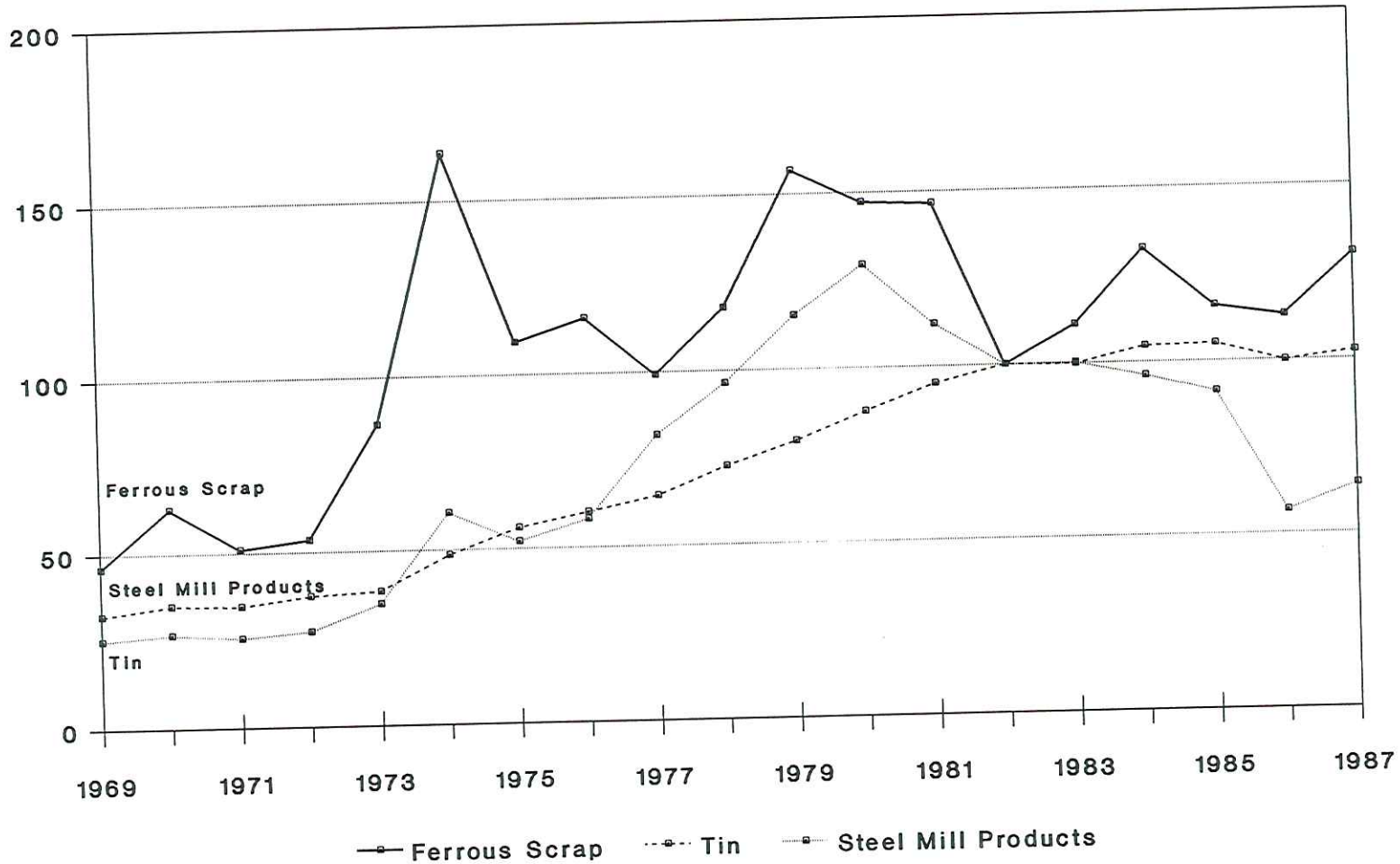
U. S. Tin Consumption and Recovery from Scrap



Sources: Business Statistics, 1986, and Survey of Current Business

Figure C-14

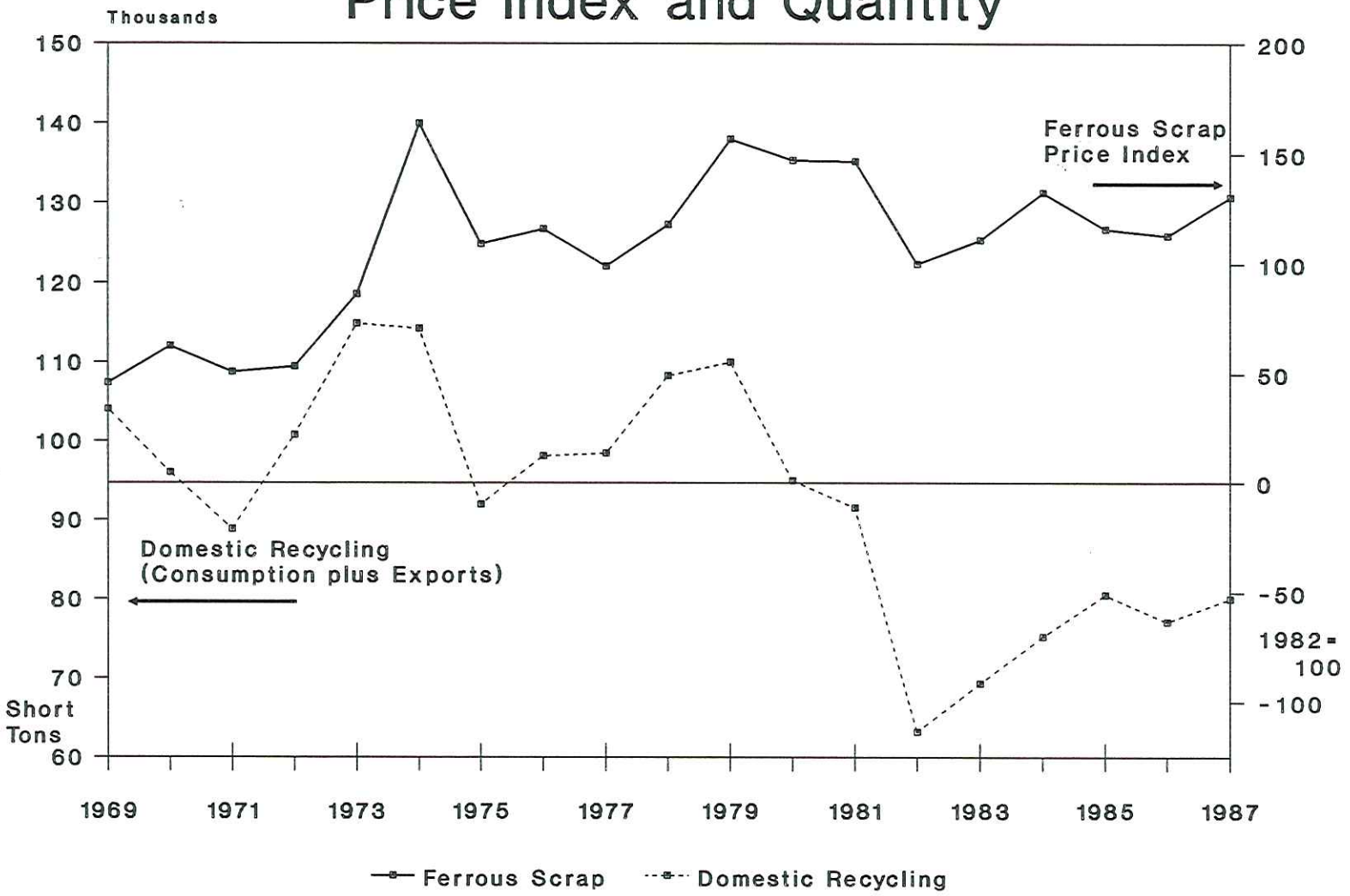
U. S. Metals Markets Price Indices
(1982 = 100)



Sources: Supplement to Producer Price Indices and Survey of Current Business

Figure C-15

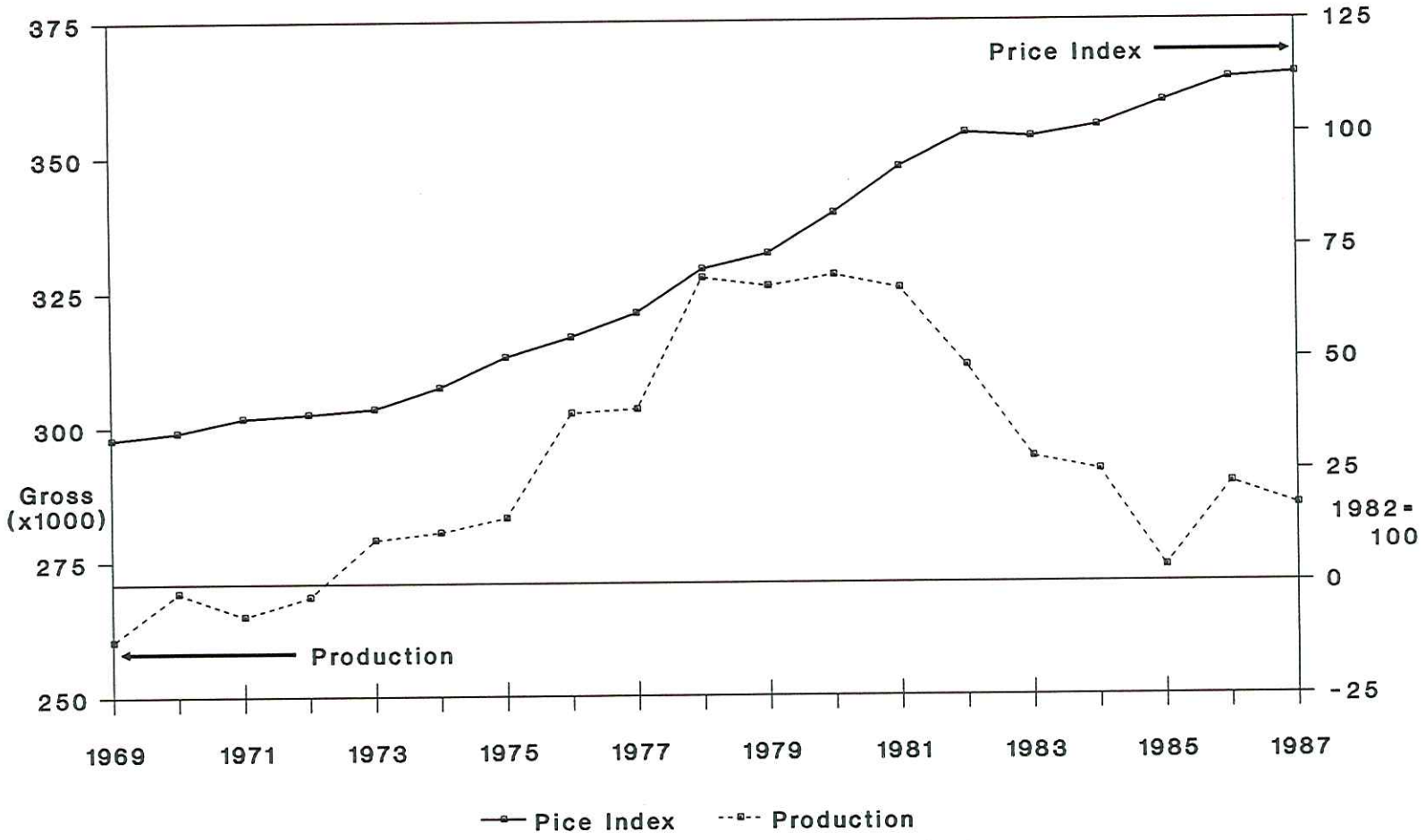
Recycled Ferrous (U. S. Consumption Plus Exports) Price Index and Quantity



Sources: Supplement to Producer Price Indices, Business Statistics, 1986 and Survey of Current Business

Figure C-16

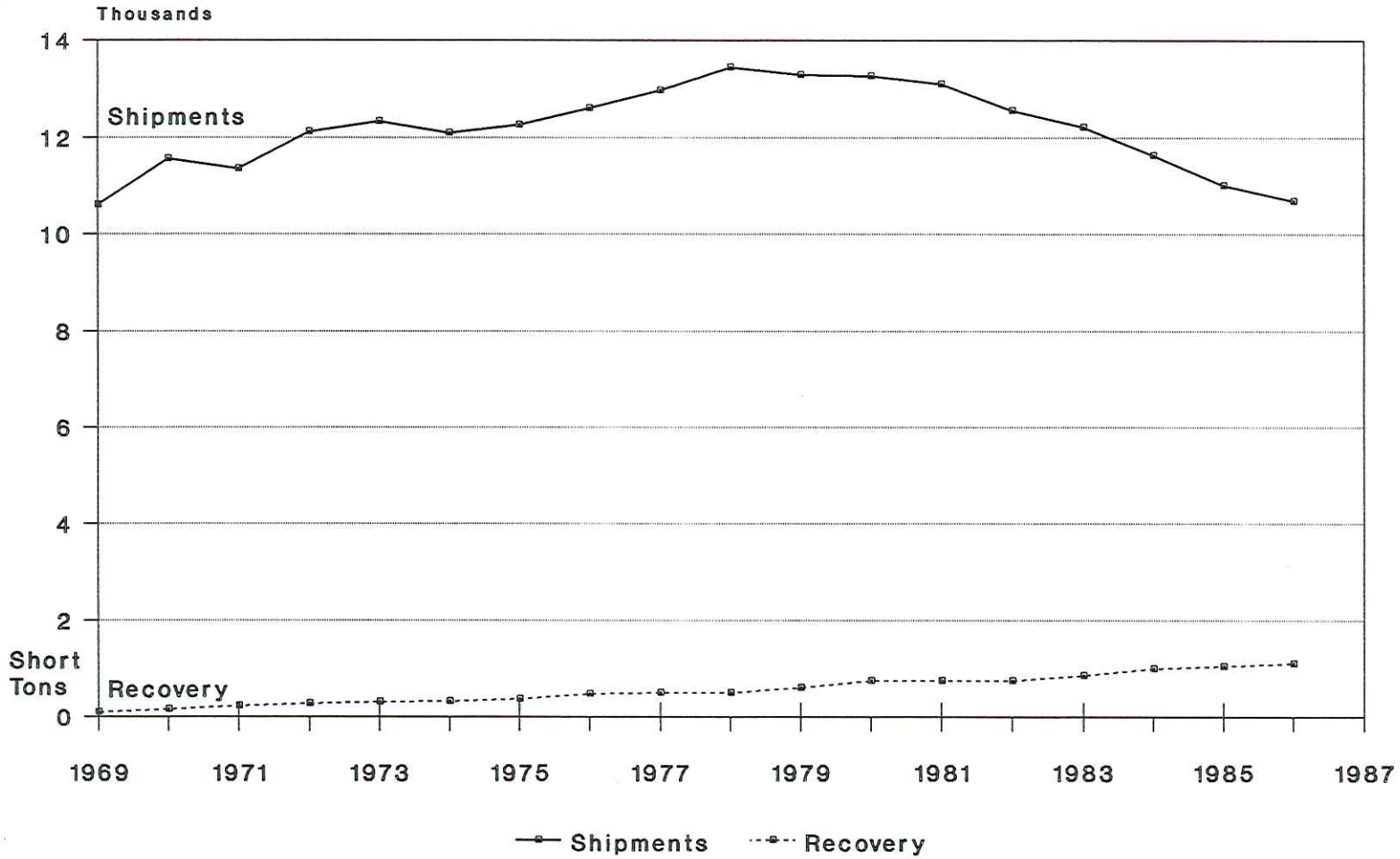
U. S. Glass Containers
Price Index and Production



Sources: Supplement to Producer Price Indices, Business Statistics, 1986, and Survey of Current Business

Figure C-17

U.S. Domestic Glass Container Shipments and Recovery



Source: Franklin Associates, Characterization of Municipal Solid Waste in the United States, 1960 to 2000, Working Papers, 1988 Update

increased during this time period from 0.9% in 1969 to 10.3% in 1986. Recovery here refers to estimated recycling from the municipal solid waste stream, and thus excludes any recovery of glass scrap directly from the glass container production process. There are no known available price indices for recycled glass.

e. Plastics Recycling

Figure C-18 exhibits the time trend in U.S. production of plastics and resin materials during the period 1969 through 1987, as well as showing movements in prices for plastics. Both time series show a strong upward trend.

Figure C-19 indicates the recovery rate from municipal solid waste for plastics of all types. There may be substantial plastics recycling outside of the municipal solid waste stream, but recovery from solid waste equals only 0.4% of plastics and resin materials production as of 1986. As was the case with recycled glass containers, there is no known U.S. aggregate price index for recycled plastic materials.

f. Washington State Recovery Compared with National and International Recovery

Table C-4 below shows world and U.S. recovery of paper fibers, ferrous scrap, and aluminum. It also exhibits Washington State's share in international and domestic recovery, and the range in shares for the eight WGA's.

Washington State in 1987 accounted for 2.2% of domestic paper recycling, 0.5% of ferrous recovery, and 0.5% of aluminum recycling. The State's shares in international recovery were 0.9% for paper, 0.1% for ferrous, and 0.2% for aluminum.

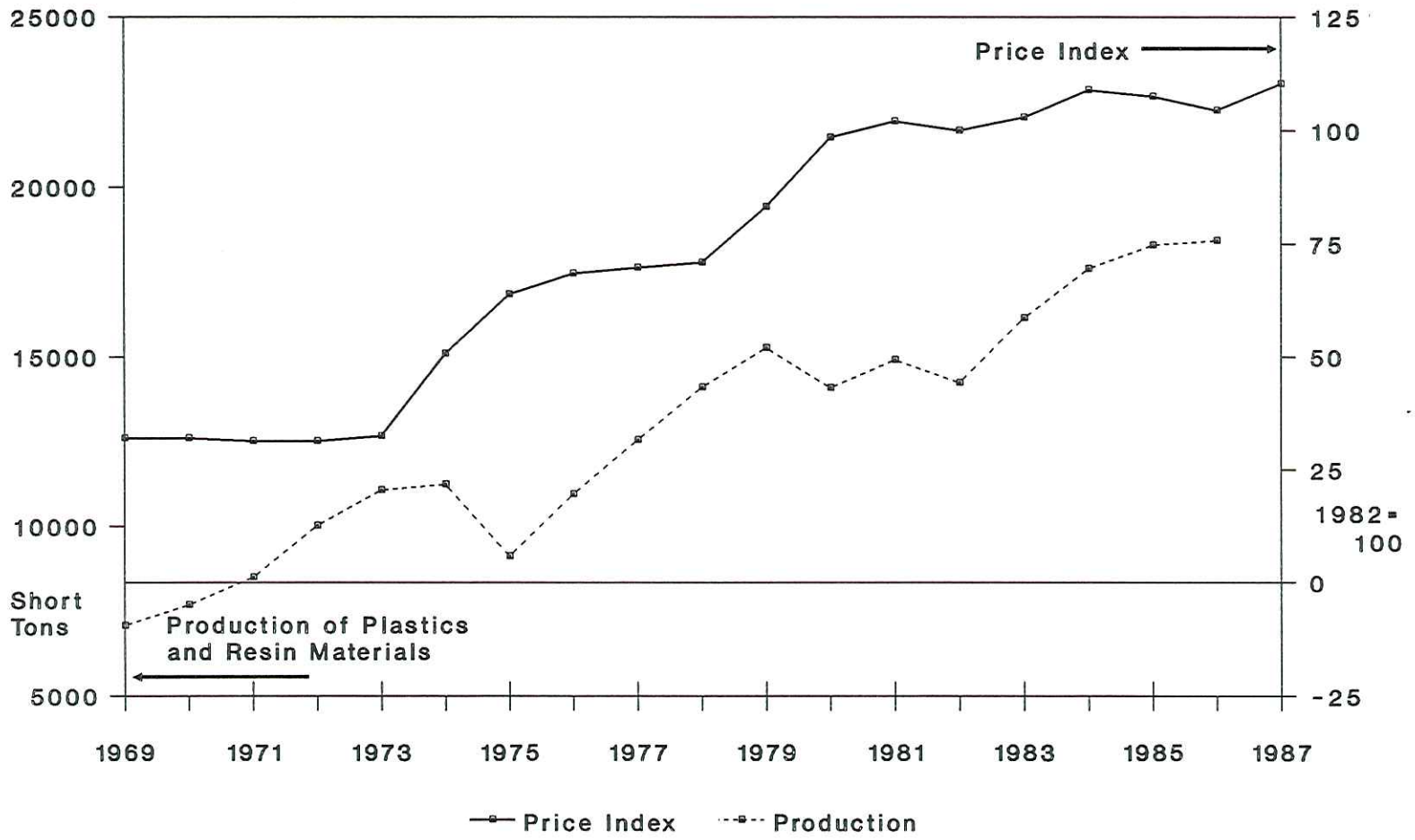
Nationally, the U.S. accounted for about 39% of world paper recovery, 23% of world ferrous recovery, and 40% of world aluminum recycling. According to the 1986 Minerals Yearbook, U.S. share in the export trade of scrap ferrous was 29%, slightly greater than the U.S. share of ferrous recycling.

g. Past Versus Potential Future Growth Rates in Material Recovery

Franklin Associates, Ltd. has projected materials recovery growth through the year 2000 assuming no dramatic changes in existing recycling practices. Their projections have paper fibers recovery from municipal waste remaining below 25%, glass recovery rising slightly from 9% to 11%, aluminum beverage can recovery remaining near 50%, and plastics recovery growing from 2% in 1986 to 4% in 2000. [Franklin Associates, Ltd., Characterization of Municipal Solid Waste in the United States, 1960 to 2000 (Update 1988), Working Papers, April 1988.]

Figure C-18

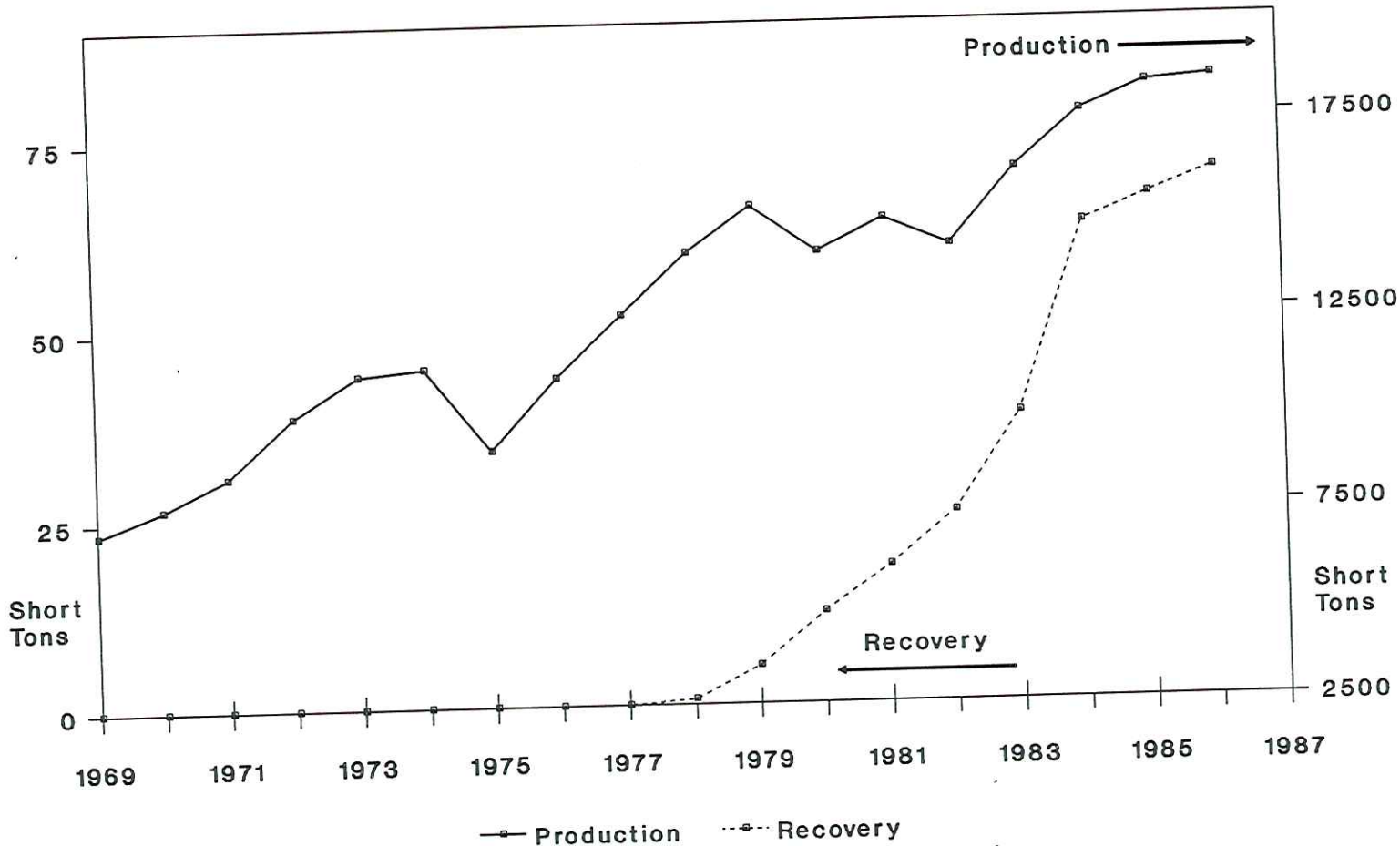
U. S. Plastics Production Price Index and Quantity



Sources: Supplement to Producer Price Indices, Business Statistics, 1986, and Survey of Current Business

Figure C-19

U. S. Plastics
Production and Recovery



Sources: Supplement to Producer Price Indices, Business Statistics, 1986, Survey of Current Business and Franklin Associates

TABLE C-4

1987 RECOVERY - WORLD AND U.S. TOTALS
FOR MAJOR COMMODITY GROUPINGS
AND WASHINGTON STATE AND WGA SHARES

	Short Tons Recovered		Washington Recovery As % of			
			World Recovery		U.S. Recovery	
	World(1) (000)	U.S. (000)	State	WGA's	State	WGA's
Paper	61,600	23,928	0.9%	0.01 -0.7%	2.2%	0.02-1.8%
Ferrous	349,873	79,982	0.1%	0.003-0.07%	0.5%	0.01-0.3%
Aluminum	5,110	2,036	0.2%	0.01 -0.07%	0.5%	0.01-0.2%

Sources for World Recovery: 1986 Minerals Yearbook, Paper Recycling Committee of the American Paper Institute, and the Aluminum Association:

(1) - World Recovery Data are 1986 for paper, 1985 for ferrous, and 1987 for aluminum.
(2) - World and U.S. aluminum recovery is metal from all sources of scrap aluminum; Washington recovery is for used aluminum beverage cans.

The growth in recovery quantities projected by Franklin Associates, Ltd. from 1986 to 2000, compared with the actual growth rate for the 1972 to 1986 period, is 2.3% compared to actual 4.2% for paper fibers; 1.6% versus actual 9.7% for glass; 2.3% compared to 18.1% for aluminum beverage cans; and 5.6% versus 66.8% during 1978 to 1986 for plastics. If actual growth rates were maintained through 2000, recovery rates would be 31% for paper fibers; 36% for glass; 100% for aluminum; and 100% for plastics.

These calculations suggest that doubling present recovery rates of glass and plastics by the year 2000 can be done with less growth in actual quantities recovered than in the past. For these materials, then, widespread, aggressive, publicly initiated recycling programs should cause little price disruption.

A similar case can be made for aluminum beverage cans. With aluminum beverage cans, the problem is more one of finding ways to extract the cans from the waste stream, than it is of obtaining an adequate price once the aluminum has been recovered.

That leaves the difference between doubling recovery of paper fibers from less than 25% at present to 50% by the year 2000 and the extended growth path recovery rate of 31% in 2000 if public recycling were to aim at doubling current recovery rates. A 50% recovery rate in the year 2000 would require a materials recovered growth rate of 7.5%, an increase of 80% over the actual growth rate of 4.2% during the 15 years preceding 1986.

To analyze the impact of accelerated growth in paper recovery, one must have information on supply and demand price elasticities, where price elasticity is measured by the ratio of the percentage change in quantity to

the percentage change in price. The vertical demand curve of Figure C-2 in Subsection C.4 above has demand price elasticity of zero because quantity demanded does not change as prices change. Recall that this vertical-type curve is called perfectly inelastic.

On the other hand, the horizontal WGA market demand curve exhibited on Figure C-3 is called perfectly elastic. This is because quantity demanded varies as supply changes with no increase or decrease in price needed to motivate a change in the quantity that can be sold at the WGA market level.

Figure C-1 of Subsection C.4 shows supply and demand curves with price elasticities in between the perfectly inelastic and the perfectly elastic. Subsection C-6 examines estimates of price elasticities for recyclable commoditites in Washington.

6. EMPIRICAL ESTIMATES FOR PRICE ELASTICITIES

To give a precise quantitative projection of the impact of widespread national and international recycling by the public sector on Washington State's existing private recycling industry requires estimating total market supply and demand curves portrayed on the right side of Figure C-3 exhibited in Subsection C.4 above. Given the estimated curves one would then need to project values for all the shift factors listed at the end of Subsection C.4. The time frame for the Best Waste Management Practices project did not permit this type of empirical work on aggregate recyclable materials markets.

We have chosen instead to estimate for each material recycled extensively in the WGA's in 1987, the local WGA supply curve shown on the left side of Figure C-3. Data are required to determine the extent to which local supply curves are elastic or inelastic with respect to price. Price changes resulting from widespread increased recycling will have varying effects on the quantity recycled by existing WGA private recyclers, depending on whether WGA supply curves are more or less elastic. The elasticity estimate reveals how local industry would respond to a price decrease.

This subsection also provides an estimate of aggregate waste paper market demand elasticity based on work by other researchers. This estimate, combined with our empirical estimates of WGA supply curves, yields the quantitative projection given below of the impact of public recycling on existing WGA recyclers.

a. WGA Demographic, Economic, and Recyclables Price-Quantity Data

Table C-5 lists tons recycled and average market price received for waste categories recovered during 1987 in each Washington State WGA. The WGA market prices were estimated by using prices paid in Seattle or Portland by end-users or exporters and then deducting costs of shipping recyclables from the WGA to whichever market yielded the highest price net of these transportation costs.

TABLE C-5

Recyclables Prices and Quantities for 1987 by WGA

Commodity	West WGA(1)		Northwest WGA(2)		Puget Sound WGA(3)		Southwest WGA(4)		N Central WGA(5)		S Central WGA(6)		Northeast WGA(7)		Southeast WGA(8)		STATE	
	TONS	PRICE	TONS	PRICE	TONS	PRICE	TONS	PRICE	TONS	PRICE	TONS	PRICE	TONS	PRICE	TONS	PRICE	TONS	PRICE
Nws	2,500	$ 48	2,800	$ 48	127,900	$ 53	7,500	$ 52	1,600	$ 53	8,800	$ 53	14,100	$ 53	1,400	$ 53	166,600	$ 53
Occ	2,500	96	2,800	96	235,900	100	7,000	99	2,100	100	7,300	100	23,300	100	6,700	100	287,600	100
Hgr	0	107	300	108	44,900	120	2,100	118	0	120	100	120	1,300	120	300	120	49,000	120
Mxd	0	16	200	17	28,900	33	3,500	30	0	15	0	22	1,400	12	100	21	34,100	32
Gls	600	24	400	29	15,400	40	1,200	39	100	31	900	35	1,500	30	2,200	34	22,300	38
Rfl(Br)	900	83	1,100	94	12,000	116	1,000	89	1,100	76	1,100	99	1,000	96	800	94	19,000	106
Rfl(Sft)	0	83	0	94	700	116	0	89	300	76	300	99	0	96	400	94	1,700	101
UBC	300	1,067	700	1,086	3,700	1,100	600	1,099	400	1,084	700	1,083	2,900	1,100	1,500	1,087	10,800	1,095
Tin	0	35	100	45	500	52	0	44	0	42	0	44	0	42	200	41	800	48
PET	0	94	0	115	0	160	0	154	0	-251	0	121	0	119	0	116	0	
Pls	0	121	0	137	0	170	1,700	166	0	-139	0	141	0	140	0	137	1,700	166
Subtotal	6,800	$113	8,400	$157	469,900	$ 91	24,600	$102	5,600	$150	19,200	$111	45,500	$145	13,600	$192	593,600	$101
Fer	9,200	$ 19	34,000	$ 38	243,200	$ 52	62,400	$ 49	14,700	$ 33	19,000	$ 35	26,700	$ 32	14,600	$ 30	423,800	$ 46
Wht	100	5	200	24	24,300	38	0	35	0	19	0	21	100	38	100	25	24,800	38
Nfr	1,000	767	800	786	33,300	800	1,500	797	600	781	3,000	783	3,700	780	2,700	778	46,600	795
Bat	300		1,500		15,000		1,800		400		900		1,500		700		22,100	
Tir	0		0		7,500		500		0		100		2,000		200		10,300	
Oil	1,200		800		39,500		7,500		500		1,200		2,800		2,700		56,200	
Total	18,600		45,700		832,700		98,300		21,800		43,400		82,300		34,600		1,177,400	

OTHER DATA

	WGA 1	WGA 2	WGA 3	WGA 4	WGA 5	WGA 6	WGA 7	WGA 8	State
Avg Tip Fee ($/ton)	$11.77	$28.43	$21.75	$9.09	$6.36	$17.07	$18.60	$9.92	
Avg Tip Haul (RT)	54	50	40	24	26	28	32	16	
Cost @ $.125/mi	$6.75	$6.25	$5.00	$3.00	$3.25	$3.50	$4.00	$2.00	
Avg Tip Cost ($/ton)	$18.52	$34.68	$26.75	$12.09	$9.61	$20.57	$22.60	$11.92	
Households	98,236	114,051	1,113,184	147,579	73,788	92,858	175,743	96,880	1,912,319
Employment									
-Office Type	29,498	27,893	578,430	59,707	22,256	30,016	62,365	46,632	856,797
-Total	54,086	66,372	1,197,777	113,106	59,373	81,080	145,076	95,570	1,812,440
Employment per Household									
-Office Type	0.30	0.24	0.52	0.40	0.30	0.32	0.35	0.48	0.45
-Total	0.55	0.58	1.08	0.77	0.80	0.87	0.83	0.99	0.95
Avg Emplymnt Income	$16,955	$16,484	$21,281	$19,006	$22,991	$14,609	$17,351	$19,570	$20,187

Note: Sources for Household Counts, Employment, and Employment income data:
Washington State Employment Security and Office of Financial Management; data for 1987.

Figures C-20 and C-21 provide a pictorial representation of recycling activity by households in each WGA. Figure C-20 shows pounds recovered per household for the paper waste categories--newsprint, corrugated cardboard, high-grade paper, and mixed waste paper. Corrugated cardboard was most frequently recycled, followed by newsprint. The high-grade and mixed-waste paper categories had recovery activity mainly in the Puget Sound and Southwest WGA's. For newsprint and corrugated cardboard the Puget Sound, Northeast and South Central WGA's had the highest levels of household recycling.

Figure C-21 indicates pounds recycled per household for the container waste categories--refillable glass containers, other recyclable glass containers, aluminum beverage containers, and tin food and beverage cans. For all types of containers, household recycling activity was more equal among the WGA's than for paper fibers recovery. The Southeast WGA tended to lead in container recycling, while the North Central WGA distinguished itself with relatively high container recycling even though its paper recycling was near or at the bottom among WGA's.

Table C-5 lists the household counts used to convert total recycling tonnages to a per household basis. That table also shows estimated tipping costs including haul costs to the disposal site. The North Central, Southeast and Southwest WGA tipping costs were lower than tipping costs in the other five WGA's by nearly 50% or more.

Additional information exhibited on Table C-5 depicts employment in total and for office occupations, employment per household, and average employment income, all for calendar year 1987. These data were all used to interpret variations among the WGA's in recycling activity that were not explainable by variations in prices received for recovered materials.

Finally Table C-5 shows a calculation of average price received for household and business generated recyclables, excluding ferrous and non-ferrous metals and white goods. These prices averaged $101 per ton in 1987, a year of peak market prices, ranging from a low of $91 in the Puget Sound WGA to a high of $192 in the Southeast WGA. The lower average price in Puget Sound was due to a high recycling rate for the low priced mixed waste paper material. The high average price in the Southeast resulted from a concentration on aluminum recovery.

b. Estimated Supply Curves and Shift Factors

Historical data on recycling in Washington State are virtually nonexistent. Data on recycling quantities and prices in each WGA in 1987 are available, although these data only provide eight observations on price-quantity pairs for each material recycled. A sample of market data for different geographic areas (here the eight WGA's) during the same time period (here 1987) is called a "cross-section" sample. By contrast, historical data on market transactions in the same geographic area at different points in time is called a "time series" sample.

The main parameter of interest for the estimated WGA supply curves is the supply price elasticity of recyclable materials by the private recycling industry in each WGA. The typical estimate of price elasticity using

Figure C-20

Paper Fibers Recycled Per WGA Household in 1987

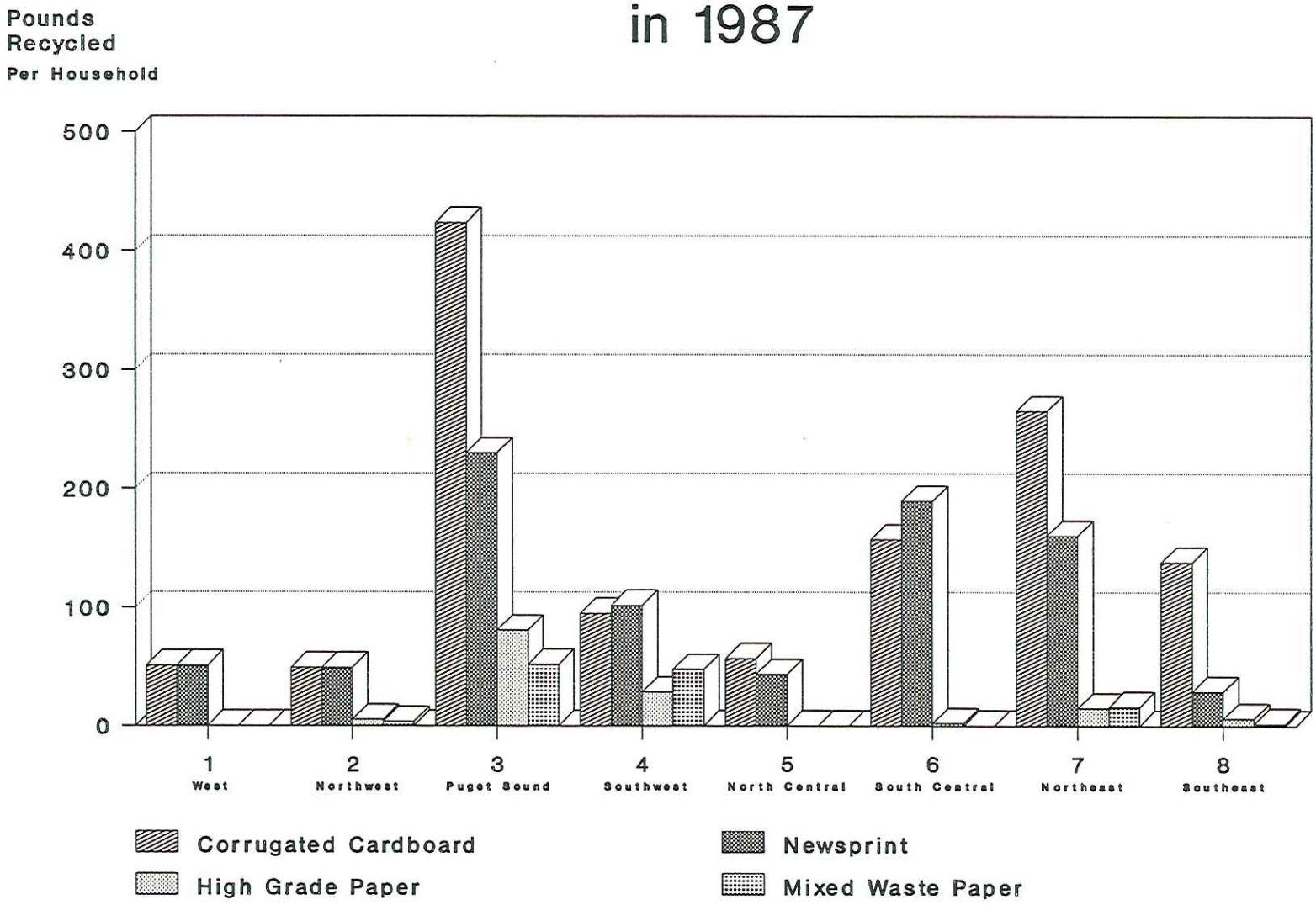
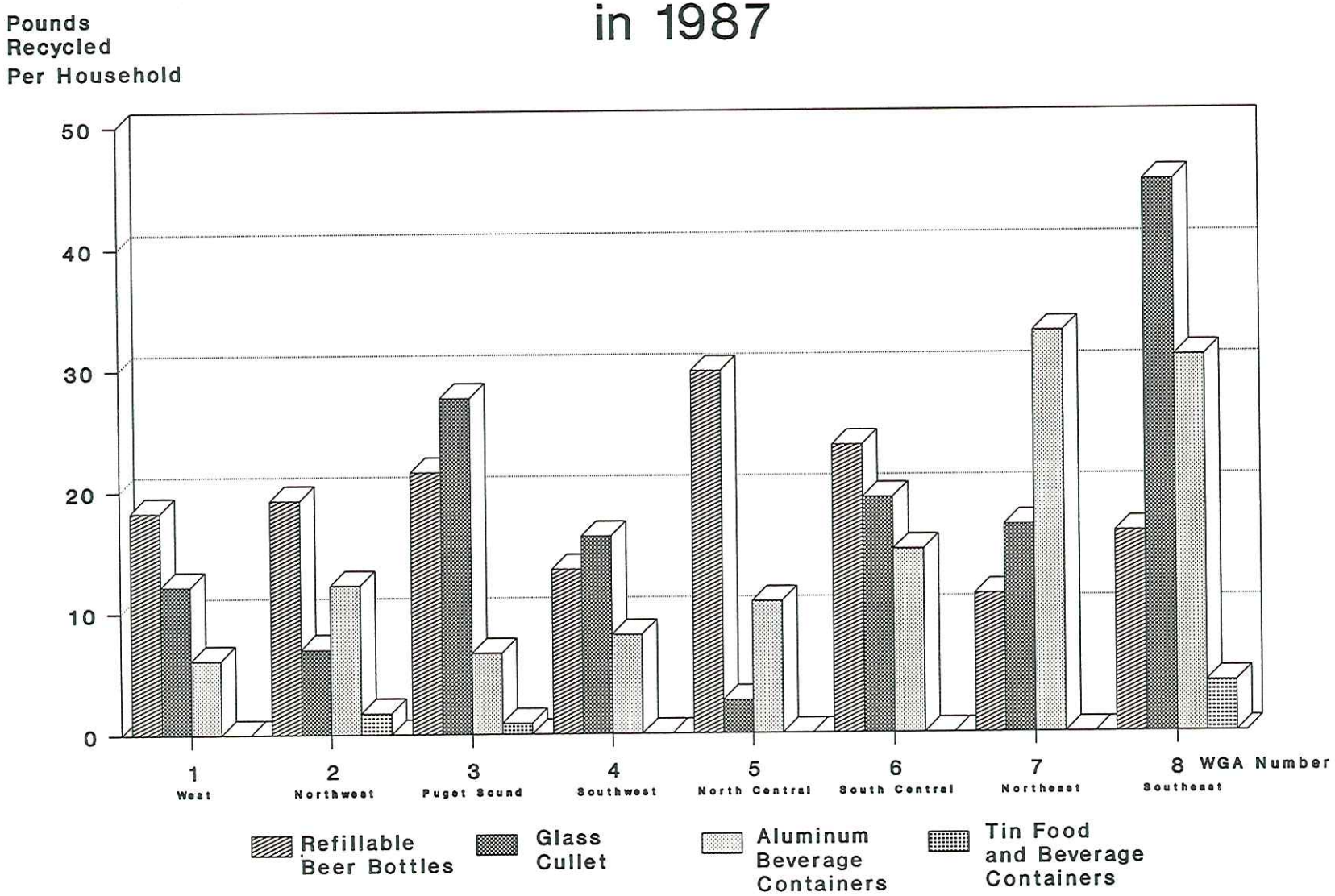


Figure C-21

Containers Recycled Per WGA Household in 1987



year-to-year data tends to measure short-run response to price change. As such it usually understates the long run price elasticity. Cross-sectional samples are better for estimating the more permanent response to price change. This is because price differences in a cross-section often represent more permanent differences. So despite the small size of the WGA cross-sectional sample, price elasticities based on this sample should tend to portray the more permanent supply response to price decreases as a result of expanded recycling.

The statistical procedure of linear regression was used to estimate WGA supply curves. Linear regression provides a method for determining the separate effects of a number of interacting factors. For each WGA material supply curve the factors believed to determine recycling per household were: price paid by end-users for the recyclable material, the tipping cost for disposing rather than recycling, the amount of business activity in the WGA as measured by number of employees per household (greater volumes of commercially generated recyclables would typically be associated with higher levels of employment per household), and average employee income (higher incomes are typically associated with increased waste and recyclables generation).

Table C-6 exhibits estimated price and tipping cost elasticities for WGA supply curves for 11 different recycled materials. Tons recycled per household was used to measure WGA recycling in order to hold constant the effect of population size variations among the WGA's. Tons recycled for each of 11 recyclable materials was regressed on a constant term, market price in dollars per ton, tip cost (the sum of tipping fee and average haul distance to the disposal site) in dollars per ton, WGA employment per household, and average employee income measured in thousands of dollars. Table C-6 also lists estimated coefficients for the constant term and each of the four explanatory variables. The term coefficient refers to the quantitative increase or decrease in WGA tons recycled per household for each unit change in the explanatory variable. For example, for newsprint, an increase by one in a WGA's employment per household yields increased newsprint recycling of .256 ton per household.

A consistent procedure was used to select significant factors for each recycled material's WGA supply curve, as well as to adjust for WGA factors not quantified by the four explanatory variables. Results are briefly summarized below for each recycled material. Detailed printouts of regression results are included in the appendix to this section.

(1) Newsprint

The supply price elasticity for newsprint in Washington State was estimated to be zero, as was tipping cost elasticity. Each employee in a household is associated with .256 ton of recycled newsprint (about 512 lbs), but higher employment income WGA's recycle less newsprint. Given that much newsprint recycling originates from paper drives and drop boxes, the zero price and tip cost elasticity estimates are not surprising.

TABLE C-6

Estimated Coefficients and Elasticities for Recyclable Materials Supply Curves

Recyclable Material	Recycled Tons/Hhld	Constant	Price/Ton	Price Elasticity	Tipcost	Tipcost Elasticity	Emp/Hhold	Avg Emplmnt Incme (000)
Newsprint	0.0871	SNS	SNS	0	SNS	0.0	0.256 (0.008)	-0.008 (0.000)
Corrugated Cardboard	0.1504	-0.223 (0.027)	SNS	0	0.007 (0.001)	1.0	0.218 (0.032)	SNS
High Grade Paper	0.0256	-0.072 (0.005)	SNS	0	0.0006 (0.0001)	0.5	0.142 (0.008)	0.001 (0.000)
Mixed Waste Paper	0.0178	-0.043 (0.002)	0.002 (0.000)	2.2	9E-05 (0.00002)	0.1	-0.027 (0.001)	0.001 (0.000)
Glass Cullet	0.0117	-0.007 (0.001)	SNS	0	SNS	0	0.019 (0.002)	SNS
Reflbl Beer Bottles	0.0099	SNS	0.0001 (0.00002)	1.3	SNS	0	SNS	SNS
Alm Bvrg Containers	0.0056	SNS	5E-06 (.0000007)	0.9	SNS	0	SNS	SNS
Tin Food & Bvrg Cans	0.0004	-0.002 (0.000)	6E-05 (0.00001)	6.7	2E-05 (0.00001)	1.2	-0.002 (0.000)	SNS
White Goods	0.0129	SNS	SNS	0	4E-05 (0.00001)	0.1	SNS	SNS
Ferrous Metals	0.2216	-0.761 (0.081)	0.018 (0.001)	2.8	SNS	0	0.326 (0.040)	SNS
Nonferrous Metals	0.0244	0.344 (0.117)	-0.0004 (0.0001)	-	SNS	0	-0.022 (0.005)	SNS

Notes:
1. SNS = Statistically Not Significantly different from zero.
2. For the supply of high grade waste paper employment per household is office type employment.
3. The price used to estimate refillable beer bottle supply is the difference between the price for refillables and the price for cullet.
4. The dependent variable for ferrous and nonferrous supply curves was tons recycled per employee, and households per employee was used in place of employees per household as an independent variable.
5. Standard errors for coefficient estimates are reported in parentheses underneath each coefficient estimate.
6. All elasticities were calculated at sample averages for price and quantity recycled.

(2) Corrugated Cardboard and High-Grade Paper

For both corrugated cardboard and high-grade paper, price was not a statistically significant explanatory variable, but tipping cost was. Given that both these materials tend to be recycled from the commercial waste stream, this result is understandable. Businesses typically face disposal costs that vary directly with quantity of waste. Cardboard and high-grade paper are easily separated and make up a substantial portion of waste for certain types of business, e.g., cardboard for retail and wholesale trades and high-grade for offices. Avoidance of disposal cost rather than resale revenue motivates separation and recovery in these commercial operations.

Employment per household, where only employment in office-type businesses was used for the high-grade equation, was a significant variable for both materials. This is again consistent with the commercial source of these recovered materials. About 436 lbs (.218 x 2,000) of cardboard and 284 lbs (.142 x 2,000) of high-grade paper were recycled in each WGA for each employee in a household.

Average employee income also was significant in explaining high-grade paper recycling. In this case the variable probably served as a proxy for relative degrees of paper generation in office occupations, assuming that higher income offices generate more paper per employee.

(3) Mixed Waste Paper

For this paper waste category, all explanatory variables were statistically significant. The supply price elasticity derived from the price coefficient is 2.2, which is quite high. The Puget Sound and Southwest WGA's recorded prices for mixed waste paper in 1987 that were 50% to 100% higher than prices paid in the other six WGA's. The resultant bifurcated sample may have yielded an upward bias to the estimate for price elasticity.

Perhaps it would be interesting to mention here that the substantial drop in price for recycled paper fibers during the 1974-75, 1980-82, and 1984-85 time intervals provides alternative estimates for the supply elasticity of recycled paper. Figure C-8 in Subsection C.5 above showed the supply side reaction to the sudden fall in price in each case, where it can be assumed that rapid shrinkage in demand led to the price decreases. The indicated price elasticity for recycled paper supply was .27 for 1974-75, .12 during 1980-82, and just .04 for 1984-85.

As discussed above, these time series elasticity estimates probably reflect short-run behavior and long-run elasticity would be greater than 0.1 to 0.3. In the case of mixed waste paper grades, it is doubtful, however, that long run WGA supply price elasticity would be as great as 2.2.

(4) Glass Cullet

The only statistically significant coefficients for glass cullet were the constant term and coefficient for household employment. Glass of this type is recycled mainly through drop boxes, the provision of which depends

more on prices for recyclables such as aluminum, paper, and scrap ferrous. Zero price and tipping cost elasticities are thus not surprising results.

(5) Refillable Beer Bottles

In estimating this supply equation the explanatory price used was the difference between the price per ton for refillables and the price for glass cullet. When this difference gets too low, recyclers avoid the extra costs of handling refillables by recycling them with other glass as cullet. This price difference variable proved to be the only statistically significant explanatory variable and yielded a calculated price elasticity of 1.3. Because recyclers can easily sell refillable beer bottles as cullet when their price as refillables falls too low, an elastic WGA supply curve seems believable. (A demand or supply curve is said to be elastic when price elasticity exceeds one because in that case the percentage quantity response to a price change is greater than the given percentage price change.)

(6) Aluminum Beverage Containers

For the supply of recycled aluminum cans, only the price paid for secondary aluminum was significant. Price elasticity for aluminum was estimated to be 0.9. This elasticity compares with .21 calculated from the decrease in aluminum recycling from 1981 to 1982 associated with the drop in real prices from 1980 to 1982; 0.08 calculated elasticity for the 1974-75 price drop; and 0.07 for the 1984-85 real price decline. (See Figure C-11 in Subsection C.5 above.) These elasticity estimates suggest that the long run supply price elasticity for aluminum is probably in the interval 0.5 ± 0.4.

(7) Tin Food and Beverage Cans

All explanatory variables except for average employment income had statistically significant correlations with tin recovery per household during 1987 in the WGA's. However, the fact that only three of the WGA's had any tin recovered suggests that the coefficient estimates are probably unreliable.

(8) White Goods

Tipping cost was the only statistically significant explanatory variable for WGA supply of recycled white goods. Estimated tipping cost elasticity of 0.1 implies that doubling tipping costs would increase white goods recycling by only 10%. As discussed in Subsection C.3, regulatory concerns are at present more important for white goods recovery than any factors considered in this econometric analysis.

(9) Ferrous Metals

WGA market prices and employment levels per household were statistically significant variables in explaining variations among the WGA;s in ferrous recovery during 1987. Estimated price elasticity of 2.8 compares with elasticities calculated from the U.S. aggregate time series data presented graphically in Subsection C.5 above of 0.6 for the 1974-75 real price decrease and 0.8 for the 1980-82 decline in real prices for ferrous scrap.

The explanation for ferrous' greater elasticity compared with paper and aluminum likely involves two factors. First, relative to paper, ferrous is more readily stored both because recyclers have more storage capacity for ferrous than for paper, and because ferrous does not deteriorate in storage as quickly as paper. When ferrous prices drop, ferrous scrap recyclers can thus more readily hold materials back from resale and wait for prices to improve.

Secondly, relative to aluminum's price, the price for ferrous probably is much closer to the point at which the collection network for the recycled good would begin to shut down. Downward movements in ferrous prices result in changes in the disposal-recycle decision more quickly than they do for aluminum.

(10) Non-Ferrous Metals

WGA market price and employment levels were statistically significant variables in explaining recovery variations among the WGA's during 1987. However, the estimated coefficient for market price was negative, the opposite of the sign expected for the slope of a supply curve. Perhaps the under-reporting of ferrous and non-ferrous metals recovery quantities encountered in estimating 1987 recycling of these materials contributed to the unreliable estimate of price effects for non-ferrous metals. Also the fact that non-ferrous is an aggregated quantity composed of various metals with different market prices could cause such an anomalous result.

(11) Plastics

Not enough plastics recycling occurred in the WGA's during 1987 to support statistical estimation of a supply curve.

c. Concluding Note on WGA Supply Price Elasticities

The evidence in Table C-5 and the data exhibited in Subsection C.5 above suggest some tentative conclusions about WGA supply price elasticities that will be used in Subsection C.7 to analyze local impacts of expanded aggregate market supplies of recyclables:

- Newsprint, corrugated cardboard and high-grade paper supplies in the WGA's have near zero price elasticities for price changes up to 10% (the range of price variation in the WGA's during 1987).

- For price decreases above 10%, price elasticities in the neighborhood of 0.2 or 0.3 can be expected for newsprint, corrugated cardboard and high-grade paper recovery for price decreases up to about 50% that do not persist longer than a few years.

- Mixed waste paper WGA supply price elasticity is higher than for the other three paper grades, and in fact may exceed the inelastic/elastic boundary value of 1.0 and be as large as 2.2.

- WGA supply price elasticity for glass cullet is near zero for price variations of 25%.
- Refillable beer bottles have a WGA supply price elasticity in the neighborhood of 1.3 for price changes as great as 20%.
- Aluminum beverage container supply price elasticity is near 1.0 for price variations up to 5%.
- For price decreases as great as 25 to 50% that persist for just a few years, aluminum recovery supply price elasticity is probably much less than 1.0 and closer to the range 0.1 to 0.2.
- Ferrous scrap supply price elasticity is about 0.7 for price decreases up to 40% that persist for just a few years.
- For long-run price decreases, WGA supply price elasticity for ferrous scrap is likely to be greater than 1.0.

7. IMPACT OF PUBLICLY SPONSORED RECYCLING ON EXISTING RECYCLERS

This section uses the information from the previous four sections to examine and project impact on the existing recycling industry in each WGA and in the State of publicly initiated recycling.

a. Effects of WGA Level Public Recycling on the WGA's Existing Recyclers

The Puget Sound WGA has the greatest recovery volume for each waste category. As a percent of U.S. recovery for domestic consumption or export, Puget Sound's paper fibers recycling accounts for about 1% of mixed waste paper recovery, about 2% of corrugated cardboard and high-grade paper recovery, and about 3% of newsprint recovery. Puget Sound accounts for between 2 and 3% of national glass recycling, less than 1% of aluminum recycling, and less than 1% of ferrous metals recovery.

Washington State in total accounts for slightly more than 1% of U.S. mixed waste paper recovery, 2 to 2.5% of corrugated cardboard and high-grade paper recycling, and almost 4% of newsprint recovery. Further, the State accounts for almost 4% of glass recycling, less than 1% of aluminum recycling and less than 1% of ferrous metals recovery. As discussed in Subsection C.5 above, the State accounts for less than 1% of world recovery of paper fibers, ferrous scrap and aluminum.

Because each WGA's waste and recovery volume is small relative to national and world market recyclables recovery, the analogy with a competitive industry discussed in Subsection C.4 above seems exactly applicable for all materials which already enjoy a developed resale market, with the possible exception of glass. That is, the price impact of increased recycling at the

WGA level, whether brought on by public initiative or not, will be essentially zero. As with current recycling volumes, the additional materials recovered can also be sold at the prevailing national/international market price without impacting that price negatively.

In the case of glass, markets are more regional than national or international. However, the analysis of current and planned glass end-user capacity presented in Subsection C.3 above suggested that the regional market could support expanded recycling in the WGA's.

For plastics, lawn and garden waste, wood waste, RDF-type prepared fuels, and other solid waste categories for which markets are just developing or not yet in existence, publicly initiated recycling will have minimal impact on the existing private recycling industry. Private recyclers have little present income to lose if public recycling of these materials becomes widespread. However, future income from private recycling of these materials could be affected by public collection activities.

Although the price effect of WGA-level public recycling is quite likely zero, there could be indirect quantity effects on existing recyclers caused by new competition in the effort to collect recyclables or to induce households and businesses to drop off or sell recyclable materials. In terms of the supply and demand Figure C-4 given in Subsection C.4 above, this increased cost of collecting recyclables would cause the existing recyclers supply curve S_0S_0 to shift back to $S_0'S_0'$. At given prices, the existing recycling industry would then be recovering a lower quantity of material than before.

Public participation in recycling could increase household and business awareness of recycling. This would lead to greater drop off activity and an increased supply for existing recyclers. This apparently occurred in Jefferson County when a pilot curbside program was added to an existing drop box/buy-back facility located at the landfill site. However, the additional drop box/buy-back center activity may have originated from parts of Jefferson County not served by the pilot curbside collection program. [Department of Ecology & Washington Conservation Corps, "Community Recycling Pilot Project," Draft Report to the Legislature, March 1986.]

The City of Seattle's Solid Waste Utility conducted an informal survey of 17 similar cities to discover the effects of curbside collection on pre-existing recycling programs. Eleven cities reported having fairly extensive private drop box/buy-back center recycling prior to curbside initiation. Of these 11, nine reported positive effects on existing recyclers, one reported taking over the existing system, and one reported a slightly negative impact. [City of Seattle Summary Memo, August 11, 1987.]

Some direct empirical evidence is beginning to accumulate from Seattle's curbside collection program which started in February 1988. Although the data are preliminary and no formal analysis has been published by the City, it would appear that there has been a large negative substitution effect inside City limits, and a positive publicity/awareness effect outside of Seattle.

Specifically, newsprint drop box volumes inside the City are down about 50% compared with 1987, and glass drop-off quantities are also lower by at least 50%. Buy-back volumes in the City are down 10% for newsprint and 8% for aluminum. Further, Seattle's private small curbside operation ceased collecting recyclables when the City-sponsored collection program began Citywide operation.

Outside Seattle, newsprint drop offs are up 23% and glass drop box quantities are up 20%. Newsprint buy-back is up 10% and aluminum buy-back is up 20%, despite the reduced market prices in 1988 for both materials.

Several conclusions seem to emerge. First, a public sector collection program which provides more convenience at similar or lower cost will reduce the flow of materials to private recyclers. Conversely, public sector recyclables collection programs will have less effect on existing private recycler operations when extra convenience comes at a price to households or businesses. Third, in areas where the new public sector program is not offered but the publicity and awareness generated by the program is noticeable, there could be a substantial positive effect on private recyclers material recovery volumes. And fourth, the net effect of local public sector collection on overall local recovery rates will be positive, despite the negative supply substitution impact on private recycler volumes.

b. Effect of State Level Public Recycling

Washington State level publicly initiated recycling activities should not differ substantially in their impact on existing private recyclers from the impacts just described for WGA-level publicly initiated recycling. At both the WGA and State levels, the volume of current and potential materials recovery is too small to significantly effect national and international price levels for recovered materials.

c. Effect of Expanded National Recovery on Washington State's Existing Private Recycling Industry

Although one WGA or the whole of Washington State cannot substantially impact prices for recovered materials even by engaging in aggressive publicly initiated recycling activities, a major open question is what impact all the states of the U.S. (and even other countries) can have on existing recyclers. This issue is put in perspective by Figure C-5 of Subsection C.4 above. Many Washington State-size jurisdictions getting involved in public recycling would shift the aggregate market supply curve S_mS_m significantly. Assuming nothing changed on the demand side, this would cause a fall in equilibrium price P_m that would persist. If aggregate demand increased because of one of the shift factors discussed in Subsection C.4, or if supply subsequently contracted because private or public recycling programs ceased operation in the face of persistent lower price, then market prices would begin to rise toward previous levels.

It should be mentioned here that public sector recycling programs, driven as they likely will be by disposal cost avoidance, will be less responsive to market price than are current private sector operations. This implies

more inelastic supply curves for both local WGA and aggregate markets. This, in turn, means that demand side shifts will lead to greater market price fluctuations because recyclables supplies will not change as much in response to demand-induced price movements.

Returning to the analysis of increased aggregate supply of recyclable materials, and Figure C-5, the size of the price decrease caused by an increased aggregate supply would be related to the magnitude of the supply side shift. It would also be related to the price elasticity of world demand. The more inelastic (vertical) the demand curve D_mD_m, the greater the price decrease associated with any given shift in recovered materials supply. A recent as yet unpublished study of the domestic paper and recycled paper markets found that end-user price elasticity of demand for recycled paper fibers was less than -0.1, a strongly inelastic demand curve. [Edgren, John A., and Moreland, Kemper W., "A Critique of Recycling Policy Based on an Econometric Analysis of Paper and Wastepaper Markets," Eastern Michigan University, December 1987.] For the reasons mentioned previously that cause time series estimates of elasticity to be low, one may question whether long-run wastepaper demand is that rigid. However, in the short run end-users for each recycled material would probably respond slowly to a large jump in materials recovery rates.

Given that demand is relatively inelastic, how large a shift might be expected in market supply, and what level of price decrease might be associated with that shift? In Subsection C.5 above, it was determined that continuation of past growth patterns in aluminum and glass containers recovery would accommodate the increased supplies of these two materials resulting from widespread publicly sponsored collection in the U.S. without significant market price disruptions. The same analysis held for plastics, although plastics recycling from municipal solid waste is in its infancy and problems exist in finding cost-effective means to collect, densify, and transport recovered plastics.

Increased ferrous and non-ferrous metal recovery from widespread residential or commercial business collection programs is unlikely to be of a magnitude that could affect market prices. Tin food and beverage cans are the only metal materials besides aluminum beverage cans likely to be targeted in public sector collection programs. The amount of tin can ferrous metal in the waste stream is inconsequential in comparison to the size of the scrap ferrous market. As discussed in Subsection C.3, the capacity for detinning is also adequate for increased recovery, and the world market for tin is quite able to absorb the extra tin supply.

Paper fibers remain the material of concern for the State's private recyclers in the event of widespread U.S. public sector involvement in recyclables collection. Markets for the various grades of recycled paper fibers have not been growing at a historical rate great enough to accommodate the supply side increases resulting from aggressive public paper recovery on a national scale.

As discussed in Subsection C.5, recovery of paper fibers would have to grow 7.5% per year to achieve the aggressive target of 50% for domestic recovery in the year 2000. This is 3.3 percentage points greater than the

4.2% growth rate for paper recovery during the 15 years prior to the present. Assuming that demand side increases would continue to absorb a 4.2% growth in supply without significant price disruptions, it is this extra 3.3 points of growth that defines an upper limit to supply side increases likely to cause price declines.

If the price elasticity of demand for recycled paper fibers is as low as -0.1, then an extraordinary supply increase of 3.3% would cause a 33% decline in market prices, all other factors remaining constant.

Given WGA supply price elasticities in the range 0.2 to 0.3 for newsprint, corrugated cardboard, and high-grade paper, Washington State's private recyclers would reduce their recovery levels for these grades by 7% to 10%. If mixed waste paper's WGA supply price elasticity is about 2, recovery levels for mixed waste paper would fall by 66%. This worst-case contraction of private sector paper recovery would continue as long as no demand side offsets occurred.

SECTION D

ECONOMIC ANALYSIS

1. INTRODUCTION

The evaluation of management methods for each WGA consists of an environmental evaluation, risk or technical feasibility evaluation and an economic evaluation. This section describes the objectives, methodology and limitations of the economic evaluation. Results of the WGA-specific economic evaluation are discussed in Section E.

2. OBJECTIVE

The overall goal of the economic analysis is to provide one basis for evaluating waste management methods. However, since a combination of methods is required to handle the whole waste stream, waste management methods cannot be individually ranked on the basis of economic impact. An appropriate ranking of methods requires examining them in the context of an integrated system. Regional variations in conditions also affect the economic impacts of different management methods. For these reasons, the specific objective of the economic evaluation is to identify the economic impacts of alternative solid waste management systems in each WGA.

3. GLOBAL IMPACTS

A solid waste management system includes all agencies, whether public, private or nonprofit, that handle solid waste from its point of generation to its final disposition, either by disposal or by sale to the recycling market. By this definition, certain costs and economic impacts external to the system are excluded from the analysis. While these impacts are not quantified in this analysis, they should be considered in the final evaluation of management methods. These external impacts include the costs to individual residents and businesses of source-separating recyclable materials from wastes and, in the case of drop-off/buy-back methods, the costs of transporting the recycled materials. Other external impacts might occur with reduction efforts; for example, when one type of good or material is substituted for another. Changes in solid waste methods could have a range of external impacts, from minor shifts in individual behavior to changes in business markets and jobs.

Another type of impact not measured by the economic analysis is the potential global impacts on allocation and use of natural resources. Resources are consumed, both in the creation of goods and when these goods are finally disposed of. It could be assumed that the value of these resources is reflected in the price paid for disposable goods, and in the cost of constructing and maintaining disposal facilities that meet all current environmental regulations. If this is the case, then standard cost estimates adequately reflect the value of the resources used. However, current prices

for these resources may not adequately reflect their long-term value. There are long-term costs associated with depletion of resources, pollution of resources, and use of irreplaceable resources. Many of these are not fully reflected in today's costs. Further, even though we include the cost of meeting current environmental regulations, it is likely that we do not have sufficient knowledge to anticipate and prevent all possible environmental degradation. Although these global impacts may be difficult to measure, they are no less real than the known and measurable costs of solid waste management.

4. QUALITATIVE ECONOMIC ANALYSIS

The following subsection describes the quantitative economic analysis of the impacts internal to the solid waste management system. Subsections D.4.a. and b. discuss the methodology and limitations of the economic analysis. The results of the economic analysis for each WGA are discussed in Section E, Evaluation of Best Management Practices for Each WGA.

a. Methodology

The approach to the economic analysis was directed by several requirements of this study. The economic analysis is based on Waste Generation Areas, requiring analysis of regions, rather than of specific jurisdictions with specific waste management responsibilities. The analysis is designed to provide information on the disposition of each component of the waste stream, as well to compare methods and system alternatives. Also, in order to avoid any a priori judgments about management methods, the economic analysis does not distinguish between public, non-profit and private operations, nor does it incorporate assumptions about existing financial and administrative arrangements for solid waste management systems, and prior investments in facilities. Typical costs for new equipment and facilities are used in the model.

The economic analysis was developed in two phases: development of specific cost estimates and assumptions about operation for selected methods; and development of a model that quantifies all cost, revenue, and waste impacts for the solid waste management system.

(1) Method Cost Estimates and Assumptions About Operation

The cost estimates and operation assumptions for methods are described in detail in Appendix B. Costs and operation assumptions were developed for a selected list of methods. The list of methods was narrowed to include only those that are currently used in the solid waste management system or that are likely to be implemented in the future, and for which adequate quantitative data could be developed.

Also, in order to provide meaningful economic data, the analysis uses combinations of methods that realistically represent the solid waste system. For example, the method of curbside collection of comingled recyclables includes intermediate processing, disposal of rejected materials, and may

include some transfer and transport, depending on location of facilities. In order to realistically describe system costs for the curbside recycling method, the related costs of these other methods must be included. In this manner, the economic analysis examines combinations of methods that represent complete programs for handling solid waste, and evaluates the whole solid waste management system, reflecting the interaction among methods and their impacts on each component of the waste stream.

In some cases, methods were not included in the model because the available data on costs and impacts on the waste stream were inadequate for quantitative analysis. This is particularly the case for reduction methods. At this time, there is very little quantitative data on the cost and effectiveness of waste reduction methods.

Some methods in the economic analysis, such as Direct Commercial Recycling, Self Hauling, and Regular Collection and Disposal of Municipal Solid Waste were included in order to provide a complete picture of the solid waste system. These methods are not being evaluated , but are included as baseline elements of the current solid waste system.

The selected management methods in the economic analysis are:

- Curbside Collection of Recyclables: Single-Family, Source-Separated.
- Curbside Collection of Recyclables: Single-Family, Comingled.
- Curbside Collection of Recyclables: Multi-Family, Comingled.
- Commercial Direct Recycling.
- Collection of Source-Separated Commercial Recyclables.
- Drop-Off or Buy-Back of Recyclables ("Regular Recyclables" and "Special Wastes".)
- Collection and Centralized Composting of Yard Waste.
- Separation of Recyclables from Targeted Commercial High-Grade Loads.
- Self-Hauled Waste.
- Regular Collection and Disposal of Municipal Solid Waste.
- Mixed Waste Processing with Materials Recovery and Composting.
- Preparation of Refuse-Derived Fuel with Materials Recovery and Composting.

Several of these management methods require some type of disposal method for final disposition of wastes. The disposal methods included in the economic analysis are:

- Mass Burn Incineration with Disposal of Ash at Monofill
- Landfill Outside of Region with Long-Haul by Rail
- Landfill Within Region
- Landfill Within Region with Volume Reduction Through Baling.

Table D-1, Description of Method Costs, identifies the costs associated with each of these methods. Costs are divided into six categories: administration, education/promotion, collection, transfer, transport and disposal. Some of the cost categories are also "methods": education, transfer, transport and disposal. The cost categorization used in the economic analysis corresponds to the way waste is handled in the solid waste system, from the point of generation to final disposal or recovery. For example, some disposal costs are associated with the "methods" of regular collection and disposal of municipal solid waste. The actual cost of disposal will vary with the selected method of disposal (e.g., landfill or incineration), but is related to the volume of waste handled through the municipal waste collection method, self-hauled and other methods.

Some solid waste system costs are not associated with specific methods, but are common to the whole solid waste system. These include costs for overall management, preparation of comprehensive management plans, administration and enforcement of regulations, and related activities. These costs tend to be associated with jurisdictional responsibilities rather than with specific waste management methods. These costs are not meaningful for evaluating different management methods, although they are real costs. For this reason, they are not included in the economic analysis. Therefore, the costs reflected in the economic analysis are lower than the total costs of the solid waste management system.

Table D-1 also identifies which subwaste streams (i.e., single-family residential, multi-family residential, commercial, and self-haul) are served by each method.

(2) Economic Analysis Model

The second phase of the economic analysis incorporates the cost estimates and operation assumptions for the selected management methods into a model of the integrated solid waste management system.

The methodology used for the model provides a cross-sectional rather than a longitudinal examination of the solid waste system. This approach was chosen because most of the important reasons for doing multi-year projections relate to jurisdiction-specific issues (e.g., life of existing facilities, impacts on landfill capacity, debt management, financing requirements, and

impacts on rates). A cross-section approach was more suited to the requirements of this study (e.g., information on the disposition of components of the waste stream, comparison of several different waste management methods, analysis of regional impacts).

The model is based on a hypothetical steady-state year in which all management methods are in full operation. The model uses average annual costs, based on the planning cost estimates and operation assumptions for each method. The average annual costs for major capital facilities are based on amortization of debt over a 20-year period at the real cost of borrowing (which excludes inflation). Capital costs include site development, and planning and design costs. However, the costs for a steady-state year do not include any costs for phasing in methods; for example, the time period needed to reach maximum participation levels in recycling programs.

Since they do not represent the actual costs and financial arrangements of any specific jurisdiction, in many respects these costs are hypothetical. They provide an appropriate general basis for comparing methods, but the unique circumstances of individual jurisdictions may create a different economic environment for choosing among solid waste management methods. For example, if a jurisdiction has recently invested in an incineration or waste processing system, its economic choices differ from a jurisdiction with less investment in its existing system.

(3) Structure of Model

The following is a brief description of how the model works. A basic model was designed using generic cost estimates and assumptions about operation for each method. In the model, waste generation amounts are broken into four subwaste streams: single-family residential, multi-family residential, commercial, and self-haul, and 27 waste categories.

Factors such as waste generation amounts, population, number of households, number of businesses, and household density are specified for each WGA. Certain costs, such as labor rates and landfill costs, and certain operation assumptions, such as recovery rates for existing recycling methods, are also specified for each WGA. Then, a combination of methods, describing a solid waste system alternative, is selected. Certain variables, such as participation levels for recycling methods, can also be selected. Once this is done, the model calculates:

- The amount of waste in each waste category that is handled by each method
- The total cost and cost per ton for each method and for the whole system
- The revenue for each method from the sale of recycled materials or from by-products such as energy or compost
- The total net cost (cost minus revenue) and net cost per ton for each method and for the whole system

The model also allows for analysis of sensitivity to changes in cost, amounts of waste generated, population, and other variables.

The model consists of several interactive "modules".

- Module 1 allows for selection of methods, and of participation rates and materials recovery and disposal rates for each method.

- Modules 2.1 - 2.5 receive and calculate the data that define the parameters of the model, including WGA-specific variables.

  2.1 calculates the tons of each waste category handled by each method, based on input from other modules.

  2.2 contains data on WGA variables (population, households, etc.) that determine some of the method costs.

  2.3 contains data on the amount of waste generated in each WGA in each waste category.

  2.4 contains unit cost data for each method.

  2.5 contains data on revenue per unit for recycled materials and compost.

- Module 3 calculates the cost and revenues for the selected solid waste system alternative.

Embedded in the model is an underlying logic determining the manner in which waste would "flow" through a solid waste management system. This logic is illustrated in Figure D-1, Waste Stream Flow Chart which is an abbreviated representation of the waste stream for one subwaste stream (single-family residential). This logic is primarily used in calculating the tonnages handled by each method by identifying the order in which methods remove materials from the waste stream.

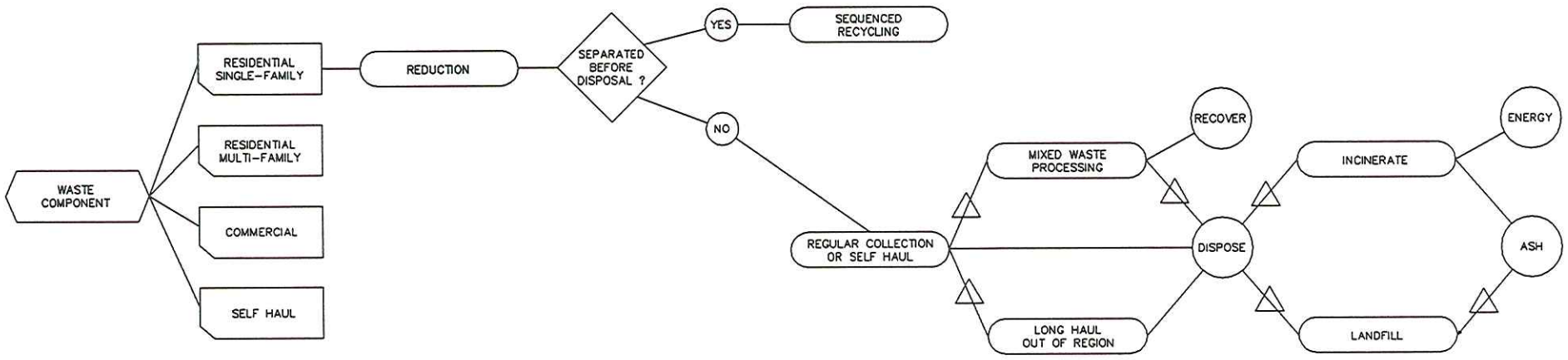
The solid waste management methods act like a system of filters. Reduction programs filter out some waste, recycling programs filter out part of the remaining waste, and the rest of the waste goes to a disposal program through regular municipal garbage collection. Within each program (reduction, recycling or disposal) several methods may be selected. The manner in which waste is "filtered" through these methods is determined by: (1) which methods are selected; (2) the sequence of methods (embedded in the model); and (3) the subwaste stream(s) served by the method.

(4) Inputs and Outputs

This section identifies the specific inputs and outputs for each module in the economic model. This information provides a more detailed description of the model structure.

Figure D-1

Waste Stream Flow Chart



SEQUENCED RECYCLING: Component is sequenced through programs that recycle through reuse, resale or processing.

△ = Points at which transport costs could be incurred; distance depends on siting.

(a) Module 1: Method Selection

Input:

- Identification of methods applicable to each subwaste stream (single-family residential, multi-family residential, commercial, self-haul).
- Sequencing of methods based on flow of waste and other priorities.
- Participation rates for each subwaste stream and each method given mandatory and voluntary participation.
- Efficiency rates for each waste stream category for each method (efficiency rate = the percentage of each waste stream category that is expected to be recovered from each participant).
- Disposal rates for each category for each method (percentage not recycled due to contamination, etc.).

Output:

- Order with which each method processes each waste category.
- Recovery rates (participation rate X efficiency rate) for each waste stream category in each method.

(b) Module 2.1: Method Tonnage

Input:

- From Module 1: recovery rates and disposal rates for each waste stream category in each method.
- From Module 2.3: total tonnages for each waste stream category for each subwaste stream.

Output:

- The number of tons handled by each method (collected and processed, recovered and disposed) for each subwaste stream and each waste stream category.

(c) Module 2.2: Unit Factors

Input:

- Demographic factors specific to WGA (urban and rural population, number of single-family households, number of multi-family households, number of employer units).

Output:

- Unit factors (number of households qualifying for curbside collection of recyclables and for collection of yard wastes, number of routes for regular garbage collection, number of businesses qualifying for collection of source-separated recyclables, percentage of urban versus rural population). These factors are used to calculate integrated system costs in Module 3.

(d) Module 2.3: Waste Generation by WGA by Category

Input:

- Tons of waste for each category, in each subwaste stream for the WGA.

Output:

- Total waste category tons to calculate method tonnage in Module 2.1.

(e) Module 2.4: Unit Revenues

Input:

- Average market revenue per ton for recovered materials (i.e., by recoverable waste stream category) for each WGA.

Output:

- Revenue factors to calculate integrated system cost/benefits in Module 3.

(f) Module 2.5: Unit Costs

Input:

- Cost per unit for categories of cost in each program. Examples include:
  - Promotion/Education Costs: cost per household or per route.

- Collection Costs: cost per household, per route, or per ton.
- Processing costs: cost per ton.
- Transfer and Transportation Costs: cost per ton or per ton mile
- Disposal Cost: cost per ton

- Identification of unit (e.g., households, ton, routes, etc.).
- Number of units for each unit cost for each method (Source: Module 2.1 and 2.2).

Ouput:

- Unit costs and unit volumes to calculate integrated system costs/benefits in Module 3.

(g) Module 3: Integrated System Costs

Input:

- Tonnage collected, processed, recovered and disposed in each method (Module 2.1).
- Unit revenues and conversion factors associated with each method (Module 2.4).
- Unit costs and unit volumes for each method (Module 2.5).

Output:

- Costs (total and by category of cost such as promotion, collection, processing and disposal) for each method.
- Revenues for each method.
- Total costs and revenues for integrated system (for all waste generated in WGA).
- Average cost and revenue per ton for each method and system total.

b. Limitations

To use the results of the economic analysis appropriately, it is important to understand the limitations of the economic analysis. Some of these limitations have been mentioned in the Methodology section.

One limitation that is particularly important in interpreting the results of the analysis is that the system costs developed in the economic analysis model do not represent the actual costs and financial arrangements of any specific jurisdiction. The model provides an appropriate general basis for comparing methods, but the unique circumstances of individual jurisdictions create a wide range of actual costs for solid waste management and different economic environments for choosing among solid waste management methods.

Another way in which the economic model does not reflect actual costs is that it does not include costs that are not associated with specific methods, but are common to the whole solid waste system. These include costs for overall management, preparation of comprehensive management plans, administration and enforcement of regulations, and related activities. These costs tend to be associated with jurisdictional responsibilities rather than with specific waste management methods,but they are real system costs.

The economic analysis uses costs for a steady-state year and does not include any costs for phasing in methods, for example, the time period needed to reach maximum participation levels in recycling programs.

Finally, the quantitative analysis is applied to the solid waste management system, and by setting certain limits on the definition of this system, it does not measure certain economic impacts on individuals, businesses, communities and the environment. These unmeasured impacts are discussed at more length in the section on Global Impacts.

TABLE D-1

DESCRIPTION OF METHOD COSTS

METHOD: / COST CATEGORY:	Curbside Recycling: Single-Family Source Separated Single-Family Comingled, Multi-Family Comingled	Commercial Direct Recycling	Collection of Commercial Source-Separated Recyclables	Drop-Off/Buy-Back	Collection and Centralized Composting of Yard Waste
Administration	Direct Administration and Supervision of Collection Program	Not Applicable	Direct Administration and Supervision of Collection Program	Direct Administration of Drop-Off/Buy-Back Operations	Direct Administration of Collection Program
Education/ Promotion	Mailings to Promote Program Public Outreach: Block Leaders, Working with the Media, Other Programs	Not Applicable	Not Applicable	Not Applicable	Mailings to Promote Program
Collection	Containers, Collection Vehicle, Vehicle O&M and Crew Costs for Weekly Collection at Eligible Residences	Not Applicable. Materials are Delivered by Commercial Establishments or Picked Up by Broker	Vehicle, Vehicle O&M and Crew Costs for Collection of Separate Weekly Routes for Cardboard, Office Paper and Glass	Per Ton Mile Transport Costs for Collection of Materials from Drop-Off Sites (Rural Tonnage)	Vehicle, Vehicle O&M and Crew Costs for Bi-Weekly Collection, 9 Months Per Year (Residential Yard Waste)
Processing	Per Ton Capital and O&M Costs for Preparation of Materials for Market (Metal Separation, Baling, Crushing, etc.) at Centralized Processing Facility	Not Applicable. Costs of Preparing Materials are Borne by Commercial Establishment and are not Part of S.W. management System	Per Ton Capital and O&M Costs for Preparation of Materials for Market at Centralized Processing Facility	Per Ton Capital and O&M Costs for Preparation of Materials for Market at Centralized Processing Facility (Urban and Rural Tonnage and Special Waste)	Per Ton Capital and O&M Costs for Centralized Composting Facility (Residential and Self-Hauled Yard Waste)
Transfer/ Transport	Not Applicable. Transport Costs are Reflected in Market Price for Materials	Not Applicable	Not Applicable	Not Applicable Transport Costs are Reflected in Market Price for Materials	Per Ton Transfer and Transport Costs for Residential Tonnage (Urban and Rural)
Disposal	Disposal Costs for Contaminated Rejects from Commingled recyclables. Costs Vary with Selected Disposal Option	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Subwaste Stream	Single-Family Residential or Multi-Family Residential	Commercial	Commercial	Single-Family Residential Multi-Family Residential Self-Haul	Single-Family Residential Self-Haul (Composting Only)

TABLE D-1

DESCRIPTION OF METHOD COSTS
(Continued)

METHOD: / COST CATEGORY:	Targeted Commercial High-Grade Loads	Self-Haul	Regular Municipal Collection and Disposal	Mixed Waste Processing with Materials Recovery and Composting	RDF Preparation with Materials Recovery and Composting
Administration	Not Applicable	Not Applicable	Direct Administration of Collection Program	Not Applicable (Reflected in Self-Haul or Regular Municipal)	Not Applicable
Education/ Promotion	Not Applicable	Not Applicable	Not Applicable	Not Applicable (Reflected in Self-Haul or Regular Municipal)	Not Applicable
Collection	Not Applicable (Reflected in Regular Municipal Collection and Disposal)	Not Applicable	Collection Vehicles, Crew and Vehicle O&M Costs for Weekly Collection	Not Applicable (Reflected in Self-Haul or Regular Municipal)	Not Applicable
Processing	Per Ton Capital and O&M Costs for Separation and Preparation of Materials at Centralized Facility	Not Applicable, Unless Mixed Waste Processing or RDF Processing is Selected	Not Applicable, Unless Mixed Waste Processing or RDF Processing is Selected	Per Ton Cost of Capital and O&M for Centralized Facility; Includes Some Transfer and Transport Costs	Per Ton Cost of Capital and O&M for Centralized Facility; Includes Some Transfer and Transport Costs
Transfer/ Transport	Not Applicable (Reflected in Regular Municipal Collection and Disposal)	Not Applicable	Costs Vary for Urban and Rural Waste; Associated with Selected Disposal Method	For Rejects: Costs Vary for Urban and Rural Waste; Associated with Selected Disposal Method	For Rejects: Costs Vary for Urban and Rural Waste; Associated with Selected Disposal Method
Disposal	Not Applicable (Reflected in Regular Municipal Collection and Disposal)	Per Ton Cost for Selected Disposal Method	Per Ton Cost for Selected Disposal Method	For Rejects: Per Ton Cost for Selected Disposal Method	For Rejects: Per Ton Cost for Selected Disposal Method
Wastestream	Commercial	Self-Haul	Single-Family Residential Multi-Family Residential Commercial	All	All

TABLE D-1

DESCRIPTION OF METHOD COSTS
(Continued)

METHOD: COST CATEGORY:	Mass Burn with Ash Monofill	Landfill with Long Haul by Rail	Landfill with Baling	Landfill Only
Administration	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Education/ Promotion	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Collection	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Processing	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Transfer/ Transport	Per Ton Transfer and Per Ton Mile Truck Transport Costs (Varies for Urban and Rural Waste)	Per Ton Transfer and Per Ton Mile Truck and Rail Transport Costs (Varies for Urban and Rural Waste)	Per Ton Transfer and Per Ton Mile Transport Costs (Varies for Urban and Rural Waste)	Per Ton Transfer and Per Ton Mile Truck Transport Costs (Varies for Urban and Rural Waste)
Disposal	Per Ton Cost for Capital and O&M Cost of Incinerator, Plus Landfill Disposal Cost for Ash, Less Revenue for Energy Generation	Per Ton Cost for Landfill Out of Region (Oregon)	Per Ton Cost for Landfill (Varies for Urban and Rural Waste and Processing Cost for Baling)	Per Ton Cost for Landfill (Varies for Urban and Rural Waste)
Subwaste Stream	All	All	All	All

SECTION E

EVALUATION OF BEST MANAGEMENT PRACTICES FOR EACH WGA

1. INTRODUCTION

This section presents information and analyses used to determine the best management practices within each waste generation area. The information presented here includes:

- A description of existing methods for managing solid waste in each waste generation area.
- An assessment of market capacity for recyclables within each waste generation area.
- An evaluation of potential methods for managing solid waste within the WGA including:
  - A technical feasibility/potential exposure-to-loss analysis
  - An environmental impact assessment
  - A cost analysis
- A ranking of methods for managing solid waste and recommendations for each WGA.

Best management practices for each WGA were evaluated considering, among other factors, technical feasibility, environmental impacts, and cost-effectiveness. The feasibility and environmental analyses were performed through an interactive process among groups working in each of the waste generation areas. The consultant team met with each WGA working group on three different occasions to identify environmental concerns, to determine technical feasibility or exposure to loss, and to rank methods.

Since solid waste management is of interest to a variety of organizations and groups in the State, representatives from concerned groups were assigned to each WGA working group. Organizations that were provided this opportunity for input into the study process include:

Association of Washington Cities
Environmental Health Directors Group
Governmental Refuse Collection and Disposal Association
Independent Business Association
League of Women Voters
Washington Citizens for Recycling
Washington Environmental Council
Washington State Association of Counties
Washington State Association of County Engineers
Washington State Recycling Association
Washington Waste Management Association

Other interested parties were encourgaed to attend and participate in the WGA working groups. In addition to the above organizations, local waste haulers, recyclers, solid waste operators, local industry, and others participated in the best management evaluation process.

While the makeup of these WGA working groups represented a broad cross-section of solid waste, recycling, business, and citizen interests, the working groups do not represent the opinions and concerns of all the individuals and organizations within a particular WGA. These groups were used to bring a local or regional group perspective into evaluating feasibility and identifying environmental concerns, since both of these varied from region to region.

The groups also ranked solid waste management methods based on weighted criteria for each WGA. The results of these WGA analyses are presented below under each WGA. A detailed description of the methodology appears in Subsection E.2.

The consultant team conducted feasibility and environmental assessments and developed a cost model. Analyses were used to evaluate various methods for managing solid wastes in each of the WGA's. They results were shared with the WGA working groups and used by the consultant team along with WGA input to conduct a final recommended ranking of methods for each of the WGA's.

The consultant team's technical feasibility/potential exposure-to-loss analysis and the team's environmental impact assessment are described in Subsection E.2.c. The WGA-specific economic models and cost analysis are also described in Subsection E.2.c. A summary of the market capacity study is presented in Subsection E.2.b. Subsection E.2.a. addresses existing methods that were considered, when appropriate, in developing recommendations. A description of the technique used to rank and evaluate solid waste management methods for each of the WGA's is in Subsection E.2.d.

The results of all the WGA-specific analyses are presented in Subsections E.3. through E.10. These are organized by WGA in the following order:

West
Northwest
Puget Sound
Southwest
North Central
South Central
Northeast
Southeast

In general, the methodology entailed:

- The documentation of existing conditions--by the consulting team
- An initial ranking of potential methods for managing solid waste--by the WGA working groups

- A Statewide assessment of technical feasibility or exposure to loss--by the consulting team--for each of the potential methods

- A WGA-specific assessment of exposure to loss--based on input from the WGA working groups

- Revisions to the Statewide exposure to loss assessment by the consulting team--based on input from the WGA's

- An identification of environmental concerns in each WGA--by the working groups

- An environmental assessment of potential waste management methods for each WGA under ideal conditions (i.e., new facilities, latest technology, and mitigation measures)--by the consulting team

- An environmental assessment for each WGA based on historical risks or failures of various waste management methods--by the consulting team

- An analysis of method costs and overall integrated systems costs--based on initial WGA ranking by the consulting team

- A review and determination of final rankings for solid waste management methods in each WGA--by the working groups--based upon the risk, environmental and cost analysis

- A ranking of recommended methods for managing solid waste in each of the waste generation areas--by the consulting team

- The development of recommendations for best management practices within each WGA--by the consultant team

Each of the steps in the WGA best management practices process are discussed in more detail below.

2. METHODOLOGY

a. Introduction to Existing Methods

The descriptions appearing in Subsection b. of each WGA section are intended to summarize the primary features of the existing solid waste management systems in each of the WGA's. These descriptions provide information about:

- Recycling programs
- Solid waste collection
- Solid waste disposal
- Solid waste planning

The approach taken to obtain these data included:

- A review of existing solid waste management plans
- Telephone interviews with public and private solid waste managers:
  - -- County/city officials and staff
  - -- Solid waste facility owners and operators
  - -- Private haulers and their personnel associated with the solid waste management
  - -- recycling industries in each county
- Numerous follow-up telephone calls to expand and verify data collected in the initial surveys
- A review by WGA working group members
- A review by county public works directors and health officials

Barriers to Best Management Practices for solid waste were also identified through this process. A discussion of general, Statewide barriers affecting all of the waste generation areas is presented in Volume III, Statewide Findings.

b. Introduction to Market Capacity

Markets for 15 key recyclable materials in the Washington State waste stream were evaluated. A detailed discussion for each of these materials as well as market factors and barriers applicable throughout the State is presented in Section C of Volume II. A brief overview of secondary materials markets is provided in this introduction; later subsections present special market considerations and market capacity summary tables for each WGA.

To determine which recycling methods are appropriate for each waste generation area, the markets for the various recoverable materials must first be evaluated. Markets are not static; the demands of end-users, processors, shippers, brokers, and buyers, and the prices paid for material often fluctuate. However, based on historical data, current availability, and known potential for market expansion, it is possible to project whether markets are likely to exist for various recyclable materials. Periodic reassessment of markets and an ability to adjust to changing markets should be integral elements of any management method that targets recovery of recyclable materials.

Markets for secondary commodities are driven by demand, not supply. Buyers of these commodities generally have the option of using virgin materials. When overall demand for a material is low, higher-quality materials will continue to be purchased while the lower-quality materials may become unsalable. Other key factors which impact the availability of markets for recyclable commodities are:

- General condition of domestic and global economies and currency exchange rates

- Regional and global supply and relative prices of virgin and secondary materials
- Capacity of mills and smelters for using recyclables
- Variations in demand and price between domestic and export markets
- Transportation and shipping costs

Each of these factors, and many more, constantly change and influence the capacity of markets for secondary materials. General market capacity for primary commodities is described below.

(1) Waste Paper

Waste paper is sold to 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; however, some speculate that worldwide pries may decrease over the next few years as a result of rapidly increasing supplies, primarily from new East Coast recycling programs. Demand for mixed waste paper is historically lower. This is reflected in an end-user price which may not cover transportation and handling costs for some areas of the State.

(2) Glass

Container glass, or cullet, from Washington State is processed in Seattle and Portland plants. There appears to be sufficient capacity and demand to utilize recovered glass. The demand for green-colored glass is less than that for clear and brown glass. Prices paid have been consistent and freight allowances permit the cost-effective recovery of glass from most communities in the State. Refillable glass containers have enjoyed a stable market; however, this trend may be reversed if local breweries no longer refill beer bottles.

(3) Scrap Metals

The demand for used aluminum cans, ferrous metals, and non-ferrous metals is strong. Capacity for reusing 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. Because tin cans have a low value, costs of preparing and transporting them to market reduces their value in some regions of the State.

White goods require handling and processing which together, under current prices, cost more than the revenues produced by many operations. However, it is potentially cheaper, 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 softened in the last two years, because of regulatory concerns over environmental liability.

(4) Plastic

Post-consumer plastics recycling is in the developmental stages. Collection, processing and marketing elements for a plastics recycling infrastructure are each receiving attention in Washington State and other areas. Limited supplies are currently recovered from the State, and it is not possible to predict the future demand for plastic with any certainty. Recovery efforts are currently focusing on PET (polyethylene terephthalate) and HDPE (high-density polyethylene) bottles 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.

(5) Organics

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

Communities currently developing recovery programs for yard waste are willing to pay a processing fee, since this is generally lower than disposal costs. The local capacity to consume compost produced must be examined prior to implementation of a yard waste recovery program.

Unique factors influence markets for recyclable commodities in each waste generation area. Market capacity summary tables (included in Subsections E.3-E.10), developed for each WGA, provide the following information:

(a) Major end-users for each commodity - includes the primary destinations of materials from the WGA.

(b) Estimated end-user price - average prices paid by end-users in the fourth quarter of 1988. The prices are estimates for planning purposes only, and are not intended to represent actual or future prices paid by end-users, brokers, or buy-back centers.

(c) Volume of WGA material recovered - estimates provided in Volume I, based on buyer and seller surveys (rounded to the nearest hundred tons).

(d) Price of WGA-collected material - a theoretical value determined by subtracting estimated transportation and processing costs from estimated end-user prices.

(e) Annual value of WGA-collected material - derived by multiplying material recovered by WGA price [(c) and (d), above].

(f) WGA market capacity - indicates whether the capacity of markets is sufficiently stable to accommodate consistent and gradual expansion of recycling efforts within the WGA.

(g) Factors affecting the WGA market for material - highlights local market factors.

c. Evaluation of Methods

(1) WGA Working Group Involvement

Feasibility, environmental, and economic analyses of waste management methods were conducted for each WGA. These analyses were completed through an iterative process with the WGA working groups. Members of the consultant team met with the WGA working groups on three different occasions to solicit input.

Two instruments were used in evaluating management methods with the WGA working groups:

- Evaluation matrices that documented the degree of exposure to loss for each management method with respect to siting, waste supply, markets, vendor technology, residue disposal, financing, and other uncontrollable circumstances.

- Evaluation matrices that identified the degree of environmental concern and potential environmental impacts for each waste management method.

This information was used by the consultant team as input to their final WGA technical feasibility and environmental assessments. A discussion of variations between WGA working group input and study team findings within each WGA is included.

(2) Feasibility Analysis

Each method's technical feasibility was evaluated by assessing the degree of exposure to loss caused by change, interruption, or failure of the technology. The degree of exposure is assessed by: (1) measuring the exposure to loss (an objective but probablistic pursuit); (2) judging the acceptability of that exposure (a matter of personal and social value judgment). No attempt is made in this analysis to perform a health risk assessment or other site-specific analyses, since these are considered beyond the scope of this programmatic review. Technical feasibility is addressed in Section B. The results of a general, statewide consultant team feasibility analysis also appear in each WGA section, along with the WGA-specific assessments.

Many factors contribute to the observed differences between the WGA working group ratings and those developed for the State as a whole by the consultant team. Conditions affecting exposure to loss vary between WGA's. For example, markets, waste composition, and siting issues can be quite different and affect the measure of technical feasibility or exposure to loss. The perception of what exposures are acceptable will also vary between WGA's. Social

and economic characteristics, previous experience with solid waste management methods, and current solid waste management planning goals all interact to affect how exposures are perceived.

The WGA exposure-to-loss matrices that appear in each WGA section were based on input from WGA working groups. These matrices present both the consultant's general, Statewide assessment and the WGA-specific assessments. Exposures to loss are evaluated for the following factors in each of the WGA's.

Siting

- Exposure: Strong public opposition with subsequent delay or inability to obtain a site for a facility required in utilizing a solid waste management method.

- Exposure: Difficulty or inability to acquire all necessary permits due to their great number and/or complexity.

- Exposure: Extensive time and cost involved in performing siting, environmental studies, permits and approvals necessary for implementation of a solid waste management method (ultimate risk is the inability to conclude implementation prior to exhaustion of other solid waste management methods).

Waste Supply

- Exposure: Unfavorable economics or failure due to excess or insufficient quantity of waste available for processing and disposal using this method.

- Exposure: Increased cost, poor economics, or failure due to the composition of waste available for processing or disposal using this method.

Markets

- Exposure: Possible net cost increase, loss of economic incentive or failure caused by inadequate markets for recovered materials or energy.

Vendor

- Exposure: Delays, cost increases, loss of economic incentive, or failure due to the inability to obtain an acceptable private vendor or inability of the private vendor to fulfill contractual obligations.

Technology/Program

- Exposure: Delay, cost overrun, or failure to successfully construct and make operational the solid waste management method.

- Exposure: Failure to successfully operate and maintain the solid waste management method over the economic life of the capital investment.

Residue Disposal

- Exposure: Loss from failure to adequately dispose of residuals generated by the solid waste management method due to the characteristics of the residuals.

- Exposure: Failure to successfully dispose of method residuals due to the inability to secure a disposal site.

Financing

- Exposure: Failure to obtain and repay financing for development of the solid waste management method (also includes failure to adequately fund operational costs of the method).

- Exposure: Cost increase or failure of the solid waste management method due to uncontrollable circumstances such as acts of God, changes in law, and other factors beyond the control of those implementing the solid waste management method.

(3) Environmental Evaluation

The environmental evaluation is based on three approaches. First, environmental impacts were evaluated from a technical perspective. This evaluation assumed new, state-of-the-art facilities, appropriately sited to minimize impacts, and operated in accordance with applicable Minimum Functional Standards. The evaluation was based on professional judgment and available data on factors such as climate, topography, and population density. This general evaluation of environmental impacts is provided in Subsection B.2. Environmental Impacts Common to Several Methods are addressed in Subsection B.2.c., and the method-specific evaluations of environmental impacts are presented with the discussion of Potential Solid Waste Management Methods in Subsections B.3., B.4., B.5., and B.6.

The second approach also evaluated environmental impacts from a technical perspective, under less favorable conditions than described above. The second approach evaluated potential impacts or failures in the implementation and operations of each method. Possible failures are outlined in Table E-1.

This second assessment was undertaken since history has shown that solid waste management methods have not always performed as expected. Lower performance has been caused by many factors, including a lack of understanding of the physical, biological, and human factors involved in operations, lack of regulatory control, and the fact that technology wears out over time. Both of these environmental assessments are presented in each of the WGA discussions, Subsections E.3 through E.10.

FIGURE E-1

POTENTIAL FAILURE MECHANISMS THAT COULD LEAD
TO ADVERSE ENVIRONMENTAL IMPACTS

Environmental Factor/Method	Home Yard Waste Composting	Curbside Collection	Multi-Family Housing Collection	Commercial Source Separation
AIR QUALITY:				
Criteria Pollutants				
Toxics				
Particulates				
ODOR:	Poor composting technique allows generation of odors which impact neighboring households			
SURFACE WATER QUALITY:				
GROUND WATER QUALITY:				
NOISE:		Collection and handling of materials generates significantly increased noise levels in residential neighborhoods	Collection and handling of materials generates significantly increased noise levels in residential neighborhoods	Same as for Curbside except disruption occurs to sensitive commercial uses (hospitals, restaurants, etc.)
RISK OF EXPLOSION:				
PUBLIC HEALTH RISKS:				
Pathogens				
Vectors	Poor composting technique leads to the attraction of dogs, rats, raccoons,etc. that spread uncomposted waste items around the local neighborhood			
Toxics				
AESTHETICS:	Poor composting technique and lack of screening causes messy conditions to develop	Poor organization or use of containers causes scattered materials at curbside	Poor organization or use of containers causes scattered materials at curbside	Poor organization or use of containers causes scattered materials at curbside
TRAFFIC:		Poor route planning and operation of collection vehicles causes congestion and safety hazards	Poor route planning and operation of collection vehicles causes congestion and safety hazards	Poor route planning and operation of collection vehicles causes congestion and safety hazards
OTHER:				

FIGURE E-1

POTENTIAL FAILURE MECHANISMS THAT COULD LEAD
TO ADVERSE ENVIRONMENTAL IMPACTS
(continued)

Environmental Factor/Method	Intermediate Processing Facility	Commercial Mixed Waste Processing	Drop-Off/Buy-Back Depots	Mixed Waste Processing
AIR QUALITY:				
Criteria Pollutants				
Toxics				
Particulates				
ODOR	Poor housekeeping practices allow odors to be generated that impact the local neighborhood	Escapement off-site of odor causing gases/fumes. Insufficient attention to general housekeeping practices or excessive residence time for handled waste leading to odor escaping off-site	Escapement off-site of odor causing gases/fumes. Insufficient attention to general housekeeping practices or excessive residence time for handled waste leading to odor escaping off-site	Escapement off-site of odor causing gases/fumes. Insufficient attention to general housekeeping practices or excessive residence time for handled waste leading to odor escaping off-site
SURFACE WATER QUALITY:				
GROUND WATER QUALITY:				
NOISE:	Customer and materials hauling vehicles and on-site processing equipment cause high noise levels in the adjacent community	On-site machinery causes disruption in nearby community	Customer and materials hauling vehicles and on-site processing equipment cause high noise levels in the adjacent community.	On-site machinery causes disruption in nearby community
RISK OF EXPLOSION:		Failure to detect presence of explosive waste. Explosion occurs in receiving area or in waste processing equipment	Failure to detect presence of explosive waste. Explosion occurs in receiving area or in equipment	Failure to detect presence of explosive waste. Explosion occurs in receiving area or in equipment
PUBLIC HEALTH RISKS:				
Pathogens				
Vectors	Including food wastes in compost pile attracting birds/vectors	Failure of cover/enclosure system and/or vector control program to prevent blowing waste and bird/vector access and egress from the waste	Failure of cover/enclosure system and/or vector control program to prevent blowing waste and bird/vector access and egress from the waste	Failure of cover/enclosure system and/or vector control program to prevent blowing waste and bird/vector access to the waste
Toxics				

FIGURE E-1

POTENTIAL FAILURE MECHANISMS THAT COULD LEAD
TO ADVERSE ENVIRONMENTAL IMPACTS
(continued)

Environmental Factor/Method	Intermediate Processing Facility	Commercial Mixed Waste Processing	Drop-Off/Buy-Back Depots	Mixed Waste Processing
AESTHETICS:	Poor site housekeeping practices combined with inadequate screening lead to messy conditions as viewed by the local neighborhood	Elevated traffic noise, nuisance, and aesthetic impacts brought about by failure of mitigation measures or decreased in buffering due to poor siting or increased population and land use density	Poor site housekeeping practices combined with inadequate screening lead to messy conditions as viewed by the local neighborhood	Elevated traffic noise, nuisance and aesthetic impacts brought about by failure of mitigation measures or decrease in buffering due to poor siting or increased population and land use density
TRAFFIC:	Poor site selection, combined with inadequate traffic infrastructure leads to congestion, vehicle conflicts and reduction in traffic safety in the immediate neighborhood	Elevated traffic noise, nuisance, and aesthetic impacts brought about by failure of mitigation measures or decreased in buffering due to poor siting or increased population and land use density. Poor routing of delivery vehicles causing elevated traffic impacts conflict with other traffic uses, noise and public safety impairment	Poor site selection, combined with inadequate traffic infrastructure leads to congestion, vehicle conflicts, and reduction in traffic safety in the immediate neighborhood	Elevated traffic noise, nuisance and aesthetic impacts brought about by failure of mitigation measures or decrease in buffering due to poor siting or increased population and land use density. Poor routing of delivery vehicles causing elevated traffic impacts conflict with other traffic uses, noise, and public safety impairment
OTHER:				

FIGURE E-1

POTENTIAL FAILURE MECHANISMS THAT COULD LEAD TO ADVERSE ENVIRONMENTAL IMPACTS
(continued)

Environmental Factor/Method	Yard Waste Composting	Mixed Waste Composting	Food Waste Processing	Special Waste Recycling and Reuse
AIR QUALITY:				
Criteria Pollutants				Tire incineration - Same failures as noted for Mass Burn Air Quality
Toxics				
Particulates				
ODOR:	Poor operating practices allows odors to be generated	Poor design and/or operations causes odors to be generated	Poor design and/or operations causes odors to be generated	Oil and Battery Processing - failure of containment system with ensuing escape of oil and/or oil and metals containing leachate
SURFACE WATER QUALITY:	Applied compost product leaches contaminant to surface runoff	Applied compost product leaches contaminant to surface runoff	Applied compost product leaches contaminant to surface runoff	Oil and Battery Processing - failure of containment system with ensuing escape of oil and/or oil and metals containing leachate
GROUND WATER QUALITY:	Rainfall leaches contaminant from applied compost into adjacent subsurface zone	Rainfall leaches contaminant from applied compost into adjacent subsurface zone	Rainfall leaches contaminant from applied compost into adjacent subsurface zone	
NOISE:	On-site machinery causes significant noise increase in the neighborhood	On-site machinery causes significant noise increase in the neighborhood	On-site machinery causes significant noise increase in the neighborhood	
RISK OF EXPLOSION:		Failure to detect presence of explosive waste. Explosion occurs in receiving area or in waste processing equipment		
PUBLIC HEALTH RISKS:				
Pathogens	Contaminant is discovered that limits or prohibits marketing of the compost product due to health reasons. Contaminant is discovered after extensive distribution and use of the compost product. Also, vectors are attracted by poorly composted vegetable and animal matter	Contaminant is discovered that limits or prohibits marketing of the compost product due to health reasons. Contaminant is discovered after extensive distribution and use of the compost product. Also, vectors are attracted by poorly composted vegetable and animal matter. Toxics are found in the form of heavy metals. Also insufficient disinfection/sterilization transmits pathogens to birds/vectors	Contaminant is discovered that limits or prohibits marketing of the compost product due to health reasons. Contaminant is discovered after extensive distribution and use of the compost product. Also, vectors are attracted by poorly composted vegetable and animal matter. Also, insufficient disinfection/sterilization permits pathogens to be transmitted to animal utilizing food waste product	
Vectors				
Toxics				

FIGURE E-1

POTENTIAL FAILURE MECHANISMS THAT COULD LEAD
TO ADVERSE ENVIRONMENTAL IMPACTS
(continued)

Environmental Factor/Method	Yard Waste Composting	Mixed Waste Composting	Food Waste Processing	Special Waste Recycling and Reuse
AESTHETICS:	Elevated traffic noise, nuisance, and aesthetic impacts brought about by failure of mitigation measures or decrease in buffering due to poor siting or increased population and land use density	Elevated traffic noise, nuisance, and aesthetic impacts brought about by failure of mitigation measures or decrease in buffering due to poor siting or increased population and land use density	Elevated traffic noise, nuisance, and aesthetic impacts brought about by failure of mitigation measures or decrease in buffering due to poor siting or increased population and land use density	Failure in proper siting or in buffering tire storage for any of the processing options
TRAFFIC:	Elevated traffic noise, nuisance, and aesthetic impacts brought about by failure of mitigation measures or decrease in buffering due to poor siting or increased population and land use density. Poor routing of delivery vehicles causing elevated traffic impacts, conflict with other traffic uses, noise and public safety impairment	Elevated traffic noise, nuisance, and aesthetic impacts brought about by failure of mitigation measures or decrease in buffering due to poor siting or increased population and land use density. Poor routing of delivery vehicles causing elevated traffic impacts, conflict with other traffic uses, noise and public safety impairment	Elevated traffic noise, nuisance, and aesthetic impacts brought about by failure of mitigation measures or decrease in buffering due to poor siting or increased population and land use density. Poor routing of delivery vehicles causing elevated traffic impacts, conflict with other traffic uses, noise and public safety impairment	
OTHER:				

FIGURE E-1

POTENTIAL FAILURE MECHANISMS THAT COULD LEAD
TO ADVERSE ENVIRONMENTAL IMPACTS
(continued)

Environmental Factor/Method	Transfer	Long Haul	Anaerobic Decomposition	Pyrolysis/Gasification
AIR QUALITY:				
Criteria Pollutants Toxics Particulates				Acute Problem - Short-term high emissions levels due to failure of combusion and air cleanup equipment or poor operations Chronic Problem - Existence of an undetected pollutant, or of an existing pollutant with chronic health significance. Also, long-term reduction in removal efficiency of air combustion and air cleanup equipment due to equipment wear and tear or reduced operations vigilance
Odor	Insufficient attention to general housekeeping practices or excessive residence time for handled waste lead-to odor escaping off-site	Insufficient attention to general housekeeping practices or excessive residence time for handled waste lead-to odor escaping off-site	Escapement off-site of odor-causing gases/fumes	Escapement off-site of odor-causing gases/fumes
SURFACE WATER QUALITY:	Contains leakage; leachate escapement off-site	Contains leakage; leachate escapement off-site	Contaminant leaching from land application of residue sludge	
GROUND WATER QUALITY:			Contaminant leading from land application of residue sludge	
NOISE:	On-site machinery causes disruption in nearby community	Truck, barge, rail operations result in significant increase in the communities through which waste is hauled		On-site machinery causes disruption in nearby community
RISK OF EXPLOSION:	Failure to detect presence of explosive waste. Explosion occurs in receiving area or in waste processing equipment		Buildup or release of gas resulting in explosion	Buildup or release of gas resulting in explosion

FIGURE E-1

POTENTIAL FAILURE MECHANISMS THAT COULD LEAD
TO ADVERSE ENVIRONMENTAL IMPACTS
(continued)

Environmental Factor/Method	Transfer	Long Haul	Anaerobic Decomposition	Pyrolysis/Gasification
PUBLIC HEALTH RISKS:				
Pathogens				
Vectors	Insufficient attention to general housekeeping practices	Insufficient attention to general housekeeping practices	Failure of cover/enclosure system and/or vector control program to prevent blowing waste and bird/vector access and egress from the waste	Failure of cover/enclosure system and/or vector control program to prevent blowing waste and bird/vector access and egress from the waste
Toxics			Presence of toxics in air and ash emissions in quantities/ concentrations above permitted levels	Presence of toxics in air and ash emissions in quantities/ concentrations above permitted levels
AESTHETICS:	Elevated traffic noise, nuisance, and aesthetic impacts brought about by failure of mitigation measures or decrease in buffering due to poor siting or increased population and land use density	Elevated traffic noise, nuisance, and aesthetic impacts brought about by failure of mitigation measures or decrease in buffering due to poor siting or increased population and land use density	Elevated traffic noise, nuisance, and aesthetic impacts brought about by failure of mitigation measures or decrease in buffering due to poor siting or increased population and land use density	Elevated traffic noise, nuisance, and aesthetic impacts brought about by failure of mitigation measures or decrease in buffering due to poor siting or increased population and land use density
TRAFFIC:	Elevated traffic noise, nuisance, and aesthetic impacts brought about by failure of mitigation measures or decrease in buffering due to poor siting or increased population and land use density. Also, poor routing of delivery, vehicles causing elevated traffic impacts, conflict with other traffic uses, noise and public safety impairment	Elevated traffic noise, nuisance, and aesthetic impacts brought about by failure of mitigation measures or decrease in buffering due to poor siting or increased population and land use density. Also, poor routing of delivery, vehicles causing elevated traffic impacts, conflict with other traffic uses, noise and public safety impairment	Elevated traffic noise, nuisance, and aesthetic impacts brought about by failure of mitigation measures or decrease in buffering due to poor siting or increased population and land use density. Also, poor routing of delivery, vehicles causing elevated traffic impacts, conflict with other traffic uses, noise and public safety impairment	Elevated traffic noise, nuisance, and aesthetic impacts brought about by failure of mitigation measures or decrease in buffering due to poor siting or increased population and land use density. Also, poor routing of delivery, vehicles causing elevated traffic impacts, conflict with other traffic uses, noise and public safety impairment
OTHER:				

FIGURE E-1

POTENTIAL FAILURE MECHANISMS THAT COULD LEAD TO ADVERSE ENVIRONMENTAL IMPACTS (continued)

Environmental Factor/Method	Refuse-Derived Fuel (RDF)	Mass Burn Incineration	Landfill	Ashfill
AIR QUALITY:				
Criteria Pollutants Toxics Particulates	Acute Problem - Short-term high emission levels due to failure of combustion and air quality control equipment or poor operations Chronic Problem - existence of an undetected pollutant, or of an existing pollutant with chronic health significance. Also long-term reduction in removal efficiency of combustion and air clean-up equipment due to equipment wear and tear or reduced operations vigilance	Acute Problem - Short-term high emission levels due to failure of combustion and air quality control equipment or poor operations Chronic Problem - existence of an undetected pollutant, or of an existing pollutant with chronic health significance. Also long-term reduction in removal efficiency of combustion and air clean-up equipment due to equipment wear and tear or reduced operations vigilance		Failure of cover/dust control measures. Ash dust blows off-site
ODOR			Gas migration off-site	
SURFACE WATER QUALITY:			Inability to adequately contain and treat collected leachate in a sewage treatment plant	Inability to adequately contain or treat collected leachate in a sewage treatment plant
GROUND WATER QUALITY:			Leachate prevention/containment system fails	Leachate prevention/containment system fails
NOISE:	On-site machinery causes disruption in nearby community	On-site machinery causes disruption in nearby community	On-site machinery causes disruption in nearby community	On-site machinery causes disruption in nearby community
RISK OF EXPLOSION:	Failure to detect presence of explosive waste. Explosion occurs in receiving area or in waste processing equipment	Failure to screen out or detect presence of explosive waste. Explosion occurs in boiler	Gas migration off-site	
PUBLIC HEALTH RISKS:				
Pathogens Vectors	Failure of cover/enclosure system and/or vector control program to prevent blowing waste and bird/vector access and egress from the waste	Failure of cover/enclosure system and/or vector control program to prevent blowing waste and bird/vector access and egress from the waste	Failure of cover/enclosure system and/or vector control program to prevent blowing waste and bird/vector access and egress from the waste	
Toxics	Presence of toxics in air and ash emissions in quantified/concentrations above permitted levels	Presence of toxics in air and air and ash emissions in quantities/concentrations above permitted levels	Gas migration off-site	Failure of cover system/dust control measures. Ash dust blows off-site

FIGURE E-1

POTENTIAL FAILURE MECHANISMS THAT COULD LEAD
TO ADVERSE ENVIRONMENTAL IMPACTS
(continued)

Environmental Factor/Method	Refuse-Derived Fuel (RDF)	Mass Burn Incineration	Landfill	Ashfill
AESTHETICS:	Elevated traffic noise, nuisance, and aesthetic impacts brought about by failure of mitigation measures or decreased in buffering due to poor siting or increased population and land use density	Elevated traffic noise, nuisance, and aesthetic impacts brought about by failure of mitigation measures or decreased in buffering due to poor siting or increased population and land use density	Elevated traffic noise, nuisance, and aesthetic impacts brought about by failure of mitigation measures or decreased in buffering due to poor siting or increased population and land use density	
TRAFFIC:	Elevated traffic noise, nuisance, and aesthetic impacts brought about by failure of mitigation measures or decreased in buffering due to poor siting or increased population and land use density. Also, poor routing of delivery vehicles causing elevated traffic impacts, conflict with other traffic uses, noise and public safety impairment	Elevated traffic noise, nuisance, and aesthetic impacts brought about by failure of mitigation measures or decreased in buffering due to poor siting or increased population and land use density. Also, poor routing of delivery vehicles causing elevated traffic impacts, conflict with other traffic uses, noise and public safety impairment	Elevated traffic noise, nuisance, and aesthetic impacts brought about by failure of mitigation measures or decreased in buffering due to poor siting or increased population and land use density. Also, poor routing of delivery vehicles causing elevated traffic impacts, conflict with other traffic uses, noise and public safety impairment	
OTHER:				

The range and degree of impacts presented by the two approaches will likely encompass all those normally associated with implementation of specific solid waste methods. How closely the methods implemented come to achieving the goals of Best Management Practices rather than the less-than-ideal historical performance of methods will be influenced by the political and regulatory climate of each WGA.

Postulated failures are severe enough to result in potentially significant adverse impacts for several potential waste management methods. The two environmental features experiencing the greatest impacts under the assumed failure conditions are ground water and air quality. Because the environmental assessment has been conducted at a programmatic level, the WGA-specific assessments of environmental impact based on potential system failures do not vary greatly among WGA's. In general, lower technology methods have lower levels of potential impacts. Potential adverse environmental impacts are much more severe for disposal methods and technically complex recycling methods than they are for reduction and lower-technology recycling methods.

The third approach reflects input obtained from the working group for each WGA. It includes the perceptions of the group with respect to the level of concern in its area for various categories of potential environmental impact for each of the methods. The resulting matrix for each WGA should be viewed as integrating a wide variety of factors including institutional arrangements, political sensitivity, past experience, current problems, economic factors, and demographic characteristics of the WGA in addition to technical factors affecting environmental impact. The matrix prepared by the WGA working group is presented, and the group's ratings are briefly compared with ratings made by other WGA groups. A narrative statement of the group's rating is also included in this section.

(4) Introduction to Economic Analysis

The economic evaluation of methods was completed in three steps. In the first step, operating assumptions and cost estimates were developed for a selected list of methods. This selected list is explained in Section D - Economic Evaluation. Cost estimates were based on a "steady-state year" using average annual costs for capital expenses and other long-term costs. To develop reasonable cost estimates, operation assumptions needed to be defined for each method. Details on cost estimates and operation assumptions are provided in Appendix B and are further discussed in Section D.

In the second step, these cost estimates and operating assumptions, along with data on market rates for recycled materials (from the Market Capacity Study, Section C), waste composition, and demographics for each WGA were applied in an economic model. The model was used to describe a single integrated solid waste management system for each WGA. Alternative integrated systems could be selected for each WGA by choosing different combinations of methods to handle the total waste stream. The model calculates the costs, revenues, and the amount and composition of waste handled by each method. (The methodology used is discussed in detail in Section D.)

The model is regional and not applicable to specific jurisdictions. Variations in demographic conditions are reflected in the analysis. For example, differing costs and operating assumptions were applied to urban versus rural areas. For methods such as collection of recyclable materials, a threshold number of households or businesses was identified. These methods were applied only in communities within the WGA with at least this number of households or businesses. This minimum size community was based on the number of households or businesses needed to form a weekly or biweekly collection route for one truck.

In the third step, alternative solid waste management systems were defined and compared for each WGA, to evaluate the economic feasibility of each alternative. Working with the WGA work groups, the consultant team identified the system alternative that described the current management system in that WGA. One or two WGA-preferred alternatives were also identified. Preliminary runs of the economic model were made to analyze the existing system and the preferred alternatives.

Preliminary economic analysis results were reviewed by the WGA work groups. Based on this review, each WGA selected a final preferred alternative. The consultant team selected a recommended alternative for each WGA, based on its review of the environmental and technical feasibility evaluations and the preliminary results of the economic model. The "WGA Working Group-Preferred" and "Consultant-Recommended" alternatives for each WGA are presented in Appendix C. Specific WGA costs for each of the recommended solid waste management methods are summarized in the WGA subsections.

(a) Limitations

To appropriately interpret the results of the economic analysis, it is necessary to understand the model's limitations. These limitations are briefly described below:

- The economic analysis reflects costs and revenues for the solid waste management system. This system is defined to include all agencies, whether public, private, or nonprofit, that handle solid waste from its point of generation to its final disposition (either by disposal or by sale to recycling markets). The analysis does not identify the costs borne by individuals, residents, or businesses to source separate, prepare, or deliver materials for recycling or, as with self-hauled waste, for final disposal. These costs are considered to be external to the system. In Section D these external or global impacts are briefly discussed.

- The economic analysis was completed on a regional basis, using general cost and demographic data, so it does not represent the costs or conditions

of individual jurisdictions. The analysis provides a basis for comparing the costs of different methods, but the unique circumstances of specific jurisdictions create a wide range of actual costs and economic choices.

- The economic analysis does not include costs that are common to the whole solid waste system, but not associated with specific methods. For example, the costs of overall management, preparation of comprehensive plans, and administration and enforcement of regulations are not included. The economic analysis does not distinguish between the costs of public, private, and nonprofit operations in order to avoid a priori judgment about management methods. Standard cost were used for labor, equipment, and operation expenses, and profit is not included.

- To develop cost estimates for each method, certain assumptions were made about operations (as described in Appendix B). For example, for the curbside recycling methods, assumptions were made about frequency of collection, type of materials collected, type of equipment used and so forth. In some jurisdictions, these assumptions may not represent the most cost-effective way to operate these methods. This is particularly the case with recycling collection methods, where there is a wide choice of operating options. Actual recycling programs often achieve cost efficiencies by using cheaper labor (such as volunteers or non-union labor) and used equipment. These kinds of efficiencies are not reflected in the economic analysis. Standard costs were used for all labor, equipment, and operating expenses.

- Estimates resulting from the economic analysis represent a range of costs, and should not be construed as actual or accurate costs. Small differences in costs (up to 10%) between system alternatives or between methods are not significant.

(b) Results

The specific results of the economic analysis are summarized in tables for each of the WGA's. This section discusses some of the results common to all or most WGA's.

The results of the economic analysis show that the cost efficiency of recycling collection methods is closely related to the volume of materials collected. For example, in evaluating residential curbside collection methods

the model assumes only the "usual" recyclable materials were collected (newspaper, glass, metal containers, and, for commingled collection, cardboard and mixed waste paper). Where larger volumes of these materials are generated in the residential waste stream (on a per-household basis), curbside collection appears to be cost-effective. Where these volumes are smaller, the cost-effectiveness of curbside collection decreases.

Volume III of this report includes a Source-Separation Analysis. This analysis examines the options for source-separating recyclable materials in determining the most cost-effective approach. This analysis examines a wider range of recyclable materials that could be collected, including plastics; one effect of adding materials is to increase total volumes collected and, within certain ranges, to increase the cost-effectiveness of curbside collection.

One of the methods examined in the economic analysis is collection of recyclable materials from multi-family dwellings. To calculate demographic data for this analysis, the average number of units per multi-family site was assumed to be 6.5. This assumption is based on samples of low-density multi-family sites and is probably representative of statewide averages. Based on this average, separate collection of recyclable materials from multi-family sites is generally not cost-effective. However, in areas where there are several multi-family sites or complexes with an average of 20 to 30 units per site, collection of recyclable materials could be cost-effective. This configuration of multi-family housing occurs primarily in larger urban areas.

The economic analysis indicates that collection and centralized composting of yard waste is a cost-effective method of diverting materials from the waste stream. Collection costs for yard waste are close to the cost collecting municipal waste, and there is a large quantity of yard waste in the waste stream. The resulting net costs (on a per ton basis) are usually less than collection and disposal costs. In several WGA's, large quantities of yard waste are self-hauled to disposal sites. In the economic analysis, it was assumed that a portion of this yard waste could be self-hauled to centralized composting facilities; for the self-hauled yard waste, this is significantly cheaper than disposal.

Methods examined in the economic analysis include existing recycling practices that appear to be cost-efficient. The "Commercial Direct Recycling" method handles a significant portion of the commercial waste stream at no cost to the system, since individual businesses bear all the costs of collecting and preparing materials for market.

The "Drop-Off--Special Waste" method handles wastes such as oil, tires, and car batteries that are currently dropped off at locations such as gas stations or auto parts stores. This method appears to be cost-effective in removing these wastes from the waste stream. However, the final disposition of these materials varies. The estimated "processing" cost for these wastes is $50 per ton; depending on the materials, this cost could include recycling, reuse, or disposal.

The methods of "Collection of Commercial Source-Separated Recyclables" and "Sorting of Targeted Commercial High-Grade Loads" are both cost-effective recycling methods, although they target a relatively small portion of the waste stream.

The cost-effectiveness of methods of final disposal (Mass Burn with Ash Monofill, Landfill with Long Haul by Rail, Landfill with Baling, and Landfill Only) are fairly comparable. However, disposal methods in particular have impacts external to the solid waste management system that should be considered in evaluating alternatives. These impacts include siting difficulties and long-term environmental impacts, and are addressed in the environmental and technical risk evaluation sections.

d. Introduction to Ranking of Methods and Recommendations

The ranking of methods, which resulted in recommendations for Best Management Practices within each of the Waste Generation Areas, occurred in four phases:

(1) WGA Working Group members ranked methods at their initial meetings considering:

- Cost-effectiveness
- Technical effectiveness, reliability
- Impact on waste stream volume
- Compatibility with other methods
- Flexibility (ease of changing method)
- Environmental impact
- Public/political acceptance
- Conservation of resources
- Ease of implementation

Instructions and the form for this process appear in Table E-2. This process involved weighting of the above-listed criteria by the WGA working groups and then ranking waste management methods. Each of the program areas--reduction, recycling, and disposal--were ranked individually. Methods were not ranked competitively (.e.g., reduction and recycling methods did not compete with disposal methods).

(2) WGA working group members identified concerns for each of the elements of the environment affected by the alternative waste management methods. They also assessed exposure to loss within their WGA's for each of the potential methods. These assessment processes are more fully described in Subsection E.c. above.

(3) Based on these analyses and the results of the economic model cost analysis, WGA working groups reviewed and, where appropriate, revised their initial rankings of solid waste management methods. These recommendations appear for each WGA analysis below.

BEST MANAGEMENT PRACTICES FOR SOLID WASTE
WGA WORKING GROUP
METHODS RANKING INSTRUCTIONS

This weighted evaluation process is designed for use in ranking alternatives based upon criteria with varying importance. The weighted evaluation forces the team to rank their recommendations in an organized fashion. These can then be reviewed when determining appropriate implementation. This evaluation can be applied at any time during the analysis process. The most important factor is that this weighted evaluation conditions its recommendations with the impact of criteria which cannot be measured solely by dollars.

The Criteria Weighting Process

The Criteria Weighting Process form is for listing and evaluating criteria. The use of the form is as follows:

The first procedure is to list and assign a letter to the criteria for a particular program. For example, during a study of an exterior wall of an office facility, the criteria used in weighting alternates were initial cost, maintainability, aesthetics, proven quality, energy impact, and redesign time. Only those criteria which have significant impact on comparing alternate methods should be listed. In addition, criteria should be unique and not overlapped by other criteria with similar properties. For example, reliability, maintainability, and proven quality have too many overlapping properties.

Next, criteria are compared to one another, and the more important for the given program determined. The comparison takes place in a series of pairs. The more important member of the pair is selected and entered in the appropriate box of the Scoring Matrix.

After selection of a criterion, the degree of its preference is established. The degrees are: major preference (3 points), and minor preference (2 points). When a preference cannot be chosen between two criteria, the two can be indicated as equal by using both letters in the Scoring Matrix and by scoring each at one point. As the degree of preference of a criterion is determined, the point number is entered into the Scoring Matrix in the appropriate comparison box. Then the points for each criterion are summed, and the totals entered in the Raw Score column. The totals represent the weights of importance of the criteria. To standardize the weighted evaluations, the raw scores are converted to a scale of 0-10 in the Weight column, 10 being the criterion receiving the highest raw score.

Before using the criteria and weights, they should be reviewed. Many times, the weights developed are too bunched or too far apart. A particular criterion may not have received any score, yet it may be important enough to have an impact in the Analysis Matrix. If this is the case, the weights should be adjusted to reflect its proper impact. On the other hand, if a criterion gets no score, and its impact is minimal, it may be dropped from the list.

The Analysis Matrix

The Analysis Matrix form is designed to take the criteria weights previously developed and use them to evaluate the effectiveness of various methods against the criteria. Total evaluation scores result that allow the methods to be ranked. The input data consist of the criteria and weights taken from the Criteria Weighting Process form, and the defined methods.

After listing the input data, each method is then evaluated against each criterion and ranked. Look at each criterion separately. Rank all methods against a single criterion before moving to the next criterion. This allows consistent comparisons among the methods and permits them to be ranked relative to each other on how well they fulfill the given criterion. use the following scale for ranking methods:

Excellent - 3 points
Good - 2 points
Poor - 1 point

The selected point value takes into consideration how well each method fulfills a criterion. For example, if evaluating against a cost criterion, the method that is most economical would usually be ranked Excellent in the appropriate ranking block (upper-left half). The next step consists of multiplying the points in each half-block by the weight of each criterion and entering the product in the lower-right half of each block. The products are then summed horizontally for each method, and the totals entered in the Total column. The methods can then be ranked, the one having the highest total ranked number 1.

Table E-2 (cont.)

ANALYSIS MATRIX

WGA .....

Date .....

List the methods to be ranked below. Determine which one stacks up the best against the desired criteria.

Criteria

	Weight	A: Cost–Effectiveness	B: Technical Effectiveness, Reliability	C: Impact on Waste Stream Volume	D: Compatibility with Other Methods	E: Flexibility (Ease of Changing Method)	F: Environmental Impact	G: Public/Political Acceptance	H: Conservation of Resources	I: Ease of Implementation	TOTAL
REDUCTION PROGRAM METHOD											
Education											
Incentives											
Disincentives											
Home Composting											
RECYCLING PROGRAM METHOD											
Education											
Incentives											
Disincentives											
Reuse											
Curbside Collection											
Multi–Family Housing Collection											
Commercial Source–Separation											
Dropoff/Buyback Depots											
Yard–Waste Composting											
MSW Composting											
Food–Waste Processing											
Special Waste Recycling/Reuse											
DISPOSAL PROGRAM METHOD											
Incinneration/Energy Recovery											
Landfill											
Long Haul											

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(4) The consultant team ranked potential methods for solid waste management within each of the WGA's. The ranking was based on:

- Economic model runs/cost analyses
- The consultant's environmental impact analysis
- Assessment of exposure to loss
- Working groups' input including their recommended ranking of methods

Reduction, recycling, and disposal methods were ranked separately. Instructions and the form for the consultant team ranking of methods appear in Table E-3. Results of these ranking processes and recommendations appear in the final section of the WGA-specific analyses.

BEST MANAGEMENT PRACTICES FOR SOLID WASTE

CONSULTANT TEAM

METHODS RANKING INSTRUCTIONS

This process is for use in ranking alternatives using evaluation criteria. The ranking forces the team members to develop recommendations in an organized and systematic fashion, considering one criterion at a time. The most important aspect of this ranking process is that criteria which cannot be measured solely by dollars are objectively considered on a relative basis.

The Analysis Matrix

The Analysis Matrix form is designed to evaluate the effectiveness of various methods against the specified criteria. Total evaluation scores result that allow the methods to be ranked. The input data consist of the criteria and the defined methods. The criteria have equal weight.

Look at each criterion separately. Rank all methods against a single criterion before moving to the next criterion. This allows consistent comparisons among the methods and permits them to be ranked relative to each other on how well they fulfill the given criterion. Use the following scale for ranking methods:

Excellent -	5 points
Very Good -	4 points
Good -	3 points
Fair -	2 points
Poor -	1 point

The selected point value takes into consideration how well each method fulfills a criterion. For example, if evaluating against a cost criterion, the item that is most economical would usually be ranked Excellent in the appropriate ranking block. After ranking each method on each criterion, the points are then summed horizontally for each method, and the totals entered in the Total Points column. The methods can then be ranked, the one having the highest total ranked number 1.

Table E-3 (cont.)

ANALYSIS MATRIX

WGA .....

Date .....

Reduction Program Method	Cost–Effectiveness	Environmental Impact	Feasibility	Volumetric Impact	Total Points	Rank
	Criteria					
Education						
Incentives						
Disincentives						
Special Governmental Programs						
Waste Exchange						
Home Yard–Waste Composting						

Recycling Program Method						
Education						
Incentives						
Disincentives						
Reuse						
Single–Family Curbside Collection						
Multi–Family Collection						
Commercial Source–Separated						
Commercial High–Grade Collection						
Dropoff/Buyback Depots						
Yard–Waste Composting						
MSW Composting						
Food–Waste Processing						
Mixed–Waste Processing						

Disposal Program Method						
Incinneration/Energy Recovery						
Landfill						
Long Haul						

3. WEST WGA

a. Introduction to West WGA

(1) Location

The West Waste Generation Area (West WGA) is located in the westernmost portion of the State of Washington. This area encompasses the Olympic Peninsula and the remaining Pacific Coast counties. The total area of the West WGA is 7,345 square miles.

The following counties are included in the West WGA:

- Clallam
- Grays Harbor
- Jefferson
- Mason
- Pacific

(2) Population

The estimated 1987 population of the West WGA was 187,800 persons. Of this, 44% resided in the 18 incorporated towns and cities of the area. The Washington State Office of Financial Management predicts an 8% growth in population by 1995, to 202,800 for the area. According to 1980 Census figures, 56% of the population lived in rural areas (defined as outside of urbanized areas or outside Census-designated places of 2,500 or more inhabitants).

In 1987, there were 87,840 housing units in the West WGA (April 1 estimate). Seventy percent (70%) of these units were single-family dwellings. This total represents an increase of 8,910 housing units since 1980 (11% growth).

(3) Economy

The Washington State Department of Employment Security estimated December 1987 employment in the West WGA to be 55,550 persons. The number of "employer units" (i.e., separate business locations) was put at 5,680. In 1986, almost half of employed persons (46%) worked in either manufacturing or government jobs; the bulk of manufacturing employment was in the lumber and wood products industries.

b. Existing Solid Waste Management Methods

(1) Solid-Waste Reduction and Recycling

There are approximately ten recycling centers in the West WGA (this figure excludes beverage distributors handling refillable bottles, as well as battery and tire distributors). In 1987, these centers handled 18,600 tons of materials, representing 7.5% of the estimated total tonnage of solid waste

generated. The following sections summarize the reduction and recycling programs in each of the counties in the West WGA.

(a) Clallam County

In Port Angeles, the largest city in Clallam County, the nine-year-old Port Angeles Recycling Team (PART) operates a full-time recycling center. PART handles most recyclable materials except plastics and refillable beer bottles. It also currently handles corrugated cardboard from commercial sources as part of a contract with the City.

The Port Angeles landfill provides onsite facilities for recycling cans, bottles, and white goods. There is also a composting facility at the landfill. The City of Port Angeles has a recycling public information program that includes brochures and radio advertising.

Olympic Disposal operates a drop-off center and curbside recycling, which serve rural portions of the County as well as Sequim.

(b) Grays Harbor County

Aberdeen has a buy-back center which takes metals, corrugated cardboard, glass, cans, and batteries. Reynolds Aluminum also operates an aluminum can buy-back center there. Montesano has drop-off stations for recyclables run by the private sector. There is also a franchised hauler who buys recyclables from Elma residents.

Currently, Hoquiam provides recycling bins for cans, paper, glass, and corrugated cardboard at the landfill, and plans to set up four drop boxes throughout the city. The City of Hoquiam also disseminates public education material about its programs.

Grays Harbor County plans to develop a formal policy and program for solid-waste reduction. It sees its main role as encouraging voluntary citizen participation through public education--pamphlets, news releases, and booths at fairs. Grays Harbor County has also recently created a recycling subcommittee of its solid-waste advisory committee, and has applied for funds to study the feasibility of expanding recycling programs. Recommendations include the investigation of possible markets for composted material.

(c) Jefferson County

Jefferson County recycling efforts are focused primarily on its largest city, Port Townsend. However curbside recycling is offered at Cape George and may soon be offered at Kala Point and other areas in the County. The 15-year-old program at Port Townsend now includes a recycling center at the County landfill, and curbside collection of recyclables from residents.

The main recycling center in Port Townsend was established by Bayshore Enterprises, a nonprofit agency staffed by developmentally disabled people. In 1983, the operation moved to the Jefferson County landfill site, into a large warehouse constructed partly with State DOE funds.

The Jefferson Recycling Project began in 1984 as a pilot program for curbside collection of recyclables; at the time, it was one of only three curbside services in the State. In addition to curbside collection, there are now recycling drop boxes scattered throughout the County. Most of these are operated by civic groups and handle newspaper, but in the near future, the County will own and operate the drop boxes.

Olympic Disposal operates curbside recycling programs and a cardboard collection route in rural areas of Jefferson County.

Jefferson County took over the planning and administration of the recycling program in 1988. Its public education activities have included brochures mailed to all Port Townsend residents, recycling kits, bus signs and other advertising, a recycling information booth, and recycling skits during public events. A city survey of recycling practices and preferences will be used as an information gathering tool

(d) Mason County

Mason County has operated a pilot curbside recycling program in Shelton for the past year-and-a-half. The initial outreach program was assisted with funds from the State DOE. The program services 100 homes and is operated through an exchange with Exceptional Foresters, a nonprofit organization staffed by developmentally disabled persons. Current funding comes from the City of Shelton, which plans to expand the service to another 100 homes in 1989. The broader public eduction program includes pamphlets, newspaper advertisements, and training for teachers.

(e) Pacific County

In Pacific County, all recycling is done privately, with no government involvement. Peninsula Sanitation--the private operator of the County transfer station--recently added facilities to accommodate its expanded recycling efforts.

In the industrial sector, timber and fishing operations recycle some of their materials. The timber industry sells lumber waste, while fish processors recycle corrugated cardboard.

(2) Solid-Waste Collection

In the West WGA, there are eight haulers collecting municipal solid waste under U.T.C. certificates (franchises). Six cities operate their own solid waste collection service. These cities are Port Angeles, Sequim, Hoquiam, Shelton, South Bend, and Raymond.

All other collection in this WGA is conducted through a contractual agreement between city and hauler. Table E-4 summarizes information on West WGA haulers.

TABLE E-4
WASHINGTON DEPARTMENT OF ECOLOGY
Recycling and Waste Stream Survey-1987
WEST WASTE GENERATION AREA
HAULERS

NAME	PUBLIC/ PRIVATE	FRANCHISES	AREA SERVED	DESTINATION/COUNTY
Gary Disposal	Private		Makah Reservation	Makah Dump/Clallam
City of Port Angeles	Public		City of Port Angeles	Port Angeles L.F./Clallam
City of Sequim	Public		City of Sequim	Port Angeles L.F./Clallam
City of Hoquiam	Public		City of Hoquiam	Hoquiam L.F./Grays Harbor
Harbor Disposal/ Aberdeen Sanitation	Private	F	Grays Harbor Co. & Pacific Co.	Aberdeen Sanitary L.F./ Grays Harbor
Montesano Sanitation	Private	F	Grays Harbor Co.	Aberdeen Sanitary L.F./ Grays Harbor
Superior Refuse	Private		City of Port Townsend	Jefferson Co. L.F./ Jefferson Co.
Olympic Disposal	Private	F	Clallam Co. & Jefferson Co.	1. Lake Creek L.F./Clallam 2. Port Angeles L.F./Clallam
City of Shelton	Public		City of Shelton	Mason Co. L.F./Mason
Mason Co. Garbage	Private	F	Mason County	Mason Co. L.F./Mason
Mason Co. Salvage	Private	F	Mason County	Mason Co. L.F./Mason
Eastern Grays Harbor Disposal	Private	F	Grays Harbor Co. & Thurston Co.	Mason Co. L.F./Mason
Peninsula Sanitation	Private	F	Pacific Co. & Wahkiakum Co.	Rainbow Valley L.F./Pacific
City of South Bend	Public		City of South Bend	Rainbow Valley L.F./Pacific
City of Raymond	Public		City of Raymond	Rainbow Valley L.F./Pacific

NAME	PUBLIC/ PRIVATE	FRANCHISES	AREA SERVED	DESTINATION/COUNTY
City of South Bend	Public		City of South Bend	Rainbow Valley L.F./Pacific
City of Raymond	Public		City of Raymond	Rainbow Valley L.F./Pacific

The operators hauled an estimated 112,000 tons of waste in 1987, 61% of which was from the commercial sector, and 39% from residences. Including self-haul tonnages, the total disposed waste for 1987 was estimated to be 208,000 tons.

It is reported that there are rural self-haul drop boxes in seven locations in Clallam, Jefferson, and Pacific Counties (depending on the definition used for "drop box," the number may vary; there appear to be different interpretations of the terms "drop box" and "transfer station"). Table E-5 describes them in greater detail.

(3) Solid Waste Disposal

There are eight operating landfills accepting municipal waste in the West WGA; seven are open to the public. The private landfill is operated by the Makah Reservation in Clallam County. Table E-6 presents more detailed information on landfills and transfer stations. The estimated remaining capacities of these landfills range from seven to 30 years (some information was unavailable); Table E-7 summarizes this information.

Based on 1987 quantities of waste disposed, rough estimates were generated for the tonnage of waste that could be accommodated by present landfills in the West WGA. Calculations were based only on information from landfills accepting municipal waste, except for those on military bases and Indian reservations. The tons of waste disposed at each landfill in 1987 were multiplied by the reported years of remaining life. Remaining life was defined as:

1) The number of years between 1987 and a closure data mandated by permit; or

2) if no mandated closure date is specified, the number of years between 1987 and an estimated closure date (due to exhaustion of site capacity, landfill noncompliance, or business closure); or

3) the smaller of the two figures, if both exist.

If a facility's capacity was not reported in terms of years, estimates were developed according to the best available information. Remaining capacity reported in cubic yards was converted to tons, using a figure of 1,100 pounds to the cubic yard.

Using this method, it was estimated that the West WGA had sufficient landfill capacity at the end of 1987 to accommodate approximately 1,224,000 additional tons of solid waste. Care should be taken when interpreting this figure, since a WGA total estimate may not reflect situations facing individual jurisdictions. Landfills which did not report sufficient information to calculate tonnage capacity are not represented in the above estimate (refer to Tables E-6 and E-7).

TABLE E-5
WASHINGTON DEPARTMENT OF ECOLOGY
Recycling and Waste Stream Survey-1987
WEST WASTE GENERATION AREA
RURAL DROP BOXES

COUNTY	LOCATION	SIZE	TYPE	OTHER
Clallam	Blue Mountain	40 CY	Non-compactor	Owned by Olympic Disposal
Jefferson	Brinnon	20 CY	Compactor	County Owned and operated
	Clearwater	20 CY	Rollaway, Compactor	County Owned and operated
	Coyle	30 CY	Rollaway	County Owned and operated
	Hadlock	20 CY	Compactor	County Owned and operated
	Quilcene	20 CY	Compactor	County Owned and operated
Pacific	Ocean Park	20 CY	Dumpster	Peninsula Sanitation owns box

TABLE E-6
WASHINGTON DEPARTMENT OF ECOLOGY
Recycling and Waste Stream Survey-1987
WEST WASTE GENERATION AREA
DISPOSAL FACILITIES

COUNTY	FACILITY	NAME	ACCESS	1987 TONS RECEIVED	REMAINING CAPACITY*	DESTINATION	1987 TIPPING FEES
Clallam	Landfills:	Lake Creek	Public	5,000	25-30 Years		$1.00/LCY or $2.00/CCY
		Makah (Neah Bay)	Private	1,000	20 Years		-0- -Indian Reservation
		Port Angeles	Public	32,200	20 Years		$23.00/Ton
	Transfer Stations:	Clallam Bay	Public	1,200		Lake Creek L.F.	$1.00/LCY or $2.00/CCY
Grays Harbor	Landfills:	Aberdeen Sanitary	Public	68,900	10-11 Years		$6.65/LCY or $7.36/CCY
		Hoquiam	Public	12,800	Not Available		$5.00/LCY or $7.75/CCY
	Transfer Stations:	Elma	Public	1,700		Hoquiam L.F.	$6.00/LCY or $2.00/CCY
		Hogan's Corner	Public	1,300		Hoquiam L.F.	$6.00/LCY or $2.00/CCY
		Humptulips	Public	300		Hoquiam L.F.	$6.00/LCY or $2.00/CCY
		Pacific Beach	Public	800		Hoquiam L.F.	$6.00/LCY or $2.00/CCY
		Westport (Ocosta)	Public	800		Hoquiam L.F.	$6.00/LCY or $2.00/CCY
Jefferson	Landfills:	Jefferson Co.	Public	11,500	7-8 Years 160 Acres		$30.00/Ton
Mason	Landfills:	Mason Co.	Public	45,000	400,000 CY		$3.85/LCY or $5.00/CCY
	Transfer Stations:	Belfair	Public	6,800		Mason Co. L.F.	$3.85/LCY or $5.00/CCY -Self haul
		Hoodsport	Public	1,700		Mason Co. L.F.	$3.85/LCY or $5.00/CCY -Self haul
		Union	Public	1,000		Mason Co. L.F.	$3.85/LCY or $5.00/CCY -Self haul

COUNTY	FACILITY	NAME	ACCESS	1987 TONS RECEIVED	REMAINING CAPACITY*	DESTINATION	1987 TIPPING FEES
Pacific	Landfills:	Rainbow Valley	Public	30,000	20 Years 20-30 Acres		$3.10/LCY or $4.75/CCY or $9.28/Ton
	Transfer Stations:	Peninsula Sanitation	Public	5,000		Rainbow Valley Landfill	$41.25/Ton

CY = Cubic Yard
CCY= Compacted Cubic Yard
LCY= Loose Cubic Yard

* Based on space available at the end of 1987, regardless of mandated or planned closure dates.

TABLE E-7
WASHINGTON DEPARIMENT OF ECOLOGY
Recycling and Waste Stream Survey-1987
WEST WASTE GENERATION AREA
LANDFILL CAPACITIES

COUNTY	FACILITY NAME	MANDATED CLOSURE (Date/None)	REMAINING CAPACITY* (Years/C.Y./Acres)	COMMENTS (#)
Clallam	Lake Creek	11/27/89	25-30 Years	1
	Makah Reservation	Not Avail.	20 Years	2
	Port Angeles	None	20 Years	
Grays Harbor	Aberdeen Sanitation	1900-1992	10-11 Years; 380,000-500,000 CY	3
	Hoquiam	1989	Not Available	4
Jefferson	Jefferson County	None	7-8 Years; 160 Acres	5
Mason	Mason County	12/31/89	400,000 CY	6
Pacific	Rainbow Valley	None	20 Years; 20-30 Acres	7

COMMENTS

1. Will close by 11/27/89 (Too much rain).
2. Open dump. Permitted by EPA and will be closed in about 20 years.
3. Not meeting certain regulations, i.e., liner.
4. Capacity difficult to determine. Only 25 of 46 acres currently in use, and due to close 11/27/87 because no liner. But if liner obtained and all 46 acres used, remaining capacity and life of landfill could be extensive.
5. Capacity potentially 20 years through use of undeveloped land.
6. Hoping to get variance to move 1989 closure to 1990, by which time, there would be a new landfill on the site.
7. Due to close 11/89, with future site study in progress.

* Based on space available at the end of 1987, regardless of mandated or planned closure dates.

(4) Solid-Waste Management Planning

Clallam County--currently updating its 1984 solid-waste plan.

Grays Harbor County--currently working with nine municipalities to complete a new solid-waste plan.

Jefferson County--currently operating under its 1983 solid waste plan, and expects to finish a new plan in 1989.

Mason County--its new solid-waste plan has been submitted to the DOE.

Pacific County--currently updating its 1974 solid-waste plan.

c. Market Capacity

Most markets for West WGA recyclables are located in the Puget Sound region. No end-users are located in this WGA. Low population densities and low supplies of some materials along with high transportation costs present obstacles to marketing material from the West. Limited access to major transportation routes and low potential for backhauls result in high instate tariffs.

Since newspaper, glass, and tin are relatively low-value materials, prices may not be adequate to generate larger supplies from the West WGA. Markets for corrugated containers, aluminum, and the high-value metals should accommodate supply from the area. Mixed waste paper could potentially be marketed if prices improve, but high transportation cost is a major barrier. The value of high-grade paper is adequate for marketing, but supplies are inadequate in most communities. The desire to avoid disposal costs may encourage greater recycling of white goods in the West WGA, and the availability of mobile crushers ("loggers") to process appliances prior to shipment could help further reduce recovery costs. Plastics are not currently recovered from the area because of low supply and high transport cost. In the future it may be possible to market plastics and yard waste from some communities; however, conditions do not currently favor recycling either material.

A market capacity summary for the West WGA is presented in Table E-8.

d. Evaluation of Methods

(1) Feasibility Analysis

Notable exceptions to the Statewide technical feasibility review for the West WGA include:

- Drop-Off/Buy-Back Depots. The group judged siting exposure to be greater than that assessed for the State as a whole. The working group felt that since depots

Table E-8

Market Capacity Summary for West WGA

	COMMODITY	MAJOR END USERS FOR MATERIAL FROM WGA (Name &/or Location)	ESTIMATED END USER PRICE '88 ($/Ton)	VOLUME OF WGA MATRL. RECOVERED (1987 Tons)	(1) WGA COLLECTED MATERIAL PRICE ($/Ton)	(1) WGA COLLECTED MATERIAL VALUE ($/Year)	(2) WGA MARKET CAPACITY	FACTORS AFFECTING WGA MARKET FOR MATERIAL
1	Newsprint	CCA - Tacoma Sonoco - Sumner Export	$45.00	2,500	$11	$27,500	ADEQUATE	Instate tariff - $.16/ton/mile
2	Corrugated Containers	CCA - Tacoma Sonoco - Sumner Export	$65.00	2,500	$36	$90,000	ADEQUATE	Instate tariff - $.16/ton/mile
3	High Grade Paper	CCA - Tacoma Scott Paper - Everett	$100.00	0	$32	$0	ADEQUATE	Little material generated in WGA
4	Mixed Waste Paper	Export Sonoco - Sumner	$25.00	0	($17)	$0	NOT SIGNIFICANT	Instate tariff - $.16/ton/mile Low supply & high transport cost
5	Container Glass	Ball-InCon - Seattle	$40.00	600	$4	$2,400	ADEQUATE	Instate tariff - $.31/ton/mile Freight assistance reduces cost
6	Refillable Glass	Rainier Brewing - Sea. Pabst/Olympia	$116.00	900	$33	$29,700	ADEQUATE	
7	Aluminum Bev. Cont.	Various Alum. Co. Ship from Seattle	$1,000.00	300	$817	$245,100	ADEQUATE	Instate tariff - $.31/ton/mile
8	Tin Cans	MRI - Seattle	$49.00	100	$12	$1,200	ADEQUATE	Instate tariff - $.31/ton/mile Freight assistance reduces cost
9	Ferrous Metals	General Metals - Tac. Salmon Bay/Seattle Steel	$65.00	9,200	$17	$156,400	ADEQUATE	Instate tariff - $.31/ton/mile
10	White Goods	General Metals - Tac. Seattle Iron & Steel	$20.00	100	($33)	($3,300)	POTENTIAL DISP. AVOID.	Mobile loggers help reduce cost
11	Non Ferrous Metals	Various - Tacoma/Seattle	$800	1,000	$617	$617,000	ADEQUATE	Instate tariff - $.31/ton/mile
12	PET Bottles	Midwest & East U.S.	$160	0	($6)	$0	NOT SIGNIFICANT	Low supply & high transport cost Potential future market
13	HDPE Bottles	Export - Puget Sound Partek - Vancouver	$200	0	$34	$0	NOT SIGNIFICANT	Low supply & high transport cost Potential future market
14	Plastic Films (LDPE)	Export - Puget Sound	$160	0	$27	$0	NOT SIGNIFICANT	Low supply & high transport cost Potential future market
15	Lawn & Garden Waste	None	($20)	0	($30)	$0	NOT SIGNIFICANT	Potential disp. avoid. market

(1) WGA prices and values are before transportation, processing and handling necessary to prepare and move material to market.

(2) WGA market capacity is based on an assessment of the markets' ability to consume consistently and gradually increasing volumes.

REFER TO TEXT FOR DETAILED DISCUSSION

would be located in areas of higher density, they would be subject to NIMBY concerns about litter, noise, and traffic.

- Mixed Waste Processing. The group judged technical risks to be lower than the Statewide rating. It was determined that the group was generally unfamiliar with the technology.

- Yard Waste Composting. Siting and waste supply exposure was seen as being greater than the level determined for the Statewide rating. The group expressed concerns regarding surface and ground water contamination from escaping leachate and that composting methodology is not always operated correctly. The group also felt that the seasonal nature of yard waste generation would make the operation less feasible.

- Food Waste Processing. The group viewed the siting exposure for food waste processing to be greater than the Statewide rating. The group expressed a strong resistance to feeding "garbage" to animals.

- Landfill. Landfill permitting exposure was judged lower than the Statewide rating by the group. The group believed that land for possible landfill sites is plentiful in the West WGA and that local governments do not generally oppose siting them.

- Financing exposure to loss was judged to be higher than the Statewide rating by the group. The group assumed most landfills would be privately financed, and that banks would perceive loans for them to be of higher risk.

The exposure to loss feasibility evaluation is presented in Table E-9.

(2) Environmental Evaluation

(a) Impacts

Environmental considerations for the West WGA from a technical perspective are generally the same as those for the State as a whole. The only exception is that the very high level of precipitation in much of this WGA increases the potential for leachate generation and resulting ground and surface water contamination with respect to all of the composting alternatives, landfills, and ashfills. These factors are reflected in the environmental impact matrix presented in Figure E-10.

An evaluation of potential environmental impacts due to failures in the technology is presented in Table E-11.

Table E-9
Evaluation of Exposure to Loss
for West WGA

VAADOW28

DEGREE OF EXPOSURE TO LOSS ASSOCIATED WITH IMPLEMENTATION & USE OF EACH METHOD

TECHNICAL IMPLEMENTATION FACTOR			REDUCTION						RECYCLING												HANDLING		DISPOSAL					
			EDUCATION	INCENTIVES	DISINCENTIVES	MODEL GOVERNMENTAL PROGRAMS	WASTE EXCHANGE	HOME YARD WASTE COMPOSTING	REUSE	CURBSIDE COLLECTION	MULTI-FAMILY HOUSING COLLECTION	COMMERCIAL SOURCE SEPARATION	INTERMEDIATE PROCESSING FACILITY	COMMERCIAL MIXED WASTE PROCESSING	DROP OFF / BUYBACK DEPOTS	MIXED WASTE PROCESSING	YARD WASTE COMPOSTING	MIXED WASTE COMPOSTING	FOOD WASTE PROCESSING	SPECIAL WASTE RECYCLING AND REUSE	TRANSFER	LONG HAUL TRANSPORT	ANAEROBIC DECOMPOSITION	PYROLYSIS / GASSIFICATION	REFUSE DERIVED FUEL PREP. & USE	MASS BURN INCINERATION	LANDFILL	ASHFILL
SITING	SITING RESISTANCE	GENERAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	L/M	L	M/H	L	M/H	M	M/H		M/H	NA	M/H	M/H	H	H	H	H
		WGA SPECIFIC	NA	NA	NA	NA	NA	NA	NA	NA	NA	L/M	L/M	M	H	M	H	H	M		M/H	NA	M/H	M/H	M/H	H	H	H
	PERMITS AQUISITION DIFFICULTY	GENERAL	NA	NA	NA	NA	NA	NA	L	L	L	L	L	L/M	L	M	L	M/H	M	L/M		M	M	M/H	M/H	H	H	H	H
		WGA SPECIFIC	NA	NA	NA	NA	NA	NA	L	L	L	L	L/M	L/M	L/M	M	M	M	M	M		M	M	M	M/H	M/H	H	L	H
	TIME & COST REQUIRED TO COMPLETE SITING	GENERAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	L/M	L	L	L	M/H	M	M/H		M/H	NA	M/H	M/H	H	H	H	H
		WGA SPECIFIC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	L	M	M	L	M/H	M/H	M/H		M	NA	M	M/H	M/H	H	H	H
WASTE SUPPLY	QUANTITY	GENERAL	NA	NA	NA	NA	L	NA	L	M	M	L	L/M	L	L	L	L	L	M/H	L/M		L/M	L/M	L/M	M	M	M	L	L
		WGA SPECIFIC	NA	NA	NA	NA	L	NA	L	L/M	M	L	L/M	L	L	L/M	M	M	M	M		L	L	L/M	M	M	M	L	L
	COMPOSITION	GENERAL	NA	NA	NA	NA	L	L	L/M	L/M	L/M	L	L/M	L	M	L/M	L/M	M	L	L/M		L	L/M	L/M	M	M	M	L	L/M
		WGA SPECIFIC	NA	NA	NA	NA	L	L	L/M	L/M	L/M	L	L/M	L	M	M	L	M	L	M		L	L	L/M	M	M	M	L/M	L
MARKETS		GENERAL	NA	NA	NA	NA	L	NA	L	M	M	L/M	L/M	L/M	L/M	M/H	M	M/H	M/H	L/M		NA	NA	L/M	M/H	M/H	M	NA	NA
		WGA SPECIFIC	NA	NA	NA	NA	L	NA	L	L/M	L/M	L/M	L/M	L/M	L/M	M/H	L/M	M/H	M/H	M/H		NA	NA	L	M/H	M/H	M	NA	NA
VENDOR		GENERAL	NA	NA	NA	NA	L	NA	NA	L/M	L/M	L/M	L/M	L/M	L	M/H	L	M/H	L/M	L/M		L	L/M	L	H	M	M	NA	NA
		WGA SPECIFIC	L	NA	NA	NA	NA	NA	NA	L/M	L/M	L/M	L/M	L/M	L	M/H	L	M/H	L/M	L/M		L	L	L	H	M	M	NA	NA
TECHNOLOGY/ PROGRAM	ABILITY TO CONSTRUCT & MAKE OPERATIONAL	GENERAL	L	M/H	M/H	L	L	M	L/M	L	M	L	L/M	L/M	L	M/H	L	L/M	L	L/M		L/M	NA	L	H	M	M	L/M	L/M
		WGA SPECIFIC	L	M/H	M/H	L	L	M	L/M	L	M	L	L/M	L/M	L	L/M	L	L/M	L	L/M		L/M	NA	L	H	M	M	M/H	L/M
	ABILITY TO OPERATE AND MAINTAIN	GENERAL	L	L/M	L/M	L	L	M	L/M	L	M	L	L/M	L/M	L/M	M	L/M	L/M	L/M	L/M		L/M	M/H	L	M/H	M/H	M	M	L
		WGA SPECIFIC	L	L/M	L/M	L	L	M	L/M	L	M	L	L/M	L/M	L/M	M	L/M	M	L/M	L/M		L/M	M/H	L	M/H	M/H	M	M/H	L
RESIDUE DISPOSAL	CHARACTERISTICS	GENERAL	NA	NA	NA	NA	NA	M	NA	L	L	L	L	L	L	L	L	L	L	M/H		NA	NA	M	M	L/M	M/H	NA	NA
		WGA SPECIFIC	NA	NA	NA	NA	NA	M	NA	L	L	L	L	L	L	L	L	L	L	M/H		NA	NA	M	M	L/M	M/H	NA	NA
	SITE AVAILABILITY	GENERAL	NA	NA	NA	NA	NA	M	NA	NA	NA	NA	L	L	L	L	L	L	L	M/H		NA	NA	M	M	L/M	M/H	NA	NA
		WGA SPECIFIC	NA	NA	NA	NA	NA	M	NA	NA	NA	NA	L	L	L	L	L	L	L	M		NA	NA	M	M	L/M	M/H	NA	NA
FINANCING		GENERAL	L	L	L	L	L	L	L	L	L/M	L	L/M	M	L	M	L	L/M	M	M		L/M	L/M	L/M	H	M/H	M/H	M	M
		WGA SPECIFIC	L	L	L	L	L	L	L	L	L	L	L/M	L/M	L	M	L	L/M	M	L/M		L/M	L/M	L/M	H	M	M/H	H	M
UNCONTROLLABLE CIRCUMSTANCES**		GENERAL	L	M	M	L	M	M	L	L	L	L	L	L	M	M	L	M	M	M/H		M	M	M	M/H	M/H	M/H	M/H	M/H
		WGA SPECIFIC	L	M	M	L	M	M	L	L	L	L	L	L	M	M	L	M	M	M		M	M	M	M/H	M/H	M/H	M/H	M/H

KEY:

NA = NOT APPLICABLE
H = HIGH
M = MODERATE
L = LOW

(b) Concerns

The West WGA working group expressed relatively high concern about potential explosion and public health risks of the recycling alternatives. (See Figure E-12.) The group assumed that processing would involve compaction or shredding of materials, including flammable or explodable items such as spray cans and batteries. Its members were also more concerned than most of the other WGA groups about aesthetic impacts of all the disposal alternatives. They rated water quality impacts a high concern for landfills and ashfills, even though containment was assumed; this reflected their lack of confidence regarding the effectiveness of leachate containment systems, particularly liners.

(3) Economic Evaluation of Alternatives

The results of the economic analysis for the West WGA are summarized in Table E-13. Detailed results appear in Appendix C.

e. Ranking of Methods and Recommendations

The following paragraphs present the working group's rankings and consultant team's rankings for best management practices, as well as each group's recommended system for reduction, recycling, and disposal in this WGA.

(1) Working Group Rankings

Evaluation criteria were weighted by the West WGA working group, and applied to the alternative solid waste management methods. The resulting rankings are shown in Table E-14.

Based on these rankings, the WGA working group selected the following preferred system for solid-waste management in this WGA:

- Reduction Program
  - -- Education
  - -- Home yard waste composting
  - -- Incentives
  - -- Disincentives
- Recycling Program
  - -- Education
  - -- Drop-off/buy-back depots
  - -- Reuse
  - -- Incentives
  - -- Disincentives
  - -- Special waste recycling/reuse
  - -- Single-family curbside collection
  - -- Multi-family collection
  - -- Commercial source-separated collection
  - -- Yard-waste composting

Table E-10

Evaluation of Environmental Impacts *

for West WGA

VAA00W26

DEGREE OF POTENTIAL ENVIRONMENTAL IMPACT ASSOCIATED WITH IMPLEMENTATION & USE OF EACH METHOD

ENVIRONMENTAL FACTOR	REDUCTION						RECYCLING												HANDLING		DISPOSAL					
	EDUCATION	INCENTIVES	DISINCENTIVES	MODEL GOVERNMENTAL PROGRAMS	WASTE EXCHANGE	HOME YARD WASTE COMPOSTING	REUSE	CURBSIDE COLLECTION	MULTI-FAMILY HOUSING COLLECTION	COMMERCIAL SOURCE SEPARATION	INTERMEDIATE PROCESSING FACILITY	COMMERCIAL MIXED WASTE PROCESSING	DROP OFF / BUYBACK DEPOTS	MIXED WASTE PROCESSING	YARD WASTE COMPOSTING	MIXED WASTE COMPOSTING	FOOD WASTE PROCESSING	SPECIAL WASTE RECYCLING AND REUSE	TRANSFER	LONG HAUL TRANSPORT	ANAEROBIC DECOMPOSITION	PYROLYSIS / GASSIFICATION	REFUSE DERIVED FUEL PREP. & USE	MASS BURN INCINERATION	LANDFILL	ASHFILL
AIR QUALITY	NA	NA	NA	NA	NA	NA	NA																			
CRITERIA POLLUTANTS: SO2, NOX, HCL								L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
TOXICS								L	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	NA	NA	L	L	L	L	L	L
PARTICULATES								L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
ODOR	NA	NA	NA	NA	NA	L	NA	NA	L	NA	L	NA	L	L	L	L	L	L	L	NA	L	L	L	L	L	NA
SURFACE WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	NA	NA	NA	L	L/M	L/M	L	L	NA	NA	L	L	L	L	L/M	L/M
GROUND WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	NA	NA	NA	L	L	L	L	L	NA	NA	L	L	L	L	L/M	L/M
NOISE	NA	NA	NA	NA	NA	L	NA	L	L	NA	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
RISK OF EXPLOSION	NA	NA	NA	NA	NA	NA	NA	NA	L	NA	NA	L	NA	L	NA	L	NA	L	L	NA	L	L	L	L	L	NA
PUBLIC HEALTH RISKS	NA	NA	NA	NA	NA	L	NA	NA		NA	L															
PATHOGENS						L		NA	L	NA	L	NA	L	L	NA	L	L	NA	L	L	L	L	L	L	L	NA
VECTORS						L		NA	L	NA	L	L	L	L	L	L	L	NA	L	L	L	L	L	L	L	NA
TOXICS						L		NA	NA	NA	L	NA	L	L	L	L	L	L	NA	NA	L/M	L/M	L/M	L/M	L	L/M
AESTHETICS	NA	NA	NA	NA	NA	L	NA	L	L	NA	L	L	L	L	L	L	L	L	L	NA	L	L	L	L	L	L
TRAFFIC	NA	NA	NA	NA	L	NA	NA	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
OTHER																										

KEY: **

NA = NOT APPLICABLE
H = HIGH RATING
M = MEDIUM RATING
L = LOW RATING

* THIS EVALUATION ASSUMES NEW "STATE OF THE ART" FACILITIES, PROPERLY SITED WITH FACILITY DESIGN INCORPORATIONG APPROPRIATE MITIGATION TECHNIQUES.

** A HIGH RATING INDICATES A HIGH LEVEL OF LOCAL ENVIRONMENTAL IMPACT
A LOW RATING INDICATES A LOW LEVEL OF ENVIRONMENTAL IMPACT

Table E-11

VAA00W27

Evaluation of Potential Environmental Impacts *
for West WGA

DEGREE OF POTENTIAL ENVIRONMENTAL IMPACT ASSOCIATED WITH IMPLEMENTATION & USE OF EACH METHOD

ENVIRONMENTAL FACTOR	REDUCTION						RECYCLING												HANDLING		DISPOSAL					
	EDUCATION	INCENTIVES	DISINCENTIVES	MODEL GOVERNMENTAL PROGRAMS	WASTE EXCHANGE	HOME YARD WASTE COMPOSTING	REUSE	CURBSIDE COLLECTION	MULTI-FAMILY HOUSING COLLECTION	COMMERCIAL SOURCE SEPARATION	INTERMEDIATE PROCESSING FACILITY	COMMERCIAL MIXED WASTE PROCESSING	DROP OFF / BUYBACK DEPOTS	MIXED WASTE PROCESSING	YARD WASTE COMPOSTING	MIXED WASTE COMPOSTING	FOOD WASTE PROCESSING	SPECIAL WASTE RECYCLING AND REUSE	TRANSFER	LONG HAUL TRANSPORT	ANAEROBIC DECOMPOSITION	PYROLYSIS / GASSIFICATION	REFUSE DERIVED FUEL PREP. & USE	MASS BURN INCINERATION	LANDFILL	ASHFILL
AIR QUALITY	NA	NA	NA	NA	NA	NA	NA																			
CRITERIA POLLUTANTS: SO2, NOX, HCL								L	L	L	L	L	L	L	L	M	L	M	M	M	M/H	H	M	M	M	L
TOXICS								L	L	L	L	L	M	L	L	L	L	M	L	L	M/H	H	M	M	H	L/M
PARTICULATES								L	L	L	L	L	L	L	L	L	L		M	M	L	L/M	H	H	L	M/H
ODOR	NA	NA	NA	NA	NA	L/M	NA	L	L	L	L/M	L	L/M	H	L	M	H	L	L/M	L/M	H	H	M	M	H	L
SURFACE WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	L	L	L/M	M	L/M	M	M	M	L	L	L	L	L	L	M	M
GROUND WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	L	L	L	M	L/M	M	M	M	L	L	L	L	L	L	H	H
NOISE	NA	NA	NA	NA	L	L	NA	L/M	L/M	L/M	L/M	M/H	M	H	M	L/M	L/M	L	M/H	M/H	M	M/H	M/H	M/H	M	M
RISK OF EXPLOSION	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	L/M	L	H	L/M	L/M	L	L	L	L	M/H	M	H	M	H	L
PUBLIC HEALTH RISKS	NA	NA	NA	NA	NA		NA																			
PATHOGENS						L		L	L	L	L	L	L/M	M	L	M	H	NA	M	L	L	L	L	L	L/M	L
VECTORS						L/M		L	L	L	L	L	L/M	M	L	M	H	M	M	L	L	L	L	L	M	L
TOXICS						L		NA	NA	NA	L	L	L	M	L	M	H	M	L	L	M/H	M/H	M/H	M/H	M/H	M
AESTHETICS	NA	NA	NA	NA	M	M	NA	L/M	L/M	L/M	L/M	M	M	H	M/H	M	M/H	L/M	M/H	M	M	M	M	M	M	M
TRAFFIC	NA	NA	NA	NA		NA	NA	L/M	L/M	L/M	M	M	L/M	H	M	M	M	L/M	M/H	M/H	H	H	H	H	H	L/M
OTHER																										

KEY: **

NA = NOT APPLICABLE
H = HIGH RATING
M = MEDIUM RATING
L = LOW RATING

* THIS EVALUATION ASSUMES THAT CERTAIN FAILURES OCCUR IN THE SITING PROCESS, DESIGN, MITIGATION MEASURES AND IN THE OPERATION & PERFORMANCE OF THE SELECTED TECHNOLOGY.

** A HIGH RATING INDICATES A HIGH LEVEL OF LOCAL ENVIRONMENTAL IMPACT
A LOW RATING INDICATES A LOW LEVEL OF ENVIRONMENTAL IMPACT

Table E-12

Environmental Concerns Evaluation

for West WGA

VAA00W25

DEGREE OF ENVIRONMENTAL CONCERN ASSOCIATED WITH IMPLEMENTATION & USE OF EACH METHOD

ENVIRONMENTAL FACTOR	REDUCTION						RECYCLING												HANDLING		DISPOSAL					
	EDUCATION	INCENTIVES	DISINCENTIVES	MODEL GOVERNMENTAL PROGRAMS	WASTE EXCHANGE	HOME YARD WASTE COMPOSTING	REUSE	CURBSIDE COLLECTION	MULTI-FAMILY HOUSING COLLECTION	COMMERCIAL SOURCE SEPARATION	INTERMEDIATE PROCESSING FACILITY	COMMERCIAL MIXED WASTE PROCESSING	DROP OFF / BUYBACK DEPOTS	MIXED WASTE PROCESSING	YARD WASTE COMPOSTING	MIXED WASTE COMPOSTING	FOOD WASTE COMPOSTING	SPECIAL WASTE PROCESSING	TRANSFER	LONG HAUL TRANSPORT	ANAEROBIC DECOMPOSITION	PYROLYSIS / GASSIFICATION	REFUSE DERIVED FUEL PREP. & USE	MASS BURN INCINERATION	LANDFILL	ASHFILL
AIR QUALITY	NA	NA	NA	NA	NA	NA	NA	L	L	L	L	L	L	L/M	L	L/M	L	M/H			L	L	M	H	M/H	
CRITERIA POLLUTANTS: SO2, NOX, HCL											M	M														L
TOXICS																										M
PARTICULATES																										M
ODOR	NA	NA	NA	NA	NA		NA	L	L	L	L	L	L/M	M	L/M	M/H	L/M	L/M		NA	L	L	L/M	L	M/H	L
SURFACE WATER QUALITY	NA	NA	NA	NA	NA		NA	NA	L	NA	NA	L	NA	L/M	M	M	L/M	M		NA	L	L	L/M	L/M	H	M/H
GROUND WATER QUALITY	NA	NA	NA	NA	NA		NA	NA	L	NA	NA	L	NA	M	M	M	M	M		NA	L	L	L/M	L/M	H	M/H
NOISE	NA	NA	NA	NA			NA	L	L	L	L/M	L/M	L/M	L/M	L/M	L/M	L/M	M			L	L	M/H	L/M	M/H	M
RISK OF EXPLOSION	NA	NA	NA	NA	NA	NA	NA	NA	L	NA	M/H	M/H	NA	M/H	L/M	M	NA	M		NA	L	M	M/H	M/H	M/H	L
PUBLIC HEALTH RISKS	NA	NA	NA	NA	NA		NA	L	L	L	M/H	L/M	L	M/H	L	L/M	L/M				L		L		M/H	
PATHOGENS																		L				L				L
VECTORS																		L				L				L
TOXICS																		M			L	M		M/H		M
AESTHETICS	NA	NA	NA	NA			NA	L/M	L/M	L/M	L/M	L	L/M	L	L/M	L/M	L	M		NA	M	H	H	H	H	M
TRAFFIC	NA	NA	NA	NA		NA	NA	M	M	M	M/H	M/H	M/H	M	M	M	M	M			L/M	M	M	M/H	H	L
OTHER																										

KEY: •

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L = LOW RATING

• A HIGH RATING INDICATES A HIGH LEVEL OF LOCAL ENVIRONMENTAL CONCERN
A LOW RATING INDICATES A LOW LEVEL OF ENVIRONMENTAL CONCERN

Table E-13

WEST: RECOMMENDED ALTERNATIVE

(COST ESTIMATES ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICTIONS.)

	ESTIMATED NET (COST) OR REVENUE	CONTRIBUTION TO SYSTEM COST	ESTIMATED TONS	PERCENT OF GENERATED TONS	RELATIVE RATIO OF COSTS TO TONS
COLLECTION AND PROCESSING:					
1. COLLECTION OF SINGLE FAMILY SOURCE SEPARATED RECYCLABLES	$0	0.0%	0	0.0%	NA
2. COLLECTION OF SINGLE FAMILY COMINGLED RECYCLABLES *	$0	0.0%	0	0.0%	NA
3. COLLECTION OF MULTI FAMILY COMINGLED RECYCLABLES *	$0	0.0%	0	0.0%	NA
4. COMMERCIAL DIRECT RECYCLING	$0	0.0%	10,756	4.3%	0.00 :1.00
5. COLLECTION OF COMMERCIAL SOURCE SEPARATED RECYCLABLES	($357,106)	1.9%	5,031	2.0%	0.95 :1.00
6A. DROP OFF/BUY BACK "REGULAR" RECYCLABLES	$180,928	-1.0%	4,477	1.8%	-0.54 :1.00
6B. DROP OFF/BUY BACK OF "SPECIAL" RECYCLABLES OR WASTES	($33,998)	0.2%	2,542	1.0%	0.18 :1.00
7. YARD WASTE COLLECTION AND COMPOSTING	($1,915,954)	10.2%	27,893	11.1%	0.92 :1.00
8. SORTING OF TARGETED COMMERCIAL HIGH GRADE LOADS *	($36,205)	0.2%	620	0.2%	0.78 :1.00
9. SELF HAULED WASTE*	($2,723,004)	14.6%	62,254	24.8%	0.59 :1.00
10. REGULAR COLLECTION AND DISPOSAL OF MUNICIPAL WASTE *	($13,818,795)	73.9%	137,538	54.8%	1.35 :1.00
11. MIXED WASTE PROCESSING*	$0	0.0%	0	0.0%	NA
12. RDF PREPARATION*	$0	0.0%	0	0.0%	NA
SYSTEM TOTAL	($18,704,134)	100.0%	251,111	100%	1.00 :1.00
AVERAGE COST PER TON GENERATED	($74)				
DISPOSAL ONLY:					
A. MASS BURN WITH ASH MONOFILL	$0	0.0%	0	0%	NA
B. LANDFILL WITH LONG HAUL BY RAIL	$0	0.0%	0	0%	NA
C. LANDFILL WITH BALING	$0	0.0%	0	0%	NA
D. LANDFILL ONLY	($8,747,186)	46.8%	199,978	80%	0.59 :1.00
DISPOSAL TOTAL	($8,747,186)	46.8%	199,978	80%	0.59 :1.00
AVERAGE COST PER TON DISPOSED	($44)				
RECYCLED TONS			51,133	20%	

* The net costs for these methods include disposal costs for residual or disposed wastes.

- Disposal Program

  -- Landfill

(a) Reduction Program

The West WGA working group ranked education significantly higher than all other reduction methods. Although its impact on waste stream volume is difficult to assess directly, the group felt that education is a low-cost, environmentally benign method with high public and political acceptance. The group recognized that education's effects occur over a long timeframe.

Home composting ranked second, and was deemed more flexible (easier to change) than incentives, which came in a close third. Concern was expressed regarding possible environmental or public health problems if home compost piles were not properly managed.

The group distinguished among the various disincentives, and felt that target project disposal bans would be much less effective than other disincentive techniques such as packaging regulations, tax surcharges, and target product bans. This decision was based on the opinion that it would be easier to target upstream (manufacturers, packagers) than downstream (disposers).

Education, home composting, incentives, and disincentives (except target disposal bans) were recommended for implementation in rural and urban areas.

(b) Recycling Program

Again, the working group ranked education above all other recycling methods. Drop-off/buy-back depots were deemed to be an effective tool in handling solid waste in this largely rural WGA, where one-third of the waste stream is self-hauled. This method was ranked higher than reuse, largely because the group believed that drop-off/buy-back depots are the more flexible (easily changeable) method. Closely following the top three were incentives and disincentives (not including product disposal bans). Their impact on the environment was identified as less positive than the impact of reuse, even though their flexibility appeared greater.

Special-waste recycling and reuse ranked sixth. Although the group saw the environmental impact of this method as excellent, it was not seen to be very cost-effective because of the capital investment required to establish and operate the necessary materials-handling facilities, and since the tonnages generated are fairly small. Curbside single-family collection followed closely in seventh place. The group felt that this method would enjoy slightly less public acceptance than special waste recycling/reuse. Multi-family housing collection, commercial source separation, and yard waste composting followed curbside collection. The first two were felt to have a lesser impact on the waste stream volume than single-family curbside collection, and yard-waste composting was viewed as less benign environmentally than the other methods because of concerns about leachate escaping from composting facilities and contaminating local ground water.

Municipal solid waste composting and food waste processing scored well behind other methods. These methods were perceived to lack cost-effectiveness and flexibility, while causing greater environmental impacts.

In conclusion, education, drop-off/buy-back depots, reuse, incentives, and disincentives were recommended for implementation in both rural and urban areas. The group felt that single-family curbside collection could be carried out in rural areas of the WGA as well as in urbanized areas if residents could be educated regarding the separation of recyclables. Area haulers felt that pickup of recyclables could be accomplished at the same time regular garbage was collected. Multi-family collection, and commercial source separation would only be appropriate in urban areas.

(c) Disposal Program

The West WGA working group classified long hauling as a waste-handling method, and did not consider it during the ranking of disposal methods. Of the two remaining methods, landfilling was considered superior to incineration. Landfilling was seen as more cost-effective in this largely rural area, where land costs are fairly low and landfill sites do not generate public opposition. These advantages appeared to offset incineration's less significant environmental impact. Landfilling was seen as much more flexible than incineration, while incineration provides an additional benefit in the form of energy recovery.

Although the group felt that landfilling enjoys better public acceptance than incineration, they recognized that the latter reduces waste stream volume to a much greater extent. The group also felt that landfilling is more reliable and easier to implement than incineration.

Overall, landfilling was the preferred disposal--applicable in both rural and urban areas.

(2) Consultant Team Rankings

The waste management methods in each program (reduction, recycling, and disposal) were ranked by the consultant team as shown in Table E-14. In the reduction program, the consultant team evaluated "special government programs" and "waste exchange," which were not ranked by the WGA working group. In addition, the consultant team ranked "commercial high-grade collection" and "mixed-waste processing" for the recycling program. "Special-waste recycling/reuse" was not ranked because of the special characteristics of these components; it was assumed that special waste management will be included in any recommended program.

Based on the criteria established for the consultant team's analysis, the consultant recommended the following solid waste management system for the West WGA:

Table E-14

BEST MANAGEMENT PRACTICES FOR
SOLID WASTE METHODS RANKING SUMMARY

WEST WGA

Reduction		Recycling		Disposal	
WGA Working Group Preference	Consultant Team Recommendations	WGA Working Group Preference	Consultant Team Recommendations	WGA Working Group Preference	Consultant Team Recommendations
1. Education	1. Education	1. Education	1. Drop-Off/Buy-Back Depots	1. Landfill	1. Incineration
Home Yard Waste Composting	2. Incentives	2. Drop-Off/Buy-Back Depots	2. Education	2. Incineration	2. Long Haul
	2. Special Governmental Programs	3. Reuse	3. Commercial Source Separation		2. Landfill
Incentives	3. Disincentives	4. Incentives	4. Incentives		
Disincentives	4. Centralized Yard Waste Composting	5. Disincentives	5. Centralized Yard Waste Composting		
	5. Waste Exchange	6. Single-Family Curb-side Collection	6. Disincentives		
			6. Reuse		
		7. Multi-Family Collection	7. Commercial High-Grade Collection		
			7. Mixed Waste Processing		
		8. Commercial Source Separated	8. Single-Family Curb-side Collection		
		9. Yard Waste Composting	9. MSW Composting		
		10. MSW Composting	10. Multi-Family Collection		
			10. Food Waste Processing		
		11. Food Waste Processing			

- Reduction Program

  -- Education
  -- Incentives
  -- Special governmental programs
  -- Disincentives
  -- Home composting
  -- Waste exchange

- Recycling Program

  -- Drop-off/buy-back depots
  -- Education
  -- Commercial source-separated collection
  -- Incentives
  -- Yard waste composting

- Disposal Program

  -- Landfill

(a) Reduction Program

The consultant team found little justification for having different waste reduction programs among the different WGA's. Thus, the recommendations are the same Statewide; however, their ramifications for the West WGA are discussed below. Education is considered to be reasonably cost-effective with excellent long-term environmental benefits, considering its effect on all other management methods. The focus of education/public involvement programs is to inform and change society's view of solid waste and its management.

A balance of incentives and disincentives will be necessary components of a waste reduction program. The cost-effectiveness of these methods is considered to be fair; however, their application will produce considerable environmental benefit. They are not expected to have a significant impact upon the volume of waste but can affect the composition of the waste stream significantly.

Special governmental programs are considered to be a good way to demonstrate waste reduction methods and to assist business and industry in reducing waste and increasing recycling.

Home yard waste composting is a cost-effective, low-risk method for significantly reducing the waste stream. Measurable public participation will require local government to vigorously "market" the program. This effort will be worthwhile, considering the significant amount of yard waste in the overall waste stream.

Industrial waste exchanges have been effective for some time; there is now potential for applying this concept to household hazardous wastes.

It is recommended that the waste reduction program be developed in the priority order listed above, and that investment of resources be made in those methods and techniques which will provide the greatest return.

(b) Recycling Program

For recycling, the consultant team ranked drop-off/buy-back depots slightly ahead of education, in the West WGA. Although education was considered to have a significantly lower environmental impact, drop-off/buy-back depots scored somewhat higher in terms of cost-effectiveness, feasibility, and impact on waste stream volume. Drop-off/buy-back depots would be an effective method for handling the large proportion of self-hauled waste in this WGA (one-third of the total waste stream). Over one-third of the waste stream is made up of materials potentially attractive to buy-back operations. However, the lack of end-users and markets for recyclable materials within the WGA and the high cost of transporting them to end-users and markets in the Portland or the Puget Sound areas reduce the potential success of buy-back operations.

Commercial source-separated collection and incentives followed in a tie for third place with relatively high scores on all evaluation criteria. The high ranking for commercial source-separated collection resulted partly from this method's relatively significant impact on waste stream volume as revealed by the economic model. The method would intercept more material than drop-off/buy-back centers at a cost comparable to the other recycling methods. Commercial and manufacturing wastes in this WGA represent over 40% of the total waste generated.

Yard-waste composting followed closely in fifth place, as the economic model showed this method could have a significant impact on waste stream volume (yard waste constitutes over 15% of the total waste stream). Also, a portion of the large amount of wood waste generated by the timber industry in this WGA (nearly 10% of the total waste stream) could be available for composting. Overall, it is estimated that composting could intercept over 10% of the total tonnage handled by the integrated waste management system at a cost below the system average.

Disincentives and reuse were both ranked sixth, with lower cost-effectiveness and volumetric impact ratings than yard waste composting. Commercial high-grade collection and mixed waste processing, tied closely behind, followed by single-family curbside collection and municipal solid waste composting. Multi-family collection and food waste processing ranked last.

Recommended for implementation are drop-off/buy-back depots, education, commercial source-separated collection, incentives, and yard waste composting. These methods are all applicable in both rural and urban areas, although some of the commercial source-separated materials may be available in sufficient volumes only in urban areas.

(c) Disposal Program

The consultant team found essentially no difference among the disposal methods in the West WGA. Incineration was ranked slightly ahead of

landfilling and long hauling due to its greater impact on waste stream disposal volumes. This method also creates revenue through energy generation. Siting incinerators would meet with limited opposition in the West WGA, as would siting landfills; however, financing of incinerators would be much more difficult.

Landfilling is relatively cost-effective in this WGA because of the availability of sites and the apparently low public consciousness in this largely rural area. Since space to handle required volumes of waste is not a problem, the main concern regarding landfilling becomes its potential environmental impact. In this WGA, several of the landfills use readily available wood waste and sewage sludge as cover material in addition to soil.

Long hauling is relatively cost-effective and technically feasible. Some garbage is currently hauled out of Pacific County, in the southern portion of the WGA.

Landfilling is the primary disposal method recommended for implementation because of its cost-effectiveness, feasibility, flexibility, and public acceptance. If selected for implementation, incinerators should be considered only on a regional basis, to assure sufficient tonnages are available.

Objectives for each category of solid waste appear in Table E-15. These objectives depict the amount of each category which could reasonably be handled by each method. The objectives are based on the results of the WGA-recommended model and on the current levels of recycling in each WGA.

VAA00W60

Table E-15
Waste Stream Category Objectives By Method for West WGA

% OF WASTE STREAM CATEGORY MANAGED BY METHOD

WASTE STREAM CATEGORY (METHOD/TECHNIQUE)	RECYCLING: REUSE	RECYCLING: SINGLE FAMILY CURBSIDE COLLECTION	RECYCLING: MULTI-FAMILY HOUSING COLLECTION	RECYCLING: COMMERCIAL SOURCE SEPARATION	RECYCLING: COMMERCIAL HIGH GRADE	RECYCLING: COMMERCIAL DIRECT	RECYCLING: DROP OFF / BUYBACK DEPOTS	RECYCLING: MIXED WASTE PROCESSING	RECYCLING: YARD WASTE COMPOSTING	RECYCLING: MIXED WASTE COMPOSTING	RECYCLING: FOOD WASTE PROCESSING	RECYCLING: SUBTOTAL RECYCLING	DISPOSAL: ANAEROBIC DECOMPOSITION	DISPOSAL: PYROLYSIS / GASSIFICATION	DISPOSAL: REFUSE DERIVED FUEL PREP. & USE	DISPOSAL: MASS BURN INCINERATION / ASHFILL	DISPOSAL: LANDFILL	DISPOSAL: LONG HAUL	DISPOSAL: SUBTOTAL DISPOSAL	TOTAL (%)
NEWSPAPER						30						30					70		70	100
CORRUGATED CARDBOARD			17	1	8	3						29					71		71	100
HIGH GRADE PAPER			13	2								15					85		85	100
MIXED SCRAP PAPER (RECYCLABLE)				1								1					99		99	100
REFILLABLE GLASS CONTAINERS			6			64						70					30		30	100
GLASS			6			9						15					85		85	100
ALUMINUM						36						36					64		64	100
TIN PLATED FOOD & BEVERAGE CANS						1						1					99		99	100
FERROUS METAL					46	4						50					50		50	100
NON-FERROUS METAL					47	3						50					50		50	100
WHITE GOODS						7						7					93		93	100
PET PLASTICS																	100		100	100
HDPE PLASTICS																	100		100	100
PLASTIC PACKAGING (LDPE)																	100		100	100
EXPANDED POLYSTYRENE																	100		100	100
OTHER PLASTICS																	100		100	100
TIRES																	100		100	100
OTHER RUBBER PRODUCTS																	100		100	100
FOOD																	100		100	100
LAWN AND GARDEN WASTE							74					74					26		26	100
WOOD																	100		100	100
DISPOSABLE DIAPERS																	100		100	100
OIL						85						85					15		15	100
BATTERIES						43						43					57		57	100
OTHER HOUSEHOLD HAZARDOUS																	100		100	100
CONSTRUCTION DEBRIS (NOT WOOD)																	100		100	100
OTHER ORGANIC																	100		100	100
OTHER INORGANIC																	100		100	100

4. NORTHWEST WGA

a. Introduction to Northwest WGA

(1) Location

The Northwest Waste Generation Area (Northwest WGA) is located in the northwestern portion of the State of Washington. This area includes the mainland region west of the Cascade Mountains and north of Puget Sound, as well as Camano, Whidbey, and the San Juan Islands. The total area of the Northwest WGA is 4,251 square miles.

The following counties are included in the Northwest WGA:

- Island
- San Juan
- Skagit
- Whatcom

(2) Population

The estimated 1987 population of the Northwest WGA was 248,000 persons. Of this, 46% resided in the 19 incorporated towns and cities of the area. The Washington State Office of Financial Management predicts a 13% growth in population by 1995, to 280,200 for the area. According to 1980 Census figures, 54% of the population lived in rural areas (defined as outside of urbanized areas or outside Census-designated places of 2,500 or more inhabitants).

In 1987, there were 114,050 housing units in the Northwest WGA (April 1 estimate). Seventy-two percent (72%) of these units were single-family dwellings. This total represents an increase of 12,610 housing units since 1980 (12% growth).

(3) Economy

The Washington State Department of Employment Security estimated December, 1987 employment in the Northwest WGA to be 77,630 persons. The number of "employer units" (i.e., separate business locations) was put at 7,000. In 1986, more than six out of ten employed persons in the Northwest WGA (63%) worked in retail, government, or service jobs.

b. Existing Solid-Waste Management Methods

(1) Solid-Waste Reduction and Recycling

There are approximately 17 recycling centers in the Northwest WGA (this figure excludes beverage distributors handling refillable bottles, as well as battery and tire distributors). In 1987, these centers handled 45,700 tons of materials, representing 18.2% of the estimated total tonnage of

solid waste generated. The following sections summarize the reduction and recycling programs in each of the counties in the Northwest WGA.

(a) Island County

Island County has drop boxes for recyclables at the Coupeville landfill and the Camano Island transfer station. Private businesses also take part in the recycling effort, and the City of Oak Harbor is looking into the possibility of curbside collection. One private recycler operates a buy-back center in Oak Harbor.

(b) San Juan County

Funded by a grant from the State DOE, the County of San Juan--in conjunction with the City of Friday Harbor--operates a recycling program at the Friday Harbor Incinerator. Drop-off centers for this operation are located on several of the other islands, and this program is promoted through State-sponsored information.

(c) Skagit County

Currently, recycling in Skagit County is conducted solely by the private sector. There are four or five buy-back operations, and several drop box sites. Operators include recycling businesses, independent collectors, and charitable organizations. A processor of recyclables in the county handles all grades of metals, paper, and glass containers. Drop-off service for recyclables will be provided in the near future at the County incinerator, where most of the county's waste is disposed. The County is in the process of developing a recycling plan.

(d) Whatcom County

Several years ago, the Whatcom County Council adopted a resolution to spend at least $25,000 a year on recycling programs and promotion. The County recently installed a recycling center at the Cedarville landfill. Further, at both the Lynden and Birch Bay convenience centers, drop boxes are available for recyclables. Bellingham Community Recycling offers curbside collection to 8,000 residences. Sanitary Services will provide curbside collection to all Bellingham residences in July of 1989. Several other private organizations are involved in recycling throughout the County as well.

(2) Solid-Waste Collection

In the Northwest WGA, there are eight haulers collecting municipal solid waste under U.T.C. certificates (franchises). Six cities operate their own solid waste collection services. These cities are Oak Harbor, Friday Harbor, Mount Vernon, Burlington, Anacortes, and Sedro Woolley. All other collection in this WGA is conducted through a contractual agreement between city and hauler. Table E-16 summarizes this information.

TABLE E-16
WASHINGTON DEPARTMENT OF ECOLOGY
Recycling and Waste Stream Survey-1987
NORTHWEST WASTE GENERATION AREA
HAULERS

NAME	PUBLIC/ PRIVATE	FRANCHISES	AREA SERVED	DESTINATION/COUNTY
City of Oak Harbor	Public		City of Oak Harbor	Coupeville L.F./Island
Island Disposal	Private	F	Whidbey Island	(1) Coupeville L.F./Island (2) Navy L.F./Island
San Juan Sanitation	Private	F	San Juan Islands	Orcas L.F./San Juan
City of Friday Harbor	Public		City of Friday Harbor	Friday Harbor Incinerator/ San Juan
City of Mt. Vernon	Public		City of Mt. Vernon	T.R.C. Incinerator/ Whatcom
City of Burlington	Public		City of Burlington	Skagit Co. Incinerator/ Skagit
City of Anacortes	Public		City of Anacortes	Skagit Co. Incinerator/ Skagit
City of Sedro Woolley	Public		City of Sedro Woolley	Skagit Co. Incinerator/ Skagit
North Cascade Disposal	Private	F	Skagit Co.	(1) Skagit Co. Incinerator/Skagit (2) Inman L.F./Skagit
Guemes Island Disposal	Private	F	Skagit Co.	Inman L.F./Skagit
Rural Skagit Sanitation	Private		Skagit Co.	Inman L.F./Skagit

NAME	PUBLIC/ PRIVATE	FRANCHISES	AREA SERVED	DESTINATION/COUNTY
Sanitary Svc. Co.	Private	F	Whatcom Co.	(1) Cedarville L.F./Whatcom (2) T.R.C. Incinerator/Whatcom
Nooksack Valley Disp.	Private	F	Whatcom Co.	Cedarville L.F./Whatcom
Pt. Roberts San.	Private	F	Pt. Roberts	Pt. Roberts T.S./Whatcom
Stanwood Camano	Private	F	Island Co. (Camano Island)	Coupeville L.F./Island

The operators hauled an estimated 122,000 tons of waste in 1987, 50% of which was from the commercial sector, and 50% from residences. Including self-haul tonnages, the total disposed waste for 1987 was estimated to be 186,000 tons.

It is reported that there are rural self-haul drop boxes in every county in the Northwest WGA (depending on the definition used for "drop box," the number may vary; there appear to be different interpretations of the terms "drop box" and "transfer station"). Table E-17 describes them in greater detail.

(3) Solid-Waste Disposal

There are nine operating landfills accepting municipal waste in the Northwest WGA; seven are open to the public. One private landfill is operated by the Whidbey Island Naval Air Station in Island County, and the other accepts ash from a municipal waste incinerator. Table E-18 presents more detailed information on landfills and transfer stations. The estimated remaining capacities of these landfills range from three to ten years (some information was unavailable); Table E-19 summarizes this information.

Based on 1987 quantities of waste disposed, rough estimates were generated for the tonnage of waste that could be accommodated by present landfills in the Northwest WGA. Calculations were based only on information from landfills accepting municipal waste, except for those on military bases and Indian reservations. The tons of waste disposed at each landfill in 1987 were multiplied by the reported years of remaining life. Remaining life was defined as:

1) The number of years between 1987 and a closure date mandated by permit; or

2) if no mandated closure date is specified, the number of years between 1987 and an estimated closure date (due to exhaustion of site capacity, landfill noncompliance, or business closure); or

3) the smaller of the two figures, if both exist.

If a facility's capacity was not reported in terms of years, estimates were developed according to the best available information. Remaining capacity reported in acres was converted to tons using a conversion factor derived from data obtained for this report. Based on information from landfill operators, the average amount of waste accommodated by one acre was 17,800 tons.

Using this method, it was estimated that the Northwest WGA had sufficient landfill capacity at the end of 1987 to accommodate approximately 950,000 additional tons of solid waste. Care should be taken when interpreting this figure, since a WGA total estimate may not reflect situations facing individual jurisdictions. Landfills which did not report sufficient information to calculate tonnage capacity are not represented in the above estimate (refer to Tables E-18 and E-19).

TABLE E-17
WASHINGTON DEPARTMENT OF ECOLOGY
Recycling and Waste Stream Survey-1987
NORTHWEST WASTE GENERATION AREA
RURAL DROP BOXES

COUNTY	LOCATION	SIZE	TYPE	OTHER
Island	Bayview	30 CY	3 Compactors	Manned
	Camano Island	30-40 CY	3 Compactors	Manned
	Coupeville	40 CY	3 Open tops	At Coupeville L.F.
	Oak Harbor	30 CY	3 Compactors	Manned
San Juan	Lopez	30 CY	Compactor	Operated by San Juan Sanitation
	Orcas	30 CY	Compactor	Operated by San Juan Sanitation
	San Juan	30 CY	Compactor	Operated by San Juan Sanitation
Skagit	Algers	40 CY	Compactor	
	Birdsview	40 CY	Compactor	
	Clear Lake	40 CY	Compactor	Manned
	Conway	40 CY	Compactor	
	Similk	40 CY	Compactor	
Whatcom	Bellingham	30 CY	Open Top	
	Birch Bay	47 CY	Open Top	
	Glacier	30 CY	Compactor	
	Lynden	47 CY	Open Top	

TABLE E-18
WASHINGTON DEPARTMENT OF ECOLOGY
Recycling and Waste Stream Survey-1987
NORTHWEST WASTE GENERATION AREA
DISPOSAL FACILITIES

COUNTY	FACILITY	NAME	ACCESS	1987 TONS RECEIVED	REMAINING CAPACITY*	DESTINATION	1987 TIPPING FEES
Island	Landfills:	Coupeville	Public	60,000	9 Years, 10 Acres		$55.00/Ton
		Whidbey Island Naval Air Station	Private	1,600	Not Avail.		-0- -Military Base
	Transfer Stations:	Camano Island	Public	2,100		Coupeville L.F.	$9.00/LCY or $63.00/Ton
San Juan	Landfills:	Orcas	Public	3,400	15-20 Years		$3.75/CCY
	Transfer Stations:	Lopez Isl.	Public	Not Avail.		Orcas L.F.	$3.75/CCY
		Orcas (Shaw)	Public	Not Avail.		Orcas L.F.	$3.75/CCY
	Transfer Stations/Incinerator:	Friday Harbor	Public	3,300			$53.37/Ton
Skagit	Landfills:	Gibraltar	Public	2,600	Not Avail.		$4.50/CY
		Inman	Public	46,000	30 Years		$27.00/Ton $45.00/T.Demo
		Sauk	Public	2,000	Not Avail.		$4.50/CY
	Transfer Station/ Incinerator:	Skagit Co.	Public	Not Avail.			$35.50/Ton

COUNTY	FACILITY	NAME	ACCESS	1987 TONS RECEIVED	REMAINING CAPACITY*	DESTINATION	1987 TIPPING FEES
Whatcom	Landfills:	Cedarville	Public	24,000	3-4 Years		$15.00/CCY, $8.00/LCY or $48.50/Ton
		Pt.Roberts	Public	100	10+ Years; 2 Acres		$6.00/CY -Demolition -0- - Ash
		T.R.C.	Private	7,000	7-10 Acres		
		Y-Road	Public	400	7-10 Years; 3 Acres		$3.50/CY - Demolition
	Transfer Stations:	Pt.Roberts	Public	800		Cedarville L.F.	$12.00/LCY or $20.00/CCY
	Incinerator:	T.R.C.	Public	35,000			$37.20/Ton

CY = Cubic Yard
CCY= Compacted Cubic Yard
LCY= Loose Cubic Yard

* Based on space available at the end of 1987, regardless of mandated or planned closure dates.

TABLE E-19
WASHINGTON DEPARTMENT OF ECOLOGY
Recycling and Waste Stream Survey-1987
NORTHWEST WASTE GENERATION AREA
LANDFILL CAPACITIES

COUNTY	FACILITY NAME	MANDATED CLOSURE (Date/None)	REMAINING CAPACITY* (Years/CY/Acres)	COMMENTS (#)
Island	Coupeville Sanitary	None	9 Years; 10 Acres	1
	Whidbey Island Naval Air Station	None	Not Available	2
San Juan	Orcas Island	None	15-20 Years	
Skagit	Inman	1995	30 Years	
	Gibraltar	12/31/88	Not Available	
	Sauk	12/31/88	Not Available	3
Whatcom	Cedarville	12/31/88	3-4 Years	4
	Point Roberts	None	10+ Years; 2 Acres	
	Thermal Reduction Co.	None	7-10 Acres	
	Y-Road	None	7-10 Years; 3 Acres	

COMMENTS

1. Coupeville currently using south half of landfill, which has 2 years capacity left, but which is also unlined. Must be lined or will close 10/89. Have requested variance to continue past 1989. Plan to line north half, but don't want to until south half is full.
2. No closure foreseen at current rate of dumping. Under consideration to be a SuperFund site.
3. Will become a transfer station in 1989. All waste will go to incineration.
4. Operating under 6-month permit.

* Based on space available at the end of 1987, regardless of mandated or planned closure dates.

TABLE E-19
WASHINGTON DEPARTMENT OF ECOLOGY
Recycling and Waste Stream Survey-1987
INCINERATOR CAPACITIES

COUNTY	FACILITY	Designed Capacity	Permitted Capacity	Throughput Capacity*	Comments (#)
San Juan	Friday Harbor	18 Tons/Day	18 Tons/Day	18 Tons/Day	1
Skagit	Skagit County Res. Rec. Facility	178 Tons/Day	178 Tons/Day	161 Tons/Day	
Whatcom	Olivine Corp.	100 Tons/Day	50 Tons/Day	96 Tons/Day	2
	Thermal Reduction Co.	100 Tons/Day	100 Tons/Day	96 Tons/Day	

COMMENTS

1. Newer incinerator with very little down-time.
2. Not open in 1987. Adding a baghouse to their facility, which will increase designed capacity to 150 tons/day with very little downtime (2-3 days/month). Temporary permit expires 6/89, at which time Olivine Corp. plans to request permanent permit for 150 tons/day operation.

* Actual capacity (allowing for down-time).

(4) Solid-Waste Management Planning

Island County--has 1986 solid-waste plan in draft form at the State DOE.

San Juan County--maintaining the status quo of 1977 plan, but anticipates an update in 1989.

Skagit County--planning to add chapters regarding recycling and reuse to its 1987 solid-waste plan.

Whatcom County--1988 solid-waste plan is in draft form at the DOE.

c. Market Capacity

The Northwest WGA has good access to end use and export markets in Puget Sound and also some potential to market paper and metals in Canada. Proximity to containerized export in Seattle enhances export possibilities, particularly for paper and metals.

Stable markets exist for aluminum cans, ferrous and non-ferrous metals, corrugated containers, and high-grade papers. Glass and tin markets are adequate to absorb supplies, but prices are not expected to be high enough to attract large volumes of material. Mixed waste paper could be marketed--primarily for export--if prices are high, but marketing may not be profitable when prices are low. White goods could be transported to a shredder in Seattle but the related transport cost would diminish its desirability. No significant volumes of plastic are currently recovered from the Northwest WGA, although a market may develop in western Washington. Yard waste is not currently processed in the WGA on any large scale, although some communities may consider markets for this material in the future.

A market capacity summary for the Northwest WGA is presented in Table E-20.

d. Evaluation of Methods

(1) Feasibility Analysis

Notable exceptions to the Statewide technical feasibility review for the Northwest WGA include:

- Commercial Mixed Waste Processing. Waste supply exposure was judged to be higher than the Statewide rating. Members of the group, many of whom represented haulers and processors, felt that guaranteed quantity and known composition of the waste would be required in order to make such a venture feasible.

Table E-20

Market Capacity Summary for Northwest WGA

	COMMODITY	MAJOR END USERS FOR MATERIAL FROM WGA (Name &/or Location)	ESTIMATED END USER PRICE '88 ($/Ton)	VOLUME OF WGA MATRL. RECOVERED (1987 Tons)	(1) WGA COLLECTED MATERIAL PRICE ($/Ton)	(1) WGA COLLECTED MATERIAL VALUE ($/Year)	(2) WGA MARKET CAPACITY	FACTORS AFFECTING WGA MARKET FOR MATERIAL
1	Newsprint	Sonoco - Sumner Michelson - Wenatchee Export	$45.00	2,800	$11	$30,800	ADEQUATE	Instate tariff - $.18/ton/mile
2	Corrugated Containers	Sonoco - Sumner Paperboard Indust. - B.C. Export	$65.00	2,800	$36	$100,800	ADEQUATE	Instate tariff - $.18/ton/mile
3	High Grade Paper	Scott Paper - Everett Mid West U.S. Export	$100.00	300	$33	$9,900	ADEQUATE	Instate tariff - $.18/ton/mile
4	Mixed Waste Paper	Sonoco - Sumner Paperboard Indust. - B.C. Export	$25.00	200	($16)	($3,200)	POTENTIAL MARKET	Instate tariff - $.18/ton/mile Low supply & high transport cost Very price sensitive
5	Container Glass	Ball-InCon - Seattle	$40.00	400	$9	$3,600	ADEQUATE	Instate tariff - $.25/ton/mile Freight assistance reduces cost
6	Refillable Glass	Rainier Brewing - Sea. Pabst/Olympia	$116.00	1,100	$44	$48,400	ADEQUATE	
7	Aluminum Bev. Cont.	Various Alum. Co. Ship from Seattle	$1,000.00	700	$836	$585,200	ADEQUATE	Instate tariff - $.16/ton/mile
8	Tin Cans	MRI - Seattle	$49.00	100	$22	$2,200	ADEQUATE	Instate tariff - $.16/ton/mile Freight assistance reduces cost
9	Ferrous Metals	General Metals - Tac. Salmon Bay/Seattle Steel	$65.00	34,000	$36	$1,224,000	ADEQUATE	Instate tariff - $.16/ton/mile
10	White Goods	Seattle Iron & Steel General Metals - Tac. Schnitzer - Portland	$20.00	900	($14)	($12,600)	POTENTIAL DISP. AVOID.	Mobile loggers help reduce cost
11	Non Ferrous Metals	Various - Tacoma/Seattle Export	$800	800	$636	$508,800	ADEQUATE	Instate tariff - $.16/ton/mile
12	PET Bottles	Midwest & East U.S.	$160	0	$15	$0	POTENTIAL MARKET	Potential future market No significant current market
13	HDPE Bottles	Export - Puget Sound Partek - Vancouver	$200	0	$55	$0	POTENTIAL MARKET	Potential future market No significant current market
14	Plastic Films (LDPE)	Export - Puget Sound	$160	0	$38	$0	POTENTIAL MARKET	Potential future market No significant current market
15	Lawn & Garden Waste	No Major End Users at Present Time	($20)	0	($30)	$0	POTENTIAL MARKET	Potential future market No significant current market

(1) WGA prices and values are before transportation, processing and handling necessary to prepare and move material to market.

(2) WGA market capacity is based on an assessment of the markets' ability to consume consistently and gradually increasing volumes.

REFER TO TEXT FOR DETAILED DISCUSSION

- Drop-Off/Buy-Back Depots. The group felt that the quantity of waste, and in particular, the expected quantity of recyclable materials, would present moderate exposure for a drop-off/buy-back operation rather than the low exposure indicated by the Statewide rating.

- Mixed Waste Processing. The availability of land and the rural nature of this WGA were noted as reasons why siting resistance or problems obtaining permits would be minimal (depending, of course, on the specific location). Thus, the group rated this method lower on exposure than the Statewide assessment. However, this method was deemed to be sensitive to the quantity of waste required to make it a reasonable venture. In sum, a moderate ranking was determined for waste supply exposure.

- Special Waste Recycling and Reuse. With respect to siting, the group felt that there would be little resistance or difficulty as long as toxic materials were not permanently stored at these sites. Therefore, the exposure was judged to be lower than for the Statewide rating. Markets also received a higher exposure-to-loss rating because long-term stable markets for items such as batteries could not be identified by the group.

- Long-Haul Transport. The exposure to loss associated with operating and maintaining a long-haul transport system was deemed to be lower than that established in the Statewide rating, since long-haul was seen simply as a trucking or rail operation.

- Ashfill. The group saw moderate exposure to loss with respect to the ability to operate and maintain a ashfill, compared to the low exposure identified in the Statewide ranking. This higher ranking was given because of expected regulations and environmental concerns. It was also based on the group's recent experience with ash disposal-related problems in Skagit County.

The exposure to loss feasibility evaluation for the Northwest WGA is presented in Table E-21.

(2) Environmental Evaluation

(a) Impacts

In general, the environmental impacts of waste management methods in the Northwest WGA are the same as those for the State as a whole. The high level of precipitation, however, does increase the possibility of leaching and

Table E-21

Evaluation of Exposure to Loss

for Northwest WGA

VAAONW28

DEGREE OF EXPOSURE TO LOSS ASSOCIATED WITH IMPLEMENTATION & USE OF EACH METHOD

TECHNICAL IMPLEMENTATION FACTOR			REDUCTION						RECYCLING												HANDLING		DISPOSAL					
			EDUCATION	INCENTIVES	DISINCENTIVES	MODEL GOVERNMENTAL PROGRAMS	WASTE EXCHANGE	HOME YARD WASTE COMPOSTING	REUSE	CURBSIDE COLLECTION	MULTI-FAMILY HOUSING COLLECTION	COMMERCIAL SOURCE SEPARATION	INTERMEDIATE PROCESSING FACILITY	COMMERCIAL MIXED WASTE PROCESSING	DROP OFF / BUYBACK DEPOTS	MIXED WASTE PROCESSING	YARD WASTE COMPOSTING	MIXED WASTE COMPOSTING	FOOD WASTE PROCESSING	SPECIAL WASTE RECYCLING AND REUSE	TRANSFER	LONG HAUL TRANSPORT	ANAEROBIC DECOMPOSITION	PYROLYSIS / GASSIFICATION	REFUSE DERIVED FUEL PREP. & USE	MASS BURN INCINERATION	LANDFILL	ASHFILL
SITING	SITING RESISTANCE	GENERAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	L/M	L	M/H	L	M/H	M	M/H	M/H	NA	M/H	M/H	H	H	H	H
		WGA SPECIFIC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	L	L	L	L	M	L/M	L	M	NA	H	H	H	H	H	H
	PERMITS AQUISITION DIFFICULTY	GENERAL	NA	NA	NA	NA	NA	NA	L	L	L	L	L	L/M	L	M	L	M/H	M	L/M	M	M	M/H	M/H	H	H	H	H
		WGA SPECIFIC	NA	NA	NA	NA	NA	NA	L	L	L	L	L	L	L	L	L	L	L/M	L	M	M	H	H	H	H	H	H
	TIME & COST REQUIRED TO COMPLETE SITING	GENERAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	L/M	L	L	L	M/H	M	M/H	M/H	NA	M/H	M/H	H	H	H	H
		WGA SPECIFIC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	L	L	L	L	M/H	L/M	L	M	NA	H	H	H	H	H	H
WASTE SUPPLY	QUANTITY	GENERAL	NA	NA	NA	NA	L	NA	L	M	M	L	L/M	L	L	L	L	L	M/H	L/M	L/M	L/M	L/M	M	M	M	L	L
		WGA SPECIFIC	NA	NA	NA	NA	L	NA	L	M	M	L	M	M	M	M	L	L	M/H	M	M	L/M	M	M	M	L	L
	COMPOSITION	GENERAL	NA	NA	NA	NA	L	L	L/M	L/M	L/M	L	L/M	L	M	L/M	L/M	M	L	L/M	L	L/M	L/M	M	M	M	L	L/M
		WGA SPECIFIC	NA	NA	NA	NA	L	L	L/M	M	M	L	M	M	M	M	L/M	M	L	M	L	L	L/M	M	M	M	L	L
MARKETS		GENERAL	NA	NA	NA	NA	L	NA	L	M	M	L/M	L/M	L/M	L/M	M/H	M	M/H	M/H	L/M	NA	NA	L/M	M/H	M/H	M	NA	NA
		WGA SPECIFIC	NA	NA	NA	NA	L	NA	L	L/M	L/M	L/M	L/M	L/M	L/M	M/H	L/M	M/H	M/H	M	NA	NA	L	M/H	M/H	M	NA	NA
VENDOR		GENERAL	NA	NA	NA	NA	L	NA	NA	L/M	L/M	L/M	L/M	L/M	L	M/H	L	M/H	L/M	L/M	L	L/M	L	H	M	M	NA	NA
		WGA SPECIFIC	L	NA	NA	NA	NA	NA	NA	L/M	L/M	L/M	L/M	L/M	L	M/H	L	M/H	L/M	L/M	L	L	L	H	M	M	NA	NA
TECHNOLOGY/ PROGRAM	ABILITY TO CONSTRUCT & MAKE OPERATIONAL	GENERAL	L	M/H	M/H	L	L	M	L/M	L	M	L	L/M	L/M	L	M/H	L	L/M	L	L/M	L/M	NA	L	H	M	M	L/M	L/M
		WGA SPECIFIC	L	M/H	M/H	L	L	M	L/M	L	M	L	L/M	L/M	L	L/M	L	L/M	L	L/M	L/M	NA	L	H	M	M	L/M	L/M
	ABILITY TO OPERATE AND MAINTAIN	GENERAL	L	L/M	L/M	L	L	M	L/M	L	M	L	L/M	L/M	L/M	M	L/M	L/M	L/M	L/M	L/M	M/H	L	M/H	M/H	M	M	L
		WGA SPECIFIC	L	L/M	L/M	L	L	M	L/M	L	M	L	L/M	L/M	L/M	M	L/M	L/M	L/M	L/M	L/M	L	L	M/H	M/H	M	M	M
RESIDUE DISPOSAL	CHARACTERISTICS	GENERAL	NA	NA	NA	NA	NA	M	NA	L	L	L	L	L	L	L	L	L	L	M/H	NA	NA	M	M	L/M	M/H	NA	NA
		WGA SPECIFIC	NA	NA	NA	NA	NA	M	NA	L	L	L	L	L	L	L	L	L	L	M/H	NA	NA	M	M	L/M	M/H	NA	NA
	SITE AVAILABILITY	GENERAL	NA	NA	NA	NA	NA	M	NA	NA	NA	NA	L	L	L	L	L	L	L	M/H	NA	NA	M	M	L/M	M/H	NA	NA
		WGA SPECIFIC	NA	NA	NA	NA	NA	M	NA	NA	NA	NA	L	L	L	L	L	L	L	M	NA	NA	M	M	L/M	M/H	NA	NA
FINANCING		GENERAL	L	L	L	L	L	L	L	L	L/M	L	L/M	M	L	M	L	L/M	M	M	L/M	L/M	L/M	H	M/H	M/H	M	M
		WGA SPECIFIC	L	L	L	L	L	L	L	L	L	L	L/M	L/M	L	M	L	L/M	M	L/M	L/M	L/M	L/M	H	M/H	M/H	M	M
UNCONTROLLABLE CIRCUMSTANCES**		GENERAL	L	M	M	L	M	M	L	L	L	L	L	L	M	M	L	M	M	M/H	M	M	M	M/H	M/H	M/H	M/H	M/H
		WGA SPECIFIC	L	M	M	L	M	M	L	L	L	L	L	L	M	M	L	M	M	M	M	M	M	M	M/H	M/H	M/H	M/H

KEY:

NA = NOT APPLICABLE
H = HIGH
M = MODERATE
L = LOW

surface or ground water contamination from all the alternatives involving composting and the landfill and ashfill alternatives. These factors are reflected in the environmental impact matrix (Table E-22).

An evaluation of potential environmental impacts due to failures in the technology is presented in Table E-23.

(b) Concerns

In comparing the Northwest WGA environmental concern evaluation matrix (Table E-24) with those for other WGA's, it appears the Northwest WGA Committee expressed a relatively high level of concern about environmental impacts of commercial source separation, home yard waste composting, intermediate waste processing, commercial mix waste processing, landfills, and ashfills. Exposure to loss for the home yard waste composting methods was rated moderate by this WGA. The group members felt that few people know how to compost properly and that odor, health, and aesthetic problems were likely to result. Intermediate waste processing and commercial waste processing received moderate ratings for air quality, odor, public health risk, aesthetics, and traffic. The group believed that these methods would require facilities that create dust, dirt, and odors, and produce significant noise and traffic. Landfills and ashfills were seen as posing a high level of environmental risk, as was incineration; public health concerns were raised about the possibility of toxics in the emissions or in the ash.

(3) Economic Evaluation of Alternatives

The results of the economic analysis for the Northwest WGA are summarized in Table E-25. Detailed results appear in Appendix C.

e. Ranking of Methods and Recommendations

The following paragraphs discuss the working group's ranking and consultant team's rankings for best management practices, as well as each group's recommended system for reduction, recycling, and disposal in this WGA.

(1) Working Group Rankings

Evaluation criteria were weighted by the Northwest WGA working group and applied to the alternative solid waste management methods. The resulting rankings are shown in Table E-26.

Based on these rankings, the WGA working group selected the following preferred system for solid-waste management in this WGA:

- Reduction Program

  -- Incentives
  -- Disincentives
  -- Home composting

Table E-22

Evaluation of Environmental Impacts *

for Northwest WGA

VAAONW26

DEGREE OF POTENTIAL ENVIRONMENTAL IMPACT ASSOCIATED WITH IMPLEMENTATION & USE OF EACH METHOD

ENVIRONMENTAL FACTOR	REDUCTION						RECYCLING												HANDLING		DISPOSAL					
	EDUCATION	INCENTIVES	DISINCENTIVES	MODEL GOVERNMENTAL PROGRAMS	WASTE EXCHANGE	HOME YARD WASTE COMPOSTING	REUSE	CURBSIDE COLLECTION	MULTI-FAMILY HOUSING COLLECTION	COMMERCIAL SOURCE SEPARATION	INTERMEDIATE PROCESSING FACILITY	COMMERCIAL MIXED WASTE PROCESSING	DROP OFF / BUYBACK DEPOTS	MIXED WASTE PROCESSING	YARD WASTE COMPOSTING	MIXED WASTE COMPOSTING	FOOD WASTE PROCESSING	SPECIAL WASTE RECYCLING AND REUSE	TRANSFER	LONG HAUL TRANSPORT	ANAEROBIC DECOMPOSITION	PYROLYSIS / GASSIFICATION	REFUSE DERIVED FUEL PREP. & USE	MASS BURN INCINERATION	LANDFILL	ASHFILL
AIR QUALITY	NA	NA	NA	NA	NA	NA	NA																			
CRITERIA POLLUTANTS: SO2, NOX, HCL								L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
TOXICS								L	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	NA	NA	L	L	L	L	L	L
PARTICULATES								L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
ODOR	NA	NA	NA	NA	NA	L	NA	NA	L	NA	L	NA	L	L	L	L	L	L	L	NA	L	L	L	L	L	NA
SURFACE WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	NA	NA	NA	L	L/M	L/M	L	L	NA	NA	L	L	L	L	L/M	L/M
GROUND WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	NA	NA	NA	L	L	L	L	L	NA	NA	L	L	L	L	L/M	L/M
NOISE	NA	NA	NA	NA	NA	L	NA	L	L	NA	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
RISK OF EXPLOSION	NA	NA	NA	NA	NA	NA	NA	NA	L	NA	NA	L	NA	L	NA	L	NA	L	L	NA	L	L	L	L	L	NA
PUBLIC HEALTH RISKS	NA	NA	NA	NA	NA	L	NA	NA		NA	L															
PATHOGENS						L		NA	L	NA	L	NA	L	L	NA	L	L	NA	L	L	L	L	L	L	L	NA
VECTORS						L		NA	L	NA	L	L	L	L	L	L	L	NA	L	L	L	L	L	L	L	NA
TOXICS						L		NA	NA	NA	L	NA	L	L	L	L	L	L	NA	NA	L/M	L/M	L/M	L/M	L	L/M
AESTHETICS	NA	NA	NA	NA	NA	L	NA	L	L	NA	L	L	L	L	L	L	L	L	L	NA	L	L	L	L	L	L
TRAFFIC	NA	NA	NA	NA	L	NA	NA	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
OTHER																										

KEY: **

NA = NOT APPLICABLE
H = HIGH RATING
M = MEDIUM RATING
L = LOW RATING

* THIS EVALUATION ASSUMES NEW "STATE OF THE ART" FACILITIES, PROPERLY SITED WITH FACILITY DESIGN INCORPORATIONG APPROPRIATE MITIGATION TECHNIQUES.

** A HIGH RATING INDICATES A HIGH LEVEL OF LOCAL ENVIRONMENTAL IMPACT
A LOW RATING INDICATES A LOW LEVEL OF ENVIRONMENTAL IMPACT

Table E-23

Evaluation of Potential Environmental Impacts *
for Northwest WGA

VAAONW27

DEGREE OF POTENTIAL ENVIRONMENTAL IMPACT ASSOCIATED WITH IMPLEMENTATION & USE OF EACH METHOD

ENVIRONMENTAL FACTOR	REDUCTION: EDUCATION	REDUCTION: INCENTIVES	REDUCTION: DISINCENTIVES	REDUCTION: MODEL GOVERNMENTAL PROGRAMS	REDUCTION: WASTE EXCHANGE	REDUCTION: HOME YARD WASTE COMPOSTING	RECYCLING: REUSE	RECYCLING: CURBSIDE COLLECTION	RECYCLING: MULTI-FAMILY HOUSING COLLECTION	RECYCLING: COMMERCIAL SOURCE SEPARATION	RECYCLING: INTERMEDIATE PROCESSING FACILITY	RECYCLING: COMMERCIAL MIXED WASTE PROCESSING	RECYCLING: DROP OFF / BUYBACK DEPOTS	RECYCLING: MIXED WASTE PROCESSING	RECYCLING: YARD WASTE COMPOSTING	RECYCLING: MIXED WASTE COMPOSTING	RECYCLING: FOOD WASTE COMPOSTING	RECYCLING: SPECIAL WASTE PROCESSING	HANDLING: TRANSFER	HANDLING: LONG HAUL TRANSPORT	DISPOSAL: ANAEROBIC DECOMPOSITION	DISPOSAL: PYROLYSIS / GASSIFICATION	DISPOSAL: REFUSE DERIVED FUEL PREP. & USE	DISPOSAL: MASS BURN INCINERATION	DISPOSAL: LANDFILL	DISPOSAL: ASHFILL
AIR QUALITY	NA	NA	NA	NA	NA	NA	NA	L	L	L	L	L	L	L	L	M	L	M	M	M	M/H	H	M	M	M	L
CRITERIA POLLUTANTS: SO2, NOX, HCL								L	L	L	L	L	L	M	L	L	L	M	L	L	M/H	H	M	M	H	L/M
TOXICS								L	L	L	L	L	L	L	L	L	L	M	M	M	L	L/M	H	H	L	M/H
PARTICULATES																										
ODOR	NA	NA	NA	NA	NA	L/M	NA	L	L	L	L/M	L	L/M	H	L	M	H	L	L/M	L/M	H	H	M	M	H	L
SURFACE WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	L	L	L/M	M	L/M	M	M	M	L	L	L	L	L	L	M	M
GROUND WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	L	L	L	M	L/M	M	M	M	L	L	L	L	L	L	H	H
NOISE	NA	NA	NA	NA	L	L	NA	L/M	L/M	L/M	L/M	M/H	M	H	M	L/M	L/M	L	M/H	M/H	M	M/H	M/H	M/H	M	M
RISK OF EXPLOSION	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	L/M	L	H	L/M	L/M	L	L	L	L	M/H	M	H	M	H	L
PUBLIC HEALTH RISKS	NA	NA	NA	NA	NA		NA	L	L	L	L	L	L/M	M	L	M	H	NA	M	L	L	L	L	L	L/M	L
PATHOGENS						L		L	L	L	L	L	L/M	M	L	M	H	M	M	L	L	L	L	L	M	L
VECTORS						L/M		L	L	L	L	L	L	M	L	M	H	M	L	L	M/H	M/H	M/H	M/H	M/H	M
TOXICS						L		NA	NA	NA	L	L	L	M	L	M	M	M	M	L						
AESTHETICS	NA	NA	NA	NA	M	M	NA	L/M	L/M	L/M	L/M	M	M	H	M/H	M	M/H	L/M	M/H	M	M	M	M	M	M	M
TRAFFIC	NA	NA	NA	NA		NA	NA	L/M	L/M	L/M	M	M	L/M	H	M	M	M	L/M	M/H	M/H	H	H	H	H	H	L/M
OTHER																										

KEY: **

NA = NOT APPLICABLE
H = HIGH RATING
M = MEDIUM RATING
L = LOW RATING

* THIS EVALUATION ASSUMES THAT CERTAIN FAILURES OCCUR IN THE SITING PROCESS, DESIGN, MITIGATION MEASURES AND IN THE OPERATION & PERFORMANCE OF THE SELECTED TECHNOLOGY.

** A HIGH RATING INDICATES A HIGH LEVEL OF LOCAL ENVIRONMENTAL IMPACT
A LOW RATING INDICATES A LOW LEVEL OF ENVIRONMENTAL IMPACT

Table E-24

Environmental Concerns Evaluation

for Northwest WGA

VAAONW25

DEGREE OF ENVIRONMENTAL CONCERN ASSOCIATED WITH IMPLEMENTATION & USE OF EACH METHOD

ENVIRONMENTAL FACTOR	REDUCTION						RECYCLING												HANDLING		DISPOSAL					
	EDUCATION	INCENTIVES	DISINCENTIVES	MODEL GOVERNMENTAL PROGRAMS	WASTE EXCHANGE	HOME YARD WASTE COMPOSTING	REUSE	CURBSIDE COLLECTION	MULTI-FAMILY HOUSING COLLECTION	COMMERCIAL SOURCE SEPARATION	INTERMEDIATE PROCESSING FACILITY	COMMERCIAL MIXED WASTE PROCESSING	DROP OFF / BUYBACK DEPOTS	MIXED WASTE PROCESSING	YARD WASTE COMPOSTING	MIXED WASTE COMPOSTING	FOOD WASTE COMPOSTING	SPECIAL WASTE PROCESSING	TRANSFER	LONG HAUL TRANSPORT	ANAEROBIC DECOMPOSITION	PYROLYSIS / GASSIFICATION	REFUSE DERIVED FUEL PREP. & USE	MASS BURN INCINERATION	LANDFILL	ASHFILL
AIR QUALITY	NA	NA	NA	NA	NA	NA	NA	L	L	L	M	M	L	M	L	M	L	L	M	L	L	H				
CRITERIA POLLUTANTS: SO2, NOX, HCL														M								H	H	H	H	
TOXICS														M								H	H	H	H	
PARTICULATES											M	M		M					M			H	H	H	H	
ODOR	NA	NA	NA	NA	NA	M	NA	L	L	L	M	M	L	M	M	M	H	L	L	NA	L	L	M	M	M/H	L
SURFACE WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	L	NA	NA	L	NA	L	L	L	L	M	L	NA	L	L	L	L	H	H
GROUND WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	L	NA	NA	L	NA	L	L	L	L	M	L	NA	L	L	L	L	H	H
NOISE	NA	NA	NA	NA	L	L	NA	L	L	L	L/M	L/M	L/M	L/M	L/M	L/M	L/M	L	L	L	L	L	L	M	M	M
RISK OF EXPLOSION	NA	NA	NA	NA	NA	NA	NA	NA	L	NA	NA	M	NA	M	L	M	NA	M	M	NA	M	M	M	M	M	L
PUBLIC HEALTH RISKS	NA	NA	NA	NA	NA	M	NA	L	L	L	M	M	L	M	L		M		M	L	L	L	H	H		H
PATHOGENS																M		L								
VECTORS						M										H	M	L	M							
TOXICS																H		H	M			L	H	H	H	H
AESTHETICS	NA	NA	NA	NA	M	M	NA	L	M	L	M	M	M	M	M	M	M	M	M	NA	M	M	M	M	H	M
TRAFFIC	NA	NA	NA	NA	L	NA	NA	L	L	L	M	M	M	M	M	M	L	L	H	H	M	M	M	M	M	L
OTHER																										

KEY: •

NA = NOT APPLICABLE
H = HIGH RATING
M = MEDIUM RATING
L = LOW RATING

• A HIGH RATING INDICATES A HIGH LEVEL OF LOCAL ENVIRONMENTAL CONCERN
A LOW RATING INDICATES A LOW LEVEL OF ENVIRONMENTAL CONCERN

Table E-25

NORTHWEST: RECOMMENDED ALTERNATIVE

(COST ESTIMATES ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICTIONS.)

	ESTIMATED NET (COST) OR REVENUE	CONTRIBUTION TO SYSTEM COST	ESTIMATED TONS	PERCENT OF GENERATED TONS	RELATIVE RATIO OF COSTS TO TONS
COLLECTION AND PROCESSING:					
1. COLLECTION OF SINGLE FAMILY SOURCE SEPARATED RECYCLABLES	$0	0.0%	0	0.0%	NA
2. COLLECTION OF SINGLE FAMILY COMINGLED RECYCLABLES *	$0	0.0%	0	0.0%	NA
3. COLLECTION OF MULTI FAMILY COMINGLED RECYCLABLES *	$0	0.0%	0	0.0%	NA
4. COMMERCIAL DIRECT RECYCLING	$0	0.0%	32,277	12.9%	0.00 :1.00
5. COLLECTION OF COMMERCIAL SOURCE SEPARATED RECYCLABLES	($338,785)	1.6%	4,716	1.9%	0.84 :1.00
6A. DROP OFF/BUY BACK "REGULAR" RECYCLABLES	$431,530	-2.0%	4,772	1.9%	-1.06 :1.00
6B. DROP OFF/BUY BACK OF "SPECIAL" RECYCLABLES OR WASTES	$41,697	-0.2%	4,245	1.7%	-0.12 :1.00
7. YARD WASTE COLLECTION AND COMPOSTING	($2,585,764)	12.1%	28,136	11.2%	1.08 :1.00
8. SORTING OF TARGETED COMMERCIAL HIGH GRADE LOADS *	($22,853)	0.1%	358	0.1%	0.75 :1.00
9. SELF HAULED WASTE*	($1,511,323)	7.1%	27,647	11.0%	0.64 :1.00
10. REGULAR COLLECTION AND DISPOSAL OF MUNICIPAL WASTE *	($17,423,315)	81.4%	148,832	59.3%	1.37 :1.00
11. MIXED WASTE PROCESSING*	$0	0.0%	0	0.0%	NA
12. RDF PREPARATION*	$0	0.0%	0	0.0%	NA
SYSTEM TOTAL	($21,408,813)	100.0%	250,983	100%	1.00 :1.00
AVERAGE COST PER TON GENERATED	($85)				
DISPOSAL ONLY:					
A. MASS BURN WITH ASH MONOFILL	($5,271,269)	24.6%	88,293	35%	0.70 :1.00
B. LANDFILL WITH LONG HAUL BY RAIL	($4,382,129)	20.5%	88,293	35%	0.58 :1.00
C. LANDFILL WITH BALING	$0	0.0%	0	0%	NA
D. LANDFILL ONLY	$0	0.0%	0	0%	NA
DISPOSAL TOTAL	($9,653,398)	45.1%	176,586	70%	0.64 :1.00
AVERAGE COST PER TON DISPOSED	($55)				
RECYCLED TONS			74,397	30%	

* The net costs for these methods include disposal costs for residual or disposed wastes.

- Recycling Program

  -- Drop-off/buy-back depots
  -- Reuse
  -- Commercial source-separated collection
  -- Incentives
  -- Disincentives
  -- Single-family curbside collection
  -- Education
  -- Multi-family collection

- Disposal Program

  -- Long haul
  -- Landfill

(a) Reduction Program

The Northwest WGA working group clearly favored the use of incentives and disincentives over education and home composting as reduction methods. Incentives received high scores in all categories. they were thought to be cost-effective, highly feasible, environmentally sound, politically acceptable, and capable of having major impacts on the waste stream. Disincentives were downgraded slightly as they were thought to be less technically feasible or reliable, less compatible with other methods, and more vulnerable to adverse public or political reaction.

Home composting was considered cost-effective, technically feasible, and capable of having a major impact on waste stream volumes. It was ranked lower than incentives and disincentives due to negative environmental impact, low public acceptance, and the perceived difficulty with implementation. Much of the perceived implementation difficulties stemmed from the assumption that implementation was dependent on individual actions rather than government action.

Education was ranked low because the group felt that it would not be cost-effective, that it would be difficult to implement, and that such programs are not necessarily effective or reliable. Education was considered a long-term solution rather than an immediate solution to today's waste management problem.

(b) Recycling Program

Drop-off/buy-back centers and reuse programs were seen as the best recycling methods in this WGA. Both received high rankings for cost-effectiveness, technical feasibility, environmental impact, and potential impact on waste stream volume. They were also seen as having a high degree of public/political acceptance, flexibility, and compatibility with existing methods.

The secondary group of preferred recycling methods include incentives, disincentives, and commercial source-separation. Incentives were

ranked slightly over disincentives because of higher public/political acceptance and easier implementation. Except for technical effectiveness and reliability, these methods were ranked high. They were seen as cost-effective and environmentally sound. Commercial source-separation was ranked high for all criteria except cost-effectiveness, where it received a moderate score.

Curbside collection ranked below the above methods primarily because of its perceived lower cost-effectiveness and difficult implementation in the Northwest WGA.

Education received high marks for cost-effectiveness, compatibility with other methods, public acceptance, and environmental impact. Still, the group felt that education programs are difficult to implement and less technically reliable. Such programs were also seen as having less potential for reducing waste-stream volumes than other methods.

Multi-family collection received a high ranking for potential impact on waste stream, environmental impact, and political acceptance. Its cost-effectiveness was ranked low, and it was seen as being difficult to implement.

The other recycling methods, including composting and food processing, were all ranked relatively low and not considered to be appropriate methods for the Northwest WGA.

(c) Disposal Program

Long-hauling was clearly favored over either incineration or landfilling, due to lower environmental impact, flexibility, and relative ease of implementation.

The second disposal choice was landfilling. This method was also clearly favored over incineration. It was deemed more technically feasible and more flexible, especially since it would allow source separation programs or intermediate processing to be considered in the future.

Incineration was seen as a long-term, inflexible commitment to a single, irreversible course of action. While incineration was perceived as having less adverse impact on the environment than a landfill, landfilling was seen as being more feasible and reliable. Costs were all considered to be high.

(2) Consultant Team Rankings

The waste management methods in each program (reduction, recycling, and disposal) were ranked by the consultant team, as shown in Table E-26. In the reduction program, the consultant team evaluated "special government programs" and "waste exchange," which were not ranked by the WGA working group. In addition, the consultant team ranked "commercial high-grade collection" and "mixed-waste processing" for the recycling program. "Special waste recycling/reuse" was not ranked because of the special characteristics of these components; it was assumed that special waste management will be included in any recommended program.

Table E-26

BEST MANAGEMENT PRACTICES FOR
SOLID WASTE METHODS RANKING SUMMARY

NORTHWEST WGA

Reduction		Recycling		Disposal	
WGA Working Group Preference	Consultant Team Recommendations	WGA Working Group Preference	Consultant Team Recommendations	WGA Working Group Preference	Consultant Team Recommendations
1. Incentives	1. Education	1. Drop-Off/Buy-Back Depots	1. Drop-Off/Buy-Back Depots	1. Long Haul	1. Incineration
1. Disincentives		1. Reuse		2. Landfill	2. Landfill
2. Home Yard Waste Composting	2. Incentives	2. Commercial Source Separated	2. Education		2. Long Haul
	2. Special Governmental Programs	2. Incentives		3. Incineration	
2. Education	3. Disincentives	2. Disincentives			
	4. Home Yard Waste Composting	3. Single-Family Curbside Collection	3. Incentives		
	5. Waste Exchange		3. Commercial Source Separated		
		4. Education	4. Commercial High-Grade Collection		
			4. Centralized Yard Waste Composting		
		5. Multi-Family Collection	5. Disincentives		
			5. Reuse		
			5. Single-Family Curbside Collection		
			5. Mixed Waste Processing		
		6. Centralized Yard Waste Composting	6. Multi-Family Collection		
		6. MSW Composting			
		6. Food Waste Processing			
			7. MSW Composting		
			8. Food Waste Processing		

Based on the criteria established for the consultant team's analysis, the consultant recommended the following solid waste management system for the Northwest WGA:

- Reduction Program
  - -- Education
  - -- Incentives
  - -- Special governmental programs
  - -- Disincentives
  - -- Home composting
  - -- Waste exchange
- Recycling Program
  - -- Drop-off/buy-back depots
  - -- Education
  - -- Incentives
  - -- Commercial source-separated collection
  - -- Commercial high-grade collection
  - -- Yard waste composting
  - -- Disincentives
  - -- Reuse
  - -- Single-family curbside collection
  - -- Mixed-waste processing
- Disposal Program
  - -- Incineration/energy recovery
  - -- Landfill
  - -- Long haul

(a) Reduction Program

The consultant team found little justification for having different waste reduction programs among the different WGA's. Based on the criteria established, the recommendations are the same Statewide. Education is considered to be reasonably cost-effective and has excellent long-term environmental benefits, considering its effect on all other management methods. The focus of education/public involvement programs is to inform and change society's view of solid waste and its management. A balance of incentives and disincentives will be necessary components of a waste reduction program. The cost-effectiveness of these methods is considered to be fair; however, their application will produce considerable environmental benefit. They are not expected to have a significant impact upon the volume of waste but can affect the composition of the waste stream significantly.

Special governmental programs are considered to be a good way to demonstrate waste reduction methods and to assist business and industry in reducing waste and increasing recycling.

Home yard waste composting is a cost-effective, low-risk method for significantly reducing the waste stream. Participation by the public sufficient to measurably reduce waste will require local government to vigorously "market" the program, a worthwhile effort considering the significant amount of yard waste in the overall waste stream.

Industrial waste exchanges have been effective for some time. There is now potential for applying this concept to household hazardous wastes as well.

It is recommended that the waste reduction program be developed in the priority order listed above, and that investment of resources be made in those methods and techniques which will provide the greatest return.

(b) Recycling Program

Using drop-off/buy-back depots received the highest ranking. This method is cost-effective, feasible, and has potential to significantly reduce the waste stream. According to the economic model, drop-off and buy-back operations at current prices are profitable. Since much of the population is dispersed and not well-suited to curbside collection methods using separate vehicles, depots could be particularly effective for collecting recyclables from the residential and self-haul waste streams, which constitute approximately 70% of the disposed waste in this WGA. Markets are relatively strong for commodities which would be handled through drop-off and buy-back operations, given this WGA's proximity to the Puget Sound processors and end-users.

Education was ranked second due to its extremely low environmental impact and its relative high ranking for long-term cost-effectiveness, feasibility, and potential impact on the waste stream. Incentives received the third highest ranking. This method again scored high in environmental impact and in potential effectiveness for reducing the quantity of waste disposed in the Northwest WGA. The above-described methods would be appropriate for both rural and urban areas.

Commercial source-separated collection and commercial high-grade collection are potentially effective recycling methods in the urbanized areas of the Northwest WGA. The economic model demonstrated that both these methods would cost considerably less than collection and disposal through long-haul or incineration (estimated costs). Both of these methods were also ranked high because of low environmental impact and low exposure to loss. Commercial source separation was ranked higher because of its potential to divert materials from the waste stream. In the economic model, commercial source-separated collection diverted almost as much tonnage as drop-off and buy-back operations. Good markets exist in this WGA for materials recovered through these methods.

Yard waste composting has significant potential for recycling materials in the entire Northwest WGA since yard waste accounts for approximately 15% of the total generated waste stream. This WGA shows some potential for developing yard waste markets. Yard waste composting is highly feasible and received a moderate environmental ranking. The economic model indicates that

collection and processing would be expensive but not as expensive as long-hauling or incinerating.

Disincentives and reuse both ranked fifth among recycling methods. although these methods cause few environmental impacts, only moderate results are expected.

Single-family curbside collection and mixed-waste processing also ranked fifth. It shows potential for moderately reducing the volume of materials destined for disposal. This method, however, would only be practical in the urbanized communities within this WGA, unless a single vehicle were used.

Based on estimated costs, mixed-waste processing may also be viable in this WGA. This method avoids some of the potential environmental risk associated with incineration and landfilling. It is considered feasible and ranks very well in terms of its potential for reducing the waste stream. If undertaken in this WGA, such a facility should be operated on a regional basis to achieve an acceptable level of cost-effectiveness. Less mechanized, more labor-intensive intermediate processing methods should also be considered, since extensive source separation throughout this WGA is unlikely. These could be implemented in conjunction with existing as well as future incinerators, landfills, or long-haul methods.

Methods not included in the recycling program are multi-family collection, source-separated collection, municipal solid waste composting, and food processing. Multi-family collection was omitted largely because of its cost outside of densely populated urban areas. MSW composting was seen as relatively costly in comparison with other recycling methods, and its potential adverse impacts--in particular, contaminants--are a concern. In addition, there are limited markets for compost in this WGA, and little experience at composting. Thus, the feasibility of composting was ranked low. Likewise, the feasibility of food waste processing was ranked low since this method is costly and shows a low potential for volumetric impact.

(c) Disposal Program

The consultant team ranked incineration with energy recovery slightly higher than local landfilling or long-haul alternatives; however, it should be emphasized that the rankings were essentially equal. Incineration won out due to a higher ranking with respect to potential for reducing waste volumes. Landfilling is anticipated to be slightly less expensive than long haul, while incineration is the most costly. Given the Northwest WGA's climatic conditions, landfilling was ranked lower than incineration in terms of potential environmental impact. Landfilling and long hauling were both considered to be more feasible than incineration. Any of these methods, even with their drawbacks, can be considered a Best Management Practice in the Northwest WGA.

Objectives for each category of solid waste appear in Table E-27. These objectives depict the amount of each category which could reasonably be handled by each method. The objectives are based on the results of the WGA-recommended model and on the current levels of recycling in each WGA.

VAA0NW60

Table E-27

Waste Stream Category Objectives By Method for Northwest WGA

% OF WASTE STREAM CATEGORY MANAGED BY METHOD

WASTE STREAM CATEGORY / METHOD/ TECHNIQUE	RECYCLING											DISPOSAL							TOTAL (%)
	REUSE	SINGLE FAMILY CURBSIDE COLLECTION	MULTI-FAMILY HOUSING COLLECTION	COMMERCIAL SOURCE SEPARATION	COMMERCIAL HIGH GRADE	COMMERCIAL DIRECT	DROP OFF / BUYBACK DEPOTS	MIXED WASTE PROCESSING	YARD WASTE COMPOSTING	MIXED WASTE COMPOSTING	FOOD WASTE PROCESSING	SUBTOTAL RECYCLING	ANAEROBIC DECOMPOSITION	PYROLYSIS / GASSIFICATION	REFUSE DERIVED FUEL PREP. & USE	MASS BURN INCINERATION / ASHFILL	LANDFILL	LONG HAUL	SUBTOTAL DISPOSAL	
NEWSPAPER						30					30				35		35	70	100
CORRUGATED CARDBOARD			20	1	12	2					34				33		33	66	100
HIGH GRADE PAPER			15	1	1						17				41		41	83	100
MIXED SCRAP PAPER (RECYCLABLE)				1							1				50		50	99	100
REFILLABLE GLASS CONTAINERS			13			70					83				9		9	17	100
GLASS			5			5					10				45		45	90	100
ALUMINUM						47					47				26		26	53	100
TIN PLATED FOOD & BEVERAGE CANS						3					3				48		48	97	100
FERROUS METAL					81	4					85				7		7	15	100
NON-FERROUS METAL					58	2					60				20		20	40	100
WHITE GOODS						17					17				41		41	83	100
PET PLASTICS															50		50	100	100
HDPE PLASTICS															50		50	100	100
PLASTIC PACKAGING (LDPE)															50		50	100	100
EXPANDED POLYSTYRENE															50		50	100	100
OTHER PLASTICS															50		50	100	100
TIRES															50		50	100	100
OTHER RUBBER PRODUCTS															50		50	100	100
FOOD															50		50	100	100
LAWN AND GARDEN WASTE							75				75				12		12	25	100
WOOD															50		50	100	100
DISPOSABLE DIAPERS															50		50	100	100
OIL						74					74				13		13	26	100
BATTERIES						85					85				8		8	15	100
OTHER HOUSEHOLD HAZARDOUS															50		50	100	100
CONSTRUCTION DEBRIS (NOT WOOD)															50		50	100	100
OTHER ORGANIC															50		50	100	100
OTHER INORGANIC															50		50	100	100

5. PUGET SOUND WGA

a. Introduction to Puget Sound WGA

(1) Location

The Puget Sound Waste Generation Area (Puget Sound WGA) encompasses the counties bordering on the east, south, and southwest edges of Puget Sound. The total area of the Puget Sound WGA is 7,022 square miles.

The following counties are included in the Puget Sound WGA:

- King
- Kitsap
- Pierce
- Snohomish
- Thurston

(2) Population

The estimated 1987 population of the Puget Sound WGA was 2,630,300 persons. Of this, 50% resided in the 76 incorporated towns and cities of the area. The Washington State Office of Financial Management predicts a 10% growth in population by 1995, to 2,893,300 for the area. According to 1980 Census figures, 17% of the population lived in rural areas (defined as outside of urbanized areas or outside Census-designated places of 2,500 or more inhabitants).

In 1987, there were 1,113,200 housing units in the Puget Sound WGA (April 1 estimate). Sixty-four percent (64%) of these units were single-family dwellings. This total represents an increase of 160,930 housing units since 1980 (17% growth).

(3) Economy

The Washington State Department of Employment Security estimated December, 1987 employment in the Puget Sound WGA to be 1,220,400 persons. The number of "employer units" (i.e., separate business locations) was put at 70,860. People in the Puget Sound WGA are employed in a variety of industries. Among persons employed in 1986, 21% worked in the service sector, 18% each worked in retail and government jobs, and 17% worked in manufacturing. Two major employers in the area are the aerospace industry and the State government offices in Thurston County.

b. Existing Solid-Waste Management Methods

(1) Solid-Waste Reduction and Recycling

There are approximately 100 recycling centers in the Puget Sound WGA (this figure excludes beverage distributors handling refillable bottles,

as well as battery and tire distributors). These centers handled 832,700 tons of materials in 1987, representing 26.8% of the estimated total tonnage of solid waste generated. The following sections summarize the reduction and recycling programs in each of the counties in the Puget Sound WGA.

(a) King County

King County's recycling program involves numerous recycling efforts, as well as education and grants to local cities. The major efforts involve the cities of Issaquah, Bothell, Bellevue, Kent, and Renton. Waste Management, Inc. and Rabanco Ltd. are heavily involved in recycling throughout the County as well.

In October of 1988, the King County Executive made recommendations regarding waste reduction and recycling programs during the next twelve years. These included: an extensive education, promotion, and public involvement effort; recyclables market development; monitoring of progress; yard-waste programs; residential curbside collection for urban areas and drop boxes in rural areas; and technical assistance for commercial waste reduction and for development of recycling facilities in the private sector. The King County Executive also recommended changes in State legislation to allow increased county authority over recycling programs, out-of-county disposal, mechanical separation at solid-waste facilities, and implementation of policies on public involvement.

The City of Seattle currently has an established curbside collection program for single-family through fourplex residential recyclables (including yard waste beginning in January, 1989). In November of 1988, Seattle began a pilot program to test curbside collection of plastics.

King County has established a goal of 65% recycling by the year 2000. The City of Seattle's goal is 60% by 1998. To do this, the County and the City have each proposed several new efforts such as mandatory yard waste separation, multifamily dwelling recycling programs, collection and composting of food waste, and incentives for local waste reduction.

The City of Issaquah hired a recycling coordinator in August, 1988 to develop and orchestrate recycling efforts. The major focus to date has been on maintaining a consistent flow of educational and public-awareness promotions. However, the coordinator will soon be responsible for business audits and implementing collection of recyclables from multifamily dwellings. A two-month curbside recycling pilot program run by Lawson Disposal, Inc., is now in operation outside the city limits. Recyclables go to Fibres International. Earlier in the year, a two-month curbside pilot program for yard and garden waste was started, as well as a two-day centralized collection effort sponsored by Alcoa. Compostable materials went to Pacific Top Soils, and other recyclables went to Community Enterprises of Issaquah and Fibres International.

The City of Bothell vigorously promotes in-house composting, recycling, and waste reduction. A six-month pilot program involving source separation and curbside collection of newspaper, waste paper, glass, tin, and

aluminum at 300 homes was initiated in September, 1988. SnoKing, the Waste Management hauler contracted by the City to provide the curbside service, will also be opening a six-month recycling drop-off center. The City's parks are stocked with aluminum recycling receptacles, and for one week each year, the City sponsors a spring cleanup in which a central dropsite is provided for the public to separate recyclables. Compostables go to Pacific Top Soils. Bothell High School students practice in-school recycling, and are presently managing a waste-oil education project involving drain-paintings and distribution of informational brochures. Grants received from King County and the Washington State Department of Ecology during the past two years provide funding for the City's efforts.

The City of Bellevue has approximately 100 drop-off centers for recyclables. Educational approaches are utilized to inform residents of their locations and availability. Curbside collection of recyclables as well as yard and garden waste are in the planning stages. A coordinator will be hired soon to work on recycling strategies for multi-family dwellings and highrise offices.

The City of Kent has a voluntary curbside collection program for recyclables operated by Kent Disposal, the local franchised hauler. This is at no direct cost to the participants. The City also has a program called the Spring-Fall-and-Christmas-tree pickup. The City will contract with a hauler to collect from various drop-off locations where the yard debris is brought in by residents.

On December 5, 1988, the City of Renton approved a curbside recycling plan for collection of bottles, cans, newspaper, and waste paper. There is interest in beginning curbside collection of yard and garden waste as well. The City plans to adopt a policy regarding hazardous and commercial waste soon, and will be hiring a recycling coordinator by February of 1989.

(b) Kitsap County

Recycling in Kitsap County is conducted predominantly by the private sector. There are three buyback operations, one of which collects standard recyclables at the Olympic View Landfill as well as in Bremerton. This operation is owned by the largest waste hauler in the County, who also has plans to provide curbside service in some areas of the County. In addition, there are two businesses that buy back various grades of metals. The County is currently developing a recycling plan.

(c) Pierce County

Pierce County encourages participation in recycling through audio-visual presentations to schools and civic groups and through distribution of brochures. The County also maintains a Recycling Roundtable to advise the County on proposals and policies pertaining to recycling issues. These are funded by a grant from the State DOE as well as by landfill owners.

The County would like to achieve 40% recycling levels by 2005. Proposals have been made toward this goal, including increased school programs, a recycling hotline, and commercial waste audits. In 1987-88, it was

estimated that almost one-fifth of the total waste generated was being diverted to recycling centers without any investment or cost to the County.

(d) Snohomish County

In Snohomish County, recycling promotion is done by non-profit organizations and by the County. The program emphasizes school presentations with video tapes, teacher workshops, classroom speakers, brochures, balloons, buttons, and bumper stickers. Various pilot recycling programs have been offered in Everett, Lynnwood, Marysville, Mountlake Terrace, and Silver Firs, and throughout unincorporated areas of the County. There also are several privately operated drop-off and buy-back facilities in the County.

The County is proposing a community-specific recycling plan which will identify necessary services and then negotiate with cities, towns, and private companies for service provision. The current plan includes recommendations for 21 recycling zones, 19 in urban areas and two in rural areas, as well as a rate incentive and penalties for haulers failing to comply with program objectives.

(e) Thurston County

Thurston County plans to achieve a 40% reduction (by weight) of municipal solid waste by 1995, with interim goals of 15% in 1987 and 35% in 1990. Recycling efforts are operated mainly by approximately 24 recycling businesses.

The City of Olympia is hoping to reach a goal of 85% household participation in curbside collection by 1990. City residents also have access to two drop-off locations for glass, aluminum, tin, cardboard, and newspaper, as well as a Christmas tree collection site. Olympia is working with the County on composting issues, and is developing a comprehensive plan to include manufacturing and commercial waste recycling.

(2) Solid-Waste Collection

In the Puget Sound WGA there are 26 haulers collecting municipal solid waste under U.T.C. certificates (franchises). Nine cities operate their own solid waste collection services. These cities are Carnation, Enumclaw, Skykomish, Ruston, Tacoma, Index, Arlington, Paulsbo, and Olympia. All other collection in this WGA is conducted through a contractual agreement between city and hauler. Table E-28 summarizes information on Puget Sound WGA haulers.

The operators hauled an estimated 1,876,000 tons of waste in 1987, 39% of which was from the commercial sector and 61% from residences. Including self-haul tonnages, the total disposed waste for 1987 was estimated to be 2,274,000 tons.

It is reported that there are rural self-haul drop boxes in King, Kitsap, Pierce, and Snohomish Counties (depending on the definition used for "drop box," the number may vary; there appear to be different interpretations of the terms "drop box" and "transfer station"). Table E-29 describes them in greater detail.

TABLE E-28
WASHINGTON DEPARTMENT OF ECOLOGY
Recycling and Waste Stream Survey-1987
PUGET SOUND WASTE GENERATION AREA
HAULERS

NAME	PUBLIC/ PRIVATE	FRANCHISES	AREA SERVED	DESTINATION/COUNTY
City of Carnation	Public		City of Carnation	Carnation L.F./King
City of Enumclaw	Public		City of Enumclaw	Enumclaw L.F./King
City of Skykomish	Public		City of Skykomish	Skykomish Drop Box (goes to Houghton T.S.)/King
Nick Raffo Garbage Co., Inc.	Private	F	King County	(1) Bow Lake T.S./King (2) South T.S./King (3) Mt Olivet Demo. L.F./King (4) Cedar Hills L.F./King
Federal Way	Private	F	King County	(1) Algona T.S./King (2) Bow Lake T.S./King (3) Cedar Hills L.F./King (4) Mt. Olivet Demo. L.F./King
RST/DBA Tri-Star	Private	F	King County	(1) Algona T.S./King (2) Bow Lake T.S./King (3) Cedar Hills L.F./King (4) Mt Olivet Demo. L.F./King
Boyd Enterprises	Private		King County	North T.S./King
Amalgamated Services, Inc.	Private		King, Snohomish and Pierce Counties	Cedar Hills/King

NAME	PUBLIC/ PRIVATE	FRANCHISES	AREA SERVED	DESTINATION/COUNTY
Meridian Valley	Private	F	S. King County	(1) Bow Lake T.S./King (2) Algona T.S./King (3) Renton T.S./King (4) Cedar Hills L.F./King
Bayside	Private	F	King County	Eastmont T.S./King
Rainier	Private	F	King County	(1) Eastmont T.S./King (2) Renton T.S./King
Seattle Disposal	Private	F	King County	Evergreen T.S./King
Lakewood Refuse Svc., Inc.	Private		Pierce Co.	(1) Hidden Valley L.F./Pierce (2) City of Tacoma L.F./Pierce
University Place Refuse Service, Inc.	Private	F	Pierce Co.	(1) Purdy L.F./Pierce (2) City of Tacoma L.F./Pierce
City of Ruston	Public		City of Ruston	City of Tacoma L.F./Pierce
City of Tacoma	Public		City of Tacoma	City of Tacoma/Pierce
Murray E. Fulton	Private		Pierce County	Hidden Valley L.F./Pierce
Pierce County Refuse	Private	F	Pierce Co. Thurston Co.	Hidden Valley L.F./Pierce
Sound Disposal, Inc.	Private	F	Snohomish Co.	(1) Southwest T.S./ Snohomish (2) Cathcart L.F./Snohomish

NAME	PUBLIC/ PRIVATE	FRANCHISES	AREA SERVED	DESTINATION/COUNTY
Rubatino's Refuse Removal, Inc.	Private	F	Snohomish Co.	(1) Cathcart L.F./Snohomish (2) Everett T.S./Snohomish
Bill's Disposal Svc.	Private	F	Snohomish Co.	(1) Cathcart L.F./Snohomish (2) Monroe Drop Box/Snohomish
Northwest Garbage Svc.	Private	F	Snohomish Co. & King Co.	(1) Snohomish T.S./Snohomish (2) 1st NE T.S./King (3) Houghton T.S./King
City of Index	Public		City of Index	Gold Bar Drop Box/Snohomish
City of Arlington	Public		City of Arlington	Arlington T.S./Snohomish
Stanwood Disposal	Private	F	Snohomish Co.	Arlington T.S./Snohomish
Apex Disposal	Private	F	Snohomish County	Southwest T.S./Snohomish
Kent Disposal	Private	F	S. King County	Bow Lake T.S./King
Montleon Trucking	Private	F	King, Snohomish & Pierce Counties	(1) Cedar Hills L.F./King (2) South T.S./King (3) Newcastle L.F./King (4) Bryant L.F./Snohomish (5) Hidden Valley L.F./Pierce (6) Southwest T.S./Snohomish (7) Evergreen T.S./King
Lawson Disposal, Inc.	Private	F	King County	(1) Factoria T.S./King (2) Hobart L.F./King
Sno King	Private	F	King County	(1) Houghton T.S./King (2) Factoria T.S./King

NAME	PUBLIC/ PRIVATE	FRANCHISES	AREA SERVED	DESTINATION/COUNTY
Sea-Tac Disposal	Private	F	King County	(1) Bow Lake T.S./King (2) Algona T.S./King (3) Renton T.S./King
Island Disposal	Private	F	Kitsap County	Olympic View L.F./Kitsap
Brem-Air Disposal	Private	F	Kitsap County	(1) Olympic View L.F./Kitsap (2) Hansville L.F./Kitsap
Bainbridge Disp., Inc.	Private	F	Kitsap County	Hansville L.F./Kitsap
City of Poulsbo	Public		City of Poulsbo	Hansville L.F./Kitsap
North Sound Sanitation	Private	F	Kitsap County	Hansville L.F./Kitsap
South Sound Sanitation	Private		Kitsap County	Olympic View L.F./Kitsap
Pacific Disposal	Private	F	Thurston County	Hawks Prairie L.F./Thurston
City of Olympia	Public		City of Olympia	Hawks Prairie L.F./Thurston
Eastside Disposal	Private	F	E. King County	(1) Factoria T.S./King (2) Houghton T.S./King (3) 1st NE T.S./King

TABLE E-29
WASHINGTON DEPARTMENT OF ECOLOGY
Recycling and Waste Stream Survey-1987
PUGET SOUND WASTE GENERATION AREA
RURAL DROP BOXES

COUNTY	LOCATION	SIZE	TYPE	OTHER
King	Skykomish	50 CY	2 Rollaway Non-Compactors	Operated by City of Skykomish (city's trash dumped in Drop Box)-Hauled to Houghton T.S. by Northwest Garbage
Kitsap	Bainbridge Island	50 CY (1x) 40 CY (2x)	3 Non-Compactors	Manned facility run by Bainbridge Disposal, Inc. Being upgraded to Transfer Station
Pierce	Anderson Island	50 CY	Non-Compactor	County-owned, privately operated (by Land Recover, Inc); goes to LRI Landfill in Purdy
	Key Center	50 CY	2 Non Compactors	"
	South Prairie	50 CY	3 Non-Compactors	"
Snohomish	Gold Bar	50 CY	Roll-off	County owned and operated
	Granite Falls	50 CY	Roll-off	County owned and operated
	Lake Roslyn	50 CY	Roll-off	County owned and operated
	Monroe	50 CY	Roll-off	County owned and operated
	Rt. 530 to Darrington	50 CY	Roll-off	County owned and operated
	Sultan	50 CY	Roll-off	County owned and operated

(3) Solid-Waste Disposal

There are 19 operating landfills in the Puget Sound WGA. Sixteen are accepting municipal waste and three accept only demolition debris. Of the 16 municipal landfills, twelve are open to the public. There are private landfills in both King and Pierce Counties. Table E-30 presents more detailed information on landfills and transfer stations. The estimated remaining capacities of these landfills range from one to forty years (some information was unavailable); Table E-31 summarizes this information.

Based on 1987 quantities of waste disposed, rough estimates were generated for the tonnage of waste that could be accommodated by present landfills in the Puget Sound WGA. Calculations were based only on information from landfills accepting municipal waste, except for those on military bases and Indian reservations. The tons of waste disposed at each landfill in 1987 were multiplied by the reported years of remaining life. Remaining life was defined as:

1) The number of years between 1987 and a closure data mandated by permit; or

2) if no mandated closure date is specified, the number of years between 1987 and an estimated closure date (due to exhaustion of site capacity, landfill noncompliance, or business closure); or

3) the smaller of the two figures, if both exist.

Using this method, it was estimated that the Puget Sound WGA had sufficient landfill capacity at the end of 1987 to accommodate approximately 10,209,000 additional tons of solid waste. Care should be taken when interpreting this figure, since a WGA total estimate may not reflect situations facing individual jurisdictions. Landfills which did not report sufficient information to calculate tonnage capacity are not represented in the above estimate (refer to Tables E-30 and E-31).

(4) Solid-Waste Management Planning

King County--currently updating its Solid-Waste Plan.

Kitsap County--began update of Solid-waste Plan in Fall of 1987; this plan is due to be in draft form in June of 1989.

Pierce County--updating its plan, with draft to be done in 1989.

Snohomish County--will complete a draft Solid-Waste Plan in 1989.

Thurston County--reviewing recommendations made by the County's Solid Waste Task Force in the County's Solid-Waste Plan.

TABLE E-30
WASHINGTON DEPARTMENT OF ECOLOGY
Recycling and Waste Stream Survey-1987
PUGET SOUND WASTE GENERATION AREA
DISPOSAL FACILITIES

COUNTY	FACILITY	NAME	ACCESS	1987 TONS RECEIVED	REMAINING CAPACITY*	DESTINATION	1987 TIPPING FEES
King	Landfills:	Carnation	Public	400	35-40 Years; 10 Acres		Not Avail.
		Cedar Falls	Public	4,100	Not Avail.		$14.00/CCY; $8.00/LCY
		Cedar Hills	Private	1,300,000	18-22 Years; 141,300,000 CY		$47.50/Ton
		Enumclaw	Public	10,100	4 Years		$14.00/CCY; $8.00/LCY
		Hobart	Public	18,200	7 Years		$14.00/CCY; $8.00/LCY
		Mt. Olivet	Private	Not Avail.	Not Avail.		Not Avail.
		Newcastle	Public	388,800	Not Avail.		-Demolition $6.50/CY
		Vashon	Public	4,200	11 Years		-Demolition $14.00/CCY; $8.00/LCY
	Transfer Stations:	1st NE	Public	73,300		Cedar Hills L.F.	$47.00/Ton
		Algona	Public	118,100		Cedar Hills L.F.	$47.00/Ton
		Bow Lake	Public	158,000		Cedar Hills L.F.	$47.00/Ton
		Eastmont	Private	128,900		Cedar Hills L.F.	$47.00-50.00/Ton
		Evergreen	Public	170,000		Cedar Hills L.F.	$47.00/Ton
		Factoria	Public	135,800		Cedar Hills L.F.	$47.00/Ton
		Houghton	Public	155,900		Cedar Hills L.F.	$47.00/Ton
		North	Public	151,500		Cedar Hills L.F.	$56.00/Ton
		Renton	Public	47,800		Cedar Hills L.F.	$47.00/Ton
		South	Public	134,100		Cedar Hills L.F.	$56.00/Ton

COUNTY	FACILITY	NAME	ACCESS	1987 TONS RECEIVED	REMAINING CAPACITY*	DESTINATION	1987 TIPPING FEES
Kitsap	Landfills:	Hansville	Public	39,100	Not Avail.		$7.05/CCY; 6.80/LCY
		Olympic View	Public	112,500	18-21 Years		$9.32/LCY
	Transfer Stations:	Olalla	Public	2,500		Olympic View L.F.	$9.00/CY (Approx.)
		Silverdale	Public	Not Avail.		Olympic View L.F.	$9.00/CY (Approx.)
Pierce	Landfills:	City of Tacoma	Public	200,000	3-5 Years		$50.00/Ton
		Fort Lewis	Private	36,400	3 Years		-0- -Military base
		Hidden Valley	Public	144,700	8-10 Years		$38.00/Ton
		McChord	Private	1,600	3-5 Years		-0- -Demolition
		McNeil Island	Private	4,100	Not Avail.		-0-
		Purdy	Public	20,000	1-2 Years		$38.00/Ton ($7.00/CY Demo)
	Transfer Stations:	Lakewood	Private			Hidden Valley L.F.	
Snohomish	Landfills:	Bryant	Public	5,900**	Closed		$6.00/CY
		Cathcart	Public	280,000	3 Years		$30.00/Ton
	Transfer Stations:	Arlington	Public	14,300***		Cathcart L.F.	$35.00/Ton
		Everett	Public	89,200		Cathcart L.F.	$35.00/Ton
		Southwest	Public	105,900		Cathcart L.F.	$35.00/Ton

COUNTY	FACILITY	NAME	ACCESS	1987 TONS RECEIVED	REMAINING CAPACITY*	DESTINATION	1987 TIPPING FEES
Thurston	Landfills:	Hawks Prairie	Public	67,000	9-12 Years; 2,108,000 CY with 527,000 CY cover		$12.50/CCY or $4.90/LCY
	Transfer Stations:	Rainier	Public	Not Avail.		Hawks Prairie L.F.	$4.90-$12.50; min $2.00
		Rochester	Public	Not Avail.		Hawks Prairie L.F.	$4.90-$12.50; min $2.00
		Summit Lake	Public	Not Avail.		Hawks Prairie L.F.	$4.90-$12.50; min $2.00

CY = Cubic Yard
CCY= Compacted Cubic Yard
LCY= Loose Cubic Yard

*Based on space available at the end of 1987, regardless of mandated or planned closure dates.
**Only operated nine months in 1987 before closing.
***October, November, and December only.

TABLE E-31
WASHINGTON DEPARTMENT OF ECOLOGY
Recycling and Waste Stream Survey-1987
PUGET SOUND WASTE GENERATION AREA
LANDFILL CAPACITIES

FACILITY	FACILITY NAME	MANDATED CLOSURE (Date/None)	REMAINING CAPACITY* (Years/CY/Acres)	COMMENTS (#)
King	Carnation	None	35-40 Years; 10 Acres	1
	Cedar Falls	None	Not Available	2
	Cedar Hills	None	18-22 Years; 141,300,000 CY	3
	Enumclaw	None	4 Years	4
	Hobart	None	7 Years	5
	Mt. Olivet Demolition	Not Avail.	Not Available	6
	Newcastle	1989	Not Available	7
	Vashon	None	11 Years	8
Kitsap	Hansville	1989	Not Available	9
	Olympic View	2005	18-21 Years	10
Pierce	City of Tacoma	None	3-5 Years	11
	Fort Lewis	1989	3 Years	
	Hidden Valley	11/91	8-10 Years	12
	McChord	None	3-5 Years	
	McNeil Island	9/30/89	Not Available	13
	Purdy	None	1-2 Years	14
Snohomish	Bryant	---	---	15
	Cathcart	None	3 Years	
Thurston	Hawks Prairie	None	9-12 Years; 2,108,000 CY with 527,000 CY cover	

COMMENTS

1. Having problems meeting minimum functional standards; due to close in 1989.
2. Will close in 1989 and become a drop-box site.
3. Capacity given is amount estimated to remain by 1989.
4. Due to close in 1991.
5. Due to close in 1994.

COMMENTS continued

6. Demolition.
7. Demolition waste. Going through unclassified use permit hearing. If it passes, landfill will be open until 1992.
8. Present landfill to be capped and new one built on top. New facility expected to last until 1998.
9. Not expected to meet compliance, so 1989 will be last year of operation. May be replaced with a transfer station.
10. Due to close in 2005, with possible extension to 2008 if demolition area added.
11. Planning to manufacture refuse derived fuel (RDF) and take it to City's steam plant/RDF incinerator, which is under construction. If this occurs, capacity could increase by 10 years.
12. Life could be increased an additional 20 years with "waste-to-energy" implementation.
13. Preparing for 9/89 closure, at which time, it will become a transfer station.
14. Life could be increased to 30 years with Fort Lewis incinerator which is under construction and would handle all waste except construction debris.
15. Closed.

*Based on space available at the end of 1987, regardless of mandated or planned closure dates.

c. Market Capacity

Because of the existence of end users or export shipping opportunities within the area, the Puget Sound WGA generally enjoys the most favorable market conditions in the State; however, outlying areas enjoy fewer advantages than do the more urban areas. High population densities and available supplies as well as numerous buyers, brokers, and exporters in the area help to stabilize markets for materials from this WGA.

Markets for newspaper, corrugated containers, high-grade paper, aluminum cans, ferrous and non-ferrous metals, and tin cans from the WGA are all adequate. Mixed waste paper can potentially be recovered and marketed from the area; however, the economics of doing so are closely related to the prices paid especially for exported material.

Processing of white goods occurs at a number of facilities in the region. This helps reduce disposal costs, and could generate revenue if future prices improve. Plastics recovery is increasing in the WGA, with most of the material destined for the export market. With increasing supply and processing capabilities, the plastics market could potentially expand. Yard waste is being processed in some communities in the WGA and processing capacities are expected to increase. Yard waste markets are generally localized, extending only 30 to 40 miles from a processing facility.

A market capacity summary for the Puget Sound WGA is presented in Table E-32.

d. Evaluation of Methods

(1) Feasibility Analysis

Notable exceptions to the Statewide technical feasibility review for the Puget Sound WGA include:

- Commercial Mixed Waste Processing. The group assigned higher levels of exposure than the Statewide ratings for siting and markets. The group cited public NIMBY concerns related to noise, odor, and traffic. The difficulty of demonstrating to government the effectiveness of containment and mitigation measures was given as the reason for assigning higher exposure rating for permits acquisition. The group doubted the existence of stable markets for the end-products and, therefore, assigned a higher exposure rating for markets.

- Drop-Off/Buy-Back Depots. The instability of markets caused the group to give a higher exposure rating to this factor.

- Mixed Waste Processing. The group judged siting exposure to be greater than the Statewide rating. The group felt it would be hard to convince permitters of

Table E-32

Market Capacity Summary for Puget Sound WGA

COMMODITY	MAJOR END USERS FOR MATERIAL FROM WGA (Name &/or Location)	ESTIMATED END USER PRICE '88 ($/Ton)	VOLUME OF WGA MATRL. RECOVERED (1987 Tons)	(1) WGA COLLECTED MATERIAL PRICE ($/Ton)	(1) WGA COLLECTED MATERIAL VALUE ($/Year)	(2) WGA MARKET CAPACITY	FACTORS AFFECTING WGA MARKET FOR MATERIAL
1 Newsprint	CCA - Tacoma Sonoco - Sumner, some to Oregon Export - some to insul. mngft.	$45.00	127,900	$16	$2,046,400	ADEQUATE	Prices may fluctuate
2 Corrugated Containers	CCA - Tacoma Sonoco - Sumner Export - some to Oregon	$65.00	235,900	$40	$9,436,000	ADEQUATE	Prices may fluctuate
3 High Grade Paper	CCA - Tacoma Scott Paper - Everett Export, Midwest, Oregon, B.C.	$100.00	44,900	$45	$2,020,500	ADEQUATE	Prices may fluctuate
4 Mixed Waste Paper	Export Sonoco - Sumner Paperboard Indust. - B.C.	$25.00	28,900	$0	$0	POTENTIAL MARKET	Ready access to export market Very price sensitive
5 Container Glass	Ball-InCon - Seattle	$40.00	15,400	$20	$308,000	ADEQUATE	WGA end user is improving glass preprocessing capability
6 Refillable Glass	Rainier Brewing - Sea. Pabst/Olympia some Soft Drink	$116.00	12,700	$66	$838,200	ADEQUATE	
7 Aluminum Bev. Cont.	Various Alum. Co. Ship from Seattle some Export	$1,000.00	3,700	$850	$3,145,000	ADEQUATE	Many brokers and processors to choose from
8 Tin Cans	MRI - Seattle	$49.00	500	$29	$14,500	ADEQUATE	
9 Ferrous Metals	General Metals - Tac. Salmon Bay/Seattle Steel Export	$65.00	243,200	$50	$12,160,000	ADEQUATE	Ready access to export
10 White Goods	General Metals - Tac. Seattle Iron & Steel some to Oregon	$20.00	23,700	$0	$0	POTENTIAL DISP. AVOID.	Cost of stripping electrl. comp. is a factor - ready access to shredders
11 Non Ferrous Metals	Various - Tacoma/Seattle Export - some to Oregon	$800	33,400	$650	$21,710,000	ADEQUATE	Ready access to export
12 PET Bottles	Midwest & East U.S.	$160	0	$60	$0	POTENTIAL MARKET	Potential future market No significant current market
13 HDPE Bottles	Export - Puget Sound Partek - Vancouver	$200	75	$100	$7,500	POTENTIAL MARKET	Potential future market Some collection and processing is currently being done
14 Plastic Films (LDPE)	Export - Puget Sound	$160	25	$60	$1,500	POTENTIAL MARKET	Potential future market Some collection and processing is currently being done
15 Lawn & Garden Waste	Pacific Topsoil-Woodnvl. Others begin 1989	($20)	10,000	($30)	($300,000)	POTENTIAL MARKET	Potential future market Several new processors begin 1989

(1) WGA prices and values are before transportation, processing and handling necessary to prepare and move material to market.

(2) WGA market capacity is based on an assessment of the markets' ability to consume consistently and gradually increasing volumes.

REFER TO TEXT FOR DETAILED DISCUSSION

the feasibility of the technology, and of the effectiveness of noise and odor mitigation measures. The group also gave a lower exposure rating than that set in the Statewide assessment. It was assumed that once the effort had been made to obtain the required permits, little additional effort and exposure would be involved.

- Long-Haul Transport. The group focused on disposal following long haul. Disposal site permitting exposure was judged higher than for the Statewide rating. Technology-related exposure was viewed as being very low.

- Anaerobic Decomposition. Market exposure was judged to be less and vendor exposure to be more than set forth in the Statewide ratings. The group regarded the end-product to be similar to sewage sludge and believed it would have no market. It was the group's opinion that there were many unproven vendors with questionable stability.

- Mass Burn Incineration. The group judged waste supply markets and vendor exposure to be lower than the Statewide ratings. The group stated that waste quantity would likely be stable over time, that ample markets exist for recovered energy, and that vendors with proven records are available.

- RDF. The group rated vendor exposure to be lower than the Statewide rating because vendors were seen as being available, capable, and stable.

- Landfilling and Ashfilling. The group judged residue disposal exposures to be greater than the Statewide rating due to potential treatment/disposal difficulties with concentrated leachate.

The exposure to loss feasibility evaluation is presented in Table E-33.

(2) Environmental Evaluation

(a) Impacts

Environmental factors in the Puget Sound area may make it somewhat more difficult to site several types of facilities. Bounded by mountains, Puget Sound is susceptible to atmospheric inversions during certain weather conditions, and several locations within the WGA are designated as non-attainment air quality areas. For these reasons, any alternatives that involve incineration will be of great concern. In addition, the high population density in most of the area will increase the risk of nuisance impacts--noise, aesthetic impacts, odor, and traffic. These factors are reflected in the environmental impacts matrix (Table E-34).

Table E-33
Evaluation of Exposure to Loss
for Puget Sound WGA

VAADPS28

DEGREE OF EXPOSURE TO LOSS ASSOCIATED WITH IMPLEMENTATION & USE OF EACH METHOD

TECHNICAL IMPLEMENTATION FACTOR			REDUCTION						RECYCLING																HANDLING		DISPOSAL					
			EDUCATION		INCENTIVES		DISINCENTIVES		MODEL GOVERNMENTAL PROGRAMS		WASTE EXCHANGE		HOME YARD WASTE COMPOSTING		REUSE		CURBSIDE COLLECTION		MULTI-FAMILY HOUSING COLLECTION		COMMERCIAL SOURCE SEPARATION		INTERMEDIATE PROCESSING FACILITY		COMMERCIAL MIXED WASTE PROCESSING		DROP OFF / BUYBACK DEPOTS		MIXED WASTE PROCESSING		YARD WASTE COMPOSTING		MIXED WASTE COMPOSTING		FOOD WASTE PROCESSING		SPECIAL WASTE RECYCLING AND REUSE		TRANSFER		LONG HAUL TRANSPORT		ANAEROBIC DECOMPOSITION		PYROLYSIS / GASSIFICATION		REFUSE DERIVED FUEL PREP. & USE		MASS BURN INCINERATION		LANDFILL		ASHFILL	
SITING	SITING RESISTANCE	GENERAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	L/M	L	M/H	L	M/H	M	M/H	M/H	NA	M/H	M/H	H	H	H	H	H	H	H	H
		WGA SPECIFIC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	M	H	L	H	L	M	H	L	M	H	L	H	M	L/M	M/H	NA	H	H	H	H	H	H	H	H
	PERMITS AQUISITION DIFFICULTY	GENERAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	L	L	L	L	L/M	L	M	L	M/H	M	L/M	M	M	M/H	H	H	H	H	H	H	H	H	H
		WGA SPECIFIC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	M	H	L	H	L/M	H	L/M	M	M/H	M	M/H	H	H	H	H	H	H	H	H	H
	TIME & COST REQUIRED TO COMPLETE SITING	GENERAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	L/M	L	L	L	M/H	M	M/H	M/H	NA	M/H	M/H	H	H	H	H	H	H	H	H
		WGA SPECIFIC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	L	L	L	L	M/H	L/M	M/H	M/H	L/M	M/H	M/H	H	H	H	H	H	H	H	H	H
WASTE SUPPLY	QUANTITY	GENERAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	NA	L	M	M	L	L/M	L	L	L	L	L	L	M/H	L/M	L/M	M/H	L/M	L/M	M	M	M	M	L	L	L	L
		WGA SPECIFIC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	NA	L	L/M	M	L	L/M	L	L	L	L	M	L	L	L/M	L/M	M/H	L/M	L/M	M	M	M	M	L	L	L	L
	COMPOSITION	GENERAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	L	L/M	L/M	L/M	L	L/M	L/M	L/M	L	L/M	L	M	L/M	L/M	M	L	L/M	L	M/H	L/M	L/M	M	M	M	L	L	L/M
		WGA SPECIFIC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	L	L/M	L/M	L/M	L	L/M	L	M	L/M	L/M	M	L	L/M	L/M	M	L	L/M	M/H	L/M	NA	M/H	L/M	M	M	L	L	L/M
MARKETS		GENERAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	NA	L	M	M	L/M	L/M	L/M	L/M	M/H	M	M/H	M/H	L/M	M	M	M/H	M/H	M	NA	NA	L/M	M/H	M	M	NA	NA
		WGA SPECIFIC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	NA	L	L/M	L/M	L/M	L/M	H	H	H	H	M	H	H	H	M	H	H	M	NA	NA	NA	H	M/H	L	NA	NA
VENDOR		GENERAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	NA	NA	L/M	L/M	L/M	L/M	L/M	L	M/H	L	M/H	L/M	L/M	L	L/M	M/H	L/M	L	L/M	L/M	L/M	L	L/M	L	L/M	L/M	L/M
		WGA SPECIFIC	L	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	NA	NA	L	L	L	L	L/M	L	M	L	M/H	M/H	M/H	L	L/M	M/H	L/M	H	H	L	L	NA	NA	L	L/M	L	L/M
TECHNOLOGY/ PROGRAM	ABILITY TO CONSTRUCT & MAKE OPERATIONAL	GENERAL	L	M/H	M/H	L	L	M	L/M	L	M	L	L/M	L/M	L/M	L	M	L	L/M	L/M	L/M	L/M	L	M/H	L	L/M	L	L/M	L/M	NA	L	H	M	M	L/M	L/M	L	H	M	M
		WGA SPECIFIC	L	M/H	M/H	L	L	M	L/M	L	M	L	L/M	L/M	L/M	L	M	L	L/M	L/M	L/M	L/M	L	M/H	L	L/M	L	L/M	L	L	L	H	M	M	L/M	L/M	L	H	M	M
	ABILITY TO OPERATE AND MAINTAIN	GENERAL	L	L/M	L/M	L	L	M	L/M	L	M	L	L/M	L/M	L/M	L	M	L	L/M	L/M	L/M	M	L/M	M	L/M	L/M	L/M	L/M	L/M	L	NA	NA	L	M/H	M/H	M	M	L	L
		WGA SPECIFIC	L	L/M	L/M	L	L	M	L/M	L	M	L	L/M	L/M	L/M	L	M	L	L/M	L/M	L/M	M	L/M	M	L/M	L/M	L/M	L/M	L/M	L	NA	L	M	M/H	M/H	M	M	L/M	L
RESIDUE DISPOSAL	CHARACTERISTICS	GENERAL	NA	NA	NA	NA	NA	M	NA	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	M/H	M	M	L/M	M/H	NA	NA	L	L	L/M	M/H	M	L
		WGA SPECIFIC	NA	NA	NA	NA	NA	M	NA	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	M/H	M	M	L/M	M/H	NA	L	M	M	L/M	M/H	M	L
	SITE AVAILABILITY	GENERAL	NA	NA	NA	NA	NA	M	NA	NA	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	M/H	M	M	L/M	M/H	NA	NA	M	M	L/M	M/H	NA	NA
		WGA SPECIFIC	NA	NA	NA	NA	NA	M	NA	NA	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	M	M	M	L/M	M/H	NA	NA	M	M	L/M	M/H	NA	NA
FINANCING		GENERAL	L	L	L	L	L	L	L	L	L	L	L/M	L	L/M	M	L	M	L	M	L	L/M	M	M	L	L/M	M	M	L/M	M/H	M	M	L/M	H	M	M	M	M
		WGA SPECIFIC	L	L	L	L	L	L	L	L	L	L	L/M	L	L/M	M	L	M	L	M	L	L/M	M	M	L	L/M	M	M	L/M	M/H	M	M	L/M	H	M	M	M	M
UNCONTROLLABLE CIRCUMSTANCES**		GENERAL	L	M	M	L	M	M	L	M	M	L	M	M	L	M	L	M	L	M	M	M	L	M	M	M/H	M	M	M	M/H	M	M	M	M	M	M/H	M	M
		WGA SPECIFIC	L	M	M	L	M	M	L	M	M	L	M	M	L	M	L	M	L	M	M	M	L	H	M	M/H	M	M	M	M/H	M	M	M	M	M	M/H	M	M

KEY:

NA = NOT APPLICABLE
H = HIGH
M = MODERATE
L = LOW

An evaluation of potential environmental impacts due to failures in the technology are presented in Table E-35.

(b) Concerns

The Puget Sound WGA working group expressed a relatively low level of concern about environmental impacts of waste management methods (see Table E-36). Working group members were apparently familiar with the technologies and assumed that all available mitigation measures would be implemented. The group did not believe its members know enough about anaerobic decomposition to rate this alternative. Group members were particularly concerned about explosion risk associated with anaerobic decomposition and pyrolysis; they assumed that batteries, spray cans, and other flammable materials would still be present in the waste supplied to these facilities.

(3) Economic Evaluation of Alternatives

The results of the economic analysis for the Puget Sound WGA are summarized in Table E-37. Additional details on the results of the economic analysis are presented in Appendix C.

e. Ranking of Methods and Recommendations

The following paragraphs discuss the working group's rankings and consultant team's rankings for best management practices, as well as each group's recommended system for reduction, recycling, and disposal in this WGA.

(1) Working Group Rankings

Evaluation criteria were weighted by the Puget Sound WGA working group, and applied to the alternative solid waste management methods. The resulting rankings are shown in Table E-38.

Based on these rankings, the WGA working group selected the following preferred system for solid waste management in this WGA:

- Reduction Program
  - -- Education
  - -- Incentives
  - -- Home composting
- Recycling Program
  - -- Commercial source-separated collection
  - -- Education
  - -- Incentives
  - -- Drop-off/buy-back depots
  - -- Yard waste composting
  - -- Reuse
  - -- Single-family curbside collection
  - -- Multi-family collection

Table E-34

Evaluation of Environmental Impacts *

for Puget Sound WGA

VAA0PS26

DEGREE OF POTENTIAL ENVIRONMENTAL IMPACT ASSOCIATED WITH IMPLEMENTATION & USE OF EACH METHOD

ENVIRONMENTAL FACTOR	REDUCTION						RECYCLING												HANDLING		DISPOSAL					
	EDUCATION	INCENTIVES	DISINCENTIVES	MODEL GOVERNMENTAL PROGRAMS	WASTE EXCHANGE	HOME YARD WASTE COMPOSTING	REUSE	CURBSIDE COLLECTION	MULTI-FAMILY HOUSING COLLECTION	COMMERCIAL SOURCE SEPARATION	INTERMEDIATE PROCESSING FACILITY	COMMERCIAL MIXED WASTE PROCESSING	DROP OFF / BUYBACK DEPOTS	MIXED WASTE PROCESSING	YARD WASTE COMPOSTING	MIXED WASTE COMPOSTING	FOOD WASTE PROCESSING	SPECIAL WASTE RECYCLING AND REUSE	TRANSFER	LONG HAUL TRANSPORT	ANAEROBIC DECOMPOSITION	PYROLYSIS / GASSIFICATION	REFUSE DERIVED FUEL PREP. & USE	MASS BURN INCINERATION	LANDFILL	ASHFILL
AIR QUALITY	NA	NA	NA	NA	NA	NA	NA	L	L	L	L	L	L	L	L	L	L	L	L	L	L/M	L/M	L/M	L/M	L	L
CRITERIA POLLUTANTS: SO2, NOX, HCL								L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	L	L	L	L	L
TOXICS								L	L	L	L	L	L	L	L	L	L	L	L	L	L/M	L/M	L/M	L/M	L	L
PARTICULATES																										
ODOR	NA	NA	NA	NA	NA	L	NA	NA	L	NA	L	NA	L	L/M	L	L/M	L/M	L	L	NA	L/M	L/M	L/M	L/M	L	NA
SURFACE WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	NA	NA	NA	L	L/M	L/M	L	L	NA	NA	L	L	L	L	L/M	L/M
GROUND WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	NA	NA	NA	L	L	L	L	L	NA	NA	L	L	L	L	L/M	L/M
NOISE	NA	NA	NA	NA	NA	L	NA	L/M	L/M	NA	L	L/M	L	L/M	L/M	L/M	L/M	L/M	L	L	L/M	L/M	L/M	L/M	L/M	L/M
RISK OF EXPLOSION	NA	NA	NA	NA	NA	NA	NA	NA	L	NA	NA	L	NA	L	NA	L	NA	L	L	NA	L	L	L	L	L	NA
PUBLIC HEALTH RISKS	NA	NA	NA	NA	NA	L	NA	NA		NA	L								L	L	L	L	L	L	L	NA
PATHOGENS						L		NA	L	NA	L	NA	L	L	NA	L	L	NA	L	L	L	L	L	L	L	NA
VECTORS						L		NA	L	NA	L	L	L	L	L	L	L	NA	L	L	L	L	L	L	L	NA
TOXICS						L		NA	L	NA	L	NA	L	L	L	L	L	L	NA	NA	L/M	L/M	L/M	L/M	L	L/M
AESTHETICS	NA	NA	NA	NA	NA	L	NA	L	L	NA	L/M	L/M	L	L/M	L/M	L/M	L/M	L	L	NA	L/M	L/M	L/M	L/M	L/M	L/M
TRAFFIC	NA	NA	NA	NA	L	NA	NA	L/M	L/M	L	L/M	L	L/M	L/M	L/M	L/M	L/M	L/M	L	L	L/M	L/M	L/M	L/M	L/M	L/M
OTHER																										

KEY: **

NA = NOT APPLICABLE
H = HIGH RATING
M = MEDIUM RATING
L = LOW RATING

* THIS EVALUATION ASSUMES NEW "STATE OF THE ART" FACILITIES, PROPERLY SITED WITH FACILITY DESIGN INCORPORATIONG APPROPRIATE MITIGATION TECHNIQUES.

** A HIGH RATING INDICATES A HIGH LEVEL OF LOCAL ENVIRONMENTAL IMPACT
A LOW RATING INDICATES A LOW LEVEL OF ENVIRONMENTAL IMPACT

Table E-35

VAAOPS27

Evaluation of Potential Environmental Impacts *
for Puget Sound WGA

DEGREE OF POTENTIAL ENVIRONMENTAL IMPACT ASSOCIATED WITH IMPLEMENTATION & USE OF EACH METHOD

ENVIRONMENTAL FACTOR	REDUCTION	EDUCATION	INCENTIVES	DISINCENTIVES	MODEL GOVERNMENTAL PROGRAMS	WASTE EXCHANGE	HOME YARD WASTE COMPOSTING	RECYCLING	REUSE	CURBSIDE COLLECTION	MULTI-FAMILY HOUSING COLLECTION	COMMERCIAL SOURCE SEPARATION	INTERMEDIATE PROCESSING FACILITY	COMMERCIAL MIXED WASTE PROCESSING	DROP OFF / BUYBACK DEPOTS	MIXED WASTE PROCESSING	YARD WASTE COMPOSTING	MIXED WASTE COMPOSTING	FOOD WASTE PROCESSING	SPECIAL WASTE RECYCLING AND REUSE	HANDLING	TRANSFER	LONG HAUL TRANSPORT	DISPOSAL	ANAEROBIC DECOMPOSITION	PYROLYSIS / GASSIFICATION	REFUSE DERIVED FUEL PREP. & USE	MASS BURN INCINERATION	LANDFILL	ASHFILL
AIR QUALITY	NA	NA	NA	NA	NA	NA		NA																						
CRITERIA POLLUTANTS: SO2. NOX. HCL									L	L	L	L	L	L	L	L	M	L	M		M	M		M/H	H	H	H	M	L	
TOXICS									L	L	L	L	L	L	M	L	L	L	M		L	L		M/H	H	M	M	H	L/M	
PARTICULATES									L	L	L	L	L	L	L	L	L	L			M	M		L	L/M	H	H	L	M/H	
ODOR	NA	NA	NA	NA	NA	L/M		NA	L	L	L	L/M	L	L/M	H	L	M	H	L		L/M	L/M		H	H	M	M	H	L	
SURFACE WATER QUALITY	NA	NA	NA	NA	NA	L		NA	NA	NA	NA	L	L	L/M	M	L/M	M	M	M		L	L		L	L	L	L	M	M	
GROUND WATER QUALITY	NA	NA	NA	NA	NA	L		NA	NA	NA	NA	L	L	L	M	L/M	M	M	M		L	L		L	L	L	L	H	H	
NOISE	NA	NA	NA	NA	L	L		NA	L/M	L/M	L/M	L/M	M/H	M	H	M	L/M	L/M	L		M/H	M/H		M	M/H	M/H	M/H	M	M	
RISK OF EXPLOSION	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	L	L/M	L	H	L/M	L/M	L	L		L	L		M/H	M	H	M	H	L	
PUBLIC HEALTH RISKS	NA	NA	NA	NA	NA			NA																						
PATHOGENS						L			L	L	L	L	L	L/M	M	L	M	H	NA		M	L		L	L	L	L	L/M	L	
VECTORS						L/M			L	L	L	L	L	L/M	M	L	M	H	M		M	L		L	L	L	L	M	L	
TOXICS						L			NA	NA	NA	L	L	L	M	L	M	M	M		L	L		M/H	M/H	M/H	M/H	M/H	M	
AESTHETICS	NA	NA	NA	NA	M	M		NA	L/M	L/M	L/M	L/M	M	M	H	M/H	M	M/H	L/M		M/H	M		M	M	M	M	M	M	
TRAFFIC	NA	NA	NA	NA		NA		NA	L/M	L/M	L/M	M	M	L/M	H	M	M	M	L/M		M/H	M/H		H	H	H	H	H	L/M	
OTHER																														

KEY: **

NA = NOT APPLICABLE
H = HIGH RATING
M = MEDIUM RATING
L = LOW RATING

* THIS EVALUATION ASSUMES THAT CERTAIN FAILURES OCCUR IN THE SITING PROCESS, DESIGN, MITIGATION MEASURES AND IN THE OPERATION & PERFORMANCE OF THE SELECTED TECHNOLOGY.

** A HIGH RATING INDICATES A HIGH LEVEL OF LOCAL ENVIRONMENTAL IMPACT
A LOW RATING INDICATES A LOW LEVEL OF ENVIRONMENTAL IMPACT

Table E-36

Environmental Concerns Evaluation

for Puget Sound WGA

VAAOPS25

DEGREE OF ENVIRONMENTAL CONCERN ASSOCIATED WITH IMPLEMENTATION & USE OF EACH METHOD

ENVIRONMENTAL FACTOR	REDUCTION						RECYCLING												HANDLING		DISPOSAL					
	EDUCATION	INCENTIVES	DISINCENTIVES	MODEL GOVERNMENTAL PROGRAMS	WASTE EXCHANGE	HOME YARD WASTE COMPOSTING	REUSE	CURBSIDE COLLECTION	MULTI-FAMILY HOUSING COLLECTION	COMMERCIAL SOURCE SEPARATION	INTERMEDIATE PROCESSING FACILITY	COMMERCIAL MIXED WASTE PROCESSING	DROP OFF / BUYBACK DEPOTS	MIXED WASTE PROCESSING	YARD WASTE COMPOSTING	MIXED WASTE COMPOSTING	FOOD WASTE COMPOSTING	SPECIAL WASTE PROCESSING	SPECIAL WASTE RECYCLING AND REUSE	TRANSFER	LONG HAUL TRANSPORT	ANAEROBIC DECOMPOSITION	PYROLYSIS / GASSIFICATION	REFUSE DERIVED FUEL PREP. & USE	MASS BURN INCINERATION	LANDFILL	ASHFILL
AIR QUALITY	NA	NA	NA	NA	NA	NA	NA				NA	NA	NA	NA	NA	NA	L	NA	NA	NA		L	L	L	M	L
CRITERIA POLLUTANTS: SO2, NOX, HCL																									L	
TOXICS																										
PARTICULATES																										
ODOR	NA	NA	NA	NA	NA	L	NA				L	L	L	L	L	M	M	NA	L/M	NA		L	L	L	M	NA
SURFACE WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA		NA	NA	L	NA	L	L	L	L	L	L	NA		L	L	L	L/M	L/M
GROUND WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA		NA	NA	L	NA	L	L	L	L	L	L	NA		L	L	L	L/M	L/M
NOISE	NA	NA	NA	NA			NA				L/M		L/M						L/M	L/M		L	L	L	L/M	L/M
RISK OF EXPLOSION	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	M/H	NA	M/H			NA			NA	M/H	M/H	M	L	L	NA
PUBLIC HEALTH RISKS	NA	NA	NA	NA	NA		NA						L												L	
PATHOGENS																										
VECTORS						M																				
TOXICS																										
AESTHETICS	NA	NA	NA	NA			NA													NA						
TRAFFIC	NA	NA	NA	NA		NA	NA	L	L	L	L/M	L/M	L/M	L/M	L/M	L/M	L/M	L	L/M	L		L/M	L/M	L/M	L/M	L
OTHER																										

KEY: •

NA = NOT APPLICABLE
H = HIGH RATING
M = MEDIUM RATING
L = LOW RATING

• A HIGH RATING INDICATES A HIGH LEVEL OF LOCAL ENVIRONMENTAL CONCERN
A LOW RATING INDICATES A LOW LEVEL OF ENVIRONMENTAL CONCERN

Table E-37

PUGET SOUND: RECOMMENDED ALTERNATIVE

(COST ESTIMATES ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICTIONS.)

	ESTIMATED NET (COST) OR REVENUE	CONTRIBUTION TO SYSTEM COST	ESTIMATED TONS	PERCENT OF GENERATED TONS	RELATIVE RATIO OF COSTS TO TONS
COLLECTION AND PROCESSING:					
1. COLLECTION OF SINGLE FAMILY SOURCE SEPARATED RECYCLABLES	$0	0.0%	0	0.0%	NA
2. COLLECTION OF SINGLE FAMILY COMINGLED RECYCLABLES *	($4,379,099)	1.9%	68,708	2.2%	0.86 :1.00
3. COLLECTION OF MULTI FAMILY COMINGLED RECYCLABLES *	($11,847,565)	5.2%	53,645	1.7%	2.99 :1.00
4. COMMERCIAL DIRECT RECYCLING	$0	0.0%	422,744	13.7%	0.00 :1.00
5. COLLECTION OF COMMERCIAL SOURCE SEPARATED RECYCLABLES	($2,526,542)	1.1%	60,562	2.0%	0.56 :1.00
6A. DROP OFF/BUY BACK "REGULAR" RECYCLABLES	$3,416,766	-1.5%	122,134	3.9%	-0.38 :1.00
6B. DROP OFF/BUY BACK OF "SPECIAL" RECYCLABLES OR WASTES	($1,344,305)	0.6%	100,201	3.2%	0.18 :1.00
7. YARD WASTE COLLECTION AND COMPOSTING	($26,260,265)	11.5%	294,374	9.5%	1.21 :1.00
8. SORTING OF TARGETED COMMERCIAL HIGH GRADE LOADS *	($81,954)	0.0%	7,399	0.2%	0.15 :1.00
9. SELF HAULED WASTE*	($14,448,665)	6.3%	296,542	9.6%	0.66 :1.00
10. REGULAR COLLECTION AND DISPOSAL OF MUNICIPAL WASTE *	($171,214,586)	74.9%	1,669,691	53.9%	1.39 :1.00
11. MIXED WASTE PROCESSING*	$0	0.0%	0	0.0%	NA
12. RDF PREPARATION*	$0	0.0%	0	0.0%	NA
SYSTEM TOTAL	($228,686,215)	100.0%	3,096,000	100%	1.00 :1.00
AVERAGE COST PER TON GENERATED	($74)				
DISPOSAL ONLY:					
A. MASS BURN WITH ASH MONOFILL	($36,828,369)	16.1%	654,512	21%	0.76 :1.00
B. LANDFILL WITH LONG HAUL BY RAIL	($31,631,218)	13.8%	654,512	21%	0.65 :1.00
C. LANDFILL WITH BALING	$0	0.0%	0	0%	NA
D. LANDFILL ONLY	($27,934,589)	12.2%	674,346	22%	NA
DISPOSAL TOTAL	($96,394,176)	42.2%	1,983,370	64%	0.66 :1.00
AVERAGE COST PER TON DISPOSED	($49)				
RECYCLED TONS			1,112,630	36%	

* The net costs for these methods include disposal costs for residual or disposed wastes.

- Disposal Program

  -- Landfill

(a) Reduction Program

Members of the working group felt strongly that overall solid waste education is of primary importance, and is the most effective method for accomplishing waste reduction objectives. Concern was expressed about the reliability of past approaches to education, which involved distribution of school curriculum materials that often were not used. It was agreed that education needs to be thought of in a broader context, employing promotion and other techniques to increase the general public's awareness of waste reduction and solid waste management activities.

Incentives were ranked second highest among reduction methods because they were thought to be more difficult to implement and modify. Incentives, as well as education, were rated very desirable in terms of waste stream impact and environmental impact, the most heavily weighted criteria.

Home composting was recognized as a cost-effective approach, although it was thought that few additional residents will be interested in composting their yard waste. For many situations, home composting would not be feasible. It was strongly felt that home composting should be encouraged but not mandated and that other options for managing yard waste should be provided.

Disincentives for waste reduction were rated very low and were not thought to be reliable or cost-effective in impacting the volume of waste.

(b) Recycling Program

Commercial source separation received the highest possible rating among recycling methods. The group believed that this method has been demonstrated as cost-effective in recovering a sizable portion of the waste stream.

As in the waste reduction program, education received a favorable ranking as a recycling program. It was noted that education will be beneficial when it is time to site disposal facilities. Incentives also ranked high among recycling methods.

Drop-off and buy-back operations were considered favorably under all criteria except that of waste stream impact. Centralized yard waste composting was considered a desirable method; many communities in the WGA are already progressing toward providing this service.

Reuse, single-family curbside collection, and multi-family collection were rated somewhat lower than the above methods because of lower anticipated waste stream impact and implementation difficulty. Curbside and multi-family collection were not thought to be compatible with some other methods; the group believed that switching to other methods once these were in place

would be difficult. Cost-effectiveness of multi-family and curbside collection were both considered good but not excellent. Reuse was believed to have little impact on reducing waste stream volumes, although it would likely receive high public acceptance.

Disincentives were not favored as a recycling method because of their perceived poor reliability and cost-effectiveness. Municipal solid waste composting and food waste composting were ranked very low because of concerns over environmental impacts, technical problems, and cost-effectiveness.

(c) Disposal Program

Long-haul disposal is currently being considered by a number of communities in the WGA. However, the working group rated it lower than other methods because they believed that long haul is only a short-term option, eventually, landfill or incineration methods will be required. Long haul was thought to have poor cost-effectiveness over the long term and low reliability especially if the disposal site were out of state.

Local landfills were favored over incineration and energy recovery methods because of greater compatibility with other waste management methods and the ability to modify methods. The group believed landfills will always be necessary, but that other alternatives to incineration exist. Incineration was believed to be less cost-effective than landfilling. However, siting of both landfills and incinerators within the WGA was recognized as a major impediment.

(2) Consultant Team Rankings

The waste management methods in each program--reduction, recycling, and disposal--were ranked by the consultant team, as shown in Table E-38 In the reduction program, the consultant team evaluated "special government programs" and "waste exchange," which were not ranked by the WGA working group. In addition, the consultant team ranked "commercial high-grade collection" and "mixed-waste processing" for the recycling program. "Special-waste recycling/reuse" was not ranked because it was assumed that special-waste management will be included in any recommended program.

Based on the criteria established for the consultant team's analysis, the consultant recommended the following solid waste management system for the Puget Sound WGA:

- Reduction Program

  -- Education
  -- Incentives
  -- Special governmental programs
  -- Disincentives
  -- Home composting
  -- Waste exchange

Table E-38

BEST MANAGEMENT PRACTICES FOR
SOLID WASTE METHODS RANKING SUMMARY

PUGET SOUND WGA

Reduction		Recycling		Disposal	
WGA Working Group Preference	Consultant Team Recommendations	WGA Working Group Preference	Consultant Team Recommendations	WGA Working Group Preference	Consultant Team Recommendations
1 Education	1. Education	1. Commercial Source Separated	1. Commercial Source Separated	1. Landfill	1. Landfill
2. Incentives	2. Incentives	2. Education	2. Education		1. Incineration
	2. Special Governmental Programs	3. Incentives	3. Single-Family Curb-side Collection		1. Long Haul
Home Yard Waste Composting	3. Disincentives	3. Drop-Off/Buy-Back Depots	3. Commercial High-Grade Collection	2. Incineration	
Disincentives	4. Home Yard Waste Composting		3. Drop-Off/Buy-Back Depots	3. Long Haul	
	5. Waste Exchange	4. Centralized Yard Waste Composting	4. Centralized Yard Waste Composting		
		5. Reuse	5. Incentives		
			5. Multi-Family Collection		
		6. Single-Family Curb-Collection	6. Reuse		
			6. Mixed Waste Processing		
		7. Multi-Family Collection	7. MSW Composting		
		8. Disincentives	8. Food Waste Processing		
		9. MSW Composting			
		9. Food Waste Processing			

- Recycling Program

  -- Commercial source-separated collection
  -- Education
  -- Single-family curbside collection
  -- Commercial high-grade collection
  -- Drop-off/buy-back depots
  -- Yard waste composting
  -- Incentives
  -- Multi-family collection

- Disposal Program

  -- Landfill
  -- Incineration/energy recovery
  -- Long haul

(a) Reduction Program

The consultant team found little justification for different waste reduction programs for different WGA's throughout the State. Based on the criteria established, the recommendations are the same Statewide and are discussed below. Education is considered to be reasonably cost-effective with excellent long-term environmental benefits considering its effect on all other management methods. The focus of education/public involvement programs is to inform and change society's view of solid waste and its management. A balance of incentives and disincentives will be necessary components of a waste reduction program. The cost-effectiveness of these methods is considered to be fair; however, their application will produce considerable environmental benefit. They are not expected to have a significant impact upon the volume of waste but can affect the composition of the waste stream significantly.

Special governmental programs are considered to be a good way to demonstrate waste reduction methods and to assist business and industry in reducing waste reduction and increasing recycling.

Home yard waste composting is a cost-effective, low-risk method for significantly reducing the waste stream. Participation by the public sufficient to measurably reduce waste will require local government to vigorously "market" the program, a worthwhile effort considering the significant amount of yard waste in the overall waste stream.

Industrial waste exchanges have been effective for some time. There is now potential for applying this concept to household hazardous wastes as well.

It is recommended that the waste reduction program be developed in the priority order listed above, and that investment of resources be made in those methods and techniques which will provide the greatest return.

(b) Recycling Program

A substantial amount of the region's existing recycling results from source separation and direct recycling in the commercial waste substream. This method was identified as a key to increased recovery of materials from the commercial and manufacturing waste substreams, which account for more than 30% of the current waste volume. Source separation with direct recycling generally costs less and has less environmental impact than other recycling methods. Low-to-moderate concerns over exposure to loss from this method relate to market and vendor stability. Sizable volumes of cardboard, high-grade office paper, ferrous metals, mixed waste paper, wood waste, plastic, and food wastes in the commercial waste stream could be managed through increased efforts at source-separated recycling.

Education is ranked second among recycling methods for the Puget Sound WGA. Because of the area's large and diverse population (about 60% of the State's entire population) major attention must be devoted to informing residents and businesses on recycling issues. The effectiveness of other methods depends greatly on the quality of education and promotion efforts. The feasibility and environmental impact of education were both deemed excellent. Concerns relate to its uncertain cost-effectiveness and impact in reducing waste volumes. These concerns can be addressed through careful program design and evaluation.

The next three recycling methods received equal ranking from the consultant team: single-family curbside collection, commercial high-grade collection, and drop-off/buy-back depots. Commercial high-grade collection was ranked high for the same reasons as commercial source separation; however, the high-grade method is expected to have less impact on the waste stream since it may not be feasible where material volumes are too low to justify a processing facility.

Single-family curbside collection and drop-off/buy-back depots together are currently the primary methods for collecting recyclable materials from the residential waste stream. Residential waste accounts for over 50% of the disposed material in the Puget Sound WGA. Both methods are recommended for urbanized areas, where population densities can support effective programs.

Drop-off/buy-back operations are considered more effective for rural areas and self-haul waste collection (which supplies nearly 20% of the WGA waste volume). Drop-off/buy-back depots will cost less than curbside collection, yet concern was expressed regarding their potential environmental impacts. These impacts can be mitigated through proper facility design.

Yard waste accounts for over 20% of the residential waste substream and more than 30% of the self-haul substream in the Puget Sound WGA. Centralized yard waste collection and composting was determined to have excellent feasibility and volumetric impact potential. Cost-effectiveness and environmental impact were identified as good. This method is particularly recommended for urban areas. The consultants believe that provisions for recovering yard waste at self-haul disposal locations should also be developed.

Multi-family collection and incentives were ranked as equal. Multi-family collection is important in the WGA, since about 30% of all dwelling units are multi-family (this percentage is much higher in some communities). However, the cost of providing multi-family collection can be high if participation is low; this causes some exposure to loss. Only moderate volumetric impacts are anticipated, although the relative impact would be greater in urban areas. Incentives may be difficult and costly to implement, depending on the specific techniques chosen. However, this method has low environmental impact and can be very effective in reducing waste volumes.

Disincentives were rated lower than incentives because they are more difficult to implement and maintain. Their cost-effectiveness was rated as only fair because of their uncertain ability to effect long-term behavior changes.

Reuse and mixed waste processing received rankings comparable to disincentives. Reuse has only a minor impact on waste volumes. Though environmental impacts of the method are very good, its cost-effectiveness and feasibility are only moderate. Mixed-waste processing may have only fair-to-good cost-effectiveness; in some situations, however, this method significantly reduces the value of recovered materials. Mixed-waste processing could be implemented within the Puget Sound WGA, although potential siting difficulties and lack of national experience with this technology create some exposure to loss. Environmental impacts of the method are considered moderate.

The feasibility of municipal solid waste composting was rated poor by the consultant team because of exposure to loss associated with siting, markets, vendors, and technology considerations. Its cost-effectiveness and environmental impact were both ranked fair; however, it has good potential for reducing disposed waste volumes.

Food waste processing was ranked lowest among the recycling methods. Its cost-effectiveness and feasibility were both considered poor, while its environmental impact was rated fair. On the other hand, food waste accounts for approximately 10% of the total waste stream in this WGA; therefore, the volumetric impact of food waste processing could be noticeable.

(c) Disposal Program

The consultant's evaluation of disposal methods resulted in equal rankings, with each method ranking higher than either of the other two on at least one criterion. For cost-effectiveness, the local landfill method was rated highest, followed by long-haul landfilling, and incineration with ash-fill.

Each of the disposal methods can be designed and operated to minimize and mitigate environmental impacts. With landfills, environmental concerns focus on toxic air emissions, odor, ground water quality, risk of explosion, traffic and, to a lesser degree, on surface water quality, noise, aesthetics, and public health risks. The environmental impacts for landfilling outside of the WGA were considered to be the same as those of local landfills (moderated by possible climatic differences), with the added impacts of

long-haul transport. Mass burn incineration raised environmental concerns over particulates, noise, public health, toxics and, to a lesser extent, criteria air pollutants, odor, risk of explosion, and aesthetics. In the consultant's ranking, environmental impacts of mass burn incineration were considered to be slightly less than those of either landfill method.

In terms of feasibility, long-haul landfilling was rated "good"; local landfilling was rated "fair"; and mass burn incineration was rated "poor." Exposure to loss from siting efforts was considered high for both local landfills and incinerators. Difficulties with ash disposal and financing caused incineration to be ranked lower than local landfilling in terms of feasibility. The potential for difficulties with out-of-jurisdiction landfill regulations caused some concern with long-haul landfilling.

Incineration received a good rating under the criterion of reduction in volumes of waste landfilled, while both landfill options were rated poor. Most rural areas within the WGA will likely best be served by a local landfill. Urban areas are likely to be best served by a variety of disposal methods including local landfill, long-haul landfill and incineration. The disposal decision of each community requires a case-by-case analysis.

Objectives for each category of solid waste appear in Table E-39. These objectives depict the amount of each category which could reasonably be handled by each method. The objectives are based on the results of the WGA-recommended model and on the current levels of recycling in each WGA.

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Table E-39

Waste Stream Category Objectives By Method for Puget Sound WGA

% OF WASTE STREAM CATEGORY MANAGED BY METHOD

WASTE STREAM CATEGORY	METHOD/ TECHNIQUE: RECYCLING											DISPOSAL						TOTAL (%)
	REUSE	SINGLE FAMILY CURBSIDE COLLECTION	MULTI-FAMILY HOUSING COLLECTION	COMMERCIAL SOURCE SEPARATION	COMMERCIAL HIGH GRADE	COMMERCIAL DIRECT	DROP OFF / BUYBACK DEPOTS	MIXED WASTE PROCESSING	YARD WASTE COMPOSTING	MIXED WASTE COMPOSTING	FOOD WASTE PROCESSING	SUBTOTAL RECYCLING	ANAEROBIC DECOMPOSITION	PYROLYSIS / GASSIFICATION	REFUSE DERIVED FUEL PREP. & USE	MASS BURN INCINERATION / ASHFILL	LANDFILL	LONG HAUL	SUBTOTAL DISPOSAL	
NEWSPAPER		11	8			39						58				14	14	14	42	100
CORRUGATED CARDBOARD		2	2	12	2	43	5					66				11	12	11	34	100
HIGH GRADE PAPER				27	22	10						59				14	15	14	41	100
MIXED SCRAP PAPER (RECYCLABLE)		7	5		2							14				28	29	28	86	100
REFILLABLE GLASS CONTAINERS		5	4	8			53					70				10	10	10	30	100
GLASS		6	4	5			10					25				25	25	25	75	100
ALUMINUM		5	4				25					34				22	22	22	66	100
TIN PLATED FOOD & BEVERAGE CANS		5	4				2					11				29	30	30	89	100
FERROUS METAL						72	4					76				8	8	8	24	100
NON-FERROUS METAL						80	4					84				5	6	5	16	100
WHITE GOODS							71					71				10	11	10	29	100
PET PLASTICS																33	34	33	100	100
HDPE PLASTICS																33	34	33	100	100
PLASTIC PACKAGING (LDPE)																33	34	33	100	100
EXPANDED POLYSTYRENE																33	34	33	100	100
OTHER PLASTICS																33	34	33	100	100
TIRES							27					27				24	25	24	73	100
OTHER RUBBER PRODUCTS																33	34	33	100	100
FOOD																33	34	33	100	100
LAWN AND GARDEN WASTE								75				75				8	9	8	25	100
WOOD																33	34	33	100	100
DISPOSABLE DIAPERS																33	34	33	100	100
OIL							93					93				2	3	2	7	100
BATTERIES							82					82				6	6	6	18	100
OTHER HOUSEHOLD HAZARDOUS																33	34	33	100	100
CONSTRUCTION DEBRIS (NOT WOOD)																33	34	33	100	100
OTHER ORGANIC																33	34	33	100	100
OTHER INORGANIC																33	34	33	100	100

6. SOUTHWEST WGA

a. Introduction to Southwest WGA

(1) Location

The Southwest Waste Generation Area (Southwest WGA) is represented by the five counties in the southwest area of the State of Washington, west of the Cascade mountain range. The total area of the Southwest WGA is 6,108 square miles.

The following counties are included in the Southwest WGA:

- Clark
- Cowlitz
- Lewis
- Skamania
- Wahkiakum

(2) Population

The estimated 1987 population of the Southwest WGA was 357,600 persons. Of this, 36% resided in the 24 incorporated towns and cities of the area. The Washington State Office of Financial Management predicts a 9% growth in population by 1995, to 389,800 for the area. According to 1980 Census figures, 36% of the population lived in rural areas (defined as outside of urbanized areas or outside Census-designated places of 2,500 or more inhabitants).

In 1987, there were 147,580 housing units in the Southwest WGA (April 1 estimate). Seventy-two percent (72%) of these units were single-family dwellings. This total represents an increase of 14,970 housing units since 1980 (11% growth).

(3) Economy

The Washington State Department of Employment Security estimated December 1987 employment in the Southwest WGA to be 116,500 persons. The number of "employer units" (i.e., separate business locations) was put at 8,630. In 1986, slightly more than one-fourth of the employed people (26%) in the area worked in manufacturing; much of this employment was in the lumber, wood products, and electronics industries. Other major employment sectors were retail (19%), government (19%), and services (18%).

b. Existing Solid-Waste Management Methods

(1) Solid-Waste Reduction and Recycling

There are approximately 17 recycling centers in the Southwest WGA (this figure excludes beverage distributors handling refillable bottles, as

well as battery and tire distributors). In 1987, these centers handled 98,300 tons of materials, representing 26.3% of the estimated total tonnage of solid waste generated. The following sections summarize the reduction and recycling programs in each of the counties in the Southwest WGA.

(a) Clark County

Clark County offers various recycling programs, such as the County Yard Debris program, educational brochures and workshops, and a published directory of recycling outlets. The County Advisory Committee will recommend that curbside collection be considered by several municipalities--Battle Ground, Camas, Vancouver, and Washougal--as well as the unincorporated urban areas of the County. The County will have spent between $60,000 and $70,000 in 1988 on recycling programs.

Clark County currently operates a yard debris collection program. In 1987, a County drop-off site will be open one day a month for eight months to receive yard and garden waste.

A multi-materials drop-off center will open in La Center some time in 1989, and the Evergreen School District will begin recycling all of its dry-mixed waste.

In January, the County will operate a Christmas tree drop-off location for one day.

Currently, there is no curbside collection of recyclables in Clark County, but a pilot program is in the planning stages for possibly spring or summer of 1989.

The two companies receiving the recyclables are Grimm's Fuels in Sherwood, Oregon, and Independent Paper Stuff in Washington.

(b) Cowlitz County

The County offers only voluntary recycling at landfills; recyclables are not purchased. The majority of recycling services in the County are provided by one private company, Waste Control Recycling. Curbside collection of recyclables is not offered.

(c) Lewis County

Within the next year, Lewis County plans to begin public education, school programs, and promotional activities about recycling. Currently, the County owns drop boxes for recyclables, which a private contractor operates at the nine County solid-waste drop box sites. The County plans to build storage for the recyclables soon and City Sanitary will be collecting glass, aluminum, and newspaper. With the exception of the City of Morton, curbside collection of recyclables and yard and garden waste is not offered in Lewis County; however, six County maintenance shops are available to the public for burning yard and garden waste.

(d) Skamania County

Currently, Skamania County operates a staffed facility for comingled recyclables at the Stevenson Transfer Station. The County also encourages individuals to separate recyclables, but it currently does not buy the materials from the public.

(e) Wahkiakum County

The recycling activities in Wahkiakum County are conducted mainly by civic groups, with little County involvement.

(2) Solid-Waste Collection

In the Southwest WGA, there are eight haulers collecting municipal solid waste under U.T.C. certificates (franchises). Five cities operate their own solid waste collection services. These cities are Camas, Longview, Kelso, Rainier, and Morton. All other collection in this WGA is conducted through a contractual agreement between city and hauler. Table E-40 summarizes this information.

The operators hauled an estimated 198,000 tons of waste in 1987, 48% of which was from the commercial sector, and 52% from residences. Including self-haul tonnages, the total disposed waste for 1987 was estimated to be 253,000 tons.

It is reported that there are rural self-haul drop boxes in Cowlitz, Lewis, and Wahkiakum Counties (depending on the definition used for "drop box," the number may vary; there appear to be different interpretations of the terms "drop box" and "transfer station"). Table E-41 describes them in greater detail.

(3) Solid-Waste Disposal

There are six operating landfills accepting municipal waste in the Southwest WGA; all are open to the public. Two accept only demolition waste; one does not accept highly putrescible waste, that is, waste subject to wet rotting. Table E-42 presents more detailed information on landfills and transfer stations. The estimated remaining capacities of these landfills range from five to sixty years (some information was unavailable); Table E-43 summarizes this information.

Based on 1987 quantities of waste disposed, rough estimates were generated for the tonnage of waste that could be accommodated by present landfills in the Southwest WGA. Calculations were based only on information from landfills accepting municipal waste, except for those on military bases and Indian reservations. The tons of waste disposed at each landfill in 1987 were multiplied by the reported years of remaining life. Remaining life was defined as:

1) The number of years between 1987 and a closure data mandated by permit; or

Table E-40
WASHINGTON DEPARTMENT OF ECOLOGY
Recycling and Waste Stream Survey-1987
SOUTHWEST WASTE GENERATION AREA
HAULERS

NAME	PUBLIC/ PRIVATE	FRANCHISES	AREA SERVED	DESTINATION/COUNTY
City of Camas	Public		City of Camas	R&R T.S./Clark
Vancouver San. Svc.	Private	F	Clark Co.	Leichner L.F./Clark
Twin City Sanitary	Private	F	Clark Co.	Leichner L.F./Clark
Buchman Sanitary	Private	F	Clark Co.	Leichner L.F./Clark
Ted's Sanitary	Private	F	Clark Co. Cowlitz Co.	Central L.F./Cowlitz Circle "C" L.F./Clark
Evergreen Waste Syst.	Private		Washougal	Marion Co./Oregon
Skamania Co. San. Svc.	Private	F	Skamania Co.	Stevenson T.S./Skamania
City of Longview	Public		City of Longview	Cowlitz Co. L.F./Cowlitz
City of Kelso	Public		City of Kelso	Cowlitz Co. L.F./Cowlitz
Stan's San. Svc.	Private	F	Cowlitz Co.	Cowlitz Co. L.F./Cowlitz
Stanley San. Svc.	Private	F	Wahkiakum Co.	Cowlitz Co. L.F./Cowlitz
City of Rainier	Public		City of Rainier	Centralia L.F./Lewis
Hub City	Private		Thurston Co.	Centralia L.F./Lewis
Clevenger San.	Private		Lewis Co.	Centralia L.F./Lewis
City of Morton	Public		City of Morton	Morton T.S./Lewis
City Sanitary Co.	Private	F	Thurston Co. & Lewis Co.	Centralia L.F./Lewis

TABLE E-41
WASHINGTON DEPARTMENT OF ECOLOGY
Recycling and Waste Stream Survey-1987
SOUTHWEST WASTE GENERATION AREA
RURAL DROP BOXES

COUNTY	LOCATION	SIZE	TYPE	OTHER
Cowlitz	Toutle	40 CY	Roll-Off	2 boxes on site
Lewis	Ethel	40 CY	2 Non-compactor Roll-aways	
	Maskill	40 CY	2 Non-compactor Roll-aways	
	Mineral	40 CY	2 Non-compactor Roll-aways	
	Mossy Rock	40 CY	2 Non-compactor Roll-aways	
	Onalaska	40 CY	2 Non-compactor Roll-aways	
	Packwood	40 CY	2 Non-compactor Roll-aways	
	Randle	40 CY	2 Non-compactor Roll-aways	
	Toledo	40 CY	2 Non-compactor Roll-aways	
	Winlock	40 CY	2 Non-compactor Roll-aways	
Wahkiakum	Summit KM Mountain	30-40 CY	Compactor	2-40 CY boxes, and 1-30 CY

2) if no mandated closure date is specified, the number of years between 1987 and an estimated closure date (due to exhaustion of site capacity, landfill noncompliance, or business closure); or

3) the smaller of the two figures, if both exist.

Using this method, it was estimated that the Southwest WGA had sufficient landfill capacity at the end of 1987 to accommodate approximately 2,989,000 additional tons of solid waste. Care should be taken when interpreting this figure, since a WGA total estimate may not reflect situations facing individual jurisdictions. Landfills which did not report sufficient information to calculate tonnage capacity are not represented in the above estimate (refer to Tables E-42 and E-43).

(4) Solid-Waste Management Planning

Clark County--amended its current plan in July of 1988. Anticipate plan update by June of 1989.

Cowlitz County--planning on reviewing the possibilities of incineration, and updating its current plan in 1989.

Lewis County--currently updating its plan; draft due in late 1988.

Skamania County--no changes to its Solid Waste Plan.

Wahkiakum--recently updated its plan; intend to maintain the status quo.

c. Market Capacity

Markets for secondary materials from the Southwest WGA are generally good given proximity to major end-use and export markets in either Portland or the Puget Sound region. Transportation routes serving major population centers provide good access to markets. Because of different transportation rate regulations, shipping to Oregon is often cheaper than shipping in-state. Thus, most paper, glass and metals from the WGA are sent to Oregon.

Markets are stable and adequate for aluminum cans, ferrous and non-ferrous metals, glass, newspaper, corrugated containers, and high-grade paper. Tin cans must be sent to Seattle for processing and freight assistance is available to reduce costs. The potential markets for mixed waste paper are better than in many other areas of the state because of access to export markets from Columbia River ports. White goods can be recovered, at cost, because of the proximity to shredders in Portland and mobile crushers operating in the area. The WGA has a relatively high current recovery of plastics (mostly HDPE) because of a processor operating in the Vancouver area. PET plastic is currently shipped from Oregon to end users in the Eastern U.S., who also could provide markets for some Southwest WGA material. Local plastics markets are not yet developed but could be available in the near future. Centralized yard

Table E-42
WASHINGTON DEPARTMENT OF ECOLOGY
Recycling and Waste Stream Survey-1987
SOUTHWEST WASTE GENERATION AREA
DISPOSAL FACILITIES

COUNTY	FACILITY	NAME	ACCESS	1987 TONS RECEIVED	REMAINING CAPACITY*	DESTINATION	1987 TIPPING FEES
Clark	Landfills:	Circle "C" (Restricted)	Public	19,500	60 Years; 30 Acres		$2.75-$15.00/LCY
		Dietrich	Public	21,300	5 Years; 7 Acres		$3.50/LCY - Demolition
		Leichner's	Public	94,600	3 Years; 1 mill. CY		$6.60/CCY
	Transfer Stations:	English Pit	Public	9,500		Oregon	$4.55 LCY or $12.30 CCY
		R & R	Public	9,400		Klickitat, OR	$36.00/Ton, $5.00 LCY or $12.50 CCY
Cowlitz	Landfills:	Central	Public	64,600	16 Years; 4 mill. CY		$16.00/Ton
		Redakovich	Public	Not Avail.	Not Avail.		Not Avail. -Demolition
Lewis	Landfills:	Centralia	Public	45,000	20 Years; 15 Acres		$15.00/Ton, $4.50/LCY or $7.50/CCY
	Transfer Stations:	Morton	Public	2,200		Centralia L.F.	$16.50/CCY
Skamania	Transfer Stations:	Mt. Pleasant	Public	500		Oregon	$3.40-$7.00/CY
		Stevenson	Public	1,600		Oregon	$3.40/CY
		Underwood	Public	200		Oregon	$3.40/CY

COUNTY	FACILITY NAME	ACCESS	1987 TONS RECEIVED	REMAINING CAPACITY*	DESTINATION	1987 TIPPING FEES

Wahkiakum - HAS NO FACILITIES FOR SOLID WASTE - JUST DROP BOXES

CY = Cubic Yard
CCY= Compacted Cubic Yard
LCY= Loose Cubic Yard

*Based on space available at the end of 1987, regardless of mandated or planned closure dates.

TABLE E-43
WASHINGTON DEPARTMENT OF ECOLOGY
Recycling and Waste Stream Survey-1987
SOUTHWEST WASTE GENERATION AREA
LANDFILL CAPACITIES

COUNTY	FACILITY NAME	MANDATED CLOSURE (Date/None)	REMAINING CAPACITY* (Years/CY/Acres)	COMMENTS (#)
Clark	Circle "C"	None	60 Years; 30 Acres	1
	Dietrich	None	5 Years; 7 Acres	
	Leichner's	12/91	3 Years; 1 million CY	2
Cowlitz	Central	None	16 Years; 4 million CY	
	Redakovich	Not Avail.	Not Avail.	
Lewis	Centralia	11/91	20 Years; 15 Acres	3

COMMENTS

1. Needs updating to meet State requirements.
2. Capacity figures were as of 3/88.
3. Expansion plans underway--15 Acres still undeveloped. Also, on Superfund list. Approach depends on whether or not it is declared a Superfund site.

*Based on space available at the end of 1987, regardless of mandated or planned closure dates.

waste processing occurs in the WGA, but not on a large scale. Some communities may develop additional processing and composting facilities to serve local areas in the future.

A market capacity summary for the Southwest WGA is presented in Table E-44.

d. Evaluation of Methods

(1) Feasibility Analysis

Notable exceptions to the Statewide technical feasibility review for the Southwest WGA include:

- Education, Incentives, and Disincentives. Technology program exposure was viewed to be higher than for the Statewide assessment. The concern with these methods was that they might not reduce the waste stream and that funding for them would be a low priority. Uncontrollable circumstances were rated moderate for these and other methods because the legislature could make changes to affect the implementation and funding of the methods.

- Home Yard Waste Composting. In the experience of the group members (several of whom were public health officials), backyard composting has been a significant health concern in many areas of the Southwest WGA. Often compost piles become open dumps. Inappropriate materials are often placed in the piles, which frequently are not managed properly. Therefore, exposure to loss was viewed as being higher here than Statewide for waste supply (composition), technology/program and residue disposal.

- Reuse. The waste supply composition exposure was viewed as higher than the Statewide rating given that items dropped off for non-profit organizations frequently are contaminated with garbage or unusable materials.

- Curbside and Multi-Family Collection. The group saw some risk with implementation of these methods in that people might not use the service. It was assumed that the selection of materials for implementation would be based on available markets, and thus there would be less exposure associated with markets. The higher than Statewide financing exposure was based on a perception that programs always have to be subsidized and that funding may not continue to be available. Market price risk is also reflected in the financing exposure category rather than in the market category (net program cost increases with low market prices).

Table E-44

Market Capacity Summary for Southwest WGA

	COMMODITY	MAJOR END USERS FOR MATERIAL FROM WGA (Name &/or Location)	ESTIMATED END USER PRICE '88 ($/Ton)	VOLUME OF WGA MATRL. RECOVERED (1987 Tons)	(1) WGA COLLECTED MATERIAL PRICE ($/Ton)	(1) WGA COLLECTED MATERIAL VALUE ($/Year)	(2) WGA MARKET CAPACITY	FACTORS AFFECTING WGA MARKET FOR MATERIAL
1	Newsprint	Smurfit - Oregon CCA - Tacoma some Export & Insul. mngftr.	$45.00	7,500	$15	$112,500	ADEQUATE	Instate tariff - $.12/ton/mile Ready access to Oregon markets
2	Corrugated Containers	OR - G.P./Wil Ind. & Whyhsr - CCA, Tacoma Export	$65.00	7,000	$39	$273,000	ADEQUATE	Instate tariff - $.12/ton/mile Ready access to Oregon markets
3	High Grade Paper	Weyerhauser - OR Midwest & Export	$100.00	2,100	$43	$90,300	ADEQUATE	Ready access to Oregon markets
4	Mixed Waste Paper	Export through Portland/Seattle	$25.00	3,500	($3)	($10,500)	POTENTIAL MARKET	Instate tariff - $.12/ton/mile Very price sensitive
5	Container Glass	Owens-Brockway, Portland	$40.00	1,200	$19	$22,800	ADEQUATE	Ready access to Oregon markets Freight assistance reduces cost
6	Refillable Glass	Rainier Brewing - Sea. Pabst/Olympia some Soft Drink	$116.00	1,000	$39	$39,000	ADEQUATE	
7	Aluminum Bev. Cont.	Various Alum. Co. Ship from Longview & Portland	$1,000.00	600	$849	$509,400	ADEQUATE	Instate tariff - $.13/ton/mile some handled through Portland
8	Tin Cans	MRI - Seattle	$49.00	100	$21	$2,100	ADEQUATE	Instate tariff - $.13/ton/mile Freight assistance reduces cost
9	Ferrous Metals	Cascade/Oregon Steel some to Sea., Tac. & Export	$65.00	62,400	$47	$2,932,800	ADEQUATE	Ready access to Oregon markets
10	White Goods	Schnitzer - Portland General Metals - Tacoma	$20.00	100	($3)	($300)	POTENTIAL DISP. AVOID.	Ready access to Oregon markets Mobile loggers help reduce cost
11	Non Ferrous Metals	Various - Tacoma/Seattle Various - Portland	$800	1,500	$647	$970,500	ADEQUATE	Ready access to Oregon markets
12	PET Bottles	Midwest & East U.S.	$160	0	$54	$0	POTENTIAL MARKET	Ready access to Oregon markets Potential future market
13	HDPE Bottles	Export - Portland/Puget Partek - Vancouver	$200	1,700	$94	$159,800	POTENTIAL MARKET	Potential future market Some collection and processing is currently being done
14	Plastic Films (LDPE)	Export - Puget Sound	$160	0	$57	$0	POTENTIAL MARKET	Ready access to Oregon markets Potential future market
15	Lawn & Garden Waste	Skamania Co.	($20)	100	($30)	($3,000)	POTENTIAL MARKET	Limited amount is being done Potential future market

(1) WGA prices and values are before transportation, processing and handling necessary to prepare and move material to market.

(2) WGA market capacity is based on an assessment of the markets' ability to consume consistently and gradually increasing volumes.

REFER TO TEXT FOR DETAILED DISCUSSION

- Commercial Source Separation. Financing-related exposure to loss was judged to be higher than the Statewide rating. The group felt that changes in market prices could affect continued operation of some private sector programs and that each business involved could have particular requirements that might impede the development and implementation of a comprehensive program.

- Intermediate Processing Center Commercial Mixed Waste Processing. Experience has shown the group that any solid waste facility will be very difficult to site and that the siting process will be time consuming and costly. Therefore, the group rated siting-related exposure to loss to be greater than the Statewide rating.

- Drop-Off/Buy-Back. Vendor and waste supply exposure was judged to be higher than Statewide ratings. Local experience has been that buy-back operations may not be profitable when prices are low, e.g., no cardboard is delivered and the buyback closes down. The group regarded this concern as a moderate risk associated with dependence on these methods to recover material from the waste stream.

- Mixed Waste/Yard Waste/Food Waste Process/Compost. Experience has shown that siting any solid waste facility is very difficult, time consuming and costly. These methods all involve potential for NIMBY reaction and may be unfamiliar to the public and government regulators. Construction of a centralized yard waste composting operation, assuming markets for the compost product, was regarded as very risky. (This was the highest exposure associated with this method, although the ability to construct and finance were also of concern since no large scale yard waste compost operation had yet been developed in the WGA.) The group agreed that a qualified vendor could easily design and construct a facility for mixed waste processing and that the major risk of the technology was in actually operating a plant.

  Food waste processing was not viewed as a widely practiced method; therefore, the risks of finding a qualified vendor to construct a plant were thought to be higher than for the other processing methods. Type of disposal required for residuals from food waste processing remains unknown, but the group anticipated some difficulty in disposing of any unusual waste. Financing and uncontrollable circumstances (legislation) which may affect funding or regulations where thought to be higher risks for methods without a proven track

record in the area. A high exposure rating for uncontrollable circumstances with mixed waste processing is likely given concern about problem wastes (e.g., solvents, explosives) which have damaged RDF plants in the past. In summary, several areas of compost implementation were viewed as entailing higher exposure to loss than the Statewide mean.

- Special Waste. The group perceived special waste handling methods entail higher exposure to loss given the potential liability and hazards associated with these materials.

- Transfer. Financing, technology and waste supply exposure to loss were rated higher than the Statewide rating. The group was particularly concerned with rural county-run drop box sites which some counties now wish to abandon. These sites have been extremely expensive ($90,000 in one instance) because of Minimal Functional Standard requirements and the need for water and electricity at each remote site. The facilities often have been underused and difficult to maintain. Experience with larger transfer stations has been better.

- Long Haul. The group viewed financing and permits exposure to be higher than the Statewide rating. The Southwest WGA is experienced in arranging long haul of waste. The group saw the major risks in obtaining permits, assuring long-term waste management, and obtaining financing.

- Anaerobic Decomposition/Pyrolysis/RDF. These methods were viewed as new and unproven and, therefore, more risky. The ranking provided by the WGA were different for two factors than the Statewide rating: Pyrolysis - ability to construct was given a high risk rating, and ability to operate and maintain was given a moderate-to-high risk rating. The exposure to loss for waste quantity for an RDF plant was considered low because all waste could go there. More exposure was associated with the ability to meet market demand for the RDF produced (i.e., volume is limited on the output side rather than on the input side). Disposal of residue from RDF users was thought to be a moderate-to-high risk because of potential ash regulations. Financing an anaerobic decomposition facility was thought to be difficult.

- Mass Burn Incineration. Ratings for vendor, technology, and financing exposures were assigned lower risk levels than the Statewide ratings because the group considered mass burn a method for which there are many sophisticated full-service providers. Experience in evaluating

regional mass burn options is available in the WGA. Judging from experience, the method's greatest potential exposures to loss are expected in facility siting and ash disposal.

The exposure to loss feasibility evaluation for the Southwest WGA is presented in Table E-45.

(2) Environmental Evaluation

(a) Impacts

Environmental impacts in the Southwest WGA do not differ substantially from those in the State as a whole, except that the high level of precipitation does require the special precautions be taken to control leachate and prevent surface or ground water contamination from all of the composting alternatives, landfills, and ashfills. These factors are reflected in the environmental impacts matrix (Figure E-46).

An evaluation of potential environmental impacts due to failures in the technology are presented in Table E-47.

(b) Concerns

The Southwest WGA working group expressed a much higher level of concern about most of the management methods than did any other WGA, as can be seen in Table E-48, to those of the WGA's. These higher ratings reflect the group's emphasis on a careful assessment of environmental factors for any proposed facility. The group also expressed a high level of concern about the risks to public health of mass burn facilities. Of particular concern were the off-site impacts of air emissions (dioxins, heavy metals) and the threats to health of occupational exposure on-site. The group wanted to be certain that methods chosen would not encourage breeding of rats, would provide adequate protection of workers from medical waste, asbestos, and PCB's, and that adequate air pollution control devices would be required. The group's primary message was that safeguards to human health and the environment be designed into the facility. The group expressed a high level of concern about the traffic associated with both yard waste processing, and transfer stations, which they interpreted to be remote drop boxes. This concern was based on the assumption that most of the waste would be moved by self haulers making many trips with small loads to compost sites or transfer stations, rather than by large collection trucks making fewer trips.

(3) Economic Evaluation of Alternatives

The results of the economic analysis for the Southwest WGA are summarized in Table E-49. Additional details on the results of the economic analysis are contained in Appendix C.

Table E-45

Evaluation of Exposure to Loss for Southwest WGA

VAA0SW28

DEGREE OF EXPOSURE TO LOSS ASSOCIATED WITH IMPLEMENTATION & USE OF EACH METHOD

TECHNICAL IMPLEMENTATION FACTOR			REDUCTION						RECYCLING												HANDLING		DISPOSAL					
			EDUCATION	INCENTIVES	DISINCENTIVES	MODEL GOVERNMENTAL PROGRAMS	WASTE EXCHANGE	HOME YARD WASTE COMPOSTING	REUSE	CURBSIDE COLLECTION	MULTI-FAMILY HOUSING COLLECTION	COMMERCIAL SOURCE SEPARATION	INTERMEDIATE PROCESSING FACILITY	COMMERCIAL MIXED WASTE PROCESSING	DROP OFF / BUYBACK DEPOTS	MIXED WASTE PROCESSING	YARD WASTE COMPOSTING	MIXED WASTE COMPOSTING	FOOD WASTE PROCESSING	SPECIAL WASTE RECYCLING AND REUSE	TRANSFER	LONG HAUL TRANSPORT	ANAEROBIC DECOMPOSITION	PYROLYSIS / GASSIFICATION	REFUSE DERIVED FUEL PREP. & USE	MASS BURN INCINERATION	LANDFILL	ASHFILL
SITING	SITING RESISTANCE	GENERAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	L/M	L	M/H	L	M/H	M	M/H	M/H	NA	M/H	M/H	H	H	H	H
		WGA SPECIFIC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	M	H	L	H	L	H	M	H	M/H	NA	H	M	H	H	H	H
	PERMITS AQUISITION DIFFICULTY	GENERAL	NA	NA	NA	NA	NA	NA	L	L	L	L	L	L/M	L	M	L	M/H	M	L/M	M	M	M/H	M/H	H	H	H	H
		WGA SPECIFIC	NA	NA	NA	NA	NA	NA	L	L	L	L	L	L	L	M	M	M	M	M/H	M	H	H	M/H	H	H	H	H
	TIME & COST REQUIRED TO COMPLETE SITING	GENERAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	L/M	L	L	L	M/H	M	M/H	M/H	NA	M/H	M/H	H	H	H	H
		WGA SPECIFIC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	M/H	M/H	L	M	M	M/H	M	H	M/H	NA	H	M	H	H	H	H
WASTE SUPPLY	QUANTITY	GENERAL	NA	NA	NA	NA	L	NA	L	M	M	L	L/M	L	L	L	L	L	M/H	L/M	L/M	L/M	L/M	M	M	M	L	L
		WGA SPECIFIC	NA	NA	NA	NA	L	NA	L	M/H	M	L	L	L	M	L	L	L	H	M	H	L	L	M	L	M	L	L/M
	COMPOSITION	GENERAL	NA	NA	NA	NA	L	L	L/M	L/M	L/M	L	L/M	L	M	L/M	L/M	M	L	L/M	L	L	L/M	M	M	M	L	L/M
		WGA SPECIFIC	NA	NA	NA	NA	L	M	M/H	L	H	L	M	L	M	L	M	M	M	H	L	L	L	M	M	M	L	L
MARKETS		GENERAL	NA	NA	NA	NA	L	NA	L	M	M	L/M	L/M	L/M	L/M	M/H	M	M/H	M/H	L/M	NA	NA	L/M	M/H	M/H	M	NA	NA
		WGA SPECIFIC	NA	NA	NA	NA	L	NA	L	L	L	L	M	M	L	M	H	H	H	H	NA	NA	L	H	H	M	NA	NA
VENDOR		GENERAL	NA	NA	NA	NA	L	NA	NA	L/M	L/M	L/M	L/M	L/M	L	M/H	L	M/H	L/M	L/M	L	L/M	L	H	M	M	NA	NA
		WGA SPECIFIC	L	NA	NA	NA	NA	NA	NA	L	L	L	L	L	M	M	L	M/H	H	H	L	L	L	H	M	L	NA	NA
TECHNOLOGY/ PROGRAM	ABILITY TO CONSTRUCT & MAKE OPERATIONAL	GENERAL	L	M/H	M/H	L	L	M	L/M	L	M	L	L/M	L/M	L	M/H	L	L/M	L	L/M	L/M	NA	L	H	M	M	L/M	L/M
		WGA SPECIFIC	M	M/H	H	L	L	M	L/M	L	M	L	L	L	L	L	M	M	M	M	L	NA	M	H	H	L	L	L
	ABILITY TO OPERATE AND MAINTAIN	GENERAL	L	L/M	L/M	L	L	M	L/M	L	M	L	L/M	L/M	L/M	M	L/M	L/M	L/M	L/M	L/M	M/H	L	M/H	M/H	M	M	L
		WGA SPECIFIC	M	M/H	L	L	L	H	L/M	L	M/H	L	L	L	M	M	L	M	M	M	H	H	M	M/H	H	L	M	L
RESIDUE DISPOSAL	CHARACTERISTICS	GENERAL	NA	NA	NA	NA	NA	M	NA	L	L	L	L	L	L	L	L	L	L	M/H	NA	NA	M	M	L/M	M/H	NA	NA
		WGA SPECIFIC	NA	NA	NA	NA	NA	H	NA	L	L	L	L	L	L	L	L	L	M	H	NA	NA	M/H	M/H	M	M/H	NA	NA
	SITE AVAILABILITY	GENERAL	NA	NA	NA	NA	NA	M	NA	NA	NA	NA	L	L	L	L	L	L	L	M/H	NA	NA	M	M	L/M	M/H	NA	NA
		WGA SPECIFIC	NA	NA	NA	NA	NA	H	NA	NA	NA	NA	L	L	L	L	L	L	M	H	NA	NA	M/H	M/H	M/H	M/H	NA	NA
FINANCING		GENERAL	L	L	L	L	L	L	L	L	L/M	L	L/M	M	L	M	L	L/M	M	M	L/M	L/M	L/M	H	M/H	M/H	M	M
		WGA SPECIFIC	M	M	M	L	L	L	L	M	M	L/M	M	M	L/M	M/H	M	M/H	H	H	H	H	L/M	M/H	H	L	L	M
UNCONTROLLABLE CIRCUMSTANCES**		GENERAL	L	M	M	L	M	M	L	L	L	L	L	L	M	M	L	M	M	M/H	M	M	M	M	M	M/H	M/H	M/H
		WGA SPECIFIC	M	M	M	L	M	M	L	L	L	M	M	M/H	M	H	M	H	H	H	L/M	M/H	M	M	H	M	M	M

KEY:

NA = NOT APPLICABLE
H = HIGH
M = MODERATE
L = LOW

Table E-46

VAAOSW26

Evaluation of Environmental Impacts *

for Southwest WGA

DEGREE OF POTENTIAL ENVIRONMENTAL IMPACT ASSOCIATED WITH IMPLEMENTATION & USE OF EACH METHOD

ENVIRONMENTAL FACTOR	REDUCTION						RECYCLING												HANDLING		DISPOSAL					
	EDUCATION	INCENTIVES	DISINCENTIVES	MODEL GOVERNMENTAL PROGRAMS	WASTE EXCHANGE	HOME YARD WASTE COMPOSTING	REUSE	CURBSIDE COLLECTION	MULTI-FAMILY HOUSING COLLECTION	COMMERCIAL SOURCE SEPARATION	INTERMEDIATE PROCESSING FACILITY	COMMERCIAL MIXED WASTE PROCESSING	DROP OFF / BUYBACK DEPOTS	MIXED WASTE PROCESSING	YARD WASTE COMPOSTING	MIXED WASTE COMPOSTING	FOOD WASTE PROCESSING	SPECIAL WASTE RECYCLING AND REUSE	TRANSFER	LONG HAUL TRANSPORT	ANAEROBIC DECOMPOSITION	PYROLYSIS / GASSIFICATION	REFUSE DERIVED FUEL PREP. & USE	MASS BURN INCINERATION	LANDFILL	ASHFILL
AIR QUALITY	NA	NA	NA	NA	NA	NA	NA																			
CRITERIA POLLUTANTS: SO2, NOX, HCL								L	L	L	L	L	L	L	L	L	L	L	L	L	L/M	L/M	L/M	L/M	L	L
TOXICS								L	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	NA	NA	L	L	L	L	L	L
PARTICULATES								L	L	L	L	L	L	L	L	L	L	L	L	L	L/M	L/M	L/M	L/M	L	L
ODOR	NA	NA	NA	NA	NA	L	NA	NA	L	NA	L	NA	L	L	L	L	L	L	L	NA	L	L	L	L	L	NA
SURFACE WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	NA	NA	NA	L	L	L/M	L/M	L	NA	NA	L	L	L	L	L/M	L/M
GROUND WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	NA	NA	NA	L	L	L	L	L	NA	NA	L	L	L	L	L/M	L/M
NOISE	NA	NA	NA	NA	NA	L	NA	L	L	NA	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
RISK OF EXPLOSION	NA	NA	NA	NA	NA	NA	NA	NA	L	NA	NA	L	NA	L	NA	L	NA	L	L	NA	L	L	L	L	L	NA
PUBLIC HEALTH RISKS	NA	NA	NA	NA	NA	L	NA	NA		NA	L															
PATHOGENS						L		NA	L	NA	L	L	L	NA	L	L	L	NA	L	L	L	L	L	L	L	NA
VECTORS						L		NA	L	NA	L	L	L	L	L	L	L	NA	L	L	L	L	L	L	L	NA
TOXICS						L		NA	NA	NA	L	NA	L	L	L	L	L	L	NA	NA	L/M	L/M	L/M	L/M	L	L/M
AESTHETICS	NA	NA	NA	NA	NA	L	NA	L	L	NA	L	L	L	L	L	L	L	L	L	NA	L	L	L	L	L	L
TRAFFIC	NA	NA	NA	NA	L	NA	NA	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
OTHER																										

KEY: **

NA = NOT APPLICABLE
H = HIGH RATING
M = MEDIUM RATING
L = LOW RATING

* THIS EVALUATION ASSUMES NEW "STATE OF THE ART" FACILITIES, PROPERLY SITED WITH FACILITY DESIGN INCORPORATIONG APPROPRIATE MITIGATION TECHNIQUES.

** A HIGH RATING INDICATES A HIGH LEVEL OF LOCAL ENVIRONMENTAL IMPACT
A LOW RATING INDICATES A LOW LEVEL OF ENVIRONMENTAL IMPACT

Table E-47

VAAOSW27

Evaluation of Potential Environmental Impacts * for Southwest WGA

DEGREE OF POTENTIAL ENVIRONMENTAL IMPACT ASSOCIATED WITH IMPLEMENTATION & USE OF EACH METHOD

ENVIRONMENTAL FACTOR	REDUCTION						RECYCLING												HANDLING		DISPOSAL					
	EDUCATION	INCENTIVES	DISINCENTIVES	MODEL GOVERNMENTAL PROGRAMS	WASTE EXCHANGE	HOME YARD WASTE COMPOSTING	REUSE	CURBSIDE COLLECTION	MULTI-FAMILY HOUSING COLLECTION	COMMERCIAL SOURCE SEPARATION	INTERMEDIATE PROCESSING FACILITY	COMMERCIAL MIXED WASTE PROCESSING	DROP OFF / BUYBACK DEPOTS	MIXED WASTE PROCESSING	YARD WASTE COMPOSTING	MIXED WASTE COMPOSTING	FOOD WASTE PROCESSING	SPECIAL WASTE RECYCLING AND REUSE	TRANSFER	LONG HAUL TRANSPORT	ANAEROBIC DECOMPOSITION	PYROLYSIS / GASSIFICATION	REFUSE DERIVED FUEL PREP. & USE	MASS BURN INCINERATION	LANDFILL	ASHFILL
AIR QUALITY	NA	NA	NA	NA	NA	NA	NA												M	M	M/H	H	M	M	M	L
CRITERIA POLLUTANTS: SO2, NOX, HCL								L	L	L	L	L	L	M	L	L	M	M	L	L	M/H	H	M	M	H	L/M
TOXICS								L	L	L	L	L	M	L	L	L	M	M	M	M	L	L/M	H	M	M	M/H
PARTICULATES								L	L	L	L	L	L	L	L	L										
ODOR	NA	NA	NA	NA	NA	L/M	NA	L	L	L	L/M	L	L/M	H	L	M	H	L	L/M	L/M	H	H	M	M	H	L
SURFACE WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	L	L	L/M	M	L/M	M	M	M	L	L	L	L	L	L	M	M
GROUND WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	L	L	L	M	L/M	M	M	M	L	L	L	L	L	L	H	H
NOISE	NA	NA	NA	NA	L	L	NA	L/M	L/M	L/M	L/M	M/H	M	H	M	L/M	L/M	L	M/H	M/H	M	M/H	M/H	M/H	M	M
RISK OF EXPLOSION	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	L/M	L	H	L/M	L/M	L	L	L	L	M/H	M	H	M	H	L
PUBLIC HEALTH RISKS	NA	NA	NA	NA	NA		NA																			
PATHOGENS						L		L	L	L	L	L	L/M	M	L	M	H	NA	M	L	L	L	L	L	L/M	L
VECTORS						L/M		L	L	L	L	L	L/M	M	L	M	H	M	M	L	L	L	L	L	M	L
TOXICS						L		NA	NA	NA	L	L	L	M	L	M	M	M	L	L	M/H	M/H	M/H	M/H	M/H	M
AESTHETICS	NA	NA	NA	NA	M	M	NA	L/M	L/M	L/M	L/M	M	M	H	M/H	M	M/H	L/M	M/H	M	M	M	M	M	M	M
TRAFFIC	NA	NA	NA	NA		NA	NA	L/M	L/M	L/M	M	M	L/M	H	M	M	M	L/M	M/H	M/H	H	H	H	H	H	L/M
OTHER																										

KEY: ••

NA = NOT APPLICABLE
H = HIGH RATING
M = MEDIUM RATING
L = LOW RATING

* THIS EVALUATION ASSUMES THAT CERTAIN FAILURES OCCUR IN THE SITING PROCESS, DESIGN, MITIGATION MEASURES AND IN THE OPERATION & PERFORMANCE OF THE SELECTED TECHNOLOGY.

•• A HIGH RATING INDICATES A HIGH LEVEL OF LOCAL ENVIRONMENTAL IMPACT
A LOW RATING INDICATES A LOW LEVEL OF ENVIRONMENTAL IMPACT

Table E-48

Environmental Concerns Evaluation

for Southwest WGA

VAAOSW25

DEGREE OF ENVIRONMENTAL CONCERN ASSOCIATED WITH IMPLEMENTATION & USE OF EACH METHOD

ENVIRONMENTAL FACTOR	REDUCTION						RECYCLING												HANDLING		DISPOSAL					
	EDUCATION	INCENTIVES	DISINCENTIVES	MODEL GOVERNMENTAL PROGRAMS	WASTE EXCHANGE	HOME YARD WASTE COMPOSTING	REUSE	CURBSIDE COLLECTION	MULTI-FAMILY HOUSING COLLECTION	COMMERCIAL SOURCE SEPARATION	INTERMEDIATE PROCESSING FACILITY	COMMERCIAL MIXED WASTE PROCESSING	DROP OFF / BUYBACK DEPOTS	MIXED WASTE PROCESSING	YARD WASTE COMPOSTING	MIXED WASTE COMPOSTING	FOOD WASTE PROCESSING	SPECIAL WASTE RECYCLING AND REUSE	TRANSFER	LONG HAUL TRANSPORT	ANAEROBIC DECOMPOSITION	PYROLYSIS / GASSIFICATION	REFUSE DERIVED FUEL PREP. & USE	MASS BURN INCINERATION	LANDFILL	ASHFILL
AIR QUALITY	NA	NA	NA	NA	NA	NA	NA		L	L			L					NA								
CRITERIA POLLUTANTS: SO2, NOX, HCL								L			L	L			L	M			L	L	M	H	H	H	L	L
TOXICS								NA			L	L			L	L			L	L	M	H	H	H	H	H
PARTICULATES								L			M	M	M	M		M			M	L	H	H	H	H	H	H
ODOR	NA	NA	NA	NA	NA	M	NA	L	L	L	L	L	L	M/H	M	M	H	M	H	NA	H	H	H	M	H	L
SURFACE WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	L	NA	NA	L	NA	H	H	H	H	H	H	NA	H	H	H	H	H	H
GROUND WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	L	NA	NA	L	NA	H	H	H	M	H	M	NA	H	H	H	H	H	H
NOISE	NA	NA	NA	NA	L	L	NA	L	L	L	L	L	L	M	M	M	L	M	M	L	L	M	H	M	M	L
RISK OF EXPLOSION	NA	NA	NA	NA	NA	NA	NA	NA	L	NA	NA	L	NA	L	M	M	NA	H	M	NA	M	H	H	M	H	L
PUBLIC HEALTH RISKS	NA	NA	NA	NA	NA		NA	L	L	L										NA						
PATHOGENS						L					L	L	L	L	L	L	M	L	M		H	L	H	H	H	L
VECTORS						M					M	M	M	M	M	M	M	L	M		M	L	H	H	H	L
TOXICS						L					L	L	L	M	L	M	L	H	M		H	H	H	H	H	H
AESTHETICS	NA	NA	NA	NA	L	M	NA	L	L	L	L	L	L	M	M	M	H	H	H	NA	H	M	H	H	H	M
TRAFFIC	NA	NA	NA	NA	L	NA	NA	L	L	L	L	L	L	M	M/H	M	L	L	H	M	M	M	M	M	M	L
OTHER																										

KEY: •

NA = NOT APPLICABLE
H = HIGH RATING
M = MEDIUM RATING
L = LOW RATING

• A HIGH RATING INDICATES A HIGH LEVEL OF LOCAL ENVIRONMENTAL CONCERN
A LOW RATING INDICATES A LOW LEVEL OF ENVIRONMENTAL CONCERN

Table E-49

SOUTHWEST: RECOMMENDED ALTERNATIVE

(COST ESTIMATES ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICTIONS.)

	ESTIMATED NET (COST) OR REVENUE	CONTRIBUTION TO SYSTEM COST	ESTIMATED TONS	PERCENT OF GENERATED TONS	RELATIVE RATIO OF COSTS TO TONS
COLLECTION AND PROCESSING:					
1. COLLECTION OF SINGLE FAMILY SOURCE SEPARATED RECYCLABLES	$0	0.0%	0	0.0%	NA
2. COLLECTION OF SINGLE FAMILY COMINGLED RECYCLABLES *	($624,143)	2.2%	3,212	0.8%	2.56 :1.00
3. COLLECTION OF MULTI FAMILY COMINGLED RECYCLABLES *	($956,390)	3.3%	4,533	1.2%	2.78 :1.00
4. COMMERCIAL DIRECT RECYCLING	$0	0.0%	61,038	16.1%	0.00 :1.00
5. COLLECTION OF COMMERCIAL SOURCE SEPARATED RECYCLABLES	($258,447)	0.9%	5,134	1.4%	0.66 :1.00
6A. DROP OFF/BUY BACK "REGULAR" RECYCLABLES	$480,623	-1.7%	8,784	2.3%	-0.72 :1.00
6B. DROP OFF/BUY BACK OF "SPECIAL" RECYCLABLES OR WASTES	($247,995)	0.9%	14,682	3.9%	0.22 :1.00
7. YARD WASTE COLLECTION AND COMPOSTING	($3,275,119)	11.4%	33,001	8.7%	1.31 :1.00
8. SORTING OF TARGETED COMMERCIAL HIGH GRADE LOADS *	($38,769)	0.1%	724	0.2%	0.71 :1.00
9. SELF HAULED WASTE*	($1,564,441)	5.5%	31,429	8.3%	0.66 :1.00
10. REGULAR COLLECTION AND DISPOSAL OF MUNICIPAL WASTE *	($22,209,413)	77.4%	215,700	57.0%	1.36 :1.00
11. MIXED WASTE PROCESSING*	$0	0.0%	0	0.0%	NA
12. RDF PREPARATION*	$0	0.0%	0	0.0%	NA
SYSTEM TOTAL	($28,694,094)	100.0%	378,237	100%	1.00 :1.00
AVERAGE COST PER TON GENERATED	($76)				
DISPOSAL ONLY:					
A. MASS BURN WITH ASH MONOFILL	($3,174,617)	11.1%	54,642	14%	0.77 :1.00
B. LANDFILL WITH LONG HAUL BY RAIL	($2,488,208)	8.7%	54,642	14%	0.60 :1.00
C. LANDFILL WITH BALING	$0	0.0%	0	0%	NA
D. LANDFILL ONLY	($6,685,608)	23.3%	139,063	37%	0.63 :1.00
DISPOSAL TOTAL	($12,348,433)	43.0%	248,347	66%	0.66 :1.00
AVERAGE COST PER TON DISPOSED	($50)				
RECYCLED TONS			129,890	34%	

* The net costs for these methods include disposal costs for residual or disposed wastes.

e. Ranking of Methods and Recommendations

The following paragraphs discuss the group's rationale and consultant team's rankings as well as each group's recommended system for reduction, recycling, and disposal in the Southwest WGA.

(1) Working Group Rankings

The Southwest WGA working group's rankings of solid waste management methods are shown in Table E-50.

The WGA working group methods ranking process produced the following preferred system for solid waste management in the Southwest WGA:

- Reduction Program
  - -- Incentives
  - -- Education
- Recycling Program
  - -- Commercial source-separated collection
  - -- Incentives
  - -- Drop-off/buy-back depots
  - -- Education
  - -- Single-family curbside collection
  - -- Multi-family collection
  - -- Reuse
- Disposal Program
  - -- Landfill
  - -- Long haul

(a) Reduction Program

The Southwest WGA working group selected education and incentives as preferred waste reduction methods, with disincentives and home yard waste composting being the least preferred methods. Education was believed to have high public and political acceptance and low environmental impact. Financial incentives were also thought to be effective but only if there were sufficient commitment to continue providing them. Disincentives were not considered effective. The group advised against changing an approach once that approach had been instituted.

Public health officials in the WGA have had many problems in the past with improperly managed home yard waste compost piles. This experience prompted the group to rate home composting low on reliability, environmental impact, waste stream impact and cost-effectiveness.

(b) Recycling Program

Commercial source-separated recycling was rated highest and was considered excellent under all criteria except flexibility (ease of changing to other methods) and environmental impact (the method rated good for both of these criteria). Incentives and drop-off/buy-back depots were both ranked just below commercial source-separation. Public and political acceptance of both methods was considered very good, although it was felt that incentives had only moderate reliability and poor flexibility. The need to continually fund incentives necessary for a long time, was considered a disadvantage of the method. Drop-off/buy-back depots were thought to have poor flexibility and only good environmental and waste stream impact. Education was highly rated, but the group saw its potential risks as being possible ineffectiveness and lack of secure, long-term funding.

The group ranked single-family and multi-family collection of recyclables moderately high overall and felt that if single-family curbside collection were implemented, multi-family collection should be instituted as well. The group saw both methods receiving high acceptance and being very compatible with other recycling methods, though once implemented, difficult to modify. Multi-family collection was considered less technically effective or reliable than curbside programs because of the increased difficulty of generating participation. It was recognized that either approach would require financial subsidy.

Reuse was given a moderate rating as the group felt that this method would have low waste stream impact and that it was often not cost-effective or technically effective.

This group rated disincentives low and expressed considerable concern about adding fees which waste haulers might be required to collect. It was felt that since most garbage service in the area is billed by private waste haulers rather than by local government, major inequities would result from applying a disincentive, particularly if revenue generation was also an objective.

Yard waste composting was rated favorably in terms of public acceptance and compatibility with other methods but very low on other criteria, such as cost-effectiveness, reliability, and environmental impact. Solid waste composting and food waste composting were both rated low due to concerns over their technical reliability, environmental impact, and public acceptance.

(c) Disposal Program

In evaluating disposal methods, the Southwest WGA working group gave highest preference to local landfilling, followed by long haul and incineration/energy recovery. Of the three methods, only long haul had a favorable rating for public and political acceptance. Environmental impacts of the three methods were seen as essentially equal assuming appropriate mitigation. Landfilling was considered the most technically reliable, and long hauling to an out-of-state landfill as least reliable. The group considers local landfilling the most cost-effective method, and regards the other two methods as

not economical given their high capital or operating costs. The WGA has recently evaluated incineration as well as long-haul. The group felt that long haul will probably be the method used to manage much of the area's waste during the next few years, but that incineration will be reexamined in the future.

(2) Consultant Team Rankings

Table E-50 illustrates the consultant team's ranking of the waste management methods in each program (reduction, recycling, and disposal). In the reduction program, the consultant team evaluated "special government programs" and "waste exchange," which were not ranked by the WGA working group. In addition, the consultant team ranked "commercial high-grade collection" and "mixed-waste processing" for the recycling program. "Special waste recycling/reuse" was not ranked due to the special characteristics of these components; it was assumed that special waste management will be included in any recommended program.

Based on the criteria established for the consultant team's analysis, the consultant recommended the following solid waste management system for the Southwest WGA:

- Reduction Program
  - -- Education
  - -- Incentives
  - -- Special government programs
  - -- Disincentives
  - -- Home composting
  - -- Waste exchange
- Recycling Program
  - -- Drop-off/buy-back depots
  - -- Education
  - -- Single-family curbside collection
  - -- Commercial source-separated collection
  - -- Commercial high-grade collection
  - -- Incentives
  - -- Multi-family collection
  - -- Yard waste composting
- Disposal Program
  - -- Incineration/energy recovery
  - -- Landfill within the WGA
  - -- Long haul

(a) Reduction Program

The consultant team found little justification for different waste reduction programs for different WGA's throughout the State. Based on the

Table E-50

BEST MANAGEMENT PRACTICES FOR
SOLID WASTE METHODS RANKING SUMMARY

SOUTHWEST WGA

Reduction		Recycling		Disposal	
WGA Working Group Preference	Consultant Team Recommendations	WGA Working Group Preference	Consultant Team Recommendations	WGA Working Group Preference	Consultant Team Recommendations
Incentives	1. Education	1. Commercial Source Separated	1. Drop-Off/Buy-Back Depots	1. Landfill	1. Incineration
Education	2. Incentives	2. Incentives	2. Education		1. Landfill
	2. Special Governmental Programs	2. Drop-Off/Buy-Back Depots	2. Single-Family Curb-side Collection		1. Long Haul
Disincentives	3. Disincentives		2. Commercial Source Separated	2. Long Haul	
Home Yard Waste Composting	4. Home Yard Waste Composting	3. Education	3. Commercial High-Grade Collection	2. Incineration	
	5. Waste Exchange	4. Single-Family Curb-side Collection	4. Incentives		
		5. Multi-Family Collection	5. Multi-Family Collection		
			5. Centralized Yard Waste Composting		
		6. Reuse	6. Reuse		
			6. Disincentives		
			6. Mixed Waste Proccessing		
		7. Disincentives	7. MSW Composting		
		7. Centralized Yard Waste Composting			
		8. MSW Composting	8. Food Waste Proccessing		
		9. Food Waste Proccessing			

criteria established, the recommendations are the same Statewide and are discussed below. Education is considered to be reasonably cost-effective with excellent long-term environmental benefits considering its effect on all other management methods. The focus of education/public involvement programs is to inform and change society's view of solid waste and its management. A balance of incentives and disincentives will be necessary components of a waste reduction program. The cost-effectiveness of these methods is considered to be fair; however, their application will produce considerable environmental benefit. They are not expected to have a significant impact upon the volume of waste but can affect the composition of the waste stream significantly.

Special governmental programs are considered to be a good way to demonstrate waste reduction methods and to assist business and industry in reducing waste and increasing recycling.

Home yard waste composting is a cost-effective, low-risk method for significantly reducing the waste stream. Participation by the public sufficient to measurably reduce waste will require local government to vigorously "market" the program, a worthwhile effort considering the significant amount of yard waste in the overall waste stream.

Industrial waste exchanges have been effective for some time. There is now potential for applying this concept to household hazardous wastes as well.

It is recommended that the waste reduction program be developed in the priority order listed above, and that investment of resources be made in those methods and techniques which will provide the greatest return.

(b) Recycling Program

Drop-off/buy-back operations are a key component of the recycling system for both urban and rural communities. Residential waste (comprising nearly 50% of the area's total waste stream) and self-haul waste (accounting for more than 15% of disposed waste), can both be reduced by effective drop-off/buy-back operations. Some of the State's first reverse vending machines for aluminum cans appeared in this WGA and a Clark County processor is encouraging the recycling of plastics through drop-off/buy-back depots. The drop-off/buy-back method was rated excellent for its cost-effectiveness, feasibility, and potential to reduce waste volumes. This method may provide the best recycling service for rural areas and, with other methods, will be important in serving urban areas.

Three methods received equally high ratings by the consultant team. These included education, single-family curbside collection, and commercial source separation. Commercial source separation occurs most actively in the urban areas of the WGA; and has the potential to expand to serve some rural areas and new businesses. The commercial/industrial waste stream accounts for approximately 20% of the total waste disposed in the WGA, while the manufacturing waste stream is about 15% of the total waste disposed. Cardboard, wood waste, and other material are potentially recoverable from these waste streams. A waste composition analysis indicates that nearly 30%

of the manufacturing waste stream is composed of inert materials and fines; programs to separate these materials at the source could effectively reduce the volumes disposed. The commercial source separation method was assigned an excellent rating for cost-effectiveness and very good ratings under all other criteria.

Single-family curbside collection was given an excellent rating in terms of feasibility for urban areas because of available markets and public acceptance. Waste stream impact, environmental impact, and cost-effectiveness in an urban setting were all ranked as very good. Targeted materials from the residential waste stream should include newspapers, glass, and metal containers. A high volume of mixed-waste paper and plastic packaging is also found in this substream and could be collected given the development of processing and market capacities.

Education and promotion of recycling opportunities is also a highly rated method for the Southwest WGA. The method was given very good ratings in terms of cost-effectiveness, feasibility, and waste stream impact, and an excellent rating on environmental impact. With public and political acceptance of solid waste management methods being such an important factor in this WGA, effective education, information, and promotion efforts are essential for implementing recycling and disposal options.

Commercial high-grade collection is a method applicable primarily in urban centers which can support the required investment in processing capacity. This method is favored for essentially the same reasons as the commercial source-separated recycling method. The primary difference is that high-grade collection is expected to have a reduced impact on waste volumes.

Incentives were also ranked moderately high because of their low environmental impact and potential for increasing recovery levels when recycling services are provided through other methods. Incentives were given good ratings for cost-effectiveness and feasibility.

Moderate ratings were given to centralized yard waste composting and multi-family recyclables collection for the Southwest WGA. Nearly 20% of the WGA's dwelling units are classified as multi-family and this method would be most appropriate in urban communities. This service can be provided economically if appropriately sized facilities are selected. Feasibility and volumetric impact of multi-family collection was rated good, while its environmental impact was rated very good.

Yard waste composting is also appropriate for urban areas within the WGA. Yard waste accounts for nearly 22% of the residential waste stream (30,000 tons per year) and 31% of the self-haul waste stream (13,000 tons per year). For rural areas or self-haul disposal sites, it would be appropriate to separate and recover yard waste when processing capabilities are available. The cost-effectiveness and environmental impact of yard waste composting were rated good, while its feasibility and volumetric impact were rated very good.

Reuse, disincentives, and mixed-waste processing were all ranked low by the consultant team for the Southwest WGA. Reuse operations are expected to have little effect in reducing waste stream volumes within the WGA, although there are some opportunities for expanding existing reuse operations. Cost-effectiveness and feasibility of reuse efforts were rated good, and their environmental impact was rated very good. Disincentives would have excellent environmental impact but were rated only fair for cost-effectiveness and feasibility though they have good impact in reducing waste volumes. Mixed-waste processing was rated low on environmental impact and had moderate ratings for cost-effectiveness and feasibility. This method has higher potential for loss due to the untested nature of its technology and uncertain markets for the materials recovered. It is not expected that mixed-waste processing will be widely utilized in the WGA, although Skamania County has some experience in operating a small-scale mixed waste processing facility.

Solid waste and food waste composting methods were both ranked low for the WGA. Feasibility of both methods was considered low due to risks associated with the technologies, lack of markets for products, and other uncertainties. Environmental impacts related to public health, odor, and aesthetics were of particular concern for food waste composting, which had an overall ranking slightly below that for MSW composting. Cost-effectiveness for MSW composting was considered fair while that of food composting was considered poor. These two methods are not likely to provide major solutions for the WGA as a whole though there is potential for some communities to undertake smaller-scaled efforts using these methods.

(c) Disposal Program

The consultants ranked each of the three disposal methods as equal. Local and long-haul landfilling have comparable costs according to the assumptions of the economic model. The cost of incineration for energy recovery is somewhat higher.

Environmental impacts of local landfills and long-haul disposal to a landfill were both considered fair, with concerns focused primarily on methane toxicity, explosion risk, odor, ground water quality and traffic. Concerns were also expressed about surface water quality, noise, public health, and aesthetics. Mass burn incineration was rated as a good method from the stand point of environmental impact; factors of high concern, however, were particulates, noise, public health, and traffic. Moderate concerns included air pollutants, odor, risk of explosion, and aesthetics. Proper design and operation of landfills and incinerators could mitigate the environmental impacts.

Feasibility of the long-haul disposal method was rated very good since its major exposure to loss is that the ability to operate might be taken away. The feasibility of local landfills was rated good since their major potential problems would involve siting or uncontrollable circumstances. Potential siting difficulties, project financing, and ash disposal were major concerns associated with incineration, resulting in its fair feasibility rating.

The final criterion used for ranking disposal methods was impact in reducing the volume of waste. The landfill and long-haul methods were both rated as poor while incineration was rated very good.

The equal ranking of the three disposal methods does not provide guidance for the WGA on the optimum approach for managing waste disposal. Each community must evaluate the options based on its unique conditions. Generally, rural communities may find local landfills to be most appropriate, and urban areas will be able to consider a wider range of disposal options.

Objectives for each category of solid waste appear in Table E-51. These objectives depict the amount of each category which could reasonably be handled by each method. The objectives are based on the results of the WGA-recommended model and on the current levels of recycling in each WGA.

Table E-51

VAA00354

Waste Stream Category Objectives By Method for Southwest WGA

% OF WASTE STREAM CATEGORY MANAGED BY METHOD

WASTE STREAM CATEGORY	METHOD/ TECHNIQUE	RECYCLING											DISPOSAL							TOTAL (%)
		REUSE	SINGLE FAMILY CURBSIDE COLLECTION	MULTI-FAMILY HOUSING COLLECTION	COMMERCIAL SOURCE SEPARATION	COMMERCIAL HIGH GRADE	COMMERCIAL DIRECT	DROP OFF / BUYBACK DEPOTS	MIXED WASTE PROCESSING	YARD WASTE COMPOSTING	MIXED WASTE COMPOSTING	FOOD WASTE PROCESSING	SUBTOTAL RECYCLING	ANAEROBIC DECOMPOSITION	PYROLYSIS / GASSIFICATION	REFUSE DERIVED FUEL PREP. & USE	MASS BURN INCINERATION / ASHFILL	LANDFILL	LONG HAUL	SUBTOTAL DISPOSAL	
NEWSPAPER		5	6				32						43				12	33	12	57	100
CORRUGATED CARDBOARD		1	2	14	1	19	3						40				13	34	13	60	100
HIGH GRADE PAPER				26	2	3							31				15	39	15	69	100
MIXED SCRAP PAPER (RECYCLABLE)		6	4		1								11				20	50	20	89	100
REFILLABLE GLASS CONTAINERS		2	4	7			50						63				8	21	8	37	100
GLASS		3	4	4			8						19				18	45	18	81	100
ALUMINUM		2	4				35						41				13	33	13	59	100
TIN PLATED FOOD & BEVERAGE CANS		2	3										6				21	53	21	95	100
FERROUS METAL						83	6						90				2	6	2	10	100
NON-FERROUS METAL						65	5						70				7	17	7	30	100
WHITE GOODS							4						4				21	54	21	96	100
PET PLASTICS																	22	56	22	100	100
HDPE PLASTICS																	22	56	22	100	100
PLASTIC PACKAGING (LDPE)																	22	56	22	100	100
EXPANDED POLYSTYRENE																	22	56	22	100	100
OTHER PLASTICS																	22	56	22	100	100
TIRES							19						19				17	44	17	78	100
OTHER RUBBER PRODUCTS																	22	56	22	100	100
FOOD																	22	56	22	100	100
LAWN AND GARDEN WASTE									74				74				6	14	6	26	100
WOOD																	22	56	22	100	100
DISPOSABLE DIAPERS																	22	56	22	100	100
OIL							93						93				2	3	2	7	100
BATTERIES							84						84				3	10	3	16	100
OTHER HOUSEHOLD HAZARDOUS																	22	56	22	100	100
CONSTRUCTION DEBRIS (NOT WOOD)																	22	56	22	100	100
OTHER ORGANIC																	22	56	22	100	100
OTHER INORGANIC																	22	56	22	100	100

7. NORTH CENTRAL WGA

a. Introduction to North Central WGA

(1) Location

The North Central Waste Generation Area (North Central WGA) is located on the eastern side of the Cascade Mountain range in northern Washington. This area encompasses the Okanogan uplands, as well as parts of the Colville Indian Reservation and the semiarid Columbia Basin. The total area of the North Central WGA is 12,673 square miles.

The following counties are included in the North Central WGA:

- Chelan
- Douglas
- Grant
- Okanogan

(2) Population

The estimated 1987 population of the North Central WGA was 155,900 persons. Of this, 46% resided in the 37 incorporated towns and cities of the area. The Washington State Office of Financial Management predicts an 8% growth in population by 1995, to 168,370 for the area. According to 1980 Census figures, 60% of the population lived in rural areas (defined as outside of urbanized areas or outside Census-designated places of 2,500 or more inhabitants).

In 1987, there were 73,790 housing units in the North Central WGA (April 1 estimate). Sixty-five percent (65%) of these units were single-family dwellings. This total represents an increase of 7,640 housing units since 1980 (12% growth).

(3) Economy

The Washington State Department of Employment Security estimated December 1987 employment in the North Central WGA to be 56,210 persons. The number of "employer units" (i.e., separate business locations) was put at 5,010. In 1986, 70% of employed persons in the North Central WGA worked in the government, retail, agriculture, or service sectors.

b. Existing Solid-Waste Management Methods

(1) Solid-Waste Reduction and Recycling

There are approximately nine recycling centers in the North Central WGA (this figure excludes beverage distributors handling refillable bottles, as well as battery and tire distributors). In 1987, these centers handled 21,800 tons of materials, representing 9.7% of the estimated total tonnage of

solid waste generated. The following sections summarize the reduction and recycling programs in each of the counties in the North Central WGA.

(a) Chelan County

The Chelan County government does not currently fund recycling efforts; they are all handled privately or through civic groups.

(b) Douglas County

Recycling is not publicly funded in this county. A private business operates a recycling effort at the Eastmont Landfill, a privately owned facility. This operation accepts newspapers, white goods, and metals.

(c) Grant County

Recycling efforts in Grant County are not publicly funded. All programs are operated by private organizations and civic groups.

(d) Okanogan County

Except for a small grant awarded to the County by the State in 1978, recycling has been a privately-funded operation. The City of Omak has an educational program, called "Keep America Beautiful." Promotion is through radio spots, newspaper advertisements, and public meetings.

(2) Solid-Waste Collection

In the North Central WGA, there are eight haulers collecting municipal solid waste under U.T.C. certificates (franchises). Nine cities operate their own solid waste collection services. These cities are Chelan, Cashmere, Leavenworth, Royal City, Quincy, Soap Lake, Ephrata, Warden, and Oroville. All other collection in this WGA is conducted through a contractual agreement between city and hauler. Table E-52 summarizes this information.

The operators hauled an estimated 95,000 tons of waste in 1987, 39% of which was from the commercial sector, and 61% from residences. Including self-haul tonnages, the total disposed waste for 1987 was estimated to be 204,000 tons.

It is reported that there are rural self-haul drop-boxes in 14 locations throughout Grant County (depending on the definition used for "drop-box," the number may vary; there appear to be different interpretations of the terms "drop-box" and "transfer station"). Table E-53 describes them in greater detail.

(3) Solid-Waste Disposal

There are seven operating landfills accepting municipal waste in the North Central WGA; all are open to the public. The Bridgeport Bar landfill closed in March 1987. Table E-54 presents more detailed information on landfills and transfer stations. The estimated remaining capacities of these

Table E-52
WASHINGTON DEPARTMENT OF ECOLOGY
Recycling and Waste Stream Survey-1987
NORTH CENTRAL WASTE GENERATION AREA
HAULERS

NAME	PUBLIC/ PRIVATE	FRANCHISES	AREA SERVED	DESTINATION/COUNTY
City of Chelan	Public		City of Chelan	Manson L.F./Chelan
City of Cashmere	Public		City of Cashmere	Dryden T.S./Chelan
City of Leavenworth	Public		City of Leavenworth	Dryden T.S./Chelan
Zippy Disposal	Private	F	Parts of Chelan, Okanogan & Douglas Counties	(1) Pine Canyon/Douglas (2) Bridgeport T.S./Douglas (3) Manson L.F./Chelan
Dependable Disposal	Private	F	Chelan Co. & Douglas Co.	Eastmont L.F./Douglas
High-Valley Disposal	Private	F	Chelan Co., Blewitt Pass & Stevens Pass	(1) Wenatchee T.S./Chelan (2) Eastmont L.F./Douglas
Royal City	Public		Royal City	Grant Co. Drop Box
City of Quincy	Public		City of Quincy	Ephrata L.F./Grant
City of Soap Lake	Public		City of Soap Lake	Ephrata L.F./Grant
City of Ephrata	Public		City of Ephrata	Ephrata L.F./Grant
Lakeside Disposal	Private		Grant Co.	Ephrata L.F./Grant
Consolidated Disposal	Private	F	Grant Co./Adams Co.	(1) Ephrata L.F./Grant (2) Bruce L.F./Adams
City of Warden	Public		City of Warden	Bruce L.F./Adams

NAME	PUBLIC/ PRIVATE	FRANCHISES	AREA SERVED	DESTINATION/COUNTY
Columbia River Disp.	Private	F	Mattawa	Drop Boxes/Grant
Okanogan Valley	Private	F	Okanogan Co.	Okanogan L.F./Okanogan
Sunrise Disposal	Private		Okanogan Co. & Grant Co.	Okanogan L.F./Okanogan
Upper Valley Disp.	Private	F	Okanogan Co.	Ellisforde L.F./Okanogan
City of Oroville	Public		City of Oroville	Ellisforde L.F./Okanogan
Methow Valley Sanitation	Private	F	Okanogan Co.	Twisp T.S./Okanogan

TABLE E-53
WASHINGTON DEPARTMENT OF ECOLOGY
Recycling and Waste Stream Survey-1987
NORTH CENTRAL WASTE GENERATION AREA
RURAL DROP BOXES

COUNTY	LOCATION	SIZE	TYPE	OTHER
Grant	Various	40 CY	Rollaway	There are 14 throughout the County.

landfills range from two to 35 years (some information was unavailable); Table E-55 summarizes this information.

Based on 1987 quantities of waste disposed, rough estimates were generated for the tonnage of waste that could be accommodated by present landfills in the North Central WGA. Calculations were based only on information from landfills accepting municipal waste, except for those on military bases and Indian reservations. The tons of waste disposed at each landfill in 1987 were multiplied by the reported years of remaining life. Remaining life was defined as:

1) The number of years between 1987 and a closure data mandated by permit; or

2) if no mandated closure date is specified, the number of years between 1987 and an estimated closure date (due to exhaustion of site capacity, landfill noncompliance, or business closure); or

3) the smaller of the two figures, if both exist.

Using this method, it was estimated that the North Central WGA had sufficient landfill capacity at the end of 1987 to accommodate approximately 3,140,000 additional tons of solid waste. Care should be taken when interpreting this figure, since a WGA total estimate may not reflect situations facing individual jurisdictions. Landfills which did not report sufficient information to calculate tonnage capacity are not represented in the above figure (refer to Tables E-54 and E-55).

(4) Solid-Waste Management Planning

Chelan County--draft plan due to be completed by winter of 1989 in conjunction with Douglas County.

Douglas County--draft plan due to be completed by winter of 1989 in conjunction with Chelan County.

Grant County--no changes to its 1987 Solid-Waste Plan.

Okanogan County--draft plan due to be completed in 1989.

c. Market Capacity

The Seattle and Puget Sound area is the destination for most materials recovered in the North Central WGA. With the exception of a specialty products manufacturer that uses newspaper in Wenatchee, there are no end users in the WGA. High transportation costs, low population densities and low volumes of material are major market barriers for this WGA.

Markets for newspaper, corrugated containers, aluminum cans, ferrous and non ferrous metals are stable for materials coming from the WGA. Low volumes of glass and minimal amounts of tin are recovered because of the costs

Table E-54
WASHINGTON DEPARTMENT OF ECOLOGY
Recycling and Waste Stream Survey-1987
NORTH CENTRAL WASTE GENERATION AREA
DISPOSAL FACILITIES

COUNTY	FACILITY	NAME	ACCESS	1987 TONS RECEIVED	REMAINING CAPACITY*	DESTINATION	1987 TIPPING FEES
Chelan	Landfills:	Manson	Public	16,500	3-5 Years; 20 Acres		$3.90/LCY $6.40/CCY
	Transfer Stations:	Dryden	Public	Not Avail.		Eastmont L.F.	$3.68/LCY $6.15/CCY
		Wenatchee	Public	18,600		Eastmont L.F.	$5.25/LCY $6.20/CCY
Douglas	Landfills:	Bridgeport Bar	Public	200	Closed 3/87		$6.03/CCY
		Pine Canyon	Public	1,200	1 Year		$6.03/CCY
		Eastmont	Public	62,600	35 Years; 50 Acres		$3.65/LCY $5.95/CCY
	Transfer Stations:	Bridgeport Bar	Public	2,800		Eastmont L.F.	$4.55/LCY $11.38/CCY
Grant	Landfills:	Ephrata	Public	35,100	20 Years; 2 million CY		$2.75/LCY $5.50/CCY
		Grand Coulee	Public	23,000	20+ Years		$3.50/LCY
Okanogan	Landfills:	Ellisforde	Public	3,500	7-10 Years		$3.75 - $8.50/CY
		Okanogan	Public	81,800	2-5 Years		$3.75 - $8.50/CY

COUNTY	FACILITY	NAME	ACCESS	1987 TONS RECEIVED	REMAINING CAPACITY*	DESTINATION	1987 TIPPING FEES
Okanogan	Transfer Stations:	Disautel	Private	1,800		Okanogan L.F.	-0- -Indian Res.
		Nespelem	Private	3,200		Grand Coulee	-0- -Indian Res.
		Twisp (Methow Valley)	Public	2,900		Eastmont L.F.	$4.55/LCY $11.38/CCY

CY = Cubic Yard
CCY= Compacted Cubic Yard
LCY= Loose Cubic Yard

*Based on space available at the end of 1987, regardless of mandated or planned closure dates.

TABLE E-55
WASHINGTON DEPARIMENT OF ECOLOGY
Recycling and Waste Stream Survey-1987
NORTH CENTRAL WASTE GENERATION AREA
LANDFILL CAPACITIES

COUNTY	FACILITY NAME	MANDATED CLOSURE (Date/None)	REMAINING CAPACITY* (Years/CY/Acres)	COMMENTS (#)
Chelan	Manson	None	3-5 Years; 20 Acres	
Douglas	Bridgeport Bar	---	---	1
	Pine Canyon	None	1 Year	2
	Eastmont	None	35 Years; 50 Acres	
Grant	Ephrata	None	20 Years; 2 million CY w/500,000 CY cover	
	Grand Coulee	None	20+ Years	
Okanogan	Ellisforde	None	7-10 Years	3
	Okanogan County	None	2-5 Years	4

COMMENTS

1. Closed 3/87. Now a transfer station.
2. Almost full. There will be a transfer station built on the site in Fall of 1988.
3. Due to close in 1989.
4. Due to close in 1989.

*Based on space available at the end of 1987, regardless of mandated or planned closure dates.

of moving the materials to market (even though freight assistance is provided for both materials) and the low volumes currently collected. High-grade papers could be marketed if they were available in sufficient quantities. Mixed waste paper is not recovered in significant quantities because of the low price and volumes as well as the high costs of processing and transporting the material to market (freight on newspaper and corrugated containers is often provided by the mills that purchase the material). White goods could be recovered from the area, at a cost; however transportation distances discourage this at present prices. Plastics markets for the area do not look promising. Current tariffs for scrap plastic from the area are unrealistically high but potentially could be reduced if plastics recycling is considered in the future. No yard waste markets presently exist.

A market capacity summary for the North Central WGA is presented in Table E-56.

d. Evaluation of Methods

(1) Feasibility Analysis

Notable exceptions to the Statewide technical feasibility review for the North Central WGA include:

- Education, Incentives, and Disincentives. Due to a general lack of funds and the difficulty in measuring the effectiveness of these methods, the group assessed financing risks to be greater than that outlined for the State as a whole.

- Home Yard Waste Composting. The group felt little concern over what to do with small piles of soil amendments in this predominantly rural WGA and, therefore, rated residue disposal exposure to be lower than the Statewide rating.

- Reuse. Previous experience with a "junky" reuse-type business, which generated some concern from surrounding establishments, led the group to acknowledge there could be siting resistance to such a facility. This led to a higher rating than assigned in the Statewide rating.

- Curbside Collection. Comments for this method are the same as those for education, incentives, and disincentives.

- Intermediate Processing, Commercial Mixed Waste Processing, and Mixed Waste Processing Facilities. Financial concerns about operating and maintaining equipment-intensive processes resulted in the group judging technology/program-related exposure to be higher than the Statewide assessment.

Table E-56

Market Capacity Summary for North Central WGA

	COMMODITY	MAJOR END USERS FOR MATERIAL FROM WGA (Name &/or Location)	ESTIMATED END USER PRICE '88 ($/Ton)	VOLUME OF WGA MATRL. RECOVERED (1987 Tons)	(1) WGA COLLECTED MATERIAL PRICE ($/Ton)	(1) WGA COLLECTED MATERIAL VALUE ($/Year)	(2) WGA MARKET CAPACITY	FACTORS AFFECTING WGA MARKET FOR MATERIAL
1	Newsprint	CCA - Tacoma Sonoco - Sumner some to OR some Export - some to Wenatchee	$45.00	1,600	$16	$25,600	ADEQUATE	End user in Wenatchee for portion of supplies - Regional mills assist w/trans $
2	Corrugated Containers	CCA - Tacoma Sonoco - Sumner Export - some to OR	$65.00	2,100	$40	$84,000	ADEQUATE	Instate tariff - $.15/ton/mile Regional mills assist with transport cost
3	High Grade Paper	CCA - Tacoma Scott Paper - Everett Midwest - Export	$100.00	0	$45	$0	ADEQUATE	Little material generated in WGA
4	Mixed Waste Paper	Export Sonoco - Sumner Paperboard Indust. - B.C.	$25.00	0	($18)	$0	NOT SIGNIFICANT	Instate tariff - $.15/ton/mile Low supply & high transport cost
5	Container Glass	Owens-Brockway - Portlan	$40.00	100	$11	$1,100	ADEQUATE	Freight assistance for interstate shipment reduces costs
6	Refillable Glass	Rainier Brewing - Sea. Pabst/Olympia some Soft Drink	$116.00	1,400	$26	$36,400	ADEQUATE	
7	Aluminum Bev. Cont.	Various Alum. Co. Ship from Seattle or Spokane	$1,000.00	400	$834	$333,600	ADEQUATE	Instate tariff - $.12/ton/mile
8	Tin Cans	MRI - Seattle	$49.00	0	$19	$0	ADEQUATE	Instate tariff - $.12/ton/mile Freight assistance reduces cost Low volume of material
9	Ferrous Metals	General Metals - Tac. Salmon Bay/Seattle Steel Export	$65.00	14,700	$31	$455,700	ADEQUATE	Instate tariff - $.12/ton/mile
10	White Goods	Seattle Iron & Steel Pacific Hide & Fur - Spokane	$20.00	0	($19)	$0	POTENTIAL DISP. AVOID.	Mobile loggers help reduce cost Low volume of material
11	Non Ferrous Metals	Various - Tacoma/Seattle Export	$800	600	$631	$378,600	ADEQUATE	Instate tariff - $.12/ton/mile
12	PET Bottles	Midwest & East U.S.	$160	0	($351)	$0	NOT SIGNIFICANT	Low supply & high transport cost Potential future market
13	HDPE Bottles	Export - Puget Sound Partek - Vancouver	$200	0	($311)	$0	NOT SIGNIFICANT	Low supply & high transport cost Potential future market
14	Plastic Films (LDPE)	Export - Puget Sound	$160	0	($146)	$0	NOT SIGNIFICANT	Low supply & high transport cost Potential future market
15	Lawn & Garden Waste	None	($20)	0	($30)	$0	NOT SIGNIFICANT	Potential disp. avoid. market

(1) WGA prices and values are before transportation, processing and handling necessary to prepare and move material to market.

(2) WGA market capacity is based on an assessment of the markets' ability to consume consistently and gradually increasing volumes.

REFER TO TEXT FOR DETAILED DISCUSSION

- Special Waste Recycling. Uncertainty about future special waste regulations generated relatively high concern. Exposure to loss associated with markets and technology/program were judged to be higher than for the State as a whole.

- Mass Burn Incineration. Availability of garbage, competition with landfills, significant hauling distances, and financial risk in operating and maintaining a capital- and equipment-intensive facility were concerns of the group. Waste supply, markets, and technology-related exposure was viewed as being higher here than for in the State as a whole.

The exposure to loss feasibility evaluation for the North Central WGA is presented in Table E-57.

(2) Environmental Evaluation

(a) Impacts

Environmental impacts in the North Central WGA are generally the same as identified in the generic discussion of impacts. Very low precipitation in much of this WGA minimizes the potential for leachate generation from methods such as composting, landfills, or ashfills. On the other hand, the high summer temperature may accelerate decomposition requiring leading to increased generation of methane gases requiring control. In addition, the summer temperatures would increase odors from facilities such as those for food waste composting, upset conditions for anaerobic composting, and cause difficulty in storing wastes before mass burn incineration. These factors are reflected in the environmental impacts matrix (Table E-58).

An evaluation of potential environmental impacts due to failures in the technology are presented in Table E-59.

(b) Concerns

Members of the North Central WGA Committee who completed the environmental evaluation expressed a relatively high level of concern about all of the disposal methods and about intermediate waste processing, mixed waste processing, and food waste processing (see Table E-60). For all of the other methods they expressed greater concern about traffic, aesthetics, and noise than did many of the WGA's. They registered relatively high levels of concern about odor, health risks, and aesthetics. The high level of concern for disposal methods is related to two factors: a high degree of sensitivity to public awareness and input, and a fairly high level of waste management knowledge. These participants, although very much in favor of landfills, are also quite aware of the potential impacts of this method.

(3) Economic Evaluation of Alternatives

The results of the economic analysis for the North Central WGA are summarized in Table E-61. Detailed results appear in Appendix C.

Table E-57

Evaluation of Exposure to Loss for North Central WGA

VAAONC28

DEGREE OF EXPOSURE TO LOSS ASSOCIATED WITH IMPLEMENTATION & USE OF EACH METHOD

TECHNICAL IMPLEMENTATION FACTOR			REDUCTION						RECYCLING														HANDLING		DISPOSAL					
			EDUCATION	INCENTIVES	DISINCENTIVES	MODEL GOVERNMENTAL PROGRAMS	WASTE EXCHANGE	HOME YARD WASTE COMPOSTING	REUSE	CURBSIDE COLLECTION	MULTI-FAMILY HOUSING COLLECTION	COMMERCIAL SOURCE SEPARATION	INTERMEDIATE PROCESSING FACILITY	COMMERCIAL MIXED WASTE PROCESSING	DROP OFF / BUYBACK DEPOTS	MIXED WASTE PROCESSING	YARD WASTE COMPOSTING	MIXED WASTE COMPOSTING	FOOD WASTE PROCESSING	SPECIAL WASTE RECYCLING AND REUSE	TRANSFER	LONG HAUL TRANSPORT	ANAEROBIC DECOMPOSITION	PYROLYSIS / GASSIFICATION	REFUSE DERIVED FUEL PREP. & USE	MASS BURN INCINERATION	LANDFILL	ASHFILL
SITING	SITING RESISTANCE	GENERAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	L/M	L	M/H	L	M/H	M	M/H	M/H	NA	M/H	M/H	H	H	H	H
		WGA SPECIFIC	NA	NA	NA	NA	NA	L	L	NA	NA	NA	L/M	L/M	L	M/H	L	M/H	L/M	M/H	M/H	NA	M/H	M/H	H	H	H	H
	PERMITS AQUISITION DIFFICULTY	GENERAL	NA	NA	NA	NA	NA	NA	L	L	L	L	L	L/M	L	M	L	M/H	M	L/M	M	M	M/H	M/H	H	H	H	H
		WGA SPECIFIC	NA	NA	NA	NA	NA	NA	L	L	L	L	L/M	M	L	M	L	M	L/M	M	M/H	M	M	H	H/H	H	H	H
	TIME & COST REQUIRED TO COMPLETE SITING	GENERAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	L/M	L	L	L	M/H	M	M/H	M/H	NA	M/H	M/H	H	H	H	H
		WGA SPECIFIC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L/M	L/M	L	L/M	L	M/H	L/M	M/H	M/H	NA	M	M/H	H/H	H	H	H
WASTE SUPPLY	QUANTITY	GENERAL	NA	NA	NA	NA	L	NA	L	M	M	L	L/M	L	L	L	L	L	M/H	L/M	L/M	L/M	L/M	M	M	M	L	L
		WGA SPECIFIC	NA	NA	NA	NA	L	NA	L/M	M	M	L	L/M	L/M	L	M	L	M	M	M	L	L	L/M	M/H	M	H	L	L
	COMPOSITION	GENERAL	NA	NA	NA	NA	L	L	L/M	L/M	L/M	L	L/M	L	M	L/M	L/M	M	L	L/M	L	L/M	L/M	M	M	M	L	L/M
		WGA SPECIFIC	NA	NA	NA	NA	L	L	L/M	L/M	M	L	L/M	L/M	M	L/M	L/M	M	L	M	L	L	L/M	M	M	M	L/M	M
MARKETS		GENERAL	NA	NA	NA	NA	L	NA	L	M	M	L/M	L/M	L/M	L/M	M/H	M	M/H	M/H	L/M	NA	NA	L/M	M/H	M/H	M	NA	NA
		WGA SPECIFIC	NA	NA	NA	NA	L	NA	L/M	M/H	M/H	L/M	L/M	L/M	L/M	M/H	L/M	M/H	M/H	M/H	NA	NA	L	M/H	M/H	H	NA	NA
VENDOR		GENERAL	NA	NA	NA	NA	L	NA	NA	L/M	L/M	L/M	L/M	L/M	L	M/H	L	M/H	L/M	L/M	L	L/M	L	H	M	M	NA	NA
		WGA SPECIFIC	L	NA	NA	NA	NA	NA	NA	M	M	L/M	L/M	L/M	L	M/H	L	M/H	L/M	M	L	L	L	H	M	M	NA	NA
TECHNOLOGY/ PROGRAM	ABILITY TO CONSTRUCT & MAKE OPERATIONAL	GENERAL	L	M/H	M/H	L	L	M	L/M	L	M	L	L/M	L/M	L	M/H	L	L/M	L	L/M	L/M	NA	L	H	M	M	L/M	L/M
		WGA SPECIFIC	L	M	H	L	L	M	L/M	M	M/H	L	M/H	M/H	L	L/M	L	M/H	M	M/H	L/M	NA	L	H	M	M/H	M	M
	ABILITY TO OPERATE AND MAINTAIN	GENERAL	L	L/M	L/M	L	L	M	L/M	L	M	L/M	L/M	L/M	M	L/M	L/M	L/M	L/M	L/M	L/M	M/H	L	M/H	M/H	M	M	L
		WGA SPECIFIC	L	M	M	L	L	M	L/M	M/H	M/H	L	M/H	M/H	L/M	M/H	L/M	M/H	M	M/H	L/M	M/H	L	M/H	M/H	H	M	M
RESIDUE DISPOSAL	CHARACTERISTICS	GENERAL	NA	NA	NA	NA	NA	M	NA	L	L	L	L	L	L	L	L	L	L	M/H	NA	NA	M	M	L/M	M/H	NA	NA
		WGA SPECIFIC	NA	NA	NA	NA	NA	L	NA	L	L	L	L	L	L	L	L	L	L	H	NA	NA	M	M	L/M	M/H	NA	NA
	SITE AVAILABILITY	GENERAL	NA	NA	NA	NA	NA	M	NA	NA	NA	NA	L	L	L	L	L	L	L	M/H	NA	NA	M	M	L/M	M/H	NA	NA
		WGA SPECIFIC	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	L	L	L	L	L	L	L	M/H	NA	NA	M	M	L/M	M/H	NA	NA
FINANCING		GENERAL	L	L	L	L	L	L	L	L	L/M	L	L/M	M	L	M	L	L/M	M	M	L/M	L/M	L/M	H	M/H	M	M	M
		WGA SPECIFIC	M	M	M	L	L	L	L/M	M	M	L	M	M	L/M	M/H	L/M	H	M	M/H	L/M	L/M	L/M	H	M	H	M/H	M/H
UNCONTROLLABLE CIRCUMSTANCES**		GENERAL	L	M	M	L	M	M	L	M	M	L	M	M	L	M	M	M/H	M	M/H	M	M	M	M/H	M/H	M/H	M/H	M/H
		WGA SPECIFIC	L	M	M	L	M	M	L	L	L	L	M	M	L	M	M	M/H	M	M/H	M	M	M	M	M/H	M/H	M/H	M/H

KEY:

NA = NOT APPLICABLE
H = HIGH
M = MODERATE
L = LOW

Table E-58

Evaluation of Environmental Impacts *

for North Central WGA

VAAONC26

DEGREE OF POTENTIAL ENVIRONMENTAL IMPACT ASSOCIATED WITH IMPLEMENTATION & USE OF EACH METHOD

ENVIRONMENTAL FACTOR	REDUCTION						RECYCLING												HANDLING		DISPOSAL					
	EDUCATION	INCENTIVES	DISINCENTIVES	MODEL GOVERNMENTAL PROGRAMS	WASTE EXCHANGE	HOME YARD WASTE COMPOSTING	REUSE	CURBSIDE COLLECTION	MULTI-FAMILY HOUSING COLLECTION	COMMERCIAL SOURCE SEPARATION	INTERMEDIATE PROCESSING FACILITY	COMMERCIAL MIXED WASTE PROCESSING	DROP OFF / BUYBACK DEPOTS	MIXED WASTE PROCESSING	YARD WASTE COMPOSTING	MIXED WASTE COMPOSTING	FOOD WASTE PROCESSING	SPECIAL WASTE RECYCLING AND REUSE	TRANSFER	LONG HAUL TRANSPORT	ANAEROBIC DECOMPOSITION	PYROLYSIS / GASSIFICATION	REFUSE DERIVED FUEL PREP. & USE	MASS BURN INCINERATION	LANDFILL	ASHFILL
AIR QUALITY	NA	NA	NA	NA	NA	NA	NA	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
CRITERIA POLLUTANTS: SO2, NOX, HCL								L	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	NA	NA	L	L	L	L	L	L
TOXICS								L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
PARTICULATES																										
ODOR	NA	NA	NA	NA	NA	L	NA	NA	L	NA	L	NA	L	L	L	L	L/M	L	L	NA	L/M	L/M	L/M	L/M	L/M	NA
SURFACE WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	NA	NA	NA	L	L	L	L	L	NA	NA	L	L	L	L	L	L
GROUND WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	NA	NA	NA	L	L	L	L	L	NA	NA	L	L	L	L	L	L
NOISE	NA	NA	NA	NA	NA	L	NA	L	L	NA	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
RISK OF EXPLOSION	NA	NA	NA	NA	NA	NA	NA	NA	L	NA	NA	L	NA	L	NA	L	NA	L	L	NA	L	L	L	L	L	NA
PUBLIC HEALTH RISKS	NA	NA	NA	NA	NA	L	NA	NA		NA	L															
PATHOGENS						L		NA	L	NA	L	NA	L	L	NA	L	L	NA	L	L	L	L	L	L	L	NA
VECTORS						L		NA	L	NA	L	L	L	L	L	L	L	NA	L	L	L	L	L	L	L	NA
TOXICS						L		NA	NA	NA	L	NA	L	L	L	L	L	L	NA	NA	L/M	L/M	L/M	L/M	L	L/M
AESTHETICS	NA	NA	NA	NA	NA	L	NA	L	L	NA	L	L	L	L	L	L	L	L	L	NA	L	L	L	L	L	L
TRAFFIC	NA	NA	NA	NA	L	NA	NA	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
OTHER																										

KEY: **

NA = NOT APPLICABLE
H = HIGH RATING
M = MEDIUM RATING
L = LOW RATING

* THIS EVALUATION ASSUMES NEW "STATE OF THE ART" FACILITIES, PROPERLY SITED WITH FACILITY DESIGN INCORPORATIONG APPROPRIATE MITIGATION TECHNIQUES.

** A HIGH RATING INDICATES A HIGH LEVEL OF LOCAL ENVIRONMENTAL IMPACT
A LOW RATING INDICATES A LOW LEVEL OF ENVIRONMENTAL IMPACT

Table E-59

VAAONC27

Evaluation of Potential Environmental Impacts * for North Central WGA

DEGREE OF POTENTIAL ENVIRONMENTAL IMPACT ASSOCIATED WITH IMPLEMENTATION & USE OF EACH METHOD

ENVIRONMENTAL FACTOR	REDUCTION						RECYCLING												HANDLING		DISPOSAL					
	EDUCATION	INCENTIVES	DISINCENTIVES	MODEL GOVERNMENTAL PROGRAMS	WASTE EXCHANGE	HOME YARD WASTE COMPOSTING	REUSE	CURBSIDE COLLECTION	MULTI-FAMILY HOUSING COLLECTION	COMMERCIAL SOURCE SEPARATION	INTERMEDIATE PROCESSING FACILITY	COMMERCIAL MIXED WASTE PROCESSING	DROP OFF / BUYBACK DEPOTS	MIXED WASTE PROCESSING	YARD WASTE COMPOSTING	MIXED WASTE COMPOSTING	FOOD WASTE PROCESSING	SPECIAL WASTE RECYCLING AND REUSE	TRANSFER	LONG HAUL TRANSPORT	ANAEROBIC DECOMPOSITION	PYROLYSIS / GASSIFICATION	REFUSE DERIVED FUEL PREP. & USE	MASS BURN INCINERATION	LANDFILL	ASHFILL
AIR QUALITY	NA	NA	NA	NA	NA	NA	NA												M	M	M/H	H	L/M	L/M	M	L
CRITERIA POLLUTANTS: SO2, NOX, HCL								L	L	L	L	L	L	L	M	L	M		L	L	M/H	H	M	M	H	L/M
TOXICS								L	L	L	L	L	M	L	L	L	M		M	M	L	L/M	H	H	H	M/H
PARTICULATES								L	L	L	L	L	L	L	L	L										
ODOR	NA	NA	NA	NA	NA	L/M	NA	L	L	L	L/M	L	L/M	H	L	M	H	L	L/M	L/M	H	H	M	M	H	L
SURFACE WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	L	L	L/M	M	L/M	M	M	M	L	L	L	L	L	L	M	M
GROUND WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	L	L	L	M	L/M	M	M	M	L	L	L	L	L	L	L/M	L/M
NOISE	NA	NA	NA	NA	L	L	NA	L/M	L/M	L/M	L/M	M/H	M	H	M	L/M	L/M	L	M/H	M/H	M	M/H	M/H	M/H	M	M
RISK OF EXPLOSION	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	L/M	L	H	L/M	L/M	L	L	L	L	M/H	M	H	M	H	L
PUBLIC HEALTH RISKS	NA	NA	NA	NA	NA		NA																			
PATHOGENS						L		L	L	L	L	L	L/M	M	L	M	H	NA	M	L	L	L	L	L	L/M	L
VECTORS						L/M		L	L	L	L	L	L/M	M	L	M	H	M	M	L	L	L	L	L	M	L
TOXICS						L		NA	NA	NA	L	L	L	M	L	M	M	M	L	L	M/H	M/H	M/H	M/H	M/H	M
AESTHETICS	NA	NA	NA	NA	M	M	NA	L/M	L/M	L/M	L/M	M	M	H	M/H	M	M/H	L/M	M/H	M	M	M	M	M	M	M
TRAFFIC	NA	NA	NA	NA		NA	NA	L/M	L/M	L/M	M	M	L/M	H	M	M	M	L/M	M/H	M/H	H	H	H	H	H	L/M
OTHER																										

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* THIS EVALUATION ASSUMES THAT CERTAIN FAILURES OCCUR IN THE SITING PROCESS, DESIGN, MITIGATION MEASURES AND IN THE OPERATION & PERFORMANCE OF THE SELECTED TECHNOLOGY.

** A HIGH RATING INDICATES A HIGH LEVEL OF LOCAL ENVIRONMENTAL IMPACT
A LOW RATING INDICATES A LOW LEVEL OF ENVIRONMENTAL IMPACT

Table E-60

Environmental Concerns Evaluation

for Northcentral WGA

VAAONC25

DEGREE OF ENVIRONMENTAL CONCERN ASSOCIATED WITH IMPLEMENTATION & USE OF EACH METHOD

ENVIRONMENTAL FACTOR	REDUCTION						RECYCLING												HANDLING		DISPOSAL					
	EDUCATION	INCENTIVES	DISINCENTIVES	MODEL GOVERNMENTAL PROGRAMS	WASTE EXCHANGE	HOME YARD WASTE COMPOSTING	REUSE	CURBSIDE COLLECTION	MULTI-FAMILY HOUSING COLLECTION	COMMERCIAL SOURCE SEPARATION	INTERMEDIATE PROCESSING FACILITY	COMMERCIAL MIXED WASTE PROCESSING	DROP OFF / BUYBACK DEPOTS	MIXED WASTE PROCESSING	YARD WASTE COMPOSTING	MIXED WASTE COMPOSTING	FOOD WASTE PROCESSING	SPECIAL WASTE RECYCLING AND REUSE	TRANSFER	LONG HAUL TRANSPORT	ANAEROBIC DECOMPOSITION	PYROLYSIS / GASSIFICATION	REFUSE DERIVED FUEL PREP. & USE	MASS BURN INCINERATION	LANDFILL	ASHFILL
AIR QUALITY	NA	NA	NA	NA	NA	NA	NA	L	L	L	L/M	M	L	M	L	M	M	M	M	L/M	M	M/H	M/H	H	M/H	H
CRITERIA POLLUTANTS: SO2, NOX, HCL																										
TOXICS																										
PARTICULATES																										
ODOR	NA	NA	NA	NA	NA	L	NA	L	L	L	M	M	L	M	M	M	M/H	M	L/M	NA	M/H	M/H	M/H	M/H	M/H	M
SURFACE WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	L	NA	NA	L	NA	L	L/M	M	M	M	L/M	NA	M	M	L/M	L/M	M	M/H
GROUND WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	L	NA	NA	L	NA	L	L	M	M	M	L/M	NA	M	L/M	L/M	L/M	M/H	M/H
NOISE	NA	NA	NA	NA	L	L	NA	L/M	L/M	L/M	M	M	M	M	L	M	M	M	M	M	L/M	L	M	M	M	M
RISK OF EXPLOSION	NA	NA	NA	NA	NA	NA	NA	NA	L	NA	NA	M	NA	M	L	M	NA	M	L	NA	M	M/H	M	M	L/M	L/M
PUBLIC HEALTH RISKS	NA	NA	NA	NA	NA		NA	L	L	L	M	M	L	M	L	M	M	M	M	M	H	H	H	H	M/H	M
PATHOGENS						L/M																				
VECTORS						L/M																				
TOXICS						L/M																				
AESTHETICS	NA	NA	NA	NA	L/M	M	NA	M	M	L	M	M	M	M	L/M	M	M	M	M/H	NA	M/H	M/H	M/H	H	H	M/H
TRAFFIC	NA	NA	NA	NA	L/M	NA	NA	M	M	L	M	M	M	M	L	M	M	M	M	M	M	M	M	M	M/H	M
OTHER																										

KEY: •

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L = LOW RATING

• A HIGH RATING INDICATES A HIGH LEVEL OF LOCAL ENVIRONMENTAL CONCERN
A LOW RATING INDICATES A LOW LEVEL OF ENVIRONMENTAL CONCERN

Table E-61

NORTH CENTRAL: RECOMMENDED ALTERNATIVE

(COST ESTIMATES ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICTIONS.)

	ESTIMATED NET (COST) OR REVENUE	CONTRIBUTION TO SYSTEM COST	ESTIMATED TONS	PERCENT OF GENERATED TONS	RELATIVE RATIO OF COSTS TO TONS
COLLECTION AND PROCESSING:					
1. COLLECTION OF SINGLE FAMILY SOURCE SEPARATED RECYCLABLES	$0	0.0%	0	0.0%	NA
2. COLLECTION OF SINGLE FAMILY COMINGLED RECYCLABLES *	$0	0.0%	0	0.0%	NA
3. COLLECTION OF MULTI FAMILY COMINGLED RECYCLABLES *	$0	0.0%	0	0.0%	NA
4. COMMERCIAL DIRECT RECYCLING	$0	0.0%	14,833	6.6%	0.00 :1.00
5. COLLECTION OF COMMERCIAL SOURCE SEPARATED RECYCLABLES	($218,747)	1.5%	4,105	1.8%	0.85 :1.00
6A. DROP OFF/BUY BACK "REGULAR" RECYCLABLES	$260,726	-1.8%	3,704	1.6%	-1.12 :1.00
6B. DROP OFF/BUY BACK OF "SPECIAL" RECYCLABLES OR WASTES	($338)	0.0%	1,669	0.7%	0.00 :1.00
7. YARD WASTE COLLECTION AND COMPOSTING	($1,427,916)	10.1%	36,892	16.4%	0.61 :1.00
8. SORTING OF TARGETED COMMERCIAL HIGH GRADE LOADS *	$0	0.0%	0	0.0%	NA
9. SELF HAULED WASTE*	($3,816,339)	26.9%	81,026	35.9%	0.75 :1.00
10. REGULAR COLLECTION AND DISPOSAL OF MUNICIPAL WASTE *	($8,993,914)	63.4%	83,320	36.9%	1.71 :1.00
11. MIXED WASTE PROCESSING*	$0	0.0%	0	0.0%	NA
12. RDF PREPARATION*	$0	0.0%	0	0.0%	NA
SYSTEM TOTAL	($14,196,528)	100.0%	225,549	100%	1.00 :1.00
AVERAGE COST PER TON GENERATED	($63)				
DISPOSAL ONLY:					
A. MASS BURN WITH ASH MONOFILL	$0	0.0%	0	0%	NA
B. LANDFILL WITH LONG HAUL BY RAIL	$0	0.0%	0	0%	NA
C. LANDFILL WITH BALING	$0	0.0%	0	0%	NA
D. LANDFILL ONLY	($7,740,790)	54.5%	164,346	73%	0.75 :1.00
DISPOSAL TOTAL	($7,740,790)	54.5%	164,346	73%	0.75 :1.00
AVERAGE COST PER TON DISPOSED	($47)				
RECYCLED TONS			61,203	27%	

* The net costs for these methods include disposal costs for residual or disposed wastes.

e. Ranking of Methods and Recommendations

The following paragraphs describe the working group and consultant team's rankings as well as each group's recommended system for reduction, recycling, and disposal in this WGA.

(1) Working Group Rankings

The North Central WGA working group's rankings of solid-waste management methods are as shown in Table E-62.

The WGA working group methods-ranking process produced the following preferred system for solid-waste management in this WGA:

- Reduction Program
  - -- Incentives
  - -- Education
- Recycling Program
  - -- Commercial source-separated collection
  - -- Incentives
  - -- Drop-off/buy-back depots
  - -- Education
  - -- Single-family curbside collection
- Disposal Program
  - -- Landfill within the WGA

(a) Reduction Program

The WGA working group identified a strong need to foster greater public awareness of solid waste issues. They felt that incentives and educational programs would be the most effective means to reduce waste. Incentives were judged to be the most cost-effective reduction method, in addition to having the most potential to reduce waste stream volumes. Providing incentives was believed to be the best way to gain public and political acceptance. The group felt that education, believed to be less effective than incentives, was a reliable method of inducing waste reduction. Disincentives could also be effective, the group felt, but are more difficult to implement. Home yard waste composting rated poorly in nearly all respects. Home composting, hampered by the dry climate in this WGA, would be difficult to implement unless made mandatory. Disincentives and home yard waste composting were not included in the preferred alternatives.

(b) Recycling Program

Two of the four top-ranked methods for recycling were incentives and education. The working group felt that these methods were as applicable for recycling as for reduction programs. Commercial source separation was

ranked as the top recycling method, slightly ahead of incentives. The third method, slightly behind incentives, was drop-off/buy-back centers. Depending heavily on incentives and public support, drop-off/buy-back depots were felt to have a significant potential for diverting a large amount of the self-hauled waste within this WGA. The group believed that a more aggressive point-of-disposal drop-off/buy-back program should be implemented.

The group recommended source-separated and targeted high-grade commercial recycling in areas of reasonable commercial concentration. Likewise, they would implement single-family curbside collection programs only in areas of sufficient population density. This WGA's relatively low population and few urbanized areas present a significant obstacle to commercial and curbside recycling. Such programs, particularly mandatory recycling, seem unlikely in areas lacking mandatory residential collection.

Multi-family collection was initially ranked fourth, ahead of single-family curbside collection. However, insufficient number of eligible multi-family units exists for this method to trigger any reduction in the waste stream within the economic model. Accordingly, the group dropped this method from final consideration.

Yard-waste composting was believed to address the evaluation criteria moderately well for all criteria except cost-effectiveness and volumetric impact, where it was considered poor. Concerns were expressed about the educational effort required to foster significant public participation and about the costs of collecting yard wastes in sparsely populated areas. Yard waste composting was omitted from the WGA's preferred program.

Reuse, food waste processing, and mixed waste processing were also excluded. Reuse was believed to be unreliable, inflexible, and ineffective in reducing the waste stream. The group believed that public acceptance would be low, particularly for a aesthetically displeasing operation. They felt that siting such an operation would meet with resistance from surrounding businesses and residential property owners.

Consideration of food waste processing and mixed-waste processing methods generated great concern about the ability of this area to construct, operate, and maintain such facilities. Questions arose over the volumes of waste necessary to economically run such processes, particularly in light of significant haul distances from sparsely populated outlying areas to a centralized WGA-wide facility (the only practical option). The group was also skeptical about potential markets for the end-products of these processes.

(c) Disposal Program

The working group ranked landfilling as the preferred disposal method. This method ranked above the others in cost-effectiveness, technical reliability, and the potential impact on waste stream volume. The arid climate of this region and remaining landfill capacities both served to foster support for continued landfilling. Incineration was judged to be lowest in cost-effectiveness and flexibility. The financial ability to operate and maintain a new capital-intensive technology was of concern, as was the lack of

public support for such methods. Environmental impacts were felt to be equivalent for all disposal methods.

(2) Consultant Team Rankings

The waste management methods in each program (reduction, recycling, and disposal) were ranked by the consultant team as shown in Table E-62. In the reduction program, the consultant team evaluated "special government programs" and "waste exchange," which were not ranked by the WGA working group. In addition, the consultant team ranked "commercial high-grade collection" and "mixed-waste processing" for the recycling program. "Special waste recycling/reuse" was not ranked due to the special characteristics of these components; it was assumed that special waste management will be included in any recommended program.

Based on the criteria established for the consultant team's analysis, the consultant recommended the following solid waste management system for the North Central WGA:

- Reduction Program
  - -- Education
  - -- Incentives
  - -- Special governmental programs
  - -- Disincentives
  - -- Home composting
  - -- Waste exchange
- Recycling Program
  - -- Drop-off/buy-back depots
  - -- Education
  - -- Commercial source-separated collection
  - -- Yard waste composting
  - -- Incentives
- Disposal Program
  - -- Landfill within the WGA
  - -- Incineration/energy recovery

(a) Reduction Program

The consultant team found little justification for different waste reduction programs for different WGA's throughout the State. Based on the criteria established, the recommendations are the same Statewide and are discussed below. Education is considered to be reasonably cost-effective with excellent long-term environmental benefits considering its effect on all other management methods. The focus of education/public involvement programs is to inform and change society's view of solid waste and its management. A balance of incentives and disincentives will be necessary components of a waste reduction program. The cost-effectiveness of these methods is considered to be

Table E-62

BEST MANAGEMENT PRACTICES FOR
SOLID WASTE METHODS RANKING SUMMARY

NORTH CENTRAL WGA

Reduction		Recycling		Disposal	
WGA Working Group Preference	Consultant Team Recommendations	WGA Working Group Preference	Consultant Team Recommendations	WGA Working Group Preference	Consultant Team Recommendations
1. Incentives	1. Education	1. Commercial Source Separated	1. Drop-Off/Buy-Back Depots	1. Landfill	1. Landfill
2. Education	2. Incentives	2. Incentives	2. Education		1. Incineration
	2. Special Governmental Programs		2. Commercial Source Separated	2. Long Haul	2. Long Haul with Disposal
3. Disincentives	3. Disincentives	3. Drop-Off/Buy-Back Depots	3. Centralized Yard Waste Composting	3. Incineration	
4. Home Yard Waste Composting	4. Home Yard Waste Composting	4. Education	4. Incentives		
	5. Waste Exchange	5. Disincentives	5. Reuse		
			5. Single-Family Curb-side Collection		
			5. Commercial High-Grade Collection		
			5. Food Waste Processing		
		6. Single-Family Curb-side Collection	6. Disincentives		
		7. Multi-Family Collection	7. Multi-Family Collection		
			7. Mixed Waste Processing		
		8. Reuse	8. MSW Composting		
		9. Centralized Yard Waste Composting			
		10. Food Waste Processing			
		11. MSW Composting			

fair; however, their application will produce considerable environmental benefit. They are not expected to have a significant impact upon the volume of waste but can affect the composition of the waste stream significantly.

Special governmental programs are considered to be a good way to demonstrate waste reduction methods and to assist business and industry in reducing waste reduction and increasing recycling.

Home yard waste composting is a cost-effective, low-risk method for significantly reducing the waste stream. Participation by the public sufficient to measurably reduce waste will require local government to vigorously "market" the program, a worthwhile effort considering the significant amount of yard waste in the overall waste stream.

Industrial waste exchanges have been effective for some time. There is now potential for applying this concept to household hazardous wastes as well.

It is recommended that the waste reduction program be developed in the priority order listed above, and that investment of resources be made in those methods and techniques which will provide the greatest return.

(b) Recycling Program

Drop-off/buy-back depots are considered to be highly cost-effective, very feasible, and have the potential to significantly impact the waste stream volume. With proper public education, this method provides an effective approach to managing the large percentage of self-hauled waste generated in this WGA. Point-of-disposal implementation of this method should be emphasized to make recycling for self-haul patrons convenient and practical.

Education was ranked high due to its low environmental impact, high feasibility, and significant volumetric impact, even though it was only rated as moderately cost-effective. Educational programs would greatly benefit this WGA because of the large self-haul volume, which may otherwise escape recycling efforts.

Commercial source-separated recycling is potentially effective, particularly in the food packaging industry. Constraints to commercial recycling include the relatively sparse clusters of commercial activity; however, sufficient amounts of commercial waste exist overall to achieve notable results in recycling, and a limited amount is currently taking place. Markets are generally adequate for materials typically collected during commercial recycling.

Yard waste composting shows excellent potential for reducing waste stream volume, although its cost-effectiveness is moderate and its environmental impacts are slightly greater than other, higher-ranking recycling methods. Currently, no significant market exists for lawn and garden waste, and market development efforts would be necessary. In the North Central WGA, approximately 70% of yard waste is found in the self-haul waste substream.

Point-of-disposal drop-off/buy-back depots could provide for convenient capture of a significant portion of yard wastes. Self-haul yard wastes alone make up approximately 15% of the current waste total.

Recycling incentives are environmentally sound. Even though they may only moderately affect volumes, this method can be used jointly with the mostly self-directed drop-off/buy-back methods recommended above.

Reuse, single-family curbside collection, commercial high-grade targeted loads, and food waste processing methods were essentially ranked as equal, having fairly low effects on volume and moderate cost-effectiveness. These methods cause low-to-moderate impacts to the environment. Single-family curbside collection techniques, feasible in a few areas, are more costly than other methods according to the economic model. The efforts necessary to conduct commercial high-grade collection would be more effective if channelled into the source-separated collection method. Food waste processing, for food industry wastes only, could enhance a yard waste composting program; however, the volumes are relatively small and seasonal.

Disincentives have a low impact on waste stream volume and are not considered effective recycling methods for this WGA.

Multi-family collection methods do not appear to offer significant volume impact, would not be cost-effective, and would be difficult to implement. This is primarily because of low population density.

Mixed-waste processing and MSW composting could have significant volumetric impacts, but would be difficult to implement in this WGA. High capital and operating costs and low public support would be major barriers to implementation.

(c) Disposal Programs

Landfilling and incineration were ranked as essentially equal, with a preference toward landfilling. Although relatively cost-effective, landfilling measures poorly in volumetric impact. While incineration shows fairly high potential for volume reduction, it would be less cost-effective and is considered less feasible than landfilling. Long hauling, with disposal out of the WGA, is not considered cost-effective. All methods present exposure to adverse environmental impacts.

Objectives for each category of solid waste appear in Table E-63. These objectives depict the amount of each category which could reasonably be handled by each method. The objectives are based on the results of the WGA-recommended model and on the current levels of recycling in each WGA.

Table E-63

VAA00355

Waste Stream Category Objectives By Method for North Central WGA

% OF WASTE STREAM CATEGORY MANAGED BY METHOD

WASTE STREAM CATEGORY (METHOD/TECHNIQUE)	RECYCLING: REUSE	SINGLE FAMILY CURBSIDE COLLECTION	MULTI-FAMILY HOUSING COLLECTION	COMMERCIAL SOURCE SEPARATION	COMMERCIAL HIGH GRADE	COMMERCIAL DIRECT	DROP OFF / BUYBACK DEPOTS	MIXED WASTE PROCESSING	YARD WASTE COMPOSTING	MIXED WASTE COMPOSTING	FOOD WASTE PROCESSING	SUBTOTAL RECYCLING	DISPOSAL: ANAEROBIC DECOMPOSITION	PYROLYSIS / GASSIFICATION	REFUSE DERIVED FUEL PREP. & USE	MASS BURN INCINERATION / ASHFILL	LANDFILL	LONG HAUL	SUBTOTAL DISPOSAL	TOTAL (%)
NEWSPAPER						21						21					79		79	100
CORRUGATED CARDBOARD			21		11	4						36					64		64	100
HIGH GRADE PAPER			19									19					81		81	100
MIXED SCRAP PAPER (RECYCLABLE)																	100		100	100
REFILLABLE GLASS CONTAINERS			15			55						70					30		30	100
GLASS			6			4						10					90		90	100
ALUMINUM						44						44					56		56	100
TIN PLATED FOOD & BEVERAGE CANS						1						1					99		99	100
FERROUS METAL					61	3						64					36		36	100
NON-FERROUS METAL					33	2						35					65		65	100
WHITE GOODS																	100		100	100
PET PLASTICS																	100		100	100
HDPE PLASTICS																	100		100	100
PLASTIC PACKAGING (LDPE)																	100		100	100
EXPANDED POLYSTYRENE																	100		100	100
OTHER PLASTICS																	100		100	100
TIRES																	100		100	100
OTHER RUBBER PRODUCTS																	100		100	100
FOOD																	100		100	100
LAWN AND GARDEN WASTE							78					78					22		22	100
WOOD																	100		100	100
DISPOSABLE DIAPERS																	100		100	100
OIL						68						68					32		32	100
BATTERIES						44						44					56		56	100
OTHER HOUSEHOLD HAZARDOUS																	100		100	100
CONSTRUCTION DEBRIS (NOT WOOD)																	100		100	100
OTHER ORGANIC																	100		100	100
OTHER INORGANIC																	100		100	100

8. SOUTH CENTRAL WGA

a. Introduction to South Central WGA

(1) Location

The South Central Waste Generation Area (South Central WGA) is located in the southern part of the State of Washington just east of the Cascades. It encompasses the Yakima Indian Reservation and the Yakima River Valley. The total area of the South Central WGA is 8,475 square miles.

The following counties are included in the South Central WGA:

- Kittitas
- Klickitat
- Yakima

(2) Population

The estimated 1987 population of the South Central WGA was 226,000 persons. Of this, 48% resided in the 22 incorporated towns and cities of the area. The Washington State Office of Financial Management predicts a 9% growth in population by 1995, to 246,340 for the area. According to 1980 Census figures, 43% of the population lived in rural areas (defined as outside of urbanized areas or outside Census-designated places of 2,500 or more inhabitants).

In 1987, there were 92,860 housing units in the South Central WGA (April 1 estimate). Sixty-nine percent (69%) of these units were single-family dwellings. This total represents an increase of 7,800 housing units since 1980 (9% growth).

(3) Economy

The Washington State Department of Employment Security estimated December, 1987 employment in the South Central WGA to be 76,220 persons. The number of "employer units" (i.e., separate business locations) was put at 5,930. In 1986, nearly seven out of ten employed persons in the South Central WGA (69%) worked in the government (18%), service (18%), retail (17%), or agricultural (16%) sectors.

b. Existing Solid-Waste Management Methods

(1) Solid-Waste Reduction and Recycling

There are approximately 16 recycling centers in the South Central WGA (this figure excludes beverage distributors handling refillable bottles, as well as battery and tire distributors). In 1987, these centers handled 43,400 tons of materials, representing 18.3% of the estimated total tonnage of solid waste generated. The following sections summarize the reduction and recycling programs in each of the counties in the South Central WGA.

(a) Kittitas County

The majority of recycling occurs in Ellensburg. The Upper County Transfer Station operates some recycling facilities, and the City of Ellensburg has a buy-back center which accepts paper, glass, aluminum, cans, batteries, and metal scrap. Other recycling efforts are conducted by nonprofit organizations.

(b) Klickitat County

The Horse Thief Landfill in Klickitat County has facilities for the collection of white goods and ferrous scrap metal. Various civic organizations operate recyclables collection as well.

(c) Yakima County

Yakima County currently directs recycling awareness and education efforts through elementary schools, brochures, and tours of landfills and recycling centers. The County also conducts reuse efforts, as well as drop-off/buy-back centers. The three County-owned landfills at Terrace Heights, Cheyne Road, and Snipes Mountain all offer separation of white goods and tires. The County has contracted with two parties to salvage cardboard, aluminum, and batteries at each of these landfills. In addition, turn-in days for household hazardous waste are offered three times each year at the County's landfills. A municipal composting site has been approved for construction in the spring of 1989.

(2) Solid-Waste Collection

In the South Central WGA, there are six haulers collecting municipal solid waste under U.T.C. certificates (franchises). Eight cities operate their own solid waste collection services. These cities are Yakima, Wapato, Granger, Toppenish, Moxee City, Selah, Grandview, and Mabton. All other collection in this WGA is conducted through a contractual agreement between city and hauler. Table E-64 summarizes this information.

The operators hauled an estimated 132,000 tons of waste in 1987, 46% of which was from the commercial sector, and 54% from residences. Including self-haul tonnages, the total disposed waste for 1987 was estimated to be 195,000 tons.

It is reported that there are seven rural self-haul drop-box sites in Yakima County (depending on the definition used for "drop-box," the number may vary; there appear to be different interpretations of the terms "drop-box" and "transfer station"). Table E-65 describes them in greater detail.

(3) Solid-Waste Disposal

There are seven operating landfills accepting municipal waste in the South Central WGA and one balefill (a landfill for which solid waste comes prebaled); six of these are open to the public. The private landfills are operated by the Yakima Indian Reservation and the U.S. Army Firing Center in

Table E-64
WASHINGTON DEPARTMENT OF ECOLOGY
Recycling and Waste Stream Survey-1987
SOUTH CENTRAL WASTE GENERATION AREA
HAULERS

NAME	PUBLIC/ PRIVATE	FRANCHISES	AREA SERVED	DESTINATION/COUNTY
O'Neil & Sons	Private		Kittitas	Ryegrass Balefill/ Kittitas
City of Yakima	Public		City of Yakima	Terrace Heights L.F./Yakima
Ellensburg Disposal	Private	F	Kittitas County	Ellensburg Baling Station/Kittitas
Yakima Valley Disp.	Private	F	Yakima Co.	Terrace Heights L.F./Yakima
City of Wapato	Public		City of Wapato	Cheyne L.F./Yakima
City of Granger	Public		City of Granger	Terrace Heights L.F./Yakima
City of Toppenish	Public		City of Toppenish	Cheyne L.F./Yakima
Moxee City	Public		Moxee City	Terrace Heights L.F./Yakima
City of Selah	Public		City of Selah	Terrace Heights L.F./Yakima
City of Grandview	Public		City of Grandview	Grandview L.F./Yakima
City of Mabton	Public		City of Mabton	Grandview L.F./Yakima
Czyhold Truck Lines Inc.	Private	F	Yakima Co.	Terrace Heights L.F./Yakima
Custom Agricultural Service, Inc.	Private		Agriculture Companies in Yakima County	Terrace Heights L.F./Yakima

NAME	PUBLIC/ PRIVATE	FRANCHISES	AREA SERVED	DESTINATION/COUNTY
Bingen Garbage Svc.	Private	F	Klickitat Co.	Horse Thief L.F./Klickitat
City of White Salmon	Public		Klickitat Co.	Horse Thief L.F./Klickitat
Environmental Waste Systems, Inc.	Private		Clark Co.	Horse Thief L.F./Klickitat
County Garbage Svc.	Private	F	Yakima Co.	Snipes Mt. L.F./Yakima
Tri-County Disposal Service, Inc.	Private	F	Klickitat Co.	Horse Thief L.F./Klickitat

Table E-65
WASHINGTON DEPARTMENT OF ECOLOGY
Recycling and Waste Stream Survey-1987
SOUTH CENTRAL WASTE GENERATION AREA
RURAL DROP BOXES

COUNTY	LOCATION	SIZE	TYPE	OTHER
Yakima	Ahtanum	40 cy	Coin-Operated	All of the Yakima Co. Drop boxes are deposited at the Terrace Heights Landfill in Yakima Co.
	Cowiche	30 cy	Coin-Operated	
	Naches	30 cy	Coin-Operated	
	Nile	30 cy	Coin-Operated	
	Selah	30 cy	Coin-Operated	
	Tampico	30 cy	Coin-Operated	
	Tieton River	30 cy	Coin-Operated	

Yakima County. Table E-66 presents more detailed information on landfills and transfer stations. The estimated remaining capacities of these landfills range from one to 500 years (some information was unavailable); Table E-67 summarizes this information.

Based on 1987 quantities of waste disposed, rough estimates were generated for the tonnage of waste that could be accommodated by present landfills in the South Central WGA. Calculations were based only on information from landfills accepting municipal waste, except for those on military bases and Indian reservations. The tons of waste disposed at each landfill in 1987 were multiplied by the reported years of remaining life. Remaining life was defined as:

1) The number of years between 1987 and a closure data mandated by permit; or

2) if no mandated closure date is specified, the number of years between 1987 and an estimated closure date (due to exhaustion of site capacity, landfill noncompliance, or business closure); or

3) the smaller of the two figures, if both exist.

Using this method, it was estimated that the South Central WGA had sufficient landfill capacity at the end of 1987 to accommodate approximately 32,083,000 additional tons of solid waste. Care should be taken when interpreting this figure, since a WGA total estimate may not reflect situations facing individual jurisdictions. Landfills which did not report sufficient information to calculate tonnage capacity are not represented in the above estimate (refer to Tables E-66 and E-67).

(4) Solid-Waste Management Planning

Kittitas County--currently updating its plan; draft due in June of 1989.

Klickitat County--recently prepared a 1988 draft plan for the DOE.

Yakima County--currently operating under its 1985 plan but will have an updated draft in 1990.

c. Market Capacity

Most of the material recovered from the South Central WGA is sent to Seattle area end-users or exporters, though some goes to Portland, and specialty product and insulation manufactures in Yakima use some scrap paper. Newspaper, corrugated containers and high-grade papers are sent to mills in the Puget Sound area, which pay freight costs. Markets for these three paper categories are adequate. Mixed waste paper is not recovered in significant amounts, partly because of low volumes and the combination of low prices and high handling costs.

Table E-66
WASHINGTON DEPARTMENT OF ECOLOGY
Recycling and Waste Stream Survey-1987
SOUTH CENTRAL WASTE GENERATION AREA

DISPOSAL FACILITIES

COUNTY	FACILITY	NAME	ACCESS	1987 TONS RECEIVED	REMAINING CAPACITY*	DESTINATION	1987 TIPPING FEES
Kittitas	Balefill:	Ryegrass	Public	14,800	500 Years; 16,852,000		$25.75/Ton
	Transfer Stations:	Upper Co.	Public	3,000		Ellensburg Baling Station	$25.75/Ton
	Baling Station:	Ellensburg	Public	14,800		Ryegrass Balefill	$25.75/Ton
Klickitat	Landfills:	Horse Thief	Public	17,400	49,900 CY		$3.25/CY; Min $5.00/Load
Yakima	Landfills:	Cheyne Rd.	Public	10,200	22-23 Years; 20 Acres		$11.35/Ton
		Grandview	Public	20,900	1-2 Years		$11.90/Ton
		Snipes Mt.	Public	10,800	27-28 Years; 27 Acres		$11.35/Ton
		Terrace Heights	Public	110,800	20+ Years; 110 Acres		$11.35/Ton
		U.S.Firing Center	Private	2,400	20 Years		-0- -Military Base
		Yakima Indian Reservation	Private	10,900	250 Acres		-0- -Indian Reservation

CY = Cubic Yard
CCY= Compacted Cubic Yard
LCY= Loose Cubic Yard

*Based on space available at the end of 1987, regardless of mandated or planned closure dates.

TABLE E-67
WASHINGTON DEPARTMENT OF ECOLOGY
Recycling and Waste Stream Survey-1987
SOUTH CENTRAL WASTE GENERATION AREA
LANDFILL CAPACITIES

COUNTY	FACILITY NAME	MANDATED CLOSURE (Date/None)	REMAINING CAPACITY* (Years/C.Y./Acres)	COMMENTS (#)
Kittitas	Ryegrass Balefill	None	500 Years; 16,852,000 CY	1
Klickitat	Horse Thief	11/89	49,900 CY	2
Yakima	Cheyne Road	None	22-23 Years; 20 Acres	3
	Grandview	None	1-2 Years	4
	Snipes Mountain	None	27-28 Years; 27 Acres	
	Terrace Heights	None	20+ Years; 110 Acres	
	U.S. Firing Center	None	20 Years	
	Yakima Indian Reservation	None	250 Acres	

COMMENTS

1. Capacity figures were as of 1986. Total site = 640 acres.
2. Scheduled to close 11/89 because of noncompliance problems.
3. In the process of leasing 600 additional acres.
4. 1-2 years capacity due to location and soil availability. Otherwise, area is sufficient for more than 1-2 years of operation.

*Based on space available at the end of 1987, regardless of mandated or planned closure dates.

Markets for aluminum cans and other high value-metals are good. Small amounts of tin cans are recovered, though capacity to handle them at the Seattle plant is high. Significant quantities of glass go to Oregon, with lower cost freight rates available for interstate shipments. No significant volumes of white goods were recovered in 1987; however, disposal costs can be reduced if the items can be compacted before being shipped to the Seattle-Tacoma or Portland area. Plastics are not currently recovered from the WGA; transportation costs for future recovery could be high. One manufacturer in Yakima currently recycles industrial scrap films, and could potentially be an end-user for post-consumer material as well. No markets for yard waste exist in the area, but could be developed in some communities.

A market capacity summary for the South Central WGA is presented in Table E-68.

d. Evaluation of Methods

(1) Feasibility Analysis

Notable exceptions to the Statewide Technical Feasibility Review for the South Central WGA include:

- Home Yard Waste Composting. Risk of residue disposal was judged lower than the Statewide rating. The working group felt that homeowners would not undertake home composting if residue disposal were a problem.

- Reuse. Siting, waste supply, and market risks were judged to be greater than the Statewide rating; the working group believed that the clutter associated with "fees market" type exchanges would be unacceptable. Existing yard sales were preferred for waste exchange. Local governments could coordinate or otherwise assist bringing together buyers and sellers for yard sales.

- Drop-Off/Buy-Back Depots. Waste composition exposures to loss were judged lower than the Statewide rating. This is likely due to relatively low disposal fees at established disposal sites resulting in little pressure to find alternative places to dump.

- Mixed Waste Processing. The working group felt that technology-related exposures to loss were lower than the Statewide rating. The required processing equipment was judged to be available and workable. Some exposure was identified with vendor selection.

- Food Waste Processing. The working group judged exposures related to food waste processing siting and waste supply to be lower than Statewide ratings. This rating is limited to food processing industry waste as compared to household and institutional food waste. Local

Table E-68

Market Capacity Summary for South Central WGA

	COMMODITY	MAJOR END USERS FOR MATERIAL FROM WGA (Name &/or Location)	ESTIMATED END USER PRICE '88 ($/Ton)	VOLUME OF WGA MATRL. RECOVERED (1987 Tons)	(1) WGA COLLECTED MATERIAL PRICE ($/Ton)	(1) WGA COLLECTED MATERIAL VALUE ($/Year)	(2) WGA MARKET CAPACITY	FACTORS AFFECTING WGA MARKET FOR MATERIAL
1	Newsprint	CCA - Tacoma Sonoco - Sumner, some to OR	$45.00	8,800	$16	$140,800	ADEQUATE	Most goes to regional mills which provide freight
2	Corrugated Containers	some local use CCA - Tacoma Sonoco - Sumner	$65.00	7,300	$40	$292,000	ADEQUATE	Most goes to regional mills which provide freight
3	High Grade Paper	some to Oregon mills CCA/Tacoma, Scott/Evrt. Weyerhser - OR, Midwest	$100.00	200	$45	$9,000	ADEQUATE	Most goes to regional mills which provide freight
4	Mixed Waste Paper	Export Sonoco - Sumner	$25.00	0	($11)	$0	NOT SIGNIFICANT	Instate tariff - $.08/ton/mile Low supply & high transport cost
5	Container Glass	Owens-Brockway, Portland	$40.00	900	$15	$13,500	ADEQUATE	Freight assistance for interstate shipment reduces costs
6	Refillable Glass	Rainier Brewing - Sea. Pabst/Olympia some Soft Drink	$116.00	1,400	$49	$68,600	ADEQUATE	
7	Aluminum Bev. Cont.	Various Alum. Co. Ship from Seattle &/or Spokane	$1,000.00	700	$833	$583,100	ADEQUATE	Instate tariff - $.12/ton/mile
8	Tin Cans	MRI - Seattle	$49.00	100	$21	$2,100	ADEQUATE	Instate tariff - $.12/ton/mile Freight assistance reduces cost
9	Ferrous Metals	General Metals - Tac. Salmon Bay/Seattle Steel some to Oregon	$65.00	19,000	$33	$627,000	ADEQUATE	Instate tariff - $.12/ton/mile
10	White Goods	General Metals - Tac. Seattle Iron & Steel Schnitzer - Portland	$20.00	0	($17)	$0	POTENTIAL DISP. AVOID.	Mobile loggers help reduce cost
11	Non Ferrous Metals	Various - Tacoma/Seattle	$800	3,000	$633	$1,899,000	ADEQUATE	Instate tariff - $.31/ton/mile
12	PET Bottles	Midwest & East U.S.	$160	0	$21	$0	NOT SIGNIFICANT	Low supply & high transport cost Potential future market
13	HDPE Bottles	Export - Puget Sound Partek - Vancouver	$200	0	$61	$0	NOT SIGNIFICANT	Low supply & high transport cost Potential future market
14	Plastic Films (LDPE)	Export - Puget Sound	$160	0	$40	$0	NOT SIGNIFICANT	Low supply & high transport cost Potential future market
15	Lawn & Garden Waste	None	($20)	0	($30)	$0	NOT SIGNIFICANT	Potential disp. avoid. market

(1) WGA prices and values are before transportation, processing and handling necessary to prepare and move material to market.

(2) WGA market capacity is based on an assessment of the markets' ability to consume consistently and gradually increasing volumes.

REFER TO TEXT FOR DETAILED DISCUSSION

food processing industries have established a record of successfully treating and economically recovering food waste for resale to other industries.

- Long-Haul Transport. Obtaining permits for long-haul transport was judged to show less exposure to loss than the Statewide rating indicates. The working group felt that the WGA region was close enough to potential long-haul destinations, such as developed landfill(s), that a simple truck transport system would be sufficient. Rail and/or barge transport is not reasonably available to this WGA.

- Landfill. The working group rated landfill siting exposure as lower than the Statewide rating. This is primarily because of the rural nature, general land availability, and the much dryer climate of this WGA.

The exposure to loss feasibility analysis for the South Central WGA is presented in Table E-69.

(2) Environmental Evaluation

(a) Impacts

Potential environmental impacts in the South Central WGA are generally same as identified in the generic discussion of impacts. The very low precipitation in this WGA limits the potential for leachate generation from methods such as composting, landfills, or ashfills. On the other hand, the high summer temperature suggests that the landfill decomposition process may be somewhat more rapid, increasing generation of methane gases. In addition, the high summer temperatures would increase the potential for odor problems from food waste composting and other facilities, anaerobic composting upset, and storage for such alternatives as mass burn incineration. In addition, incineration must be considered in light of the Yakima vicinity's classification as a non-attainment area for particulates. These factors are reflected in the environmental impact matrix (Table E-70).

An evaluation of potential environmental impacts due to failures in the technology are presented in Table E-71.

(b) Concerns

As can be seen from the environmental concern evaluation matrix (Table E-72), the South Central WGA working group expressed less concern about potential environmental impacts of food waste processing, landfills, and ashfills than in other WGA's. The lower concern about food waste processing reflects experience with successful use of waste from food processing plants as animal feed.

Table E-69

Evaluation of Exposure to Loss

for South Central WGA

VAA0SC28

DEGREE OF EXPOSURE TO LOSS ASSOCIATED WITH IMPLEMENTATION & USE OF EACH METHOD

TECHNICAL IMPLEMENTATION FACTOR			REDUCTION						RECYCLING														HANDLING		DISPOSAL					
			EDUCATION	INCENTIVES	DISINCENTIVES	MODEL GOVERNMENTAL PROGRAMS	WASTE EXCHANGE	HOME YARD WASTE COMPOSTING	REUSE	CURBSIDE COLLECTION	MULTI-FAMILY HOUSING COLLECTION	COMMERCIAL SOURCE SEPARATION	INTERMEDIATE PROCESSING FACILITY	COMMERCIAL MIXED WASTE PROCESSING	DROP OFF / BUYBACK DEPOTS	MIXED WASTE PROCESSING	YARD WASTE COMPOSTING	MIXED WASTE COMPOSTING	FOOD WASTE PROCESSING	SPECIAL WASTE RECYCLING AND REUSE	TRANSFER	LONG HAUL TRANSPORT	ANAEROBIC DECOMPOSITION	PYROLYSIS / GASSIFICATION	REFUSE DERIVED FUEL PREP. & USE	MASS BURN INCINERATION	LANDFILL	ASHFILL
SITING	SITING RESISTANCE	GENERAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	L/M	L	M/H	L	M/H	M	M/H	M/H	NA	M/H	M/H	H	H	H	H
		WGA SPECIFIC	NA	NA	NA	NA	NA	NA	M	NA	NA	NA	L	M	L	M	L/M	M	L	M/H	M	NA	M	M/H	H	M/H	M	H
	PERMITS AQUISITION DIFFICULTY	GENERAL	NA	NA	NA	NA	NA	NA	L	L	L	L	L	L/M	L	M	L	M/H	M	L/M	M	NA	M	M/H	H	H	H	H
		WGA SPECIFIC	NA	NA	NA	NA	NA	NA	M	L	L	L	L	M	L	M	L/M	M	M	L/M	L/M	NA	L/M	M/H	H	H	M	H
	TIME & COST REQUIRED TO COMPLETE SITING	GENERAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	L/M	L	L	L	M/H	M	M/H	M	NA	M/H	M/H	H	H	H	H
		WGA SPECIFIC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	M	L	M	L	M/H	L	M	M	NA	M	M/H	H	H	M/H	H
WASTE SUPPLY	QUANTITY	GENERAL	NA	NA	NA	NA	L	NA	L	M	M	L	L/M	L	L	L	L	L	M/H	L/M	L/M	L/M	L/M	M	M	M	L	L
		WGA SPECIFIC	NA	NA	NA	NA	L	NA	M/H	M/H	M/H	L	M	L	L	L	L	L	L	M	L	L	L/M	M	M	M	L	L
	COMPOSITION	GENERAL	NA	NA	NA	NA	L	L	L/M	L/M	L/M	L	M	L/M	L/M	L/M	L/M	M	L	L/M	L	L/M	L	L/M	M	M	L	L/M
		WGA SPECIFIC	NA	NA	NA	NA	L	L	M/H	L/M	L/M	L	L	M	L	M	L	M/H	L	M	L	L	L	L/M	M	M	L	L
MARKETS		GENERAL	NA	NA	NA	NA	L	NA	L	M	M	L/M	L/M	L/M	L/M	M/H	M	M/H	M/H	L/M	NA	NA	L/M	M/H	M/H	M	NA	NA
		WGA SPECIFIC	NA	NA	NA	NA	L	NA	H	L/M	L/M	L/M	M	M	M	M	L/M	M	L	M/H	NA	NA	L/M	M/H	M/H	M/H	NA	NA
VENDOR		GENERAL	NA	NA	NA	NA	L	NA	NA	L/M	L/M	L/M	L/M	L/M	L	M/H	L	M/H	L/M	L/M	L	L/M	L	H	M	M	NA	NA
		WGA SPECIFIC	L	NA	NA	NA	NA	NA	NA	L	L	L	L	M	L	M/H	L	M/H	L	M/H	L	L	L	H	M	M	NA	NA
TECHNOLOGY/ PROGRAM	ABILITY TO CONSTRUCT & MAKE OPERATIONAL	GENERAL	L	M/H	M/H	L	L	M	L/M	L	M	L	L/M	L/M	L	M/H	L	L/M	L	L/M	L/M	NA	L	H	M	M	L/M	L/M
		WGA SPECIFIC	L	M/H	M/H	L	L	M	L/M	L	L	L	L	M	L	L/M	L	M	L	L/M	L/M	L	L	H	M	M	L/M	L/M
	ABILITY TO OPERATE AND MAINTAIN	GENERAL	L	L/M	L/M	L	L	M	L/M	L	M	L	L/M	L/M	L/M	M	L/M	L/M	L/M	L/M	L/M	M/H	L	M/H	M/H	M	M	L
		WGA SPECIFIC	L	L/M	L/M	L	L	M	L/M	L	M/H	L	L	M	L	M	L	L/M	L	L/M	M	L/M	L	M/H	M/H	M	L/M	L/M
RESIDUE DISPOSAL	CHARACTERISTICS	GENERAL	NA	NA	NA	NA	NA	M	NA	L	L	L	L	L	L	L	L	L	L	M/H	NA	NA	M	M	L/M	M/H	NA	NA
		WGA SPECIFIC	NA	NA	NA	NA	NA	L	NA	L	L	L	L	L	L	L	L	L	L	M/H	NA	NA	M	M	L/M	M/H	NA	NA
	SITE AVAILABILITY	GENERAL	NA	NA	NA	NA	NA	M	NA	NA	NA	NA	L	L	L	L	L	L	L	M/H	NA	NA	M	M	L/M	M/H	NA	NA
		WGA SPECIFIC	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	L	L	L	L	L	L	L	M/H	NA	NA	M	M	L/M	M/H	NA	NA
FINANCING		GENERAL	L	L	L	L	L	L	L	L	L/M	L	L/M	M	L	M	L	L/M	M	M	L/M	L/M	L/M	H	M/H	M/H	M	M
		WGA SPECIFIC	L	L	L	L	L	L	L	M	M	L	M/H	M/H	M	M	L	L/M	M	M	L/M	L	L/M	H	M/H	H	M	M
UNCONTROLLABLE CIRCUMSTANCES**		GENERAL	L	M	M	L	M	M	L	L	L	L	L	L/M	M	M	L	M	M	M/H	M	M	M	M/H	M/H	M/H	M/H	M/H
		WGA SPECIFIC	L	M	M	L	M	M	L	M	M	M	M	L/M	M	M	L	M	M	M/H	L/M	M	M	M/H	M/H	M/H	M/H	M/H

KEY:

NA = NOT APPLICABLE
H = HIGH
M = MODERATE
L = LOW

Table E-70

Evaluation of Environmental Impacts *

for South Central WGA

VAADSC26

DEGREE OF POTENTIAL ENVIRONMENTAL IMPACT ASSOCIATED WITH IMPLEMENTATION & USE OF EACH METHOD

ENVIRONMENTAL FACTOR	REDUCTION						RECYCLING												HANDLING		DISPOSAL					
	EDUCATION	INCENTIVES	DISINCENTIVES	MODEL GOVERNMENTAL PROGRAMS	WASTE EXCHANGE	HOME YARD WASTE COMPOSTING	REUSE	CURBSIDE COLLECTION	MULTI-FAMILY HOUSING COLLECTION	COMMERCIAL SOURCE SEPARATION	INTERMEDIATE PROCESSING FACILITY	COMMERCIAL MIXED WASTE PROCESSING	DROP OFF / BUYBACK DEPOTS	MIXED WASTE PROCESSING	YARD WASTE COMPOSTING	MIXED WASTE COMPOSTING	FOOD WASTE PROCESSING	SPECIAL WASTE RECYCLING AND REUSE	TRANSFER	LONG HAUL TRANSPORT	ANAEROBIC DECOMPOSITION	PYROLYSIS / GASSIFICATION	REFUSE DERIVED FUEL PREP. & USE	MASS BURN INCINERATION	LANDFILL	ASHFILL
AIR QUALITY	NA	NA	NA	NA	NA	NA	NA	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
CRITERIA POLLUTANTS: SO2, NOX, HCL								L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	L	L	L	L	L
TOXICS								L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L/M	L/M	L	L
PARTICULATES																										
ODOR	NA	NA	NA	NA	NA	L	NA	NA	L	NA	L	NA	L	L	L	L	L/M	L	L	NA	L/M	L/M	L/M	L/M	L/M	NA
SURFACE WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	NA	NA	NA	L	L	L	L	L	NA	NA	L	L	L	L	L	L
GROUND WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	NA	NA	NA	L	L	L	L	L	NA	NA	L	L	L	L	L	L
NOISE	NA	NA	NA	NA	NA	L	NA	L	L	NA	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
RISK OF EXPLOSION	NA	NA	NA	NA	NA	NA	NA	NA	L	NA	NA	L	NA	L	NA	L	NA	L	L	NA	L	L	L	L	L	NA
PUBLIC HEALTH RISKS	NA	NA	NA	NA	NA	L	NA	NA		NA	L								L	L	L	L	L	L	L	NA
PATHOGENS						L		NA	L	NA	L	NA	L	L	NA	L	L	NA	L	L	L	L	L	L	L	NA
VECTORS						L		NA	L	NA	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	NA
TOXICS						L		NA	L	NA	L	L	L	L	L	L	L	L	NA	NA	L/M	L/M	L/M	L/M	L	L/M
AESTHETICS	NA	NA	NA	NA	NA	L	NA	L	L	NA	L	L	L	L	L	L	L	L	L	NA	L	L	L	L	L	L
TRAFFIC	NA	NA	NA	NA	L	NA	NA	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
OTHER																										

KEY: **

NA = NOT APPLICABLE
H = HIGH RATING
M = MEDIUM RATING
L = LOW RATING

* THIS EVALUATION ASSUMES NEW "STATE OF THE ART" FACILITIES, PROPERLY SITED WITH FACILITY DESIGN INCORPORATIONG APPROPRIATE MITIGATION TECHNIQUES.

** A HIGH RATING INDICATES A HIGH LEVEL OF LOCAL ENVIRONMENTAL IMPACT
A LOW RATING INDICATES A LOW LEVEL OF ENVIRONMENTAL IMPACT

Table E-71

VAA0SC27

Evaluation of Potential Environmental Impacts *
for South Central

DEGREE OF POTENTIAL ENVIRONMENTAL IMPACT ASSOCIATED WITH IMPLEMENTATION & USE OF EACH METHOD

ENVIRONMENTAL FACTOR	REDUCTION						RECYCLING												HANDLING		DISPOSAL					
	EDUCATION	INCENTIVES	DISINCENTIVES	MODEL GOVERNMENTAL PROGRAMS	WASTE EXCHANGE	HOME YARD WASTE COMPOSTING	REUSE	CURBSIDE COLLECTION	MULTI-FAMILY HOUSING COLLECTION	COMMERCIAL SOURCE SEPARATION	INTERMEDIATE PROCESSING FACILITY	COMMERCIAL MIXED WASTE PROCESSING	DROP OFF / BUYBACK DEPOTS	MIXED WASTE PROCESSING	YARD WASTE COMPOSTING	MIXED WASTE COMPOSTING	FOOD WASTE PROCESSING	SPECIAL WASTE RECYCLING AND REUSE	TRANSFER	LONG HAUL TRANSPORT	ANAEROBIC DECOMPOSITION	PYROLYSIS / GASSIFICATION	REFUSE DERIVED FUEL PREP. & USE	MASS BURN INCINERATION	LANDFILL	ASHFILL
AIR QUALITY	NA	NA	NA	NA	NA	NA	NA												M	M	M/H	H	M	M	M	L
CRITERIA POLLUTANTS: SO2, NOX, HCL								L	L	L	L	L	L	M	L	M	L	M	L	L	M/H	H	M	M	H	L/M
TOXICS								L	L	L	L	L	M	L	L	L	L	M	M	M	L	L/M	H	M	H	M/H
PARTICULATES								L	L	L	L	L	L	L	L	L	L									
ODOR	NA	NA	NA	NA	NA	L/M	NA	L	L	L	L/M	L	L/M	H	L	M	H	L	L/M	L/M	H	H	M	M	H	L
SURFACE WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	L	L	L/M	M	L/M	M	M	M	L	L	L	L	L	L	M	M
GROUND WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	L	L	L	M	L/M	M	M	M	L	L	L	L	L	L	L/M	L/M
NOISE	NA	NA	NA	NA	L	L	NA	L/M	L/M	L/M	L/M	M/H	M	H	M	L/M	L/M	L	M/H	M/H	M	M/H	M/H	M/H	M	M
RISK OF EXPLOSION	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	L/M	L	H	L/M	L/M	L	L	L	L	M/H	M	H	M	H	L
PUBLIC HEALTH RISKS	NA	NA	NA	NA	NA		NA																			
PATHOGENS						L		L	L	L	L	L	L/M	M	L	M	H	NA	M	L	L	L	L	L	L/M	L
VECTORS						L/M		L	L	L	L	L	L/M	M	L	M	H	M	M	L	L	L	L	L	M	L
TOXICS						L		NA	NA	NA	L	L	L	M	L	M	M	M	L	L	M/H	M/H	M/H	M/H	M/H	M
AESTHETICS	NA	NA	NA	NA	M	M	NA	L/M	L/M	L/M	L/M	M	M	H	M/H	M	M/H	L/M	M/H	M	M	M	M	M	M	M
TRAFFIC	NA	NA	NA	NA		NA	NA	L/M	L/M	L/M	M	M	L/M	H	M	M	M	L/M	M/H	M/H	H	H	H	H	H	L/M
OTHER																										

KEY: **

NA = NOT APPLICABLE
H = HIGH RATING
M = MEDIUM RATING
L = LOW RATING

* THIS EVALUATION ASSUMES THAT CERTAIN FAILURES OCCUR IN THE SITING PROCESS, DESIGN, MITIGATION MEASURES AND IN THE OPERATION & PERFORMANCE OF THE SELECTED TECHNOLOGY.

** A HIGH RATING INDICATES A HIGH LEVEL OF LOCAL ENVIRONMENTAL IMPACT
A LOW RATING INDICATES A LOW LEVEL OF ENVIRONMENTAL IMPACT

Table E-72

Environmental Concerns Evaluation for South Central WGA

VAAOSC25

DEGREE OF ENVIRONMENTAL CONCERN ASSOCIATED WITH IMPLEMENTATION & USE OF EACH METHOD

ENVIRONMENTAL FACTOR	REDUCTION						RECYCLING												HANDLING		DISPOSAL					
	EDUCATION	INCENTIVES	DISINCENTIVES	MODEL GOVERNMENTAL PROGRAMS	WASTE EXCHANGE	HOME YARD WASTE COMPOSTING	REUSE	CURBSIDE COLLECTION	MULTI-FAMILY HOUSING COLLECTION	COMMERCIAL SOURCE SEPARATION	INTERMEDIATE PROCESSING FACILITY	COMMERCIAL MIXED WASTE PROCESSING	DROP OFF / BUYBACK DEPOTS	MIXED WASTE PROCESSING	YARD WASTE COMPOSTING	MIXED WASTE COMPOSTING	FOOD WASTE PROCESSING	SPECIAL WASTE RECYCLING AND REUSE	TRANSFER	LONG HAUL TRANSPORT	ANAEROBIC DECOMPOSITION	PYROLYSIS / GASSIFICATION	REFUSE DERIVED FUEL PREP. & USE	MASS BURN INCINERATION	LANDFILL	ASHFILL
AIR QUALITY CRITERIA POLLUTANTS: SO2, NOX, HCL TOXICS PARTICULATES	NA	NA	NA	NA	NA	NA	NA	L	L	L	L	L	L	L	L	L	L	L	L	L	L	M	M/H	H H H	L/M	L L M
ODOR	NA	NA	NA	NA	NA	M	NA	L	L	L	L	L/M	L	M	M	M	M	L	L/M	NA	L/M	L/M	M	M	M	L
SURFACE WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	NA	L	NA	L	L/M	L/M	L/M	L/M	L	NA	L	L	L	L	L	L
GROUND WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	NA	L	NA	L	L	L	L/M	L	L	NA	L	L	L	L	L	L
NOISE	NA	NA	NA	NA	L	L	NA	L	L	L	L/M	L/M	L	L/M	L/M	M	L	L	L/M	L	L	L	M	M	M	M
RISK OF EXPLOSION	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	NA	M	NA	NA	NA	L	L	NA	M	M	M	M	L	L
PUBLIC HEALTH RISKS PATHOGENS VECTORS TOXICS	NA	NA	NA	NA	NA	L	NA	L	L	L	L	L	L	M	L	M	L	L L/M M	M	L	L/M	L/M	L/M	L L M	L/M	L L M
AESTHETICS	NA	NA	NA	NA	L/M	L/M	M	M	M	L	L	L/M	L/M	M	L/M	M	M	M	M	NA	M	M	M	M	M	L/M
TRAFFIC	NA	NA	NA	NA	L/M	NA	NA	L	L	L	L	L	M	M	M	M	L	L	M	L	M	L/M	M	M	M	L
OTHER																										

KEY: •

NA = NOT APPLICABLE
H = HIGH RATING
M = MEDIUM RATING
L = LOW RATING

• A HIGH RATING INDICATES A HIGH LEVEL OF LOCAL ENVIRONMENTAL CONCERN
A LOW RATING INDICATES A LOW LEVEL OF ENVIRONMENTAL CONCERN

(3) Economic Evaluation of Alternatives

The results of the economic analysis for the South Central WGA are summarized in Table E-73. Detailed results appear in Appendix C.

e. Ranking of Methods and Recommendations

The following paragraphs discuss the working group's rankings and consultant team's rankings for best management practices, as well as each group's recommended system for reduction, recycling, and disposal in this WGA.

(1) Working Group Rankings

Evaluation criteria were weighted by the South Central WGA working group and applied to the alternative solid waste management methods. The resulting rankings are shown in Table E-74.

The WGA working group methods ranking process produced the following preferred WGA system for solid waste management in this WGA:

- Reduction Program
  - -- Education
  - -- Incentives
  - -- Home Composting
- Recycling Program
  - -- Commercial source-separated collection with targeted high-grade materials
  - -- Education
  - -- Reuse
  - -- Drop-off and buy-back centers
  - -- Food waste processing (from food processors)
- Disposal Program
  - -- Landfill disposal within WGA

(a) Reduction Program

The working group considered education and public information to be vital parts of the waste reduction and recycling programs. The group believed that the investment in education would produce long-term benefits, and that information provided to the community was also necessary and would produce near-term response for recycling programs. It was felt education could result in positive environmental benefits with minimal exposure to loss.

The group considered incentives to be more effective than disincentives based primarily on the premise that people will respond to positive reinforcement more favorably than punitive motivation. Home yard waste composting was judged to be a potential waste reduction method for this region.

Table E-73

SOUTH CENTRAL: RECOMMENDED ALTERNATIVE

(COST ESTIMATES ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICTIONS.)

	ESTIMATED NET (COST) OR REVENUE	CONTRIBUTION TO SYSTEM COST	ESTIMATED TONS	PERCENT OF GENERATED TONS	RELATIVE RATIO OF COSTS TO TONS
COLLECTION AND PROCESSING:					
1. COLLECTION OF SINGLE FAMILY SOURCE SEPARATED RECYCLABLES	$0	0.0%	0	0.0%	NA
2. COLLECTION OF SINGLE FAMILY COMINGLED RECYCLABLES *	$0	0.0%	0	0.0%	NA
3. COLLECTION OF MULTI FAMILY COMINGLED RECYCLABLES *	$0	0.0%	0	0.0%	NA
4. COMMERCIAL DIRECT RECYCLING	$0	0.0%	24,493	10.3%	0.00 :1.00
5. COLLECTION OF COMMERCIAL SOURCE SEPARATED RECYCLABLES	($224,702)	1.4%	5,731	2.4%	0.58 :1.00
6A. DROP OFF/BUY BACK "REGULAR" RECYCLABLES	$461,598	-2.9%	11,370	4.8%	-0.60 :1.00
6B. DROP OFF/BUY BACK OF "SPECIAL" RECYCLABLES OR WASTES	($10,413)	0.1%	3,080	1.3%	0.05 :1.00
7. YARD WASTE COLLECTION AND COMPOSTING	($1,893,217)	11.8%	27,776	11.6%	1.01 :1.00
8. SORTING OF TARGETED COMMERCIAL HIGH GRADE LOADS *	$0	0.0%	0	0.0%	NA
9. SELF HAULED WASTE*	($2,154,772)	13.4%	46,539	19.5%	0.69 :1.00
10. REGULAR COLLECTION AND DISPOSAL OF MUNICIPAL WASTE *	($12,242,560)	76.2%	119,536	50.1%	1.52 :1.00
11. MIXED WASTE PROCESSING*	$0	0.0%	0	0.0%	NA
12. RDF PREPARATION*	$0	0.0%	0	0.0%	NA
SYSTEM TOTAL	($16,064,066)	100.0%	238,525	100%	1.00 :1.00
AVERAGE COST PER TON GENERATED	($67)				
DISPOSAL ONLY:					
A. MASS BURN WITH ASH MONOFILL	$0	0.0%	0	0%	NA
B. LANDFILL WITH LONG HAUL BY RAIL	$0	0.0%	0	0%	NA
C. LANDFILL WITH BALING	($2,059,430)	12.8%	41,519	17%	0.74 :1.00
D. LANDFILL ONLY	($5,630,034)	35.0%	124,556	52%	0.67 :1.00
DISPOSAL TOTAL	($7,689,464)	47.9%	166,075	70%	0.69 :1.00
AVERAGE COST PER TON DISPOSED	($46)				
RECYCLED TONS			72,450	30%	

* The net costs for these methods include disposal costs for residual or disposed wastes.

(b) Recycling Program

Corrugated cardboard is commercially source-separated at this time and has some potential for expansion. Approximately 6% of the waste stream is still available in cardboard. The working group believed that this method combined with targeted high-grade loads through an intermediate processing center can be effective. These systems can be operated at relatively low cost, particularly source separation of corrugated cardboard. With strong markets, these are profitable operations. Intermediate processing centers, a vital part of a comprehensive recycling program, currently exist in this WGA.

Reuse of recyclable commodities was considered to be an appropriate waste management method; however, it was not considered to have a significant impact on waste stream quantity or composition. Still, existing techniques such as yard sales, nonprofit organizations, and radio exchange programs, should be encouraged.

Drop-off/buy-back operations are considered an important part of a recycling program in this rural area. Concerns were expressed regarding the siting of facilities, particularly buy-back depots, and the effects of competition on waste supply quantity and composition. However, depots are a significant element in existing recycling currently being accomplished in the WGA, representing the foundation of the recycling program. They are considered to have minimal environmental impact with the potential for a significant impact on waste stream volume. Existing drop-off/buy-back depots are working well and could be expanded to increase their overall effectiveness. This group felt that special wastes were a particular problem and that reuse and recycling through drop-off operations was an appropriate management method.

The existing food processing industry is currently processes food waste and will continue to do so. The area has a strong market for food waste processed as animal feed and, in some cases, for human consumption. It was generally felt that this effort could be expanded. Domestic food waste processing, however, is not considered to be cost-effective.

The WGA working group members did not consider either curbside single-family or multi-family collection appropriate for their WGA. Although these methods are generally considered to be feasible, they were rejected by the group because of their high cost and incompatibility with municipal garbage collection systems. The group believed that significant capital investment for additional equipment would be required to implement a curbside program. Significant concern was expressed for program costs because of budget constraints on local government and low profitability for private sector operations.

Yard waste composting was considered to be a potentially cost-effective approach in this WGA. A significant quantity of yard waste is available (nearly 16% of the waste stream), and a yard waste composting system, based on self-haul, could be feasible if costs were at least comparable to landfilling. Composting facilities could be located at existing landfill sites to employ existing personnel for operation of both the composting system and the landfill. However, the general consensus of this working group was that yard waste composting is not a high priority waste management method.

Mixed municipal solid waste processing methods were not considered effective for the South Central WGA. The working group believed that with the existing landfill capacity and relatively low cost of disposal, these methods offered little opportunity for improved management of the solid waste system. Markets for municipal solid waste compost or RDF were considered to be poor to nonexistent.

(c) Disposal Program

Landfilling within the WGA was considered to be the best disposal method based on existing landfill capacity and relative ease in siting new landfills, compared to other areas of the State. The cost of landfilling was considered relatively low compared to other disposal methods, with minimal environmental impact or exposure to loss for the majority of the WGA.

Long hauling was preferred over incineration as the second ranked alternative. A concern was expressed over air quality impacts with incineration, although it was generally believed that these concerns could be mitigated. This method was not considered a good alternative for this WGA.

(2) Consultant Team Rankings

The management methods in each program (reduction, recycling, and disposal) were also ranked by the consultant team as shown in Table E-74. In the reduction program, the consultant team evaluated "special government programs" and "waste exchange," which were not ranked by the WGA working group. In addition, the consultant team ranked "commercial high-grade collection" and "mixed-waste processing" for the recycling program. "Special waste recycling/reuse" was not ranked due to the special characteristics of these components; it was assumed that special waste management will be included in any recommended program.

Based on the criteria established for the consultant team's analysis, the consultant recommended the following solid waste management system for the South Central WGA:

- Reduction Program
  - -- Education
  - -- Incentives
  - -- Special governmental programs
  - -- Disincentives
  - -- Home composting
  - -- Waste exchange
- Recycling Program
  - -- Drop-off/buy-back depots (urban/rural)
  - -- Education (urban/rural)
  - -- Commercial source-separated collection (urban)
  - -- Food waste processing (urban/rural)
  - -- Yard waste composting (urban/rural)

Table E-74

BEST MANAGEMENT PRACTICES FOR
SOLID WASTE METHODS RANKING SUMMARY

SOUTH CENTRAL WGA

Reduction		Recycling		Disposal	
WGA Working Group Preference	Consultant Team Recommendations	WGA Working Group Preference	Consultant Team Recommendations	WGA Working Group Preference	Consultant Team Recommendations
1. Education	1. Education	1. Commercial Source Separated	1. Drop-Off/Buy-Back Depots	1. Landfill	1. Landfill
2. Incentives	2. Incentives	2. Education	2. Education	2. Long Haul	2. Landfill
	2. Special Governmental Programs		2. Commercial Source Separated		2. Long Haul
Home Yard Waste Composting	3. Disincentives		2. Food Waste Processing	3. Incineration	
Disincentives	4. Home Yard Waste Composting	3. Reuse	3. Centralized Yard Waste Composting		
	5. Waste Exchange	4. Drop-Off/Buy-Back Depots	4. Incentives		
		5. Food Waste Processing	5. Reuse		
			5. Single-Family Curbside Collection		
			5. Commercial High-Grade Collection		
		6. Single-Family Curbside Collection	6. Disincentives		
		6. Multi-Family Collection			
		7. Centralized Yard Waste Composting	7. Mixed Waste Processing		
		8. Incentives	8. Multi-Family Collection		
		9. Disincentives	9. MSW Composting		
		9. MSW Composting			

-- Incentives (urban/rural)
-- Reuse (urban/rural)
-- Single-family curbside collection (urban)
-- Targeted commercial high-grade collection (urban)

- Disposal Program

-- Incineration
-- Landfill within the WGA

(a) Reduction Program

The consultant team found little justification for different waste reduction programs for different WGA's throughout the State. Based on the criteria established, the recommendations are the same Statewide and are discussed below. Education is considered to be reasonably cost-effective with excellent long-term environmental benefits considering its effect on all other management methods. The focus of education/public involvement programs is to inform and change society's view of solid waste and its management. A balance of incentives and disincentives will be necessary components of a waste reduction program. The cost-effectiveness of these methods is considered to be fair; however, their application will produce considerable environmental benefit. They are not expected to have a significant impact upon the volume of waste but can affect the composition of the waste stream significantly.

Special governmental programs are considered to be a good way to demonstrate waste reduction methods and to assist business and industry in reducing waste reduction and increasing recycling.

Home yard waste composting is a cost-effective, low-risk method for significantly reducing the waste stream. Participation by the public sufficient to measurably reduce waste will require local government to vigorously "market" the program, a worthwhile effort considering the significant amount of yard waste in the overall waste stream.

Industrial waste exchanges have been effective for some time. There is now potential for applying this concept to household hazardous wastes as well.

It is recommended that the waste reduction program be developed in the priority order listed above, and that investment of resources be made in those methods and techniques which will provide the greatest return.

(b) Recycling Program

The recommended recycling program for the South Central WGA is very similar to that preferred by the WGA working group with the addition of centralized yard waste composting and single-family curbside collection. Drop-off/buy-back depots ranked highest and are considered to offer the greatest single potential for effective recycling. Education is considered to be a necessary method for long-term benefits and ranked equally with commercial source separation (primarily for cardboard) and food industry waste processing.

Yard waste composting ranked third and is considered to be an effective way to manage nearly 16% of the waste stream in the South Central region. With self-haul of yard waste and the location of waste composting facilities at existing landfills, cost savings may be sufficient to justify this method. Markets for yard waste compost could be developed in this highly agricultural area. Incentives and reuse are considered to be components of a comprehensive recycling program in this WGA for reasons discussed previously. These methods ranked fourth and fifth, respectively.

Single-family curbside collection, which also ranked fifth, may be appropriate in one or more of the urban areas of the South Central WGA. If a different, less capital-intensive method of curbside collection is selected than was used in the economic analysis, a cost-effective single-family collection system for source-separated recycables could be established. Each urban area would require a detailed study of alternative methods and costs before a curbside program was selected. Additionally, the impact of a curbside program to existing drop-off/buy-back depots in the urban areas should be reviewed.

Commercial high-grade collection was rated equally with reuse and single-family curbside collection. When combined with commercial source separation through an intermediate processing facility, this method can be effective in recovering a substantial portion of the commercial waste stream.

Disincentives may offer limited benefits when combined with the reduction program; however, in general, they are not considered to be effective compared to other methods.

Mixed-waste processing, municipal solid waste composting, and RDF preparation are not recommended for the South Central WGA. Multi-family collection of recyclables is not recommended; however, urbanized areas should review this method based on existing conditions and opportunities available in their communities.

(c) Disposal Program

Review of the disposal program for the South Central WGA resulted in a slightly higher ranking for incineration than for landfilling and long haul. Landfilling within the WGA is considered to be most cost-effective, but has the greatest potential for adverse environmental impacts and has a moderate exposure to loss. Incineration is less cost-effective and has moderate potential for environmental impact; however, it has a relatively high exposure to loss compared to landfilling and long haul. Long haul has the least environmental impact within the WGA, less exposure to loss, and is considered moderately cost-effective. Even though incineration ranked slightly higher than either landfilling or long haul, there is no clear indication that it is the superior disposal method for this WGA. It is recommended that each agency evaluate the merits of each alternative based on its existing conditions.

Kittitas County has successfully implemented a baling system for volume reduction at its landfill. This facility also serves as a waste processing center for a recycling operation. It has proved to be a cost-effective method for the unique conditions of Kittitas County. It is, therefore, included as part of the rural alternatives for the South Central WGA.

Objectives for each category of solid waste appear in Table E-75. These objectives depict the amount of each category which could reasonably be handled by each method. The objectives are based on the results of the WGA-recommended model and on the current levels of recycling in each WGA.

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Table E-75

Waste Stream Category Objectives By Method for South Central WGA

% OF WASTE STREAM CATEGORY MANAGED BY METHOD

WASTE STREAM CATEGORY	RECYCLING: REUSE	RECYCLING: SINGLE FAMILY CURBSIDE COLLECTION	RECYCLING: MULTI-FAMILY HOUSING COLLECTION	RECYCLING: COMMERCIAL SOURCE SEPARATION	RECYCLING: COMMERCIAL HIGH GRADE	RECYCLING: COMMERCIAL DIRECT	RECYCLING: DROP OFF / BUYBACK DEPOTS	RECYCLING: MIXED WASTE PROCESSING	RECYCLING: YARD WASTE COMPOSTING	RECYCLING: MIXED WASTE COMPOSTING	RECYCLING: FOOD WASTE PROCESSING	RECYCLING: SUBTOTAL RECYCLING	DISPOSAL: ANAEROBIC DECOMPOSITION	DISPOSAL: PYROLYSIS / GASSIFICATION	DISPOSAL: REFUSE DERIVED FUEL PREP. & USE	DISPOSAL: MASS BURN INCINERATION / ASHFILL	DISPOSAL: LANDFILL	DISPOSAL: LONG HAUL	DISPOSAL: SUBTOTAL DISPOSAL	TOTAL (%)
NEWSPAPER						60						60					40		40	100
CORRUGATED CARDBOARD			21		24	4						49					51		51	100
HIGH GRADE PAPER			18		1							19					81		81	100
MIXED SCRAP PAPER (RECYCLABLE)																	100		100	100
REFILLABLE GLASS CONTAINERS			10			60						70					30		30	100
GLASS			6			11						17					83		83	100
ALUMINUM						54						54					46		46	100
TIN PLATED FOOD & BEVERAGE CANS						1						1					99		99	100
FERROUS METAL					62	3						65					35		35	100
NON-FERROUS METAL					65	3						68					32		32	100
WHITE GOODS						2						2					98		98	100
PET PLASTICS																	100		100	100
HDPE PLASTICS																	100		100	100
PLASTIC PACKAGING (LDPE)																	100		100	100
EXPANDED POLYSTYRENE																	100		100	100
OTHER PLASTICS																	100		100	100
TIRES						6						6					94		94	100
OTHER RUBBER PRODUCTS																	100		100	100
FOOD																	100		100	100
LAWN AND GARDEN WASTE							75					75					25		25	100
WOOD																	100		100	100
DISPOSABLE DIAPERS																	100		100	100
OIL						86						86					14		14	100
BATTERIES						72						72					28		28	100
OTHER HOUSEHOLD HAZARDOUS																	100		100	100
CONSTRUCTION DEBRIS (NOT WOOD)																	100		100	100
OTHER ORGANIC																	100		100	100
OTHER INORGANIC																	100		100	100

9. NORTHEAST WGA

a. Introduction to Northeast WGA

(1) Location

The Northeast Waste Generation Area (Northeast WGA) is located in the northeast corner of the State of Washington. The total area of the Northeast WGA is 10,142 square miles.

The following counties are included in the Northeast WGA:

- Ferry
- Lincoln
- Pend Oreille
- Spokane
- Stevens

(2) Population

The estimated 1987 population of the Northeast WGA was 410,700 persons. Of this, 51% resided in the 31 incorporated towns and cities of the area. The Washington State Office of Financial Management predicts an 8% growth in population by 1995, to 443,560 for the area. According to 1980 Census figures, 28% of the population lived in rural areas (defined as outside of urbanized areas or outside Census-designated places of 2,500 or more inhabitants).

In 1987, there were 175,700 housing units in the Northeast WGA (April 1 estimate). Sixty-nine percent (69%) of these units were single-family dwellings. This total represents an increase of 14,100 housing units since 1980 (9% growth).

(3) Economy

The Washington State Department of Employment Security estimated December, 1987 employment in the Northeast WGA to be 147,800 persons. The number of "employer units" (i.e., separate business locations) was put at 9,680. In 1986, more than six out of ten employed persons (63%) worked in service (24%), retail (21%), or government jobs (18%).

b. Existing Solid-Waste Management Methods

(1) Solid-Waste Reduction and Recycling

There are approximately 27 recycling centers in the Northeast WGA (this figure excludes beverage distributors handling refillable bottles, as well as battery and tire distributors). In 1987, these centers handled 82,300 tons of materials, representing 17% of the estimated total tonnage of solid waste generated. The following sections summarize the reduction and recycling programs in each of the counties in the Northeast WGA.

(a) Ferry County

There is one private firm operating a recycling collection operation. The County does not currently fund any reduction or recycling efforts.

(b) Lincoln County

There is no established recycling depot, and no County funding of waste reduction or recycling. The Odessa Landfill accepts car bodies and tires to be salvaged; various civic groups in the County operate other small recycling efforts.

(c) Pend Oreille

Other than salvagers and one private recycler in Newport (called Wa-Lu Recycling), there are no organized recycling programs in this County.

(d) Spokane County

County officials estimate that approximately 20% of County waste (including the City of Spokane) is currently being recycled. Until now, it has been handled through private recyclers operating drop-off/buy-back centers. To help reach a goal of 31-37% recycling, the City and County Waste Disposal Project has recently hired a recycling coordinator.

(e) Stevens County

Although there are no major recycling efforts currently in operation in the County, there is some segregation and collection of recyclables at the North Stevens County Landfill.

(2) Solid-Waste Collection

In the Northeast WGA, there are ten haulers collecting municipal solid waste under U.T.C. certificates (franchises). Six cities operate their own solid waste collection services. These cities are Spokane, Kettle Falls, Marcus, Colville, Davenport, and Odessa. All other collection in this WGA is conducted through a contractual agreement between city and hauler. Table E-76 summarizes this information.

The operators hauled an estimated 258,000 tons of waste in 1987, 59% of which was from the commercial sector, and 41% from residences. Including self-haul tonnages, the total disposed waste for 1987 was estimated to be 341,000 tons.

It is reported that there are rural self-haul drop-boxes in Pend Oreille and Spokane Counties (depending on the definition used for "drop-box," the number may vary; there appear to be different interpretations of the terms "drop-box" and "transfer station"). Table E-77 describes them in greater detail.

Table E-76
WASHINGTON DEPARTMENT OF ECOLOGY
Recycling and Waste Stream Survey-1987
NORTHEAST WASTE GENERATION AREA
HAULERS

NAME	PUBLIC/ PRIVATE	FRANCHISES	AREA SERVED	DESTINATION/COUNTY
Valley Garbage Svc.	Private	F	Spokane Co.	Mica L.F./Spokane
City of Spokane	Public		City of Spokane	Northside L.F./Spokane
City of Kettle Falls	Public		City of Kettle Falls	Stevens Co. L.F./Stevens
City of Marcus	Public		City of Marcus	Stevens Co. L.F./Stevens
City of Colville	Public		City of Colville	Stevens Co. L.F./Stevens
Metropolitan Svc.	Private	F	Spokane Co.	Marshall L.F./Spokane
Couse's Sanitation Service	Private	F	Ferry and Okanogan Counties	Torboy Dump/Ferry
City of Davenport	Public		City of Davenport	Harrington L.F./Lincoln
City of Odessa	Public		City of Odessa	Odessa L.F./Lincoln
Larry Clark	Private	F	Lincoln County	Northwest County L.F./Lincoln
Robinson Excavating and Trucking	Private	F	Pend Oreille County	North County L.F./Pend Oreille
Sunshine Disposal	Private	F	Spokane Co., rural Lincoln Co., & City of Ritzville (Adams Co.)	Sunshine Recyclers Center/ Spokane
Olson's Sanitation	Private	F	Spokane, Stevens & Ferry Counties; City of Reardan in Lincoln Co.	(1) Mica L.F./Spokane (2) Stevens Co. L.F./Stevens

NAME	PUBLIC/ PRIVATE	FRANCHISES	AREA SERVED	DESTINATION/COUNTY
Western Refuse	Private	F	Not Avail.	Marshall L.F./Spokane
Newman Lake Garbage	Private	F	Spokane	Mica L.F./Spokane
Empire Disposal, Inc.	Private	F	Spokane, Whitman and Columbia Co's; City of Sprague in Lincoln Co.	(1) Whitman L.F./Whitman (2) Mica L.F./Spokane (3) Marshall L.F./Spokane (4) Northwest County L.F./Lincoln

Table E-77
WASHINGTON DEPARTMENT OF ECOLOGY
Recycling and Waste Stream Survey-1987
NORTHEAST WASTE GENERATION AREA
RURAL DROP BOXES

COUNTY	LOCATION	SIZE	TYPE	OTHER
Pend Oreille	Usk	10 cy	Compactor	Manned
Spokane	Deep Creek	10 cy	Compactor	
	Fairfield	10 cy	Compactor	

(3) Solid-Waste Disposal

There are eleven operating landfills accepting municipal waste in the Northeast WGA; ten are open to the public. The private landfill is operated by the Spokane Indian Reservation, in Stevens County. Table E-78 presents more detailed information on landfills and transfer stations. The estimated remaining capacities of these landfills range from four to 100 years (some information was unavailable); Table E-79 summarizes this information.

Based on 1987 quantities of waste disposed, rough estimates were generated for the tonnage of waste that could be accommodated by present landfills in the Northeast WGA. Calculations were based only on information from landfills accepting municipal waste, except for those on military bases and Indian reservations. The tons of waste disposed at each landfill in 1987 were multiplied by the reported years of remaining life. Remaining life was defined as:

1) The number of years between 1987 and a closure data mandated by permit; or

2) if no mandated closure date is specified, the number of years between 1987 and an estimated closure date (due to exhaustion of site capacity, landfill noncompliance, or business closure); or

3) the smaller of the two figures, if both exist.

If a facility's capacity was not reported in terms of years, estimates were developed from the best available information. Remaining capacity reported in acres was converted to tons using a conversion factor derived from data obtained for this report. Based on information from landfill operators, the average amount of waste accommodated by one acre was 17,800 tons.

Using this method, it was estimated that the Northeast WGA had sufficient landfill capacity at the end of 1987 to accommodate approximately 12,301,000 additional tons of solid waste. Care should be taken when interpreting this figure, since a WGA total estimate may not reflect situations facing individual jurisdictions. Landfills which did not report sufficient information to calculate tonnage capacity are not represented in the above estimate (refer to Tables E-78 and E-79).

(4) Solid-Waste Management Planning

Ferry County--does not have an approved draft Solid-Waste plan.

Lincoln County--will begin an update in the near future; currently operating under its 1983 Solid Waste Plan.

Pend Oreille County--operating under its 1978 Solid Waste Plan.

Table E-78
WASHINGTON DEPARIMENT OF ECOLOGY
Recycling and Waste Stream Survey-1987
NORTHEAST WASTE GENERATION AREA
DISPOSAL FACILITIES

COUNTY	FACILITY	NAME	ACCESS	1987 TONS RECEIVED	REMAINING CAPACITY*	DESTINATION	1987 TIPPING FEES
Ferry	Landfills:	Torboy	Public	3,800	1-2 Years		$7.00/CCY
	Transfer Stations:	Inchelium	Private	2,100		N.Stevens L.F.	-0- -Indian Res.
		Keller	Private	1,100		Grand Coulee L.F./Grant Co.	-0- -Indian Res.
Lincoln	Landfills:	Harrington	Public	2,400	19 Years; 30,000 CY		$2.25/CCY
		Northwest Lincoln Co.	Public	1,200	20+ Years; 10 Acres		-0-
		Odessa	Public	1,300	15 Years		-0- -All Self-Haul
		Davenport	Public	Not Avail.			-0-
Pend Oreille	Landfills:	N. County	Public	1,100	5 Years; 5 Acres		$2.00/CY
		S. County	Public	2,300	14-15 Years; 20 Acres		$2.00/CY
Spokane	Landfills:	Marshall	Public	92,000	Not Avail.		$5.00/LCY $10.00/CCY
		Mica	Public	38,000	4-8 Years		$5.00/LCY $10.00/CCY
		Northside	Public	180,000	4-9 Years		$31.00/Ton

COUNTY	FACILITY	NAME	ACCESS	1987 TONS RECEIVED	REMAINING CAPACITY*	DESTINATION	1987 TIPPING FEES
Stevens	Landfills:	N.Stevens County	Public	8,300	6 Years; 163,600 CY		$32.00/Ton
		Spokane Indian Reservation	Private	Not Avail.	Not Avail.		-0-
	Transfer Stations:	Hunters	Public	100		N. Stevens Co.	$7.50/LCY $11.25/CCY
		Loon Lake	Public	400		N. Stevens Co.	$7.50/LCY $11.25/CCY
		North Port	Public	100		N. Stevens Co.	$7.50/LCY $11.25/CCY
		Park Rap.	Public	100		N. Stevens Co.	$7.50/LCY $11.25/CCY

CY = Cubic Yard
CCY= Compacted Cubic Yard
LCY= Loose Cubic Yard

*Based on space available at the end of 1987, regardless of mandated or planned closure dates.

TABLE E-79
WASHINGTON DEPARTMENT OF ECOLOGY
Recycling and Waste Stream Survey-1987
NORTHEAST WASTE GENERATION AREA
LANDFILL CAPACITIES

COUNTY	FACILITY NAME	MANDATED CLOSURE (Date/None)	REMAINING CAPACITY* (Years/C.Y./Acres)	COMMENTS (#)
Ferry	Torboy	Not Avail.	1-2 Years	1
Lincoln	Harrington	12/31/90	19 Years; 30,000 CY	
	Northwest Lincoln County	None	20+ Years; 10 Acres	
	Odessa	None	15 Years	
	Davenport	None		2
Pend Oreille	North County	None	5 Years; 5 Acres	
	South County	None	14-15 Years; 20 Acres	
Spokane	Marshall	None	Not Available	
	Mica	None	4-8 Years	
	Northside	None	4-9 Years	
Stevens	Stevens County	None	6 Years; 163,600 CY	
	Spokane Indian Reservation	Not Avail.	Not Available	

COMMENTS

1. 10-acre open dump which will operate for 1-2 years.
2. Takes only garden waste from the public.

*Based on space available at the end of 1987, regardless of mandated or planned closure dates.

Spokane County--currently updating its 1984 Solid Waste Plan; draft due in mid-1989.

Stevens County--applying for a grant from the State DOE to begin an update of its 1980 Solid Waste Plan.

c. Market Capacity

Primary markets for materials from the Northeast WGA are in the Puget Sound region and in Oregon. Newspaper, corrugated containers, and high-grade paper are mostly bought by Oregon mills. A significant amount of mixed waste paper is recovered even though processing and transportation costs indicate a low value for collected material. Spokane is a primary shipping point for aluminum beverage cans destined for major aluminum producers. A new resmelter to be located nearby in Idaho in 1989, is likely to further improve the market for Northeast WGA aluminum cans.

Other metals markets for the area are stable. Low volumes of tin cans are recovered, and transport of the comparatively low-value material to available processing capacity in Seattle hinders recovery. A shredder for white goods in Spokane helps reduce the cost of recovering these items. Plastics recycling markets do not currently exist for the area, though they could develop in the future. Yard waste markets are not yet found in the area, though some communities may help establish them in the near future.

A market capacity summary for the Northeast WGA is presented in Table E-80.

d. Evaluation of Methods

(1) Feasibility Analysis

Notable exceptions to the Statewide technical feasibility review for the Northeast WGA include:

- Waste Exchange. The Spokane area has undertaken a lengthy waste exchange feasibility study. Based on the outcome of this study, which recommends a regional approach, it was determined that implementing a waste exchange program has slightly greater exposure to loss than indicated on the Statewide risk assessment. In particular, the working group members believed that such a program would be more sensitive to waste supply quantity and composition as well as to the availability of markets. They also felt that the ability to operate and maintain should be upgraded to a moderate exposure level, again based on a consultant's feasibility study.

- Curbside Collection. Members of the Northeast WGA felt that curbside collection programs would be at high exposure to loss because of their cost with respect to markets.

Table E-80

Market Capacity Summary for Northeast WGA

COMMODITY	MAJOR END USERS FOR MATERIAL FROM WGA (Name &/or Location)	ESTIMATED END USER PRICE '88 ($/Ton)	VOLUME OF WGA MATRL. RECOVERED (1987 Tons)	(1) WGA COLLECTED MATERIAL PRICE ($/Ton)	(1) WGA COLLECTED MATERIAL VALUE ($/Year)	(2) WGA MARKET CAPACITY	FACTORS AFFECTING WGA MARKET FOR MATERIAL
1 Newsprint	Smurfit - Oregon some to Wenatchee Sonoco - Sumner	$45.00	14,100	$16	$225,600	ADEQUATE	Most goes to regional mills which provide freight
2 Corrugated Containers	Various Oregon mills Sonoco - Sumner CCA - Tacoma	$65.00	23,300	$40	$932,000	ADEQUATE	Most goes to regional mills which provide freight
3 High Grade Paper	Weyerhsr. - OR & Midwest Scott Paper - Everett	$100.00	1,300	$45	$58,500	ADEQUATE	Most goes to regional mills which provide freight
4 Mixed Waste Paper	Export Sonoco - Sumner Paperboard Indust. B.C.	$25.00	1,400	($21)	($29,400)	NOT SIGNIFICANT	Instate tariff - $.07/ton/mile High transport $ due to distance
5 Container Glass	Owens-Brockway, Portland	$40.00	1,500	$10	$15,000	ADEQUATE	Freight assistance for interstate shipment reduces costs
6 Refillable Glass	Rainier Brewing - Sea. Pabst/Olympia some Soft Drink	$116.00	1,000	$46	$46,000	ADEQUATE	
7 Aluminum Bev. Cont.	Various Alum. Co. Ship from Spokane	$1,000.00	2,900	$850	$2,465,000	ADEQUATE	New resmelter to be located nearby in Idaho, 1989 Spokane is current shipping point
8 Tin Cans	MRI - Seattle	$49.00	100	$19	$1,900	ADEQUATE	Instate tariff - $.07/ton/mile Freight assistance reduces cost
9 Ferrous Metals	General Metals - Tac. Salmon Bay/Seattle Steel Local processors - Spokane	$65.00	26,700	$30	$801,000	ADEQUATE	Instate tariff - $.07/ton/mile
10 White Goods	Seattle Iron & Steel Pacific Hide & Fur - Spokane	$20.00	100	$0	$0	POTENTIAL DISP. AVOID.	Shredder & compactor in Spokane help reduce transport costs
11 Non Ferrous Metals	Various - Tacoma/Seattle Various - Portland	$800	3,700	$630	$2,331,000	ADEQUATE	Instate tariff - $.07/ton/mile
12 PET Bottles	Midwest & East U.S.	$160	0	$19	$0	NOT SIGNIFICANT	Low supply & high transport cost Potential future market
13 HDPE Bottles	Export - Puget Sound Partek - Vancouver	$200	0	$59	$0	NOT SIGNIFICANT	Low supply & high transport cost Potential future market
14 Plastic Films (LDPE)	Export - Puget Sound	$160	0	$40	$0	NOT SIGNIFICANT	Low supply & high transport cost Potential future market
15 Lawn & Garden Waste	None	($20)	0	($30)	$0	NOT SIGNIFICANT	Potential disp. avoid. market

(1) WGA prices and values are before transportation, processing and handling necessary to prepare and move material to market.

(2) WGA market capacity is based on an assessment of the markets' ability to consume consistently and gradually increasing volumes.

REFER TO TEXT FOR DETAILED DISCUSSION

- Multi-Family Collection. Comments for this method are the same as for curbside collection.

- Intermediate Processing Facility. Spokane has recently been through the siting of an incinerator as well as an ashfill and is sensitive to this issue. Based on the group's experience, members felt that an intermediate solid waste processing center would be at moderate exposure to loss in terms of permits acquisition and time and cost required to complete siting. (NOTE: This rating assumed that an IPC would process waste for disposal rather than recyclables.)

- Commercial Mixed Waste Processing. The group judged all exposure related to siting to be higher than the Statewide assessment and indicated again that, merely because the facility would be dealing with mixed solid waste, siting problems would be encountered.

- Mixed Waste Processing. Siting exposure was judged to be high for the same reason outlined for commercial mixed waste processing. However, the group did not see any reason for a higher risk rating with respect to ability to construct, since in some forms this is relatively simple. In any case, a mixed waste processing facility was judged to be no more difficult to construct than an incinerator.

- Yard Waste Composting. Siting exposure was judged to be high for the same reason outlined for commercial mixed waste processing. Yard waste composting has moderate exposure with respect to the waste supply quantity, since the Northeast WGA produces significant amounts of pine needles, which are seasonal in nature, and no grass, leaves, etc., during winter months. (NOTE: This is the perceived state, but actual data were not available.) Much of the area's yard wsate is incinerated in open pits at one of the numerous burning sites for yard and garden waste in the Northeast WGA.

  A lack of information on the availability of compost markets resulted in a high exposure rating. Little knowledge was available on competent, experienced vendors who could operate the yard waste composting facility. Thus, this exposure area was also given a higher rating.

- Mixed Waste Composting. Siting exposure was judged to be high for the same reasons outlined for commercial mixed waste processing.

- Food Waste Processing. Siting exposure was judged high for the same reasons outlined for commercial mixed waste processing.

- Special Recycling and Reuse. The work group felt that obtaining a permit for special waste recycling and reuse would be more difficult than indicated. In fact, they assigned a high exposure level to this method since these facilities would be dealing with toxics and other potential pollutants. This would presumably require a more complex permitting process.

- Anaerobic Decomposition. The exposure to loss due to markets was given a high rating since there was very little familiarity with the process.

- RDF Preparation and Use. Exposure to loss associated with vendor selection was rated lower than in the Statewide rating since the City of Spokane has recently received several qualified proposals from vendors.

- Mass Burn Incineration. Because of their recent experience, group members from Spokane felt that much lower exposure is associated with markets, vendors, and the technology or ability to construct and maintain a mass burn facility than that indicated on a Statewide basis. These group members indicated that they had received several qualified proposals.

- Ashfill. The siting resistance exposure was lowered to moderate from the Statewide high rating since an ashfill was thought to be less objectionable than a mixed waste landfill and since the community has had recent experience siting such a disposal facility.

The exposure to loss feasibility evaluation for the Northeast WGA is presented in Table E-81.

(2) Environmental Evaluation

(a) Impacts

Environmental impacts in the Northeast WGA are generally the same as identified in the generic discussion of impacts. The very low precipitation in this WGA reduces the potential for leachate generation from methods such as composting, landfills, or ashfills. On the other hand, the high summer temperature suggests that landfill decomposition may be somewhat more rapid, leading to increased generation of methane gases. In addition, the high summer temperatures would increase the potential for odor problems from other facilities such as food waste composting and waste storage for incineration. Furthermore, incineration must be considered in light of Spokane's classification as a non-attainment area for particulates. These factors are reflected in the environmental impact matrix (Table E-82).

Table E-81

Evaluation of Exposure to Loss

for Northeast WGA

VAAONE28

DEGREE OF EXPOSURE TO LOSS ASSOCIATED WITH IMPLEMENTATION & USE OF EACH METHOD

TECHNICAL IMPLEMENTATION FACTOR			REDUCTION						RECYCLING												HANDLING		DISPOSAL					
			EDUCATION	INCENTIVES	DISINCENTIVES	MODEL GOVERNMENTAL PROGRAMS	WASTE EXCHANGE	HOME YARD WASTE COMPOSTING	REUSE	CURBSIDE COLLECTION	MULTI-FAMILY HOUSING COLLECTION	COMMERCIAL SOURCE SEPARATION	INTERMEDIATE PROCESSING FACILITY	COMMERCIAL MIXED WASTE PROCESSING	DROP OFF / BUYBACK DEPOTS	MIXED WASTE PROCESSING	YARD WASTE COMPOSTING	MIXED WASTE COMPOSTING	FOOD WASTE PROCESSING	SPECIAL WASTE RECYCLING AND REUSE	TRANSFER	LONG HAUL TRANSPORT	ANAEROBIC DECOMPOSITION	PYROLYSIS / GASSIFICATION	REFUSE DERIVED FUEL PREP. & USE	MASS BURN INCINERATION	LANDFILL	ASHFILL
SITING	SITING RESISTANCE	GENERAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	L/M	L	M/H	L	M/H	M	M/H	M/H	NA	M/H	M/H	H	H	H	H
		WGA SPECIFIC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	M	L/M	M/H	M	H	H	M/H	M/H	NA	H	H	H	H	H	H
	PERMITS AQUISITION DIFFICULTY	GENERAL	NA	NA	NA	NA	NA	NA	L	L	L	L	L	L/M	L	M	L	M/H	M	L/M	M	M	M/H	M/H	H	H	H	H
		WGA SPECIFIC	NA	NA	NA	NA	NA	NA	L	L	L	L	M	H	L	H	H	H	H	H	M	M	H	H	H	H	H	H
	TIME & COST REQUIRED TO COMPLETE SITING	GENERAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	L/M	L	L	L	M/H	M	M/H	M/H	NA	M/H	M/H	H	H	H	H
		WGA SPECIFIC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	M	H	L	M	M	M	M	M	M/H	NA	H	H	H	H	H	H
WASTE SUPPLY	QUANTITY	GENERAL	NA	NA	NA	NA	L	NA	L	M	M	L	L/M	L	L	L	L	L	M/H	L/M	L/M	L/M	L/M	M	M	M	L	L
		WGA SPECIFIC	NA	NA	NA	NA	M	NA	L	L/M	M	L	L/M	L	L	L	M	L	M/H	L/M	L	L	L/M	M	M	M	L	L
	COMPOSITION	GENERAL	NA	NA	NA	NA	L	L	L/M	L/M	L/M	L	L/M	L	M	L/M	L/M	M	L	L/M	L	L/M	L/M	M	M	M	L	L/M
		WGA SPECIFIC	NA	NA	NA	NA	M	L	L/M	L/M	L/M	L	L/M	L	M	L/M	L/M	M	L	L/M	L	L	L/M	M	M	M	L	L
MARKETS		GENERAL	NA	NA	NA	NA	L	NA	L	M	M	L/M	L/M	L/M	L/M	M/H	M	M/H	M/H	L/M	NA	NA	L/M	M/H	M	NA	NA
		WGA SPECIFIC	NA	NA	NA	NA	M	NA	L	H	H	L/M	M	L/M	L/M	H	H	M/H	M/H	L/M	NA	NA	H	M/H	L	NA	NA
VENDOR		GENERAL	NA	NA	NA	NA	L	NA	NA	L/M	L/M	L/M	L/M	L/M	L	M/H	L	M/H	L/M	L/M	L	L/M	L	H	M	M	NA	NA
		WGA SPECIFIC	L	NA	NA	NA	NA	NA	NA	L	L/M	L/M	L/M	L/M	L	M/H	M/H	M/H	L/M	L/M	L	L	L	H	L	L	NA	NA
TECHNOLOGY/ PROGRAM	ABILITY TO CONSTRUCT & MAKE OPERATIONAL	GENERAL	L	M/H	M/H	L	L	M	L/M	L	M	L	L/M	L/M	L	M/H	L	L/M	L	L/M	L/M	NA	L	H	M	M	L/M	L/M
		WGA SPECIFIC	L	M/H	M/H	L	M	M	L/M	L	M	L	L/M	L/M	L	L/M	L	L/M	L	L/M	L/M	NA	L	H	M	L	L/M	L/M
	ABILITY TO OPERATE AND MAINTAIN	GENERAL	L	L/M	L/M	L	L	M	L/M	L	M	L	L/M	L/M	L/M	M	L/M	L/M	L/M	L/M	L/M	M/H	L	M/H	M/H	M	M	L
		WGA SPECIFIC	L	L/M	L/M	L	M	M	L/M	L	M	L	L/M	L/M	L/M	M	L/M	L/M	L/M	L/M	L/M	M/H	L	M/H	M/H	L	M	L
RESIDUE DISPOSAL	CHARACTERISTICS	GENERAL	NA	NA	NA	NA	NA	M	NA	L	L	L	L	L	L	L	L	L	L	M/H	NA	NA	M	M	L/M	M/H	NA	NA
		WGA SPECIFIC	NA	NA	NA	NA	NA	M	NA	L	L	L	L	L	L	L	L	L	L	M/H	NA	NA	M	M	M	M/H	NA	NA
	SITE AVAILABILITY	GENERAL	NA	NA	NA	NA	NA	M	NA	NA	NA	NA	L	L	L	L	L	L	L	M/H	NA	NA	M	M	L/M	M/H	NA	NA
		WGA SPECIFIC	NA	NA	NA	NA	NA	M	NA	NA	NA	NA	L	L	L	L	L	L	L	M	NA	NA	M	M	L/M	M/H	NA	NA
FINANCING		GENERAL	L	L	L	L	L	L	L	L	L/M	L	L/M	M	L	M	L	L/M	M	L	L/M	L/M	L/M	H	M/H	M/H	M	M
		WGA SPECIFIC	L	L	L	L	L	L	L	L	L/M	L	L/M	L/M	L	M	L	L/M	M	L/M	L/M	L/M	L/M	H	M	M/H	M	M
UNCONTROLLABLE CIRCUMSTANCES**		GENERAL	L	M	M	L	M	M	L	L	L	L	L	L	M	M	L	M	M	M/H	M	M	M	M/H	M/H	M/H	M/H	M/H
		WGA SPECIFIC	L	M	M	L	M	M	L	L	L	L	L	L	M	M	L	M	M	M	M	M	M	M	M	M/H	M/H	M/H

KEY:

NA = NOT APPLICABLE
H = HIGH
M = MODERATE
L = LOW

An evaluation of potential environmental impacts due to failures in the technology are presented in Table E-83.

(b) Concerns

The Northeast WGA work group expressed a higher degree of concern over several of the waste processing systems than for many of the disposal options (see Table E-84). Particular concern was evident for mixed waste processing, mixed waste composting, and special waste recycling and reuse. Concerns were greatest in the areas of air quality, water quality, and public health risks. Disposal methods registering the highest concern were anaerobic decomposition, landfilling and refuse-derived fuel preparation. When compared with landfilling, the group favored mass burn incineration. There was less concern for all factors except for traffic and air quality. These were rated equally. Ashfill was rated lower in environmental concern than landfill disposal.

(3) Economic Evaluation of Alternatives

The results of the economic analysis for the Northeast WGA are summarized in Table E-85. Detailed results appear in Appendix C.

e. Ranking of Methods and Recommendations

The following paragraphs discuss the working group's rankings and the consultant team's rankings for best management practices, as well as each group's recommended system for reduction, recycling, and disposal in this WGA.

(1) Working Group Rankings

Evaluation criteria were weighted by the Northeast WGA working group, and applied to the alternative solid waste management methods. The resulting rankings are shown in Table E-86.

Based on these rankings, the WGA working group selected the following preferred system for solid-waste management in this WGA:

- Reduction Program
  - -- Incentives
  - -- Disincentives
  - -- Education
  - -- Home yard waste composting
- Recycling Program
  - -- Drop-off/buy-back depots
  - -- Commercial source-separated collection
  - -- Incentives
  - -- Disincentives
  - -- Education
  - -- Yard waste composting
  - -- Reuse

Table E-82

Evaluation of Environmental Impacts *

for Northeast WGA

VAAONE26

DEGREE OF POTENTIAL ENVIRONMENTAL IMPACT ASSOCIATED WITH IMPLEMENTATION & USE OF EACH METHOD

ENVIRONMENTAL FACTOR	REDUCTION						RECYCLING												HANDLING		DISPOSAL					
	EDUCATION	INCENTIVES	DISINCENTIVES	MODEL GOVERNMENTAL PROGRAMS	WASTE EXCHANGE	HOME YARD WASTE COMPOSTING	REUSE	CURBSIDE COLLECTION	MULTI-FAMILY HOUSING COLLECTION	COMMERCIAL SOURCE SEPARATION	INTERMEDIATE PROCESSING FACILITY	COMMERCIAL MIXED WASTE PROCESSING	DROP OFF / BUYBACK DEPOTS	MIXED WASTE PROCESSING	YARD WASTE COMPOSTING	MIXED WASTE COMPOSTING	FOOD WASTE PROCESSING	SPECIAL WASTE RECYCLING AND REUSE	TRANSFER	LONG HAUL TRANSPORT	ANAEROBIC DECOMPOSITION	PYROLYSIS / GASSIFICATION	REFUSE DERIVED FUEL PREP. & USE	MASS BURN INCINERATION	LANDFILL	ASHFILL
AIR QUALITY	NA	NA	NA	NA	NA	NA	NA	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
CRITERIA POLLUTANTS: SO2, NOX, HCL								L	NA	NA	NA	NA	NA	NA	NA	NA	L	NA	NA	L	L	L	L	L	L	L
TOXICS								L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
PARTICULATES																					L/M	L/M	L	L	L	L
ODOR	NA	NA	NA	NA	NA	L	NA	NA	L	NA	L	NA	L	L	L	L	L/M	L	L	NA	L/M	L/M	L/M	L/M	L/M	NA
SURFACE WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	NA	NA	NA	L	L	L	L	L	NA	NA	L	L	L	L	L	L
GROUND WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	NA	NA	NA	L	L	L	L	L	NA	NA	L	L	L	L	L	L
NOISE	NA	NA	NA	NA	NA	L	NA	L	L	NA	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
RISK OF EXPLOSION	NA	NA	NA	NA	NA	NA	NA	NA	L	NA	NA	L	NA	L	NA	L	NA	L	L	NA	L	L	L	L	L	NA
PUBLIC HEALTH RISKS	NA	NA	NA	NA	NA	L	NA	NA		NA	L															
PATHOGENS						L		NA	L	NA	L	NA	L	L	NA	L	L	NA	L	L	L	L	L	L	L	NA
VECTORS						L		NA	L	NA	L	L	L	L	L	L	L	NA	L	L	L	L	L	L	L	NA
TOXICS						L		NA	NA	NA	L	NA	L	L	L	L	L	L	NA	NA	L/M	L/M	L/M	L/M	L	L/M
AESTHETICS	NA	NA	NA	NA	NA	L	NA	L	L	NA	L	L	L	L	L	L	L	L	L	NA	L	L	L	L	L	L
TRAFFIC	NA	NA	NA	NA	L	NA	NA	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
OTHER																										

KEY: **

NA = NOT APPLICABLE
H = HIGH RATING
M = MEDIUM RATING
L = LOW RATING

* THIS EVALUATION ASSUMES NEW "STATE OF THE ART" FACILITIES, PROPERLY SITED WITH FACILITY DESIGN INCORPORATIONG APPROPRIATE MITIGATION TECHNIQUES.

** A HIGH RATING INDICATES A HIGH LEVEL OF LOCAL ENVIRONMENTAL IMPACT
A LOW RATING INDICATES A LOW LEVEL OF ENVIRONMENTAL IMPACT

VAAONE27

Table E-83

Evaluation of Potential Environmental Impacts *
for Northeast WGA

DEGREE OF POTENTIAL ENVIRONMENTAL IMPACT ASSOCIATED WITH IMPLEMENTATION & USE OF EACH METHOD

ENVIRONMENTAL FACTOR	REDUCTION: EDUCATION	REDUCTION: INCENTIVES	REDUCTION: DISINCENTIVES	REDUCTION: MODEL GOVERNMENTAL PROGRAMS	REDUCTION: WASTE EXCHANGE	REDUCTION: HOME YARD WASTE COMPOSTING	RECYCLING: REUSE	RECYCLING: CURBSIDE COLLECTION	RECYCLING: MULTI-FAMILY HOUSING COLLECTION	RECYCLING: COMMERCIAL SOURCE SEPARATION	RECYCLING: INTERMEDIATE PROCESSING FACILITY	RECYCLING: COMMERCIAL MIXED WASTE PROCESSING	RECYCLING: DROP OFF / BUYBACK DEPOTS	RECYCLING: MIXED WASTE PROCESSING	RECYCLING: YARD WASTE COMPOSTING	RECYCLING: MIXED WASTE COMPOSTING	RECYCLING: FOOD WASTE PROCESSING	RECYCLING: SPECIAL WASTE RECYCLING AND REUSE	HANDLING: TRANSFER	HANDLING: LONG HAUL TRANSPORT	DISPOSAL: ANAEROBIC DECOMPOSITION	DISPOSAL: PYROLYSIS / GASSIFICATION	DISPOSAL: REFUSE DERIVED FUEL PREP. & USE	DISPOSAL: MASS BURN INCINERATION	DISPOSAL: LANDFILL	DISPOSAL: ASHFILL
AIR QUALITY	NA	NA	NA	NA	NA	NA	NA																			
CRITERIA POLLUTANTS: SO2, NOX, HCL								L	L	L	L	L	L	L	L	M	L	M	M	M	M/H	H	H	H	M	L
TOXICS								L	L	L	L	L	L	M	L	L	L	M	L	L	M/H	H	M	M	H	L/M
PARTICULATES								L	L	L	L	L	L	L	L	L	L		M	M	L	L/M	H	H	L	M/H
ODOR	NA	NA	NA	NA	NA	L/M	NA	L	L	L	L/M	L	L/M	H	L	M	H	L	L/M	L/M	H	H	M	M	H	L
SURFACE WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	L	L	L/M	M	L/M	M	M	M	L	L	L	L	L	L	M	M
GROUND WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	L	L	L	M	L/M	M	M	M	L	L	L	L	L	L	H	H
NOISE	NA	NA	NA	NA	L	L	NA	L/M	L/M	L/M	L/M	M/H	M	H	M	L/M	L/M	L	M/H	M/H	M	M/H	M/H	M/H	M	M
RISK OF EXPLOSION	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	L/M	L	H	L/M	L/M	L	L	L	L	M/H	M	H	M	H	L
PUBLIC HEALTH RISKS	NA	NA	NA	NA	NA		NA																			
PATHOGENS						L		L	L	L	L	L	L/M	M	L	M	H	NA	M	L	L	L	L	L	L/M	L
VECTORS						L/M		L	L	L	L	L	L/M	M	L	M	H	M	M	L	L	L	L	L	M	L
TOXICS						L		NA	NA	NA	L	L	L	M	L	M	M	M	L	L	M/H	M/H	M/H	M/H	M/H	M
AESTHETICS	NA	NA	NA	NA	M	M	NA	L/M	L/M	L/M	L/M	M	M	H	M/H	M	M/H	L/M	M/H	M	M	M	M	M	M	M
TRAFFIC	NA	NA	NA	NA		NA	NA	L/M	L/M	L/M	M	M	L/M	H	M	M	M	L/M	M/H	M/H	H	H	H	H	H	L/M
OTHER																										

KEY: **

NA = NOT APPLICABLE
H = HIGH RATING
M = MEDIUM RATING
L = LOW RATING

* THIS EVALUATION ASSUMES THAT CERTAIN FAILURES OCCUR IN THE SITING PROCESS, DESIGN, MITIGATION MEASURES AND IN THE OPERATION & PERFORMANCE OF THE SELECTED TECHNOLOGY.

** A HIGH RATING INDICATES A HIGH LEVEL OF LOCAL ENVIRONMENTAL IMPACT
A LOW RATING INDICATES A LOW LEVEL OF ENVIRONMENTAL IMPACT

Table E-84

Environmental Concerns Evaluation for Northeast WGA

VAAONE25

DEGREE OF ENVIRONMENTAL CONCERN ASSOCIATED WITH IMPLEMENTATION & USE OF EACH METHOD

ENVIRONMENTAL FACTOR	REDUCTION						RECYCLING												HANDLING		DISPOSAL						
	EDUCATION	INCENTIVES	DISINCENTIVES	MODEL GOVERNMENTAL PROGRAMS	WASTE EXCHANGE	HOME YARD WASTE COMPOSTING	REUSE	CURBSIDE COLLECTION	MULTI-FAMILY HOUSING COLLECTION	COMMERCIAL SOURCE SEPARATION	INTERMEDIATE PROCESSING FACILITY	COMMERCIAL MIXED WASTE PROCESSING	DROP OFF / BUYBACK DEPOTS	MIXED WASTE PROCESSING	YARD WASTE COMPOSTING	MIXED WASTE COMPOSTING	FOOD WASTE PROCESSING	SPECIAL WASTE RECYCLING AND REUSE	TRANSFER	LONG HAUL TRANSPORT	ANAEROBIC DECOMPOSITION	PYROLYSIS / GASSIFICATION	REFUSE DERIVED FUEL PREP. & USE	MASS BURN INCINERATION	LANDFILL	ASHFILL
AIR QUALITY	NA	NA	NA	NA	NA	NA	NA	L	L	L	L	L	L	H L H H	L	H M H	L	M M	M H	M M	H M H	L L L	H	M	M M M	M
CRITERIA POLLUTANTS: SO2, NOX, HCL																										
TOXICS																										
PARTICULATES																										
ODOR	NA	NA	NA	NA	NA	L	NA	L	L	L	L	L	L	H	M	H	H	L	H	NA	H	L	M	L	M	L
SURFACE WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	L	NA	NA	NA	NA	L	M	H	L	H	L	NA	H	L	L	L	M	L
GROUND WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	NA	NA	NA	L	M	H	L	H	L	NA	H	L	L	L	H	M
NOISE	NA	NA	NA	NA	L	L	NA		M	L	M	M	M	H	L	M	L	M	M	M	L	L	M	L	M	M
RISK OF EXPLOSION	NA	NA	NA	NA	NA	NA	NA	NA	L	NA	NA	L	NA	M	L	M	NA	M	L	NA	H	L	H	M	M	L
PUBLIC HEALTH RISKS	NA	NA	NA	NA	NA	L	NA	L	L	L	L	L	L	M M M M	L	H H H H	M	H L H H	L	L	H	L	H	M	H	M
PATHOGENS																										
VECTORS																										
TOXICS																										
AESTHETICS	NA	NA	NA	NA	L	L	NA	M	H	L	L	L	M	L	L	H	L	H	M	NA	L	L	L	L	H	M
TRAFFIC	NA	NA	NA	NA	L	NA	NA	L	L	L	L	L	H	M	M	M	L	L	H	L	H	H	H	H	H	L
OTHER																										

KEY: •

NA = NOT APPLICABLE
H = HIGH RATING
M = MEDIUM RATING
L = LOW RATING

• A HIGH RATING INDICATES A HIGH LEVEL OF LOCAL ENVIRONMENTAL CONCERN
A LOW RATING INDICATES A LOW LEVEL OF ENVIRONMENTAL CONCERN

Table E-85

NORTHEAST: RECOMMENDED ALTERNATIVE

(COST ESTIMATES ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICTIONS.)

	ESTIMATED NET (COST) OR REVENUE	CONTRIBUTION TO SYSTEM COST	ESTIMATED TONS	PERCENT OF GENERATED TONS	RELATIVE RATIO OF COSTS TO TONS
COLLECTION AND PROCESSING:					
1. COLLECTION OF SINGLE FAMILY SOURCE SEPARATED RECYCLABLES	$0	0.0%	0	0.0%	NA
2. COLLECTION OF SINGLE FAMILY COMINGLED RECYCLABLES *	($1,352,209)	3.4%	7,503	1.5%	2.19 :1.00
3. COLLECTION OF MULTI FAMILY COMINGLED RECYCLABLES *	$0	0.0%	0	0.0%	NA
4. COMMERCIAL DIRECT RECYCLING	$0	0.0%	43,971	9.1%	0.00 :1.00
5. COLLECTION OF COMMERCIAL SOURCE SEPARATED RECYCLABLES	($356,375)	0.9%	11,741	2.4%	0.37 :1.00
6A. DROP OFF/BUY BACK "REGULAR" RECYCLABLES	$2,395,010	-6.0%	18,149	3.7%	-1.61 :1.00
6B. DROP OFF/BUY BACK OF "SPECIAL" RECYCLABLES OR WASTES	($141,603)	0.4%	7,945	1.6%	0.22 :1.00
7. YARD WASTE COLLECTION AND COMPOSTING	($5,400,174)	13.5%	54,008	11.1%	1.22 :1.00
8. SORTING OF TARGETED COMMERCIAL HIGH GRADE LOADS *	($58,543)	0.1%	936	0.2%	0.76 :1.00
9. SELF HAULED WASTE*	($4,387,842)	11.0%	84,631	17.4%	0.63 :1.00
10. REGULAR COLLECTION AND DISPOSAL OF MUNICIPAL WASTE *	($30,581,512)	76.7%	256,492	52.8%	1.45 :1.00
11. MIXED WASTE PROCESSING*	$0	0.0%	0	0.0%	NA
12. RDF PREPARATION*	$0	0.0%	0	0.0%	NA
SYSTEM TOTAL	($39,883,248)	100.0%	485,376	100%	1.00 :1.00
AVERAGE COST PER TON GENERATED	($82)				
DISPOSAL ONLY:					
A. MASS BURN WITH ASH MONOFILL	($12,651,366)	31.7%	222,400	46%	0.69 :1.00
B. LANDFILL WITH LONG HAUL BY RAIL	$0	0.0%	0	0%	NA
C. LANDFILL WITH BALING	$0	0.0%	0	0%	NA
D. LANDFILL ONLY	($5,086,463)	12.8%	119,754	25%	0.52 :1.00
DISPOSAL TOTAL	($17,737,829)	44.5%	342,154	70%	0.63 :1.00
AVERAGE COST PER TON DISPOSED	($52)				
RECYCLED TONS			143,222	30%	

* The net costs for these methods include disposal costs for residual or disposed wastes.

- Disposal Program

  -- Landfill
  -- Long haul
  -- Incineration/energy recovery

(a) Reduction Program

The WGA working group combined incentives and disincentives and ranked them as their clear preference over education and home yard waste composting. Incentives and disincentives were ranked over education based on cost-effectiveness and technical feasibility. The group felt that incentives could have a significant impact on waste stream volumes and minimal environmental impacts. While the group lumped incentives and disincentives together, they were opposed to regulatory measures, particularly as disincentives. Education, while ranked significantly below incentives, was favored over home yard waste composting, largely because of education's potential positive impact on the waste stream and its low environmental impact. The acceptance of education programs was also deemed to be far greater than either incentives/disincentives or home yard waste composting.

(b) Recycling Program

Preferred methods for recycling in the Northeast WGA were commercial source-separated collection and drop-off/buy-back depots. Both methods were highly ranked due to their cost-effectiveness, technical feasibility, potential impact on the waste stream, and low environmental impact. These methods were also thought to have a relatively high level of public/political acceptance.

In addition to these methods, the use of incentives, disincentives and education programs ranked high. Non-regulatory incentives and disincentives were considered to be cost-effective, technically feasible, capable of having a large impact on the waste stream, and environmentally sound. Education was deemed slightly less cost-effective, less reliable, and not capable of producing as large an impact on the waste stream as incentives and disincentives.

Centralized yard waste composting was also selected as an effective recycling methods in the Northeast. Yard waste composting was seen as having a potentially significant impact on the waste stream, while being compatible with other methods, cost-effective, and environmentally safe.

Reuse ranked high in terms of compatibility with other methods, environmental impact, and public acceptance. Its cost and impact on the waste stream were rated relatively low.

Other recycling methods all ranked significantly lower than the above seven options.

(c) Disposal Program

The working group ranked landfilling above other disposal options. Long-haul was ranked second and incineration/energy recovery a close third. While the methods were ranked for the waste generation area as a whole, the working group expressed a clear preference for incineration within the Spokane urban area, while continuing to rely on landfills in the less-populated rural counties. Landfilling was selected as the preferred method for the region due to its lower cost.

(2) Consultant Team Rankings

The waste management methods in each program (reduction, recycling, and disposal) were ranked by the consultant team as shown in Table E-86. In the reduction program, the consultant team evaluated "special government programs" and "waste exchange," which were not ranked by the WGA working group. In addition, the consultant team ranked "commercial high-grade collection" and "mixed-waste processing" for the recycling program. "Special waste recycling/reuse" was not ranked because of the special characteristics of these components; it was assumed that special waste management will be included in any recommended program.

Based on the criteria established for the consultant team's analysis, the consultant team recommended the following solid waste management system for the Northeast WGA:

- Reduction Program
  - -- Education
  - -- Incentives
  - -- Special governmental programs
  - -- Disincentives
  - -- Home composting
  - -- Waste exchange
- Recycling Program
  - -- Drop-off/buy-back depots
  - -- Education
  - -- Commercial source-separated collection
  - -- Yard waste composting
  - -- Incentives
  - -- Disincentives
  - -- Reuse
  - -- Single-family curbside collection
  - -- Commercial high-grade collection
  - -- Mixed-waste processing
- Disposal Program
  - -- Incineration/energy recovery
  - -- Landfill

Table E-86

BEST MANAGEMENT PRACTICES FOR
SOLID WASTE METHODS RANKING SUMMARY

NORTHEAST WGA

Reduction		Recycling		Disposal	
WGA Working Group Preference	Consultant Team Recommendations	WGA Working Group Preference	Consultant Team Recommendations	WGA Working Group Preference	Consultant Team Recommendations
1. Incentives	1. Education	1. Drop-Off/Buy-Back Depots	1. Drop-Off/Buy-Back Depots	1. Landfill	1. Incineration
Disincentives		1. Commercial Source Separated		2. Long Haul	2. Landfill
1. Education	2. Incentives	2. Incentives	2. Education	3. Incineration	3. Long Haul
	2. Special Governmental Programs	3. Disincentives	3. Commercial Source Separated		
1. Home Yard Waste Composting	3. Disincentives	4. Education	4. Centralized Yard Waste Composting		
	4. Home Yard Waste Composting		4. Incentives		
	5. Waste Exchange	5. Centralized Yard Waste Composting	5. Disincentives		
			5. Reuse		
			5. Single-Family Curb-side Collection		
			5. Commercial High-Grade Collection		
			5. Mixed Waste Processing		
		6. Reuse	6. MSW Composting		
			6. Food Waste Processing		
		7. Multi-Family Collection	7. Multi-Family Collection		
		7. MSW Composting			
		7. Food Waste Composting			
		8. Single-Family Curb-side Collection			

(a) Reduction Program

The consultant team found little justification for different waste reduction programs for different WGA's throughout the State. Based on the criteria established, the recommendations are the same Statewide and are discussed below. Education is considered to be reasonably cost-effective with excellent long-term environmental benefits considering its effect on all other management methods. The focus of education/public involvement programs is to inform and change society's view of solid waste and its management. A balance of incentives and disincentives will be necessary components of a waste reduction program. The cost-effectiveness of these methods is considered to be fair; however, their application will produce considerable environmental benefit. They are not expected to have a significant impact upon the volume of waste but can affect the composition of the waste stream significantly.

Special governmental programs are considered to be a good way to demonstrate waste reduction methods and to assist business and industry in reducing waste reduction and increasing recycling.

Home yard waste composting is a cost-effective, low-risk method for significantly reducing the waste stream. Participation by the public sufficient to measurably reduce waste will require local government to vigorously "market" the program, a worthwhile effort considering the significant amount of yard waste in the overall waste stream.

Industrial waste exchanges have been effective for some time. There is now potential for applying this concept to household hazardous wastes as well.

It is recommended that the waste reduction program be developed in the priority order listed above, and that investment of resources be made in those methods and techniques which will provide the greatest return.

(b) Recycling Program

Drop-off and buy-back depots proved to be highly cost-effective in the Northeast WGA having a net revenue potential, given present prices for recycled materials. They received a moderate environmental rating. Drop-off and buy-back operations have the potential to divert significant amounts of waste from disposal and are technically very feasible. Adequate markets exist for the commodities handled by these facilities. They should be encouraged throughout the WGA in both urban and rural areas.

Education was ranked high due to its low environmental impact, technical feasibility, potential for impact on the waste stream, and long-term cost-effectiveness.

Commercial source-separated collection is also an extremely viable recycling method in the Northeast WGA. According to the economic model, its costs per ton are only about 25% of regular municipal collection and disposal. Adequate markets exist for the waste categories which would be handled by this method: corrugated cardboard, high-grade paper, and glass. This method would primarily serve urban areas with sufficient commercial volumes.

Yard-waste composting, another effective recycling measure, is only slightly more cost-effective than regular municipal solid waste collection and disposal, according to the economic model. This method has a relatively moderate environmental impact, is very feasible, and has potential to greatly reduce waste being disposed of by incineration or landfilling. Approximately 15% of the waste stream in the Northeast WGA is comprised of lawn and garden waste. Wood waste, which comprises about 7% of the waste stream, could also be handled through these programs. However, limited markets presently exist for compost materials. Centralized yard waste composting would be compatible with either incineration or with landfill disposal options and equally applicable in urban and rural areas.

Incentives and disincentives were ranked relatively high because of their low environmental impact and moderate potential for diverting waste.

Other potential programs include reuse, single-family curbside collection, and commercial high-grade collection. These methods are environmentally sound and technically feasible, while their relative impact on the waste stream is moderate. Costs vary greatly. Reuse, while not included in the economic model, was considered to be moderately cost-effective. Commercial high-grade collection costs represent less than half of the cost of regular collection and disposal, according to the economic model. To be viable, these methods would have to focus on the more urban areas of the WGA. Single-family curbside collection net costs are greater than the cost of regular collection and disposal for the region as a whole. However, in highly urbanized areas, such programs could prove to be cost-effective.

Finally, mixed waste processing has potential application in this WGA because of its moderate cost-effectiveness and because of its potential to reduce waste flowing to disposal facilities. If the region elects not to pursue aggressive front-end recycling through source-separated collection or expanded drop-off and buy-back operations, this alternative should seriously be considered in conjunction with either mass incineration or local landfills. A stand-alone facility would have to serve the region to be cost-effective. Limited intermediate or preprocessing may be feasible in conjunction with other facilities.

Multi-family collection was not included in the recommended program largely because of its high cost and because of the relatively small impact it would have upon the Northeast WGA waste stream. Municipal solid waste composting and food waste processing were also omitted from the list of recommended methods because of their relatively low ratings with respect to feasibility, the lack of established markets, lack of operating experience, and health and environmental concerns.

(c) Disposal Program

There are extreme variations in population within this WGA, which includes both very rural counties with dispersed populations as well as the more densely populated area of Spokane. Environmental conditions and levels of concern also vary dramatically. As a result, no one disposal method can be considered to be the Best Management Practice for this WGA. The consultant

team ranking placed incineration slightly ahead of the other methods, even though it was the most expensive disposal option. The preference was based on the potential for volume reduction, which would greatly reduce the requirement for landfill capacity. Even though landfilling was ranked below incineration, it is the preferred method in less densely populated, rural areas of this WGA. Both methods present environmental exposure to loss and thus raise concerns among those living within the WGA.

Objectives for each category of solid waste appear in Table E-87. These objectives depict the amount of each category which could reasonably be handled by each method. The objectives are based on the results of the WGA-recommended model and on the current levels of recycling in each WGA.

Table E-87

VAAONE60

Waste Stream Category Objectives By Method for Northeast WGA

% OF WASTE STREAM CATEGORY MANAGED BY METHOD

WASTE STREAM CATEGORY / METHOD/ TECHNIQUE	RECYCLING											DISPOSAL							TOTAL (%)
	REUSE	SINGLE FAMILY CURBSIDE COLLECTION	MULTI-FAMILY HOUSING COLLECTION	COMMERCIAL SOURCE SEPARATION	COMMERCIAL HIGH GRADE	COMMERCIAL DIRECT	DROP OFF / BUYBACK DEPOTS	MIXED WASTE PROCESSING	YARD WASTE COMPOSTING	MIXED WASTE COMPOSTING	FOOD WASTE PROCESSING	SUBTOTAL RECYCLING	ANAEROBIC DECOMPOSITION	PYROLYSIS / GASSIFICATION	REFUSE DERIVED FUEL PREP. & USE	MASS BURN INCINERATION / ASHFILL	LANDFILL	LONG HAUL	SUBTOTAL DISPOSAL	
NEWSPAPER	10				50						60			26	14		40	100	
CORRUGATED CARDBOARD	2		17	1	32	4					56			29	15		44	100	
HIGH GRADE PAPER			17	1	2						20			52	28		80	100	
MIXED SCRAP PAPER (RECYCLABLE)	6			1							7			61	33		93	100	
REFILLABLE GLASS CONTAINERS	4		12			36					52			38	20		58	100	
GLASS	5		6			9					20			52	28		80	100	
ALUMINUM	5					60					65			23	12		35	100	
TIN PLATED FOOD & BEVERAGE CANS	4					1					5			62	33		95	100	
FERROUS METAL					59	3					62			25	13		38	100	
NON-FERROUS METAL					68	3					71			18	11		29	100	
WHITE GOODS						3					3			63	34		97	100	
PET PLASTICS														65	35		100	100	
HDPE PLASTICS														65	35		100	100	
PLASTIC PACKAGING (LDPE)														65	35		100	100	
EXPANDED POLYSTYRENE														65	35		100	100	
OTHER PLASTICS														65	35		100	100	
TIRES						37					37			41	22		63	100	
OTHER RUBBER PRODUCTS														65	35		100	100	
FOOD														65	35		100	100	
LAWN AND GARDEN WASTE							75				75			16	9		25	100	
WOOD														65	35		100	100	
DISPOSABLE DIAPERS														65	35		100	100	
OIL						86					86			9	5		14	100	
BATTERIES						69					69			20	11		31	100	
OTHER HOUSEHOLD HAZARDOUS														65	35		100	100	
CONSTRUCTION DEBRIS (NOT WOOD)														65	35		100	100	
OTHER ORGANIC														65	35		100	100	
OTHER INORGANIC														65	35		100	100	

10. SOUTHEAST WGA

a. Introduction to Southeast WGA

(1) Location

The Southeast Waste Generation Area (Southeast WGA) is located in the southeast corner of the State of Washington. This area includes the Snake River Valley, the Palouse farmlands, and part of the semiarid Columbia Basin. The total area of the Southeast WGA is 10,500 square miles.

The following counties are in the Southeast WGA:

- Adams
- Asotin
- Benton
- Columbia
- Franklin
- Garfield
- Walla Walla
- Whitman

(2) Population

The estimated 1987 population of the Southeast WGA was 264,800 persons. Of this, 63% resided in the 39 incorporated towns and cities of the area. The Washington State Office of Financial Management predicts an 8% growth in population by 1995, to 286,000 for the area. According to 1980 Census figures, 28% of the population lived in rural areas (defined as outside of urbanized areas or outside Census-designated places of 2,500 or more inhabitants).

In 1987, there were 96,880 housing units in the Southeast WGA (April 1 estimate). Seventy percent (70%) of these units were single-family dwellings. This total represents an increase of 3,090 housing units since 1980 (3% growth).

(3) Economy

The Washington State Department of Employment Security estimated December 1987 employment in the West WGA to be 94,390 persons. The number of "employer units" (i.e., separate business locations) was put at 6,360. In 1986, more than six out of ten employed persons in the Southeast WGA (64%) worked in government (24%), service (22%), or manufacturing jobs (18%). Two major government employers are Washington State University (Whitman County) and the U.S. Department of Energy (Benton County); employment related to the USDOE Reservation figures prominently in the manufacturing sector.

b. Existing Solid-Waste Management Methods

(1) Solid-Waste Reduction and Recycling

There are approximately 25 recycling centers in the Southeast WGA (this figure excludes beverage distributors handling refillable bottles, as well as battery and tire distributors). In 1987, these centers handled 34,600 tons of materials, representing 10.5% of the estimated total tonnage of solid waste generated. The following sections summarize the reduction and recycling programs in each of the counties in the Southeast WGA.

(a) Adams County

They City of Ritzville in Adams County operates a recycling program through the Marshall Landfill in Spokane County. Sorting of recyclables is done there, and the profits are shared between the landfill and the City of Ritzville. The County is not currently operating any recycling programs.

(b) Asotin County

In Asotin County, recyclables either go to the one private recycler operating in the county, or into Idaho.

(c) Benton County

Benton County government does not currently fund recycling efforts; they are all handled privately or through civic groups.

(d) Columbia County

Currently there is no coordinated program operated by the County. All recycling efforts are managed by civic groups.

(e) Franklin County

In Franklin County, all recycling programs are owned and operated by the private sector. Various methods of promotion have been attempted to increase public awareness, but the most successful approaches have been advertisements in periodicals and radio announcements.

(f) Garfield County

In Garfield County, there are currently no recycling programs in operation.

(g) Walla Walla County

The regional planning budget for Walla Walla County includes promotion of recycling programs, but the bulk of recycling is done by private civic groups.

(h) Whitman County

Whitman County will begin a campaign for recycling in the near future. It will include videos, news releases, and school presentations. The County landfill currently salvages recyclables, but does not buy any from the public.

(2) Solid-Waste Collection

In the Southeast WGA, there are seven haulers collecting municipal solid waste under U.T.C. certificates (franchises). Eight cities operate their own solid waste collection services. These cities are Garfield, College Place, Waitsburg, Walla Walla, Dayton, Richland, Clarkston, and Pomeroy. All other collection in this WGA is conducted through a contractual agreement between city and hauler. Table E-88 summarizes this information.

The operators hauled an estimated 225,000 tons of waste in 1987, 39% of which was from the commercial sector, and 61% from residences. Including self-haul tonnages, the total disposed waste for 1987 was estimated to be 283,000 tons.

It is reported that there are rural self-haul drop-boxes throughout most of Whitman County and in Touchet, Dixie, and Prescott in Walla Walla County (depending on the definition used for "drop-box," the number may vary; there appear to be different interpretations of the terms "drop-box" and "transfer station"). Table E-89 describes them in greater detail.

(3) Solid-Waste Disposal

There are seven operating landfills accepting municipal waste in the Southeast WGA; all are open to the public. Table E-90 presents more detailed information on landfills and transfer stations. The estimated remaining capacities of these landfills range from 15 to 300 years (some information was unavailable); Table E-91 summarizes this information.

Based on 1987 quantities of waste disposed, rough estimates were generated for the tonnage of waste that could be accommodated by present landfills in the Southeast WGA. Calculations were based only on information from landfills accepting municipal waste, except for those on military bases and Indian reservations. The tons of waste disposed at each landfill in 1987 were multiplied by the reported years of remaining life. Remaining life was defined as:

1) The number of years between 1987 and a closure data mandated by permit; or

2) if no mandated closure date is specified, the number of years between 1987 and an estimated closure date (due to exhaustion of site capacity, landfill noncompliance, or business closure); or

3) the smaller of the two figures, if both exist.

Table E-88
WASHINGTON DEPARTMENT OF ECOLOGY
Recycling and Waste Stream Survey-1987
SOUTHEAST WASTE GENERATION AREA
HAULERS

NAME	PUBLIC/ PRIVATE	FRANCHISES	AREA SERVED	DESTINATION/COUNTY
City of Garfield	Public		City of Garfield	Whitman Co. L.F./Whitman
Pullman Disposal Svc.	Private	F	Whitman County	Whitman Co. L.F./Whitman
Disposal Services	Private	F	Walla Walla and Columbia Counties	City of Walla Walla L.F./ Walla Walla
Empire Disposal, Inc.	Private	F	Spokane Co. Whitman Co. & Columbia Co.	(1) Whitman Co. L.F./Whitman (2) Mica L.F./Spokane (3) Marshall L.F./Spokane (4) Northwest Co. L.F./Lincoln
City of College Place	Public		City of College Place	City of Walla Walla L.F./ Walla Walla
City of Waitsburg	Public		City of Waitsburg	City of Walla Walla L.F./ Walla Walla
City of Walla Walla	Public		City of Walla Walla	City of Walla Walla L.F./ Walla Walla
Ada-Lin Waste Systems	Private		Adams, Lincoln & Whitman Counties	Adams Co. Drop Box (which goes to Bruce L.F.)/Adams
City of Warden	Public		City of Warden, Grant Co.	Bruce L.F./Adams
Consolidated Disposal	Private	F	Grant/Adams Counties	(1)Bruce L.F./Adams (2)Ephrata L.F./Grant
City of Dayton	Public		City of Dayton	Columbia Co. T.S./Columbia

NAME	PUBLIC/ PRIVATE	FRANCHISES	AREA SERVED	DESTINATION/COUNTY
Basin Recycling and Basin Disp., Inc.	Private	F	Benton, Franklin and Walla Walla Counties	(1) Pasco Sanitary L.F./Franklin (2) Richland Sanitary L.F./Benton
Ed's Disposal	Private	F	Benton County	Pasco Sanitary L.F./ Franklin
City of Richland	Public		City of Richland	Richland Sanitary L.F./ Benton
Kennewick Disposal	Private	F	Benton County	(1) Richland Sanitary L.F./ Benton (2) Grandview L.F./Yakima
Nasland Disposal Ser.	Private	F	Asotin County	Asotin County L.F./Asotin
City of Clarkston	Public		City of Clarkston	Asotin County L.F./Asotin
City of Pomeroy	Public		City of Pomeroy	Garfield County L.F./ Garfield

TABLE E-89
WASHINGTON DEPARTMENT OF ECOLOGY
Recycling and Waste Stream Survey-1987
SOUTHEAST WASTE GENERATION AREA
RURAL DROP BOXES

COUNTY	LOCATION	SIZE	TYPE	OTHER
Walla Walla	Dixie	30-45 CY	Non-compactor	Disposal Service operates these. They are all manned
	Prescott	30-45 CY	Non-compactor	"
	Touchet	30-45 CY	Non-compactor	"
	Burbank	30 CY Approx.	Non-compactor	Basin Disposal operated.
Whitman	Not Avail.	40 CY	Not Avail.	6 Drop Box sites, throughout county, county-operated, attended by part-time workers. As of 11/1/88 all are closed.

Table E-90
WASHINGTON DEPARTMENT OF ECOLOGY
Recycling and Waste Stream Survey-1987
SOUTHEAST WASTE GENERATION AREA
DISPOSAL FACILITIES

COUNTY	FACILITY	NAME	ACCESS	1987 TONS RECEIVED	REMAINING CAPACITY*	DESTINATION	1987 TIPPING FEES
Adams	Landfills:	Bruce	Public	14,400	40 Years; 85 Acres		$2.50/LCY $4.25/CCY
Asotin	Landfills:	Asotin Co.	Public	69,000	20-30 Years; 90.5 Acres		$3.00/CY
Benton	Landfills:	Richland Sanitary	Public	70,000	30-40 Years; 60 Acres		$9.35/Ton $1.60/LCY $2.85/CCY
	Transfer Stations:	Kennewick	Public	42,900		Richland Sanitary L.F.	$3.78/LCY
Columbia	Transfer Stations:	Columbia Co.	Public	1,900		City of Walla Walla L.F.	$34.00/Ton
Franklin	Landfills:	Pasco Sanitary	Public	55,000	15-20 Years		$9.35/Ton
Garfield	Landfills:	Garfield County	Public	1,000	200 Years; 35 Acres		$21.00/Ton
Walla Walla	Landfills	City of Walla Walla	Public	50,000	200-300 Years; 1,000 Acres		$13.80/Ton
Whitman	Landfills:	Whitman County	Public	23,900	15-20 Years		$45.00/Ton -$12.50/Ton Demolition

CY = Cubic Yard
CCY= Compacted Cubic Yard
LCY= Loose Cubic Yard

*Based on space available at the end of 1987, regardless of mandated or planned closure dates.

TABLE E-91
WASHINGTON DEPARTMENT OF ECOLOGY
Recycling and Waste Stream Survey-1987
SOUTHEAST WASTE GENERATION AREA
LANDFILL CAPACITIES

COUNTY	FACILITY NAME	MANDATED CLOSURE (Date/None)	REMAINING CAPACITY* (Years/C.Y./Acres)	COMMENTS (#)
Adams	Bruce	None	40 Years; 85 Acres	1
Asotin	Asotin County	None	20-30 Years; 90.5 Acres	2
Benton	Richland Sanitary	None	15-20 Years; 60 Acres	
Franklin	Pasco Sanitary	None	15-20 Years	
Garfield	Garfield County	None	200 Years; 35 Acres	3
Walla Walla	Walla Walla	None	200-300 Years; 1,000 Acres	4
Whitman	Whitman County	None	15-20 Years	5

COMMENTS

1. No restriction on permitted capacity.
2. Permit renewed annually. Life could be extended 50 years with baling system.
3. Some talk of closure.
4. Permit renewed annually.
5. Using baling system. New land will be bought alongside the site, or it will be converted to a transfer station.

*Based on space available at the end of 1987, regardless of mandated or planned closure dates.

Using this method, it was estimated that the Southeast WGA had sufficient landfill capacity at the end of 1987 to accommodate approximately 17,007,000 additional tons of solid waste. Care should be taken when interpreting this figure, since a WGA total estimate may not reflect situations facing individual jurisdictions. Landfills which did not report sufficient information to calculate tonnage capacity are not represented in the above estimate (refer to Tables E-90 and E-91).

(4) Solid-Waste Management Planning

Adams County--began update of its 1977 plan in 1985; this draft is not currently approved.

Asotin County--currently updating its 1975 plan.

Benton County--trying to obtain a grant from the State DOE to update its 1977 Solid-Waste Plan.

Columbia County--operating on its previous solid waste plan.

Franklin County--trying to obtain a grant from the State DOE to update its 1977 Solid Waste Plan.

Garfield County--draft Solid Waste Plan due to DOE in winter of 1989.

Walla Walla County--1987 Plan accepted by DOE.

Whitman County--submitted a 1982 draft to the DOE; not currently approved.

c. Market Capacity

The Southeast WGA markets most of its paper and glass in Oregon while other materials typically go to Spokane or the Puget Sound area. Low volumes of some materials as well as great distance to market are barriers for this area, neverhtless, significant volumes of some materials are recovered.

Newspaper, corrugated and high-grade paper markets are stable with most material bought by Oregon mills. Aluminum cans, ferrous and non ferrous metals enjoy good markets. Mixed waste paper prices are low in relation to required processing costs, yet some material is still recovered. The transportation savings made possible by marketing glass in Portland support a recovery level of 2,200 tons per year. White goods can be shredded in Spokane and this helps reduce costs of disposal. Tin cans are a low value material for the area but are none-the-less marketed. Plastics and yard waste markets are not currently accessed from the WGA, although they may be in the future.

A market capacity summary for the Southeast WGA is presented in Table E-92.

Table E-92

Market Capacity Summary for Southeast WGA

	COMMODITY	MAJOR END USERS FOR MATERIAL FROM WGA (Name &/or Location)	ESTIMATED END USER PRICE '88 ($/Ton)	VOLUME OF WGA MATRL. RECOVERED (1987 Tons)	(1) WGA COLLECTED MATERIAL PRICE ($/Ton)	(1) WGA COLLECTED MATERIAL VALUE ($/Year)	(2) WGA MARKET CAPACITY	FACTORS AFFECTING WGA MARKET FOR MATERIAL
1	Newsprint	Smurfit - Oregon some to Seattle	$45.00	1,400	$16	$22,400	ADEQUATE	Most goes to regional mills which provide freight
2	Corrugated Containers	Various mills - Oregon some to Seattle	$65.00	6,700	$40	$268,000	ADEQUATE	Most goes to regional mills which provide freight
3	High Grade Paper	Weyerhsr. - Oregon some to Midwest	$100.00	300	$45	$13,500	ADEQUATE	Most goes to regional mills which provide freight
4	Mixed Waste Paper	Export Portland or Seattle	$25.00	100	($12)	($1,200)	NOT SIGNIFICANT	Instate tariff - $.10/ton/mile High transport $ due to distance
5	Container Glass	Owens-Brockway, Portland	$40.00	2,200	$14	$30,800	ADEQUATE	Freight assistance for interstate shipment reduces costs
6	Refillable Glass	Rainier Brewing - Sea. Pabst/Olympia some Soft Drink	$116.00	1,200	$44	$52,800	ADEQUATE	
7	Aluminum Bev. Cont.	Various Alum. Co. Ship from Spokane	$1,000.00	1,500	$837	$1,255,500	ADEQUATE	New resmelter to be located nearby in Idaho, 1989 Spokane is current shipping point
8	Tin Cans	MRI - Seattle	$49.00	200	$18	$3,600	ADEQUATE	Instate tariff - $.10/ton/mile Freight assistance reduces cost
9	Ferrous Metals	General Metals - Tac. Salmon Bay/Seattle Steel	$65.00	14,600	$28	$408,800	ADEQUATE	Instate tariff - $.10/ton/mile
10	White Goods	Seattle Iron & Steel Pacific Hide & Fur - Spokane	$20.00	100	($13)	($1,300)	POTENTIAL DISP. AVOID.	Shredder & compactor in Spokane help reduce transport costs
11	Non Ferrous Metals	Various - Tacoma/Seattle	$800	2,700	$628	$1,695,600	ADEQUATE	Instate tariff - $.10/ton/mile
12	PET Bottles	Midwest & East U.S.	$160	0	$16	$0	NOT SIGNIFICANT	Low supply & high transport cost Potential future market
13	HDPE Bottles	Export - Puget Sound Partek - Vancouver	$200	0	$56	$0	NOT SIGNIFICANT	Low supply & high transport cost Potential future market
14	Plastic Films (LDPE)	Export - Puget Sound	$160	0	$38	$0	NOT SIGNIFICANT	Low supply & high transport cost Potential future market
15	Lawn & Garden Waste	None	($20)	0	($30)	$0	NOT SIGNIFICANT	Potential disp. avoid. market

(1) WGA prices and values are before transportation, processing and handling necessary to prepare and move material to market.

(2) WGA market capacity is based on an assessment of the markets' ability to consume consistently and gradually increasing volumes.

REFER TO TEXT FOR DETAILED DISCUSSION

d. Evaluation of Methods

(1) Feasibility Analysis

Notable exceptions to the Statewide technical feasibility review for the Southeast WGA are as follows:

- Education. Vendor exposure to loss was judged to be higher than the Statewide rating. The moderate rating reflects the group's concern about the availability of professionals trained in waste reduction and recycling. This concern reflects the importance of this element to the overall success of any program.

  Financing exposure to loss was viewed, throughout the risk matrix, from the perspective of private financing and the risks associated with securing and repaying debt. The economic analysis assumes public financing of facilities. Most of the "front-end systems" are privately owned and operated in the Southeast region. These deviations, therefore, were not considered to be highly significant.

- Waste Exchange. Exposure to loss was considered to be higher than the Statewide rating. Concern was expressed regarding the ability to start and operate a coordinate, "one-call system" waste exchange. An industrial waste exchange was seen as feasible.

- Reuse. Reuse exposure was judged higher than the Statewide rating. Concerns center on the perception of reuse facilities as being aesthetically displeasing. The group considered a Salvation Army/Goodwill Industries type of operation repairing, and reselling materials rather than a salvage operation at a disposal facility.

  Market exposure was assessed to be higher than the Statewide rating. The variety of materials available for reuse was seen as insufficient to sustain a reuse facility.

  The higher rating for uncontrollable circumstances reflects the concern for competition and its effect on a marginal activity.

- Curbside Collection. Some of the exposures related to curbside were judged higher than the Statewide rating. There was generally a negative feeling about curbside collection and the rating reflects and general concern that participation would be low and that the general public would not support such a program.

The group saw a high exposure in obtaining a vendor able to sustain a curbside program. Again, this may be a reflection on the lack of confidence in the method.

Concern for competition for recyclables in the waste stream resulted in higher than Statewide ratings for uncontrollable circumstances exposure.

- Multi-Family Housing Collection. Exposure to loss for this method was also judged to be higher than for Statewide ratings. Reaction to this method parallels the response to curbside collection.

- Intermediate Processing Facility. Market exposure was judged higher than the Statewide rating. There was general concern that the markets for recyclable materials are inadequate in the Southeast WGA and that a multi-material intermediate processing facility would be at risk due to market conditions.

- Commercial Mixed Waste Processing. Waste supply exposure was judged higher than the Statewide rating. This likely reflects the rural nature of the WGA and the general sense that the area would not support a mixed-waste processing facility for commercial waste.

  Market exposure was deemed higher than in the Statewide rating.

- Drop-Off/Buy-Back Depots. Siting exposure was viewed as being higher than the Statewide rating. Higher ratings reflect difficulties encountered by the private sector in relocating a buy-back depot in the face of residential encroachment. Generally, the concern reflects the need for convenience and accessibility to the public. These comments do not reflect any concern about the traditional drop-off box system of recycling.

  Waste supply exposure was judged to be higher than the Statewide rating. This again reflects concern over the ability of a buy-back depot to attract an adequate supply of recyclables. It also likely reflects the rural nature of the area.

- Yard Waste Composting. The group's feeling was that with the exception of Whitman County, there was not enough yard waste in the area to support a centralized yard waste composting facility.

  The higher than Statewide rating for market exposure generally reflects the group's negative feeling toward yard waste composting, again with the exception of Whitman County.

- Mixed Waste Composting. The higher than Statewide ratings for residue disposal was likely due to the group's recognition that this residue would require landfilling and would contain heavy metals and potentially toxic materials. Some group members were concerned that the residue might be classified as a hazardous waste.

- Food Waste Processing. Waste supply exposure was judged to be lower than in the Statewide rating. Note that all ratings for food waste processing involved waste and not household food waste. The waste supply from the food processing industry is considered very good and, thus, presenting a low rating for exposure to loss.

The exposure to loss feasibility evaluation for the Southeast WGA is presented in Table E-93.

(2) Environmental Evaluation

(a) Impacts

Environmental impacts in the Southeast WGA are generally the same as identified in the generic discussion of impacts. The very low precipitation in this WGA reduces leachate generation from composting, landfills, or ashfills. On the other hand, high summer temperature probably accelerate landfill decomposition processes, leading to increased generation of methane gases requiring control. In addition, high summer temperatures would increase odors from facilities such as food waste composting, upset conditions of anaerobic composting, and make storage for alternatives such as mass burn incineration more difficult. These factors are reflected in the environmental impact matrix (Table E-94).

An evaluation of potential environmental impacts due to failures in the technology are presented in Table E-95.

(b) Concerns

The environmental concern evaluation matrix (Table E-96) indicates less concern on the part of the Southeast WGA Committee about food waste processing, landfills, and ashfills than in other WGA's. The lower concern about food waste processing reflects experience with successful reuse of food processing plant wastes as animal feed. The greater concern about traffic and aesthetic impacts reflects Committee members' experience in trying to site facilities. Lower concern about potential public health risks is based on their opinion that the relatively low population density and low precipitation would minimize potential for exposure to such risks.

(3) Economic Evaluation of Alternatives

The results of the economic analysis for the Southwest WGA are summarized in Table E-97. Detailed results appear in Appendix C.

Table, E-93

Evaluation of Exposure to Loss for Southeast WGA

VAADSE28

DEGREE OF EXPOSURE TO LOSS ASSOCIATED WITH IMPLEMENTATION & USE OF EACH METHOD

TECHNICAL IMPLEMENTATION FACTOR			REDUCTION						RECYCLING										HANDLING		DISPOSAL					
			EDUCATION	INCENTIVES	DISINCENTIVES	MODEL GOVERNMENTAL PROGRAMS	WASTE EXCHANGE	HOME YARD WASTE COMPOSTING	REUSE	CURBSIDE COLLECTION	MULTI-FAMILY HOUSING COLLECTION	COMMERCIAL SOURCE SEPARATION	INTERMEDIATE PROCESSING FACILITY	COMMERCIAL MIXED WASTE PROCESSING	DROP OFF / BUYBACK DEPOTS	MIXED WASTE PROCESSING	YARD WASTE COMPOSTING	MIXED WASTE COMPOSTING	FOOD WASTE PROCESSING	SPECIAL WASTE RECYCLING AND REUSE	TRANSFER	LONG HAUL TRANSPORT	ANAEROBIC DECOMPOSITION	PYROLYSIS / GASSIFICATION	REFUSE DERIVED FUEL PREP. & USE	MASS BURN INCINERATION	LANDFILL	ASHFILL
SITING	SITING RESISTANCE	GENERAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	L/M	L	M/H	L	M/H	M	M/H	M/H	NA	M/H	M/H	H	H	H	H
		WGA SPECIFIC	NA	NA	NA	NA	NA	NA	M/H	NA	NA	NA	L	L	M	H	L/M	H	L/M	M/H	M/H	NA	M/H	M/H	H	H	H	H
	PERMITS AQUISITION DIFFICULTY	GENERAL	NA	NA	NA	NA	NA	NA	L	L	L	L	L	L/M	L	M	L	M/H	M	L/M	M	M	M/H	M/H	H	H	H	H
		WGA SPECIFIC	NA	NA	NA	NA	NA	NA	M/H	L	L	L	L	L	M	M	L/M	H	L/M	L	M	M	M/H	M/H	H	H	H	H
	TIME & COST REQUIRED TO COMPLETE SITING	GENERAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	L/M	L	L	L	M/H	M	L/M	M/H	NA	M/H	M/H	H	H	H	H
		WGA SPECIFIC	NA	NA	NA	NA	NA	NA	M	NA	NA	NA	L	L	M	M	L	H	L	M/H	M/H	NA	M/H	M/H	H	H	H	H
WASTE SUPPLY	QUANTITY	GENERAL	NA	NA	NA	NA	L	NA	L	M	M	L	L/M	L	L	L	L	L	M/H	L/M	L/M	L/M	L/M	M	M	M	L	L
		WGA SPECIFIC	NA	NA	NA	NA	L	NA	L	H	H	L	L/M	M	M	L	M	L	L	L/M	L/M	L	L/M	M	M	M	L	L
	COMPOSITION	GENERAL	NA	NA	NA	NA	L	L	L/M	L/M	L/M	L	L/M	L	M	L/M	L/M	M	L	L/M	L/M	L	L/M	M	M	M	L	L/M
		WGA SPECIFIC	NA	NA	NA	NA	L	L	L	L/M	L/M	L	L/M	L	M	L/M	L/M	M	L	L/M	L/M	L	L/M	M	M	M	L	L
MARKETS		GENERAL	NA	NA	NA	NA	L	NA	L	M	M	L/M	L/M	L/M	L/M	M/H	M	M/H	M/H	L/M	NA	NA	L/M	M/H	M/H	M	NA	NA
		WGA SPECIFIC	NA	NA	NA	NA	L	NA	M	M/H	M/H	L/M	M/H	M/H	L/M	M/H	H	H	M	L/M	NA	NA	H	H	H	M	NA	NA
VENDOR		GENERAL	NA	NA	NA	NA	L	NA	NA	L/M	L/M	L/M	L/M	L/M	L	M/H	L	M/H	L/M	L/M	L	L/M	L	H	M	M	NA	NA
		WGA SPECIFIC	M	NA	NA	NA	NA	NA	NA	H	H	L/M	L	L/M	L	M	L	M	L/M	L/M	L	L	L	H	M/H	M	NA	NA
TECHNOLOGY/ PROGRAM	ABILITY TO CONSTRUCT & MAKE OPERATIONAL	GENERAL	L	M/H	M/H	L	L	M	L/M	L	L/M	L/M	L	M/H	L	L/M	L	L/M	L/M	NA	L/M	NA	L	H	M	M	L/M	L/M
		WGA SPECIFIC	L	M/H	M/H	L	M/H	M	L/M	L	M	L	L	L	L	M	L	L/M	L	L/M	L/M	NA	L	H	M	M	L/M	L/M
	ABILITY TO OPERATE AND MAINTAIN	GENERAL	L	L/M	L/M	L	L	M	L/M	L	M	L/M	L/M	L/M	M	L/M	L/M	L/M	L/M	L/M	L/M	M/H	L	M/H	M/H	M	M	L
		WGA SPECIFIC	L	L/M	L/M	L	M/H	M/H	L/M	L	M	L	L/M	L/M	M	L/M	L/M	L/M	L/M	L/M	L/M	M/H	L	H	M/H	M	M	L
RESIDUE DISPOSAL	CHARACTERISTICS	GENERAL	NA	NA	NA	NA	NA	M	NA	L	L	L	L	L	L	L	L	L	L	M/H	NA	NA	M	M	L/M	M/H	NA	NA
		WGA SPECIFIC	NA	NA	NA	NA	NA	M	NA	L	L	L	M	L	L	L	M	L	L	M/H	NA	NA	M	M/H	L/M	M/H	NA	NA
	SITE AVAILABILITY	GENERAL	NA	NA	NA	NA	NA	M	NA	NA	NA	NA	L	L	L	L	L	L	L	M/H	NA	NA	M	M	L/M	M/H	NA	NA
		WGA SPECIFIC	NA	NA	NA	NA	NA	M	NA	NA	NA	NA	L	L	L	M	L	M	L	M	NA	NA	M	M/H	L/M	M/H	NA	NA
FINANCING		GENERAL	L	L	L	L	L	L	L	L	L/M	L	L/M	M	L	M	L	L/M	M	M	L/M	L/M	L/M	H	M/H	M/H	M	M
		WGA SPECIFIC	H	H	H	L	M/H	L	M/H	H	H	L	H	H	L	M/H	H	H	M	L/M	L/M	L/M	L/M	H	M/H	M	M/H	M/H
UNCONTROLLABLE CIRCUMSTANCES**		GENERAL	L	M	M	L	M	M	L	L	L	L	L	L	M	M	L	M	M	M/H	M	M	M	M/H	M/H	M/H	M/H	M/H
		WGA SPECIFIC	L	M	M	L	M	M	M	M	M	L	L/M	L/M	M	M	L	M	M	M	M	M	M	M/H	M/H	M/H	H	H

KEY:

NA = NOT APPLICABLE
H = HIGH
M = MODERATE
L = LOW

Table E-94

Evaluation of Environmental Impacts *

for Southeast WGA

VAAOSE26

DEGREE OF POTENTIAL ENVIRONMENTAL IMPACT ASSOCIATED WITH IMPLEMENTATION & USE OF EACH METHOD

ENVIRONMENTAL FACTOR	REDUCTION						RECYCLING												HANDLING		DISPOSAL					
	EDUCATION	INCENTIVES	DISINCENTIVES	MODEL GOVERNMENTAL PROGRAMS	WASTE EXCHANGE	HOME YARD WASTE COMPOSTING	REUSE	CURBSIDE COLLECTION	MULTI-FAMILY HOUSING COLLECTION	COMMERCIAL SOURCE SEPARATION	INTERMEDIATE PROCESSING FACILITY	COMMERCIAL MIXED WASTE PROCESSING	DROP OFF / BUYBACK DEPOTS	MIXED WASTE PROCESSING	YARD WASTE COMPOSTING	MIXED WASTE COMPOSTING	FOOD WASTE COMPOSTING	SPECIAL WASTE PROCESSING	SPECIAL WASTE RECYCLING AND REUSE	TRANSFER	LONG HAUL TRANSPORT	ANAEROBIC DECOMPOSITION	PYROLYSIS / GASSIFICATION	REFUSE DERIVED FUEL PREP. & USE	MASS BURN INCINERATION	LANDFILL	ASHFILL
AIR QUALITY	NA	NA	NA	NA	NA	NA	NA																			
CRITERIA POLLUTANTS: SO2, NOX, HCL								L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
TOXICS								L	NA	NA	NA	NA	NA	NA	NA	NA	L	NA	NA	L	L	L	L	L	L	L
PARTICULATES								L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
ODOR	NA	NA	NA	NA	NA	L	NA	NA	L	NA	L	NA	L	L	L	L	L/M	L	L	NA	L/M	L/M	L/M	L/M	L/M	NA
SURFACE WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	NA	NA	NA	L	L	L	L	L	NA	NA	L	L	L	L	L	L
GROUND WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	NA	NA	NA	L	L	L	L	L	NA	NA	L	L	L	L	L	L
NOISE	NA	NA	NA	NA	NA	L	NA	L	L	NA	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
RISK OF EXPLOSION	NA	NA	NA	NA	NA	NA	NA	NA	L	NA	NA	L	NA	L	NA	L	NA	L	L	NA	L	L	L	L	L	NA
PUBLIC HEALTH RISKS	NA	NA	NA	NA	NA	L	NA	NA		NA	L															
PATHOGENS						L		NA	L	NA	L	NA	L	L	NA	L	L	NA	L	L	L	L	L	L	L	NA
VECTORS						L		NA	L	NA	L	L	L	L	L	L	L	NA	L	L	L	L	L	L	L	NA
TOXICS						L		NA	NA	NA	L	NA	L	L	L	L	L	L	NA	NA	L/M	L/M	L/M	L/M	L	L/M
AESTHETICS	NA	NA	NA	NA	NA	L	NA	L	L	NA	L	L	L	L	L	L	L	L	L	NA	L	L	L	L	L	L
TRAFFIC	NA	NA	NA	NA	L	NA	NA	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
OTHER																										

KEY: **

NA = NOT APPLICABLE
H = HIGH RATING
M = MEDIUM RATING
L = LOW RATING

* THIS EVALUATION ASSUMES NEW "STATE OF THE ART" FACILITIES, PROPERLY SITED WITH FACILITY DESIGN INCORPORATIONG APPROPRIATE MITIGATION TECHNIQUES.

** A HIGH RATING INDICATES A HIGH LEVEL OF LOCAL ENVIRONMENTAL IMPACT
A LOW RATING INDICATES A LOW LEVEL OF ENVIRONMENTAL IMPACT

Table E-95

VAA0SE27

Evaluation of Potential Environmental Impacts * for Southeast WGA

DEGREE OF POTENTIAL ENVIRONMENTAL IMPACT ASSOCIATED WITH IMPLEMENTATION & USE OF EACH METHOD

ENVIRONMENTAL FACTOR	REDUCTION						RECYCLING												HANDLING		DISPOSAL					
	EDUCATION	INCENTIVES	DISINCENTIVES	MODEL GOVERNMENTAL PROGRAMS	WASTE EXCHANGE	HOME YARD WASTE COMPOSTING	REUSE	CURBSIDE COLLECTION	MULTI-FAMILY HOUSING COLLECTION	COMMERCIAL SOURCE SEPARATION	INTERMEDIATE PROCESSING FACILITY	COMMERCIAL MIXED WASTE PROCESSING	DROP OFF / BUYBACK DEPOTS	MIXED WASTE PROCESSING	YARD WASTE COMPOSTING	MIXED WASTE COMPOSTING	FOOD WASTE PROCESSING	SPECIAL WASTE RECYCLING AND REUSE	TRANSFER	LONG HAUL TRANSPORT	ANAEROBIC DECOMPOSITION	PYROLYSIS / GASSIFICATION	REFUSE DERIVED FUEL PREP. & USE	MASS BURN INCINERATION	LANDFILL	ASHFILL
AIR QUALITY	NA	NA	NA	NA	NA	NA	NA																			
CRITERIA POLLUTANTS: SO2, NOX, HCL								L	L	L	L	L	L	L	L	M	L	M	M	M	M	L/M	M	M	M	L
TOXICS								L	L	L	L	L	M	L	L	L	L	M	L	L	M	M	M	H	H	L/M
PARTICULATES								L	L	L	L	L	L	L	L	L	L	M	M	L	H	H	H	H	L	M/H
ODOR	NA	NA	NA	NA	NA	L/M	NA	L	L	L	L/M	L	L/M	H	L	M	H	L	L/M	L/M	H	H	M	M	H	L
SURFACE WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	L	L	L/M	M	L/M	M	M	M	L	L	L	L	L	L	M	M
GROUND WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	L	L	L	M	L/M	M	M	M	L	L	L	L	L	L	L/M	L/M
NOISE	NA	NA	NA	NA	L	L	NA	L/M	L/M	L/M	L/M	M/H	M	H	M	L/M	L/M	L	M/H	M/H	M	M/H	M/H	M/H	M	M
RISK OF EXPLOSION	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	L	L/M	L	H	L/M	L/M	L	L	L	L	M/H	M	H	M	H	L
PUBLIC HEALTH RISKS	NA	NA	NA	NA	NA		NA																			
PATHOGENS						L		L	L	L	L	L	L/M	M	L	M	H	NA	M	L	L	L	L	L	L/M	L
VECTORS						L/M		L	L	L	L	L	L/M	M	L	M	H	M	M	L	L	L	L	L	M	L
TOXICS						L		NA	NA	NA	L	L	L	M	L	M	M	M	L	L	M/H	M/H	M/H	M/H	M/H	M
AESTHETICS	NA	NA	NA	NA	M	M	NA	L/M	L/M	L/M	L/M	M	M	H	M/H	M	M/H	L/M	M/H	M	M	M	M	M	M	M
TRAFFIC	NA	NA	NA	NA		NA	NA	L/M	L/M	L/M	M	M	L/M	H	M	M	M	L/M	M/H	M/H	H	H	H	H	H	L/M
OTHER																										

KEY: ••

NA = NOT APPLICABLE
H = HIGH RATING
M = MEDIUM RATING
L = LOW RATING

* THIS EVALUATION ASSUMES THAT CERTAIN FAILURES OCCUR IN THE SITING PROCESS, DESIGN, MITIGATION MEASURES AND IN THE OPERATION & PERFORMANCE OF THE SELECTED TECHNOLOGY.

•• A HIGH RATING INDICATES A HIGH LEVEL OF LOCAL ENVIRONMENTAL IMPACT
A LOW RATING INDICATES A LOW LEVEL OF ENVIRONMENTAL IMPACT

VAAOSE25

Table E-96

Environmental Concerns Evaluation for Southeast WGA

DEGREE OF ENVIRONMENTAL CONCERN ASSOCIATED WITH IMPLEMENTATION & USE OF EACH METHOD

ENVIRONMENTAL FACTOR	REDUCTION: EDUCATION	REDUCTION: INCENTIVES	REDUCTION: DISINCENTIVES	REDUCTION: MODEL GOVERNMENTAL PROGRAMS	REDUCTION: WASTE EXCHANGE	REDUCTION: HOME YARD WASTE COMPOSTING	RECYCLING: REUSE	RECYCLING: CURBSIDE COLLECTION	RECYCLING: MULTI-FAMILY HOUSING COLLECTION	RECYCLING: COMMERCIAL SOURCE SEPARATION	RECYCLING: INTERMEDIATE PROCESSING FACILITY	RECYCLING: COMMERCIAL MIXED WASTE PROCESSING	RECYCLING: DROP OFF / BUYBACK DEPOTS	RECYCLING: MIXED WASTE PROCESSING	RECYCLING: YARD WASTE COMPOSTING	RECYCLING: MIXED WASTE COMPOSTING	RECYCLING: FOOD WASTE PROCESSING	RECYCLING: SPECIAL WASTE RECYCLING AND REUSE	HANDLING: TRANSFER	HANDLING: LONG HAUL TRANSPORT	DISPOSAL: ANAEROBIC DECOMPOSITION	DISPOSAL: PYROLYSIS / GASSIFICATION	DISPOSAL: REFUSE DERIVED FUEL PREP. & USE	DISPOSAL: MASS BURN INCINERATION	DISPOSAL: LANDFILL	DISPOSAL: ASHFILL
AIR QUALITY	NA	NA	NA	NA	NA	NA	NA	L	L	L	L	L	L	L	M	M	L	L	L	L	L	L/M	M		L	L
CRITERIA POLLUTANTS: SO2, NOX, HCL																								H		
TOXICS																								H		
PARTICULATES																								H		
ODOR	NA	NA	NA	NA	NA	M	NA	L	L/M	L/M	L	L	L	M/H	M	M	L	L	M	NA	L/M	L/M	L/M	H	L	L
SURFACE WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	NA	L	NA	M	M	M	L	L	L	NA	L	L/M	L/M	L	L	L
GROUND WATER QUALITY	NA	NA	NA	NA	NA	L	NA	NA	NA	NA	NA	L	NA	M	M	M	L	L	L	NA	L	L	L/M	L	M	M
NOISE	NA	NA	NA	NA	L/M	L	NA	L/M	L/M	L	L/M	L/M	L	M	L	L	L	L	M	L/M	L	L/M	L/M	M	L	L
RISK OF EXPLOSION	NA	NA	NA	NA	NA	NA	NA	NA	L	NA	NA	L	NA	M	NA	L	NA	L	L	NA	M	M	M	M	L/M	L
PUBLIC HEALTH RISKS	NA	NA	NA	NA	NA	L	NA	L	L	L	L	L	L	M	L	M	L		L	NA		M			L/M	
PATHOGENS																		L			L		M	L		L
VECTORS																		L			L		M	L		L
TOXICS																		M			L		M	M		M
AESTHETICS	NA	NA	NA	NA	M	M	NA	M	M	M	M	M	M	M	M	M	L	M	M/H	NA	L	M	M	M	M	M
TRAFFIC	NA	NA	NA	NA	M	NA	NA	M	M	M	M	M	M	M	M	M	M	M	M	M	L/M	L/M	L/M	M	M	M
OTHER																										

KEY: •

NA = NOT APPLICABLE
H = HIGH RATING
M = MEDIUM RATING
L = LOW RATING

• A HIGH RATING INDICATES A HIGH LEVEL OF LOCAL ENVIRONMENTAL CONCERN
A LOW RATING INDICATES A LOW LEVEL OF ENVIRONMENTAL CONCERN

Table E-97

SOUTHEAST: RECOMMENDED ALTERNATIVE

(COST ESTIMATES ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICTIONS.)

	ESTIMATED NET (COST) OR REVENUE	CONTRIBUTION TO SYSTEM COST	ESTIMATED TONS	PERCENT OF GENERATED TONS	RELATIVE RATIO OF COSTS TO TONS
COLLECTION AND PROCESSING:					
1. COLLECTION OF SINGLE FAMILY SOURCE SEPARATED RECYCLABLES	$0	0.0%	0	0.0%	NA
2. COLLECTION OF SINGLE FAMILY COMINGLED RECYCLABLES *	$0	0.0%	0	0.0%	NA
3. COLLECTION OF MULTI FAMILY COMINGLED RECYCLABLES *	$0	0.0%	0	0.0%	NA
4. COMMERCIAL DIRECT RECYCLING	$0	0.0%	20,645	6.3%	0.00 :1.00
5. COLLECTION OF COMMERCIAL SOURCE SEPARATED RECYCLABLES	($278,969)	1.4%	5,034	1.5%	0.91 :1.00
6A. DROP OFF/BUY BACK "REGULAR" RECYCLABLES	$1,045,296	-5.2%	7,084	2.2%	-2.42 :1.00
6B. DROP OFF/BUY BACK OF "SPECIAL" RECYCLABLES OR WASTES	($60,658)	0.3%	4,564	1.4%	0.22 :1.00
7. YARD WASTE COLLECTION AND COMPOSTING	($2,052,600)	10.2%	48,726	14.8%	0.69 :1.00
8. SORTING OF TARGETED COMMERCIAL HIGH GRADE LOADS *	($30,813)	0.2%	628	0.2%	0.80 :1.00
9. SELF HAULED WASTE*	($4,168,301)	20.7%	89,104	27.0%	0.77 :1.00
10. REGULAR COLLECTION AND DISPOSAL OF MUNICIPAL WASTE *	($14,573,526)	72.4%	153,685	46.6%	1.55 :1.00
11. MIXED WASTE PROCESSING*	$0	0.0%	0	0.0%	NA
12. RDF PREPARATION*	$0	0.0%	0	0.0%	NA
SYSTEM TOTAL	($20,119,571)	100.0%	329,470	100%	1.00 :1.00
AVERAGE COST PER TON GENERATED	($61)				
DISPOSAL ONLY:					
A. MASS BURN WITH ASH MONOFILL	$0	0.0%	0	0%	NA
B. LANDFILL WITH LONG HAUL BY RAIL	$0	0.0%	0	0%	NA
C. LANDFILL WITH BALING	($3,038,583)	15.1%	60,744	18%	0.82 :1.00
D. LANDFILL ONLY	($8,328,190)	41.4%	182,233	55%	0.75 :1.00
DISPOSAL TOTAL	($11,366,773)	56.5%	242,977	74%	0.77 :1.00
AVERAGE COST PER TON DISPOSED	($47)				
RECYCLED TONS			86,493	26%	

* The net costs for these methods include disposal costs for residual or disposed wastes.

e. Ranking of Methods and Recommendations

The following paragraphs discuss the working group;s rankings and consultant team's rankings for best management practices, as well as each group's recommended system for reduction, recycling, and disposal in this WGA.

(1) Working Group Rankings

Table E-98 shows the Southeast WGA working group's rankings of solid waste management methods based on criteria and their relative weights adopted by this working group.

The WGA working group methods ranking process recommended the following system for solid waste management in this WGA:

- Reduction Program
  - -- Education
  - -- Incentives
- Recycling Program
  - -- Education
  - -- Drop-off and buy-back centers
  - -- Reuse
  - -- Food waste processing (from food processors)
  - -- Commercial source-separated collection with targeted high-grade materials
- Disposal Program
  - -- Landfill disposal within WGA

(a) Reduction Program

The working group considered education and public information to be a vital part of any waste management system. The group agreed that education's investment in the next generation would produce long-term benefits, and information provided to the general public would produce the near-term response necessary for successful implementation of recycling programs. This method was viewed as leading to environmental benefits with minimal exposure to loss.

The group considered incentives to be more effective than disincentives. Incentives are felt to be of value particularly in encouraging business and industry to adopt waste reduction techniques for manufacturing and packaging. Financial assistance in the form of tax credits encouraging business and industry to incorporate waste reduction and recycling practices would have long-term benefits. It was also felt that market support would be required during down market conditions. Home yard waste composting was not considered to be an effective waste reduction method for this rural, relatively arid region.

(b) Recycling Program

In addition to education and incentives, drop-off/buy-back depots were considered an important part of a recycling program in this rural area. There were concerns expressed regarding the siting of facilities in areas convenient to the public, particularly buy-back centers, and the exposure to loss from competition for the waste supply. However, drop-off/buy-back operations are a significant element in the recycling currently being accomplished in the Southeast region and are considered an important part of an effective recycling program for this WGA. They are considered to have minimal environmental impact with the potential to significantly reduce the waste stream. This group felt that special wastes were a particular problem and that reuse and recycling through drop-off depots was an appropriate management method.

Reuse of recyclable commodities was considered to be an appropriate waste management method; however, it was not considered to have a significant impact on waste stream quantity. Existing techniques such as yard sales, recycling by nonprofit organizations, and radio exchange programs, were considered appropriate and should continue to be encouraged.

The WGA's food processing industry is currently processing food waste into marketable products and will continue to do so. Animal feed and in some cases products for human consumption (e.g., fruit leather and fruit flavoring), provide strong markets for processed food waste. It was generally felt that this effort could be expanded.

Commercial source separation of corrugated cardboard is being conducted at this time and has some potential for expansion. The WGA working group members believed that this method can be effective when combined with processing high-grade loads through existing intermediate processing centers. These systems can be operated at relatively low cost, and can be profitable particularly when processing source-separated corrugated.

The WGA working group did not believe that either curbside single-family or multi-family collection would be cost-effective for this WGA although they are considered to be technically feasible with low environmental impact. The group believed that curbside programs would require significant capital investment for additional equipment.

Centralized yard waste composting was not considered to be a cost-effective approach due to the low cost of landfilling and significant available landfill capacity in this WGA. It was recognized that yard waste represents approximately 19% of the waste stream in this WGA and that a yard waste composting system, if based on self haul, could be feasible if costs were comparable to landfilling. If implemented, composting facilities should be located at existing landfill sites in order to use the same personnel for both operations. However, with some exception, the general consensus of this WGA is that yard waste composting is not necessary.

Mixed municipal solid waste processing and composting or RDF preparation was not considered to be an effective waste management method for the Southeast WGA. The working group believed that with the existing landfill

capacity and relatively low cost of disposal, these methods offered little opportunity for improved management of solid waste. Markets for municipal solid waste compost were considered to be poor to nonexistent.

(c) Disposal Program

Landfilling within the WGA was considered to be the best disposal method for the Southeast region based on existing landfill capacity and relative ease in siting new landfills as compared to other areas of the State. The cost of landfilling was considered to be relatively low compared to other disposal methods with minimal environmental impact or exposure to loss for the majority of the WGA.

(2) Consultant Team Rankings

The consultant team's ranking of the waste management methods in each program (reduction, recycling, and disposal) are shown in Table E-98. In the reduction program, the consultant team evaluated "special government programs" and "waste exchange," which were not ranked by the WGA working group. In addition, the consultant team ranked "commercial high-grade collection" and "mixed-waste processing" for the recycling program. "Special waste recycling/reuse" was not ranked due to the special characteristics of these components; it was assumed that special waste management will be included in any recommended program.

Based on the criteria established for the consultant team's analysis, the consultants recommend the following solid waste management system for the Southeast WGA:

- Reduction Program
  - -- Education
  - -- Incentives
  - -- Special governmental programs
  - -- Disincentives
  - -- Home composting
  - -- Waste exchange
- Recycling Program
  - -- Drop-off/buy-back depots (urban/rural)
  - -- Education (urban/rural)
  - -- Food waste processing (urban/rural)
  - -- Commercial source-separated collection (urban)
  - -- Yard waste composting (urban/rural)
  - -- Incentives (urban/rural)
  - -- Reuse (urban/rural)
  - -- Targeted commercial high grade collection (urban)
  - -- Single-family curbside collection (urban)

Table E-98

BEST MANAGEMENT PRACTICES FOR
SOLID WASTE METHODS RANKING SUMMARY

SOUTHEAST WGA

Reduction		Recycling		Disposal	
WGA Working Group Preference	Consultant Team Recommendations	WGA Working Group Preference	Consultant Team Recommendations	WGA Working Group Preference	Consultant Team Recommendations
1. Education	1. Education	1. Drop-Off/Buy-Back Depots	1. Drop-Off/Buy-Back Depots	1. Landfill	1. Incineration
2. Incentives	2. Incentives	1. Education			1. Landfill
	2. Special Governmental Programs	2. Reuse	2. Education	2. Long Haul	2. Long Haul
3. Disincentives	3. Disincentives		2. Food Waste Processing	3. Incineration	
4. Home Yard Waste Composting	4. Home Yard Waste Composting	3. Food Waste Processing	3. Commercial Source Separated		
	5. Waste Exchange	4. Commercial Source Separated	4. Centralized Yard Waste Composting		
		5. Incentives	5. Incentives		
		6. Disincentives	6. Reuse		
			6. Commercial High-Grade Collection		
		7. Single-Family Curbside Collection	7. Single-Family Curbside Collection		
			7. Disincentives		
		8. Multi-Family Collection	8. Mixed Waste Processing		
		8. Centralized Yard Waste Composting			
		9. MSW Composting	9. Multi-Family Collection		
			10. MSW Composting		

- Disposal Program

  -- Incineration
  -- Landfill

(a) Reduction Program

The consultant team found little justification for different waste reduction programs for different WGA's throughout the State. Based on the criteria established, the recommendations are the same Statewide and are discussed below. Education is considered to be reasonably cost-effective with excellent long-term environmental benefits considering its effect on all other management methods. The focus of education/public involvement programs is to inform and change society's view of solid waste and its management. A balance of incentives and disincentives will be necessary components of a waste reduction program. The cost-effectiveness of these methods is considered to be fair; however, their application will produce considerable environmental benefit. They are not expected to have a significant impact upon the volume of waste but can affect the composition of the waste stream significantly.

Special governmental programs are considered to be a good way to demonstrate waste reduction methods and to assist business and industry in reducing waste reduction and increasing recycling.

Home yard waste composting is a cost-effective, low-risk method for significantly reducing the waste stream. Participation by the public sufficient to measurably reduce waste will require local government to vigorously "market" the program, a worthwhile effort considering the significant amount of yard waste in the overall waste stream.

Industrial waste exchanges have been effective for some time. There is now potential for applying this concept to household hazardous wastes as well.

It is recommended that the waste reduction program be developed in the priority order listed above, and that investment of resources be made in those methods and techniques which will provide the greatest return.

(b) Recycling Program

The recommended recycling program for the Southeast WGA is very similar to that selected by the WGA working group. As with the WGA-preferred system, the majority of methods are appropriate for both urban and rural areas. Curbside collection, commercial source-separated collection, and targeted high-grade commercial loads are considered urban methods.

Drop-off/buy-back operations are considered to be the number one recycling method for this WGA. These operations are considered to be very cost-effective with a significant effect of waste volume and minimum environmental impact.

Education, ranked number two with food industry waste processing, is considered to be cost-effective based on long-term benefits. Commercial source separated cardboard and targeted high-grade commercial collection have been established as an appropriate method in this area and could be expanded for greater benefits.

Yard waste composting, ranked number four, is considered by the consultant team to be an effective way to manage a substantial portion of the waste stream in the Southeast region. With self haul of yard waste and the establishment of waste composting facilities at existing landfills, cost savings may be sufficient to justify the method. Markets for yard waste compost could be developed in this highly agricultural area.

Incentives can also provide long-term benefits when aimed at specific goals. Local support of appropriate legislation is encouraged. Support for existing reuse industries is also encouraged.

Single-family curbside collection may be appropriate in some of the urban areas of the Southeast region. There are many different methods of curbside collection, and there appears to be good potential for single-family collection of source-separated recycables with a less capital-intensive system than shown in the economic analysis. Each urban area would require a detailed study of alternative methods and costs before implementing a curbside program. Also, the impact on existing drop-off/buy-back depots in the urban areas should be reviewed.

Mixed-waste processing, municipal solid waste composting, and RDF preparation are not recommended for the Southeast WGA. Multi-family collection of recyclables is also not recommended; urbanized areas, however, should review this method based on existing conditions and opportunities available in particular communities.

(c) Disposal Program

Review of the disposal program for the Southeast WGA resulted in an equal ranking for incineration and landfill; however, landfilling is considered to be the most cost-effective. It is recommended that each agency evaluate the merits of each alternative based on pertinent existing conditions.

Whitman County has successfully implemented a system for volume reduction by baling at their landfill. This facility also serves as a mixed waste processing facility for a dump-and-pick operation. Expansion of the sorting capability at this facility could result in a model facility for other rural areas. It is, therefore, included as part of the rural alternatives for the Southeast WGA.

Objectives for each category of solid waste appear in Table E-99. These objectives depict the amount of each category which could reasonably be handled by each method. The objectives are based on the results of the WGA-recommended model and on the current levels of recycling in each WGA.

Table E-99

VAA0SE60

Waste Stream Category Objectives By Method for Southeast WGA

% OF WASTE STREAM CATEGORY MANAGED BY METHOD

WASTE STREAM CATEGORY	RECYCLING											DISPOSAL							TOTAL (%)
METHOD/ TECHNIQUE	REUSE	SINGLE FAMILY CURBSIDE COLLECTION	MULTI-FAMILY HOUSING COLLECTION	COMMERCIAL SOURCE SEPARATION	COMMERCIAL HIGH GRADE	COMMERCIAL DIRECT	DROP OFF / BUYBACK DEPOTS	MIXED WASTE PROCESSING	YARD WASTE COMPOSTING	MIXED WASTE COMPOSTING	FOOD WASTE PROCESSING	SUBTOTAL RECYCLING	ANAEROBIC DECOMPOSITION	PYROLYSIS / GASSIFICATION	REFUSE DERIVED FUEL PREP. & USE	MASS BURN INCINERATION / ASHFILL	LANDFILL	LONG HAUL	SUBTOTAL DISPOSAL	
NEWSPAPER				1		12						13					87		87	100
CORRUGATED CARDBOARD			15	1	21	4						41					59		59	100
HIGH GRADE PAPER			16	1	1							18					82		82	100
MIXED SCRAP PAPER (RECYCLABLE)				1								1					99		99	100
REFILLABLE GLASS CONTAINERS			8			54						62					38		38	100
GLASS			3			16						19					81		81	100
ALUMINUM				1		59						60					40		40	100
TIN PLATED FOOD & BEVERAGE CANS				1		5						6					94		94	100
FERROUS METAL				1	56	3						60					40		40	100
NON-FERROUS METAL					67	3						70					30		30	100
WHITE GOODS						3						3					97		97	100
PET PLASTICS																	100		100	100
HDPE PLASTICS																	100		100	100
PLASTIC PACKAGING (LDPE)																	100		100	100
EXPANDED POLYSTYRENE																	100		100	100
OTHER PLASTICS																	100		100	100
TIRES						8						8					92		92	100
OTHER RUBBER PRODUCTS																	100		100	100
FOOD																	100		100	100
LAWN AND GARDEN WASTE							76					76					24		24	100
WOOD																	100		100	100
DISPOSABLE DIAPERS																	100		100	100
OIL						88						88					12		12	100
BATTERIES						53						53					47		47	100
OTHER HOUSEHOLD HAZARDOUS																	100		100	100
CONSTRUCTION DEBRIS (NOT WOOD)																	100		100	100
OTHER ORGANIC																	100		100	100
OTHER INORGANIC																	100		100	100

APPENDIX A

MARKET CAPACITY MODEL DIAGNOSTICS

LS // Dependent Variable is HLDNWS
Date: 12-02-1988 / Time: 12:15
SMPL range: 1 - 8
Number of observations: 8

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	0.2342052	0.2799455	0.8366101	0.491
PNWS	-0.0052067	0.0058949	-0.8832510	0.470
TIPCOST	-0.0002125	0.0009324	-0.2278451	0.841
HLDEMP	0.2854692	0.0761253	3.7499927	0.064
AVGWGE	-0.0068834	0.0021052	-3.2696450	0.082
DUM8	-0.0881664	0.0176450	-4.9966798	0.038

R-squared	0.974739	Mean of dependent var	0.053356
Adjusted R-squared	0.911588	S.D. of dependent var	0.038464
S.E. of regression	0.011437	Sum of squared resid	0.000262
Durbin-Watson stat	2.498506	F-statistic	15.43494
Log likelihood	29.96101		

LS // Dependent Variable is HLDNWS
Date: 12-02-1988 / Time: 12:16
SMPL range: 1 - 8
Number of observations: 8

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
HLDEMP	0.2277190	0.0221268	10.291561	0.000
AVGWGE	-0.0064968	0.0009526	-6.8203271	0.001
DUM8	-0.0830447	0.0105786	-7.8502828	0.001

R-squared	0.958626	Mean of dependent var	0.053356
Adjusted R-squared	0.942076	S.D. of dependent var	0.038464
S.E. of regression	0.009257	Sum of squared resid	0.000428
Durbin-Watson stat	1.518651	F-statistic	57.92401
Log likelihood	27.98736		

LS // Dependent Variable is HLDNWS
Date: 12-02-1988 / Time: 12:17
SMPL range: 1 - 8
Number of observations: 8

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
HLDEMP	0.2560963	0.0007157	357.81576	0.002
AVGWGE	-0.0075532	3.298E-05	-229.02205	0.003
DUM1	0.0125118	0.0002292	54.599191	0.012
DUM4	-0.0019014	0.0001836	-10.354675	0.061
DUM5	-0.0107300	0.0002502	-42.885733	0.015
DUM6	-0.0184992	0.0002174	-85.088468	0.007
DUM8	-0.0903636	0.0001827	-494.52661	0.001

R-squared	0.999998	Mean of dependent var	0.053356
Adjusted R-squared	0.999986	S.D. of dependent var	0.038464
S.E. of regression	0.000145	Sum of squared resid	2.11E-08
Durbin-Watson stat	1.816570	F-statistic	81922.26
Log likelihood	67.66813		

LS // Dependent Variable is HLDOCC
Date: 12-02-1988 / Time: 12:24
SMPL range: 1 - 8
Number of observations: 8

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-0.7454457	2.2987119	-0.3242885	0.767
POCC	0.0050358	0.0242094	0.2080111	0.849
TIPCOST	0.0041527	0.0028703	1.4467880	0.244
HLDEMP	0.2566308	0.2320347	1.1060019	0.349
AVGWGE	0.0019457	0.0079642	0.2443108	0.823

R-squared	0.786172	Mean of dependent var	0.077270
Adjusted R-squared	0.501068	S.D. of dependent var	0.065458
S.E. of regression	0.046237	Sum of squared resid	0.006413
Durbin-Watson stat	2.789024	F-statistic	2.757494
Log likelihood	17.16369		

LS // Dependent Variable is HLDOCC
Date: 12-02-1988 / Time: 12:26
SMPL range: 1 - 8
Number of observations: 8

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-0.2421672	0.0771828	-3.1375797	0.026
TIPCOST	0.0036031	0.0016492	2.1847963	0.081
HLDEMP	0.3079414	0.0777135	3.9625198	0.011

R-squared	0.780118	Mean of dependent var	0.077270
Adjusted R-squared	0.692166	S.D. of dependent var	0.065458
S.E. of regression	0.036318	Sum of squared resid	0.006595
Durbin-Watson stat	2.875898	F-statistic	8.869756
Log likelihood	17.05202		

LS // Dependent Variable is HLDOCC
Date: 12-02-1988 / Time: 12:33
SMPL range: 1 - 8
Number of observations: 8

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-0.2225147	0.0271723	-8.1890335	0.004
TIPCOST	0.0074375	0.0008537	8.7122102	0.003
HLDEMP	0.2186298	0.0318414	6.8662012	0.006
DUM2	-0.1381000	0.0233233	-5.9211120	0.010
DUM6	-0.0427596	0.0139138	-3.0731797	0.054

R-squared	0.984192	Mean of dependent var	0.077270
Adjusted R-squared	0.963114	S.D. of dependent var	0.065458
S.E. of regression	0.012572	Sum of squared resid	0.000474
Durbin-Watson stat	1.592817	F-statistic	46.69400
Log likelihood	27.58228		

LS // Dependent Variable is HLDHGR
Date: 12-02-1988 / Time: 12:57
SMPL range: 1 - 8
Number of observations: 8

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-0.2224134	0.2221827	-1.0010382	0.422
PHGR	0.0014095	0.0021349	0.6602136	0.577
TIPCOST	0.0012680	0.0007046	1.7995285	0.214
HLDEMP	-0.0637071	0.0937850	-0.6792893	0.567
HGREMPHL	0.1577278	0.1017650	1.5499213	0.261
AVGWGE	0.0019153	0.0017363	1.1030637	0.385

R-squared	0.843497	Mean of dependent var	0.008596
Adjusted R-squared	0.452241	S.D. of dependent var	0.013684
S.E. of regression	0.010127	Sum of squared resid	0.000205
Durbin-Watson stat	1.437414	F-statistic	2.155869
Log likelihood	30.93384		

LS // Dependent Variable is HLDHGR
Date: 12-02-1988 / Time: 12:59
SMPL range: 1 - 8
Number of observations: 8

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-0.0787079	0.0276069	-2.8510228	0.046
TIPCOST	0.0009405	0.0003969	2.3693890	0.077
HGREMPHL	0.1014928	0.0352478	2.8794111	0.045
AVGWGE	0.0017109	0.0013416	1.2752567	0.271

R-squared	0.806470	Mean of dependent var	0.008596
Adjusted R-squared	0.661323	S.D. of dependent var	0.013684
S.E. of regression	0.007963	Sum of squared resid	0.000254
Durbin-Watson stat	1.329246	F-statistic	5.556212
Log likelihood	30.08440		

LS // Dependent Variable is HLDHGR
Date: 12-02-1988 / Time: 13:05
SMPL range: 1 - 8
Number of observations: 8

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-0.0716497	0.0052195	-13.727403	0.005
TIPCOST	0.0006421	7.945E-05	8.0814553	0.015
HGREMPHL	0.1417799	0.0075833	18.696341	0.003
AVGWGE	0.0010135	0.0002601	3.8966593	0.060
DUM7	-0.0033611	0.0016319	-2.0596218	0.176
DUM8	-0.0209849	0.0019763	-10.618410	0.009

R-squared	0.996638	Mean of dependent var	0.008596
Adjusted R-squared	0.988234	S.D. of dependent var	0.013684
S.E. of regression	0.001484	Sum of squared resid	4.41E-06
Durbin-Watson stat	2.514422	F-statistic	118.5909
Log likelihood	46.29646		

LS // Dependent Variable is HLDMXD
Date: 12-02-1988 / Time: 13:17
SMPL range: 1 - 8
Number of observations: 8

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-0.0429558	0.0015379	-27.931059	0.001
PMXD	0.0019165	3.378E-05	56.741324	0.000
TIPCOST	8.506E-05	2.238E-05	3.8000856	0.063
HLDEMP	-0.0265446	0.0013212	-20.090976	0.002
AVGWGE	0.0014996	7.451E-05	20.125359	0.002
DUM7	0.0218938	0.0006095	35.918658	0.001

R-squared	0.999550	Mean of dependent var	0.007554
Adjusted R-squared	0.998426	S.D. of dependent var	0.011004
S.E. of regression	0.000437	Sum of squared resid	3.81E-07
Durbin-Watson stat	1.023073	F-statistic	889.2904
Log likelihood	56.08737		

Residual Plot	obs	RESIDUAL	ACTUAL	FITTED
	1	-9.4E-05	0.00000	9.4E-05
	2	-9.4E-05	0.00175	0.00185
	3	4.6E-05	0.02596	0.02592
	4	-8.3E-06	0.02372	0.02372
	5	0.00027	0.00000	-0.00027
	6	0.00031	0.00000	-0.00031
	7	-3.5E-18	0.00797	0.00797
	8	-0.00043	0.00103	0.00147

LS // Dependent Variable is HLDGLS
Date: 12-02-1988 / Time: 13:22
SMPL range: 1 - 8
Number of observations: 8

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-0.0003805	0.0149308	-0.0254843	0.982
PGLS	0.0001517	0.0004428	0.3426459	0.765
TIPCOST	5.548E-05	0.0002036	0.2725350	0.811
HLDEMP	0.0165271	0.0149706	1.1039685	0.385
AVGWGE	-0.0006166	0.0006495	-0.9493221	0.443
DUM8	0.0130323	0.0050874	2.5616598	0.125

R-squared	0.907016	Mean of dependent var	0.009234
Adjusted R-squared	0.674555	S.D. of dependent var	0.006647
S.E. of regression	0.003792	Sum of squared resid	2.88E-05
Durbin-Watson stat	2.064195	F-statistic	3.901801
Log likelihood	38.79257		

LS // Dependent Variable is HLDGLS
Date: 12-02-1988 / Time: 13:26
SMPL range: 1 - 8
Number of observations: 8

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-0.0053127	0.0059088	-0.8991188	0.410
HLDEMP	0.0161279	0.0073875	2.1831371	0.081
DUM8	0.0121115	0.0037655	3.2164082	0.024

R-squared	0.831515	Mean of dependent var	0.009234
Adjusted R-squared	0.764121	S.D. of dependent var	0.006647
S.E. of regression	0.003228	Sum of squared resid	5.21E-05
Durbin-Watson stat	2.362495	F-statistic	12.33810
Log likelihood	36.41490		

LS // Dependent Variable is HLDGLS
Date: 12-02-1988 / Time: 13:27
SMPL range: 1 - 8
Number of observations: 8

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-0.0070078	0.0014784	-4.7400991	0.042
HLDEMP	0.0192666	0.0016558	11.636064	0.007
DUM1	0.0025079	0.0007021	3.5721242	0.070
DUM2	-0.0006972	0.0006618	-1.0533492	0.403
DUM5	-0.0071396	0.0004513	-15.821633	0.004
DUM8	0.0107103	0.0004625	23.157823	0.002

R-squared	0.999039	Mean of dependent var	0.009234
Adjusted R-squared	0.996636	S.D. of dependent var	0.006647
S.E. of regression	0.000386	Sum of squared resid	2.97E-07
Durbin-Watson stat	1.422014	F-statistic	415.7193
Log likelihood	57.08032		

LS // Dependent Variable is HLDRFL
Date: 12-02-1988 / Time: 13:31
SMPL range: 1 - 8
Number of observations: 8

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	0.0104593	0.0193168	0.5414590	0.626
PDIF	-0.0002674	0.0004253	-0.6285977	0.574
TIPCOST	0.0002548	0.0004238	0.6013637	0.590
HLDEMP	0.0073938	0.0164082	0.4506144	0.683
AVGWGE	0.0002382	0.0007384	0.3226453	0.768

R-squared	0.242182	Mean of dependent var	0.009633
Adjusted R-squared	-0.768243	S.D. of dependent var	0.002924
S.E. of regression	0.003888	Sum of squared resid	4.54E-05
Durbin-Watson stat	2.420467	F-statistic	0.239683
Log likelihood	36.96975		

LS // Dependent Variable is HLDRFL
Date: 12-02-1988 / Time: 13:33
SMPL range: 1 - 8
Number of observations: 8

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
PDIF	0.0001539	2.073E-05	7.4228116	0.000

R-squared	-0.510761	Mean of dependent var	0.009633
Adjusted R-squared	-0.510761	S.D. of dependent var	0.002924
S.E. of regression	0.003594	Sum of squared resid	9.04E-05
Durbin-Watson stat	1.874620	Log likelihood	34.21005

LS // Dependent Variable is HLDRFL
Date: 12-02-1988 / Time: 13:37
SMPL range: 1 - 8
Number of observations: 8

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
PDIF	0.0001392	1.869E-06	74.477018	0.000
DUM1	0.0009469	0.0002317	4.0870820	0.055
DUM2	0.0005947	0.0002372	2.5068178	0.129
DUM5	0.0086421	0.0002204	39.208062	0.001
DUM6	0.0029351	0.0002363	12.423016	0.006
DUM7	-0.0034993	0.0002382	-14.691609	0.005

R-squared	0.998613	Mean of dependent var	0.009633
Adjusted R-squared	0.995146	S.D. of dependent var	0.002924
S.E. of regression	0.000204	Sum of squared resid	8.30E-08
Durbin-Watson stat	2.774467	F-statistic	288.0236
Log likelihood	62.18339		

LS // Dependent Variable is HLDALM
Date: 12-02-1988 / Time: 17:01
SMPL range: 1 - 8
Number of observations: 8

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-0.1178575	0.3176732	-0.3710024	0.735
PALM	0.0001283	0.0003052	0.4203943	0.702
TIPCOST	-0.0001850	0.0003689	-0.5014542	0.651
HLDEMP	0.0088502	0.0195097	0.4536273	0.681
AVGWGE	-0.0009503	0.0011949	-0.7952884	0.485

R-squared	0.268743	Mean of dependent var	0.007691
Adjusted R-squared	-0.706267	S.D. of dependent var	0.005341
S.E. of regression	0.006976	Sum of squared resid	0.000146
Durbin-Watson stat	1.415766	F-statistic	0.275631
Log likelihood	32.29405		

LS // Dependent Variable is HLDALM
Date: 12-02-1988 / Time: 17:10
SMPL range: 1 - 8
Number of observations: 8

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
PALM	4.530E-06	6.600E-07	6.8638325	0.001
DUM7	0.0115184	0.0019006	6.0602742	0.002
DUM8	0.0105590	0.0018974	5.5650384	0.003

R-squared	0.922729	Mean of dependent var	0.007691
Adjusted R-squared	0.891820	S.D. of dependent var	0.005341
S.E. of regression	0.001757	Sum of squared resid	1.54E-05
Durbin-Watson stat	2.027594	F-statistic	29.85353
Log likelihood	41.28382		

LS // Dependent Variable is HLDTIN
Date: 12-02-1988 / Time: 17:12
SMPL range: 1 - 8
Number of observations: 8

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-0.0020673	0.0003156	-6.5498225	0.023
PTIN	5.284E-05	1.380E-05	3.8292776	0.062
TIPCOST	2.521E-05	5.868E-06	4.2953940	0.050
HLDEMP	-0.0015211	0.0003256	-4.6715419	0.043
AVGWGE	3.432E-05	1.385E-05	2.4783165	0.131
DUM8	0.0024936	0.0001073	23.249914	0.002

R-squared	0.997216	Mean of dependent var	0.000424
Adjusted R-squared	0.990255	S.D. of dependent var	0.000736
S.E. of regression	7.27E-05	Sum of squared resid	1.06E-08
Durbin-Watson stat	2.562834	F-statistic	143.2681
Log likelihood	70.42824		

LS // Dependent Variable is HLDTIN
Date: 12-02-1988 / Time: 17:16
SMPL range: 1 - 8
Number of observations: 8

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-0.0018357	0.0003386	-5.4212720	0.032
PTIN	6.170E-05	1.431E-05	4.3105950	0.050
TIPCOST	2.404E-05	6.425E-06	3.7408680	0.065
HLDEMP	-0.0015137	0.0003693	-4.0992040	0.055
DUM5	0.0002314	0.0001108	2.0893458	0.172
DUM8	0.0025772	0.0001237	20.834725	0.002

R-squared	0.996439	Mean of dependent var	0.000424
Adjusted R-squared	0.987535	S.D. of dependent var	0.000736
S.E. of regression	8.22E-05	Sum of squared resid	1.35E-08
Durbin-Watson stat	1.712887	F-statistic	111.9181
Log likelihood	69.44356		

LS // Dependent Variable is HLDWHT
Date: 12-05-1988 / Time: 0:44
SMPL range: 1 - 8
Number of observations: 8

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-0.0538383	0.0202163	-2.6631164	0.076
PWHT	-0.0001276	0.0002503	-0.5095715	0.645
TIPCOST	-0.0006894	0.0002988	-2.3068364	0.104
HLDEMP	0.0256705	0.0160134	1.6030668	0.207
AVGWGE	0.0014102	0.0009360	1.5065791	0.229

R-squared	0.769268	Mean of dependent var	0.003275
Adjusted R-squared	0.461626	S.D. of dependent var	0.007523
S.E. of regression	0.005520	Sum of squared resid	9.14E-05
Durbin-Watson stat	2.052033	F-statistic	2.500529
Log likelihood	34.16663		

LS // Dependent Variable is HLDWHT
Date: 12-05-1988 / Time: 0:50
SMPL range: 1 - 8
Number of observations: 8

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
TIPCOST	-3.665E-05	9.830E-06	-3.7284943	0.010
DUM3	0.0208488	0.0005878	35.467965	0.000

R-squared	0.995814	Mean of dependent var	0.003275
Adjusted R-squared	0.995117	S.D. of dependent var	0.007523
S.E. of regression	0.000526	Sum of squared resid	1.66E-06
Durbin-Watson stat	0.961447	F-statistic	1427.492
Log likelihood	50.20507		

LS // Dependent Variable is EMPFER
Date: 12-05-1988 / Time: 0:19
SMPL range: 1 - 8
Number of observations: 8

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-0.7720558	0.1051740	-7.3407511	0.018
PFER	0.0166071	0.0029896	5.5549787	0.031
TIPCOST	-0.0016464	0.0029819	-0.5521424	0.636
EMPHLD	0.4052769	0.1284298	3.1556307	0.087
DUM1	-0.0789897	0.1161313	-0.6801754	0.567
DUM3	-0.2210833	0.1087379	-2.0331754	0.179

R-squared	0.985172	Mean of dependent var	0.281979
Adjusted R-squared	0.948102	S.D. of dependent var	0.157782
S.E. of regression	0.035944	Sum of squared resid	0.002584
Durbin-Watson stat	2.145182	F-statistic	26.57611
Log likelihood	20.79992		

LS // Dependent Variable is EMPFER
Date: 12-05-1988 / Time: 0:21
SMPL range: 1 - 8
Number of observations: 8

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-0.7182513	0.2705173	-2.6551032	0.045
PFER	0.0134222	0.0039089	3.4337605	0.019
EMPHLD	0.3984079	0.1308604	3.0445270	0.029

R-squared	0.740052	Mean of dependent var	0.281979
Adjusted R-squared	0.636073	S.D. of dependent var	0.157782
S.E. of regression	0.095184	Sum of squared resid	0.045300
Durbin-Watson stat	2.597096	F-statistic	7.117310
Log likelihood	9.344047		

LS // Dependent Variable is EMPFER
Date: 12-05-1988 / Time: 0:22
SMPL range: 1 - 8
Number of observations: 8

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-0.7613160	0.0805001	-9.4573339	0.001
PFER	0.0182365	0.0013360	13.650042	0.000
EMPHLD	0.3256441	0.0401064	8.1195042	0.001
DUM3	-0.2865872	0.0394510	-7.2643896	0.002

R-squared	0.981685	Mean of dependent var	0.281979
Adjusted R-squared	0.967948	S.D. of dependent var	0.157782
S.E. of regression	0.028248	Sum of squared resid	0.003192
Durbin-Watson stat	2.114611	F-statistic	71.46503
Log likelihood	19.95500		

LS // Dependent Variable is EMPNFR
Date: 12-05-1988 / Time: 0:25
SMPL range: 1 - 8
Number of observations: 8

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	0.4031679	0.1108883	3.6358010	0.068
PNFR	-0.0004512	0.0001380	-3.2702956	0.082
TIPCOST	0.0002378	0.0001720	1.3828716	0.301
EMPHLD	-0.0249429	0.0048387	-5.1548783	0.036
DUM5	-0.0119449	0.0036594	-3.2641419	0.082
DUM6	0.0108137	0.0033769	3.2023037	0.085

R-squared	0.972146	Mean of dependent var	0.021558
Adjusted R-squared	0.902511	S.D. of dependent var	0.009544
S.E. of regression	0.002980	Sum of squared resid	1.78E-05
Durbin-Watson stat	2.598341	F-statistic	13.96059
Log likelihood	40.72078		

LS // Dependent Variable is EMPNFR
Date: 12-05-1988 / Time: 0:28
SMPL range: 1 - 8
Number of observations: 8

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	0.3443479	0.1169455	2.9445167	0.060
PNFR	-0.0003751	0.0001445	-2.5961378	0.081
EMPHLD	-0.0218888	0.0049165	-4.4520888	0.021
DUM5	-0.0141228	0.0037722	-3.7439384	0.033
DUM6	0.0113875	0.0038271	2.9755167	0.059

R-squared	0.945513	Mean of dependent var	0.021558
Adjusted R-squared	0.872864	S.D. of dependent var	0.009544
S.E. of regression	0.003403	Sum of squared resid	3.47E-05
Durbin-Watson stat	2.590076	F-statistic	13.01473
Log likelihood	38.03684		

APPENDIX B

DETAILED COST ESTIMATES AND OPERATING ASSUMPTIONS FOR METHOD COSTS IN ECONOMIC EVALUATION

1. CURBSIDE WEEKLY COLLECTION (SINGLE FAMILY RESIDENCES) - SOURCE SEPARATED

KEY METHOD ASSUMPTIONS:

Weekly curbside collection of source separated: news, glass containers & metal containers (tin & aluminum)
Program provides 3 bins to each household.
One driver/collector required for each truck, truck has 3 bins.
Materials sorted and processed by program or broker to prepare for market.
Truck O & M costs based on average 1,000 drivebys per day, 5 days a week.
Capital costs for trucks increased by 10 % for downtime coverage.
Finance, interest and start-up costs not included, recycling revenue is calculated separately.
Theshold level for method is 5,000 households in a jurisdiction.
High participation rates (over 50 percent of households) are assumed.
Number of drivebys per day varies with density: 1400 drivebys for densities of over 1000 households per square mile, 700 drivebys for densities of under 1000 households per square mile.

EFFICIENCY RATES: Single Family Residential

NEWSPAPER	85%
GLASS	50%
TIN-CANS	40%
ALUM CANS	40%

COST CATEGORY	ITEM	BASIS	ANNUAL COST WEST	ANNUAL COST EAST	COST PER DRIVEBY WEST HIGH DENSITY 1400	COST PER DRIVEBY WEST LOW DENSITY 700	COST PER DRIVEBY EAST HIGH DENSITY 1400	COST PER DRIVEBY EAST LOW DENSITY 700
COLLECTION COSTS:								
CAPITAL	THREE 11 GAL. CONTAINERS	$18 each, 10 % reolacement per year			$1.80	$1.80	$1.80	$1.80
	THREE BIN VEHICLE	$50,000 + 10%, S/L over 7 yrs	$7,857	$7,857				
O & M	LABOR (including fringe)							
	DRIVER	$20 OR $15/hr X 2080 hrs.	$41,600	$31,200				
	VEHICLE OPERATION & MAINTENANCE							
	FUEL	$25 PER DAY	$6,500	$6,500				
	INSURANCE		$2,400	$2,400				
	LICENSE & INSPECTION		$1,250	$1,250				
	MAINTENANCE	$450 PER MONTH	$5,400	$5,400				
TOTAL COLLECTION COST (PER ROUTE AND PER HOUSEHOLD)			$65,007	$54,607	$11.09	$20.37	$9.60	$17.40
TOTAL ADMINISTRATION COST (PER ROUTE AND PER HOUSEHOLD)		.25% of Direct Costs	$16,252	$13,652	$2.32	$4.64	$1.95	$3.90
PROMOTION/EDUCATION (PER HOUSEHOLD)	FLIERS/MAILINGS/ADS/ETC.	$2.00/household/yr			$2.00	$2.00	$2.00	$2.00

PROCESSING COST:	FACILITY SIZE:	(50 TPD	50 -100 TPD)	100 TPD
	TRANSPORT 25 MI @ $.25/TM	$6	$6	$6
	PROCESSING	$50	$33	$22
TOTAL PROCESSING COST (PER TON)		$56.25	$39.25	$28.25

TRANSPORT: Cost of transporting materials to market are reflected in variation commodity prices.

* COSTS AND ASSUMPTIONS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICTIONS.

2. CURBSIDE WEEKLY COLLECTION (SINGLE FAMILY RESIDENCES) - COMINGLED RECYCLABLES

KEY METHOD ASSUMPTIONS:

Weekly curbside collection of comingled recyclables: news, glass containers and metal containers, cardboard and mixed waste paper.
Program provides one bin to each household.
One driver/collector required for each truck.
Packer truck with 20 cu. yd. capacity.
Truck O & M costs based on average 1,000 drive bys per day, 5 days a week.
Capital costs for trucks increased by 10 % for downtime coverage.
Finance, interest and start-up costs not included, recycling revenue is calculated separately.
Theshold level for method is 5,000 households in a jurisdiction.
High participation rates (over 50 percent of households) are assumed.
Number of drivebys per day varies with density: 1500 drivebys for densities of over 1000 households per square mile, 750 drivebys for densities of under 1000 households per square mile.

EFFICIENCY RATES: Single Family Residential

NEWSPAPER	85%	CARDBOARD	75%
GLASS	50%	RECYCLABLE MIXED PAPER	75%
TIN-CANS	40%		
ALUM CANS	40%		

COST CATEGORY	ITEM	BASIS	ANNUAL COST WEST	ANNUAL COST EAST	COST PER DRIVEBY WEST HIGH DENSITY 1500	COST PER DRIVEBY WEST LOW DENSITY 750	COST PER DRIVEBY EAST HIGH DENSITY 1500	COST PER DRIVEBY EAST LOW DENSITY 750
COLLECTION COSTS:								
CAPITAL	30 GAL. CONTAINERS	$12 per container, 10 % replacement per year			$1.20	$1.20	$1.20	$1.20
	COLLECT VEHICLE	$75,000 + 10 %, S/L over 7 yrs	$7,071	$7,071				
O & M	LABOR (including fringe)							
	DRIVER	$20 OR $15/hr X 2080 hrs.	$41,600	$31,200				
	VEHICLE OPERATION & MAINTENANCE							
	FUEL	$25 PER DAY	$6,500	$6,500				
	INSURANCE		$2,400	$2,400				
	LICENSE & INSPECTION		$1,250	$1,250				
	MAINTENANCE	$450 PER MONTH	$5,400	$5,400				
TOTAL COLLECTION COST (PER RTE AND PER HOUSEHOLD)			$64,221	$53,821	$9.76	$18.33	$8.38	$15.55
TOTAL ADMINISTRATION COST (PER RTE AND PER HOUSEHOLD)		25% of direct costs	$16,055	$13,455	$2.14	$4.28	$1.79	$3.59
PROMOTION/EDUCATION (PER HOUSEHOLD)	FLIERS/MAILINGS/ADS/ETC.	$2.00/household/yr	$10,000	$10,000	$2.00	$2.00	$2.00	$2.00

PROCESSING COST:	FACILITY SIZE:	(50 tpd	50 -100 TPD)	100 TPD
	TRANSPORT 25 MI @ $.25/TM	$6	$6	$6
	PROCESSING	$70	$50	$30
TOTAL PROCESSING COST (PER TON)		$76.25	$56.25	$36.25

TRANSPORT: Costs of transporting materials to market are reflected in commodity prices.

DISPOSAL: for 10% residual.

* COSTS AND ASSUMPTIONS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICTIONS.

3. COMMON AREA BINS FOR MULTI-FAMILY COMINGLED RECYCLABLES COLLECTION

KEY METHOD ASSUMPTIONS:

Bi-weekly collection of comingled recyclables from common area bins in multi-family dwellings (of six units or more)
Program provides one bin or trash cart (90-300 gal) at each site, newspaper, cardboard, mixed waste paper, glass, tin cans and aluminum cans are collected.
One driver/collector required for each automated collection truck.
100% of multi-family complexes will be served with 40% participation of units.
Each vehicle can service 50 sites per day or 500 sites/2 wks
To estimate the number of multifamily sites, the number of multifamily units is divided by an assumed average number of units per site. Based on sample data, this average is 6.5 units. However, in order to be cost effective, a separate multifamily collection program would probably be implemented only in areas with high density multifamily sites (20 to 30 units per site).
The threshold level for method is minimum of 500 sites or 3250 multifamily units participating.
Finance, interest and start-up costs not included, recycling revenue is calculated separately.

EFFICIENCY RATES: Multi Family Residential

NEWSPAPER	85%	CARDBOARD	75%
GLASS	50%	RECYCLABLE MIXED PAPER	75%
TIN-CANS	40%		
ALUM CANS	40%		

COST CATEGORY	ITEM	BASIS	WEST ANNUAL COST/RTE	EAST ANNUAL COST/RTE	WEST COST PER MF SITE	EAST COST PER MF SITE
COLLECTION COST						
CAPITAL	COLLECTION BINS	640 (90g) @ $45, 160 (300g) @ $180, 10 % replace	$5,760	$5,760	$14.40	$14.40
	COLLECTION VEHICLE	$110,000, S/L over 7 yrs + 10 %	$17,286	$17,286	$43.21	$43.21
O&M	LABOR (including fringe)					
	DRIVER	$20 or $15/hr X 2080 hrs.	$41,600	$31,200	$104.00	$78.00
	VEHICLE OPERATION & MAINTENANCE					
	FUEL	$25 PER DAY	$6,500	$6,500	$16.25	$16.25
	INSURANCE		$2,400	$2,400	$6.00	$6.00
	LICENSE & INSPECTION		$1,250	$1,250	$3.13	$3.13
	MAINTENANCE	$450 PER MONTH	$5,400	$5,400	$13.50	$13.50
TOTAL COLLECTION COSTS			$80,196	$69,796	$200	$174
TOTAL ADMINISTRATION COSTS (PER RTE AND PER SITE)			$20,049	$17,449	$50.12	$43.62
PROMOTION/EDUCATION	FLIERS/MAILINGS/ADS/ETC.	$2 PER UNIT OR $13 PER SITE			$13.00	$13.00

PROCESSING COST:	FACILITY SIZE:	(50 tpd	50 -100 TPD	) 100 TPD
	TRANSPORT 25 MI @ $.25/TN	$6	$6	$6
	PROCESSING	$70	$50	$30
TOTAL PROCESSING COST (PER TON)		$76.25	$56.25	$36.25

TRANSPORT: Transport costs are reflected in commodity prices by WGA

DISPOSAL: for 15% residual.

* COSTS AND ASSUMPTIONS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICTIONS.

4. COMMERCIAL DIRECT RECYCLING

KEY METHOD ASSUMPTIONS:

A significant portion of existing recycling of certain commercial waste stream components (cardboard, high grade paper, ferrous and non-ferrous metals) is done directly by the commercial generators, because it is economically beneficial to do so. Materials are collected and processed by the commercial generators and picked up or delivered to brokers.

No costs are shown for this method, because costs are born by the generator. This assumption is consistent with the assumptions used for residential recycling programs, which do not include costs born by the individual resident for sorting, cleaning, etc.

Efficiency rates for this method are based on actual data for each WGA on the amount of cardboard, high paper, ferrous and non-ferrous metals recycled from the commercial waste stream; and the overall assumption that 80 percent of all recycled cardboard, 8 percent of all recycled high grade paper and 90 percent of all scrap metal is handled through this method. This assumption is based on results of the Waste Composition Study.

EFFICIENCY RATES: Commercial

	WEST	NORTHWEST	PUGET SOUND	SOUTHWEST	N. CENTRAL	S. CENTRAL	NORTHEAST	SOUTHEAST
Cardboard	11.0%	19.0%	55.0%	27.0%	20.0%	34.0%	42.0%	35.0%
High Grade Paper	0.0%	1.0%	5.0%	3.0%	0.0%	0.3%	2.0%	1.0%
Ferrous Metals	57.0%	82.0%	76.0%	85.0%	77.0%	74.0%	66.0%	72.0%
Non-ferrous Metals	74.0%	80.0%	80.0%	76.0%	72.0%	84.0%	81.0%	86.0%

5. COMMERCIAL COLLECTION OF SOURCE SEPARATED MATERIALS

KEY METHOD ASSUMPTIONS

Separate routes are used to collect three separate materials from designated businesses that generate significant quantities of each:

wholesale & retail:	cardboard
restaurants, bars, hotels :	glass
offices and government:	office paper

A 20 cubic yd. truck is used interchangeably for all materials.
The truck makes an average of 2 trips a day, 5 days a week.
Based on average density for each material, and assuming that actual truckloads average 85 percent of the truck capacity, a truckload handles:

1.7 tons cardboard (200 lbs/cu. yd.)
4.7 tons office paper (550 lbs./cu.yd.)
5.1 tons glass (600 lbs./cu.yd.)

The threshold level for method is a sufficient quantity of materials generated by designated businesses to provide 520 truckloads per year.
Truckloads = (cardboard/1.7)+(office paper/4.7)+(glass/5.1)

Cost of method is based on the number of truck routes (total truckloads/520).

Efficiency rates are based on the quantity of materials available from designated businesses as measured by the percentage each material that is generated by designated businesses (based on SIC code) within each WGA.

EFFICIENCY RATE: Commercial Waste Stream

	WEST	NORTHWEST	PUGET SOUND	SOUTHWEST	N. CENTRAL	S. CENTRAL	NORTHEAST	SOUTHEAST
Cardboard	23%	32%	15%	20%	40%	29%	23%	25%
High Grade Paper	15%	19%	8%	9%	30%	22%	17%	21%
Glass	16%	33%	31%	23%	46%	28%	30%	28%

ITEM AND BASIS FOR COST		WEST ANNUAL COST	EAST ANNUAL COST	
VEHICLE $50,000, S/L 7 YRS + 10%		$7,857	$7,857	
DRIVER ($20 OR $15 X 2080)		$41,600	$31,200	
VEHICLE O & M				
FUEL $25 per day		$6,500	$6,500	
INSURANCE		$2,400	$2,400	
MAINTENANCE $450 per mth		$5,400	$5,400	
LICENSE & INSPECTION		$1,250	$1,250	
TOTAL COLLECTION COST (PER ROUTE)		$65,007	$54,607	
ADMINISTRATION (PER ROUTE)		$16,252	$13,652	
PROCESSING COST:	FACILITY SIZE:		(50 TPD	50 -100 TPD	100 TPD
	TRANSPORT 25 MI @ $.25/TN		$6	$6	$6
	PROCESSING		$50	$33	$22
TOTAL PROCESSING COST (PER TON)			$56.25	$39.25	$28.25

TRANSPORT: Transport costs are reflected in variation in commodity prices by WGA.

* COSTS AND ASSUMPTIONS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICTIONS.

6. DROP-OFF AND/OR BUY-BACK CENTER FOR SOURCE SEPARATED RECYCLABLES

KEY METHOD ASSUMPTIONS:

Method includes several drop off or buy back alternatives. "Regular drop off
"Regular" drop off and buy back handles: newspaper, corrugated containers, mixed
waste paper, 3 colors of glass containers, aluminum and tin cans.
Materials are collected from drop off sites to be processed
at medium (50 - 100 TPD) or large (over 100 TPD) processing facility.
Direct costs include collection (from drop off sites) and processing.
Materials brought to buy back centers have no collection costs.
Portion of materials handled by drop off versus buy back varies with WGA.
For initial estimates of these portions, it was assumed that rural waste
was taken to drop off sites, and urban waste was taken to buy back centers.

"Special waste" drop off includes scrap metal, white goods and oil from the
residential sector and tires, oil and batteries from the commercial sector.
Special waste materials have processing costs but no collection cost; the actual
recycling of these materials occurs through a variety of drop off systems.
Administrative costs are calculated as a percentage of direct costs.

Recovery rates for residential and commercial waste are based on current recycling
levels in each WGA. Recovery rates for self hauled waste (by definition, none of
this waste is currently recycled) are based on experience from other programs. Rates
for self haul are: 10 % for cardboard, newspaper and glass; 3 % for aluminum and
2 % for tin cans.

RECOVERY RATES: Residential Single Family and Multi Family

	WEST	NORTHWEST	PUGET SOUND	SOUTHWEST	N. CENTRAL	S. CENTRAL	NORTHEAST	SOUTHEAST
RESIDENTIAL WASTE:								
"REGULAR" DROP OFF/BUY BACK								
Newspaper	48%	29%	64%	47%	30%	66%	60%	16%
Cardboard	11%	5%	30%	10%	7%	18%	24%	53%
Refillable Glass	45%	63%	27%	56%	83%	80%	53%	70%
Glass	16%	5%	15%	11%	2%	14%	12%	21%
Tins Cans	0%	4%	2%	0%	0%	0%	0%	7%
Aluminum Cans	45%	42%	27%	34%	44%	52%	68%	62%
SPECIAL WASTE DROP OFF/BUY BACK								
Ferrous Metals	65%	72%	64%	80%	68%	69%	60%	52%
Non-ferrous Metals	28%	11%	33%	16%	15%	41%	29%	29%
White Goods	70%	65%	96%	0%	0%	0%	40%	47%
Oil	74%	42%	78%	85%	46%	63%	65%	71%
COMMERCIAL:								
SPECIAL WASTE DROP OFF/BUY BACK								
Tires	0%	0%	38%	32%	0%	10%	51%	16%
Oil	98%	97%	99%	99%	97%	98%	98%	99%
Batteries	91%	99%	97%	98%	97%	97%	96%	96%

COLLECTION COSTS (PER TON DROP OFF ONLY) Avg. 25 miles @ $.25/TM $6

PROCESSING:

FACILITY SIZE / MATERIAL	< 50 tpd "REGULAR"	50-100 TPD "REGULAR"	>100 TPD "REGULAR"	FERROUS	NON-FERROUS	WHITE GOODS	OIL, TIRES & BATTERIES
PROCESSING COSTS (PER TON)	$50	$33	$22	$15	$15	$20	$40
ADMINISTRATION (25 % OF DIRECT)	$13	$8	$6	$4	$4	$5	$10
TOTAL W/OUT COLLECTION (PER TON)	$63	$41	$28	$19	$19	$25	$50

COSTS AND ASSUMPTIONS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICTIONS.

7. CURBSIDE COLLECTION OF YARD WASTE TWICE PER MONTH - MARCH THRU NOVEMBER

KEY METHOD ASSUMPTIONS:

Twice monthly collection of yard waste during 9 months of the year
A packer truck is used on each route with 2 crew members
Average density of yard waste is 415 lbs./cu. yd. (based on average for several types of yard waste—compacted and uncompacted leaves, wood chips and grass clippings--from National Recycling Coalition draft report of Recycling Standards.
Each truck can drive by 500 single family households per day.
Threshold level is 10,000 sf households per jurisdiction
Service provided to all residents who source separate yard waste in either plastic bags or cans
Finance, Interest and start-up costs and recycling revenue not included

PROJECTED RECOVERY RATES: Residential Single Family and Self Haul Waste Streams

Yard Waste 80%

COST CATEGORY	ITEM	BASIS	WEST ANNUAL COST	EAST ANNUAL COST	WEST COST PER HOUSEHOLD	EAST COST PER HOUSEHOLD
COLLECTION COST:						
CAPITAL	COLLECTION VEHICLE	$85,000, S/L over 7 yrs	$12,143	$12,143	$2.43	$2.43
O&M	LABOR (including fringe)					
	DRIVER & CREW	$20 OR $15/hr X 2 FTE X 1560 hrs.	$62,400	$46,800	$12.48	$9.36
	VEHICLE OPERATION & MAINTENANCE					
	FUEL	$25 PER DAY	$4,875	$4,875	$0.98	$0.98
	INSURANCE		$4,000	$4,000	$0.80	$0.80
	LICENSE & INSPECTION		$2,500	$2,500	$0.50	$0.50
	MAINTENENCE	$900 PER MONTH	$8,100	$8,100	$1.62	$1.62
COLLECTION TOTAL			$94,018	$78,418	$18.80	$15.68
ADMINISTRATION COST (PER RTE AND PER HOUSEHOLD)			$23,504	$19,604	$4.70	$3.92
PROMOTION/EDUCATION	FLIERS/MAILINGS/ADS/ETC.	$1.00/household/yr	$5,000	$5,000	$1.00	$1.00
TOTAL COST	FOR COLLECTION, ADMIN & PROMO ==========)		$122,522	$103,022	$24.50	$20.60

TRANSFER $11.50 PER TON
URBAN: 90% IS TRANSFERRED $10.35 PER TON
RURAL: 40% IS TRANSFERRED $4.60 PER TON

TRANSPORT AVERAGE 10 MILES, URBAN OR RURAL $2.50 PER TON

PROCESSING CENTRALIZED FACILITY, $23 TO $40/TON $30 PER TON

Processing costs vary with size of facility from $40 per ton for small facility (a.g. 4,000 tons per year) to $23 per ton for larger facility (22,000 tons per year). Overall average assumed: $30 per ton.

REVENUE ASSUMPTION
Conversion: 2 tons waste = 1 ton compost
Price per ton of compost = $10 $5 PER TON OF WASTE

COSTS AND ASSUMPTIONS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICTIONS.

8. COMMERCIAL TARGETED HIGH GRADE LOADS

KEY METHOD ASSUMPTIONS:
Regular municipal weekly collection, 5 % or 1 in 20 commercial or combined commercial and multifamily routes are targeted for high grade processing.

PROJECTED EFFICIENCY RATES

CORRUGATE	50%	NEWSPRINT	55%
OFFICE P.	60%	ALUMINUM	50%
MIXED W.P.	55%	FERROUS	50%
GLASS	0%	NON FERROUS	50%

COST CATEGORY	ITEM AND BASIS FOR COST	WEST ANNUAL COST	EAST ANNUAL COST	
COLLECTION COSTS (PER ROUTE) (Regular Municipal Collection)		$105,843	$90,243	
ADMINISTRATION/OVERHEAD COST (PER ROU(Regular)		$26,461	$22,561	
PROCESSING COST:	FACILITY SIZE:	(50 tpd	50 -100 TPD	100 TPD
	TRANSPORT 25 MI @ $.25/TN	$6	$6	$6
	PROCESSING	$70	$50	$30
TOTAL PROCESSING COST (PER TON)		$76.25	$56.25	$36.25

TRANSPORT: Transport costs are reflected in commodity prices by WGA

DISPOSAL COST for 30% residual.

* COSTS AND ASSUMPTIONS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICTIONS.

9. SELF HAULED WASTE

KEY METHOD ASSUMPTIONS:
This method applies to the self hauled waste stream. Consistent with assumptions for other methods, no costs are reflected for the transportation of waste The amount of waste handled by this method depends on alternative methods that impact the self hauled waste stream. This method handles 100 % of remaining waste

DISPOSAL COSTS vary with selected disposal methods.

10. REGULAR COLLECTION AND DISPOSAL OF MUNICIPAL SOLID WASTE

KEY METHOD ASSUMPTIONS:

Weekly collection, packer truck, crew size varies from 1 to 2, averaging 1.5.
Number of households and business served per route is based on hauler survey and varies with WGA
Most routes are combined single family, multi family and commercial,.

	WEST	NORTHWEST	PUGET SOUND	SOUTHWEST	N. CENTRAL	S. CENTRAL	NORTHEAST	SOUTHEAST
AVG. RESIDENCES/RTE/DAY	400	400	450	400	400	400	400	400
AVG. BUSINESSES/RTE/DAY	70	70	70	70	70	70	70	70

COST CATEGORY	ITEM AND BASIS FOR COST		WEST ANNUAL COST	EAST ANNUAL COST
CAPITAL				
	VEHICLE $125,000, S/L 7 YRS + 10 %		$19,643	$19,643
O & M	LABOR (including fringe)			
	DRIVER & CREW ($20 OR $15 X 1.5 X 2080)		$62,400	$46,800
	VEHICLE OPERATION & MAINTENANCE			
	FUEL $25 PER DAY		$6,500	$6,500
	INSURANCE		$4,000	$4,000
	LICENSE & INSPECTION		$2,500	$2,500
	MAINTENANCE $900 PER MONTH		$10,800	$10,800
TOTAL COLLECTION COSTS			$105,843	$90,243
ADMINISTRATION/OVERHEAD 25 % OF COLLECTION			$26,461	$22,561
COLLECTION COST PER ROUTE			$132,304	$112,804
TRANSFER	$10 PER TON	AVG. PER TON		
	URBAN: 90% IS TRANSFERRED	$9.00		
	RURAL: 50% IS TRANSFERRED	$5.00		
TRANSPORT	$ .20 PER TON MILE			
	URBAN: 25 MILES AVERAGE DISTANCE	$5.00		
	RURAL: 20 MILES AVERAGE DISTANCE	$4.00		

DISPOSAL COSTS vary with selected disposal option

* COSTS AND ASSUMPTIONS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICTIONS.

11. MIXED WASTE PROCESSING WITH MSW COMPOSTING AND MATERIALS RECOVERY

KEY METHOD ASSUMPTIONS

Mixed waste processing designed to recover recyclables, and compost most of remaining waste (except for rejects).
Processing costs based on medium sized facility (400 TPD)
Facility costs are amortized over 20 years based on real cost of financing (4%).
Facility operates 12 hours a day, 6 days a week, with 15 percent downtime. (265 days per year)

Revenue from recycled (recovered) materials are calculated at less than full market price, due to contamination or breakage: paper at 50% of market price, aluminum, tin and ferrous metals at 75% of market price, and non-ferrous metals and white goods at 50% of market price.

	Costs per TPD Capacity	Average Annual Cost	Capital Per Ton	O & M Per Ton	Rural Total Per Ton	Urban Total Per Ton
PROCESSING	$40,000	$2,943	11.11	20.00	$31.11	$31.11
TRANSFER $10 per ton	50 % of urban and 80 % of rural				$8.00	$5.00
TRANSPORT: $.20 per ton mile, 30 miles for rural and 15 miles for urban.					$6.00	$3.00
TOTAL "PROCESSING" COST					$45.11	$39.11

DISPOSAL COSTS for rejects varies with selected disposal option

EFFICIENCY RATES: All waste streams

	Recovered	Composted	Disposed
Newspaper	15%	70%	15%
Corrugated	15%	70%	15%
High Grade Paper	15%	70%	15%
Scrap Paper	15%	60%	25%
Refillable Glass	60%		40%
Glass Containers	60%		40%
Aluminum	60%		40%
Tin Cans	80%		20%
Ferrous	80%		20%
Non Ferrous	40%		60%
White Goods	85%		15%
PET Bottles	10%		90%
HDPE Bottles	10%		90%
Expanded Polystyrene		15%	85%
Other Plastics		25%	75%
Tires		5%	95%
Other Rubber Products		20%	80%
Food		95%	5%
Lawn and Garden		90%	10%
Wood		90%	10%
Disposable Diapers		15%	85%
Oil	50%	10%	40%
Batteries	50%	10%	40%
Other Household Hazardous		10%	90%
Construciton/Demolition		20%	80%
Other Organic		90%	10%
Other Inorganics		30%	70%

12. RDF PREPARTION WITH MSW COMPOSTING AND MATERIALS RECOVERY

KEY METHOD ASSUMPTIONS:
Preparation of high quality RDF combined with recovery of recyclables and composting.
RDF is given aways for use as fuel substitute for existing boilers; this use does not provide positive revenues, but avoids disposal costs.
Processing costs based on medium sized facility (400 TPD)
Facility costs are amortized over 20 years based on real cost of financing (4%).
Facility operates year round with 15 percent down time (total 310 days per year).

Revenue from recycled (recovered) materials are calculated at less than full market price, due to contamination or breakage.

	Capital per TPD Capacity	Average Annual Cost	Capital Per Ton	O & M Per Ton	Urban Total Per Ton	Rural Total Per Ton
PROCESSING	$70,000	$5,151	16.62	25.00	41.62	41.62
TRANSFER $10 per ton	50 % of urban and 80 % of rural				$5.00	$8.00
TRANSPORT: $.20 per ton mile, 30 miles for rural and 15 miles for urban.					$3.00	$6.00
TOTAL "PROCESSING" COST					$49.62	$55.62

DISPOSAL COSTS for rejects varies with selected disposal option

EFFICIENCY RATES: All waste streams

	Recovered	RDF	Composted	Disposed
Newspaper	15%	70%	5%	10%
Corrugated	15%	70%	5%	10%
High Grade Paper	15%	70%	5%	10%
Scrap Paper	15%	70%	5%	10%
Refillable Glass	60%	5%	5%	30%
Glass Containers	60%	5%	5%	30%
Aluminum	90%			10%
Tin Cans	80%			20%
Ferrous	90%		5%	5%
Non Ferrous	80%		5%	15%
White Goods	100%			
PET Bottles	10%	80%		10%
HDPE Bottles	10%	80%		10%
Expanded Polystyrene		90%		10%
Other Plastics		90%		10%
Tires		90%		10%
Other Rubber Products		90%		10%
Food		10%	80%	10%
Lawn and Garden		10%	80%	10%
Wood		10%	70%	20%
Disposable Diapers		80%	10%	10%
Oil	100%			
Batteries	50%	10%	10%	30%
Other Household Hazardous		10%	10%	80%
Construciton/Demolition			20%	80%
Other Organic			80%	20%
Other Inorganics			20%	80%

A. MASS BURN INCINERATION

Mass incineration of mixed solid waste, assuming prior removal of toxic/hazardous substances (batteries, tires, household hazardous waste) from waste stream.
Recovery of energy produced at rate of 450 kwh/ton. Energy revenue = $30 - $40/mgh. based on estimated levelized rates over 20 years.
Facility operates 24 hours a day, year round, with 17 percent downtime. (303 days per year)
Ash disposal at monofill (landfill) site.

INCINERATION COST:

	Total Capital Costs	Costs per TPD Capacity	Average Annual Cost	Capital Per Ton	O & M Per Ton	Urban Total Per Ton	Rural Total Per Ton
High End		$90,000	$6,622	21.86	30.00	51.86	51.86
Low End		$75,000	$5,519	18.21	25.00	43.21	43.21
Average						$47.53	$47.53
Revenue						($15.75)	($15.75)
NET INCIENRATION COST						$31.78	$31.78
TRANSFER $10 per ton 50 % of urban and 80 % of rural						$5.00	$8.00
TRANSPORT: $.20 per ton mile, 30 miles for rural and 15 miles for urban.						$3.00	$6.00
ASH DISPOSAL: Ash residual = 30% of waste, disposal = $50 per ton						$15.00	$15.00
TOTAL DISPOSAL COST (PER TON AVERAGE)						$54.78	$60.78

B. LANDFILL WITH LONG HAUL

KEY METHOD ASSUMPTIONS:
Municipal solid waste is long hauled to Arlington Oregon or comparable landfill site.
Waste is hauled via rail from population centers.
Transfer costs reflect special equipment to containerize waste.
Transport costs include truck transport to rail heads in population centers.
This method is under consideration for three WGA, costs are only for those three WGAs. Railheads location are in parentheses.

	PUGET SOUND (Seattle)	NORTHWEST (Bellingham)	SOUTHWEST (Vancouver)
TRANSFER	$12.50	$12.50	$12.50
TRUCK HAUL (avg. 20 miles)	$4.00	$4.00	$4.00
RAIL HAUL	$10.40	$11.50	$7.50
LANDFILL TIPPING FEE	$21.63	$21.63	$21.63
TOTAL DISPOSAL COST (PER TON)	$48.53	$49.63	$45.63

C. LANDFILL WITHIN REGION

KEY METHOD ASSUMPTIONS:
Landfills meet all minimum requirement under existing legislation.
Closure and post closure cost are allocated to per ton cost during active life of landfill
Landfill cost varies by size of facility; small landfill are assumed for rural areas, large landfills for urban areas.
Costs vary with regions dure to variations is climate and geologic conditions.

TRANSFER $10 PER TON FOR 50% RURAL AND 90% URBAN	$5	$9
TRANSPORT: 20 MILES RURAL OR 25 MILES URBAN AT $.20/TN	$4	$5

DISPOSAL COST (PER TON)

	WEST	NORTHWEST	PUGET SOUND	SOUTHWEST	N. CENTRAL	S. CENTRAL	NORTHEAST	SOUTHEAST
LARGE LANDFILL	$28	$30	$27	$33	$16	$16	$25	$20
SMALL LANDFILL	$35	$37	$34	$40	$40	$40	$40	$40

D. LANDFILL WITHIN REGION WITH REDUCTION THROUGH BALING

KEY METHOD ASSUMPTIONS
Volume reduction through baling reduces size requirment for landfill and related leachate treatment costs by about 10%.
Regular operations and maintenance costs are reduced by about 65%.
Weighted reduction in landfill costs: (10% X 65%) + (65% X 35%) = 29%

"PROCESSING" COST PER TON FOR BALING	$15	
TRANSFER $10 PER TON FOR 50% RURAL AND 90% URBAN	$5	$9
TRANSPORT: 20 MILES RURAL OR 25 MILES URBAN AT $.20/TN	$4	$5

DISPOSAL COST (PER TON)

	WEST	NORTHWEST	PUGET SOUND	SOUTHWEST	N. CENTRAL	S. CENTRAL	NORTHEAST	SOUTHEAST
LARGE LANDFILL	$20	$21	$19	$23	$11	$11	$18	$14
SMALL LANDFILL	$25	$26	$24	$28	$28	$28	$28	$28

* COSTS AND ASSUMPTIONS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICTIONS.

APPENDIX C

WGA ECONOMIC ANALYSIS SUPPORT DATA
(Integrated System Costs and Summary Tonnages)

WEST WGA PREFERRED* 23-Dec-88

MODULE 3:INTEGRATED SYSTEM COSTS AND BENEFITS

	1 SF COLLECT. SOURCE SEP.		2 SF COLLECT. COMINGLE		3 MF COLLECT COMINGLE		4 COMMERCIAL DIRECT RECYCLING		5 COMMERCIAL SOURCE SEP.		6a DROP OFF/ BUY BACK		6b DROP OFF/ SPECIAL WASTES	
TOTAL TONS PROCESSED	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON
	0 tons		954 tons		0 tons		10,756 tons		5,031 tons		4,282 tons		2,542 tons	
ADMINISTRATION	$0	$0	$48,287	$51	$0	$0			$77,368	$15	$29,973	$7	$0	$0
EDUCATION/PROMOTION	$0	$0	$22,564	$24	$0	$0			$0	$0	$34,255	$8	$0	$0
COLLECTION	$0	$0	$206,799	$217	$0	$0			$309,467	$62	$23,283	$5	$0	$0
PROCESSING	$0	$0	$72,708	$76	$0	$0	$0	$0	$283,012	$56	$267,619	$63	100,037	$39
TOTAL TONS DISPOSED	0 tons		95 tons		0 tons		0 tons		0 tons		0 tons		0 tons	
TRANSFER & TRANSPORT														
A. MASS BURN W/ ASHFILL														
B. LONG HAUL & LANDFILL														
C. BALE & LANDFILL														
D. LOCAL LANDFILL														
DISPOSAL														
A. MASS BURN W/ ASHFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
B. LONG HAUL & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
C. BALE & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
D. LOCAL LANDFILL	$0	$0	$3,251	$34	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL GROSS COST	$0	$0	$353,609	$371	$0	$0	$0	$0	$669,847	$133	$355,131	$83	$100,037	$39
TONS RECYCLED	0 tons		858 tons		0 tons		10,756 tons		5,031 tons		4,282 tons		2,242 tons	
TOTAL REVENUE	$0	$0	$43,011	$50	$0	$0	$0	$0	$312,741	$62	$536,099	$125	$66,039	$29
NET COST	$0	$0	$310,597	$326	$0	$0	$0	$0	$357,106	$71	($180,968)	($42)	$33,998	$13

*COST ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICITONS.

WEST WGA PREFERRED* 23-Dec-88

	7 YARD WASTE COLLECTION		COLLECTION COSTS FOR HIGH GRADE LOADS ARE INCLUDED IN METHOD 10 8 COMMERCIAL HI GRADE		9 SELF HAULED WASTE		10 REGULAR MSW COLLECTION		SEPARATE COSTS FOR METHODS 11 & 12 —SHOWN HERE FOR CLARIFICATION— ARE INCLUDED IN COSTS FOR METHODS 1 - 10 11 MIXED WASTE PROCESS		12 RDF PREPARATION RECOVERY		SYSTEM TOTAL	
TOTAL TONS PROCESSED	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON
	0 tons		0 tons		82,839 tons		144,708 tons		0 tons		0 tons		251,111 tons	
ADMINISTRATION	$0	$0					$1,560,587	$11					$1,716,215	$7
EDUCATION/PROMOTION	$0	$0					$0	$0					$56,819	$0
COLLECTION	$0	$0					$6,242,287	$43					$6,781,837	$27
PROCESSING	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$723,376	$3
TOTAL TONS DISPOSED	0 tons		0 tons		82,839 tons		144,708 tons		0 tons		0 tons		227,642 tons	
TRANSFER & TRANSPORT														
A. MASS BURN W/ ASHFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
B. LONG HAUL & LANDFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
C. BALE & LANDFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
D. LOCAL LANDFILL			$0	$0	$799,393	$10	$1,396,432	$10		$0		$0	$2,195,825	$10
DISPOSAL														
A. MASS BURN W/ ASHFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
B. LONG HAUL & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
C. BALE & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
D. LOCAL LANDFILL	$0	$0	$0	$0	$2,823,970	$34	$4,933,096	$34	$0	$0	$0	$0	$7,760,316	$34
TOTAL GROSS COST	$0	$0	$0	$0	$3,623,363	$44	$14,132,402	$98	$0	$0	$0	$0	$19,234,389	$77
TONS RECYCLED	0 tons		0 tons		0 tons		0 tons		0 tons		0 tons		23,169 tons	
TOTAL REVENUE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$957,891	$41
NET COST	$0	$0	$0	$0	$3,623,363	$44	$14,132,402	$98	$0	$0	$0	$0	$18,276,498	$73

*COST ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICITONS.

WEST RECOMMENDED* 23-Dec-88

MODULE 3:INTEGRATED SYSTEM COSTS AND BENEFITS

	1 SF COLLECT. SOURCE SEP.		2 SF COLLECT. COMINGLE		3 MF COLLECT COMINGLE		4 COMMERCIAL DIRECT RECYCLING		5 COMMERCIAL SOURCE SEP.		6a DROP OFF/ BUY BACK		6b DROP OFF/ SPECIAL WASTES	
TOTAL TONS PROCESSED	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON
	0 tons		0 tons		0 tons		10,756 tons		5,031 tons		4,477 tons		2,542 tons	
ADMINISTRATION	$0	$0	$0	$0	$0	$0			$77,368	$15	$31,336	$7	$0	$0
EDUCATION/PROMOTION	$0	$0	$0	$0	$0	$0			$0	$0	$35,812	$8	$0	$0
COLLECTION	$0	$0	$0	$0	$0	$0			$309,467	$62	$24,341	$5	$0	$0
PROCESSING	$0	$0	$0	$0	$0	$0	$0	$0	$283,012	$56	$279,784	$63	100,037	$39
TOTAL TONS DISPOSED	0 tons		0 tons		0 tons		0 tons		0 tons		0 tons		0 tons	
TRANSFER & TRANSPORT														
A. MASS BURN W/ ASHFILL														
B. LONG HAUL & LANDFILL														
C. BALE & LANDFILL														
D. LOCAL LANDFILL														
DISPOSAL														
A. MASS BURN W/ ASHFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
B. LONG HAUL & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
C. BALE & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
D. LOCAL LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL GROSS COST	$0	$0	$0	$0	$0	$0	$0	$0	$669,847	$133	$371,273	$83	$100,037	$39
TONS RECYCLED	0 tons		0 tons		0 tons		10,756 tons		5,031 tons		4,477 tons		2,242 tons	
TOTAL REVENUE	$0	$0	$0	$0	$0	$0	$0	$0	$312,741	$62	$552,201	$123	$66,039	$29
NET COST	$0	$0	$0	$0	$0	$0	$0	$0	$357,106	$71	($180,928)	($40)	$33,998	$13

*COST ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICITONS.

WEST RECOMMENDED* 23-Dec-88

COLLECTION COSTS FOR HIGH GRADE LOADS ARE INCLUDED IN METHOD 10

SEPARATE COSTS FOR METHODS 11 & 12 —SHOWN HERE FOR CLARIFICATION— ARE INCLUDED IN COSTS FOR METHODS 1 - 10

TOTAL TONS PROCESSED	7 YARD WASTE COLLECTION		8 COMMERCIAL HI GRADE		9 SELF HAULED WASTE		10 REGULAR MSW COLLECTION		11 MIXED WASTE PROCESS		12 RDF PREPARATION RECOVERY		SYSTEM TOTAL	
	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON
	27,893 tons		620 tons		62,254 tons		137,538 tons		0 tons		0 tons		251,111 tons	
ADMINISTRATION	$191,784	$7					$1,560,587	$11					$1,861,074	$7
EDUCATION/PROMOTION	$40,805	$1					$0	$0					$76,617	$0
COLLECTION	$767,134	$28					$6,242,287	$45					$7,343,230	$29
PROCESSING	$1,055,699	$38	$47,242	$76	$0	$0	$0	$0	$0	$0	$0	$0	$1,765,773	$7
TOTAL TONS DISPOSED	0 tons		186 tons		62,254 tons		137,538 tons		0 tons		0 tons		199,978 tons	
TRANSFER & TRANSPORT														
A. MASS BURN W/ ASHFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
B. LONG HAUL & LANDFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
C. BALE & LANDFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
D. LOCAL LANDFILL			$1,794	$10	$600,754	$10	$1,327,244	$10		$0		$0	$1,929,791	$10
DISPOSAL														
A. MASS BURN W/ ASHFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
B. LONG HAUL & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
C. BALE & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
D. LOCAL LANDFILL	$0	$0	$6,336	$34	$2,122,250	$34	$4,688,677	$34	$0	$0	$0	$0	$6,817,263	$34
TOTAL GROSS COST	$2,055,421	$74	$55,372	$89	$2,723,004	$44	$13,818,795	$100	$0	$0	$0	$0	$19,793,749	$79
TONS RECYCLED	27,893 tons		434 tons		0 tons		0 tons		0 tons		0 tons		50,833 tons	
TOTAL REVENUE	$139,467	$5	$19,166	$44	$0	$0	$0	$0	$0	$0	$0	$0	$1,089,616	$21
NET COST	$1,915,954	$69	$36,205	$58	$2,723,004	$44	$13,818,795	$100	$0	$0	$0	$0	$18,704,134	$74

*COST ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICITONS.

NORHTWEST WGA PREFERRED*

MODULE 3:INTEGRATED SYSTEM COSTS AND BENEFITS

	1 SF COLLECT. SOURCE SEP.		2 SF COLLECT. COMINGLE		3 MF COLLECT COMINGLE		4 COMMERCIAL DIRECT RECYCLING		5 COMMERCIAL SOURCE SEP.		6a DROP OFF/ BUY BACK		6b DROP OFF/ SPECIAL WASTES	
TOTAL TONS PROCESSED	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON
	0 tons		2,174 tons		0 tons		32,277 tons		4,716 tons		4,538 tons		4,245 tons	
ADMINISTRATION	$0	$0	$56,363	$26	$0	$0			$72,596	$15	$31,765	$7	$0	$0
EDUCATION/PROMOTION	$0	$0	$26,338	$12	$0	$0			$0	$0	$36,303	$8	$0	$0
COLLECTION	$0	$0	$241,388	$111	$0	$0			$290,379	$62	$23,256	$5	$0	$0
PROCESSING	$0	$0	$165,745	$76	$0	$0	$0	$0	$265,284	$56	$283,614	$63	77,993	$18
TOTAL TONS DISPOSED	0 tons		217 tons		0 tons		0 tons		0 tons		0 tons		0 tons	
TRANSFER & TRANSPORT														
A. MASS BURN W/ ASHFILL														
B. LONG HAUL & LANDFILL														
C. BALE & LANDFILL														
D. LOCAL LANDFILL														
DISPOSAL														
A. MASS BURN W/ ASHFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
B. LONG HAUL & LANDFILL	$0	$0	$4,702	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
C. BALE & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
D. LOCAL LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL GROSS COST	$0	$0	$494,536	$228	$0	$0	$0	$0	$628,259	$133	$374,938	$83	$77,993	$18
TONS RECYCLED	0 tons		1,956 tons		0 tons		32,277 tons		4,716 tons		4,538 tons		2,738 tons	
TOTAL REVENUE	$0	$0	$97,331	$50	$0	$0	$0	$0	$289,474	$61	$797,293	$176	$119,690	$44
NET COST	$0	$0	$397,205	$183	$0	$0	$0	$0	$338,785	$72	($422,355)	($93)	($41,697)	($10)

* COSTS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICITONS.

NORHTWEST WGA PREFERRED*

TOTAL TONS PROCESSED	7 YARD WASTE COLLECTION		COLLECTION COSTS FOR HIGH GRADE LORDS ARE INCLUDE IN METHOD 10 8 COMMERCIAL HI GRADE		9 SELF HAULED WASTE		10 REGULAR MSW COLLECTION		SEPARATE COSTS FOR METHODS 11 & 12 —SHOWN HERE FOR CLARIFICATION— ARE INCLUDED IN COSTS FOR METHODS 1 - 10 11 MIXED WASTE PROCESS		12 RDF PREPARATION RECOVERY		SYSTEM TOTAL	
	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON
	0 tons		358 tons		36,788 tons		165,886 tons		0 tons		0 tons		250,982 tons	
ADMINISTRATION	$0	$0					$1,857,502	$11					$2,018,226	$8
EDUCATION/PROMOTION	$0	$0					$0	$0					$62,641	$0
COLLECTION	$0	$0					$7,429,937	$45					$7,984,960	$32
PROCESSING	$0	$0	$27,298	$76	$0	$0	$0	$0	$0	$0	$0	$0	$819,933	$3
TOTAL TONS DISPOSED	0 tons		107 tons		36,788 tons		165,886 tons		0 tons		0 tons		202,999 tons	
TRANSFER & TRANSPORT														
A. MASS BURN W/ ASHFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
B. LONG HAUL & LANDFILL			$3,007	$28	$1,030,076	$28	$4,644,814	$28		$0		$0	$5,677,898	$28
C. BALE & LANDFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
D. LOCAL LANDFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
DISPOSAL														
A. MASS BURN W/ ASHFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
B. LONG HAUL & LANDFILL	$0	$0	$2,323	$22	$795,734	$22	$3,588,119	$22	$0	$0	$0	$0	$4,390,878	$22
C. BALE & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
D. LOCAL LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL GROSS COST	$0	$0	$32,629	$91	$1,825,810	$50	$17,520,372	$106	$0	$0	$0	$0	$20,954,536	$83
TONS RECYCLED	0 tons		251 tons		0 tons		0 tons		0 tons		0 tons		46,476 tons	
TOTAL REVENUE	$0	$0	$10,216	$41	$0	$0	$0	$0	$0	$0	$0	$0	$1,314,003	$28
NET COST	$0	$0	$22,413	$63	$1,825,810	$50	$17,520,372	$106	$0	$0	$0	$0	$19,640,532	$78

* COSTS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICITONS.

NORHTWEST RECOMMENDED* 23-Dec-88

MODULE 3:INTEGRATED SYSTEM COSTS AND BENEFITS

	1 SF COLLECT. SOURCE SEP.		2 SF COLLECT. COMINGLE		3 MF COLLECT COMINGLE		4 COMMERCIAL DIRECT RECYCLING		5 COMMERCIAL SOURCE SEP.		6a DROP OFF/ BUY BACK		6b DROP OFF/ SPECIAL WASTES	
TOTAL TONS PROCESSED	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON
	0 tons		0 tons		0 tons		32,277 tons		4,716 tons		4,772 tons		4,245 tons	
ADMINISTRATION	$0	$0	$0	$0	$0	$0			$72,596	$15	$33,402	$7	$0	$0
EDUCATION/PROMOTION	$0	$0	$0	$0	$0	$0			$0	$0	$38,174	$8	$0	$0
COLLECTION	$0	$0	$0	$0	$0	$0			$290,379	$62	$24,455	$5	$0	$0
PROCESSING	$0	$0	$0	$0	$0	$0	$0	$0	$265,284	$56	$298,235	$62	77,993	$18
TOTAL TONS DISPOSED	0 tons		0 tons		0 tons		0 tons		0 tons		0 tons		0 tons	
TRANSFER & TRANSPORT														
A. MASS BURN W/ ASHFILL														
B. LONG HAUL & LANDFILL														
C. BALE & LANDFILL														
D. LOCAL LANDFILL														
DISPOSAL														
A. MASS BURN W/ ASHFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
B. LONG HAUL & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
C. BALE & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
D. LOCAL LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL GROSS COST	$0	$0	$0	$0	$0	$0	$0	$0	$628,259	$133	$394,267	$83	$77,993	$18
TONS RECYCLED	0 tons		0 tons		0 tons		32,277 tons		4,716 tons		4,772 tons		2,738 tons	
TOTAL REVENUE	$0	$0	$0	$0	$0	$0	$0	$0	$289,474	$61	$825,796	$173	$119,690	$44
NET COST	$0	$0	$0	$0	$0	$0	$0	$0	$338,785	$72	($431,530)	($90)	($41,697)	($10)

* COSTS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICITONS.

NORHTWEST RECOMMENDED* 23-Dec-88

	7 YARD WASTE COLLECTION		COLLECTION COSTS FOR HIGH GRADE LOADS ARE INCLUDE IN METHOD 10 8 COMMERCIAL HI GRADE		9 SELF HAULED WASTE		10 REGULAR MSW COLLECTION		SEPARATE COSTS FOR METHODS 11 & 12 —SHOWN HERE FOR CLARIFICATION— ARE INCLUDED IN COSTS FOR METHODS 1 - 10 11 MIXED WASTE PROCESS		12 RDF PREPARATION RECOVERY		SYSTEM TOTAL	
TOTAL TONS PROCESSED	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON
	28,136 tons		358 tons		27,647 tons		148,832 tons		0 tons		0 tons		250,982 tons	
ADMINISTRATION	$317,198	$11					$1,857,502	$12					$2,280,698	$9
EDUCATION/PROMOTION	$67,489	$2					$0	$0					$105,663	$0
COLLECTION	$1,268,793	$45					$7,429,937	$50					$9,013,564	$36
PROCESSING	$1,072,963	$38	$27,298	$76	$0	$0	$0	$0	$0	$0	$0	$0	$1,741,772	$7
TOTAL TONS DISPOSED	0 tons		107 tons		27,647 tons		148,832 tons		0 tons		0 tons		176,586 tons	
TRANSFER & TRANSPORT														
A. MASS BURN W/ ASHFILL			$694	$13	$178,600	$13	$961,452	$13		$0		$0	$1,140,745	$13
B. LONG HAUL & LANDFILL			$1,504	$28	$387,058	$28	$2,083,642	$28		$0		$0	$2,472,203	$28
C. BALE & LANDFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
D. LOCAL LANDFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
DISPOSAL														
A. MASS BURN W/ ASHFILL	$0	$0	$2,512	$47	$646,663	$47	$3,481,170	$47	$0	$0	$0	$0	$4,130,345	$47
B. LONG HAUL & LANDFILL	$0	$0	$1,162	$22	$299,002	$22	$1,609,613	$22	$0	$0	$0	$0	$1,909,777	$22
C. BALE & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
D. LOCAL LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL GROSS COST	$2,726,443	$97	$33,169	$93	$1,511,323	$55	$17,423,315	$117	$0	$0	$0	$0	$22,794,768	$91
TONS RECYCLED	28,136 tons		251 tons		0 tons		0 tons		0 tons		0 tons		72,889 tons	
TOTAL REVENUE	$140,680	$5	$10,216	$41	$0	$0	$0	$0	$0	$0	$0	$0	$1,385,855	$19
NET COST	$2,585,764	$92	$22,953	$64	$1,511,323	$55	$17,423,315	$117	$0	$0	$0	$0	$21,408,912	$85

* COSTS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICITONS.

PUGET SOUND WSA PREFERRED# 23-Dec-88

MODULE 3:INTEGRATED SYSTEM COSTS AND BENEFITS

	1 SF COLLECT. SOURCE SEP.		2 SF COLLECT. COMINGLE		3 MF COLLECT COMINGLE		4 COMMERCIAL DIRECT RECYCLING		5 COMMERCIAL SOURCE SEP.		6a DROP OFF/ BUY BACK		6b DROP OFF/ SPECIAL WASTES	
TOTAL TONS PROCESSED		AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON
	0 tons		68,708 tons		53,645 tons		422,744 tons		60,562 tons		122,134 tons		100,201 tons	
ADMINISTRATION	$0	$0	$815,620	$12	$2,305,767	$43		$0	$966,257	$16	$854,938	$7	$0	$0
EDUCATION/PROMOTION	$0	$0	$578,968	$8	$598,064	$11		$0	$0	$0	$977,072	$8	$0	$0
COLLECTION	$0	$0	$3,610,779	$53	$9,200,985	$172		$0	$3,864,967	$64	$198,468	$2	$0	$0
PROCESSING	$0	$0	$2,490,672	$36	$1,944,637	$36		$0	$1,710,887	$28	$3,328,152	$27	3,969,837	$40
TOTAL TONS DISPOSED	0 tons		6,871 tons		8,047 tons		0 tons		0 tons		0 tons		0 tons	
TRANSFER & TRANSPORT														
A. MASS BURN W/ ASHFILL														
B. LONG HAUL & LANDFILL														
C. BALE & LANDFILL														
D. LOCAL LANDFILL														
DISPOSAL														
A. MASS BURN W/ ASHFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
B. LONG HAUL & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
C. BALE & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
D. LOCAL LANDFILL	$0	$0	$198,017	$29	$231,908	$29	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL GROSS COST	$0	$0	$7,694,056	$112	$14,281,360	$266	$0	$0	$6,542,111	$108	$5,358,630	$44	$3,969,837	$40
TONS RECYCLED	0 tons		61,837 tons		45,598 tons		422,744 tons		60,562 tons		122,134 tons		77,850 tons	
TOTAL REVENUE	$0	$0	$3,339,377	$54	$2,462,394	$54	$0	$0	$4,015,569	$66	$8,775,396	$72	$2,625,531	$34
NET COST	$0	$0	$4,354,679	$63	$11,818,966	$220	$0	$0	$2,526,542	$42	($3,416,766)	($28)	$1,344,305	$13

COSTS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICITONS.

PUGET SOUND WGA PREFERRED* 23-Dec-88

MODULE 3:INTEGRATED SYSTEM

COLLECTION COSTS FOR HIGH GRADE LOADS ARE INCLUDED IN METHOD 10

SEPARATE COSTS FOR METHODS 11 & 12 —SHOWN HERE FOR CLARIFICATION— ARE INCLUDED IN COSTS FOR METHODS 1 - 10

	7 YARD WASTE COLLECTION		8 COMMERCIAL HI GRADE		9 SELF HAULED WASTE		10 REGULAR MSW COLLECTION		11 MIXED WASTE PROCESS		12 RDF PREPARATION RECOVERY		SYSTEM TOTAL	
TOTAL TONS PROCESSED	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON
	294,374 tons		7,399 tons		296,542 tons		1,669,691 tons		0 tons		0 tons		3,096,001 tons	
ADMINISTRATION	$2,984,650	$10					$17,972,279	$11					$25,899,511	$8
EDUCATION/PROMOTION	$635,032	$2					$0	$0					$2,789,136	$1
COLLECTION	$11,938,602	$41					$71,888,435	$43					$100,702,234	$33
PROCESSING	$12,173,853	$41	$268,208	$36	$0	$0	$0	$0	$0	$0	$0	$0	$25,886,247	$8
TOTAL TONS DISPOSED	0 tons		2,220 tons		296,542 tons		1,669,691 tons		0 tons		0 tons		1,983,370 tons	
TRANSFER & TRANSPORT														
A. MASS BURN W/ ASHFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
B. LONG HAUL & LANDFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
C. BALE & LANDFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
D. LOCAL LANDFILL			$28,190	$13	$3,766,078	$13	$21,205,080	$13		$0		$0	$24,999,348	$13
DISPOSAL														
A. MASS BURN W/ ASHFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
B. LONG HAUL & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
C. BALE & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
D. LOCAL LANDFILL	$0	$0	$63,970	$29	$8,546,329	$29	$48,120,503	$29	$0	$0	$0	$0	$57,160,728	$29
TOTAL GROSS COST	$27,732,137	$94	$360,368	$49	$12,312,408	$42	$159,186,296	$95	$0	$0	$0	$0	$237,437,204	$77
TONS RECYCLED	294,374 tons		5,179 tons		0 tons		0 tons		0 tons		0 tons		1,090,279 tons	
TOTAL REVENUE	$1,471,872	$5	$294,404	$57	$0	$0	$0	$0	$0	$0	$0	$0	$22,984,544	$21
NET COST	$26,260,265	$89	$65,964	$9	$12,312,408	$42	$159,186,296	$95	$0	$0	$0	$0	$214,452,660	$69

COSTS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICITONS.

PUGET SOUND WGA RECOMMENDED* 23-Dec-88

MODULE 3:INTEGRATED SYSTEM COSTS AND BENEFITS

	1 SF COLLECT. SOURCE SEP.		2 SF COLLECT. COMINGLE		3 MF COLLECT COMINGLE		4 COMMERCIAL DIRECT RECYCLING		5 COMMERCIAL SOURCE SEP.		6a DROP OFF/ BUY BACK		6b DROP OFF/ SPECIAL WASTES	
TOTAL TONS PROCESSED		AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON
	0 tons		68,708 tons		53,645 tons		422,744 tons		60,562 tons		122,134 tons		100,201 tons	
ADMINISTRATION	$0	$0	$815,620	$12	$2,305,767	$43		$0	$966,257	$16	$854,938	$7	$0	$0
EDUCATION/PROMOTION	$0	$0	$578,968	$8	$598,064	$11		$0	$0	$0	$977,072	$8	$0	$0
COLLECTION	$0	$0	$3,610,779	$53	$9,200,985	$172		$0	$3,864,967	$64	$198,468	$2	$0	$0
PROCESSING	$0	$0	$2,490,672	$36	$1,944,637	$36		$0	$1,710,887	$28	$3,328,152	$27	3,969,837	$40
TOTAL TONS DISPOSED	0 tons		6,871 tons		8,047 tons		0 tons		0 tons		0 tons		0 tons	
TRANSFER & TRANSPORT														
A. MASS BURN W/ ASHFILL														
B. LONG HAUL & LANDFILL														
C. BALE & LANDFILL														
D. LOCAL LANDFILL														
DISPOSAL														
A. MASS BURN W/ ASHFILL	$0	$0	$106,068	$0	$124,221	$47	$0	$0	$0	$0	$0	$0	$0	$0
B. LONG HAUL & LANDFILL	$0	$0	$49,043	$0	$57,437	$22	$0	$0	$0	$0	$0	$0	$0	$0
C. BALE & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
D. LOCAL LANDFILL	$0	$0	$67,326	$10	$78,849	$29	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL GROSS COST	$0	$0	$7,718,476	$112	$14,309,960	$267	$0	$0	$6,542,111	$108	$5,358,630	$44	$3,969,837	$40
TONS RECYCLED	0 tons		61,837 tons		45,598 tons		422,744 tons		60,562 tons		122,134 tons		77,850 tons	
TOTAL REVENUE	$0	$0	$3,339,377	$54	$2,462,394	$54	$0	$0	$4,015,569	$66	$8,775,396	$72	$2,625,531	$34
NET COST	$0	$0	$4,379,099	$64	$11,847,565	$221	$0	$0	$2,526,542	$42	($3,416,766)	($28)	$1,344,305	$13

COSTS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICITONS.

PUGET SOUND WGA RECOMMENDED# 23-Dec-88

	7 YARD WASTE COLLECTION		COLLECTION COSTS FOR HIGH GRADE LOADS ARE INCLUDED IN METHOD 10 — 8 COMMERCIAL HI GRADE		9 SELF HAULED WASTE		10 REGULAR MSW COLLECTION		SEPARATE COSTS FOR METHODS 11 & 12 —SHOWN HERE FOR CLARIFICATION— ARE INCLUDED IN COSTS FOR METHODS 1 - 10 — 11 MIXED WASTE PROCESS		12 RDF PREPARATION RECOVERY		SYSTEM TOTAL	
TOTAL TONS PROCESSED	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON
	294,374 tons		7,399 tons		296,542 tons		1,669,691 tons		0 tons		0 tons		3,096,001 tons	
ADMINISTRATION	$2,984,650	$10					$17,972,279	$11					$25,899,511	$8
EDUCATION/PROMOTION	$635,032	$2					$0	$0					$2,789,136	$1
COLLECTION	$11,938,602	$41					$71,888,435	$43					$100,702,234	$33
PROCESSING	$12,173,853	$41	$268,208	$36	$0	$0	$0	$0	$0	$0	$0	$0	$25,886,247	$8
TOTAL TONS DISPOSED	0 tons		2,220 tons		296,542 tons		1,669,691 tons		0 tons		0 tons		1,983,370 tons	
TRANSFER & TRANSPORT														
A. MASS BURN W/ ASHFILL			$7,003	$10	$935,529	$10	$5,267,542	$10		$0		$0	$5,210,074	$9
B. LONG HAUL & LANDFILL			$19,704	$27	$2,632,400	$27	$14,821,850	$27		$0		$0	$17,473,953	$27
C. BALE & LANDFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
D. LOCAL LANDFILL			$9,584	$13	$1,280,467	$13	$7,209,727	$13		$0		$0	$8,499,778	$13
DISPOSAL														
A. MASS BURN W/ ASHFILL	$0	$0	$34,266	$47	$4,577,831	$47	$25,775,693	$47	$0	$0	$0	$0	$30,618,079	$47
B. LONG HAUL & LANDFILL	$0	$0	$15,844	$22	$2,116,684	$22	$11,918,090	$22	$0	$0	$0	$0	$14,157,098	$22
C. BALE & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
D. LOCAL LANDFILL	$0	$0	$21,750	$29	$2,905,752	$29	$16,360,971	$29	$0	$0	$0	$0	$19,434,648	$29
TOTAL GROSS COST	$27,732,137	$94	$376,359	$51	$14,448,664	$49	$171,214,586	$103	$0	$0	$0	$0	$251,670,758	$81
TONS RECYCLED	294,374 tons		5,179 tons		0 tons		0 tons		0 tons		0 tons		1,090,279 tons	
TOTAL REVENUE	$1,471,872	$5	$294,404	$57	$0	$0	$0	$0	$0	$0	$0	$0	$22,984,544	$21
NET COST	$26,260,265	$89	$81,954	$11	$14,448,664	$49	$171,214,586	$103	$0	$0	$0	$0	$228,686,214	$74

COSTS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICITONS.

SOUTHWEST WGA PREFERRED* 23-Dec-88

MODULE 3:INTEGRATED SYSTEM COSTS AND BENEFITS

	1 SF COLLECT. SOURCE SEP.		2 SF COLLECT. COMINGLE		3 MF COLLECT COMINGLE		4 COMMERCIAL DIRECT RECYCLING		5 COMMERCIAL SOURCE SEP.		6a DROP OFF/ BUY BACK		6b DROP OFF/ SPECIAL WASTES	
	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON
TOTAL TONS PROCESSED	0 tons		3,212 tons		0 tons		61,038 tons		5,134 tons		9,641 tons		14,682 tons	
ADMINISTRATION	$0	$0	$91,468	$28	$0	$0		$0	$79,875	$16	$67,487	$7	$0	$0
EDUCATION/PROMOTION	$0	$0	$42,742	$13	$0	$0		$0	$0	$0	$77,128	$8	$0	$0
COLLECTION	$0	$0	$391,730	$122	$0	$0		$0	$319,493	$62	$33,741	$3	$0	$0
PROCESSING	$0	$0	$244,893	$76	$0	$0		$0	$196,368	$38	$397,690	$41	601,187	$41
TOTAL TONS DISPOSED	0 tons		321 tons		0 tons		0 tons		0 tons		0 tons		0 tons	
TRANSFER & TRANSPORT														
A. MASS BURN W/ ASHFILL														
B. LONG HAUL & LANDFILL														
C. BALE & LANDFILL														
D. LOCAL LANDFILL														
DISPOSAL														
A. MASS BURN W/ ASHFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
B. LONG HAUL & LANDFILL	$0	$0	$3,473	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
C. BALE & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
D. LOCAL LANDFILL	$0	$0	$5,929	$18	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL GROSS COST	$0	$0	$780,236	$243	$0	$0	$0	$0	$595,735	$116	$576,046	$60	$601,187	$41
TONS RECYCLED	0 tons		2,891 tons		0 tons		61,038 tons		5,134 tons		9,641 tons		12,444 tons	
TOTAL REVENUE	$0	$0	$158,164	$55	$0	$0	$0	$0	$337,289	$66	$1,082,649	$112	$353,192	$28
NET COST	$0	$0	$622,071	$194	$0	$0	$0	$0	$258,447	$50	($506,603)	($53)	$247,995	$17

COSTS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICTIONS.

SOUTHWEST WGA PREFERRED* 23-Dec-88

COLLECTION COSTS FOR HIGH GRADE LOADS ARE INCLUDED IN METHOD 10

SEPARATE COSTS FOR METHODS 11 & 12 —SHOWN HERE FOR CLARIFICATION— ARE INCLUDED IN COSTS FOR METHODS 1 - 10

	7 YARD WASTE COLLECTION		8 COMMERCIAL HI GRADE		9 SELF HAULED WASTE		10 REGULAR MSW COLLECTION		11 MIXED WASTE PROCESS		12 RDF PREPARATION RECOVERY		SYSTEM TOTAL	
	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON
TOTAL TONS PROCESSED	0 tons		724 tons		41,821 tons		241,985 tons		0 tons		0 tons		378,237 tons	
ADMINISTRATION	$0	$0					$2,294,532	$9					$2,533,361	$7
EDUCATION/PROMOTION	$0	$0					$0	$0					$119,870	$0
COLLECTION	$0	$0					$9,178,041	$38					$9,923,005	$26
PROCESSING	$0	$0	$55,180	$76	$0	$0	$0	$0	$0	$0	$0	$0	$1,495,318	$4
TOTAL TONS DISPOSED	0 tons		217 tons		41,821 tons		241,985 tons		0 tons		0 tons		284,344 tons	
TRANSFER & TRANSPORT														
A. MASS BURN W/ ASHFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
B. LONG HAUL & LANDFILL			$2,605	$24	$501,855	$24	$2,903,819	$24		$0		$0	$3,408,279	$24
C. BALE & LANDFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
D. LOCAL LANDFILL			$1,216	$11	$234,204	$11	$1,355,145	$11		$0		$0	$1,590,564	$11
DISPOSAL														
A. MASS BURN W/ ASHFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
B. LONG HAUL & LANDFILL	$0	$0	$2,348	$22	$452,297	$22	$2,617,067	$22	$0	$0	$0	$0	$3,075,185	$22
C. BALE & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
D. LOCAL LANDFILL	$0	$0	$4,008	$37	$772,013	$37	$4,467,000	$37	$0	$0	$0	$0	$5,248,950	$37
TOTAL GROSS COST	$0	$0	$65,357	$90	$1,960,369	$47	$22,815,603	$94	$0	$0	$0	$0	$27,394,532	$72
TONS RECYCLED	0 tons		507 tons		0 tons		0 tons		0 tons		0 tons		91,654 tons	
TOTAL REVENUE	$0	$0	$27,218	$54	$0	$0	$0	$0	$0	$0	$0	$0	$1,958,512	$21
NET COST	$0	$0	$38,139	$53	$1,960,369	$47	$22,815,603	$94	$0	$0	$0	$0	$25,436,021	$67

COSTS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICTIONS.

SOUTHWEST RECOMMENDED= 23-Dec-88

MODULE 3:INTEGRATED SYSTEM COSTS AND BENEFITS

	1 SF COLLECT. SOURCE SEP.		2 SF COLLECT. COMINGLE		3 MF COLLECT COMINGLE		4 COMMERCIAL DIRECT RECYCLING		5 COMMERCIAL SOURCE SEP.		6a DROP OFF/ BUY BACK		6b DROP OFF/ SPECIAL WASTES	
	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON
TOTAL TONS PROCESSED	0 tons		3,212 tons		4,533 tons		61,038 tons		5,134 tons		8,784 tons		14,682 tons	
ADMINISTRATION	$0	$0	$91,468	$28	$157,963	$35		$0	$79,875	$16	$61,488	$7	$0	$0
EDUCATION/PROMOTION	$0	$0	$42,742	$13	$40,972	$9		$0	$0	$0	$70,271	$8	$0	$0
COLLECTION	$0	$0	$391,730	$122	$630,338	$139		$0	$319,493	$62	$30,741	$3	$0	$0
PROCESSING	$0	$0	$244,893	$76	$345,618	$76		$0	$196,368	$38	$362,337	$41	601,187	$41
TOTAL TONS DISPOSED	0 tons		321 tons		680 tons		0 tons		0 tons		0 tons		0 tons	
TRANSFER & TRANSPORT														
A. MASS BURN W/ ASHFILL														
B. LONG HAUL & LANDFILL														
C. BALE & LANDFILL														
D. LOCAL LANDFILL														
DISPOSAL														
A. MASS BURN W/ ASHFILL	$0	$0	$3,306	$0	$6,998	$47	$0	$0	$0	$0	$0	$0	$0	$0
B. LONG HAUL & LANDFILL	$0	$0	$1,528	$0	$3,236	$22	$0	$0	$0	$0	$0	$0	$0	$0
C. BALE & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
D. LOCAL LANDFILL	$0	$0	$6,640	$21	$14,056	$37	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL GROSS COST	$0	$0	$782,307	$244	$1,199,181	$265	$0	$0	$595,735	$116	$524,837	$60	$601,187	$41
TONS RECYCLED	0 tons		2,891 tons		3,853 tons		61,038 tons		5,134 tons		8,784 tons		12,444 tons	
TOTAL REVENUE	$0	$0	$158,164	$55	$242,791	$63	$0	$0	$337,289	$66	$1,005,460	$114	$353,192	$28
NET COST	$0	$0	$624,143	$194	$956,390	$211	$0	$0	$258,447	$50	($480,623)	($55)	$247,995	$17

COSTS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICTIONS.

SOUTHWEST RECOMMENDED* 23-Dec-88

	7 YARD WASTE COLLECTION		COLLECTION COSTS FOR HIGH GRADE LOADS ARE INCLUDED IN METHOD 10 6 COMMERCIAL HI GRADE		9 SELF HAULED WASTE		10 REGULAR MSW COLLECTION		SEPARATE COSTS FOR METHODS 11 & 12 —SHOWN HERE FOR CLARIFICATION— ARE INCLUDED IN COSTS FOR METHODS 1 - 10 11 MIXED WASTE PROCESS		12 RDF PREPARATION RECOVERY		SYSTEM TOTAL	
	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON
TOTAL TONS PROCESSED	33,001 tons		724 tons		31,429 tons		215,700 tons		0 tons		0 tons		378,237 tons	
ADMINISTRATION	$409,050	$12					$2,294,532	$11					$3,094,375	$8
EDUCATION/PROMOTION	$87,032	$3					$0	$0					$241,017	$1
COLLECTION	$1,636,202	$50					$9,178,041	$43					$12,186,545	$32
PROCESSING	$1,307,840	$40	$55,180	$76	$0	$0	$0	$0	$0	$0	$0	$0	$3,113,423	$8
TOTAL TONS DISPOSED	0 tons		217 tons		31,429 tons		215,700 tons		0 tons		0 tons		248,348 tons	
TRANSFER & TRANSPORT														
A. MASS BURN W/ ASHFILL			$543	$11	$78,554	$11	$539,124	$11		$0		$0	$618,221	$11
B. LONG HAUL & LANDFILL			$1,146	$24	$165,964	$24	$1,139,022	$24		$0		$0	$1,306,133	$24
C. BALE & LANDFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
D. LOCAL LANDFILL			$1,362	$11	$197,111	$11	$1,352,785	$11		$0		$0	$1,551,258	$11
DISPOSAL														
A. MASS BURN W/ ASHFILL	$0	$0	$2,235	$47	$323,492	$47	$2,220,144	$47	$0	$0	$0	$0	$2,556,175	$47
B. LONG HAUL & LANDFILL	$0	$0	$1,033	$22	$149,575	$22	$1,026,544	$22	$0	$0	$0	$0	$1,181,917	$22
C. BALE & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
D. LOCAL LANDFILL	$0	$0	$4,488	$37	$649,743	$37	$4,459,221	$37	$0	$0	$0	$0	$5,134,148	$37
TOTAL GROSS COST	$3,440,124	$104	$65,987	$91	$1,564,441	$50	$22,209,413	$103	$0	$0	$0	$0	$30,983,212	$82
TONS RECYCLED	33,001 tons		507 tons		0 tons		0 tons		0 tons		0 tons		127,651 tons	
TOTAL REVENUE	$165,005	$5	$27,218	$54	$0	$0	$0	$0	$0	$0	$0	$0	$2,289,119	$18
NET COST	$3,275,119	$99	$38,769	$54	$1,564,441	$50	$22,209,413	$103	$0	$0	$0	$0	$28,694,093	$76

COSTS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICTIONS.

NORTH CENTRAL WGA PREFERRED* 22-Dec-88

MODULE 3:INTEGRATED SYSTEM COSTS AND BENEFITS

	1 SF COLLECT. SOURCE SEP.		2 SF COLLECT. COMINGLE		3 MF COLLECT COMINGLE		4 COMMERCIAL DIRECT RECYCLING		5 COMMERCIAL SOURCE SEP.		6a DROP OFF/ BUY BACK		6b DROP OFF/ SPECIAL WASTES	
	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON
TOTAL TONS PROCESSED	0 tons		0 tons		0 tons		14,833 tons		4,105 tons		3,704 tons		1,669 tons	
ADMINISTRATION	$0	$0	$0	$0	$0	$0	$0	$0	$52,399	$13	$25,927	$7	$0	$0
EDUCATION/PROMOTION	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$29,630	$8	$0	$0
COLLECTION	$0	$0	$0	$0	$0	$0	$0	$0	$209,593	$51	$20,834	$6	$0	$0
PROCESSING	$0	$0	$0	$0	$0	$0	$0	$0	$230,911	$56	$231,487	$63	59,652	$36
TOTAL TONS DISPOSED	0 tons		0 tons		0 tons		0 tons		0 tons		0 tons		0 tons	
TRANSFER & TRANSPORT														
A. MASS BURN W/ ASHFILL														
B. LONG HAUL & LANDFILL														
C. BALE & LANDFILL														
D. LOCAL LANDFILL														
DISPOSAL														
A. MASS BURN W/ ASHFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
B. LONG HAUL & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
C. BALE & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
D. LOCAL LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL GROSS COST	$0	$0	$0	$0	$0	$0	$0	$0	$492,903	$120	$307,878	$83	$59,652	$36
TONS RECYCLED	0 tons		0 tons		0 tons		14,833 tons		4,105 tons		3,704 tons		1,268 tons	
TOTAL REVENUE	$0	$0	$0	$0	$0	$0	$0	$0	$274,156	$67	$568,604	$154	$59,314	$47
NET COST	$0	$0	$0	$0	$0	$0	$0	$0	$218,747	$53	($260,726)	($70)	$338	$0

*COSTS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICTIONS.

NORTH CENTRAL WGA PREFERRED* 23-Dec-88

	7 YARD WASTE COLLECTION		COLLECTION COSTS FOR HIGH GRADE LOADS ARE INCLUDED IN METHOD 10 — 8 COMMERCIAL HI GRADE		9 SELF HAULED WASTE		10 REGULAR MSW COLLECTION		SEPARATE COSTS FOR METHODS 11 & 12 —SHOWN HERE FOR CLARIFICATION— ARE INCLUDED IN COSTS FOR METHODS 1 - 10 — 11 MIXED WASTE PROCESS		12 RDF PREPARATION RECOVERY		SYSTEM TOTAL	
	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON
TOTAL TONS PROCESSED	0 tons		0 tons		107,818 tons		93,420 tons		0 tons		0 tons		225,548 tons	
ADMINISTRATION	$0	$0					$1,013,920	$11					$1,092,246	$5
EDUCATION/PROMOTION	$0	$0					$0	$0					$29,630	$0
COLLECTION	$0	$0					$4,055,636	$43					$4,286,063	$19
PROCESSING	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$522,049	$2
TOTAL TONS DISPOSED	0 tons		0 tons		107,818 tons		93,420 tons		0 tons		0 tons		201,238 tons	
TRANSFER & TRANSPORT														
A. MASS BURN W/ ASHFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
B. LONG HAUL & LANDFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
C. BALE & LANDFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
D. LOCAL LANDFILL			$0	$0	$1,024,267	$10	$887,491	$10		$0		$0	$1,911,758	$10
DISPOSAL														
A. MASS BURN W/ ASHFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
B. LONG HAUL & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
C. BALE & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
D. LOCAL LANDFILL	$0	$0	$0	$0	$4,053,942	$38	$3,512,596	$38	$0	$0	$0	$0	$7,566,538	$38
TOTAL GROSS COST	$0	$0	$0	$0	$5,078,209	$47	$9,469,644	$101	$0	$0	$0	$0	$15,408,285	$68
TONS RECYCLED	0 tons		0 tons		0 tons		0 tons		0 tons		0 tons		23,910 tons	
TOTAL REVENUE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$902,073	$38
NET COST	$0	$0	$0	$0	$5,078,209	$47	$9,469,644	$101	$0	$0	$0	$0	$14,506,211	$64

*COSTS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICTIONS.

NORTH CENTRAL RECOMMENDED* 22-Dec-88

MODULE 3:INTEGRATED SYSTEM COSTS AND BENEFITS

	1 SF COLLECT. SOURCE SEP.		2 SF COLLECT. COMINGLE		3 MF COLLECT COMINGLE		4 COMMERCIAL DIRECT RECYCLING		5 COMMERCIAL SOURCE SEP.		6a DROP OFF/ BUY BACK		6b DROP OFF/ SPECIAL WASTES	
	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON
TOTAL TONS PROCESSED	0 tons		0 tons		0 tons		14,833 tons		4,105 tons		3,704 tons		1,669 tons	
ADMINISTRATION	$0	$0	$0	$0	$0	$0	$0	$0	$52,399	$13	$25,927	$7	$0	$0
EDUCATION/PROMOTION	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$29,630	$8	$0	$0
COLLECTION	$0	$0	$0	$0	$0	$0	$0	$0	$209,593	$51	$20,834	$6	$0	$0
PROCESSING	$0	$0	$0	$0	$0	$0	$0	$0	$230,911	$56	$231,487	$63	59,652	$36
TOTAL TONS DISPOSED	0 tons		0 tons		0 tons		0 tons		0 tons		0 tons		0 tons	
TRANSFER & TRANSPORT														
A. MASS BURN W/ ASHFILL														
B. LONG HAUL & LANDFILL														
C. BALE & LANDFILL														
D. LOCAL LANDFILL														
DISPOSAL														
A. MASS BURN W/ ASHFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
B. LONG HAUL & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
C. BALE & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
D. LOCAL LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL GROSS COST	$0	$0	$0	$0	$0	$0	$0	$0	$492,903	$120	$307,878	$83	$59,652	$36
TONS RECYCLED	0 tons		0 tons		0 tons		14,833 tons		4,105 tons		3,704 tons		1,268 tons	
TOTAL REVENUE	$0	$0	$0	$0	$0	$0	$0	$0	$274,156	$67	$568,604	$154	$59,314	$47
NET COST	$0	$0	$0	$0	$0	$0	$0	$0	$218,747	$53	($260,726)	($70)	$338	$0

*COSTS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICITIONS.

NORTH CENTRAL RECOMMENDED* 22-Dec-88

	7 YARD WASTE COLLECTION		COLLECTION COSTS FOR HIGH GRADE LOADS ARE INCLUDED IN METHOD 10 8 COMMERCIAL HI GRADE		9 SELF HAULED WASTE		10 REGULAR MSW COLLECTION		SEPARATE COSTS FOR METHODS 11 & 12 —SHOWN HERE FOR CLARIFICATION— ARE INCLUDED IN COSTS FOR METHODS 1 - 10 11 MIXED WASTE PROCESS		12 RDF PREPARATION RECOVERY		SYSTEM TOTAL	
	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON
TOTAL TONS PROCESSED	36,892 tons		0 tons		81,026 tons		83,320 tons		0 tons		0 tons		225,548 tons	
ADMINISTRATION	$28,290	$1					$1,013,920	$12					$1,120,536	$5
EDUCATION/PROMOTION	$11,642	$0					$0	$0					$41,272	$0
COLLECTION	$182,547	$5					$4,055,636	$49					$4,468,609	$20
PROCESSING	$1,389,896	$38	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,911,945	$8
TOTAL TONS DISPOSED	0 tons		0 tons		81,026 tons		83,320 tons		0 tons		0 tons		164,346 tons	
TRANSFER & TRANSPORT														
A. MASS BURN W/ ASHFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
B. LONG HAUL & LANDFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
C. BALE & LANDFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
D. LOCAL LANDFILL			$0	$0	$769,750	$10	$791,537	$10		$0		$0	$1,561,287	$10
DISPOSAL														
A. MASS BURN W/ ASHFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
B. LONG HAUL & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
C. BALE & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
D. LOCAL LANDFILL	$0	$0	$0	$0	$3,046,589	$38	$3,132,820	$38	$0	$0	$0	$0	$6,179,409	$38
TOTAL GROSS COST	$1,612,374	$44	$0	$0	$3,816,339	$47	$8,993,914	$108	$0	$0	$0	$0	$15,283,059	$68
TONS RECYCLED	36,892 tons		0 tons		0 tons		0 tons		0 tons		0 tons		60,802 tons	
TOTAL REVENUE	$184,459	$5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,086,532	$18
NET COST	$1,427,916	$39	$0	$0	$3,816,339	$47	$8,993,914	$108	$0	$0	$0	$0	$14,196,527	$63

*COSTS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICITIONS.

SOUTH CENTRAL WGA 'PREFERRED* 23-Dec-88

MODULE 3:INTEGRATED SYSTEM COSTS AND BENEFITS

TOTAL TONS PROCESSED	1 SF COLLECT. SOURCE SEP.		2 SF COLLECT. COMINGLE		3 MF COLLECT COMINGLE		4 COMMERCIAL DIRECT RECYCLING		5 COMMERCIAL SOURCE SEP.		6a DROP OFF/ BUY BACK		6b DROP OFF/ SPECIAL WASTES	
	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON
	0 tons		0 tons		0 tons		24,493 tons		0 tons		11,370 tons		3,080 tons	
ADMINISTRATION/ ENFORCEMENT	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$79,590	$7	$0	$0
EDUCATION/PROMOTION	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$90,960	$8	$0	$0
COLLECTION	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$56,850	$5	$0	$0
PROCESSING	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$710,629	$63	127,650	$41
TOTAL TONS DISPOSED	0 tons		0 tons		0 tons		0 tons		0 tons		0 tons		0 tons	
TRANSFER & TRANSPORT														
A. MASS BURN W/ ASHFILL														
B. LONG HAUL & LANDFILL														
C. BALE & LANDFILL														
D. LOCAL LANDFILL														
DISPOSAL														
A. MASS BURN W/ ASHFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
B. LONG HAUL & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
C. BALE & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
D. LOCAL LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL GROSS COST	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$938,030	$83	$127,650	$41
TONS RECYCLED	0 tons		0 tons		0 tons		24,493 tons		0 tons		11,370 tons		2,086 tons	
TOTAL REVENUE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,158,015	$102	$117,237	$56
NET COST	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	($219,984)	($19)	$10,413	$3

COSTS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICTIONS.

SOUTH CENTRAL WGA PREFERRED# 23-Dec-88

	7 YARD WASTE COLLECTION		COLLECTION COSTS FOR HIGH GRADE LOADS ARE INCLUDED IN METHOD 10 8 COMMERCIAL HI GRADE		9 SELF HAULED WASTE		10 REGULAR MSW COLLECTION		SEPARATE COSTS FOR METHODS 11 & 12 —SHOWN HERE FOR CLARIFICATION— ARE INCLUDED IN COSTS FOR METHODS 1 - 10 11 MIXED WASTE PROCESS		12 RDF PREPARATION RECOVERY		SYSTEM TOTAL	
TOTAL TONS PROCESSED	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON
	0 tons		506 tons		61,928 tons		137,149 tons		0 tons		0 tons		238,525 tons	
ADMINISTRATION/ ENFORCEMENT	$0	$0					$1,341,623	$10					$1,421,214	$6
EDUCATION/PROMOTION	$0	$0					$0	$0					$90,960	$0
COLLECTION	$0	$0					$5,366,434	$39					$5,423,284	$23
PROCESSING	$0	$0	$38,563	$76	$0	$0	$0	$0	$0	$0	$0	$0	$876,842	$4
TOTAL TONS DISPOSED	0 tons		152 tons		61,928 tons		137,149 tons		0 tons		0 tons		199,228 tons	
TRANSFER & TRANSPORT														
A. MASS BURN W/ ASHFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
B. LONG HAUL & LANDFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
C. BALE & LANDFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
D. LOCAL LANDFILL			$1,517	$10	$619,275	$10	$1,371,488	$10		$0		$0	$1,992,281	$10
DISPOSAL														
A. MASS BURN W/ ASHFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
B. LONG HAUL & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
C. BALE & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
D. LOCAL LANDFILL	$0	$0	$5,341	$35	$2,179,850	$35	$4,827,638	$35	$0	$0	$0	$0	$7,012,828	$35
TOTAL GROSS COST	$0	$0	$45,420	$90	$2,799,125	$45	$12,907,183	$94	$0	$0	$0	$0	$16,817,409	$71
TONS RECYCLED	0 tons		354 tons		0 tons		0 tons		0 tons		0 tons		38,304 tons	
TOTAL REVENUE	$0	$0	$19,048	$54	$0	$0	$0	$0	$0	$0	$0	$0	$1,294,299	$34
NET COST	$0	$0	$26,373	$52	$2,799,125	$45	$12,907,183	$94	$0	$0	$0	$0	$15,523,110	$65

COSTS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICTIONS.

SOUTH CENTRAL RECOMMENDED* 23-Dec-88

MODULE 3:INTEGRATED SYSTEM COSTS AND BENEFITS

TOTAL TONS PROCESSED	1 SF COLLECT. SOURCE SEP.		2 SF COLLECT. COMINGLE		3 MF COLLECT COMINGLE		4 COMMERCIAL DIRECT RECYCLING		5 COMMERCIAL SOURCE SEP.		6a DROP OFF/ BUY BACK		6b DROP OFF/ SPECIAL WASTES	
	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON
	0 tons		0 tons		0 tons		24,493 tons		5,731 tons		11,370 tons		3,080 tons	
ADMINISTRATION/ ENFORCEMENT	$0	$0	$0	$0	$0	$0	$0	$0	$77,003	$13	$79,590	$7	$0	$0
EDUCATION/PROMOTION	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$90,960	$8	$0	$0
COLLECTION	$0	$0	$0	$0	$0	$0	$0	$0	$308,007	$54	$56,850	$5	$0	$0
PROCESSING	$0	$0	$0	$0	$0	$0	$0	$0	$219,211	$38	$469,015	$41	127,650	$41
TOTAL TONS DISPOSED	0 tons		0 tons		0 tons		0 tons		0 tons		0 tons		0 tons	
TRANSFER & TRANSPORT														
A. MASS BURN W/ ASHFILL														
B. LONG HAUL & LANDFILL														
C. BALE & LANDFILL														
D. LOCAL LANDFILL														
DISPOSAL														
A. MASS BURN W/ ASHFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
B. LONG HAUL & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
C. BALE & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
D. LOCAL LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL GROSS COST	$0	$0	$0	$0	$0	$0	$0	$0	$604,221	$105	$696,416	$61	$127,650	$41
TONS RECYCLED	0 tons		0 tons		0 tons		24,493 tons		5,731 tons		11,370 tons		2,086 tons	
TOTAL REVENUE	$0	$0	$0	$0	$0	$0	$0	$0	$379,519	$66	$1,158,015	$102	$117,237	$56
NET COST	$0	$0	$0	$0	$0	$0	$0	$0	$224,702	$39	($461,598)	($41)	$10,413	$3

COSTS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICTIONS.

SOUTH CENTRAL RECOMMENDED: 23-Dec-88

	7 YARD WASTE COLLECTION		COLLECTION COSTS FOR HIGH GRADE LOADS ARE INCLUDED IN METHOD 10 — 8 COMMERCIAL HI GRADE		9 SELF HAULED WASTE		10 REGULAR MSW COLLECTION		SEPARATE COSTS FOR METHODS 11 & 12 —SHOWN HERE FOR CLARIFICATION— ARE INCLUDED IN COSTS FOR METHODS 1 - 10 — 11 MIXED WASTE PROCESS		12 RDF PREPARATION RECOVERY		SYSTEM TOTAL	
TOTAL TONS PROCESSED	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON
	27,776 tons		0 tons		46,539 tons		119,536 tons		0 tons		0 tons		238,525 tons	
ADMINISTRATION/ ENFORCEMENT	$184,518	$7					$1,341,623	$11					$1,682,735	$7
EDUCATION/PROMOTION	$47,071	$2					$0	$0					$138,031	$1
COLLECTION	$738,073	$27					$5,366,434	$45					$6,469,365	$27
PROCESSING	$1,062,435	$38	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,878,310	$8
TOTAL TONS DISPOSED	0 tons		0 tons		46,539 tons		119,536 tons		0 tons		0 tons		166,075 tons	
TRANSFER & TRANSPORT														
A. MASS BURN W/ ASHFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
B. LONG HAUL & LANDFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
C. BALE & LANDFILL			$0	$0	$116,348	$10	$298,839	$10		$0		$0	$415,188	$10
D. LOCAL LANDFILL			$0	$0	$349,045	$10	$896,518	$10		$0		$0	$1,245,563	$10
DISPOSAL														
A. MASS BURN W/ ASHFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
B. LONG HAUL & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
C. BALE & LANDFILL	$0	$0	$0	$0	$460,740	$40	$1,183,403	$40	$0	$0	$0	$0	$1,644,143	$40
D. LOCAL LANDFILL	$0	$0	$0	$0	$1,228,639	$35	$3,155,742	$35	$0	$0	$0	$0	$4,384,381	$35
TOTAL GROSS COST	$2,032,097	$73	$0	$0	$2,154,772	$46	$12,242,560	$102	$0	$0	$0	$0	$17,857,716	$75
TONS RECYCLED	27,776 tons		0 tons		0 tons		0 tons		0 tons		0 tons		71,457 tons	
TOTAL REVENUE	$138,880	$5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,793,650	$25
NET COST	$1,893,217	$68	$0	$0	$2,154,772	$46	$12,242,560	$102	$0	$0	$0	$0	$16,064,066	$67

COSTS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICTIONS.

NORTHEAST WSA PREFERRED* 23-Dec-88

MODULE 3:INTEGRATED SYSTEM COSTS AND BENEFITS

	1 SF COLLECT. SOURCE SEP.		2 SF COLLECT. COMINGLE		3 MF COLLECT COMINGLE		4 COMMERCIAL DIRECT RECYCLING		5 COMMERCIAL SOURCE SEP.		6a DROP OFF/ BUY BACK		6b DROP OFF/ SPECIAL WASTES	
TOTAL TONS PROCESSED	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON
	0 tons		0 tons		0 tons		43,971 tons		11,741 tons		20,321 tons		7,945 tons	
ADMINISTRATION	$0	$0	$0	$0	$0	$0		$0	$158,220	$13	$142,244	$7	$0	$0
EDUCATION/PROMOTION	$0	$0	$0	$0	$0	$0		$0	$0	$0	$162,564	$8	$0	$0
COLLECTION	$0	$0	$0	$0	$0	$0		$0	$632,869	$54	$44,451	$2	$0	$0
PROCESSING	$0	$0	$0	$0	$0	$0		$0	$331,688	$28	$553,735	$27	347,416	$44
TOTAL TONS DISPOSED	0 tons		0 tons		0 tons		0 tons		0 tons		0 tons		0 tons	
TRANSFER & TRANSPORT														
A. MASS BURN W/ ASHFILL														
B. LONG HAUL & LANDFILL														
C. BALE & LANDFILL														
D. LOCAL LANDFILL														
DISPOSAL														
A. MASS BURN W/ ASHFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
B. LONG HAUL & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
C. BALE & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
D. LOCAL LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL GROSS COST	$0	$0	$0	$0	$0	$0	$0	$0	$1,122,777	$96	$902,995	$44	$347,416	$44
TONS RECYCLED	0 tons		0 tons		0 tons		43,971 tons		11,741 tons		20,321 tons		4,437 tons	
TOTAL REVENUE	$0	$0	$0	$0	$0	$0	$0	$0	$766,403	$65	$3,452,725	$170	$205,813	$46
NET COST	$0	$0	$0	$0	$0	$0	$0	$0	$356,375	$30	($2,549,730)	($125)	$141,603	$18

*COSTS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICTIONS.

NORTHEAST WSA PREFERRED* 23-Dec-88

MODULE 3:INTEGRATED SYSTEM

COLLECTION COSTS FOR HIGH GRADE LOADS ARE INCLUDED IN METHOD 10

SEPARATE COSTS FOR METHODS 11 & 12 —SHOWN HERE FOR CLARIFICATION— ARE INCLUDED IN COSTS FOR METHODS 1 - 10

	7 YARD WASTE COLLECTION		8 COMMERCIAL HI GRADE		9 SELF HAULED WASTE		10 REGULAR MSW COLLECTION		11 MIXED WASTE PROCESS		12 RDF PREPARATION RECOVERY		SYSTEM TOTAL	
TOTAL TONS PROCESSED	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON
	0 tons		936 tons		112,614 tons		287,849 tons		0 tons		0 tons		485,376 tons	
ADMINISTRATION	$0	$0					$3,456,662	$12					$3,757,126	$8
EDUCATION/PROMOTION	$0	$0					$0	$0					$162,564	$0
COLLECTION	$0	$0					$13,826,493	$48					$14,503,813	$30
PROCESSING	$0	$0	$71,385	$76	$0	$0	$0	$0	$0	$0	$0	$0	$1,304,225	$3
TOTAL TONS DISPOSED	0 tons		281 tons		112,614 tons		287,849 tons		0 tons		0 tons		400,743 tons	
TRANSFER & TRANSPORT														
A. MASS BURN W/ ASHFILL			$1,844	$10	$739,308	$10	$1,889,727	$10		$0		$0	$2,630,879	$10
B. LONG HAUL & LANDFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
C. BALE & LANDFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
D. LOCAL LANDFILL			$1,204	$12	$482,831	$12	$1,234,151	$12		$0		$0	$1,718,187	$12
DISPOSAL														
A. MASS BURN W/ ASHFILL	$0	$0	$8,540	$47	$3,424,242	$47	$8,752,617	$47	$0	$0	$0	$0	$12,185,399	$47
B. LONG HAUL & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
C. BALE & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
D. LOCAL LANDFILL	$0	$0	$2,974	$30	$1,192,297	$30	$3,047,599	$30	$0	$0	$0	$0	$4,242,869	$30
TOTAL GROSS COST	$0	$0	$85,946	$92	$5,838,679	$52	$32,207,248	$112	$0	$0	$0	$0	$40,505,062	$83
TONS RECYCLED	0 tons		655 tons		0 tons		0 tons		0 tons		0 tons		81,125 tons	
TOTAL REVENUE	$0	$0	$27,404	$42	$0	$0	$0	$0	$0	$0	$0	$0	$4,452,344	$55
NET COST	$0	$0	$58,543	$63	$5,838,679	$52	$32,207,248	$112	$0	$0	$0	$0	$36,052,717	$74

*COSTS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICTIONS.

NORTHEAST RECOMMENDED* 23-Dec-88

MODULE 3:INTEGRATED SYSTEM COSTS AND BENEFITS

	1 SF COLLECT. SOURCE SEP.		2 SF COLLECT. COMINGLE		3 MF COLLECT COMINGLE		4 COMMERCIAL DIRECT RECYCLING		5 COMMERCIAL SOURCE SEP.		6a DROP OFF/ BUY BACK		6b DROP OFF/ SPECIAL WASTES	
TOTAL TONS PROCESSED	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON
	0 tons		7,503 tons		0 tons		43,971 tons		11,741 tons		18,149 tons		7,945 tons	
ADMINISTRATION	$0	$0	$199,004	$27	$0	$0		$0	$158,220	$13	$127,043	$7	$0	$0
EDUCATION/PROMOTION	$0	$0	$110,866	$15	$0	$0		$0	$0	$0	$145,192	$8	$0	$0
COLLECTION	$0	$0	$861,983	$115	$0	$0		$0	$632,869	$54	$39,701	$2	$0	$0
PROCESSING	$0	$0	$572,128	$76	$0	$0		$0	$331,688	$28	$494,560	$27	347,416	$44
TOTAL TONS DISPOSED	0 tons		750 tons		0 tons		0 tons		0 tons		0 tons		0 tons	
TRANSFER & TRANSPORT														
A. MASS BURN W/ ASHFILL														
B. LONG HAUL & LANDFILL														
C. BALE & LANDFILL														
D. LOCAL LANDFILL														
DISPOSAL														
A. MASS BURN W/ ASHFILL	$0	$0	$22,815	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
B. LONG HAUL & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
C. BALE & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
D. LOCAL LANDFILL	$0	$0	$7,944	$11	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL GROSS COST	$0	$0	$1,774,741	$237	$0	$0	$0	$0	$1,122,777	$96	$806,496	$44	$347,416	$44
TONS RECYCLED	0 tons		6,753 tons		0 tons		43,971 tons		11,741 tons		18,149 tons		4,437 tons	
TOTAL REVENUE	$0	$0	$422,532	$63	$0	$0	$0	$0	$766,403	$65	$3,201,506	$176	$205,813	$46
NET COST	$0	$0	$1,352,209	$180	$0	$0	$0	$0	$356,375	$30	($2,395,010)	($132)	$141,603	$18

*COSTS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICTIONS.

NORTHEAST RECOMMENDED* 23-Dec-88

	7 YARD WASTE COLLECTION		COLLECTION COSTS FOR HIGH GRADE LOADS ARE INCLUDED IN METHOD 10 — 8 COMMERCIAL HI GRADE		9 SELF HAULED WASTE		10 REGULAR MSW COLLECTION		SEPARATE COSTS FOR METHODS 11 & 12 —SHOWN HERE FOR CLARIFICATION— ARE INCLUDED IN COSTS FOR METHODS 1 - 10 — 11 MIXED WASTE PROCESS		12 RDF PREPARATION RECOVERY		SYSTEM TOTAL	
TOTAL TONS PROCESSED	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON
	54,008 tons		936 tons		84,631 tons		256,492 tons		0 tons		0 tons		485,376 tons	
ADMINISTRATION	$659,297	$12					$3,456,662	$13					$4,600,226	$9
EDUCATION/PROMOTION	$168,188	$3					$0	$0					$424,246	$1
COLLECTION	$2,637,188	$49					$13,826,493	$54					$17,998,234	$37
PROCESSING	$2,205,540	$41	$71,385	$76	$0	$0	$0	$0	$0	$0	$0	$0	$4,022,717	$8
TOTAL TONS DISPOSED	0 tons		281 tons		84,631 tons		256,492 tons		0 tons		0 tons		342,154 tons	
TRANSFER & TRANSPORT														
A. MASS BURN W/ ASHFILL			$1,844	$10	$555,600	$10	$1,683,872	$10		$0		$0	$2,241,316	$10
B. LONG HAUL & LANDFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
C. BALE & LANDFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
D. LOCAL LANDFILL			$1,204	$12	$362,854	$12	$1,099,711	$12		$0		$0	$1,463,769	$12
DISPOSAL														
A. MASS BURN W/ ASHFILL	$0	$0	$8,540	$47	$2,573,362	$47	$7,799,162	$47	$0	$0	$0	$0	$10,403,879	$47
B. LONG HAUL & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
C. BALE & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
D. LOCAL LANDFILL	$0	$0	$2,974	$30	$896,026	$30	$2,715,612	$30	$0	$0	$0	$0	$3,622,556	$30
TOTAL GROSS COST	$5,670,213	$105	$85,946	$92	$4,387,842	$52	$30,581,512	$119	$0	$0	$0	$0	$44,776,943	$92
TONS RECYCLED	54,008 tons		655 tons		0 tons		0 tons		0 tons		0 tons		139,715 tons	
TOTAL REVENUE	$270,039	$5	$27,404	$42	$0	$0	$0	$0	$0	$0	$0	$0	$4,893,695	$35
NET COST	$5,400,174	$100	$58,543	$63	$4,387,842	$52	$30,581,512	$119	$0	$0	$0	$0	$39,883,248	$82

*COSTS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICTIONS.

SOUTHEAST WGA PREFERENCE* 22-Dec-88

MODULE 3:INTEGRATED SYSTEM COSTS AND BENEFITS

	1 SF COLLECT. SOURCE SEP.		2 SF COLLECT. COMINGLE		3 MF COLLECT COMINGLE		4 COMMERCIAL DIRECT RECYCLING		5 COMMERCIAL SOURCE SEP.		6a DROP OFF/ BUY BACK		6b DROP OFF/ SPECIAL WASTES	
	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON
TOTAL TONS PROCESSED	0 tons		0 tons		0 tons		20,645 tons		0 tons		7,084 tons		4,564 tons	
ADMINISTRATION	$0	$0	$0	$0	$0	$0		$0	$0	$0	$49,590	$7	$0	$0
EDUCATION/PROMOTION	$0	$0	$0	$0	$0	$0		$0	$0	$0	$56,674	$8	$0	$0
COLLECTION	$0	$0	$0	$0	$0	$0		$0	$0	$0	$34,536	$5	$0	$0
PROCESSING	$0	$0	$0	$0	$0	$0		$0	$0	$0	$442,767	$63	198,885	$44
TOTAL TONS DISPOSED	0 tons		0 tons		0 tons		0 tons		0 tons		0 tons		0 tons	
TRANSFER & TRANSPORT														
A. MASS BURN W/ ASHFILL														
B. LONG HAUL & LANDFILL														
C. BALE & LANDFILL														
D. LOCAL LANDFILL														
DISPOSAL														
A. MASS BURN W/ ASHFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
B. LONG HAUL & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
C. BALE & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
D. LOCAL LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL GROSS COST	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$583,566	$82	$198,885	$44
TONS RECYCLED	0 tons		0 tons		0 tons		20,645 tons		0 tons		7,084 tons		3,664 tons	
TOTAL REVENUE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,628,862	$230	$138,227	$38
NET COST	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	($1,045,296)	($148)	$60,658	$13

* COSTS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICTIONS.

SOUTHEAST WGA PREFERENCE* 22-Dec-88

MODULE 3:INTEGRATED SYSTEM

	7 YARD WASTE COLLECTION		COLLECTION COSTS FOR HI GRADE LOADS ARE INCLUDED IN METHOD 10 — 8 COMMERCIAL HI GRADE		9 SELF HAULED WASTE		10 REGULAR MSW COLLECTION		SEPARATE COSTS FOR METHODS 11 & 12 —SHOWN HERE FOR CLARIFICATION— ARE INCLUDED IN COSTS FOR METHODS 1 - 10 — 11 MIXED WASTE PROCESS		12 RDF PREPARATION RECOVERY		SYSTEM TOTAL	
	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON
TOTAL TONS PROCESSED	0 tons		741 tons		118,567 tons		177,869 tons		0 tons		0 tons		329,469 tons	
ADMINISTRATION	$0	$0					$1,476,843	$8					$1,526,432	$5
EDUCATION/PROMOTION	$0	$0					$0	$0					$56,674	$0
COLLECTION	$0	$0					$5,907,305	$33					$5,941,841	$18
PROCESSING	$0	$0	$56,482	$76	$0	$0	$0	$0	$0	$0	$0	$0	$698,134	$2
TOTAL TONS DISPOSED	0 tons		222 tons		118,567 tons		177,869 tons		0 tons		0 tons		296,658 tons	
TRANSFER & TRANSPORT														
A. MASS BURN W/ ASHFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
B. LONG HAUL & LANDFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
C. BALE & LANDFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
D. LOCAL LANDFILL			$2,244	$10	$1,197,523	$10	$1,796,474	$10		$0		$0	$2,996,241	$10
DISPOSAL														
A. MASS BURN W/ ASHFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
B. LONG HAUL & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
C. BALE & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
D. LOCAL LANDFILL	$0	$0	$7,911	$36	$4,220,972	$36	$6,332,126	$36	$0	$0	$0	$0	$10,561,009	$36
TOTAL GROSS COST	$0	$0	$66,637	$90	$5,418,495	$46	$15,512,747	$87	$0	$0	$0	$0	$21,780,331	$66
TONS RECYCLED	0 tons		519 tons		0 tons		0 tons		0 tons		0 tons		31,911 tons	
TOTAL REVENUE	$0	$0	$31,348	$60	$0	$0	$0	$0	$0	$0	$0	$0	$1,798,437	$56
NET COST	$0	$0	$35,290	$48	$5,418,495	$46	$15,512,747	$87	$0	$0	$0	$0	$19,981,894	$61

* COSTS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICTIONS.

SOUTHEAST RECOMMENDED* 22-Dec-88

MODULE 3:INTEGRATED SYSTEM COSTS AND BENEFITS

	1 SF COLLECT. SOURCE SEP.		2 SF COLLECT. COMINGLE		3 MF COLLECT COMINGLE		4 COMMERCIAL DIRECT RECYCLING		5 COMMERCIAL SOURCE SEP.		6a DROP OFF/ BUY BACK		6b DROP OFF/ SPECIAL WASTES	
	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON
TOTAL TONS PROCESSED	0 tons		0 tons		0 tons		20,645 tons		5,034 tons		7,084 tons		4,564 tons	
ADMINISTRATION	$0	$0	$0	$0	$0	$0		$0	$65,708	$13	$49,590	$7	$0	$0
EDUCATION/PROMOTION	$0	$0	$0	$0	$0	$0		$0	$0	$0	$56,674	$8	$0	$0
COLLECTION	$0	$0	$0	$0	$0	$0		$0	$262,826	$52	$34,536	$5	$0	$0
PROCESSING	$0	$0	$0	$0	$0	$0		$0	$283,154	$56	$442,767	$63	198,885	$44
TOTAL TONS DISPOSED	0 tons		0 tons		0 tons		0 tons		0 tons		0 tons		0 tons	
TRANSFER & TRANSPORT														
A. MASS BURN W/ ASHFILL														
B. LONG HAUL & LANDFILL														
C. BALE & LANDFILL														
D. LOCAL LANDFILL														
DISPOSAL														
A. MASS BURN W/ ASHFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
B. LONG HAUL & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
C. BALE & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
D. LOCAL LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL GROSS COST	$0	$0	$0	$0	$0	$0	$0	$0	$611,687	$122	$583,566	$82	$198,885	$44
TONS RECYCLED	0 tons		0 tons		0 tons		20,645 tons		5,034 tons		7,084 tons		3,664 tons	
TOTAL REVENUE	$0	$0	$0	$0	$0	$0	$0	$0	$332,718	$66	$1,628,862	$230	$138,227	$38
NET COST	$0	$0	$0	$0	$0	$0	$0	$0	$278,969	$55	($1,045,296)	($148)	$60,658	$13

* COSTS ARE FOR GENERAL COMPARISON ONLY, AND ARE NOT REPRESENTATIVE OF SPECIFIC JURISDICTIONS.

SOUTHEAST RECOMMENDED* 22-Dec-88

MODULE 3:INTEGRATED SYSTEM

	7 YARD WASTE COLLECTION		COLLECTION COSTS FOR HI GRADE LOADS ARE INCLUDED IN METHOD 10 — 8 COMMERCIAL HI GRADE		9 SELF HAULED WASTE		10 REGULAR MSW COLLECTION		SEPARATE COSTS FOR METHODS 11 & 12 —SHOWN HERE FOR CLARIFICATION— ARE INCLUDED IN COSTS FOR METHODS 1 - 10 — 11 MIXED WASTE PROCESS		12 RDF PREPARATION RECOVERY		SYSTEM TOTAL	
	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON	COST	AVG/TON
TOTAL TONS PROCESSED	48,726 tons		628 tons		89,104 tons		153,685 tons		0 tons		0 tons		329,469 tons	
ADMINISTRATION	$81,230	$2					$1,476,843	$10					$1,673,370	$5
EDUCATION/PROMOTION	$20,722	$0					$0	$0					$77,396	$0
COLLECTION	$324,921	$7					$5,907,305	$38					$6,529,587	$20
PROCESSING	$1,869,354	$38	$47,847	$76	$0	$0	$0	$0	$0	$0	$0	$0	$2,842,007	$9
TOTAL TONS DISPOSED	0 tons		188 tons		89,104 tons		153,685 tons		0 tons		0 tons		242,977 tons	
TRANSFER & TRANSPORT														
A. MASS BURN W/ ASHFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
B. LONG HAUL & LANDFILL			$0	$0	$0	$0	$0	$0		$0		$0	$0	$0
C. BALE & LANDFILL			$475	$10	$224,988	$10	$388,054	$10		$0		$0	$613,518	$10
D. LOCAL LANDFILL			$1,426	$10	$674,965	$10	$1,164,163	$10		$0		$0	$1,840,554	$10
DISPOSAL														
A. MASS BURN W/ ASHFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
B. LONG HAUL & LANDFILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
C. BALE & LANDFILL	$0	$0	$1,879	$40	$889,261	$40	$1,533,775	$40	$0	$0	$0	$0	$2,424,915	$40
D. LOCAL LANDFILL	$0	$0	$5,026	$36	$2,379,086	$36	$4,103,386	$36	$0	$0	$0	$0	$6,487,498	$36
TOTAL GROSS COST	$2,296,227	$47	$56,654	$90	$4,168,301	$47	$14,573,526	$95	$0	$0	$0	$0	$22,488,847	$68
TONS RECYCLED	48,726 tons		439 tons		0 tons		0 tons		0 tons		0 tons		85,591 tons	
TOTAL REVENUE	$243,628	$5	$25,841	$59	$0	$0	$0	$0	$0	$0	$0	$0	$2,369,275	$28
NET COST	$2,052,600	$42	$30,813	$49	$4,168,301	$47	$14,573,526	$95	$0	$0	$0	$0	$20,119,572	$61

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