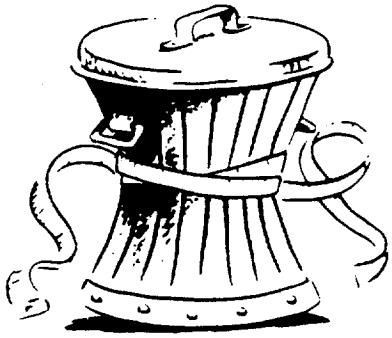
Preliminary Recycling Plan
Fiscal Year 1991

The City of New York
David N. Dinkins, *Mayor*

Department of Sanitation
Steven M. Polan, *Commissioner*

Office of Operations Planning

APPENDICES



Help Reduce
New York's Waste.
Please Recycle.

New York City Recycles

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Glossary of Terms, Materials and Programs

Glossary of Terms

Bulk Waste: Any waste object which is too large to fit into a covered 30 gallon container (e.g., large appliances and furniture).

Capture Rate: Percent of material retrieved from the recyclable portion of the waste stream.

Census Tracts: Population areas designated by the U.S. Census Bureau, averaging about 4,000 in population.

Compacted Density: Density of waste when pressed or packed together either by manual or automated compaction (approximately 800 to 1000 lbs. per cubic yard).

Compaction Ratio: Compacted density divided by loose density.

Diversion Rate: Percent of recyclable materials designated for collection that is actually captured by our collection program.

Loose Density: Density of waste prior to compaction (approximately 200 lbs. per cubic yard).

Participation Rate: Percent compliance (in a given population) with a particular recycling program.

Population Density: In waste composition study, measured as number of persons per acre.

Recovery Rate: Rate (in lbs. per household) of diversion of recyclables from the total waste stream.

Recyclables: Materials which can be removed from the waste stream (prior to incineration or landfilling)and converted for reuse.

Relay: The delivery of materials to a recycling center on a Department vehicle which was fully loaded on a previous shift.

Reuse: The extension of the useful lifespan of products and materials that would otherwise be discarded, without significant reprocessing, e.g., refilling bottles – Improving the durability of products at the point of manufacture, or recycling, which entails extensive processing, are not forms of reuse.

Seasonality: Variation (e.g., in waste composition) due to seasonal effects (such as weather changes).

Stratum: A population according to specified characteristics; for example, the waste composition study divides the New York City population into nine different strata according to the household income and population density of each household's census tract.

Stratified Sampling: The division of a population into strata, and then individually sampling those strata.

Truckshift:	Deployment of a truck on an eight hour route (like man-hours: two trucks completing two routes each equals four truckshifts).
Waste Composition:	Classification of waste according to type (quantified by percentage).
Waste Generation:	Classification of waste according to amount produced (quantified in pounds or tons).
Waste Prevention:	Reduction of waste generation before it has been created, through a decrease in the consumption of materials and products. The strategy is one of waste avoidance, obviating the need for waste management.
Waste Reduction:	Decrease in the quantity and toxicity (by weight and/or volume) of materials and products entering the waste stream for disposal. Includes waste prevention, reuse, and recycling.

Glossary of Materials

BULK:	Large items, i.e.: furniture, appliances, metal, tires, rugs, and wood.
BATTERIES	
Car Batteries:	Electrical cells containing lead, acid and plastic casing.
Dry Cell Batteries:	Electrical cells containing powdered acid which are used to power consumer products, e.g., flashlights, toys and cameras.
MEDICAL WASTE:	Hospital Waste, i.e.: needles, syringes, IV bags, soiled bandages, disposable sheets, surgical gloves, blood samples, etc..
ORGANIC	
Lumber:	Non-bulk wood items.
Rubber:	Non-bulk rubber items.
Textiles:	Fabric materials, i.e.: clothing, small pieces of rugs, carpets, upholstery, cushioning, etc..
Yard Waste:	Biodegradable waste resulting from construction, groundskeeping and landscaping operations: i.e.: grass, leaves, brush, prunings, stumps, etc..
PAPER	
Book/Phone Book:	Inked paper bound with glue.
Corrugated:	Unbleached, unwaxed kraft paper with ruffled inner liner used in shipments.
Magazine:	Heavily treated or coated inked paper, i.e., glossies and inserts.
Mixed Paper:	Low grade paper: a mixture of various types and qualities of paper not limited to a type of packing or fiber content, i.e.: paper milk and juice containers, junk mail, envelopes, greeting cards, paper bags, etc..
Newspaper:	Low grade inked paper used for newsprint.

Non-Corrugated: Linerboard or paperboard such as cereal boxes, or lining for clothing.

Office/Computer: High grade paper free of chemical treatments, coatings, or heavily printed stock, i.e.: white ledger, bond, writing paper, xerographic paper and computer printout sulphite.

PLASTICS

Film: Plastic bags, i.e.: garbage bags, grocery bags, and plastic wrap.

HDPE: High density polyethylene: flexible and translucent, e.g.: milk and water containers, detergent bottles, and base cups of soft drink containers.

LDPE: Low density polyethylene: moisture proof and inert, flexible (non-cracking) plastic containers, e.g., some resin types of margarine and cheese tubs, coated papers.

Misc.: All other plastic items, e.g., toys, etc..

PET: Polyethylene terepthalate: tough and shatterproof, e.g., soft drink bottles.

PP: Polyproplene: stiff, heat and chemical resistant durable items, i.e.: fibers, diaper liners, syrup bottles, car battery casings, and office furniture.

PS: Polystyrene: brittle, clear, good thermal properties (styrofoam), e.g.: fast food packaging, hotcups, and meat trays; also used in crackable rigid and semi-rigid containers such as cottage cheese and yogurt containers, utensils, cassette tapes, etc..

PVC: Polyvinyl chloride: clear, brittle unless modified with plasticizers; durable construction products, e.g., pipes and siding, cooking oil bottles, shampoo and household cleaning containers.

Rigid: The sum of: HDPE, PET, PVC, PP, LDPE, PS and returnables.

RETURNABLES: Plastic, aluminum and glass beverage containers, i.e., containers subsumed under the Bottle Bill.

Glossary of Programs

Buyback Centers: Facilities that pay individuals for a variety of recyclables including tin, glass, newspaper, mixed paper, corrugated cardboard, wood, and many kinds of plastic.

Christmas Tree Program: Clean, decoration-free trees are set at the curb. Specially designated trucks collect and deliver them to City facilities for chipping. The wood chips are distributed to City residents, nonprofit institutions, and community gardens to be used as ground cover and mulch.

City Agencies/ Institutions Recycling Programs: A program for large public and nonprofit institutions – such as prisons, hospitals, schools, universities, shelters, soup kitchen, and mass transit facilities – that receive or are eligible for Department collection of waste.

Compost Program: Leaf and yard waste is collected separately and composted. The end product may be sold as mulch or used as top cover at the landfill.

Containerized Recycling Program: A program for the collection of recyclables in Department-provided large metal "dumpsters" in buildings generally larger than 200 units.

Curbside Collection: The most common collecton method, for both the residential and institutional sectors. Rinsed metal, glass and plastic containers are placed in blue recycling containers. Newspaper, magazines, and corrugated cardboard are tied into bundles no more than 18" high. The bundled paper is set beside the recycling container at the curb the night before the scheduled recycling collection day. One truck picks up the paper products; a second truck picks up the containers.

Designated Materials

City Agencies/ Institutions: Newspaper, magazines, catalogues, corrugated cardboard; glass, metal and plastic containers; aluminum foil and foil products; high-grade office paper; bulk materials.

Commercial Sector: Office paper, newspaper, magazines, corrugated cardboard; metal, glass and plastic containers; bulk materials and construction and demolition debris.

Residential Sector: Newspaper, magazines, catalogues, corrugated cardboard; glass, metal, and plastic containers; aluminum foil and foil products; leaf and yard waste; Christmas trees; bulk materials.

Intermediate Processing Center: A facility where commingled recyclable materials are separated into various product types (e.g., clear glass and aluminum cans), cleaned and prepared to meet market specifications. Also known as Material Recovery Facilities (MRFs) and Processing Centers.

Leaf and Yard Waste Program: See Compost Program.

Office Paper Program: All City agencies, organizations, and institutions are required to separate for recycling their high-grade office paper (typing paper, letterhead, copy paper, reports, computer paper, computer tab cards, colored paper, and manila file folders).

Redemption Centers: Facilities where redeemable bottles and cans can be returned for the $0.05 deposit.

Residential Bulk Program: Wood and metal are salvaged from bulk items such as old furniture and appliances. Residents call their Sanitation District office to arrange a specially scheduled collection.

Self Help Bulk Program: Six sites are available for residents who either have more bulk material than Sanitation will collect or who do not want to wait for collection.

Transfer Station: A facility that receives garbage, extracts and processes the recyclables, compacts the remaining garbage and arranges for its disposal.

APPENDIX II

Waste Composition Analysis

Purpose of the Study

The fundamental variables influencing waste management strategies include: generation rates, composition, and physical and chemical characteristics of the waste components. The waste composition study tested these variables against critical parameters including income and population density in the residential sector, services and clientele in the institutional sector, products and markets in the commercial/industrial sector, and, in all cases, variability of waste over the course of the week, season, and year, as well as location of generators.

The results of the waste composition study fulfill informational needs for policy decisions in certain important aspects of waste management including:

- Who the generators are, the quantity and composition of the waste generated, and where and when it is generated in the City, Boroughs, Districts and Sections;
- The quantity and composition of recyclable materials in the waste stream;
- Determination of the most efficient disposal alternatives for the major components and individual materials contained in the waste stream, depending in part on their physical and chemical characteristics.

In addition, the results of the waste composition study are intended to be used in the design and implementation of educational, outreach, and enforcement programs to maximize participation in recycling programs, and to bring about waste reduction through changes in buying habits.

Methodology of the Study

Historical data analysis and literature review were used to identify major waste generators. The study was organized, accordingly, in three sectors: residential, grouped into nine demographic strata; institutional, consisting of eleven categories; and commercial, consisting of ten industries (see Exhibit AII.1). The heterogeneity within each of these sectors required stratified (rather than random) sampling of the specific populations. The sampling procedure was first designed and the waste was then sorted. A period of data analysis followed and projections were made.

Stratification of the residential sector was based on median household income and population density as they are the driving forces behind discard habits. This information was tabulated from the 1980 Census. A total of 180 loads yielding 1302 samples were sorted.

In addition, a special subsort of 20 categories was conducted on waste generated at pre-selected sites, all currently on recycling programs in high density areas but characterized by three different income classifications -- high, medium and low. Twenty-four waste loads yielding 117 samples were sorted to identify: opportunities for waste reduction, the diversion/capture rate for individual materials presently

EXHIBIT AII.1
Parameters and Number of Samples for Individual Sectors of the Waste Composition Study
Residential Sector

Strata Inc/Den	Census Tract #	Income $/HH	Density Pers./Acre	Loads	# Samples
Low/Low	363	8424	32	16	124
Low/Low	974	9428	43		
Low/Med	69	9383	62	16	117
Low/Med	1120	11473	64		
Low High	48	9977	123	24	150
Low High	233	11078	176		
Med/Low	208	13250	42	16	129
Med/Low	141	13446	43		
Med/Med	70	13904	68	36	260
Med/Med	151	16078	87		
Med/Med	263	15819	89		
Med/Med	782	13642	94		
Med/High	181	13277	163	20	132
Med/High	281	15958	171		
High/Low	347	17000	29	16	135
High/Low	524	18949	32		
High/Med	249	16427	89	16	116
High/Med	518	17109	98		
High/High	289	16678	109	20	139
High/High	281	16927	117		
Total				180	1302

INSTITUTIONAL SECTOR

Category	# Parameters	Loads	Samples
Schools	Students		
Elementary	Students	31	170
Junior High	Students	9	73
Senior High	Students	6	83
Private Elementary	Students	8	72
Private High School	Students	8	48
Subtotal		62	446
Colleges	Students	12	86
Hospitals	Beds		
Non-Profit	Beds	5	49
Teaching	Beds	9	102
Municipal	Beds	12	77
Psychiatric	Beds	12	70
Subtotal	Beds	38	298
Nursing Homes	Residents	20	108
Correction Facility	Residents	15	85
Municipal Building	Square Feet	31	139
Transporation Hubs	Commuters	20	116
TOTAL		198	1278

COMMERCIAL/INDUSTRIAL SECTOR

Segment	% SIC #	# Empl	% Waste	# Route
Offices	60-67,73,81,86,89	35	13	2
Eating-Drinking	5812	4	11	2
Food Retail	54	2	14	1
General Retail	52,53,56,57,59	5	16	1
Apparel & Textile	22,23	4	3	1
Paper/Printing/Publishing	26,27	3	2	1
Wholesale Trade	50,51	7	5	1
Hotels/Motels	70	1	2	1

recycled, and the concentration in the waste stream of additional materials under consideration for recycling.

The categories of the institutional sector were chosen on the basis of their size and the quantity of waste generated. These eleven sectors account for approximately 85 percent of total institutional waste. The design of the sampling procedure also took into consideration the types of institutions entitled to free disposal. A total of 198 loads yielding 1278 samples were sorted.

The segments of the commercial sector were chosen on the basis of two criteria; their representativeness of the industry and their expected stability in the future. The chosen industries comprise 80 percent of total commercial tonnage. The loads and samples were sorted from ten private carter routes.

The materials sampled from the waste stream (see Appendix I) were grouped into 46 categories (see Exhibits AII.2 and AII.3) selected according to the following criteria: concentration of at least five percent of the waste; potential for reduction or inclusion in additional recycling programs; characteristics posing potential threats to public health; and suitability for alternative methods of management, e.g. composting.

Explanation of the Seasonality Factor

Throughout the waste composition study, much of the analysis tries to characterize and explain variation in waste generation and composition during the course of the year. An important aspect of this variation is seasonality. For example, in most municipalities yard waste increases in the fall due to leaf waste, and decreases in winter.

Seasonality is calculated relative to the yearly average. For example, let us assume the figures for Staten Island yard waste (in tons per day) are 2.0, 3.2, 2.9, and 3.9 for winter, spring, summer, and autumn, respectively, and the yearly average is 3.0. If we then divide each season's figure by the average, we obtain ratios which measure seasonality. In this example, the four ratios are 0.67, 1.067, 0.967, and 1.3. Thus, yard waste in this hypothetical example is 23 percent below average in winter, 6.7 percent above average in spring, 3.3 percent below average in summer, and 30 percent above average in autumn. Seasonality is usually characterized in terms of percent above or below the average. The following seasonality analyses should be read with these points in mind.

Residential Sector

According to our data, the quantity of waste generated by all groups varies moderately over the course of the seasons (see Exhibit AII.4), peaking in summer and bottoming out in the fall and winter. In general, seasonality is most pronounced in the Low/Medium, Medium/Low, and High/Low income/density strata. Exhibits number AII.5 through AII.8 show how seasonality affects to varying degrees all materials; it is negligible for some materials and pronounced for mixed paper, metal, glass, miscellaneous plastics, organic material, and bulk waste.

Even for the same materials, seasonality often varies across strata: in the Low/Low stratum it is highest for bulk; in the Medium/Medium and High/High, seasonality is highest for miscellaneous paper and plastics.

EXHIBIT AII.2

RESIDENTIAL WASTE GENERATION AND COMPOSITION BY BOROUGHS AND CITY AVERAGE

	BROOKLYN	BRONX	MANHATTAN	QUEENS	STATEN ISLAND	CITY AVERAGE
PAPER	29.4	28.8	33.8	32.4	29.6	30.8
CORRUGATED CARDBOARD	4.4	4.7	5.0	4.5	3.9	4.6
NEWSPAPER	8.2	8.0	10.3	9.5	8.2	8.8
OFFICE PAPER	0.7	0.6	0.7	0.9	0.7	0.7
MAGAZINES	2.5	2.4	3.0	3.0	2.8	2.7
BOOKS	0.7	0.7	0.8	0.9	0.9	0.8
NONCORRUGATED CARDBOARD	2.4	2.4	2.7	2.2	1.8	2.4
MIXED PAPER	10.4	10.0	11.3	11.5	11.2	10.8
PLASTICS	8.2	8.7	9.8	8.1	6.8	8.5
CLEAR HDPE	0.6	0.6	0.6	0.5	0.3	0.5
COLORED HDPE	0.6	0.6	0.6	0.6	0.6	0.6
LDPE	0.1	0.1	0.1	0.1	0.1	0.1
FILM	4.3	4.7	5.5	4.3	3.6	4.6
GREEN PET	0.2	0.1	0.1	0.1	0.1	0.1
CLEAR PET	0.4	0.4	0.5	0.4	0.3	0.4
PVC	0.1	0.2	0.2	0.1	0.1	0.1
POLYSTYRENE	0.6	0.6	0.6	0.7	0.6	0.6
POLYPROPYLENE	0.1	0.1	0.2	0.1	0.1	0.1
MISCELLANEOUS	1.2	1.2	1.3	1.1	1.0	1.2
ORGANICS	36.1	37.0	38.0	37.6	39.0	37.3
GRASS	2.9	2.0	1.9	6.1	9.3	3.9
BRUSH	0.7	0.4	0.3	0.8	1.1	0.6
LUMBER	2.0	2.2	2.1	2.1	2.2	2.1
TEXTILES	4.5	5.1	5.5	3.9	3.4	4.6
RUBBER	0.2	0.2	0.2	0.3	0.4	0.2
FINES	2.3	2.4	2.2	2.2	2.0	2.3
DIAPERS	3.3	3.6	3.7	3.1	3.1	3.4
FOOD WASTE	12.7	13.1	13.6	11.6	10.5	12.5
MISCELLANEOUS	7.6	7.9	8.5	7.4	7.0	7.7
GLASS	5.1	5.4	5.5	4.4	3.8	5.0
CLEAR GLASS	3.0	3.1	3.1	2.7	2.5	2.9
GREEN GLASS	1.0	1.1	1.1	0.8	0.7	1.0
BROWN GLASS	0.9	1.0	0.9	0.7	0.7	0.9
MISCELLANEOUS	0.2	0.3	0.3	0.2	0.0	0.2
ALUMINUM	0.9	0.9	1.0	0.9	0.8	0.9
BEVERAGE CONTAINERS	0.5	0.5	0.5	0.5	0.4	0.5
NON BEVERAGE CONTAINERS	0.3	0.3	0.3	0.3	0.3	0.3
MISCELLANEOUS	0.1	0.1	0.1	0.1	0.1	0.1
METAL	3.8	4.0	4.2	4.0	4.0	4.0
METAL CONTAINERS	1.9	2.1	2.3	1.7	1.4	1.9
OTHER METALS	1.9	1.9	1.9	2.3	2.6	2.1
INORGANICS	2.4	2.4	2.4	2.0	1.0	2.2
CERAMICS	0.2	0.2	0.2	0.1	0.2	0.2
MISCELLANEOUS	2.3	2.2	2.3	1.8	0.8	2.0
HAZARDOUS	0.3	0.4	0.4	0.3	0.3	0.4
BULK	13.4	12.1	4.2	10.7	15.4	10.9
TOTAL	99.8	99.7	99.3	100.4	100.7	100.0
% of waste recyclable	41.1	40.3	36.1	39.6	41.2	39.7
% of NYC Residential waste	31.0	15.0	19.0	29.0	8.0	100.0
% of NYC Residential recyclables	30.0	14.0	18.0	32.0	6.0	100.0
GENERATION RATE (lbs/wk/hh)	47.0	45.0	34.0	52.0	63.0	45.0

(*) NYC Recyclables include: newspaper, magazines, corrugated cardboard, rigid containers, ferrous metal, aluminum, glass, bulk.

EXHIBIT AII.3
INSTITUTIONAL WASTE GENERATION AND COMPOSITION
BY BOROUGHS AND CITY AVERAGE

	BROOKLYN	BRONX	MANHATTAN	QUEENS	STATEN ISLAND	CITYWIDE AVERAGE **
PAPER	44.4	44.2	49.0	45.1	46.1	45.5
CORRUGATED CARDBOARD	11.3	12.1	12.5	11.6	11.3	11.7
NEWSPAPER	4.2	3.2	5.9	3.9	3.6	4.3
OFFICE PAPER	4.2	4.3	6.3	4.7	5.8	4.8
MAGAZINES	1.0	1.0	1.3	1.0	1.2	1.1
BOOKS	0.9	0.9	1.0	1.0	1.1	1.0
NONCORRUGATED CARDBOARD	4.5	4.5	4.1	4.5	4.4	4.4
MIXED PAPER	18.4	18.1	17.9	18.4	18.7	18.3
PLASTICS	10.1	10.7	11.0	10.4	10.2	10.4
CLEAR HDPE	0.2	0.2	0.2	0.2	0.2	0.2
COLORED HDPE	0.2	0.2	0.3	0.2	0.2	0.2
LDPE	0.1	0.1	0.1	0.1	0.1	0.1
FILM	4.6	4.7	4.8	4.7	4.6	4.7
GREEN PET	0.1	0.1	0.1	0.1	0.1	0.1
CLEAR PET	0.2	0.2	0.2	0.2	0.2	0.2
PVC	0.0	0.1	0.1	0.1	0.0	0.1
POLYSTYRENE	3.3	3.6	3.6	3.4	3.4	3.4
POLYPROPYLENE	0.1	0.1	0.1	0.1	0.1	0.1
MISCELLANEOUS	1.9	2.2	2.5	2.1	2.1	2.1
ORGANICS	32.1	32.3	28.6	31.7	31.3	31.4
GRASS	2.9	2.9	2.0	2.8	2.8	2.7
BRUSH	0.3	0.3	0.2	0.3	0.3	0.3
LUMBER	1.1	1.0	0.9	1.0	1.0	1.0
TEXTILES	2.1	2.2	2.5	2.1	2.0	2.2
RUBBER	0.2	0.2	0.3	0.2	0.2	0.2
FINES	1.4	1.3	1.3	1.3	1.3	1.3
DIAPERS	2.4	2.4	3.0	2.5	2.8	2.6
FOOD WASTE	16.7	16.8	13.9	16.4	16.1	16.1
MISCELLANEOUS	5.1	5.1	4.6	5.0	4.9	5.0
GLASS	2.1	2.1	2.7	2.1	2.1	2.2
CLEAR GLASS	1.4	1.4	1.8	1.4	1.4	1.5
GREEN GLASS	0.3	0.3	0.3	0.3	0.3	0.3
BROWN GLASS	0.2	0.2	0.2	0.2	0.2	0.2
MISCELLANEOUS	0.2	0.2	0.4	0.2	0.2	0.3
ALUMINUM	0.9	0.9	1.0	0.9	0.9	0.9
BEVERAGE CONTAINERS	0.3	0.3	0.4	0.3	0.3	0.3
NON BEVERAGE CONTAIERS	0.5	0.5	0.5	0.5	0.5	0.5
MISCELLANEOUS	0.1	0.1	0.1	0.1	0.1	0.1
METAL	3.7	3.5	3.4	3.5	3.4	3.5
METAL CONTAINERS	2.3	2.3	2.1	2.3	2.2	2.2
OTHER METALS	1.4	1.2	1.3	1.3	1.2	1.3
INORGANICS	4.4	3.9	2.5	3.9	3.8	3.8
CERAMICS	0.1	0.1	0.1	0.1	0.1	0.1
MISCELLANEOUS	4.3	3.8	2.4	3.8	3.7	3.7
HAZARDOUS	0.3	0.3	0.5	0.3	0.3	0.3
BULK	2.1	2.0	1.3	1.9	1.9	1.9
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0
% of waste recycable (*)	32.8	32.8	38.1	33.4	33.6	34.0
% of NYC Institutional waste	36.7	15.2	18.0	21.5	8.5	100.0
% of NYC Institutional recyclables	35.5	14.7	20.2	21.2	8.5	100.0
GENERATION RATE (tpd)	304.4	189.2	165.8	265.4	91.3	1016.0

(*) NYC Recyclables include: newspaper, magazines, corrugated cardboard, office paper, rigid containers, ferrous metal, aluminum, glass, bulk.
(**) Weighted average

Seasonality is present in both waste composition and generation (Exhibits AII.9 through AII.12), although the patterns are different for the individual institutions and materials.

Among these, mixed paper is the most seasonal, followed by corrugated cardboard, metal, glass and plastics. Turning to seasonality in composition, this is lowest in municipal buildings, probably because the flow of activities is not likely to undergo drastic changes over the course of the year. The patterns of seasonality are roughly comparable in schools and hospitals, with some major exceptions (aside from mixed paper): plastics are more seasonal in hospitals, while bulk, is more seasonal in schools, probably as a consequence of renovation work which is usually done during the summer.

Literature Review of Waste Composition in the Commercial/Industrial Sector

Before the results of the waste composition study became available, the Department of Sanitation estimated commercial/ industrial waste composition in the city from available data on waste generation in specific segments of the national industries, adjusted for the relative size of those industries in New York City.

The results of the waste composition study verify that the major materials are generally within the range of the estimates based on the survey (Exhibit AII.13), plastic and metal being the exceptions. However, the concentration of paper materials turned out to be generally higher than expected. In Exhibit AII.13, DOS data are citywide averages for the individual materials, while the minimum, maximum and median columns represent, respectively, the lowest, highest and most frequent values found in the literature survey. Therefore, the recyclables' total is not the arithmetic sum of the individual components for the last three columns.

EXHIBIT AII.4
SEASONALITY IN THE RESIDENTIAL SECTOR
Institutional Sector

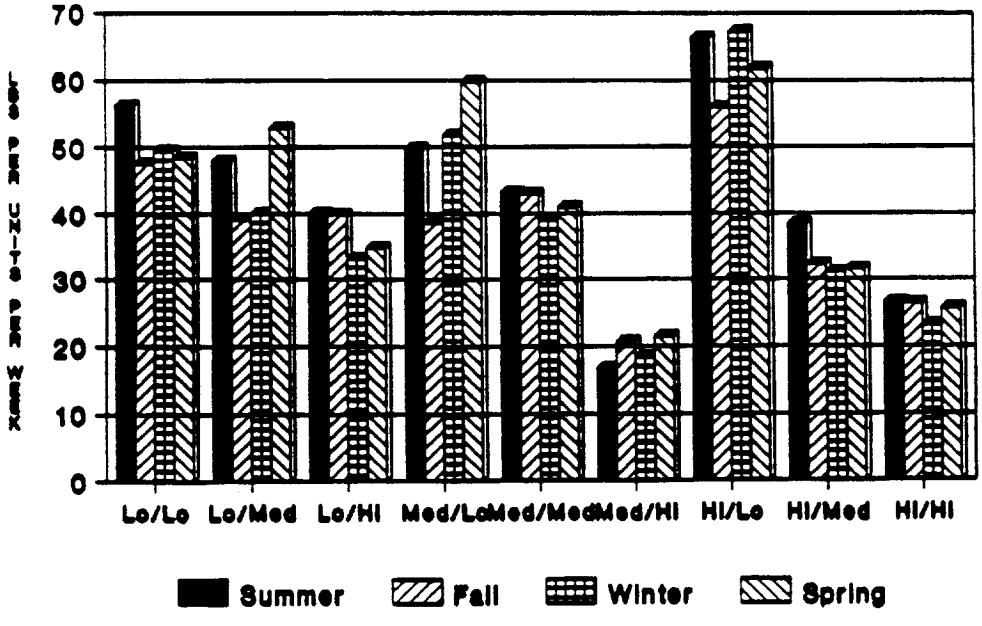


EXHIBIT AII.5
Summer Waste Composition
for the Residential Sector

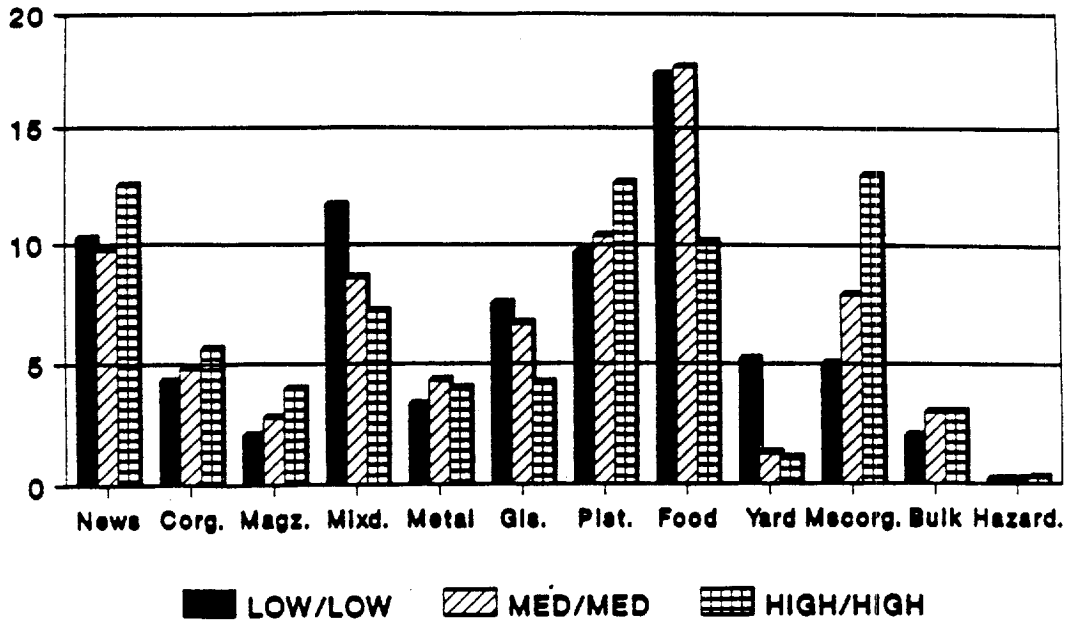
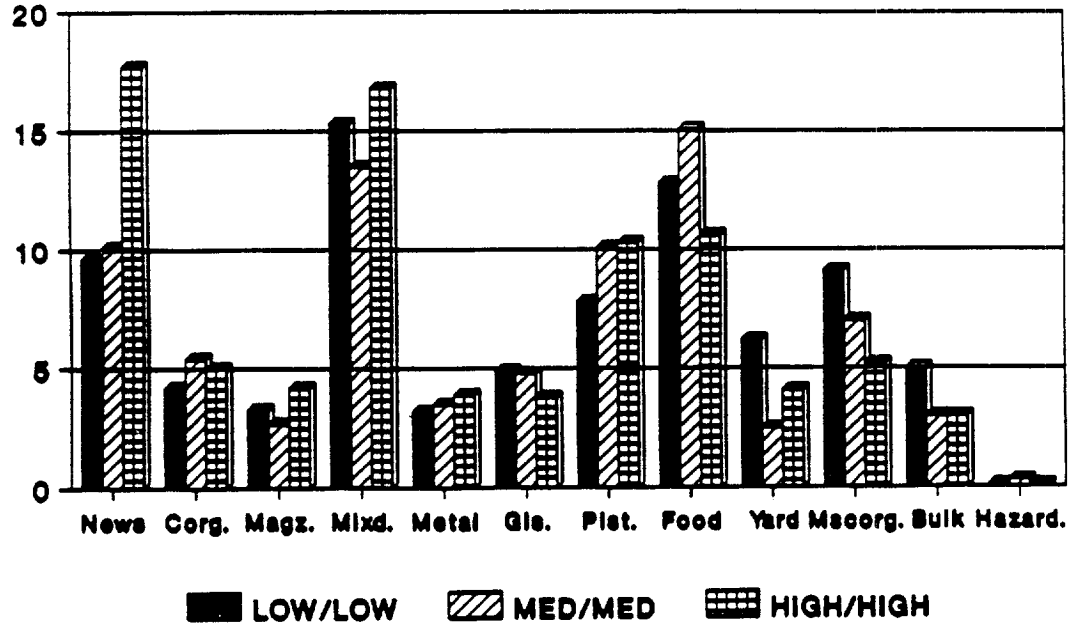


EXHIBIT AII.6
Fall Waste Composition
for the Residential Sector



News= Newspaper, Corg.= Corrugated Paper, Mixd.= Mixed Paper
Gls.= Glass, Plst.= Plastic, Miscorg.= Miscellaneous Organic

EXHIBIT AII.7
Winter Waste Composition
for the Residential Sector

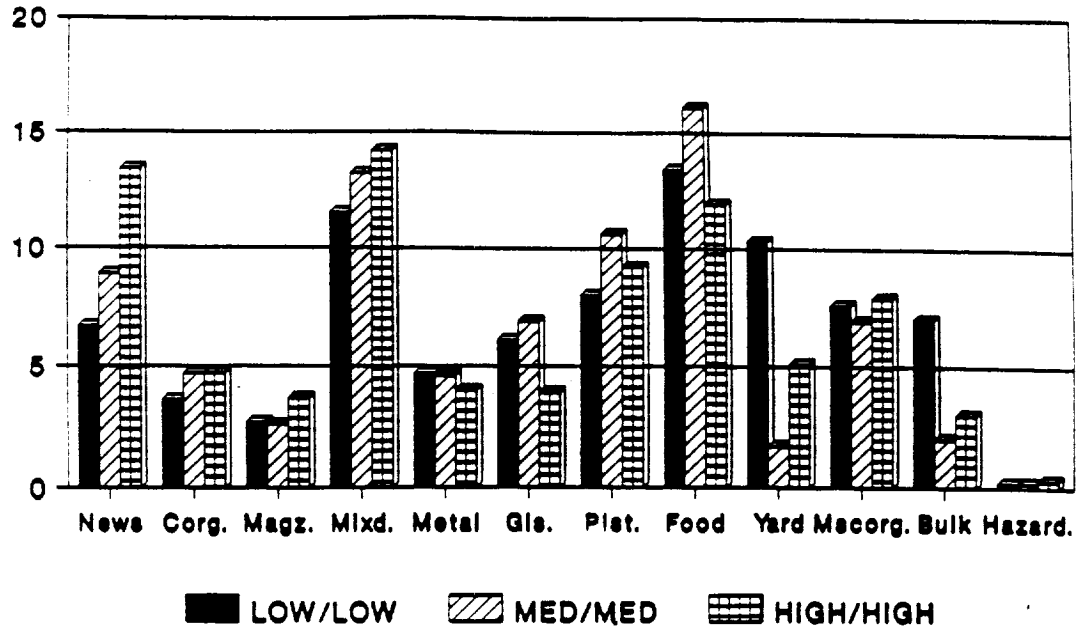
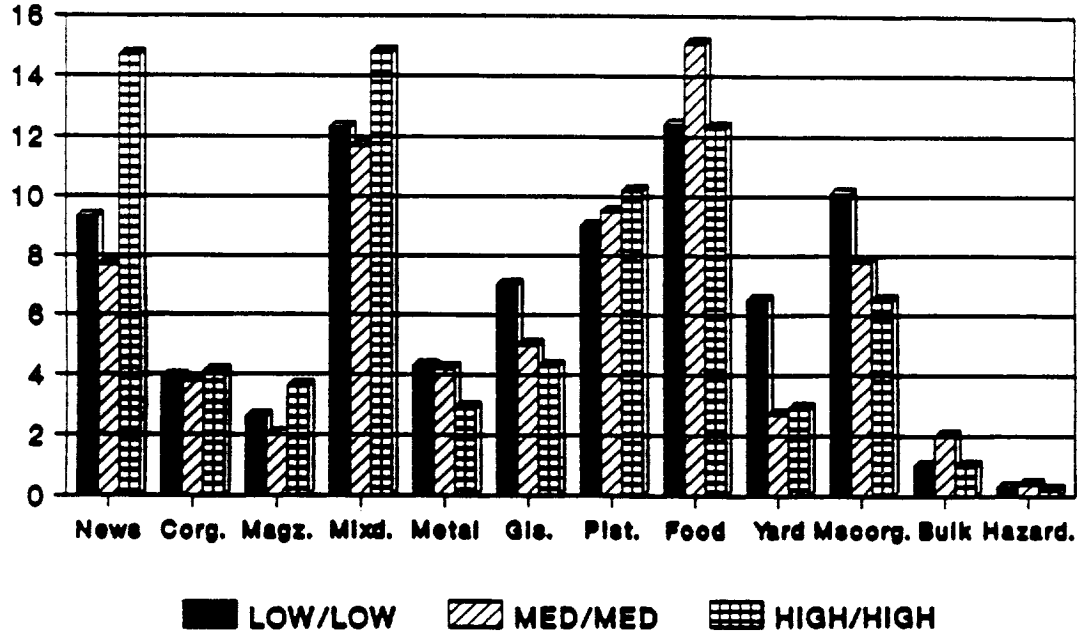


EXHIBIT AII.8
Spring Waste Composition
for the Residential Sector



News= Newspaper, Corg.= Corrugated Paper, Mixd.= Mixed Paper
Gls.= Glass, Plst.= Plastic, Mscorg.= Miscellaneous Organic

EXHIBIT AII.9
Summer Waste Composition
for the Institutional Sector

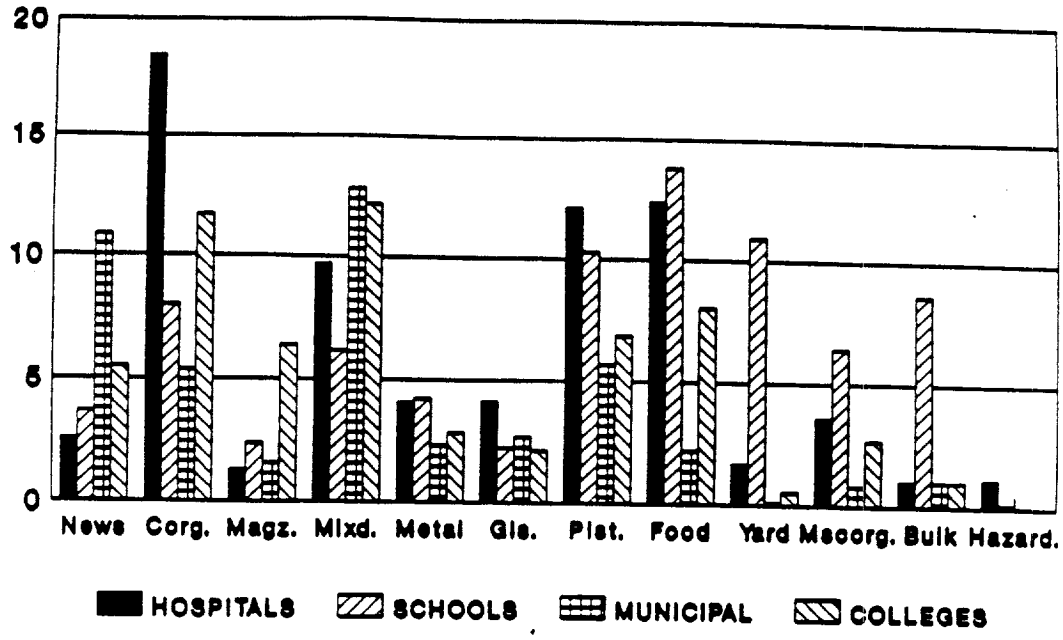
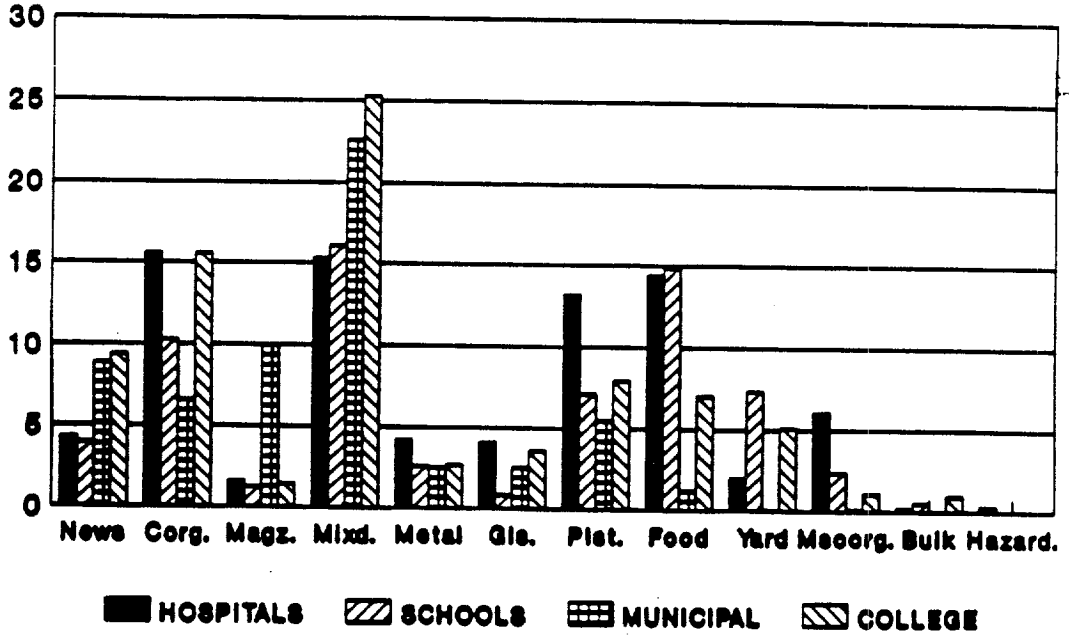


EXHIBIT AII.10
Fall Waste Composition
for the Insitutional Sector



News Newspaper, Corg.= Corrugated Paper, Mixd.= Mixed Paper
Gls.= Glass, Plst.= Plastic, Miscorg.= Miscellaneous Organic

EXHIBIT AII.11
Winter Waste Composition
for the Institutional Sector

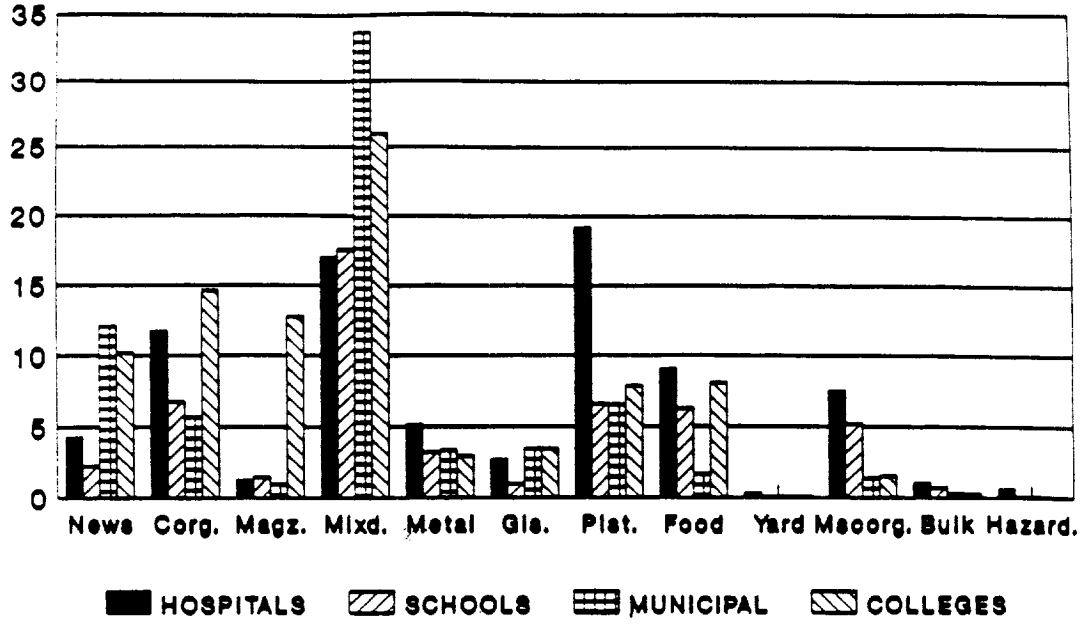
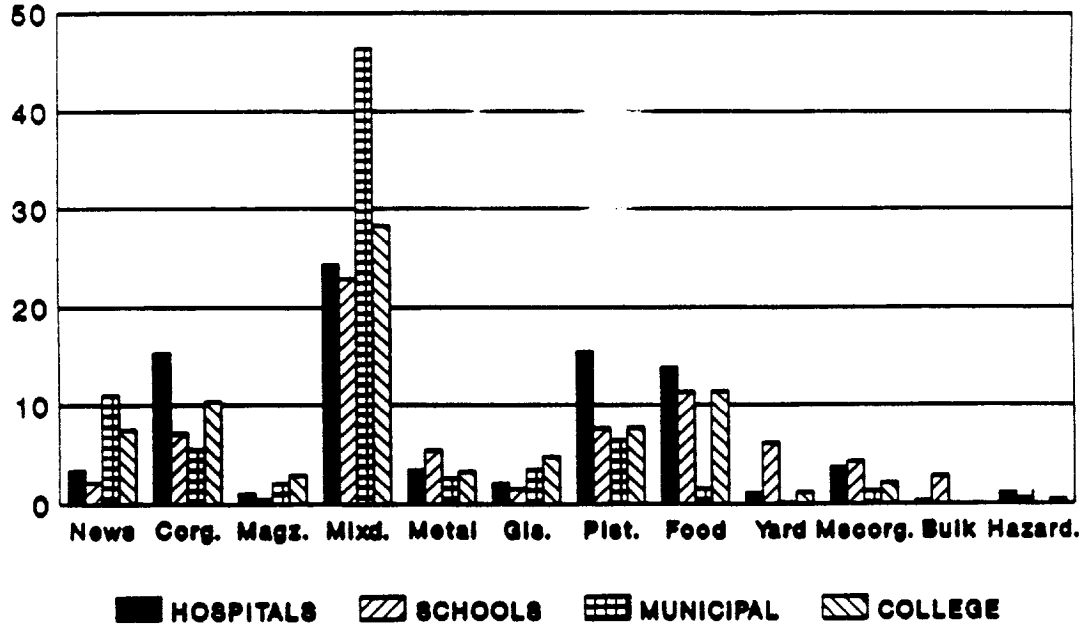


EXHIBIT AII.12
Spring Waste Composition
for the Institutional Sector



News- Newspaper, Corg.- Corrugated Paper, Mixd.- Mixed Paper
Gls.- Glass, Plst.- Plastic, Mscorg.- Miscellaneous Organic

EXHIBIT AII.13
Alternative Estimates Of The Recyclable Pool In The Commercial Sector

	IN-HOUSE LITERATURE SURVEY			
SURVEY	DOS	MIN	MAX	MEDIAN
PAPER				
NEWSPAPER	5.8	0.2	6.4	3.2
CORRUGATED CARDBOARD	13.9	7.0	32.7	15.1
OFFICE PAPER	9.0	1.6	23.0	7.3
PLASTICS	1.9	6.2	18.5	9.8
METALS	2.5	1.6	10.0	5.6
GLASS	2.5	0.6	4.0	2.0
OTHER MATERIALS	17.8	1.8	38.7	20.1
% WASTE RECYCLABLE	53.4	39.0	77.0	50.0

Caution is needed in the interpretation of these results, however, for in all cases, the waste sorting was carried out in different municipalities, seasons and years. In the waste composition study, commercial/industrial waste was sampled only in the summer season; therefore, seasonal data are not available. Seasonality may be captured, in part, by estimates based on the survey.

Other Analyses

Compaction Ratio

Costs of waste disposal are typically related to the waste's weight or volume, the latter defined by its density, i.e., pounds per cubic yard. Density varies significantly by material.

The compactibility of waste (i.e., the ratio of compacted to loose density) has implications in all aspects of waste management, for it determines the equipment and manpower requirements of waste collections and, even more importantly, the pace at which landfill space will become exhausted. This is a topic of great urgency as landfill space becomes increasingly scarce and its true costs -- not captured by direct budgetary costs -- increase accordingly. To save on landfill space, priority in recycling and waste reduction plans should be directed to low compactibility materials such as paper and wood.

Applying national data on loose and compacted density of materials to their respective concentration in the waste stream of the five boroughs yielded estimates of waste compaction ratios. Detailed results are presented in Exhibit AII.14

EXHIBIT AII.14
The Compaction Ratio Analysis

	BKYN.	BRONX	MAHTTN	QUEENS	STATEN ISLAND
Non-recyclables & bulk	3.0	2.9	2.8	3.0	3.0
All waste except bulk	3.0	2.9	2.9	3.0	3.0
Recyclables only	1.5	1.5	1.5	1.5	1.5
All waste assuming recyclables' diversion rates of: 30 %	3.3	3.2	3.1	3.3	3.3
50 %	3.5	3.4	3.3	3.5	3.5
75 %	3.8	3.8	3.7	3.8	3.8

The patterns are remarkably similar. Increasing the recyclables' capture rates to 75 percent raises the aggregated compaction ratio of the remaining waste by 28 percent. Compactibility was found to be lower for recyclables than for the aggregated waste. This is due to the different composition of the recyclables, and especially to the low compactibility of newspapers.

This finding has significant implications for the Department's

calculations as to which collection route extensions are appropriate given the diversion of recyclables.

Toxic Metals

According to public perception, hazardous waste is a well defined, visible category. In fact, hazardous substances may be present as contaminants of common categories of waste such as food and paper, and the damage they cause to the environment is real.

Applying parts per million (PPM) of eight metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver) to their respective concentration in the waste stream, the Department calculated the presence of toxic metals in the City's waste (see Exhibit AII.15).

EXHIBIT AII.15
The Chemical Analysis Study

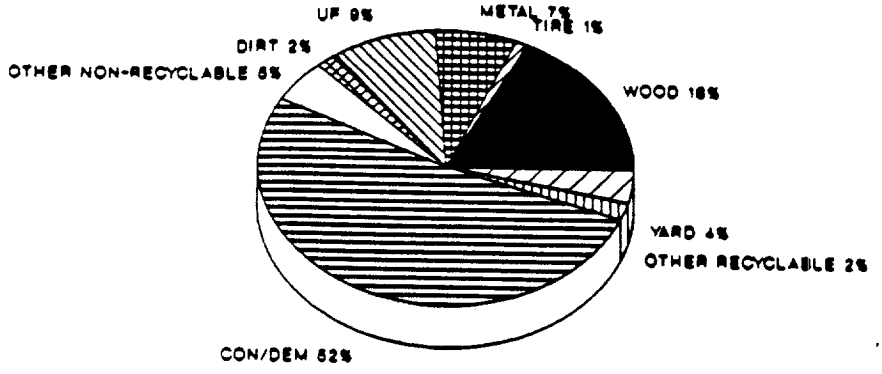
	As	Ba	Cd	Cr	Pb	Hg	Se	Ag	Total
Total waste-no recyclables	7	54	4	22	424	0.6	4	0.8	516
Recyclables only	3	12	1	9	248	0.2	2	0.3	275
All waste assuming recyclables' diversion rates of: 30%	7	58	4	23	400	0.6	4	0.8	497
50%	7	61	4	23	380	0.6	4	0.8	497
75%	7	66	5	23	348	0.7	3	0.8	453

Increasing capture rates of recyclables to 75 percent would cut the overall concentration of toxic metals in the remaining waste stream by 12 percent, largely due to reductions in the quantity of lead.

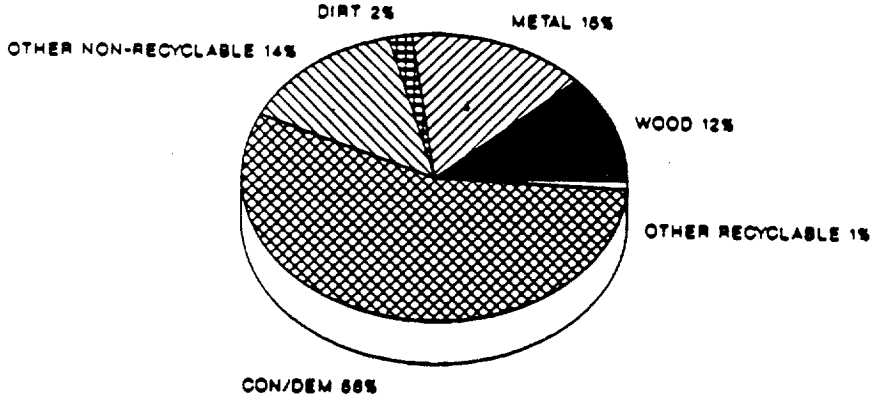
Bulk Composition, Historical Trends and Seasonality

Residential (curbside) bulk differs significantly in composition from self help and lot cleaning bulk because of marked differences in their generators (Exhibit AII.16). Metal is the major component of residential/curbside bulk, and second to construction/demolition waste which dominates in the other programs. Wood is the third largest material in all cases. Exhibit AII.17 presents data for (non recycled) curbside bulk collections from July 1983 through February 1990. The variation over that period exhibits a strong seasonal pattern, with high generation in summer (31 percent above average in June), and low generation in winter (23 percent below average in February). The numbers increased sharply in 1987 and 1988, with levels 15 percent above the 1983-1990 trend. Scales were not always operational during the period in question, and the "standard weights" (not scale weights) which are used in such cases tend to overestimate true weights by about 16 percent. The decline from the trend in 1989 was due to the introduction of bulk recycling in the twelve side-loader districts.

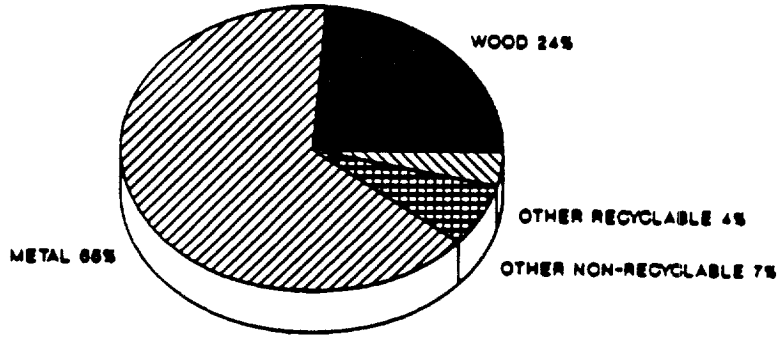
EXHIBIT AII.16
BULK WASTE COMPOSITION



SELF HELP



LOT CLEANING



RESIDENTIAL/CURBSIDE

Derelict Vehicles Operations

The Department instituted a program in 1968 to remove derelict vehicles from City's streets and highways. In the early years, the operations were carried out with existing manpower and equipment. The accelerating growth in the numbers of such vehicles became too heavy a strain on existing resources, and in the late 1980s the Department turned to private salvage firms. The Department still removes abandoned trailers, buses, and trucks.

Exhibit AII.18 depicts the trend in the number of abandoned vehicles -- rising dramatically through the 1980s from 33,112 to 140,428. Vehicle theft trends are included in the Exhibit. The striking similarity of the two trends since the mid-1980s supports the conclusion that many, if not most, derelict cars are, in fact, stolen. This raises issues about the Department's ability to forecast this important category of bulk waste.

Seasonality is present, but is not exceedingly significant, with collections slightly below average in winter (-3 percent in November) and slightly above average in spring and summer (+3 percent in March). Further study into the reasons for the large

increase (which is certainly not explained by thefts alone) may be warranted in order to improve future forecasts; continuation of the same trend seems unlikely.

Free Disposal

Waste brought to Sanitation for free disposal comes from other city agencies, Housing Authority, state and federal agencies, tax exempt properties, and certain private residences. This portion of the waste stream amounts to over 1600 tons per day. In this survey we focus only on the four major waste generators, Department of Transportation, Department of Environmental Protection, Transit Authority, and Parks and Recreation.

In Exhibit AII.19, information is presented on generation of waste and of recyclables only for the four agencies. The table details the breakdown of waste generated by office employees, field employees, and users of the service. We are assuming that 20 percent of employees are office employees and the remainder are field workers. By focusing on office, field, and user waste we can capture potential diversion rates of paper (office), corrugated and bulk (field operations), and other materials (recyclables generated by the user population vary by sector). Ninety percent of all waste from office buildings is recyclable. Bulk and corrugated paper were estimated to account for 25 percent of the recyclables. Forty-one percent of the waste from these departments is recyclable.

The Transit Authority generates 28 percent of all free-disposal waste, and 31 percent of the recyclables. Field waste

estimates are based on 9 lbs. per day per employee found in the transportation equipment industry. Commuters (approximately 3 million per day) are estimated to generate .05 lbs. per day.

The Parks and Recreation Department generates 25 percent of the total waste, but 49 percent of the recyclable material within this free-disposal category. The recyclable pool includes yard waste and wood.

The Department of Environmental Protection generates 34 percent of the waste, yet only 10 percent of the recyclables.

EXHIBIT AII.17
Bulk Collection Trends 1983-90

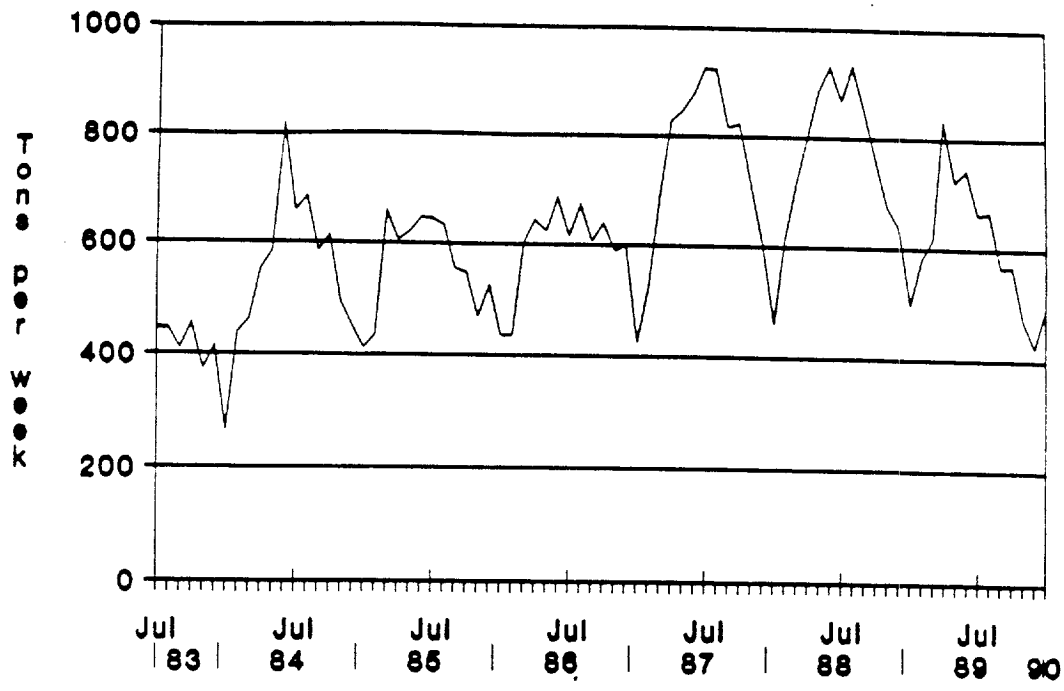


EXHIBIT AII.18
NYC Stolen and Abandoned Vehicles
1980-1990

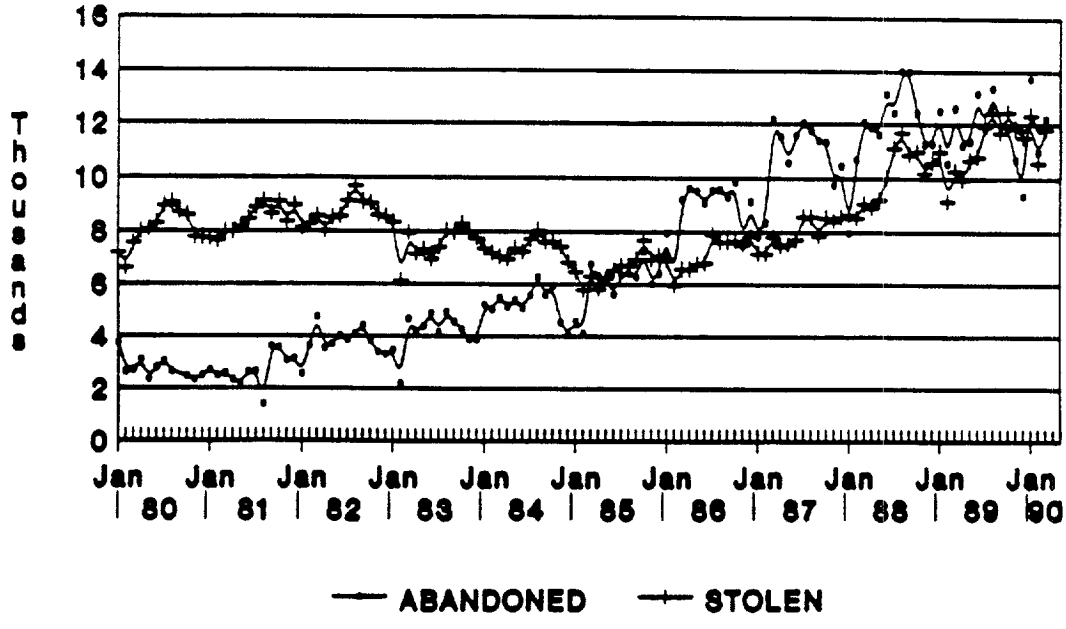


EXHIBIT AII.19
Free Disposal/Waste and Recyclables Generators
(000's)

AGENCY	ACTUAL DISPOS	EMPLOYEES			WASTE TONS				% TOTAL WASTE	RECYCLABLES					% TOTAL RECYCL
		TOTAL	OFFICE	FIELD	OFFICE	FIELD	USER	TOTAL		OFFICE	FIELD	USER	TOTAL	% RECYCL	
TA.....	78	50.00	10.00	40.00	2.00	52.00	27.00	81	0.28	1.80	13	22	37	0.46	0.31
PARKS	65	5.00	1.00	4.00	0.20	25.00	40.00	65	0.22	0.18	25	33	58	0.89	0.49
DEP	98	5.00	1.00	4.00	0.20	10.00	87.00	98	0.34	0.18	3	9	11	0.12	0.10
DOT	45	8.00	1.60	6.40	0.30	8.00	36.00	45	0.16	0.27	2	9	11	0.25	0.10
OTHER ..	8	NA	NA	NA	NA	NA	NA	8	0.02	NA	NA	NA	4	0.50	0.03
TOTAL ..	**294**							**289**	**1.00**				**118**	**0.41**	**1.00**
TPD	**1**							**1**					**0.40**		

EXHIBIT AII.20
Growth Forecasts of Recyclable Materials in New York City and Nation, 1990-95

MATERIAL	CYCLE	SENSITIVITY TO GROWTH IN: Bus. Popul	Econ	Tech	1990 CONCENTRATION (%) DOS (NYC)	Franklin (US)	Radian (US)	ANNUALIZED GROWTH RATES (*) 1990-1995 DOS/NYC (RANGE)	Franklin (US)	Radian (US)	U.S. Com Dept.	1995 CONCENTRATION (% of all waste) DOS (NYC)	Franklin (US)	Radian (US)
ALL PAPER	YES	YES	YES	YES	03.80	37.6	38.30	0-1	0.90	0.70	1.10	30.8-33.3	39.40	39.80
NEWSPAPER	YES	YES	YES	NO	8.80	6.7	NA	0-1	-0.80	NA	0.20	8.8-9.6	7.0	NA
MAGAZINES** ..	YES	YES	YES	YES	2.70	3.4**	NA	0-4	2.80	NA	2.00	2.7-3.3	3.90	NA
CORRUGATED ..	YES	YES	YES	NO	4.60	9.0	NA	-2.0-0	1.50	NA	2.30	4.1-4.6	9.70	NA
PLASTIC	NO	YES	YES	YES	8.50	4.3	8.30	0-2	2.20	1.70	2.00	8.1-10.1	4.80	9.00
ALL METALS	YES	YES	YES	YES	4.50	2.7	9.40	-1.9-0	-1.5	-0.40	3.70	4.1-4.5	2.50	9.20
ALL GLASS	YES	YES	YES	NO	5.0	8.0	8.80	-2.2-0	-1.5	-1.30	NA	4.2-4.7	7.40	8.20

* Growth rates are annual, based on projected changes in concentration.
For the Radian Study, growth rates are based on 1990 - 2000 projections.
For the Franklin Study, growth rates are based on 1990 and 1995 figures.
For Commerce Department, rates based on sales growth in 1988 at constant (1987) dollars.

** Magazines and Books

The Department of Transportation generates 16 percent of the waste, but only 10 percent of the recyclable materials (excluding asphalt). It is estimated that paper -- primarily, newspaper and office paper -- accounts for 82 percent of the recyclables.

Trends in Waste Generation and Composition

General Considerations

Changes in consumption are reflected eventually in changes in waste composition. In this context, recyclable materials command special attention. Accurate forecasts on the availability of recyclables are unattainable. A range can be predicted, however, based on past sales trends of packaging materials and on the major forces driving future sales. These are summarized in Exhibit AII.20. Population shifts occur over the longer term, and they set in motion changes in consumption patterns reflected, in turn, in the waste stream. State projections for the City show contrasting trends: while the number of households is expected to grow from 3 million in 1990 to 3.1 million in 1995, population will decline over the same period from 7.029 to 7.019 million, implying that household size will also decline. Staten Island, a high income/low density borough, will have the largest increase, with households and population increasing by 2.2 percent and 3.1 percent per year, respectively, followed by Queens (0.2 and 0.8 percent per year), Brooklyn and the Bronx (each registering a 0.7 percent per year increase in the number of households and a 0.2 percent per year decline in population) and last, by Manhattan, which will lose population (-0.3 percent per year) and gain marginally (0.2 percent per year) in the number of households. Based on these projections, City waste will increase in proportion to the increase in the number of households. Staten Island and Queens will further increase their lead as generators.

As mentioned, consumption shifts represent the other fundamental variable underlying changes in waste composition over time. In the long term, they follow population shifts; in the short term, they respond to changes in incomes and prices. Among currently targetted recyclables only household plastics are unaffected by the business cycle and economic growth. Newspaper concentration is related to competition from magazines and other media, and the absolute amount of advertising which reflects, in turn, both economic activity and the changing nature of retailing activities. While the underlying forces may be comparable for most waste materials, growth projections are specific, reflecting individual trends and anticipated changes on the supply and demand side.

The Department projects growth rates of recyclable materials within ranges based on alternative assumptions: no growth implies, simply, continuation of the status quo -- no change in population or consumption, and, as a consequence, no change in waste generation or composition. The alternatives are population growth, which will bring about an increase in discards even without changes in consumption per capita, and changes in population, in consumption, and in economic trends.

The Department's projected growth rates for discards are generally consistent with their recent sales performance as reported by the U.S. Commerce Department, and also with projections reported in other studies of the U.S. waste stream as a whole. However, the methodologies of such studies are different; for instance, Franklin Associates adopted loosely the materials' flow approach, following materials from production to discards.

Turning to the individual materials, we observe the following:

- Paper: Continued growth is expected, due the fact that we use this material in almost all the activities we pursue, and that potential competition from plastics, metal, and glass will be largely limited to packaging.
- Newspapers: The market is saturated and under heavy competition from television and magazines. This will limit the growth rate of newspaper discards.
- Magazines: Readership is growing, while increasing numbers of trade and special interest magazines are reaching the market. The Department anticipates that magazines will be the growth sector of paper discards; however, they will remain a relatively minor component of the paper category through the mid 1990's, even with the high growth rate.
- Corrugated Cardboard: Uses of corrugated paper are, to some extent, cyclical since the material is used to package bulk purchases. But cardboard is also used by people when they move; therefore, its discards also reflect population growth. The Department projects a slight decline.
- Plastics: As a broad category, this is the fastest growing material because of its convenience and versatility, although environmental concerns may set limits on future growth. Like paper, plastics are used in most of our daily activities. Plastic packaging of food has virtually displaced glass; plastic shopping bags have virtually displaced paper bags.
- Metals: This group includes metal bulk and food containers. The first is cyclical, as people discard furniture and appliances only when they are able to purchase new items. The second is stable, as food spending tends to remain stable over time -- however, metal containers are losing out to plastics. As a consequence, the Department expects a further decline in this recyclable material.
- Glass: Glass discards are expected to decline because consumers have turned away from this material; it is heavy, breakable, and not compatible with the changing preference for "heat and eat" microwaveable containers. In addition, the declining popularity of alcoholic drinks in the general population will further reduce the concentration of this material.

In sum, the Department does not expect a dramatic shift in the composition of recyclables during the next five years; however, trends presently in motion will increase the amount of paper and plastics. Metals and glass will decline in importance.

Limitations of the Study and Recommendations for Further Analysis

Existing waste management studies suffer from a paucity of data and from the poor quality of the data which exist. For example, there is generally no correlation with the characteristics of waste generators. As a consequence, the literature offers few insights into the waste generation process and ways to reduce waste. Even definitions are ambiguous -- it is not always clear whether "per capita" waste generation data refers to residential waste only, or to the entire municipal waste stream; and whether "solid waste" includes liquid waste. There is also little agreement on whether individuals or households should be the proper unit for the measurement of waste generation. Such clarification is important for planning and forecasting, for there is evidence that economies of scale in waste generation follow from economies of scale in household consumption. A minimum amount of waste is produced by all households, regardless of their size. In addition, there are categories (for instance, newspapers or yard waste) whose quantity is unrelated to household size. As a consequence, small households produce relatively more waste than the larger ones, even if all other characteristics are the same. This implies that forecasts based on trends of waste per household yield different results from those based upon waste per person.

To a large extent, these ambiguities are due to the fact that waste management became a subject of intensive quantitative analysis only in recent years. Many issues are still being formulated; as a consequence, recycling and waste reduction goals are based on a very imperfect knowledge of the drivers of waste and, indeed, of waste itself. These considerations suggest that comparisons of the data generated by New York City's waste composition study with data from studies conducted in other cities is difficult, even ignoring the "uniqueness" of New York City.

New York City's waste composition study offers the basis for identifying and quantifying consumption/waste relationships in the City as avenues for waste management and planning. The population profiles are up-to-date for the institutional and commercial segments. For the residential segment, 1980 Census data are used; these numbers should be updated when 1990 Census data become available.

At a fundamental level, the accuracy of the results depends upon the population models underlying the study, on the dynamics of such populations, and on the concentration of the specific materials in the waste stream. The potential for bias exists in both areas. In the residential sector, waste generation and composition were derived by extrapolating the study's results to the entire City -- with its extremes of rich and poor. In terms of the waste composition itself, materials accounting for less then one percent of the total (for instance, hazardous waste) created problems. Because they can be analyzed only at the citywide level, and then on a yearly basis, it is difficult to disentangle random from systematic variations over the course of the year.

The analysis of the study has not been completed, and as result the data should be utilized with caution. The additional analysis which is required to make this data more reliable can be summarized as follows:

Residential Sector

- Measuring errors in the samples, resulting from inaccurate weights and inconsistency in sorting, both of which added to the statistical errors and weakened the reliability of the data;
- Updating the demographic data when the 1990 Census becomes available;
- Identifying all the population characteristics affecting discard behavior;
- Estimating relevant demographic trends based on such characteristics.

Institutional Sector

- Identifying the relevant activities and markets for the sectors sampled, and relating the waste data to such activities and to their dynamics;
- Undertaking a special study of the major free disposal waste generators, including how their waste differs from the rest of the office waste.

Commercial Sector

- Identifying economic forces: markets, production processes, the impact of new technologies, and the business cycle, which eventually affect generation and composition of discards;
- Evaluating the impact of seasonality on waste generation and composition.

Other Subjects for Study:

- Measuring the compaction ratios of waste materials to determine truckshift needs;
- Determining the potential for waste reduction, largely on the basis of the amount of packaging found in the waste stream;
- Evaluating the implications of proposed modifications to the Bottle Bill for the composition and growth of the City's recycling pool, and for the fulfillment of the mandates of Local Law 19;
- Forecasting the number of abandoned vehicles for the recycling potential of their component materials (metal, plastics, glass, rubber, and textiles);
- Undertaking a comprehensive analysis of bulk waste generated by the institutional and commercial sectors to ensure that its recycling potential is realized.
- Quantifying waste deposited by pedestrians in litter baskets in order to include this category in a comprehensive waste management strategy.

Long-Term Issues

Tastes, lifestyles and populations themselves change over time; waste generation and composition will change with them. In addition, the integrated waste management strategy currently being promoted (in order of importance, reduction, recycling, waste to energy, and landfilling) may lead to changes in the discard patterns of all population

groups, and these will have to be monitored. Clearly, more sophisticated waste composition studies will have to be undertaken at regular intervals if these studies are to become an integral part of the formulation of our waste management strategy.

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APPENDIX III

Market Development

This appendix contains 1) summaries of contract types utilized by the Department and 2) individual market analyses for recyclables. It concludes with references to the sources consulted for each market area. Unless otherwise noted, all projections for estimated supply of materials are based on the Department's tonnage projection analysis, detailed in Appendix VI.

MARKETING METHODS

The Department currently utilizes four types of contracts to market recyclable materials, and different materials are handled in different ways. These contracts are alike, however, in that they require the vendor to be responsible for the sale of recyclables to end markets. (No direct marketing is done by the Department at this time.) This approach capitalizes on private processor experience in the secondary materials markets and their ability to respond more quickly and with greater flexibility to changing market prices and opportunities for new markets.

Fixed-Price Contracts

Using competitively bid public contracts, vendors for the Curbside and Containerized Apartment House, Institutional and

Bulk programs have been selected to accept recyclable materials for a bid price on a per-ton basis. The Department's responsibility is to deliver the material. The vendor must remove any contaminants, prepare the material for market, and find buyers. Changes in market conditions resulting in higher or lower revenues for the vendor do not impact on the contract with the Department.

Adjustable Price Contracts

This year the Department developed and began using adjustable price contracts for the paper (newspaper, magazines, and corrugated cardboard) recyclables collected in the Curbside and Containerized programs. Contracts are bid publicly and again the successful vendors have full responsibility for finding end markets. However, the bid price is adjusted every two months to reflect changes in the market price for a specific grade of waste paper. These changes are monitored by the Bureau of Labor Statistics of the U.S. Department of Commerce and published on a monthly basis as the Producer Price Index.

Percentage-based Contracts

This type of contract is used only for the City Agency program. It differs in two ways from the previous types of agreement. First, bidders do not specify a price in dollars in their bid. Rather, they indicate a percentage of the gross revenues from the paper received from the Department and then, depending on market prices, remit to the Department payments reflecting the value of paper sold. Second, the vendor must collect from all City Agency buildings at the direction of the Department. No City collection personnel or vehicles are involved. In common with the other types of

contracts described, the vendor assumes all risks and gains from the sale of material. Once the material is removed from the agency location, the vendor must market the paper.

Processing Center Operating Contract

For metal, glass, and plastic collected by the Curbside and Containerized programs, the processing and marketing of materials is performed by a service contract with a vendor to operate the City-owned East Harlem Intermediate Processing Center (IPC). This agreement limits the Department's responsibility to delivery of material, but the City is the sole customer of the IPC. The contract also provides for certain agreed "pass through" costs such as fixed costs and equipment repair or replacement. There is also a form of profit-sharing for revenues derived from the materials processed. The operation of the IPC is detailed in Chapter X. For marketing purposes, the IPC operator has responsibilities similar to the vendors under all the other contracts. The vendor is required to sell the materials received from the City as business conditions permit.

HIGH GRADE OFFICE PAPER

Markets for high grade papers are tied to the availability and price of wood pulp and preconsumer waste paper (print shop surpluses, obsolete inventories at paperboard converter plants, trimmings from envelope manufacturers, etc.) and historically have seen price ranges in the hundreds of dollars per ton.

Supply

In the U.S., approximately 200,000 tons of various grades of high quality waste paper were collected through office paper recycling programs (Sorenson). The Department collected 3,000 tons of high grade office paper in FY 89, and this increased to 4,000 tons in FY 90. Department projections indicate that at full implementation the program could generate 8,000 tons per year. In FY 89 the office paper program generated revenues of $300,000 or approximately $70.00 per ton. The market for high grades has deteriorated in the first two quarters of 1990, with as much as 25 percent price declines seen in some grades.

These declines are tied to increased availability of wood pulp and preconsumer paper (also referred to as "pulp substitutes"). These paper fiber sources are always preferred to postconsumer papers since they are not printed and therefore do not require processing through de-inking equipment at the manufacturer. The outlook for the second half of 1990 is for further declines.

Demand

According to the American Paper Institute (API), the major trade organization for the paper industry, demand for postconsumer high grade paper is expected to increase from 3.5 percent per year to 4.0 percent in the 1990s (Franklin, 1). This is due to consumer and manufacturer pressure to produce more paper and paper board products with recycled content, and the fact that available tonnages are relatively limited. API and other industry experts predict that office paper recycling programs will expand significantly, but not rapidly enough nor will they generate the quantities demanded. As a result, over the medium term (2-5 years), the prices paid to waste paper generators and collectors are likely to increase.

High grade office papers are a valuable source of good quality fiber. While pulp and pulp substitutes will continue to play a role in the determination of price levels, markets for the City's material are secure and will continue to generate revenue. In fact, some industry analysts see a shortage of supply once the potential sources of postconsumer paper reach high levels of recovery. This would lead to increased pressure on prices to move upward.

NEWSPAPER

Postconsumer newspaper, or ONP (for "old newspaper," as it is known in the waste paper industry), is the largest single material in the residential waste stream, with New York City's ONP ranging from eight to ten percent of the waste stream, according to the City's waste composition study.

ONP has been targeted by many municipalities for recycling due to its quantity in the waste stream, its easy identification and storage, as well as the public's previous voluntary recycling of this material.

Historically, ONP has been collected by nonprofit or charity organizations through paper drives or drop-off locations and by preconsumer sources of newsprint (returns from newsstands, printing overruns, unprinted surplus). The remainder of this section looks at the changes in supply patterns brought about by substantial mandatory residential recycling programs and the short and longer term demand for ONP.

Supply

In FY 90 the Department collected approximately 55,000 tons of ONP, which entered a waste paper market flooded with newsprint from numerous recycling programs in New York State, New Jersey, Connecticut, Pennsylvania, Rhode Island, and Massachusetts. If the national average recycling rate for ONP is applied to the Northeast (as defined above), a total of 1.17 million tons of ONP were recycled in 1989. With respect to New York State, which consumed 1.4 million tons of newsprint, about 467,000 thousand tons were recycled in 1989 (New York State Task Force, Ferretti). New York City's residential collection represented about 12 percent of the state's total. Department projections indicate that 150,000 -200,000 tons per year of ONP will be collected by 2FY 96.

The Port of New York is the largest export point for waste paper in the country, and almost all the ONP generated in the region is compressed into 1,500 - 2,000 pound bales and transported by truck in sea containers to the Port Elizabeth, New Jersey, containerport.

Market Prices

Prices paid for ONP by end users declined throughout 1989 and 1990. Recycling Times, a trade publication, charted declines in prices for Paper Stock Institute (PSI) Grade #6 from $22 per ton in April, 1989 to -$5 per ton in May, 1990 (see also Institute of Scrap Recycling Industries for all PSI grades and specicifications). In other words, the end user or market price for #6 ONP decreased during this span of time to the point where the costs of cleaning, sorting, baling and transporting it were greater than the prices the paper dealers or brokers were able to obtain from paper mills or other manufacturers.

In FY 90 the Department's prices ranged from $0 to -$36 per ton. However, this "processing fee" includes the cost of separating the commingled loads of ONP, magazines (known as OMG in the industry) and corrugated cardboard (or OCC) that are collected in the Curbside and Containerized recycling programs. This is not reflected in the prices paid by manufacturers for #6 ONP discussed above.

Demand

The major consumers of ONP are newsprint, paper tissue, and box manufacturers, with small amounts used by the molded pulp, animal bedding, packaging, and cellulose insulation industries. ONP use in the production of newsprint has increased an average of 7.7 percent per year since 1970. Total U.S. demand for ONP in 1989 was split between newsprint producers (1.4 million tons) and other papermaking uses (2.3 million tons). A total of 1.1 million tons of ONP was exported last year (Franklin, 1). Since the Department does not require contractors to provide detailed information on their customers, it is not possible to be precise about how much of the City's ONP is recycled domestically and how much is exported. However, the Department estimates that at least 90 percent of City-collected ONP is sold to the export markets.

In terms of demand for newsprint, there are 26 mills in the U.S., eight of which use ONP. Canada, responsible for a 60 percent market share in the U.S., has 48 newsprint production plants, only one of which uses recycled fiber (Franklin, 1, Pearson). Total North American production of newsprint containing ONP was 2.2 million tons. Of this total, Northeastern consumption of ONP was 11 percent. New York City regional consumption is quite limited as there is only one newsprint mill using ONP exclusively as its raw material. This mill has an annual production of approximately 200,000 tons per year (Ferretti).

Export Demand

In 1989, total exports of ONP were one million tons or 17 percent of all waste paper exports. The majority of ONP exported went to Asia, primarily South Korea and Taiwan, though Japan, Indonesia, Thailand, and the People's Republic of China also received shipments. In addition, Spain, Portugal, and Italy also imported U.S. ONP (Franklin, 1, 2). The export or "offshore" market is extremely volatile, and has a major impact on prices local paper dealers obtain.

Factors affecting export price include distance from secondary fibers supplies, availability of sea containers, freight rate changes, currency fluctuations, and, in the case of China, serious political disturbances, which could not have been forecast.

Buyers of ONP and other waste paper grades tend to place orders of large magnitude when their inventories are low, and often will place the same order with several paper brokers, thus increasing demand. Unscrupulous brokers can take advantage of the demand jump by claiming inadequate supplies, thus further forcing up prices. However, once these large, multiple orders have been filled, foreign buyers may retreat from the market and not place orders for weeks or months. The additional supply drawn out by higher prices has nowhere to go, nor does the municipally generated material, which is not at all sensitive to price changes.

Future Market Trends

The ONP markets for the City will remain depressed for the next three to five years and revenue to the City should not be anticipated during this period. The reason for this lack of immediate change is that a significant amount of new newsprint production capacity is coming on line during 1990-95, amounting to 2.8 million tons. This capacity, planned and constructed in the mid to late 1980s, does not feature much recycled fiber usage. Although several mills have announced plans to add de-inking equipment to these new mills, and several other producers have begun feasibility studies on a recycled newsprint facility, these changes will not occur for several years. Even retrofits of existing wood pulp newsprint mills may take one to two years once a decision is made (Pearson, Veverka, Franklin, 1).

API reviewed all announcements of new ONP capacity in the spring of 1990 and determined that if all go ahead by 1995, over 3.7 million tons of recycled newsprint capacity will be added to the North American market (Franklin, 1). The impact on prices for the final product, newsprint, will be downward. With more newsprint on the market, prices will drop and the ability of domestic mills to operate competitively will depend the retirement of inefficient virgin mills and a low-cost source of ONP. While these changes will mean that our short-term marketing problems will continue, there are both promising developments at the state level and additional efforts which the City can make to take advantage of the changes in the ONP markets.

New York State Task Force

In the summer of 1989, Governor Cuomo assembled a task force on newspaper recycling in the state. Participants included the New York Newspaper Publishers Association (NYNPA), the Departments of Economic Development (DED) and Environmental Conservation (DEC), and representatives of recycled newsprint manufacturers. The task force issued its final report in December 1989; it committed the NYNPA member companies to significantly increase their purchases of newsprint with ONP content. The publishers agreed to increase their consumption from the present seven to 11 percent in 1992, 23 percent in 1995, and 40 percent by the year 2000. This will provide a strong incentive for newsprint producers to invest in retrofits or new productive capacity.

The task force also recommended a concerted effort by DED and DEC to market New York State as a site for a new de-inking mill. At the present time DED is in competition with other Northeastern states to site such a mill, and serious consideration is being given to an upstate New York State location.

Direct Marketing Project

The Department has requested funding from DED for feasibility studies to determine the costs and benefits of selling the City's ONP (and other low grade papers, perhaps) directly to a paper mill. This would entail contracting for processing with existing paper dealers and/or use of future City IPCs to process paper and market it to an end user. This project, if funded, will require nine months for completion and will provide policy options based on costs, logistics, and legal ramifications.

CORRUGATED CARDBOARD

Old corrugated containers (OCC) are the largest single source of waste paper recycled, comprising some 40 percent of the total (Andover). The Department's waste composition study indicates that OCC comprises three to five percent of the residential waste stream. In FY 89 the Department collected 762 tons of OCC; in FY 90 (through April) the figure was 3,700 tons. FY 91 projections indicate that 8,000 to 13,000 tons of OCC will be collected, increasing to 50,000 to 100,000 tons by FY 96.

Nationally, in 1988, 12 million tons were collected, out of 25.1 million tons consumed. This was 47 percent of all waste paper, a high recycling rate. The projected figure for total U.S. OCC consumption in 1991 is 24.5 million tons, and for 1993, 25.9 million tons (Andover).

Supply

Although Department collections will be substantial, the main source of OCC in New York City is the commercial sector, namely the major department stores and retailers. Waste composition estimates range from seven to over 30 percent citywide. In 1989, estimated OCC generated by commercial establishments in the City was 600,000 tons; industry estimates for 2000 range up to 900,000 tons (Andover, Pulp and Paper, Beck).

Unlike the market for most grades of waste paper, the OCC market has a tight cycle. The retailer who receives the goods in corrugated cartons is also the recycler who sends the OCC back to the end user. The process for sorting, collecting and baling the OCC is well established in the industry.

In order to compete with existing sellers, new entrants into the market must deliver material that meets the specifications of PSI Grade # 11. This standard requires that the material be clean and free of contaminants; mills and brokers have rejected OCC loads that were poorly sorted or contaminated.

Demand

An important determining factor for OCC demand is the general health of the economy, and thereby, the quantity of packaging material used. Waste paper dealers obtain half of their OCC directly, frequently through contracts. The remainder is purchased from private collectors and waste haulers.

Between 1980 and 1985, figures quoted by prospective buyers of OCC ranged from $20 to $25 per ton. The prices quoted in the May 22, 1990 issue of Recycling Times, ranged from $ 0 to $ 25, for loose, unbaled material in the Northeast.

The Department operates a program in the Manhattan and Brooklyn municipal buildings and other government institutions, in which a mixture of OCC (80 percent) and ONP (20 percent) is collected. Contracts for this program in FY 90 required the City to pay the vendor five to ten dollars per ton.

In 1987, 1,425,000 tons of postconsumer corrugated was consumed by mills in the mid-Atlantic region (see Exhibit A.III 1). New York State paper and paperboard mills consumed more than 11 percent, or 164,000 tons (Andover).

EXHIBIT A III.1
REGIONAL CONSUMPTION OF POSTCONSUMER OCC
1987

State	OCC Consumed	Regional Total (%)
New York	164,000	11.5
Delaware	30,000	2.1
Maryland	79,000	5.5
New Jersey	215,000	15.1
Ohio	448,000	31.4
Pennsylvania	428,000	30.0
West Virginia	61,000	4.3
TOTAL	1,425,000	100.0

Export Markets

As with other waste paper groups, there is a major export market for OCC, with Taiwan, South Korea, and Japan major destinations (see exhibit A III.2). OCC is the major paper grade exported from Northeast ports.

In 1988 OCC export figures reached 2.2 million tons out of a total 5.6 million tons waste paper exports - 40 percent. Though the ratio dipped slightly from the previous year, there was an increase of 300,000 tons in real terms. Department of Commerce figures showed that OCC exports for 1989 (through September) were 1,901,477 metric tons (Andover, *Pulp and Paper*).

EXHIBIT A III.2
ANNUAL OCC EXPORTS/DESTINATION
(Selected Years; Thousands of Tons)

	YEAR						
Country	1979	'80	'81	'83	'85	'87	'88
China	0.0	0.0	0.6	26.0	10.0	26.0	52.0
India	0.0	0.0	0.0	3.0	42.0	21.0	30.0
Japan	80.0	118.0	42.0	81.0	91.0	347.0	310.0
S. Korea	264.0	196.0	169.0	153.0	220.0	290.0	346.0
Philippines	08.0	17.0	16.0	6.0	10.0	25.0	12.0
Taiwan	100.0	160.0	149.0	170.0	258.0	413.0	458.0
TOTAL	452.0	491.0	376.6	439.0	631.0	1122.0	1198.0

Exhibit A III.3 presents the breakdown, by region, of OCC exports (Andover).

EXHIBIT A III.3
REGIONAL OCC EXPORTS

Port	OCC Exported (Thousands of Tons)
Baltimore, MD	46.7
Boston, MA	9.5
Buffalo, NY	91.5
New York, NY	444.8
Ogdensburg, NY	5.2
Philadelphia, NY	14.9
St. Albans, NY	2.2
REGIONAL TOTAL	614.8

In 1986, seven major ports accounted for 614,800 tons of OCC exports, over 40 percent of OCC exports from the U.S. It should be noted that the Port of New York, with 444,800 tons, accounted for 72 percent of regional exports (Andover).

The residential and institutional sectors are capable of generating significant quantities of OCC. The main area of increased tonnage, however, is the commercial sector. Surveys conducted by a consultant (Beck) to the Department found several City-based stores not recycling OCC. The main reason given by these stores was that they did not have baling capacity. On the basis of this limited sample, we can therefore assume that there may be considerable quantities of OCC potentially available for recycling.

To assess future regional demand, it is imperative that all plans for siting new mills within the area be closely monitored. As was the case with the ONP market, with increased supplies, there has been a downturn in the price of the material. For baled material, however, prospects for continued expansion of the OCC market are good. There is also a strong export market for the material.

MAGAZINES

Supply

The Department currently collects magazines (OMG) with ONP and OCC from the Curbside program and OMG commingled with ONP from the Containerized program. As outlined in the newspaper section, these commingled materials are delivered in loose form to local paper dealers who sort, bale, and sell it, mostly to overseas mills.

According to the waste composition study, OMG composes approximately two to three percent of the residential waste stream. In FY 89, the Department collected approximately 2,110 tons of OMG and in FY 90 to date (April) 4,885 tons have been collected, reflecting the growth of our collection programs. The Department projects that it will collect 15,000 - 19,000 tons of magazines in FY 91. By FY 96, this number is expected to increase to 55,000 - 65,000 tons.

Demand

As a single paper grade (PSI #27-S), OMG is not recyclable in significant quantities and consequently is not desired by our paper dealers or their overseas customers. It does not have a market price as there are few secondary uses; OMG is in fact a contaminant when commingled with newspaper. Because the Department collects ONP commingled with OMG, it, along with other contaminants, contributes to lowering the grade of each load from PSI #8 to a less valuable PSI #6. Grade #6 ONP cannot be used to produce newsprint, but is used by paperboard mills which produce "grey" cardboard (cereal boxes, writing pad backing) and tissue mills for the production of industrial toweling and other tissue products.

OMG is not desired by old newspaper de-inking mills mainly because of its glue, clay, and dye content, which interferes with the newspaper washing and reformulation process. However, the future for recycling OMG looks promising. An alternative de-inking process, the "flotation" system, is emerging as the preferred de-inking method, replacing the "washing" system. In the flotation process, the clay contained in OMG is actually desired and essential for proper operation (Pearson, Sorenson). The clay helps to remove ink from the ONP while the dyes brighten the recycled sheets.

The only remaining obstacle is glue, and mills are working not only to convince glue manufacturers to create a kind that will not impede the flotation process, but also to research ways to remove glue from the de-inking system or render it inert. The preferred ratio, by weight, of OMG to ONP in the flotation mix is 3:10, which closely resembles the proportion of these materials in the waste stream. Because almost all new mills coming on line now and in the future will be of the flotation type, OMG will be in demand within three to five years. In addition, the clay sludge resulting from the flotation process is rich in kaolin, which can be used as a soil nutrient in sod farms.

In the short term, most mills which receive the City's paper are not of the flotation variety. Therefore, if most of our wastepaper continues to be sold to these buyers, it still will be considered less valuable than straight loads of ONP. Further, this makes the Department's paper (ONP, OMG, and OCC commingled) less attractive to wastepaper dealers and consumers relative to recycling programs in the region collecting only ONP, or requiring source separation of ONP from other paper types. It is expected, however, that the large increase in annual wastepaper tonnage collected by the City in the next five years will result in the development of domestic markets, mainly flotation mills, for a considerable portion of this wastepaper.

Further Research

The only significant use for OMG developed to date is through the flotation de-inking system. This development alone, however, should create a demand for all of the magazines the Department can provide.

HOUSEHOLD MIXED WASTEPAPER

As defined by the Department, household mixed wastepaper consists of computer paper, cereal boxes, egg cases, shirt board, junk mail, greeting cards, tissue boxes, shoe boxes, paper bags of any color, envelopes, and paper towel tubing. It does not include wax- or plastic-coated paper.

Supply

According to the waste composition study, household mixed wastepaper comprise nine to 12 percent of the residential waste stream. The Department does not currently collect this material for recycling but is evaluating the potential for future collection.

Demand

There are currently no markets for household mixed paper as a commodity; the individual paper types would need to be separated Sound Resource Management Group, 1, 2). Should the Department initiate a collection program for mixed household paper, the material would be collected in an unsorted state; given the low value of the individual paper grades contained in the residential mix, it would be economically unfeasible to sort mixed paper after collection. Household mixed wastepaper is at the bottom of the grading hierarchy for wastepaper types, well below ONP.

According to surveys (Sound Resource Management Group 1, 2) conducted for the Department, less than 15 percent of all paper and paperboard manufacturers utilize household mixed paper. But for these and most other uses, household mixed paper is marketable only in a separated, contaminant-free form. Only composting and animal bedding present commingled marketing opportunities, but not on a significant scale. Because separation is not economically feasible after collection, it would have to be done by residents prior to collection. Collection of separated materials in this scenario seems operationally difficult.

Products that can be made using clean, separated components of household mixed wastepaper include paper and molded pulp products. But because of its low grade, even household mixed wastepaper in this form is not preferred by manufacturers. Only in a situation where demand for ONP exceeds supply would demand for these components increase considerably.

Two major factors influence the ability to recycle household mixed wastepaper on a large scale. The first is the ability to successfully sort the components into separate, marketable commodities. Second is the lack of established markets. At the moment, the future remains problematic.

NON-FERROUS METALS

The non-ferrous metals which are currently recycled include aluminum, copper, lead, zinc, and tin. Aluminum represents the major item among all the non-ferrous metals recycled, amounting to 86 percent of the annual total in 1989. About 60 percent of used aluminum in the United States was recycled in 1989. This is a dramatic increase in the rate of recycling in the industry compared to a mere 37.3 percent ten years ago and 54.6 percent in 1988 (Recycling Today, 1, 2).

Prices received by the IPC in FY 90 for aluminum ranged from $700 to $1,000 per ton for used beverage cans or UBCs and from $140 to $370 per ton for aluminum foil.

Supply

There are presently eleven non-ferrous metal secondary smelters in the greater New York metropolitan area handling approximately 185,000 tons a year of mainly aluminum and other non-ferrous metals such as tin, lead, zinc, and copper. The residential sector generated 40 percent while the commercial sector generated 60 percent of the total (Harben). In the Department's waste composition study, aluminum represented approximately one percent of the residential waste stream. The Department collected 3,500 tons of aluminum in FY 90 and estimates that 10,000 - 15,000 tons will be collected in FY 96.

Used Beverage Cans

A major domestic source of aluminum in the non-ferrous recycling industry is the all-aluminum UBC. Aluminum now accounts for 99.9 percent of the cans used for beer and 92.2 percent for soft drinks, for an overall average of 96 percent; this represents 76 billion aluminum cans out of a total 81 billion beverage cans. Industry forecasts estimate that aluminum cans will grow to 125 billion by the year 2000, and the expected recycling rate will increase to approximately 75 percent (Recycling Today, 1, 2).

Demand

UBC scrap is shredded and melted into secondary metals and remanufactured as can sheet, or may be alloyed with additives to bring it up to certain other alloy specifications. These secondary metal alloys are good enough to be used for die casting or other aluminum purposes but are not sufficiently pure to be used for foil or can sheet.

Of 36.5 billion aluminum UBCs recycled in 1987, 85 percent of the manufacturing was divided among four major companies (see Exhibit A III.4. Source: Harben).

EXHIBIT A III.4
U.S. ALUMINUM MANUFACTURERS

Firm	Location	Market Share
Alcoa	Pittsburgh, Pa	33%
Reynolds Aluminum	Richmond, Va	22%
Alcan Aluminum Corp	Cleveland, Oh	15%
Kaiser Aluminum & Chemical	Pleasanton, Ca	15%
Others		15%

In Exhibit A. III.5 an overview of the UBC recycling picture for 1985-88, including recycling rates and the numbers of cans reclaimed and shipped, is presented (Harben).

EXHIBIT A III.5
U.S. ALUMINUM UBC RECYCLING
(pounds in billions)

	1985	1986	1987	1988
UBC Melted & Consumed	1.2	1.2	1.3	1.5
Cans Per Pound	26.6	27.0	27.4	28.3
Cans Reclaimed	32.8	32.2	36.8	42.5
Cans Shipped	64.96	68.3	72.4	77.9
Recycling Rate	50.5%	47.1%	50.5%	54.6%

Non-ferrous scrap originating in the City can find domestic buyers in New England, Connecticut, upstate New York, New Jersey, Pennsylvania, and Ohio. There are several large secondary smelters in this region that buy scrap to refine back into usable metals. Canada, particularly Ontario and Quebec, is a major buyer of copper and aluminum scrap (around 30,000 tons of each in 1988).

Export Markets

Scrap metals are a major export item from the Port of New York. As such the recycling of non-ferrous metals is closely related to the export market. Material may be shipped thousands of miles by relatively cheap ocean transportation and remain competitive in price relative to expensive land routes to domestic smelters. The U.S. is the major exporter of scrap metals to Eastern Asian and European markets. Overall in 1988, U.S. exports of aluminum scrap totalled 486,615 tons valued at $774,227,000 for an average of $1,591 per ton. Exports were divided into aluminum waste and scrap (394,382 tons), UBCs (4,720 tons), and remelted scrap ingot (88,350 tons).

Out of the above-mentioned total, 55 percent went to Japan, 13.5 percent to Taiwan, and 7 percent to Korea; in the European market, 2.6 percent was exported to the Netherlands and France, 1.7 percent to Italy, and less than one percent each to Belgium, West Germany, and the United Kingdom (Harben).

Further Research

Recycling of non-ferrous metals, particularly aluminum, is accomplished primarily by the private sector because of the high economic value of the materials. The use of aluminum for beverage containers is increasing rapidly, as is the recycling rates of UBCs, exceeding 60 percent in 1989. Non-ferrous markets are strong and the City should be able to market all its materials within the existing infrastructure.

An area that needs further research, however, concerns the data on all secondary smelters and scrap dealers in the New York region. A breakdown is needed for the types of non-ferrous metals processed by each firm and the respective tonnages for each material as well as their outlets.

FERROUS CANS

Ferrous cans, which include tin and bimetal cans, recovered from municipal solid waste constitute a small portion of the scrap tin and steel produced in this country. The Department collected 910 tons of ferrous cans in FY 89, and 2,700 tons to date (April) in FY 90; prices paid to the IPC for these cans ranged from $30 to $70 per ton.

Steel and aluminum are competitors in the beverage can markets. Can plants using the draw and iron technology can make either aluminum or bimetal cans with minor equipment modifications. As noted in the non-ferrous section, aluminum cans have largely replaced steel in this market. Many industry analysts believe that steel is making a comeback, due to various factors, including a concerted marketing effort by the steel industry.

Supply

The waste composition study indicates that ferrous cans compose two to four percent of the City's residential waste stream. Department projections indicate that 4,000 to 5,000 tons of ferrous cans will be collected in FY 91, increasing to 40,000 to 60,000 tons in FY 96.

The supply and demand analysis for ferrous cans encompasses the region defined by a 500-mile radius around New York City, including Connecticut, Rhode Island, Massachusetts, Pennsylvania, New Jersey, and New York (Gershman, Brickner & Bratton, 1, 2).

Demand

Steel is manufactured with iron ore and scrap. Over the last five years the ratio of scrap to the total production of steel has increased. In 1983 scrap composed 73 percent of steel production and in 1988, 76.9 percent. Scrap is replacing iron ore in the production of iron and steel.

The Steel Can Recycling Institute (SCRI) reports that the steel can recycling rate in 1989 was 21.6 percent, a 44 percent increase over the 1988 rate of 15 percent (Gershman, 1). SCRI is promoting the recycling of paint cans, which are composed of a high grade steel that should therefore increase the quality of the can-scrap batches.

The markets for ferrous cans are steel mills, detinners, and export. There are two types of steel mills, integrated mills and mini-mills, and both are accepting increasing proportions of can scrap. The integrated mills within the region have a capacity to consume more than 19 million tons of scrap per year.

Mini-mills

Mini-mills are defined as steel mills within a 300-mile radius of their markets, have limited capacity, an electric arc furnace (EAF), and consume 100 percent scrap steel. About 60 percent of the ferrous scrap consumed in the U.S. is melted in EAFs, most of which are in mini-mills. Mini-mills use scrap as a raw material and, since they do not need to be near mines, are an obvious end-user for ferrous scrap recycled from municipal waste. Five mini-mills within the region claim to buy ferrous can scrap. Some mini-mills produce specialty steel, however, and therefore cannot use can scrap because of alloying problems.

Detinners

The tin plating and the lead solder on steel cans must be removed before the steel can be used by mills. Detinners remove these metals and recover them, thereby providing steel mills with a higher quality feedstock. Detinned steel can be sold as No. 1 bundles; non-detinned steel, which is a lower grade, sells as No. 2 bundles, for about half the price.

The New York City region is potentially a prime location for a detinning plant since demand for steel-can scrap is greater than the potential supply. If the City is to compete on a quality and price basis with traditional scrap and virgin materials for industry demand, it should secure detinning capacity for the projected quantities of ferrous cans that will be collected annually by 1996.

Detinning capacity in the study region is expanding. The two major detinners have plans for this region: AMG already has detinning plants in Baltimore and Pittsburgh, and plans to open a new plant in New Jersey; Proler plans to build a plant in Allentown, Pennsylvania.

Export

The U.S. is the largest exporter of scrap steel, and the market is expected to strengthen as developing countries increase production levels. It is not possible to determine from Department of Commerce export data whether the exported No. 1 and No. 2 bundles originate through municipal waste recycling.

The key issues pertaining to ferrous can markets in this region are summarized below:

- Mills surveyed by consultants to the Department did not provide information on the percentages of can scrap used or prices paid. Small quantities of can scrap trade on the spot market at inconsistent prices. To become a recognized grade, ferrous cans must be processed to meet specifications set by the American Society for Testing Materials (ASTM). Processing must include shredding, magnetic separation, air classification, screening, and densification. Such wide scale processing will help to establish can scrap as a commodity with some price stability.
- Ferrous can scrap, unlike the aluminum UBC is not an established grade of scrap but can be processed by detinners and may be used by both integrated mills and mini-mills.
- The demand for ferrous scrap exceeds the supply of scrap available in the New York City region.The total supply of tin cans from the region is estimated to comprise only 0.39 percent of total demand in 1990, and 0.86 percent in 2000. New York City's supply alone would comprise 0.05 percent of the total regional demand in 1990, and 0.03 percent of the demand in 2000.
- Department-collected ferrous can scrap should compete on a quality and price basis with traditional scrap and virgin steel for industry demand. This can be accomplished by detinning the steel.

- Intermediate processing (including detinning) is necessary to turn recovered ferrous cans into a recognized grade. Specifically, the City should secure sufficient detinning capacity for the projected 40,000 - 60,000 tons of ferrous cans that will be collected annually by FY 96.

FERROUS SCRAP

The type of ferrous scrap derived from discarded products and demolished structures containing iron and steel is called "obsolete scrap." This category includes items such as white goods (refrigerators, ovens) and automobiles.

Supply

Obsolete scrap is sold for recycling through a system consisting of processors and brokers. The ability to recycle a large volume of obsolete discards requires an extensive reclamation and processing network. The recycling system includes collection, identification, extraction, and segregation of the various metals a product may contain, sorting and sizing into industry established grades, and transportation to steel plants for melting and processing into new products.

The New York City region (New York City, Long Island, Northern New Jersey, and Connecticut) generates approximately five percent of the nationwide supply of obsolete ferrous scrap. In 1989, this amounted to 3.1 million tons. The Department's contribution to this number is very low. The Bulk program collected approximately 5,000 tons of recyclable obsolete scrap in 1989, and the Department was paid ten to twenty dollars per ton.

Most of the scrap originating in the region is sold within five states: New York, New Jersey, Pennsylvania, Maryland, and Virginia. In addition, the region exports approximately 1.7 million tons of scrap annually through New York City ports.

Demand

The leading consumers of obsolete scrap are the 50 EAF mini-mills which were originally constructed to accept low grades of obsolete scrap and, in turn, manufacture low quality but marketable products. In recent years, market forces have forced mini-mills to diversify and increase the quality of their product line. As a result, they have been increasingly selective when purchasing obsolete scrap.

Unfortunately, as the demand for higher quality scrap increases, the overall quality of incoming mini-mill scrap is decreasing. Increased production yields in the steel industry have reduced the rates at which high quality scrap is generated in the steel production process. Similarly, increased manufacturing yields by steel product manufacturers has also diminished the amount of high quality scrap generated.

This decrease in high quality scrap generation inhibits mini-mills from properly blending high quality scrap with low quality obsolete scrap, resulting in an increasingly lower quality product. A solution to this problem is for mini-mills to purchase higher quality, higher cost scrap as well as install contaminant-reduction technology. This will improve the product quality but will also drive up prices.

In the next ten years, the region's demand for obsolete scrap is expected to increase with the expansion of many area mini-mills. However, this expansion will also create an even larger demand for higher quality scrap.

The supply of obsolete scrap could decrease as a result of a decline in railroad scrappage and periodic downturn in the demolition of buildings.

The region's ferrous-scrap market is in a state of troubled balance. The demand for quality is increasing as the supply is decreasing in both volume and quality. However, obsolete tonnage is an important component of a mini-mill's input because of its low cost relative to higher grades of scrap. Its demand is, therefore, unlikely to diminish. The solution will come from finding other sources of high quality ferrous to complement the supply of obsolete ferrous scrap and from improving contaminant-removal technology.

CONTAINER GLASS

The steadily expanding collection of waste glass will increase pressure to find new and larger markets for the glass that is collected. Estimates vary, but between 180,000 and 350,000 tons per year of container glass may be available for recycling in the New York regional residential waste stream (Resource Management Associates). The Department collected 1,624 tons of glass in FY 89 and has collected 6,200 tons as of April FY 90.

The use of glass cullet by the container industry has increased dramatically, primarily because of the industry's aggressive promotion campaign combined with the recent expansion of source-separation recycling programs.

The supply and demand analysis for waste cullet, according to the Department's consultant, encompasses the region defined by a 500-mile radius around New York City, including Connecticut, Rhode Island, Massachusetts, Pennsylvania, New Jersey, New York, portions of Ohio, and Ontario.

The Glass Packaging Institute (GPI), the major industry organization for container glass manufacturers, estimates that about 30 million tons of cullet were used by the glass container industry in 1988. This represents over 90 percent of all recycled container cullet in the national waste stream (Resource Management Associates).

Supply

There are two major sources of postconsumer bottle cullet in the region -- residential recycling programs and deposit bottle returns. Bottlers and distributors provide a minor portion of the supply. The waste composition study indicates that three to five percent of the City's residential waste stream is glass, while estimates for the commercial waste stream range from one to four percent. The Department projects collecting 50,000 to 80,000 tons of glass annually by FY 96. Connecticut and New York State estimate that about 80 percent of the redeemable glass containers are returned -- the return rate in the City is estimated to be about 60 percent.

Demand

Most of the glass processed in the New York region ends up at glass container plants within the region, with the exception of green cullet which often goes to more distant markets in Illinois, Wisconsin, or Canada. Markets for green cullet are dwindling, and hauling costs may exceed the lower prices paid by Canadian firms. One reason that markets for green cullet are difficult to find in the New York region is that the few plants with green furnaces have been accepting greater volumes of mixed-color cullet,

which has displaced markets for green cullet. A small portion of postconsumer cullet is used for non-container uses, such as fiber glass or reflective beads.

Because the supply of recovered glass is independent of market demand, cullet supply is expected eventually to exceed demand. The glass container industry can take steps to increase cullet usage by installing "beneficiation" facilities, which can improve the quality of the incoming cullet, allowing higher amounts to be used. In addition the industry can further increase capacity by investing in expensive plant and equipment modifications. Once modifications are complete, container manufacturers will be able to use 80 to 90 percent cullet in their batches (Resource Management Associates).

Resource Management Associates found that most container plants could use over 70 percent cullet in their batches, but that problems with routine high levels of cullet use are a deterrent. The most commonly cited problem is the uncertainty of obtaining consistent and reliable quantities of cullet at reasonable prices.

Another obstacle is the technical feasibility of high cullet use. As increasing proportions of cullet are used, the chance of contamination becomes higher. Contaminants such as ceramics will create weaknesses in the glass.

Market Conditions

Local glass prices gradually declined in 1989, but they are expected to remain fairly constant over the next year. As long as the City continues to sell glass to private manufacturers, it will be subject to the fluctuating demands of the industry. The Department can best prepare for this by producing a clean, color-sorted cullet that can compete with virgin glass. It is possible that, in a few years, mixed-color cullet will be a worthless commodity.

Alternative manufacturing uses for cullet currently in commercial production are foam glass and glass wool. Also, glass can be used as an aggregate for such uses as glassphalt or roadbeds. The Department requested permission from DEC to conduct field tests using five to 15 percent crushed cullet mixed with soil as a cover at City landfills.

In Exhibit A III.6 local glass prices (prices paid to the operator for cullet processed at the IPC), are presented. It appears prices have remained fairly constant over the past several months, with the exception of green glass prices, which declined to a low in December and increased again in January 1990. While these prices partially indicate market trends, they also reflect the IPC operator's contract periods. Also, some of their vendors pick up the glass and pay less, while others pay more because it is delivered to them.

EXHIBIT A III.6
EAST HARLEM IPC PRICE TRENDS 1989-1990
NET CURRENT PRICE PER TON*

	Nov.	Dec.	Jan.	Feb.	March
Flint	48.60	45.12	46.10	53.58	50.43
Green	15.00	9.03	20.83	20.08	19.27
Amber	38.25	45.94	40.00	29.99	40.00

* Net current price reflects current price minus processing costs per ton.

Flint glass is the most valuable color, followed by amber and green. The least valuable is mixed-color glass, which sells for $10 per ton in some regions, but Sanitation gives it to the Department of Transportation (DOT) for use in its glassphalt plant. Cost savings result with the use of cullet because less rock and sand is purchased. DOT currently uses about 8.5 percent cullet and 15 percent recycled asphalt per batch -- the savings resulting from the cullet use is $1 per ton.

In FY 91, 50 percent of the mix will be cullet and recycled asphalt, resulting in a gross savings of about $6 per ton. The cost of the materials required to produce one ton of virgin asphalt is about $13.00. If 50 percent cullet and recycled asphalt is used, the net savings to the City will be $7.00 per ton.

Supply and Demand

Based on preliminary Department projections and glass industry surveys, regional supply will outstrip demand in the early 1990s. However, GPI and other glass experts disagree with this estimate and believe that the glass industry will consume available supplies for much longer. It should also be noted that the Department did not include mixed-color markets, such as glassphalt, in its analysis.

The DOT glassphalt plant consumes the crushed mixed-color cullet from the IPC, which averages approximately 40 percent of the glass entering the plant. In FY 90 the glassphalt plant consumed about 30,500 tons of mixed crushed cullet from the IPC and two other local processors; about 40,000 tons will be consumed in FY 91.

Further Research

For the next five years, the glass container industry will very likely continue to be the main user of waste glass collected through the City's recycling program. Since glass market experts have suggested that the markets may become glutted in the next few years, the Department will investigate other markets for cullet besides the container market.

PLASTICS

Plastics markets are in their formative period compared to all other recyclable materials and are relatively less stable and harder to predict. Plastics are also divided into numerous grades according to the name of specific plastic resins. The main resins and examples of their uses are as follows:

- Polyethylene Terephthalate, or PET (soft-drink bottles);
- High Density Polyethylene, or HDPE (juice and milk jugs, soda bottle base cups, detergent and motor oil containers);
- Polystyrene and Expanded Polystyrene, or PS (packaging -- cottage cheese and yogurt containers, for example, disposable food utensils and dishes, furniture, appliance cabinets, luggage) and EPS (known by its trade-marked name of "styrofoam" -- disposable fast food containers, packing "peanuts," egg cartons);
- Polypropylene or PP (car battery casings);

- Polyvinylchloride or PVC (pipe, construction materials, auto parts, household cleaner/shampoo containers, pipes); and,

- Low Density Polyethylene, or LDPE (grocery and trash bags).

All other resin types, or unsorted loads of recycled plastic, are called "mixed" plastic.

Supply Overview

Waste composition analyses conducted for the Department indicate that the targeted resins described above comprise two to three percent of the residential waste stream by weight. Forecasts indicate that plastic use will grow to ten to 20 percent of the waste stream in 2000.

New York City's recycling programs currently collect a very small amount of plastics (20 tons in FY 89 and 121 tons in FY 90), but major expansions are planned for the coming years. The Department projects that it will collect 3,000 to 4,000 tons in FY 91 and that collections will increase to 30,000 - 80,000 tons in FY 96.

In addition to the Department's collection of residential plastics, other sources of supply should be noted, though quantities are not known. The two primary sources are the plastic bottles (PET) returned for deposit under the New York State "Bottle Bill," and plastics from the industrial and commercial sectors. Bottle Bill tonnage is estimated by the DEC at 450 tons per day in the City, but since this number includes metal and glass containers returned as well as plastics, the amount of plastics recycled through this system is difficult to determine. Consultants to the Department (Resource Integration Systems) estimate that of all PET recycling in the New York region, 80 percent is recovered through container deposit laws. No estimates are available on the amount of potential plastics available through the industrial or commercial sectors. However, some of the resins discussed below do originate in these areas (PP battery casings and PVC construction products, for example).

Supply and Demand by Resin Type

The supply, demand, and market price trends for specific resins are quite different. Below are the market conditions for each resin (Resource Integration Systems).

PET

PET, along with HDPE and PP battery casings make up 95 percent of all postconsumer plastics recycling in the region. Demand estimates indicate that the existing production capacity to use PET is ten times present consumption levels. Surveys conducted for the Department indicate that at least five companies are planning expansions of 150-200 million pounds in 1990-91. The Bottle Bill collection system supplies an overwhelming majority of recycled PET.

Prices for PET are determined by the amount of sorting and materials handling done after collection. For segregated and baled clear PET, prices range from nine to 15 cents per pound ($180 - $300 per ton), while the same material in granulated form has sold for 11 - 18 cents per pound or $220 - $360 per ton. For loose or bagged material, prices are substantially lower, and are between two to five cents per pound for clear, green

or mixed PET. Green PET is lower in value (five to ten cents baled, nine to 14 cents granulated), while mixed-color PET falls in the middle: five to 11 cents baled, nine to 15 cents for granulated material.

HDPE

Markets for HDPE are robust, like PET markets, with strong demand, sufficient existing capacity, and several planned expansions announced for the next two years. Prices range from ten to 18 cents per pound for clear granulated material to four to six cents per pound for loose or bagged HDPE. There is no price advantage to color separation for loose material.

PP

Polypropylene, used primarily to manufacture automotive battery casings, is recycled by auto dismantlers, who sell the used batteries for the value of both the PP casing and the lead in the battery itself. Postconsumer PP bottles are the second smallest plastic component of the residential waste stream, accounting for 0.15 percent of the City waste composition study. Prices are in the range of five to 15 cents for baled material, 15 - 20 cents for granulated, and zero to eight cents for loose PP. This market is of limited significance to the Department's collection efforts and is in rough balance with existing supply and demand.

PVC

Over 60 percent of PVC produced in the U.S. is used by the industrial sector and according to the City's waste composition study, it is the smallest component of the residential plastics stream at 0.13 percent. These two factors, combined with the difficulty in distinguishing PVC containers from other resins, imply that City-collected PVC will be primarily consumed as a part of the mixed plastic market (see below). One major PVC manufacturer has offered to accept all PVC products at a price of nine to ten cents per pound at the seller's dock (i.e., the buyer will pay transportation costs); however, the material must be separated from other resins and baled.

Industrial PVC sells for zero to two cents per loose pound and six to ten cents for baled or granulated material.

PS and EPS

Markets for polystyrene and polystyrene foam (EPS) are weak on both the supply and demand sides. In 1989 several small scale polystyrene recycling facilities were established, but their capacity is less that the available quantities of the material, which makes up 0.83 percent of the residential waste stream in the City. Uses for the recycled PS products are similarly small; typically they are consumed by the firms producing the virgin resin-based products. Major problems with the markets for PS and EPS are contamination from food and other packaging materials (paper, metal foils), and high collection costs. Neither supply or demand is sufficient at this time to generate substantial investment in cleaning, compaction or collection technologies. Prices are between zero and ten cents per pound in the region.

LDPE

Low-density polyethylene is extremely limited in supply, and little demand for the material exists, primarily because of contamination problems and the very lack of supplies. In the second quarter of 1990 several grocery chains, supported by the LDPE bag manufacturers, have announced programs to buy back used LDPE grocery bags or accept them for no payment, and a major resin producer has announced the development of a film plastics (including LDPE) recycling facility in New Jersey, which is expected to open in the next year. LDPE is exported to the People's Republic of China and other Asian countries where the bags are cleaned and either reused as bags or split and used as agricultural sheeting.

Mixed Plastic

Mixed plastic recycling has seen a burst of activity in the region; at least four firms have started or will start operations in 1990 (Plastics Recycling Update). The primary product is a synthetic lumber material which so far has seen limited success with institutional purchasers, though the market potential may be significant in the long run. The Department's Intensive Recycling Project is collecting mixed plastic and has contracted with a local user.

Markets are well established for PET, HDPE and PP. These materials command good prices when cleaned and segregated from other resin types. Demand for PS, PVC, LDPE and mixed plastic is limited and supply inconsistent.

The Department currently collects very little plastic and our direct experience with plastics markets has been limited. However, significant growth in production capacity and plastics recycling technologies are forecast for the future (Brewer, Schell).

WOOD

This section provides a brief overview of woodwaste generated in the City, the consumer markets both in the City and the region, and the role that the Department's landfills play as end users of this material. We have also listed current and future prospects that use, or will use, woodchips other than as a fuel source, its current primary market.

Supply

Estimates for the amount of woodwaste generated by public and private sources in the City are imprecise and vary from 600,000 to 1.5 million tons annually (Atlantis, Northeastern Biomass). There are presently about a dozen wood processors active in the City with a total processing capacity of close to 500,000 tons. These firms currently handle approximately 300,000 tons per year, consisting of five major categories: demolition (54 percent), pallets (15 percent), boxes and crates (8 percent), wood manufacturing scrap (8 percent), construction scrap (8 percent), and others (7 percent). All urban wood (e.g. construction scrap, demolition waste, pallets, crates) must be chipped before it can be used for either fuel or non-fuel purposes (Atlantis). This is primarily because of the greater efficiency in transportation and handling that is achieved by densifying woodwaste into chips.

The Department's Bulk program produces about 6,000 tons of chipped wood annually, based on program data for 1989. This tonnage represents two percent of the total woodwaste being processed in the City. The wood from the Bulk program is distin-

guished from the commercial urban wood described above in that it contains a much higher proportion of painted and treated wood. This wood is harder to recycle and has far fewer markets.

Additionally, the Department of Parks and Recreation generates an estimated 65,000 - 75,000 tons of woodwaste per year (trees, prunings, and stumps). Due to Parks Department infrastructural constraints, much of this material is stockpiled on vacant park land.

Outlets for Woodwaste

There is only one major private sector consumer of woodchips in the City: the Proctor & Gamble Manufacturing Company's cogeneration facility at Port Ivory, Staten Island. The estimated total capacity of the wood-burning component of the facility is 102,500 tons per year.

The other outlet in the New York City region is at the Fresh Kills and Edgemere landfills, which use woodchips for road stabilization and ponding control. The rest of the woodchips produced in the City are either transported by truck to burners in states including New Hampshire, Maine and South Carolina or to landfills outside the City. One woodwaste processor has opened markets as remote as India and South Africa.

Current Status of the Market

A breakdown of the tonnage of woodchip consumption by category of outlet for 1989 is shown in Exhibit A III.7.

EXHIBIT A III.7
MARKET OUTLETS FOR WOODCHIPS GENERATED IN NEW YORK CITY

Market Outlet	Tons per Year
Proctor & Gamble Burner	102,500
Landfill & Road-Bed Cover	25,000
Others uses*	172,000
TOTAL	300,000

*The other uses category includes the use of woodchips as fuel for wood burners in Northeastern states outside of New York and other, non-fuel uses.

Woodwaste Use at Fresh Kills and Edgemere Landfills

Seven of the major wood chippers in the City are currently sending material to Fresh Kills and Edgemere landfills. These woodchips are used for road stabilization and ponding control.

The delivery of woodchips comes at no charge to the Department and began in November of 1988. From the initial monthly tonnage of 388 tons to 5,754 tons in October 1989, the Bureau of Waste Disposal (BWD) increased its requirements for woodchips at these two landfills to a average of 1,900 tons per month for the period November 1989 through January 1990. The total amount of woodchips accepted by BWD during this period was 28,400 tons.

According to BWD, its current need for woodchips is 720 tons per week (2,880 tons per month), but this is expected to diminish to 240 tons per week in the foreseeable future as BWD's demolition processing plant comes on line. This plant will provide the landfills with the necessary aggregate crushed from construction debris for road stabilization thereby eliminating the need of woodchips for that use. The 240-ton-per-week estimate represents about 33 percent of the present weekly usage.

Wood-fired Power Plants in the Northeast

Other than the landfills and the P & G burner, the other major outlets that currently serve as the City's market for woodwaste are energy-generating wood burners in the Northeast and South Carolina. The current market for urban woodchips in the Northeast is small and inconsistent. For this reason, current woodchip prices are widely variable, going from zero to $20 per ton, delivered (Atlantis).

Other Markets

Thus far the other possible outlets for woodwaste besides the usage of woodchips for burners and landfills -- such as use as a bulking agent in sewage sludge composting facilities, compressing woodchips into particle board, mosquito control in swamp areas, mulch for landscaping, and livestock bedding -- have been unimportant markets for woodchips (Atlantis). However, some of the current projects that are either being developed by vendors or the Department show that there is much potential in these areas.

Further Research

There are several initiatives that the Department and private firms in the region are pursuing to promote woodwaste recycling in the City:

- Assist the efforts of energy companies to develop wood-fuel power plants in New York region or in New York City.
- Research and promote the export of woodchips to countries where deforestation has created a great demand for woodchips either as fuel sources or lower grade paper pulp.
- Research as to the feasibility of using woodchips for animal bedding at dairy and poultry farms.
- Research and promote the use of woodchips as an absorption agent on construction sites and as mosquito control in swampy areas.
- Assess and promote the use of the City's woodchips as mulch among community garden organizations.

TIRES

Tires are chemically complex, precision engineered, and designed to last. This durability is a contributing impediment to the economic feasibility of many recycling options. As a result, many tires are illegally dumped on roadways or in vacant lots, and many are simply landfilled. In landfills, they take up precious volume and rise to the top of the trash heap. Here, as when accumulated in piles on the side of

roadways or in empty lots, tires become an excellent breeding ground for mosquitos and vermin as well as pose an excellent target for arsonists. A tire fire can burn for weeks, polluting the air and leaching hazardous chemicals into the ground.

Supply

It is estimated that 468,000 tires per year are collectable for recycling in New York City. The Department currently collects approximately 300,000 old tires annually on its residential collection routes and 40,000 from vacant lots (all of which are landfilled). The Department forbids commercial dumping of tires in the landfill but accepts tires which are included with residential waste. The Parks Department estimates that it can collect 80,000 waste tires and the Department of Transportation can collect 20,000 waste tires annually.

In addition, the Department of General Services (DGS) runs a collection facility in Queens for tires generated by City agencies. Approximately 20,000 tires annually are accepted and sent to an upstate firm which specializes in retreading tires. Currently, DGS is paid a nominal fee for the tires; however, this contract may not be renewed because the firm is seeking funding from DGS.

Currently, the Department has no tire recycling program in place, with the exception of a small pilot program in which tires collected by the Department at self-help bulk sites have been delivered to a vendor in Brooklyn. This program has not been successful, however, because the firm has not been able to identify a recycling market for the tires and is simply stockpiling them.

Demand

There are many tire recycling technologies available today; however, most are economically infeasible because of the high cost of converting a tire into a secondary product. Some methods are economically feasible but produce goods with limited marketability (Recycling Research Institute).

The two most promising methods of tire utilization are rubberized asphalt for the paving of roads and waste-to-energy incineration.

Rubberized asphalt is manufactured by mixing ground tires with regular asphalt. It currently costs twice as much as regular asphalt but can last between ten to 15 years. Many states (including New York) and cities have conducted tests using rubberized asphalt with mostly favorable results. Because New York State's report has not yet been officially released, the material has not been approved for use on state roadways.

Given the product's longevity, rubberized asphalt seems economically feasible as well as extremely marketable. But while it may be suitable for some roads, City DOT reports that many City roads are dug up by utilities on an average of every three years, making use of the product on these roads a costly proposition. Nevertheless, Sanitation believes that there may be specific applications worthy of further exploitation.

The two main methods of uses for scrap tires are rubberized asphalt paving and waste-to-energy incineration. Because new tire recycling technologies are developed each year, the Department will continue to monitor new products and processes.

COMPOST

A substantial potential market exists for yard waste compost. In some cases the compost material is sold to individual consumers. Prices for the material range from $ 1.50 to $ 21.00 per ton. The material is also made available for use at no charge, depending on the quality.

Supply

Yard waste compost may be produced from leaves, grass, and tree clippings. In the City, the main sources will be the numerous City-owned parks and residential yards in the outer boroughs. The Department's waste composition study indicates that four to five percent of the residential waste stream is yard waste (grass and brush).

Demand

There are a number of products and major user groups. These include soil amendments used in parks agencies, nurseries, top soil dealers, commercial agriculture, landfill cover, and mine reclamation (EPA, O'Brien & Gere).

Contractors are the single largest private-sector user group. As a rule, it is harder to break into the nursery market than into the landscape market. This requires more testing, such as growing trials conducted by an accepted authority.

The potential market for the City's yard waste compost are City agencies, landscaping firms, golf courses, and cemeteries.

Initially, it is advisable that compost from the Department be used as admixture for daily and final landfill cover because this is a natural market (O'Brien & Gere).

In April 1989, the Department surveyed 30 potential consumers of yard waste compost in the region. The survey yielded the following information:

- 21 of 30 firms expressed interest in end-products from the proposed yard waste compost;
- 16 firms anticipated an increase in market demand for the material; five believed demand would remain constant; the rest made no projections;
- The general specifications among the nurseries surveyed were that the product be sterilized, have good organic mix, be free of weed and contaminants, and be bagged;
- The landscapers expressed a preference to receive the material in bulk form;
- Prices quoted for bagged material ranged from $1.00 to $4.00 per 40-pound bag; and
- Prices quoted for bulk material ranged from $5.00 to $30.00 per cubic yard.

In 1986 the Cornell Cooperative Extension conducted a survey of Brooklyn nurseries and other potential compost consumers to discern their interest in the siting of a compost facility in that borough. Two-thirds of the respondents expressed interest in using material from the facility. This figure is identical to the one obtained by the

Department (21 out of 30) in the April 1989 survey. In addition, over a one-year period, 48 of the landscapers surveyed composted more than 23,000 cubic yards of yard waste.

Pricing

Some variables determining price are the price structure of competing markets, quality of compost, transportation, production, research & development, and marketing costs, as well as the volume of material which may be purchased by a single consumer (Segall, Razvi).

Large-volume buyers should be granted considerable discount. Even when revenue is not realized, costs could be avoided. For example, in Omaha, Nebraska, in excess of eight to ten dollars per ton is saved when the material is used for top soil in county parks rather than disposed of as solid waste (EPA). Yard waste not landfilled in the City would result in savings of at least $80 per ton, the current tip fee.

Marketing (Sales) Options

With the bag and bushel method, small scale gardeners could readily acquire the material. The bulk load pick up method permits those with vehicles to pick up the larger quantities needed. The home delivery method, a more costly endeavor, offers consumers, willing to pay, the luxury of having the material delivered (EPA, Segall).

To decide on the delivery method most suitable for the City, consumer preference should be determined through a survey, and the City's product quality assessed. If the initial compost loads are not of superior quality, then the best possible use would be as landfill cover.

Quality specifications are crucial for most uses. In the horticultural industry, which includes nurseries, landscapers, greenhouses, golf courses, and urban gardeners, compost of the "highest quality" is required. Commercial users require premium quality material with minimum odor, pH between six to seven, particle size no greater than 1/2" diameter, and no liming material. Home gardeners require specifications similar to the commercial standard. In addition, they require a moisture concentration of less than 40 percent. Nurseries that employ field-like conditions do not require the higher quality levels.

Further Research

While a ready market exists in City agencies to offset current expenditures, the Department should explore all available markets. It is advisable that a multiple marketing strategy be used for the City's compost because of the multiple uses available, the numerous methods through which it can be distributed, and the costs associated with each type of end use. For example, nurseries prefer the material in bagged form while landscapers prefer it loose.

It is recommended that product endorsement be sought from independent sources such as a university or a large greenhouse. This would increase product credibility and is especially crucial to realize revenues from the material. Increased acceptance is likely to increase sales.

Future areas of study will include a comprehensive market identification survey. The survey will establish the number of potential private retailers of compost material, estimated quantities consumed, and average selling prices.

Several new market studies will be conducted in FY 91. Their scopes of work are indicated in the following section.

Rock and Stone Aggregates

Market research on rock and stone aggregates will be conducted by a consultant contracted by the Department; this area includes rock, brick, asphalt, and concrete from construction and demolition in the City. This research will be a broad survey of processors of stone aggregates in the greater New York metropolitan region and will include a description of current technologies employed and prospects for improved processing efficiencies.

In addition, the scope of work includes an identification of sub-groups within the rock and stone aggregates' waste stream (concrete, brick, etc.) and products marketed, as well as the processors, public and private, that handle material generated in New York City.

The study will also examine the volumes of stone aggregates handled by these processors and their total capacity.An analysis of planned expansions of existing facilities and the projected future demand for stone aggregates material over the next five years (1990-1995) will also be conducted.

The project also involves an investigation into the obstacles and opportunities for expanding current markets. This will include an evaluation of the differences in cost to the consumer in the use of stone aggregates material versus virgin material, the environmental and economic impacts of expanding the manufacturing capability of processors of this material, and the estimated facility development costs for such plants. Possible new markets will also be considered.

Textiles

In FY 91, market research on postconsumer textiles will be conducted by a consultant contracted by the Department. The scope of work for the research will include a definition of the different textile grades found in the residential waste stream, as well as the processing and manufacturing specifications (amount and definition of permitted contaminants, shipping requirements, etc.).

The consultant will describe the flow of material from the level of primary residential consumption to secondary end use (e.g.industrial or commercial), including all intermediate levels of processing and the material specifications and level of separation required for acceptance of each grade of textile by manufacturers.

As in the rock and stone aggregates project, the Department will require that the consultant provide an overview of the present and anticipated technologies utilized for the processing and manufacturing of products containing recycled textiles, and supply and demand characteristics of the textiles market.

Mixed-Color Glass

The Department must find markets for the significant amounts of container glass it will collect in the future. In FY 90 research conducted for the Department predicted that the regional container manufacturing market would reach capacity within the next

five years. Demand is significantly greater when mixed-color markets are included in the equation, and so research in FY 91 will examine this area of the glass market.

The study will cover the total potential supply for the period 1990-1995, the volume collected through public and private recycling programs in the region through 1995, as well as the processing capacity and technologies for mixed color cullet.

The scope of work includes an identification of the products currently manufactured and an analysis of the demand for mixed color cullet, which will include a listing of facilities and their capacities planned or currently operating, for the period 1990 - 1995.

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APPENDIX IV

Recycling Enforcement Plan

The Department of Sanitation began issuing notice of violations (NOV's) in mid-August 1990. In July, the attached "Recycling Enforcement Plan" was prepared. Its purpose was to advise interested parties of this impending action and to provide them with information about the implementation schedule as well as a list of the violations for which NOV's would be issued.

OBJECTIVE

To commence issuing Notices of Violations (NOV's) related to improper recycling.

OVERVIEW

Local Law 19 establishes penalties for an enforcement program to be defined in the residential regulations and be implemented accordingly. Those regulations were finalized in January, 1990. This plan lays out the steps for implementation.

The Department sees the recycling enforcement program as an adjunct to its other recycling education and outreach efforts. Since November, 1989, Enforcement has issued over 30,000 warnings in community boards already recycling. Building owners and managers who have received four or more warnings were invited to meetings with the outreach staff to learn more about the requirements of the mandatory recycling program.

The general public has been informed of the law and regulations in a variety of ways. In April advertisements appeared in six major newspapers. From late May through the month of June paid public service announcements were broadcast on 17 different radio stations in both English and Spanish. Flyers announcing the responsibilities of tenants and landlords under the regulations were posted in such public places as libraries and grocery store bulletin boards and were mailed to all community boards as well as 4,250 civic associations and community groups on Community Assistance Unit's mailing list.

The enforcement officers for the recycling program were recruited from the ranks of Sanitation Workers who have been on the job for at least two years. They participated in a 49 day training program before being paired with experienced Sanitation Police for additional field training. Like other Sanitation Police they have received weapons training and carry guns. They now have more than six months experience writing warnings and educating building superintendents and local residents about the recycling program.

It is the intent of the Department of Sanitation to begin issuing NOV's in mid-August 1990.

PROGRAM DESCRIPTION

It is the policy of the Department of Sanitation not to issue NOV's in a community district until the recycling program has been in place for six months. In addition, when a new material is added for collection, e.g., plastic, no NOV's -- only warnings for that material -- will be issued until that material has been collected for six months.

The six month warning period is for the district, not the individual. Therefore, once the grace period has expired an individual may receive an NOV without ever having received a warning.

Officers determine whether a violation has occurred by examining the garbage, the recyclables, the recycling containers and, when necessary, the recycling collection system inside the building. To facilitate the examination of garbage or recyclables without risking litter problems, the officer may dump the contents of the container or bag into a clear plastic bag. The officers will use discretion in determining if sufficient recyclables are mixed with garbage to warrant an NOV.

Both warnings and NOV's are issued via "attempted personal service" i.e., the officer tries to meet with the responsible party to explain the violation. If unsuccessful the officer leaves a summons on-site and mails a copy to the building owner of record or resident. Educational material is included with the mailed copy.

There are seventeen (17) different violations, each with four levels of penalties: 1) First violation, $25; 2) Second violation, $50; 3) Third violation, $100; 4) Persistent violators (four or more violations, within a six month period), $500 per violation not to exceed $10,000 in a 24 hour period. Unless a building is in the persistent violator category, only one summons will be written at any given time.

These violations are:

1. Improper curbside recycling containers or improper use of recycling containers -- Curbside containers must be no larger than 32 gallons, with a lid, either Department distributed or identified by two Department-supplied recycling decals. Recycling containers may not be used for regular garbage;

2. Improper removal of the curbside recycling container;

3. Improper mechanized container or improper use of container -- Mechanized containers must be provided by the Department or meet the Department's specifications. Recycling containers may not be used for regular garbage;

4. Failure to inform/distribute/post required information about the recycling program;

5. Recycling storage area not accessible to residents;

6. Recycling storage beyond the property line;

7. Improperly maintained recycling storage area;

8. Tenant failure to properly dispose of designated/non-designated material;

9. Tenant failure to properly rinse/bundle recyclable materials;

10. Failure to properly bundle newspapers/corrugated cardboard for collection;

11. Failure to properly collapse cardboard for mechanized collection -- Corrugated cardboard must be cut up so as not to jam the container. (The Department prefers to collect corrugated through the curbside program);

12. Mechanized recycling collection area inaccessible;

13. Mixed material out for recyclable curbside collection on recycling day (garbage in the recyclables);

14. Mixed material out for non-recyclable curbside collection on non-recycling day (recyclables in the garbage);

15. Mixed material out for recyclable mechanized collection on recycling day (garbage in the recyclables);

16. Mixed material out for non-recyclable mechanized collection on non-recycling day (recyclables in the garbage);

17. Failure to comply with required alternative disposal (transparent bags or other means) as required by the Commissioner.

IMPLEMENTATION

Community boards and elected officials for districts recycling longer than six months will receive a letter indicating that the issuance of recycling NOV's will begin in mid-August 1990.

In the future, notification of the start date for enforcement will be sent to community boards and elected officials during the fifth month. Public Relations will issue a press release to the local newspapers. Enforcement will schedule the use of sound cars with recorded messages announcing the end of the warning period.

APPENDIX V

Interagency Cooperation

If recycling opportunities are to be maximized, the cooperation and concentrated effort of other City agencies will be required. This cooperation will involve certain difficulties -- managerial and limited financial resources will have to be reallocated and a certain amount of inconvenience endured. The Department recognizes these difficulties and is willing to work with the relevant parties to resolve them.

The following is a list of agencies and issues, apart from compliance with the City agency recycling regulations, that must be attended to -- the starred items are already being addressed:

Board of Education

*Develop and introduce recycling curriculum

Develop a recycling program that includes collection of recyclables from the classroom and the cafeteria

*Resolve the role of the custodial union in handling recyclables in schools

Buildings Department

Revise building codes to require space for the collection and storage of recyclables

Coordinate with the Fire Department on establishing codes for the storage of recyclables

Evaluate new materials with recycled content (e.g., plastic lumber) for use in New York City

City Planning

*Develop zoning regulations for transfer stations and processing centers

Assist in potential site identification for processing facilities and industries utilizing secondary materials

Consumer Affairs

*Coordinate with DOS on the promulgation of regulations controlling private carters, the commercial generators, pre- and post-collection separation of recyclables, and the collection of data regarding same

Cultural Affairs

*Develop a DOS-funded project for arts groups and not-for-profits to reuse furniture and materials donated by the commercial sector

Department of General Services

*Develop specifications for the procurement of goods with recycled content

*Develop specifications for the procurement of reusable goods and of equipment that supports waste reduction, e.g., copiers that conveniently produce double-sided copies

*Evaluate new products with recycled content for City use

With Office of Municipal Labor Relations resolve union issues to enable maintenance collection of recyclables in all DGS managed buildings

Design space for the collection and storage of recyclables in all new City construction and renovation

Department of Environmental Protection

Explore sharing compost sites and co-composting of sludge with food waste

Consult with DOS on household hazardous waste programs and used oil recycling

Department of Transportation

*Pioneer the recycling of mixed glass into glassphalt

Pilot rubberized glassphalt

Fire Department

*Develop policy regarding the storage of recyclables in apartment buildings, office buildings, and schools

Health and Hospitals Corporation

*Consult with DOS on the development of recycling regulations for patient care areas

Housing, Preservation and Development

*Ensure participation in all HPD owned or managed buildings

Build space for the collection and storage of recyclables in all new construction and renovation

Housing Authority

*Redesign the collection program to increase its convenience for tenants; resolve union issues related to maintenance staff handling recyclables

Parks

*Evaluate the potential for shared composting facilities and/or use of park property for DOS composting

APPENDIX VI

Tonnage Goal Assumptions

The Department conducted a set of sensitivity analyses for each of the recycling programs. These "what if" scenarios enable us to simulate some of the unknown factors and assumptions used in recycling tonnage projections.

Any projection inherently is limited by certain factors -- participation, composition, capture and diversion rates, and industry/consumer trends -- and these in turn affect the amount of recyclables that can be diverted from the waste stream and consequently the collection, processing and marketing efforts needed. While these factors were considered in our projections, they require further and more complex analysis to improve the confidence level we and others have in the Department's tonnage projections.

The factors simulated in these analyses were program specific, and minimum, medium and maximum tonnage estimates were projected for each program for FY 91, 92, 93 and 94 (see Exhibit AVI.1). In addition, the aggregate Department-collected ton per day (tpd) projections were compared to the LL 19 mandated Department-collected tpd goals. From these projections it appears that, given presently planned programs, the Department is likely to meet the FY 91 mandate, may meet the FY 92 mandates, and is unlikely to meet the FY 93 and 94 mandates.

EXHIBIT AVI.1
SENSITIVITY ANALYSIS FOR
DEPARTMENT COLLECTED WASTE
(TONS PER DAY)

PROGRAM		FY 91	FY 92	FY 93	FY 94
Curbside/Containerized	MIN	750	1000	1100	1100
	MED	800	1100	1250	1250
	MAX	950	1400	1700	1800
Residential Bulk	MIN	83	100	100	100
	MED	125	150	150	150
	MAX	161	171	182	193
Lot Cleaning	MIN	175	259	259	259
	MED	305	450	450	450
	MAX	447	518	589	659
Self Help	MIN	66	88	88	88
	MED	90	120	120	120
	MAX	302	335	369	402
Yard Waste	MIN	4	4	106	106
	MED	7	7	235	235
	MAX	15	15	360	441
Free Disposal	MIN	20	40	80	120
	MED	35	60	105	220
	MAX	50	70	150	300
Recycled Asphalt	MIN	100	125	150	200
	MED	120	150	200	250
	MAX	150	200	250	300
Contractual	MIN	30	30	30	30
	MED	35	45	55	65
	MAX	40	50	60	70
TOTAL	MIN	1228	1646	1913	2003
	MED	1517	2082	2565	2740
	MAX	2115	2759	3660	4165
Mandated Goal		1400	2100	3400	4250
Med - Mandated		117	-18	-835	-1510

Recycling Department Collected Waste Projection Assumptions:
Curbside/Containerized

These tonnage projections do not reflect the effects of enforcement, or the possible increase in overall diversion generated by the addition of plastics in a district. This is due to the fact none of the above mentioned variables were in effect prior to FY 91 and therefore are not reflected in the historical information upon which these projections were based.

The capture rate (the percent of material actually put out for collection versus the total amount available) of plastics and corrugated cardboard is uncertain. Our experience with corrugated recycling is very limited and our experience with plastic recycling is based only on the intensive recycling pilot study conducted in FY 90.

Based on available data, the capture rate for corrugated cardboard is significantly lower than that of newspaper, which requires only bundling whereas corrugated requires cutting, folding and bundling.

In the case of plastics, we assume that the capture rate for plastic beverage containers, which do not require much cleaning, will be higher than that for other plastic containers such as margarine bowls, which require more cleaning. Products which consist of plastic and metals (e.g., toys) are problematic because residents may not be willing or able to remove the plastic portion of this item for recycling.

The film/bag plastic composition numbers derived in the Waste Composition Study included both plastic garbage bags and plastic shopping bags. Because plastic garbage bags are use for the purpose of packaging the non-recycable portion of the waste stream -- raw garbage -- they were not included in our projections of recycable tonnage. While some plastic shopping bags are also use to package raw garbage, the majority of these bags are not use for that purpose. In future these plastic shopping bags are likely to be designate as recyclables. Therefore, the percentage of plastic shopping bags which is not used to package raw garbage was included in our tonnage projections.

The projections for the curbside/containerized program are based on the following assumptions:

Minimum Projections

- Based on the historical trend of diversion rates across the various income and density strata, the average strata specific paper diversion rate, ranging from 20 to 51percent and the average metal, glass and plastic diversion rate ranging, from 15 to 40 percent, form the basis of this scenario.

- Preliminary analysis suggests that there is no statistical evidence to support the original White Paper assumption that diversion rates, after the initial 12 months a district is on the program, grow over time. Therefore, for this scenario growth in initial diversion rates was not considered.

- The concentration/content of corrugated cardboard in the waste stream is two percent.

- The concentration of plastic, including rigid plastics but exclusive of redeemable plastic bottles, is two percent of the total waste stream.

Medium Projections

- The first two assumptions are the same as the minimum projections.

- The concentration/content of corrugated cardboard in the waste stream is three percent.

- The concentration/content of plastic, including rigid plastics but exclusive of redeemable plastic bottles, is three percent of the total waste stream.

Maximum Projections

- Based on the historical trend of initial diversion rates across the various income and density strata, the strata specific paper diversion rate ranging from five to 30percent and the metal, glass and plastic diversion rate ranging from five to 32 percent form the basis of this scenario.

- Preliminary analysis suggests that there is no statistical evidence to support an assumption that after the first 12 months of initial growth, diversion rates continue to grow over time. That analysis, however, did not take into account the effects of new educational strategies and enforcement. Therefore, this scenario takes into account a monthly growth rate over the initial diversion estimates.

- Monthly growth in initial diversion rates for paper variedby strata from 0.5 to 1.2 percent with the maximum diversion rate of 70 percent across all strata.

- Monthly growth in initial diversion rates for metal, glass and plastic varied by strata from 0.2 to 1.1 percent with the maximum diversion rate of 50 percent across all strata.

- The concentration/content of corrugated cardboard in the waste stream is five percent.

- The concentration/content of plastic, including rigid plastics and plastic shopping bags, is five percent of the total waste stream.

Bulk Programs

In the bulk programs, key factors to exploit are material expansion, including market development, and recovery performance improvements. Program specific variation among the bulk programs are far greater than variations among the curbside and containerized programs. This is explained by the fact that the amount of uncertainty in the bulk program is proportional to the Department's lack of experience with this program. Secondly, the discarding of bulk items is more dependent upon economic conditions than are the materials targeted for the curbside and containerized programs.

Improvements in all three bulk programs (residential, self help and lot cleaning) can be realized by working with private vendors to improve their recovery performance of recyclable material from the mixed residential material the Department delivers and by examining current markets and expanding new markets and uses for bulk items which frequently are found in the bulk waste stream. For example, the use of construction and demolition waste as cover for the landfill can be achieved through the use of a rock crusher. The Bureau of Waste Disposal already has purchased a rock crusher which will enable the Department to process more than 1,000 tpd.

If an existing market can be found, or a market can be established for mattresses and upholstered furniture, the tpd recycled can be increased significantly. Although upholstered furniture contains some of the currently targeted materials (metal and wood) extraction of these materials is extremely labor intensive.

Residential Bulk

The projections for residential bulk are based on the following assumptions:

Minimum Projections

- A recyclable pool of 50 percent and a vendor recovery rate of 40 percent;

Medium Projections

- A recyclable pool of 50 percent, and a vendor recovery rate of 60 percent;

Maximum Projections

- A recyclable pool of 50 percent, and a vendor recovery rate growing from 70 to 85 percent.

Lot Cleaning

The lot cleaning projections are based on the following assumptions:

Minimum Projections

- The number of screen-all machines for FY 91 and 92 are 12 and 18, respectively;
- A recovery rate of 50 percent;

Medium Projections

- The number of screen-all machines for FY 91 and 92 are 18 and 25, respectively;
- Self help bulk sites will process in FY 91 and 92, five percent and ten percetn, respectively of the material collected by lot cleaning crews;
- A recovery rate of 50 percent;

Maximum Projections

- The number of screen-all machines for FY 91 through 94 will be 25;
- Self help bulk sites will process in FY 91 and 92, ten percent and 25 percent, respectively of the material collected by lot cleaning crews;
- In FY 93, self help bulk sites will process, for the firsttime, construction and demolition material collected by the lot cleaning crews;
- In FY 94 the recovery rate will increase to 60 percent because the Department will, for the first time, recycle construction and demolition material collected by screen all crews.

Self Help Bulk

The self help projections are based on the following assumptions:

Minimum Projections

- The number of self help sites operating in FY 91 and 92 will be six and seven respectively;

Medium Projections

- In FY 91, seven self help sites will be operating;
- Starting in FY 92, six sites will be equipped with screen-alls and wood chippers enabling dirt to be processed, therefore, the recyclable pool will increase to 30 percent;

Maximum Projections

- In FY 91, seven self help sites will be operating;
- Starting in FY 91, six sites will be equipped with screen-alls and shredders enabling dirt and construction and demolition material to be processed;
- The recovery rates for construction and demolition material will grow from 50 percent in FY 91 to 80 percent in FY 94;

Yard Waste

To date we have limited experience with either the collection of or the actual composting of the organic material. The percent of material recovered from the tons collected depends on the end use of the finished product. For example, if the finished product is to be used as fertilizer, we can expect that only 70 percent of the tons collected will be recycled, and there will be a 30 percent residue. If the composted material is to be used as cover, we can expect to recover 100 percent of the material.

The percent of recovered or recycled composts depends on the type of composting method used by the Department, open windrow -- where the organic material is put into long parallel piles and periodically turned over, or in-vessel -- where the material is put into some type of container in which chemicals are added to speed the composting process. Depending on the method used, each process generates a different recovery rate.

Another factor which will affect the tpd of leaf and yard waste recycled is the implementation of a master composting plan, which would enable residents independently to compost their own material in their back yards.

The spring yard waste implementation schedule includes one section of Staten Island 3 in FY 91 and 92. In FY 93 the program will be expanded to include 33 districts for three seasons (spring, summer and fall).

The yard waste projections are based on the following assumptions:

Minimum Projections

- A composition of three percent and a diversion rate of 30 percent;

Medium Projections

- A composition of four percent and a diversion rate of 50 percent;

Maximum Projections

- A composition of five percent and a diversion rate of 75 percent;

Free Disposal

The free disposal program includes city agency collection of recyclables, based on the following targeted materials: newspaper, magazines, corrugated, metal, glass, plastic, office paper, bulk, and yard waste (Parks Department). Success of the program in terms of all of the materials depends on the cooperation of management, custodians and staff. The collection of the recyclable material in the free disposal program can be performed by either the Department, which requires source separation by building personnel and additional Department personnel and truckshifts, by the city agency itself or by private carters. If the agency in question decides to recycle on their own or to contract out to a private carter, then the question of source separation or post collection separation is up to the agency. Depending on the choice of collection agent, the Department or a private carter, a different diversion rate, implementation schedule and cost will be realized.

The total pool of recyclables in the institutional sector is almost twice that of the residential sector but, in order to realize this potential, cooperation at every level of staff is critical.

The projections for free disposal are based on the following assumptions:

Minimum Projections

- In FY 91 city agencies recycle office paper at currentlevels;

- Beginning with FY 92 and continuing through FY 94 diversion rates for other recyclable materials (in addition to office paper) will grow from five to 30 percent;

Medium Projections

- In FY 91 city agency office paper is recycled at its current level and three percent of other recyclable material is diverted;

- Beginning with FY 92 and continuing through FY 94 diversion rates for other recyclable materials (in addition to city agency office paper) will grow from ten to 50 percent;

Maximum Projections

- In FY 91 city agency office paper is recycled at its current level and seven percent of other recyclable material are diverted;

- Beginning with FY 92 and continuing through FY 94 diversion rates for other recyclable materials (in addition to office paper) will grow from 12 to 75 percent;

Recycled Asphalt

The amount of asphalt the Department of Transportation recycles is constrained by the need for an additional asphalt plant. It is important to note that the addition of glass to asphalt (glassphalt) and the recycling of asphalt are two separate programs. Recycled asphalt refers to the reuse of asphalt that has already been used to pave a street, while glassphalt refers to the addition of crushed glass to asphalt.

The projections for recycled asphalt are based on the following assumptions:

Minimum Projections

- Department of Transportation will have one plant operating in FY 91 , FY 92 and FY 93 using seven, eight and ten percent old asphalt, respectively;

- In FY 94 two asphalt plants will be operating; each using seven percent old asphalt as a component in the production of new asphalt;

Medium Projections

- Department of Transportation will have one plant operating in FY 91 through FY 92 using eight and ten percent old asphalt, respectively;

- In FY 93 two asphalt plants will be operating -- each of which will use seven percent old asphalt and in FY 94 this will increase to eight percent;

Maximum Projections

- Department of Transportation will have one plant operating in FY 91 using ten percent old asphalt;

- In FY 92 two asphalt plants will be operating -- each of which will use seven percent old asphalt, and in FY 94 this will increase to ten percent.

Contractual

By FY 94, it is projected that a total of five buyback centers will be operating. As each of these sites open, there will be an increase in the tonnage recycled by this program. Participation will depend on the site's location, ease of access and the amount of payment for the material delivered.

The contractual projections are based on the following assumptions:

Minimum Projections

- The current level of one buyback center and one redemption center is maintained;

Medium Projections

- The number of buyback centers will grow from two in FY 91 to four in FY 94. In addition, two redemption centers will open in FY 92;

Maximum Projections

- **The number of buyback centers will grow from two in FY 91 to five in FY 94. In addition, two redemption centers will open in FY 92;**

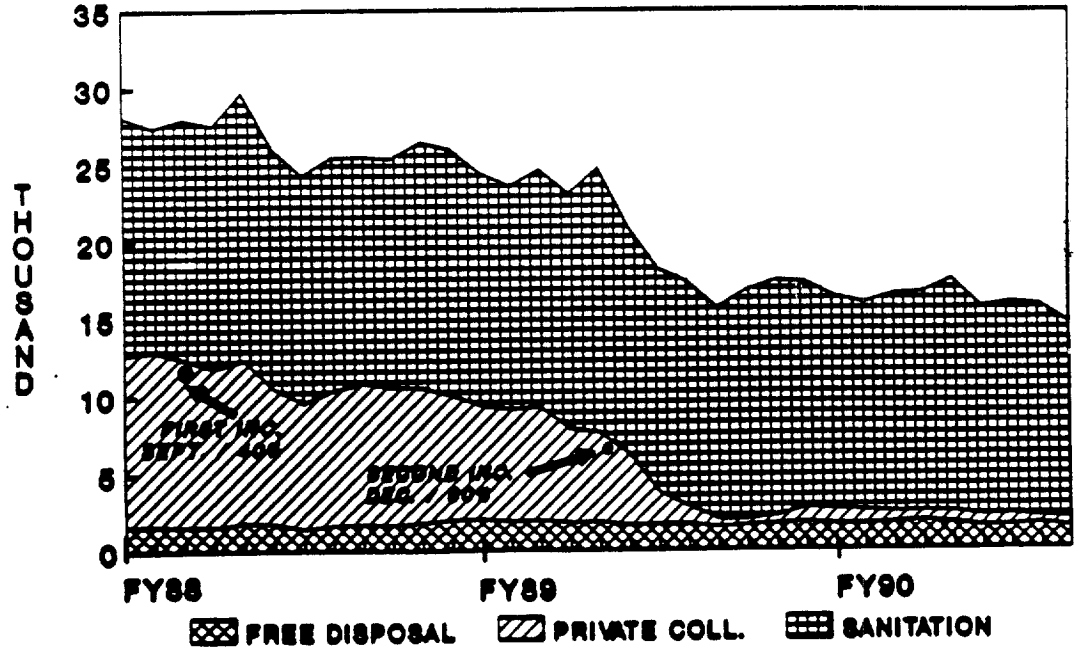
Commercial Waste

Prior discussion in this section (Tonnage Goals) refers to Department-collected projections. Before discussing the commercial projections themselves, several issues must be clarified.

Local Law 19 mandated goals for both Department-disposed and Department-collected waste streams. The difference between Department-disposed and Department-collected is the amount of recyclables Local Law 19 expects to be collected by commercial/private carters.

In July of 1988 private carters disposed of 13,000 tpd at City landfills; by the time of Local Law 19, the figure decreased to 1,000 tpd (see Exhibit AVI.2). The reasons for this drastic reduction is explained in Chapter III.

EXHIBIT AVI.2
DOS Waste Disposal
(FY 88-90)



Prior to the enactment of Local Law 19, private carters already recycled a portion of their waste stream. For the purpose of these projections, we estimate pre-Local Law 19 commercial recycling as 25 percent of the commercial waste generated. The recycling taking place prior to Local Law 19 cannot be included toward meeting the mandated goals, and is thereby referred to as the baseline.

Projections were established for three ranges in the commercial sector, minimum, medium and maximum. As can be seen in Exhibit AVI.3, it appears that commercial recycling will fall short of the mandated goal, even considering the optimistic (maximum) projections.

EXHIBIT AVI.3
Project Commercial Recyclables Diverted
Tons Per Day

	Baseline	90	91	92	93	94
MIN	2817	3214	3462	3834	4279	4527
MED	2817	3362	3610	4183	4555	4952
MAX	2817	3610	4055	4575	4948	5424
Median net of baseline:		545	793	1366	1738	2135
Mandated Goal:		730	1470	2200	2340	2930
Surplus or Shortfall:		-185	-677	-834	-602	-795

Source: New York City Waste Composition and Generation Study.

Projection Assumptions

The assumptions used to calculate the baseline and the three ranges are described below.

In determining the baseline, the Department assumes that private carters base recycling decisions on economies of scale, separating only highly concentrated recyclables in order to offset the extra cost of separate collection or post-collection separation. The baseline estimates consists of 75 percent of office paper from large office buildings, 50 percent of corrugated from food, drug and general retail/wholesale, 100 percent of office paper from printing and publishing, and 80 percent of citywide wood and ferrous scrap.

The overall commercial recycling projections for FY 91 - 94 are based on the following assumptions which are above the baseline:

Minimum Projections

- Paper diversion rates grow from 15 to 60 percent;
- Metal and glass diversion rates grow from 10 to 45 percent;

Medium Projections

- Paper diversion rates grow from 20 to 75 percent;
- Metal and glass diversion rates grow from 15 to 50 percent;

Maximum Projections

- Paper diversion rates grow from 30 to 80 percent;
- Metal and glass diversion rates grow from 20 to 75 percent;

As in the public sector, the commercial projections assume adequate processing capacity and markets to purchase recyclables.