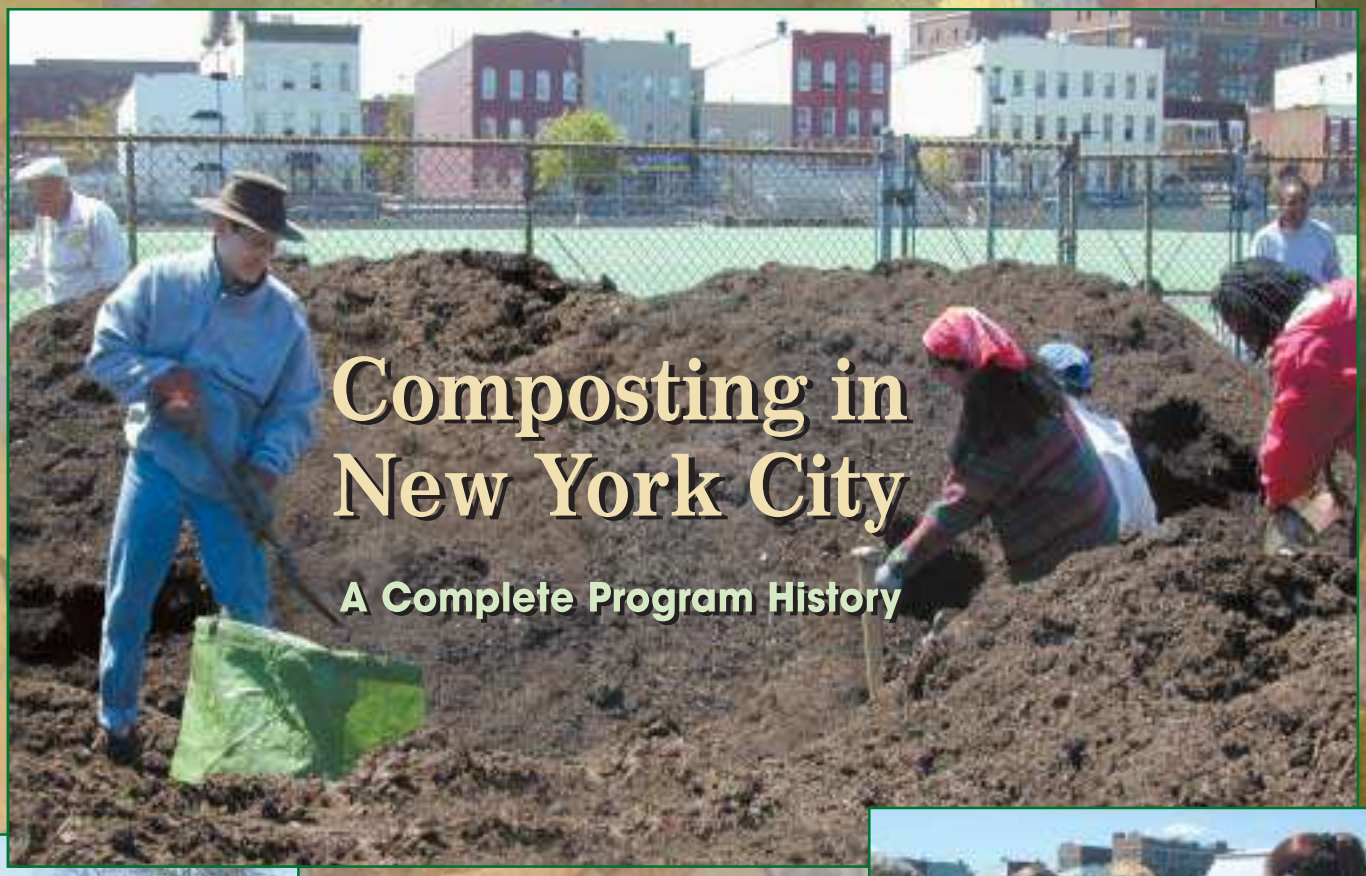
New York City Department of Sanitation

Kevin P. Farrell
Commissioner



Composting in New York City

A Complete Program History

Prepared by

Bureau of Waste Prevention, Reuse and Recycling
Robert Lange, Director

August 2001

Table of Contents

List of Tables

Abbreviations and Definitions

Agitated Bay	Compost technology comprised of concrete channels or bays through which material is slowly pushed as it is periodically turned by an overhead flail or agitator.
Biofilter	An engineered bed of soil, compost, and/or woodchips covering a distribution system of perforated pipes. Contaminated air is blown into the perforated pipes and biologically "scrubbed" of odor-causing compounds as it diffuses up through the filtration media.
Capture Rate	Weight of recyclables collected divided by the total weight of recyclables present in the waste stream.
Centralized Composting	Strategy for capturing the organic fraction of the waste stream, whereby material is collected from a number of outlets and brought to a centralized facility for composting.
Compost	A dark, crumbly, nutrient-rich material resembling topsoil. The end product of the controlled decomposition process known as composting.
Composting Drum	A large, rotating, cylindrical vessel (resembling an elongated concrete mixer) used at composting facilities.

Compost Givebacks	Events held in the spring and fall around NYC, where compost made by the Department is distributed free of charge, and backyard compost bins are sold at a subsidized price to City residents.
Compost Project	A compost outreach and education program sponsored by the Department of Sanitation and run through the City's Botanical Gardens.
Curing	Maturation period required for compost to become stable and nontoxic to plant life.
Decentralized Composting	Strategy for capturing organic fraction of the waste stream, whereby composting operations are set up at a number of decentralized locations. See also "On-Site Composting."
Department, DOS	NYC Department of Sanitation
Districts	One of the 59 administrative districts of NYC whose Boards advise Borough Presidents and City agencies on planning and services. Sanitation Districts, designated by the NYC Department of Sanitation for operational/administrative purposes, contain the same boundaries as community districts.
In-Sink, Food-Waste Disposals	Motorized grinder attached to sink, which pulverizes food waste for disposal in septic systems or sewer drains.
In-Vessel, Food-Waste Composting	The controlled decomposition of food waste in an enclosed container.
Leave it on the Lawn	A public education campaign designed to get New York City residents and their landscapers to not bag grass clippings for collection.
MGP	Metal, glass, and plastic items collected in municipal recycling programs
Non-Source-Separated	A waste management strategy where the responsibility for segregating targeted material is transferred from the generator to the processor.
NYCHA	New York City Housing Authority
On-Site Composting	A strategy where composting operations are set up at the site of waste generation.
Organic	Material derived from living or once-living organisms.
Windrow Turner	Any piece of machinery used to flip or agitate piles of composting material in order to introduce oxygen.
Source-Separated	A waste management strategy where generators segregate designated materials for separate collection and processing.
Tipping Floor	The area of a waste-processing facility designed to accept incoming material.
Trommel	A revolving sieve shaped like a cylinder used for screening and sizing compost.
Windrow	An elongated pile into which organic materials are formed during the composting process.

Director's Note

The New York City Department of Sanitation ("Department" or "Sanitation") is responsible for collecting and disposing of roughly 12,000 tons of waste generated by City residents and public institutions each day. A private sanitation infrastructure exists to handle the additional 12,000 tons per day of commercial waste generated in New York City.

The Department of Sanitation's Bureau of Waste Prevention, Reuse and Recycling (BWPRR) derives its name, as well as its mission, from the U.S. Environmental Protection Agency's hierarchy of preferred waste management practices: Reduce, Reuse, Recycle. Through a variety of initiatives, BWPRR encourages New York City residents, government agencies, and private businesses to prevent waste before it occurs. BWPRR also administers the strategic planning and public education for the Department's various recycling programs.

Items currently collected in the Department's curbside recycling program include mixed paper, beverage cartons, bottles, cans, metal, and foil. Citywide, the recycling program diverts about 20 percent of the waste stream from disposal. This translates into 2,200 tons of material recycled daily.

The organic portion of the waste stream—materials such as leaves, grass, yard waste, food scraps, and non-recyclable paper—can be recycled into *compost*. Compost is a product similar to topsoil, and depending on its quality can be sold to landscapers; used to beautify City parks, ball fields, and gardens; distributed to City residents; or used as final cover for highway landscaping and landfill projects.

BWPRR formally incorporated composting into its larger recycling program in 1990 when the Department composted 1,000 tons of leaves under a pilot project at the Edgemere landfill in Queens. The program

Recyclable materials at the curb.



Examples of some of the Department's composting programs: fall leaf collection, on-site composting at City institutions, and food-waste composting on Riker's Island.

has grown significantly since then. Today, the Department diverts an average of 47,000 tons of organic material a year from export and disposal. This organic material includes:

- 20,000 tons of leaves collected in 34 of the City's 59 Districts.
- 7,500 tons of food waste (including wood chips) from five Riker's Island prison facilities.
- 2,500 tons of Christmas trees.
- 7,000 tons of private landscaper yard waste.
- An estimated 10,000 tons of grass clippings and leaves that are handled on site by City institutions with technical assistance and education from the Department.

To accomplish the diversion of this much organic material, the Department oversees a wide variety of composting operations and educational projects. These include:

- A separate leaf-composting site in each borough except Manhattan.
- The nation's largest in-vessel, food-waste-composting facility at Riker's Island.
- Citywide compost distribution to parks, ball fields, community gardens, and public greening projects.
- Unique public education programs through the City's four Botanical Gardens.
- Pilot projects to assess the potential of different composting techniques to divert additional organic material from the waste stream.

How much organic or biodegradable material is actually in New York City's waste stream? A recent snapshot of a "typical" community reveals an interesting answer. In February of 2001, the Department conducted a one-week, waste-characterization study in Staten Island District 2, a low-density district with a recycling diversion rate close to the citywide average. **Post-recycling, the study revealed that 55 percent of the waste stream is biodegradable.**[1] This includes paper products, food, yard waste, and other

[1] For qualifications and methodology, please see Appendix I.

Collected leaf and yard waste is de-bagged and then placed in rows to degrade.

The material is later screened to produce finished compost.

readily biodegradable items that do not fit into these categories, such as diapers, animal feces, and cut flowers.

Composting represents an important option as the City looks to increase its recycling rate in the face of the closure of its last active landfill and the mounting cost of exporting garbage. What is the best way to extract and compost this biodegradable component from the City's waste stream? Any answer to this question needs to take into account NYC's dense urban environment, where space is limited and valuable, and compost facilities are difficult to site.

Through a number of pilot and ongoing programs over the past ten years, the Department has looked at two overarching strategies to recover the compostable fraction of the residential and institutional waste stream: centralized composting and decentralized (or on-site) composting. The centralized strategy involves collecting organic material and transporting it to a centralized facility for composting. The decentralized approach entails composting organic material at the site of generation. This report summarizes the Department's experiences as well as its recommendations for advancing the most promising aspects of each approach.

I would like to thank Venetia Lannon, Deputy Director of Composting at the Bureau of Waste Prevention, Reuse and Recycling, for her contributions to this report, as well as her two predecessors, Robert LaValva and Thomas Outerbridge.

Robert Lange
Director
Bureau of Waste Prevention, Reuse and Recycling

What Is Composting?

Composting—as opposed to natural decomposition—is the biological decay of organic matter under controlled conditions that produces a finished product similar to humus, the naturally occurring organic fraction of soil. The composting process uses as its raw material organic matter, which can be loosely defined as anything derived from once living organisms. Microorganisms such as bacteria, molds, and fungi carry out the decomposition, which is aided by the physical breakdown of material by small insects such as mites, millipedes, and earthworms.

Optimal conditions for composting are formed by three principal parameters: moisture content, carbon:nitrogen (C:N) ratio, and oxygen. Ideally, the composting mix will have a 55 percent moisture content, and a blend of both carbon-rich materials ("brown" substances such as wood, paper, and dried leaves) and nitrogen-laden wastes ("green" plant cuttings, grass clippings, and food wastes) so that the carbon to nitrogen or C:N ratio is about 30:1. Additionally, the mix should be kept well aerated. Such conditions promote the efficient breakdown of organic wastes over a period of months, while preventing anaerobic and/or unbalanced conditions which result in the formation of noxious or odoriferous compounds (such as hydrogen sulfide, cadaverine, and putrescine), as well as alcohols and acids that can harm plants.

Finished compost is used to enrich and stabilize soil. It promotes availability of nutrients to plants, and prevents erosion in sandy or clay soils by holding in moisture and inorganic materials. Compost attracts and nourishes earthworms, whose tunnels aerate the soil and improve drainage, bringing up minerals from the subsoil. Although compost is not considered fertilizer, it contains plant nutrients and essential trace elements which release slowly into the earth. Compost may be applied as mulch or mixed into soil on farms, in residential yards and gardens, in street tree planters, or in parkland and other property.

Two Models for Centralized Composting: Source Separated and Mixed Material

To recover the organic fraction of the residential and institutional waste stream, the Department of Sanitation has employed two basic strategies: centralized composting and decentralized (or on-site) composting. In centralized composting, organic material is collected at the point of generation and brought to a centralized facility for processing. In decentralized composting, on the other hand, the organic material is treated on site instead of being transported to a central facility. The following section will describe the Department's experiences with centralized composting.

Within the centralized composting approach there are two different models for recovering organic waste. The first model, commonly known as source separation, is employed by most curbside recycling programs. This model requires the generator of the waste to separate out the desired material at the source before it is collected and transported to a centralized composting facility.

The second model, not based on source separation, resembles the mixed-waste-processing approach for recovering recyclables. Organic material is collected together with other waste, just like traditional garbage collection. The mixed material is then brought to a centralized facility, where the biodegradable element is separated out for composting using a variety of methods.

As the following sections will detail, the Department has pursued both models. A permanent source-separation program for leaf and yard waste is in place, and the Department has conducted several pilots to examine the feasibility of implementing source-separated, food-waste collection for residents and institutions. Regarding the mixed-material approach, the Department recently completed a pilot project to examine the potential in New York City for this type of centralized composting.

Centralized Composting: Source-Separated Leaf and Yard Waste

Fall leaf and yard-waste collection is a source-separated, centralized program which has proven to be very successful and relatively economical. For a several-week period each fall, the Department provides separate collection for fall leaves and yard waste (small brush, Halloween pumpkins, etc.) to 35 of the City's 59 Districts.

Fall leaves at the curb for Department of Sanitation collection.

The program began on Staten Island in 1990 when the Department opened its first yard-waste composting facility at the Fresh Kills landfill. Since that time, an average of 3,200 tons per year of leaves collected from Staten Island have been taken to the facility for composting. The Department also accepts approximately 7,500 tons per year of yard waste from private landscapers at this facility.

Leaf and yard-waste collection was expanded in 1997, as recommended by the Mayor's Task Force Report on closing the Fresh Kills landfill. That year, the Department collected 1,200 tons of leaves from Bronx Districts 7, 8, 10, 11, and 12. Program expansion continued in 1998 with the inclusion of 12 Brooklyn Districts, which resulted in the collection of an additional 1,900 tons of leaves. When all 14 Queens Districts were added in 1999, the Department collected nearly 10,000 tons of leaves in that borough alone, and over 19,000 tons of leaves citywide. (See Table 1 for a summary of program implementation.)

Newspaper ads and posters on collection trucks remind NYC residents about the fall leaf collection program dates.

Table 1

Summary of Fall Leaf Collection Program Implementation

Date	Borough	Community Districts
1990	Staten Island	All 3 Districts
1997	Bronx	7, 8, 10, 11, 12
1998	Brooklyn	2, 5, 7, 9, 10, 11, 12, 14, 15, 16, 17, 18
1999	Queens	All 14 Districts
2000	Brooklyn	6

In fall 1998, the Department piloted a new leaf collection schedule whereby residents were asked to place leaves at the curb on three alternate Saturday evenings for pick-up by the Department the next day. As leaves were the only material at the curb, this Sunday collection schedule resulted in high truck efficiencies (7.2 average tons/truck compared to 4.8 in 1998) and led to a substantial increase in total tonnages collected. (Previously, residents in leaf collection districts were asked to place their leaves on the curb the day *after* their recycling collection day.) The additional benefit of a Sunday collection was that no other material was set out on the curb that day, thereby reducing the possibility of confusion and contamination.

The Department collects leaves in 35 of the City's 59 Sanitation Districts.

The Department mails a postcard to all residents and institutions in leaf collection districts to provide relevant program information.

Facility Siting

Concerns about the cost and related impacts of trucking leaves from every borough to Fresh Kills on Staten Island, as well as the desire to have finished compost available at decentralized locations, led the Department to consider alternate facility options. City parks seemed like a natural fit. In fact, Department staff began exploring the potential for combined Sanitation/Parks Department composting sites not long after the Fresh Kills facility was constructed in 1990.

Discussions with the Parks Department—in particular with the Parks Natural Resources Group—led to the creation of a Memorandum of Understanding, signed by the Commissioners of Parks and Sanitation in October 1997 (see Appendix II). Under the terms of the agreement, in exchange for the temporary use of Parks' sites, Sanitation agreed to utilize the compost produced for environmental

restoration or other Parks' maintenance and beautification projects citywide.

It is important to understand that the Parks Department sites that Sanitation has used for its composting operations do not constitute "parks" in the popular sense of the word. Rather they comprise large, vacant, often undesirable tracts of land, which have been placed under the jurisdiction of the Parks Department for potential rehabilitation at an unspecified, future date. These sites are generally former landfills overgrown with invasive plant species, where illegal dumping often occurs.

The Department of Sanitation uses marginal Parks Department properties to compost the City's leaf and yard waste; these properties have often been the site of prior illegal dumping .

In 1997, Sanitation began composting leaves in a portion of Ferry Point Park in the Bronx. The following year a site was developed in Canarsie Park to accept Brooklyn leaves. Since 1999, Queens leaves have been taken to a Parks' site in Idlewild, by Kennedy Airport.

While the cooperative venture between Sanitation and Parks is sound in principal, it has proven difficult to dedicate sites for long-term composting operations. For example, Sanitation was asked to vacate the Ferry Point Park site in early 2000 to allow for development of a new City golf course on the premises. A new composting site was therefore developed in Soundview Park. Other pressures are currently forcing the Department to vacate its composting area in Canarsie Park and Idlewild Park. The limited, long-term availability of Parks' sites places Sanitation in the difficult position of needing to locate new acreage for composting, with only a limited pool of sites that meet the necessary requirements in terms of acreage and setback distances from residences.[2]

Facility Operations

In brief, the facilities operate as follows. Most leaves arrive at the site in plastic bags (see discussion on page 15 about the preference for paper bags). Leaves are removed from the bags using a trommel screen with blades, which both tears open the bags and reduces the size of the leaves.

Leaves waiting to be de-bagged at an NYC compost site.

[2] Additionally, sites that can be used for more than seven years may be paid for out of the City's capital budget. Sites that must be "vacated" in less than seven years have to be developed using monies from the City's annual expense budget.

At compost sites, collected leaves are passed through a trommel screen to remove the plastic bags and reduce the size of the leaves.

De-bagged leaves are then placed in piles approximately 12 feet wide, 8 feet high, and 100 feet long. The piles, known as "windrows," are watered as necessary and periodically turned with a machine designed for this purpose. The addition of water and oxygen (through turning) creates an ideal environment for microorganisms to colonize and flourish in the leaf piles. The body temperature of the bacteria raises the temperature of the actively composting windrows to between 120° and 140°F. After approximately nine months, bacteria will completely digest the leaves, leaving a stable organic matter, similar to potting soil, called compost.

Turning the windrows at the Fresh Kills compost facility.

Distribution of Finished Compost

The majority of finished compost is used by the Parks Department for soil remediation and landscaping projects throughout the City, as outlined in the agreement between Parks and Sanitation. About 2,000 cubic yards of compost is given away each year to City residents during Department-sponsored "giveback" events (see description on page 49). An additional 1,000 cubic yards per year is delivered, free of charge, to hundreds of community gardens and groups.

Windrows of finished, screened compost ready for delivery to NYC Parks, community gardens, and "giveback" events.

Future Directions for Leaf and Yard-Waste Composting

When the leaf program started, the Department focused primarily on securing sites with enough capacity to handle the City's leaves and then operating them in a nuisance-free manner. With the program running efficiently, the Department can now turn its attention toward diverting greater amounts of material. Two potential programs are under consideration: a separate, spring yard-waste

collection, and expanded access to composting facilities for private, residential landscapers. To improve composting operations, the Department also plans to require that leaves be set out in paper rather than plastic bags.

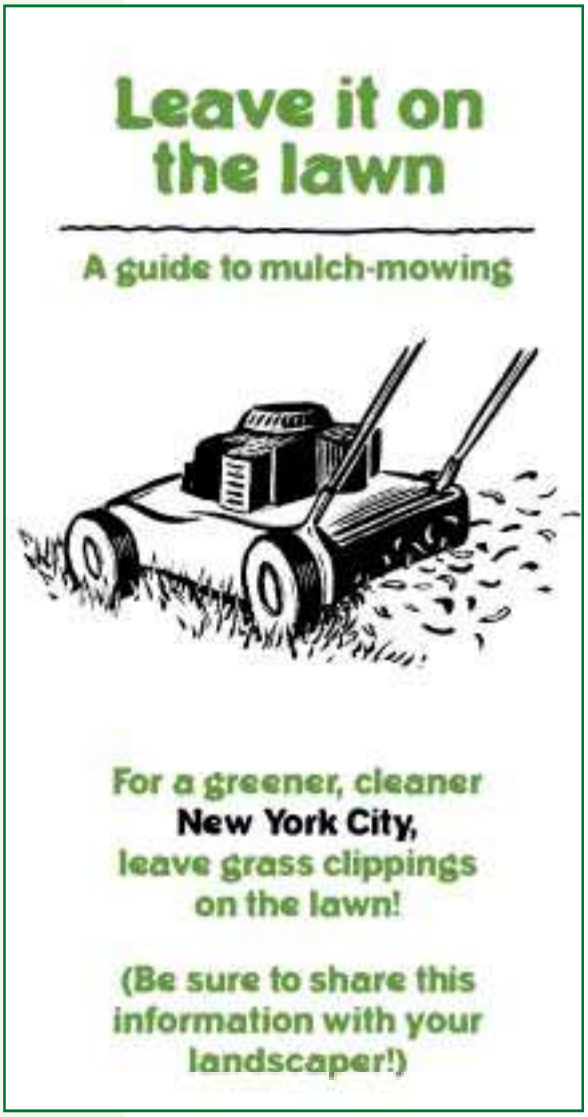
Spring Yard-Waste Collection

The Department is considering conducting a pilot for a separate, spring collection of source-separated yard waste. Similar in structure to the fall leaf program, the collection would take place on Sunday, when no other material is at the curb in order to minimize confusion and contamination. The pilot program would determine if the amounts of material collected justify sending out extra collection vehicles.

Residents in the pilot area would receive a mailing alerting them to the collection dates, the accepted materials, and the proper methods of setting the material at the curb. Targeted materials would include those typically found in backyards when residents undertake a spring cleaning: dead grass, plants, brush, and any remaining fall leaves. If truck tonnages and contamination levels prove acceptable, then, pending the availability of future funding, the program would be instituted citywide.

Landscaper Material

Market research conducted by the Department revealed that close to 30 percent of all New Yorkers with a yard use a private landscaping service.[3] Despite the Department's efforts to educate New Yorkers about the benefits of leaving grass clippings on the lawn (see page 46 for information on the "Leave it on the Lawn" program), many landscape professionals continue to bag grass clippings for disposal. By law, as private businesses these landscapers are required to handle the disposal of grass themselves, by either taking the material to a transfer station or composting facility. However, the reality is that many landscapers (when faced with high tipping fees at transfer stations and the lack of private, local composting opportunities) leave this material at the homeowner's curb for Sanitation collection.



*The Department's **Leave it on the lawn** brochure describes the benefits of not bagging grass clippings for collection.*

[3] For more details, see the Department of Sanitation's fall 1999 report, *Recycling: What Do New Yorkers Think? Five Years of Market Research*, p. 102.

Sanitation currently accepts grass and other organic material from private landscapers at its Fresh Kills compost facility on Staten Island. The site receives an average of 2,000 cubic yards a month of landscaper material during the growing season. However, due to current Department procedures, landscapers must have their trucks measured at a Departmental facility in Queens. In addition, they must also prove that they are registered as a licensed business with the Department of Consumer Affairs. Most landscapers view these steps as more trouble than they are worth. Since many maintain their businesses as a second job, they are not registered with the Department of Consumer Affairs. The Department is currently looking into ways to address these concerns and is working to promote the Fresh Kills facility to more Staten Island landscapers.

While some landscapers in southern Brooklyn utilize the Fresh Kills compost facility, the majority of Brooklyn and Queens landscapers do not find this location convenient or economical. Therefore, the Department is exploring the possibility of expanding its future operations to accept landscaper material at its other leaf composting sites.

The implementation of this program will depend on a variety of factors, including first and foremost, the willingness of the New York State Department of Environmental Conservation to grant a permit for this activity. Other factors include the capacity at these sites and the availability of future funding to increase site staffing. While it is difficult to estimate the amount of additional landscaper material that might be recovered through these measures, it is realistic to expect that the current recovery rate of 7,000 tons per year could be doubled.

De-Bagging and Plastic: The Case for Paper

Finally, the Department is moving to require that all residents and leaf-generating institutions (such as the Housing Authority) set out leaf and yard waste in heavy-duty, paper bags designed especially for this purpose. Because they naturally break down with the leaves into compost, paper bags are used in many municipal leaf collection programs throughout North America.

The advantages to the Department of this practice would be substantial. Currently leaves are de-bagged mechanically and the plastic is torn into shreds. These plastic shreds have the tendency to blow out of the windrows into the surrounding area, making the site visually unappealing. To remedy this situation, additional labor is required to continuously clean the sites. Plastic that is not removed initially must be screened out of the finished compost for disposal. All of these factors add significantly to the cost of composting and could be avoided by using paper bags.

Shreds of plastic bags found in pre-screened compost. The Department plans to require that leaves be set out for collection in paper bags, as plastic bags do not decompose, are difficult to remove, and are unsightly.

Residents will be informed of participating stores in NYC that stock paper bags for leaf collection. Paper bags will also be available for sale at fall compost givebacks.

The Department is requesting that residents use paper bags this year, and next year will require that they do so by law. Local retail chains contacted by the Department have agreed to stock the bags. The Department will list these retailers as "participating stores" on the mailing that goes out to residents describing program details. In addition, the Department will make bags available for sale at the fall compost giveback events (see description on page 49 for details on this program).

Centralized Composting: Source-Separated Food Waste

The Department conducted two food-waste-composting pilots based on the source-separated, centralized model. The Intensive Zone Pilot tested the feasibility of asking select residents to source-separate food waste (plus some yard waste) for collection and centralized composting, while the Staten Island Institutional Pilot asked select institutions to do so.

Intensive Zone Pilot

As the Department began to phase in curbside collection of recyclable materials in the early 1990s, it researched the potential for increasing recycling diversion by designating additional materials, experimenting with different collection methods, and providing enhanced public education. In cooperation with several environmental associations and citizen advisory panels, the Department developed the "intensive recycling" concept. This planning effort led to the establishment of several "intensive zones"

that served as test neighborhoods for numerous programs, including a separate collection for organics to be composted at a centralized, outdoor facility. The programs that proved both successful and practicable (such as mixed-paper collection) were eventually expanded citywide and have become a permanent part of the Department's recycling program.

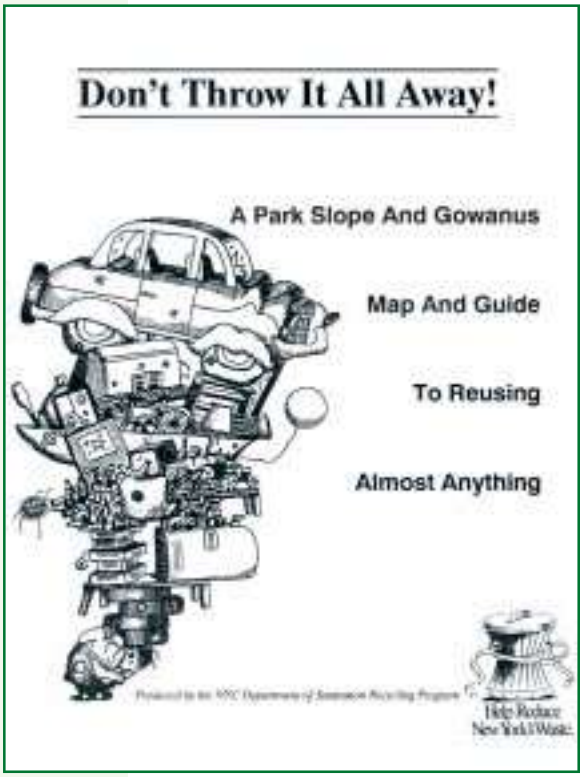
Park Slope

The first intensive zone was designated in 1991 and consisted of a 22,000 household portion of Brooklyn Community District 6. This area, which includes portions of the Park Slope, Carroll Gardens, and Gowanus neighborhoods, was chosen in part because it was considered demographically representative of 30 percent of the City characterized by "medium income/medium density" housing.

In addition, Park Slope residents and their elected representatives have historically embraced environmental initiatives, and this neighborhood had been one of the first to receive curbside recycling collection. The Park Slope intensive zone program and its outcome are described in detail in an Interim Report released by the Department in March 1992 (see Appendix III). A synopsis of the food-waste-collection component of the program is provided below.

Sanitation targeted the entire intensive zone area to test newly developed public education programs (such as the Department's first reuse guide to promote waste prevention practices) and the City's first household hazardous waste collection day. Additionally, the Department worked with several community-based environmental groups to promote residential backyard and community garden-based composting throughout the intensive zone.

The Department promoted the "Intensive Zone" through billboards and mailers.



In addition, Sanitation designated a portion of the intensive zone consisting of 5,900 households (served by two separate Sanitation recycling collection routes) as an "intensive collection zone." All residents were asked to separate additional, potentially recyclable materials from their waste, including film and foam plastics, and mixed paper. (Residents in the zone were already recycling the following materials: newspapers, magazines, catalogs, corrugated cardboard, bottles, cans, and aluminum foil products.)

Residents in the "food-waste-collection area" of the "Intensive Collection Zone" put out three separate containers: blue for metal, glass, and plastic; green for mixed paper; and black for organic waste.

The most innovative aspect of the Intensive Zone Pilot was the inclusion of organic waste as a recyclable material designated for source-separated collection. The Department asked approximately 3,500 residents in the "Intensive Collection Zone" described earlier to separate their food scraps and other select organic materials (such as spent plants and flowers, food-soiled paper, and yard waste). Residents were initially given cellophane-lined kraft paper bags to collect organic waste in their home. These bags were to be placed in a specially marked, curbside collection container.

As with other recyclables, Sanitation collected food waste once per week with a standard rear-loading compactor truck. Food-waste collection averaged 4.1 tons per week during the first few months of the pilot, and stabilized at approximately 3.7 tons per week by the time the pilot ended in early 1996. Based on waste composition data, this added six percentage points to the diversion rate for the intensive collection zone, which by February 1992 totaled 27.5 percent in the section that was asked to recycle additional materials but not organic waste, and 33.8 percent in the smaller section that included organics collection. The "capture rate" for food waste was estimated at 41 percent, which is comparable to the capture rate for other recyclables.[4]

The organic-waste-collection program was described in a separate brochure mailed to all residents in the designated portion of the "Intensive Zone."

The organic waste collected in Park Slope was delivered to the Department's newly constructed compost facility at the Fresh Kills

[4] The "capture rate" is defined as the tons of recyclables placed out for collection divided by the tons of all recyclables present in the waste stream. It basically measures "how well" people are recycling by estimating how much of what *can* be recycled actually *is* recycled. This is different than the "diversion rate," which measures just how much material people are putting in the recycling bin. (The diversion rate is calculated by dividing the total tons of recyclables collected by the total tons of the waste [recyclables plus trash] collected.)

landfill, where it was processed under a special permit modification granted by the New York State Department of Environmental Conservation. The Department hired a consultant team with extensive expertise in composting and compost testing to supervise this portion of the pilot. The various tests performed on the finished compost showed that it met the State's standards for "Class I" compost.

Starrett City

In 1993, the Department established a second intensive zone in a section of Starrett City, Brooklyn. The pilots conducted at Starrett City were more limited in scope than those carried out in Park Slope, and were designed to test the "intensive recycling" concept in high-rise apartment housing.

Starrett City afforded certain amenities that facilitated the set up of the pilot as well as data collection. These included the following:

- Utility rooms on each floor which could accommodate the installation of multiple bins for source-separated collection.
- Large elevators to allow maintenance staff to wheel recyclables away from each floor.
- Sufficient space behind each building for the location of special collection dumpsters.

While such amenities may not be representative of high-density housing throughout the City, the pilot at Starrett City allowed the Department to study a "best case" scenario for high-rise intensive recycling.

Of the 46 Starrett City buildings housing a total of 20,000 residents, the Department selected six buildings containing about 600 households for the pilot. The Department asked residents within the selected buildings to separate household trash into the following four categories:

- Paper/textiles.
- Recyclable containers.
- Food waste.
- Trash (non-recyclables).

Residents were informed that food scraps could be placed in plastic grocery bags, which in turn, were to be placed in the "organic waste" bin on each floor. (This policy was also instituted in Park Slope after residents depleted their original supply of kraft paper bags.) Maintenance staff collected recyclables and food waste daily and deposited the material in outdoor dumpsters. All remaining solid waste was to be placed in the building's garbage chute system.

Although residents learned of the program through building meetings, the Starrett City newsletter, and door-to-door visits by the same environmental consultant who provided outreach in Park Slope, changes in the diversion rate were not as consistent. In particular, food waste diversion was significantly lower at Starrett City. In addition, what little material was collected proved to be so contaminated with plastic that it could not be composted.

Site inspection and building surveys showed that residents were concerned about potential pest problems and were therefore reluctant to store food waste in the utility room even though a sealed bin was available.

Residents of the Starrett City high-rise complex received instructions and posters describing the additional materials that they could recycle as part of the Intensive Zone Pilot.

Those residents who did separate their food often wrapped it in multiple layers of plastic before taking it out of their apartment, which contributed to the excessive contamination found at the compost facility. The maintenance staff in some of the buildings showed some reservations about recycling food scraps. Since the Department collected this material only once a week, they were inclined to dispose of it as refuse. These experiences attest to the difficulty of convincing high-rise residents to treat organic waste as a recyclable material, to be stored and collected separately from refuse.

Conclusion

From experiences in both Brooklyn pilots, the Department extrapolated the readily practicable "intensive recycling" concepts and applied them to its overall recycling program. For example, the Department designated mixed paper as a recyclable material on Staten Island in 1995 and has collected this material citywide since 1997. As in Park Slope and Starrett City, residents citywide responded positively to both the inclusion of additional paper products in the recycling program and the ability to place this material loose (as opposed to bundled) into recycling containers. While film and foam plastics weren't ultimately added to the metal, glass, and plastic (MGP) stream, willingness on the part of "intensive zone" residents to separate these materials contributed to the Department's decision to add small metal items to the list of recyclables collected.

Finally, and most importantly for composting, the education program on composting originally instituted in Park Slope was the precursor to the "Compost Project," a program run through the City's four Botanical Gardens with Department funding since 1993. (More information on the Compost Project is provided on page 43 of this report.)

One aspect of the "intensive zone" pilots that was not expanded citywide was the designation of food waste as a material for source separation and collection. As mentioned, participation rates achieved in

As of September 1997, all NYC residents, agencies, and nonprofit institutions are required to recycle the following materials:

Paper and Cardboard
(in green bins with labels or clear bags)

- *Newspapers, magazines, and catalogs*
- *Mixed paper and envelopes*
- *Smooth cardboard*
- *Paper bags*
- *Phone books*
- *Corrugated cardboard*

Beverage Cartons, Bottles, Cans, Metal, and Foil
(in blue bins with labels or translucent blue bags)

- *Beverage cartons (milk and juice cartons, drink boxes)*
- *Glass bottles and jars*
- *Plastic bottles and jugs*
- *Metal cans*
- *Small metal items*
- *Aluminum foil wrap and trays*

Park Slope—whose residents tend to be among the City's most environmentally conscious—were not duplicated in Starrett City, where concerns over odor and vermin seemed to override any other considerations. Similar concerns would certainly be a factor in high-rise buildings not equipped with the same storage space and maintenance personnel found at Starrett City.

However, the more significant reason for not pursuing citywide, residential source-separation of organic waste is the cost of transporting this material. Although the diversion rate in Park Slope did increase, truck tonnages (the average number of tons collected per truck) were too low to justify collecting only food waste.[5] The expense, not to mention the environmental impact, of adding a fourth and inefficient truck route to the City's waste collection system outweighed the benefit of capturing the organic waste.

Staten Island Institutional Pilot

While truck efficiencies could not be readily achieved on the residential side, institutions seemed a more promising front for generating and collecting large amounts of food waste. From 1993–1996, the Department ran an institutional, food-waste-collection pilot on Staten Island. Participants included a dozen of the largest food waste generators that met the following criteria:

- Received collection service from the Department.
- Could house an extra dumpster.
- Were willing to participate in the program.

DOS supplied these institutions with a two-cubic-yard dumpster, indoor collection buckets and bags, as well as educational materials and training for kitchen personnel and other appropriate staff.

The pilot targeted for collection all solid food (including meat and dairy products), but left out liquids such as oils, milk, and soup. Non-recyclable paper products generated in the kitchen and cafeteria areas were also targeted, with the exception of "poly-coated" products such as

[5] Trucks generally collected a maximum of 4.5 tons, versus the citywide average of 8 tons for regular garbage routes.

milk and juice cartons. Organic wastes were generally collected from preparation areas and kitchens. In some cases, plate waste from dish rooms was also targeted.

The Department serviced the dumpsters twice a week and delivered the materials to the compost facility at Fresh Kills landfill. The composting process operated as follows: food waste was tipped onto a pad of leaves and covered with more leaves and Christmas tree chips; this was mixed with a windrow turner, formed into a windrow, and given a final covering of leaf and wood waste to deter gulls and crows.

Table 2

Average Cubic Yards Collected from Staten Island Food-Waste Pilot

(Data for January through October 1995)

Institution Name	Average Cubic Yards per Collection
South Beach	1.28
Arthur Kill	0.96
Seaview Hospital	0.87
Bayley Seton	0.86
Basic Research	0.24
Mount Loretto	0.14
Snug Harbor	0.51
S.I. Armory	0.01
S.I. College	0.17
Home for the Homeless	0.28
Wagner College	0.39
St. Vincent Hospital	0.29
Sts. Cosmas & Damian	1.66
S.I. Zoo	0.3

Average Tonnage Collected

Table 2 shows the average amount of cubic yards collected per visit from each institution participating in the Staten Island Institutional, Food-Waste-Collection Pilot. The institutional pilot, like the Intensive Zone Pilot (the residential, organic-waste-collection component), did not achieve impressive results in terms of tonnages collected for two reasons. First, participation was on a voluntary basis, and institutions had no incentive to separate food waste since they don't pay directly for waste-collection services. Diversion of organic material was high when institutions first started the program, but leveled off as the program became more routine. Second, the collection route was inefficient because service was limited to institutions that could house an extra dumpster. As this was a small number despite several solicitations, trucks traveled long distances between collection sites.

Conclusion

In order to establish efficient routes for the collection of institutional food waste, the Department would need to use the same collection method for all institutions and provide an incentive for institutions to participate. Both of these conditions are problematic.

The vehicles the Department has available for this type of collection are designed to service dumpsters.[6] As mentioned above, many institutions indicated that they could not participate in the pilot because they lacked space to store an additional dumpster. The only way to include these institutions would be to change the Department's collection methods, which requires procuring

[6] The vehicles are called EZ Pack trucks; they have special attachments which mechanically lift dumpsters over the height of their body and tip them so that their contents empty into the back of the truck.

specialized, smaller, food-waste receptacles (such as Schaffer carts) and retrofitting collection vehicles (see photo of Schaffer cart and collection truck below). These changes would entail a significant investment and perhaps, more importantly, they would necessitate labor negotiations regarding how waste is collected.

While several institutions were enthusiastic and reliable participants in the pilot, after the program was initiated, most institutions lacked the incentive to source separate organic waste. In most cases, institutions viewed the program as extra work for those responsible for handling waste, as well as for those who had to train and retrain this staff.

Food waste was collected on a pilot basis from City institutions using EZ-Pack trucks (designed to empty dumpsters). Only institutions with space for an extra dumpster could participate in the pilot program. More institutions could have participated if Schaffer carts were used (shown below), but this would have involved retrofitting a portion of the Department's rear-loading fleet.

Separation mistakes by staff members do not impact the mission of the institution, but they do affect the quality of the compost and the cost associated with removing contaminants. Financial incentives have proven to be the most effective way to minimize contamination problems. However, this option is not available due to the fact that institutions, just like NYC residents, don't directly pay for waste collection.

Department-wide changes such as retrofitting vehicles and altering the way waste is collected might be warranted if a separate route for institutional organic waste was implemented citywide. However, as the pilot demonstrated, this would not be a prudent decision unless a financial incentive system could be implemented to encourage effective source separation.

Future Directions for Centralized Food-Waste Composting

The Department gained valuable information from the Intensive Zone and Staten Island Institutional Pilots that will guide it in planning the future of centralized food-waste composting in New York City. This information can be categorized as follows: Facility Siting and Design, Incentives and Contamination, Capture Rate, and Collection Efficiency.

Facility Siting and Design

The food waste from both pilots was taken to the Department's composting facility at the Fresh Kills landfill, where it was composted

outdoors in open windrows. This site proved adequate given the limited scale of the pilots. However, if a food-waste composting program were implemented citywide, several sites would be necessary.

Due to operational factors, regulatory concerns (such as odor, vermin, and leachate control), and the need to be a good neighbor, large-scale, food-waste composting would have to be conducted in an enclosed structure (in-vessel), rather than in open windrows as was the case at the Fresh Kills facility. The ability to secure sites for in-vessel composting represents one of the important factors contributing to the potential viability of any expanded food-waste-composting program.

Incentives and Contamination

As the pilot projects demonstrated, incentives constitute another important factor when it comes to source separation of organic waste. Since the Department currently collects waste at no direct cost to residents and institutions, there are no existing financial incentives to source separate. Therefore, it is important to anticipate that any organic material collected will likely be contaminated.

Another way to think about this inevitability is to look at the Department's recycling program. Processors of the City's metal, glass, and plastic recyclables routinely record contamination rates of up to 25 percent. Why would organic waste be any different? Because of likely contamination, a potential compost facility (once it was sited) would need to be designed to handle non-source-separated material (mixed waste), even if residents and institutions were asked to source separate organics as a third recyclable stream.

Capture Rate

The Department also learned from the pilots the difficulty of capturing a high percentage of the designated materials available in the waste stream. (This was corroborated by the Department's other recycling programs.) In the Intensive Zone Pilot, the capture rate for organic waste was roughly 40 percent. This means that of all the items designated for organic-waste collection that are known to be present in the waste stream, only 40 percent was "captured." This figure is similar to the City's current capture rate for other recyclables in the residential waste stream.

In the case of organic waste, providing more comprehensive public education as to what items are designated for organics collection may not significantly increase capture rates. This is because residents may want to put things like spoiled food or used diapers into the garbage for immediate disposal, rather than storing them for separate collection.

Collection Efficiency

Also gleaned from the Intensive Zone and Staten Island Institutional Pilots is the importance of efficient collection routes, which lead to high tonnages per collection vehicle. This essentially means that residents and/or institutions must set aside enough organic waste, and be geographically close enough to each other, so that a collection truck can fill up without having to travel long distances.

In the Intensive Zone Pilot, even though collection points were close to one another, the routes proved to be inefficient due to the small amount of food waste each household put out for collection. In the case

of the Staten Island Institutional Pilot, the amount of waste generated was greater per site, but the sites were far apart from one another. If these conditions hold, the benefit of capturing the organic waste will not outweigh the labor, equipment, and environmental costs associated with putting another collection vehicle on the streets.

The Advantages of Mixed-Material Composting

As explained above, any NYC food-waste-composting facility would need to be in-vessel and designed to handle non-source-separated material in anticipation of a fair degree of contamination. If such a facility were designed to handle mixed waste then it calls into question the need to collect source-separated organic waste. This is especially the case when the problems associated with capture rates and truck routes for source-separated material are taken into account.

For this reason, the Department began to consider the advantages of collecting waste as it currently does (separate from designated recyclables), but instead bringing it to a centralized facility which would extract the biodegradable element for composting. The benefits of such as system include the following:

- One hundred percent of the organic material in the waste stream would be captured for composting.
- The Department could take advantage of the efficient truck routes it already has in place to service residents and institutions.
- There would be no need to devise incentives to get residents or institutions to separate out a third component from the waste stream.

Because the Department had reservations about the quality of compost that could be made from non-source-separated material, it decided to conduct a pilot to address this important question. The pilot took place in February 2001 and will be explained in the section that follows.

Centralized Composting: Mixed-Material Pilot

The Department was familiar with non-source-separated (NSS), centralized composting before it decided to conduct a full-scale pilot in 2001. As part of its ongoing assessment of strategies to improve the performance of its curbside recycling program, the Department conducted a pilot in December 1997 to measure the effectiveness of recovering *recyclables* through *mixed-waste processing*. In addition to examining the potential to recover recyclables, the mixed-waste-processing test provided an opportunity to evaluate, on a preliminary basis, the suitability of composting the residue from such a processing operation.

The Department sent one day's worth of the organic residue from the mixed-waste-processing trials to an NSS-composting facility, owned by Bedminster Bioconversion Corporation in Sevierville, Tennessee.[7] Since there were many questions raised that could not be answered by composting one day's worth of residue from the mixed-waste-processing pilot, the Department decided to take a more extensive look at NSS composting.

[7] The results from these trials can be found in the report titled, "Mixed Waste Processing in New York City: A Pilot Test Evaluation," available on the Department's website at http://nyc.gov/html/dos/html/recywprpts.html.

In 1999, a full-scale Bedminster composting facility opened in Marlborough, Massachusetts, similar to the one in Sevierville, Tennessee, which the Department used to compost the residue from the mixed-waste-processing pilot. In order to perform a careful evaluation, the Department decided to send one week's worth of residential waste to the Marlborough facility.

For part of the pilot, the Department worked with a NYC environmental consulting group. This organization received a New York State grant to examine the potential for composting commercial waste containing high levels of organic content (such as waste coming from grocery stores and restaurants). For this reason, one week's worth of commercial material was also sent to the Marlborough facility. The consultant also performed a survey of three other successfully operating NSS-composting facilities in North America. A full report on this pilot project, including the results from the commercial waste trials and the survey, is forthcoming. However, some preliminary information on the residential waste trials is provided below.

The Non-Source-Separated-Composting Process

Non-Source-Separated-composting technologies share a mixed, twenty-year history. Some of the early facilities have closed their doors, while others are operating quite successfully. Odor control represents one of the primary improvements made to this process over the years. Successful facilities are designed and operated with the goal of zero odor emissions. Features that help achieve this goal include doors that automatically close after vehicles enter, and holding all buildings under negative air pressure. Fresh air is drawn in through a series of pumps and vents, while contaminated air is blown out and processed through a *biofilter*.

A biofilter is an engineered bed of soil, compost, and/or woodchips covering a distribution system of perforated pipes. Contaminated air is blown into the perforated pipes, slowly diffuses up through the biofilter media, and is biologically "scrubbed" of odor-causing compounds. Facility operators pay as much attention to the state of the biofilter as they do to the finished compost, since escaping odors can jeopardize their overall operation.

The greatest testimony to the Marlborough facility's success in controlling odor emissions lies in its good relations with its neighbors—half-million-dollar homes are located less than a quarter of a mile away from the facility. The Marlborough facility formed an "odor committee" with these neighbors to monitor odors and immediately register complaints. *The facility has not received a single complaint in two years of continuous operation.*

Incoming waste is unloaded onto a tipping floor at the Marlborough mixed-waste-composting facility. Bulky items, such as mattresses, are pushed aside with a front-end loader.

The Marlborough facility employs all the elements found in successful, drum-based, NSS-composting technologies. Below is a general description of how the process works.

Incoming waste is unloaded onto a tipping floor, where easily identifiable bulk items such as sofas and mattresses are pushed aside with a front-end loader.

Material is then moved with a front-end loader onto a conveyor belt, where it moves past a line of manual sorters who remove "problematic" items. These items include long wires and hosing (which can cause "hair balls" in the composting drum), as well as large pieces of wood, textiles, or other bulk items that won't rapidly biodegrade. In some facilities, additional attention is paid to recovering recyclable items, such as tin cans and plastic jugs, which have been incorrectly placed in the mixed-waste stream.

The conveyor then deposits the waste, most of it still in plastic bags, directly into the composting drum. What is significant about this technology is that there is no additional preprocessing of the waste. For example, there is no shredding or mechanical de-bagging. Bags break open by the force of gravity as the composting drum slowly rotates and the material tumbles against itself and the walls of the drum. One advantage of this approach is that it avoids typical preprocessing procedures, such as shredding, which tend to crush glass and pulverize other contaminants, making them difficult to screen out of the finished compost.

The composting drum provides the ideal conditions for the rapid breakdown of the organic fraction of the waste stream. Material is loaded into the drum from one building and is discharged in a different building.

Material, still largely in bags, passes by workers, who manually remove bulky items and problematic materials that can cause "hair balls" inside the composting drum.

The composting drum is a compartmented, rotary vessel that serves as a biomechanical, preprocessing, and composting device. The drum essentially creates the ideal conditions for the rapid microbial breakdown of the organic fraction of the waste. Each of the drum's three separate zones provides a different composting environment that can be independently controlled. The three zones

are operated according to the following daily system:

- Waste from Zone 3 is unloaded and screened.
- Waste from Zone 2 is transferred to Zone 3, and waste from Zone 1 is transferred to Zone 2.
- New waste is added to Zone 1.

This rotation system ensures continuous throughput, or daily processing of waste. The Marlborough facility employs two such drums, each with a 150-ton-per-day capacity. Another advantage of the system is the flexibility the drums provide with regard to throughput. Facility designers can size drums to accommodate the waste stream and operators can manipulate throughput speeds to handle daily fluctuations (i.e., discharge materials earlier from the drum).

Within each zone of the drum, temperature, oxygen, and moisture levels are monitored to control the composting process. Operators can adjust the conditions in any of the three zones without interrupting the composting process in adjacent compartments.

After one day in each of the three zones (or a total of three days in the drum), the material is unloaded and passed through a rotary trommel screen that separates raw compost from the oversized, inorganic materials. Facility operators remove the inorganic residue for disposal off site, and place the remaining immature compost in windrows. The windrows are formed in an enclosed building, on an aerated floor, and are turned to keep oxygen flowing through them so that active degradation continues. While retention time varies at different facilities, Marlborough operators maintain the windrows for 21 days, and then screen the compost again before shipping it off site where it is blended with sand for landscaping applications.

Preliminary Pilot Results

For five days (February 26 to March 2, 2001), the Department sent approximately 50 tons per day of residential and institutional solid waste (not including materials collected separately through the curbside recycling program) from Staten Island District 2 to the Marlborough, Massachusetts facility.

For the pilot, the Department chose Staten Island District 2, comprising the middle section of Staten Island, for two reasons. One, its recycling rate of 23 percent is close to the citywide average of 20.1 percent; and two, it is geographically close to the Fresh Kills landfill, the location for waste characterization and transfer during the pilot. Given the limited scale of the pilot, it was not possible to get a sample that was representative of the entire City.

At Fresh Kills, each day for five days, Department vehicles emptied the waste collected onto an asphalt pad at the leaf- and yard-waste-composting facility. At this point, a detailed waste characterization was performed. The final report of this characterization can be found in Appendix I. Table 3 on the next page presents a summary of the results from the waste-characterization study.

The waste was then loaded onto long-haul vehicles and transported to the Marlborough facility where it was weighed and recorded. Table 4 on the next page lists the recorded incoming weights.

As previously mentioned, the Marlborough facility employs two rotating digester drums. Operators emptied one of the

Table 3

Waste Composition of Samples Taken from Staten Island District 2 for the Marlborough Pilot

Waste Category	Average Percentage in the 70 Samples
Paper	32.1%
Food Waste	15.9%
Yard Waste*	1.6%
Other Degradables**	6.0%
All Degradables	**55.6%**
Bulk Wood	3.4%
Plastic	15.4%
Textiles	5.3%
Glass and Ceramics	3.3%
Metal	3.1%
Large Composite Items	1.0%
Nondegradable Fines	3.5%
Other Nondegradables	5.1%
All Nondegradables	**40.1%**
Unclassifiable Fines	4.3%
Total	**100.0%**

* It should be noted that the waste characterization was performed in February, so the yard waste totals are at their lowest for the year.

** This category includes all small, readily biodegradable items that do not fit the definition of paper, food waste, or yard waste. This includes: disposable diapers and their contents, sanitary napkins, animal feces, cut flowers, dryer lint, etc.

drums in advance of the pilot to avoid cross-contamination and to ensure that the data recorded reflected only NYC material. To avoid cross-contamination in the tipping area, NYC material was received in the evening and loaded into the drum at night, after the regular day shift.

Table 4

Weight of NYC Solid Waste Transported to the Marlborough Composting Facility

Date	Weight of Solid Waste (tons)
February 26, 2001	49.23
February 27, 2001	54.64
February 28, 2001	53.99
March 1, 2001	51.96
March 2, 2001	49.23
Total	**259.05**

Using a front-end loader on the tipping floor, workers at the Marlborough facility removed bulk items from the NYC waste, such as the sofa cushions and plywood featured in this picture.

Following the facility procedure outlined earlier, NYC waste was unloaded from the long-haul vehicles onto the tipping floor. From there, bulky items, such as mattresses and large pieces of wood, were removed. These items, plus anything pulled off of the sort line (together designated as "Front-End Residue"), were put into a roll-off container and taken away for disposal. Table 5 lists the "Front-End Residue" tonnages that were recorded.

Table 5

Front-End Residue Removed from NYC Solid Waste Brought to the Marlborough Composting Facility

Date	Weight of Front-End Residue (tons)	Percent of Total Incoming Solid Waste
February 26, 2001	7.21	14.6%
February 27, 2001	7.16	13.1%
February 28, 2001	6.86	12.7%
March 1, 2001	6.97	13.4%
March 2, 2001	5.98	12.1%
Average	**6.84**	**13.2%**

NYC waste enters the composting drum via a conveyor belt. A waste characterization showed that 55 percent of the material is biodegradable.

Following the removal of bulky materials on the tipping floor and other contaminants on the sort line, the NYC waste moved on a conveyor belt into the designated digester drum. Again, it is important to stress that no pretreatment of the waste was performed. It was not de-bagged, shredded, or otherwise manipulated, but simply conveyed into the drum, where it was mixed with a prescribed ratio of sewage sludge (biosolids).

As the logistics and cost associated with transporting NYC biosolids didn't warrant this undertaking, biosolids from the Marlborough facility were used. These biosolids were also sampled and sent to a lab for analysis in order to document their impact on the final compost quality. Table 6 shows a breakdown of inputs into the drum.

The NYC material remained in the digester drum for three days. For example, on Thursday, March 1, the waste loaded on Monday, February 26 was discharged. Facility operators took daily thermometer readings in different sections of the drum to ensure that the necessary temperatures to achieve pathogen kill were reached. By the second day in the drum, temperatures averaged between 158° and 160°F.

After three days, facility operators discharged the material from Zone 3 of the digester drum. The discharged material moved on a conveyor belt and emptied onto

Table 6

Amounts of Biosolids and Solid Waste Placed in the Marlborough Digester Drum for the Pilot

Date	Biosolids (tons)	Solid Waste (tons)	Total Input to Drum (tons)
February 26, 2001	18.01	42.02	60.03
February 27, 2001	23.12	47.48	70.60
February 28, 2001	23.61	47.13	70.74
March 1, 2001	21.91	44.99	66.90
March 2, 2001	19.80	43.25	63.05
Total	**106.45**	**224.87**	**331.32**

a two-inch trommel screen. This screen separated the larger, nondegradable items (primarily plastic bags) from the partially decomposed organic material. Table 7 shows the weight of material recorded after the initial screening (the two-inch "overs" versus the two-inch "unders").

A view inside the building where material is discharged from the composting drum. The conveyor belt under the drum moves the material to a two-inch trommel screen.

After three days in the drum, the organic fraction of the waste had broken down into an immature compost. The material then passed over a two-inch screen, where the large inorganic items that did not break down were pulled out for disposal. The bucket on the left contains a sample of the two-inch "overs" (the material that was rejected by the two-inch trommel screen) and the one on the right holds the two-inch "unders" (or immature compost). Note that much of what was pulled out was plastic bags.

Table 7

NYC Material Remaining After Three Days in the Digester Drum and Two-Inch Screening

Date of Discharge	Two-Inch Screen "Unders" (tons)	Two-Inch Screen "Overs" (tons)
March 1, 2001	45.36	14.14
March 2, 2001	58.50	14.83
March 3, 2001	36.56	15.63
March 5, 2001	45.00	18.19
March 7, 2001	52.80	15.17
Total	**236.22**	**77.96**

Facility operators removed the nondegradable, two-inch "overs" for disposal and transfered the partially decomposed two-inch "unders" onto an aerated floor (called a curing floor). Aeration ducts run the length of the floor to pump air into the piles of material. As explained earlier, odor is controlled because this is all performed in an enclosed building under negative air pressure.

The partially decomposed material placed onto the curing floor contained visibly recognizable pieces of inert, inorganic material such as shreds of glass and plastic. A finer screening at the end of the 21-day-composting process will remove these contaminants.

While most successful mixed-waste-composting operations employ a similar drum-based process, how these facilities treat the material after it is discharged from the drum varies significantly. This area of facility management continues to evolve as processors try to minimize retention time (thereby maximizing throughput) while still creating quality compost. One of the goals of the survey performed in conjunction with this


Piles of immature NSS compost begin to "cure" on an aerated floor at the Marlborough facility.

pilot was to assess the different "back-end" handling systems in use. The Department intends to use this information to explore the potential that this technology might hold for processing a portion of New York City's waste stream. As mentioned previously, the results of this survey, as well as a more detailed analysis of possible facility operations, will be presented in a forthcoming, final pilot report.

During normal operations at the Marlborough facility, material is generally discharged from the drum, placed on the air floor for approximately 21 days, and put through a final screening process using a 1/2-inch screen. Depending on the final market, the material is either sold as is or is taken off-site, blended with sand, and then screened through a 3/8-inch screen to make a topsoil mix. The coarser material is sold for land reclamation projects (for places like gravel pits or mines), while the topsoil mix is marketed to local landscapers, golf courses, and other commercial outlets.

After 21 days on the aeration floor, facility operators passed the NYC material through a 1/2-inch screen. Table 8 shows the results of this screening. It is significant to note that approximately 100 tons of material was "lost" from the time of discharge from the drum to the end of the three-week period on the aeration floor. (Operators originally transferred about 236 tons to the curing floor but passed only about 139 tons through the 1/2-inch screen three weeks later.) While some


The NYC material was run through a final 3/8-inch screen to remove particles of glass, plastic, and other fine contaminants.

Table 8

NYC Material Remaining After 21 Days on the Aeration Floor and 1/2-Inch Screening

1/2-Inch Screen "Unders" (tons)	1/2-Inch Screen "Overs" (tons)
122.36	16.59

Table 9

NYC Material Remaining After Final 3/8-Inch Screening

3/8-Inch Screen "Unders" (tons)	3/8-Inch Screen "Overs" (tons)
118.44	3.92

of this "loss" can be traced to the invariable displacement that occurs during material handling, the bulk of this reduction results from moisture and carbon dioxide loss taking place during this active stage of composting.

Ordinarily, after the 1/2-inch screening, the Marlborough plant transfers material off site for final curing and screening. New York State regulations require that no more than one percent of the compost made from non-source-separated material be comprised of material sized over 10mm (3/8"). For this reason, the NYC material was run through a final 3/8-inch screen at the facility. Table 9 shows the results of this screen.

Of the 365 tons of material that the Marlborough facility processed (259 tons of non-source-separated NYC waste plus 106 tons of biosolids):

- 133 tons or 36 percent was discarded as residue (34 tons from front-end residue and 99 tons from the various screening processes).
- 118 tons or 32 percent was turned into compost.
- Approximately 114 tons or 31 percent was released as moisture and carbon dioxide through evaporation.

These numbers make sense when considering the original characterization of the NYC waste brought to the Marlborough facility (Table 3 on page 29): 56 percent was characterized as biodegradable and 40 percent as non-biodegradable. Therefore, the process more or less recovered 100 percent of the degradable material in the waste stream.

Laboratory Results

In order to see if the compost made from NYC waste would meet State regulations, a one-cubic-yard sample from the 1/2-inch "unders" was sent to a research laboratory with expertise in compost analysis.

The New York State Department of Environmental Conservation (in accordance with 6 NYCRR Part 360.5) regulates the construction and operation of all composting facilities including those processing sewage sludge, septage, yard waste, and other solid waste. Regulations were passed in 1993 with pending modifications made in 1995. Though the proposed modifications were never passed, the compost from the Marlborough pilot was tested against both the 1993 and the pending 1995 regulations.

For compost made from mixed waste and biosolids, the 1993 regulations designate such compost as either Class I or Class II. Uses for Class I Compost include: distribution for use by the public, food chain crops (meaning crops that are fed to animals, not for direct human consumption), and other agricultural and horticultural uses. Class II compost can only be used for non-food-chain crops.

The 1995 pending regulations collapse the distinction between Class I and Class II Compost, and provide one set of parameters for mixed-waste compost made with biosolids. The proposed regulations stipulate that the product may not be used in any public contact areas, or for any crops, during the first year of facility operation until a consistent quality record is established.

Lab tests were performed on the Marlborough sample compost 59 days after it was discharged from the drum (21 days in windrows at the Marlborough facility and 38 additional days curing at the research laboratory). The DEC requires a minimum on-site detention time (including active composting and curing) of 50 days.

Table 10 compares the concentration limits established by the 1993 regulations (and the pending 1995 modifications) with the preliminary laboratory results from the Marlborough sample. As indicated in this table, compost made from non-source-separated, NYC waste during this trial would be granted a Class I designation under the current regulations. Since the Department wanted to be as thorough as possible in addressing potential environmental concerns associated with NSS composting, a number of additional laboratory tests were performed which are not required by the DEC. The initial results look promising, and will all be available in the forthcoming final report.

Conclusion

The NSS-centralized approach to composting holds promise as an effective, supplemental, waste-management strategy. Curbside recycling already diverts about 20 percent of the waste stream; mixed-waste, centralized composting could add about another 60 percent to achieve a potential citywide diversion rate of 80 percent.

While the Department is pleased with the results of this initial pilot and the NSS-composting process itself, a number of practical questions remain concerning the suitability of this technology for New York City. The final report on the pilot will address some of these questions by presenting an economic analysis (including the potential market for the resulting compost), as well as a summary of some of the siting and design issues associated with a potential NYC facility.

Table 10

Comparisons Between Concentration Limits Established for Non-Source-Separated Compost and Preliminary Lab Results from the Marlborough Sample

Parameter	1993 Class I Concentration Limit (ppm dry weight*)	1995 Proposed Concentration (ppm dry weight*)	Marlborough Sample Results
Mercury	10	26	1.0
Cadmium	10	15	4.0
Nickel	200	420	57.6
Lead	250	450	239.6
Chromium	100	1800	10.8
Copper	1000	2250	150.8
Zinc	2500	4200	568.0
PCB (total)	1	1	<1.0
Arsenic	Not Required	62	4.6
Molybdenum	Not Required	75	5.5
Selenium	Not Required	42	1.4

* Results are reported in parts per million on a dry-weight basis.

Decentralized (On-Site) Composting

The other strategy for recovering the organic fraction of the waste stream is through decentralized, or on-site composting. Rather than collecting waste and transporting it to a centralized facility, the decentralized approach seeks to assist individuals and institutions in handling the organic fraction of their respective waste streams "in their own backyards." The Department promotes and maintains a number of on-site composting programs, for both City institutions and NYC residents.

Composting On-Site at City Institutions

Riker's Island

At Riker's Island, the nation's largest municipal prison system, over 17,000 inmates and 7,000 officers generate over 20 tons of food residuals per day. Since Riker's is a City institution, the Department of Sanitation handles all waste collection services for the island. Services provided to Riker's tend to be more expensive than services provided to other City institutions due to the entrance and exit procedures for any vehicle accessing the island. For this reason, any on-site processing of waste is potentially more efficient than removing the waste from the island for disposal.

In order to handle the food waste at Riker's, the Department decided to construct a pilot facility, one that would be fully enclosed and employ the latest agitated-bay technology. The Department wanted to use the Riker's facility to test the feasibility of agitated-bay technology for composting food waste. Up until the construction of the Riker's facility, this technology had been used almost exclusively for sewage sludge and yard-waste composting in other parts of the country. By most measures, the Riker's Island facility has proved to be a success. Since it began operating, the facility has dramatically increased its throughput while effectively addressing all odor issues.

Aerial view of Riker's Island and the in-vessel, food-waste-composting facility. The facility features the world's largest installation of a translucent photovoltaic panel roofing system. Installed with funding from the New York Power Authority, the roof panels provide 40 kilowatts of power to the plant.

Sanitation originally developed the Riker's facility with the understanding that the Department of Corrections (DOC) would be changing their food preparation operation from one where food was prepared on-site to one where food would be received prepackaged and prepared. This latter type of food-service system is one that many institutions adopted in the 1990s. From the

point of view of building an on-site, food-waste-composting facility, the prepackaged food system would mean far less food waste. For this reason, the facility was conceived and built to handle these anticipated lower tonnages. Ultimately, DOC did not change its food-preparation system as planned, leaving the compost facility somewhat undersized. However, as the Department has gained expertise over the past six years, the facility is now operated so that it can handle almost all of Riker's food waste.

The Waste Stream

Approximately 500 tons per month of food material is collected from four different prison kitchens and the Riker's bakery.[8] Food waste is comprised of pre-consumer waste (such as vegetable trimmings, rotten or expired food, or food that has fallen on the floor), as well as leftover prepared food and post-consumption plate scrapings. Typical materials include meats, pasta, vegetables, fruit, bread (and its wax packaging), cereal boxes, milk cartons, and a liquid component (soups, stews, and casseroles). It is important to note that three of the four jails participate (although not on a regular basis) in the City Harvest project wherein edible, unused food is set aside to be transported to soup kitchens to feed the homeless.

Inmates working in a prison cafeteria empty food waste into a specially designated, 44-gallon, yellow container.

Food-Waste Collection and Facility Operations

Containers used for source separation are color-coded. Food waste is collected in specially marked, 44-gallon, plastic, yellow containers. Because of the weight of the food waste, cafeteria staff place the containers on

The 44-gallon containers are wheeled to the loading dock of the cafeteria and emptied into a separate dumpster. These dumpsters are transported to the compost facility and emptied.

[8] The Department collects food waste from four of Riker's seven kitchens. The remaining three kitchens are not included in the program because two of the kitchens do not prepare their own food, and the third has a loading dock which would require use of a different kind of dumpster.

The dumpsters containing food waste are emptied onto the floor of the receiving area at the compost facility.

Food waste is comprised of pre-consumer waste as well as leftover prepared food and post-consumption plate scrapings. Facility operators mix this material with wood chips (shown below) before loading it into the concrete bays.

dollies and haul them to the outdoor dock areas. There they empty the food waste into a separate, yellow dumpster. The dumpsters are collected from each participating jail and transported to the composting facility, where the contents are emptied onto the floor of the receiving area.

Facility operators mix the food waste with a prescribed amount of wood chips and then move the material into two narrow, concrete bays. Since food waste contains a high degree of nitrogen, the added wood chips supply the required carbon to achieve optimal conditions for rapid decomposition. The wood chips also provide porosity to the mix, which allows for better airflow through the material and thus helps maintain aerobic (or oxygenated) conditions.

Agitating equipment mechanically blends the material and pushes it forward in the bays, while air is drawn through the floor of the bays by a computer-controlled temperature regulation system. To mitigate odors, the entire building is kept under negative air pressure, with exhaust air directed

outside of the building, where it passes through a blend of wood chips and finished compost, called a *biofilter*. The microorganisms in the filtration media essentially "eat" the volatile organic compounds that produce odors, thereby serving as biological scrubbers.

The processing period in the bays generally lasts 14 days. By the time the material reaches the end of the bays, its composition and texture have dramatically

The agitator, pictured above, moves along the bays, slowly pushing the material forward as it mixes it. After 14 days in the bays, the food waste has broken down into compost.

Exhaust air is blown outside the building underground, where it passes up through a biofilter, shown above. Microbes that live in this specially engineered bed of woodchips and compost effectively "scrub" the air of odor-causing compounds. A network of above-ground pipes and sprinklers keeps the biofilter moist.

Facility operators transfer the material from the end of the bays to an indoor curing area where it remains for an additional seven to ten days. After this time, the material is moved to an outdoor curing area on Riker's Island where it stays for about another month. With one final screening to remove the contaminants, the material is ready to be used as an amendment for the poor quality soils changed. The food waste that was originally introduced at the loading area has decomposed and the material has a soil-like resemblance. Wood chips are still present in the mixture as well as contaminants such as plastic utensils from the cafeteria. (For security reasons, the cafeteria uses plastic utensils instead of reusable metal ones.)

After operators remove compost from the back end of the bays, they form it into piles in the indoor curing area at the back of the facility.

of Riker's, which was itself a landfill in the earlier part of the last century.

The level of contamination in the daily deliveries of food waste varies, and identifying the source of contamination is difficult. The major contaminants tend to be plastic utensils and plastic gloves. Other types of contaminants (such as plastic serving trays) are also present in the food waste. However, the smaller plastic items pose the biggest challenge in terms of implementing procedures to reduce their presence during source separation as well as in the composting process. Only continued staff education and vigilance can help reduce these contamination levels.

Note that plastic utensils are the major source of contamination in the compost. These and other contaminants are removed through screening at the outdoor area, shown below, where the material finishes curing for about a month.

Conclusion

Over 80 percent of Riker's food waste is composted through the Riker's compost facility. A number of factors contribute to the success of this facility. These include the following:

- A large amount of food waste generated in a compact area, ensuring efficient collection and cost savings.
- Personnel within the institution who "adopt" the program and make sure that source-separation measures are kept in place.
- A supply of labor that can take on the extra tasks associated with keeping food waste separate, such as cleaning food-waste receptacles and loading a separate dumpster.
- A supply of wood chips (or other sources of carbon, such as corrugated cardboard) to mix with the food waste.
- Available space for the composting facility itself (including the biofilter), food-waste dumpsters at generator locations, and outdoor curing.
- Facility operators who understand the composting process, are responsible for facility performance, and are provided with adequate resources to perform their task.

Other In-Vessel Projects at City Institutions

Over the past ten years, the Department has funded various pilot projects to test the installation and operation of different small- to medium-scale "in-vessel" composting technologies at a number of NYC institutions.

In-vessel technologies are those systems that enclose the composting materials, thereby allowing for the efficient use of space, and the capture and treatment of exhaust gases. The key barrier identified in the pilot studies was the cost (capital and operating) associated with the in-vessel systems currently on the market, relative to the current cost for collection and disposal.

The pilot studies also highlighted other obstacles to the wide-scale implementation of this technology. Since composting is a living, dynamic process, the maintenance of a composting system requires more attention and training than standard recycling and waste-disposal practices. Also, in order to secure the proper mix of ingredients for optimal composting conditions, institutions often needed to locate and acquire additional materials off site (such as shredded paper, wood shavings, or wood chips).

The following section summarizes the Department's experience with promoting in-vessel composting at various NYC institutions.

Queens Hospital

The Earth Tub, a small-scale, in-vessel composting unit manufactured by Green Mountain Technology, Inc., was installed in 1997 at the New York Medical Hospital in Flushing, Queens (NYMHQ, now called the New York Hospital, Queens). After a series of modifications from earlier prototypes, two more Earth Tubs were integrated into the grounds of this urban hospital in 1998. All three remained in operation until the summer of 2001.

"Earth Tubs" are examples of small, in-vessel units the Department has helped to install at several City institutions to test the feasibility of on-site composting of food waste.

Temperature profiles logged over the course of the initial pilot suggest that heating to proper temperatures for composting, pathogen kill, and weed seed destruction did occur, and that these temperatures were maintained for a number of weeks. Odors were not a problem, even though the amount of nitrogen in the waste, generally 3 percent to 4 percent, was relatively high, probably reflecting a large percentage of meat scraps in the mix.

Not including potential revenue from compost sales or offset in procurement of soil products for grounds maintenance, the hospital benefits from the composting system by reducing its waste-carting bill. At the time of the pilot, NYMHQ was paying its carter a weight-based rate for collection and disposal of approximately $0.03 per pound, or $60

per ton. With up to a half-ton of food scraps being composted per week, the hospital avoids approximately $1,500 per year in disposal costs. Assuming a modest value for the compost, the economic benefits to the hospital could conceivably approach $2,000 per year.

However, when the full cost of labor is accounted for, operating costs alone are more than double this figure, reaching nearly $5,000 per year, not including the labor cost associated with pre-composting, food scrap handling. Assuming that all labor is redirected from less important tasks, the actual additional incremental operating costs are small. Still, with fixed capital costs exceeding $17,000 (covering the equipment and installation), the project did not present an economically attractive proposition.

In sum, without subsidy for equipment costs and the availability of free or inexpensive labor, economic incentives alone are not sufficient to justify this kind of installation.

City College and St. Barnabas Hospital

The Canadian firm, Wright Environmental Management, Inc., has developed an in-vessel composting unit that is in use at a number of locations in Canada and the U.S. Wright has models ranging in capacity from a few hundred pounds up to several tons per day. During the course of the City's pilot, two Wright units were tested—the WEMI #500 (total daily load: 500 pounds) and the WEMI #750 (total daily load: 750 pounds).

The initial trials with the WEMI #500 during the fall of 1996 at City College of New York were disappointing due to odor problems, and the equipment was removed by January 1997. In retrospect, the complete odor control required for the indoor site selected (an indoor loading dock with corridors leading straight to a faculty lounge) was probably an unreasonable expectation for any composting technology.

Operation of the second installation in 1997 (a WEMI #750) at St. Barnabas Hospital in the Bronx ran into problems due to a contaminated food waste stream. Plastic plates, utensils, and trays consistently made their way into the feedstock, despite intensive staff training. The operation lasted for approximately one year.

Thus, neither of these trials provided for a thorough evaluation of the Wright system. The problems experienced, however, did not appear to be with the technology itself, and a broader review of Wright installations around the country indicates that the technology does perform well, producing a reasonably stable compost product in 28 days, without odor problems (assuming the unit is well sited and operated).

Nevertheless, as with the Earth Tub technology, avoided collection and disposal costs (at current NYC rates) cannot justify the investment economically. With an $80,000 price tag ($82,000 including installation in 1996 dollars), the WEMI #750 has a per-ton annualized, full-capacity processing cost of $173, based on capital costs alone (assuming a seven-year equipment amortization). This does not take into account site preparation costs ($10,000 at St. Barnabas), leasing of land, or operating expenses.

Open Road of New York, Inc.

Open Road is a local, nonprofit group working in the field of outdoor environmental education. They manufacture the Hot Box—

a low-technology option suitable for small-scale, non-capital-intensive composting. The original prototype of the Hot Box was built in 1994. Subsequent real-world testing and refinement led to the current design. A patent was awarded on June 16, 1998.

Hot Boxes are used at about 10 sites around New York City. These include public and private schools, community gardens, and colleges. They are being used to compost a range of materials, including pre- and post-consumer food scraps, stable waste, and grass clippings.

The Hot Box consists of a cubic-yard box, typically made of untreated pine or plastic lumber. The box is intersected by a series of horizontal perforated pipes, set at predetermined levels. Convection serves to draw air through these pipes and into the composting materials inside the box. Loading, mixing, and unloading are performed manually using standard garden tools. Materials can be either premixed and then loaded, or mixed directly in the box. The goal, in both cases, is to obtain a mixture with the proper moisture content (about 60%) and porosity, since materials are not further agitated after the initial mixing.

Students of the Project Roots program at I.S. 318 in Brooklyn experiment with a clear lid for their "Hot Box."

Biofiltration is usually accomplished with a 3-inch to 6-inch layer of finished compost applied on top of the compostable material once the box is loaded. However, there is at least one site where Hot Boxes have been set up with an external biofilter as well. Lids for the boxes are constructed if an external biofilter is to be used, or if the system is operated out-of-doors. The front of the box is removable to facilitate loading and unloading.

The Hot Box has proven, over its six years of use in New York City, to be a reliable and flexible system with relatively low capital costs. While it is generally used for smaller quantities of waste than other technologies, the Hot Box has found its way into a broad array of applications. Despite the "low-tech" nature of the system, it has proven suitable for different types of food waste in a variety of settings.

Students, teachers, gardeners, or others who have a vested interest in the process and end product perform the manual tasks. Labor costs then do not present an obstacle at these installations, and as noted, capital costs are modest. However, as with other composting technologies tested by the Department, if the full labor costs associated with Hot Box composting were applied, it would not prove to be economically attractive, given current collection and disposal costs.

Conclusion

The prospects for small- to medium-scale, in-vessel composting are mixed. While a number of effective, in-vessel composting systems exist, the costs of purchasing and operating this equipment are difficult to justify given current waste disposal costs. For institutions or businesses with high waste-

disposal costs (or for those who are eager to implement an environmentally sound, organic-waste-management program), there are now viable options to successfully process food waste on site without odor or vector problems. Grant funding or other government subsidies could further encourage the implementation of composting programs. However, under current market conditions, the potential waste-disposal savings are not sufficient to warrant widespread adoption of these on-site, small-scale composting systems.

Although the prohibitive monetary and labor investments do not make on-site, in-vessel composting widely appealing as a waste management strategy, the Department still believes that such projects are suitable for institutions with an educational mission. For example, in 2000 the Department funded the installation of two Earth Tub food-waste-composting units at The New York Botanical Garden to serve their catering operation. They use the Earth Tubs to demonstrate the possibility of increased recycling, and will feature the operation in an upcoming conference on managing organic waste on site for New York City institutions. The Department continues to monitor developments in on-site composting technology and to seek out potential institutions for which such technology might be appropriate.

The Compost Project Outreach and Education Program

The decentralized approach to composting requires that as many institutions and residents as possible learn about the benefits of composting, and have access to technical assistance. For this reason, Sanitation worked with the Department of Cultural Affairs in July 1993 to establish contracts with the City's four Botanical Gardens to promote composting in NYC. Through this arrangement, Sanitation funds full-time staff (at the Brooklyn Botanic Garden, the Queens Botanical Garden, the Staten Island Botanical Garden, and The New York Botanical Garden in the Bronx) to promote backyard and on-site composting to NYC residents, institutions, and businesses through a program known as the *Compost Project*.

A "Master Composter" staffs an information table at a "Compost Giveback" in Brooklyn.

The Department wanted to promote composting through the Botanical Gardens because each Garden already had a visible presence and name recognition in neighborhoods and community gardens throughout the City. By funding these existing institutions to encourage composting, the Department gained improved services, expertise, and the ability to target specific audiences that would not be easily reached through existing Sanitation programs or advertising campaigns.

The goal of the Compost Project is to teach New Yorkers about the composting process and its benefits, from horticultural, ecological, and waste-management perspectives. The Compost Project established a backyard

composting demonstration site at each Botanical Garden and at a satellite site (such as a park or nature center) in each of their respective boroughs. The demonstration sites display different kinds of backyard compost bins (and how to use them), and provide information on mulching, grass recycling, and alternative ground covers.

In addition to the demonstration sites, in 1997 each Garden set up a telephone help line to answer questions about composting. Descriptions of other principal Compost Project programs are provided in the sections that follow.






The Department funds the Compost Project, an outreach and education program run through the City's Botanical Gardens. Compost demonstration sites were established at each Garden. Pictured here are the demonstration sites at the Brooklyn Botanic Garden and The New York Botanical Garden in the Bronx.

Master Composter Course

While the Compost Project reaches a significant number of people, Project staff can't visit every NYC neighborhood and communicate in the dozens of languages spoken in those neighborhoods. Therefore, Project staff designed a program to convey this information to committed individuals within various NYC communities.

Adapted from Master Composter and Master Gardener projects carried out in other states, the *New York City Master Composter Certificate Course* is a "train-the-trainer"–style program, designed to provide participants with:

- Technical knowledge about composting.
- Hands-on skills at creating compost systems.
- Outreach techniques to teach others about composting.

Compost Project staff annually select a diverse group of volunteers from all over the City to take the Master Composter Course. These volunteers demonstrate an interest in and a commitment to composting, plus a desire to share their knowledge with their community.



"Master Composters" (MCs) are a diverse group of New Yorkers who share an enthusiasm for composting and gardening, as well as provide an active link to their respective communities. Each year the Compost Project trains about 20 MC volunteers in each borough. The MCs pictured here are helping at an outreach event in Queens and demonstrating how to build a better worm bin.

The Brooklyn Botanic Garden and the Staten Island Botanical Garden first ran the program as a pilot in 1999. During its first year, the Master Composter program had 25 participants, divided between the two Garden sites. In 2000, the course was evaluated, refined, and offered citywide. During 2000, the Master Composter program had 61 participants, divided among the four Botanical Gardens.

To acquire the Master Composter certificate, each participant attends 20 hours of classes (including field trips) and completes 30 hours of public outreach service. Field trips include visiting:

- The Fresh Kills landfill and compost facility.
- The Riker's Island compost facility.
- Small, in-vessel, composting units in locations around the City.
- Installations of residential, backyard compost bins.

Most participants complete their volunteer hours, while several exceed expectations by performing 60 hours and beyond of compost community outreach. Service projects completed by volunteers include:

- Setting up worm bins for composting food waste at a Buddhist temple in Queens.
- Conducting composting workshops in Brooklyn community gardens and Bronx public schools.
- Tabling at street fairs and farmers' markets in Manhattan and the mall in Staten Island.



Master Composters must complete 20 hours of classes (including field trips) and 30 hours of public outreach service in order to receive certification.



A variety of techniques are used by the New York City Housing Authority to compost leaves on site. The Compost Project provides training and ongoing assistance to NYCHA.

Assistance to New York City Institutions and NYCHA

From 1994 to 1997, the Compost Project specifically directed technical assistance to NYC institutions, as well as to housing complexes managed by the NYC Housing Authority (NYCHA). During this period, Project staff gave presentations about on-site leaf composting and grass recycling to approximately 15 public schools, 16 higher learning institutions, 16 cemeteries, 8 golf courses, and 8 hospitals.

As a result of a series of seminars held for NYCHA grounds staff and managers, NYCHA enacted a policy to cease bagging grass clippings for Sanitation collection. A conservative estimate of the citywide impact of this effort ranges from 8,000 to 15,000 tons of grass clippings diverted from landfilling each year.

By February 1997, after receiving training and continuous outreach from Garden staff, 58 NYCHA locations throughout the City began composting their leaves on-site. A survey conducted by Garden and Sanitation staff shows that these sites are diverting nearly 6,500 cubic yards of leaves per year from landfilling. While these diversion rates are not terribly high in terms of the City's total waste generation, they do justify the expense of running this outreach program.

While the focus of the Compost Project as a whole has turned more toward residential composting in the past few years, the Compost Project at The New York Botanical Garden will host a conference in the coming year for NYC institutions. The conference will broadly address how institutions can maximize their reuse and recycling of organic waste, through donation to food banks and composting.

"Leave it on the Lawn" Campaign and Landscaper Training

The Department estimates that 78,000 tons of grass clippings are disposed of per year in New York City. Therefore, the Department began a "Leave it on the Lawn" campaign, asking City residents and institutions not to place grass clippings out for collection and disposal. Rather than raking and bagging grass clippings, Sanitation encourages New Yorkers to leave them on the lawn, where they can

decompose naturally and return nutrients and moisture to the soil.

In 1994, the Department produced a *Leave It On The Lawn* brochure and mailed it to elected officials, community district offices, lawn mower equipment distributors and manufacturers, landscapers, gardening groups, and community and civic associations. Compost Project staff regularly distribute the brochure during their outreach activities. The Department produced an updated version of the brochure in April 2001.

*The Department produced this first **Leave It On The Lawn** brochure in 1994 to encourage NYC residents to leave their grass clippings on their lawns instead of bagging them for Sanitation collection.*

Compost Project staff have incorporated "grass recycling" or mulch-mowing information into their public education materials. In areas with more lawns (such as Staten Island and Queens), Compost Project staff hold regularly scheduled workshops that teach residents how to integrate mulch-mowing into a more environmentally sensitive approach to lawn care.

Approximately one-third of New Yorkers employ private landscaping services, making landscapers an important target for the Compost Project's "Leave it on the Lawn" campaign. From 1995 through 1998, the Queens and Staten Island Botanical Gardens constructed and operated small-scale composting facilities on their own grounds, which were designed to process the leaves and yard waste generated by local, private landscapers. One of the goals of the facilities was to train these private landscapers in grass mulching, decreased pesticide and fertilizer use, and the utilization of compost.

Through the Compost Project, the Department established and operated small-scale sites designed to accept landscaper waste at the Queens (above) and Staten Island Botanical Gardens.

decompose naturally and return nutrients and moisture to the soil.

In 1994, the Department produced a *Leave It On The Lawn* brochure and mailed it to elected officials, community district offices, lawn mower equipment distributors and manufacturers, landscapers, gardening groups, and community and civic associations. Compost Project staff regularly distribute the brochure during their outreach activities. The Department produced an updated version of the brochure in April 2001.

*The Department produced this first **Leave It On The Lawn** brochure in 1994 to encourage NYC residents to leave their grass clippings on their lawns instead of bagging them for Sanitation collection.*

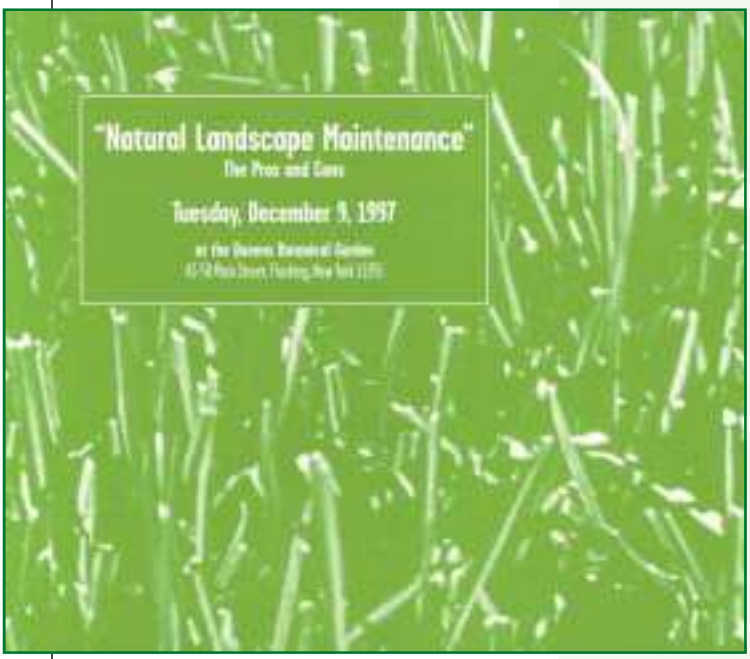
Compost Project staff have incorporated "grass recycling" or mulch-mowing information into their public education materials. In areas with more lawns (such as Staten Island and Queens), Compost Project staff hold regularly scheduled workshops that teach residents how to integrate mulch-mowing into a more environmentally sensitive approach to lawn care.

Approximately one-third of New Yorkers employ private landscaping services, making landscapers an important target for the Compost Project's "Leave it on the Lawn" campaign. From 1995 through 1998, the Queens and Staten Island Botanical Gardens constructed and operated small-scale composting facilities on their own grounds, which were designed to process the leaves and yard waste generated by local, private landscapers. One of the goals of the facilities was to train these private landscapers in grass mulching, decreased pesticide and fertilizer use, and the utilization of compost.

Through the Compost Project, the Department established and operated small-scale sites designed to accept landscaper waste at the Queens (above) and Staten Island Botanical Gardens.

Input from landscapers helped the Gardens design conferences to address landscapers' concerns about practices intended to minimize waste production and environmental impacts. The first such event, entitled "Natural Landscape Maintenance: The Pros and Cons," was held at the Queens Botanical Garden in December 1997, and was attended by 140 landscape professionals from both the private sector and public agencies. The Brooklyn Botanic Garden held a second conference in March 1998, with 150 attendees. A third conference was held at the Staten Island Botanical Garden in February of 1999, with 80 attendees. These conferences were aimed at both private landscapers, as well as institutional grounds staff, and were generally presented as a series of lectures.

Beginning in 2000, both Staten Island and Queens Botanical Gardens pioneered a new kind of landscaper conference based on their experience and learning over the previous five years. Given the large numbers of private landscapers in their respective boroughs, they decided to run conferences based exclusively on the concerns of this group. The focus shifted from academic and scientific presentations about the benefits of natural lawn care and mulch-mowing, to the practical means of providing services based on these ideas, while still maintaining and growing a profitable business.



The Compost Project has held a number of conferences designed especially to educate NYC landscapers and institutional grounds staff about environmentally sensitive lawn care.

The group size was reduced to 15–30 professionals to better facilitate conversation in a roundtable style. Presenters were landscapers themselves, who possessed real-world experience and the ability to speak the same language as the participants. In addition, Project staff selected a model landscaper from each borough who agreed to mulch mow all of his clients' lawns and document the results (in return for a discounted mulching mower). These individuals have proved to be an incredible resource since they have direct experience with successfully integrating these services within a NYC environment. The Compost Project will continue to reach out to landscapers through these roundtable events.

Teacher Training

In 1999, the Compost Project designed a course to train teachers, called *Wormbin Composting in the Classroom*. During the year 2000, Compost Project staff demonstrated to 240 public school teachers from all five boroughs how to incorporate a worm bin into their curricula.

Working with worms in the classroom offers a great, hands-on way to teach about

natural systems, recycling, and gardening. As part of the course, teachers learn how to:

- Set up a worm bin to keep in their classroom.
- Feed worms with food scraps.
- Maintain a healthy worm bin ecosystem.
- Harvest finished compost.

The course also presents activities, cross-curriculum ideas, and ways to incorporate worm composting into science, math, and language arts for students of all ages. The workshops are held at the Botanical Gardens, where teachers receive a kit including a *Worms Eat Our Garbage* activity guide, red wriggler worms, and a plastic worm bin with start-up material. The Board of Education has approved this course for three new teacher-training credits.

Compost Giveback Events: Free Compost Distribution and Subsidized Compost Bin Sales

The Department began distributing free compost to NYC residents at the Fresh Kills landfill in 1992. Residents could drive into the landfill and pick up the material during operating hours. Since this arrangement was less than optimal from a safety and security standpoint, the Department decided to move the distribution location to the Staten Island Botanical Garden in 1994. It was called the "compost giveback program" as the Department gave back the compost it made from leaves that residents set out each fall. The Compost Project in Brooklyn began distributing Department-made compost by appointment from the Brooklyn Botanic Garden in 1993. This arrangement lasted until 1996 when Project staff decided to move the compost distribution to Prospect Park in Brooklyn. The following year the Brooklyn Compost Project also offered a limited number of subsidized backyard composting bins at the Prospect Park distribution event.

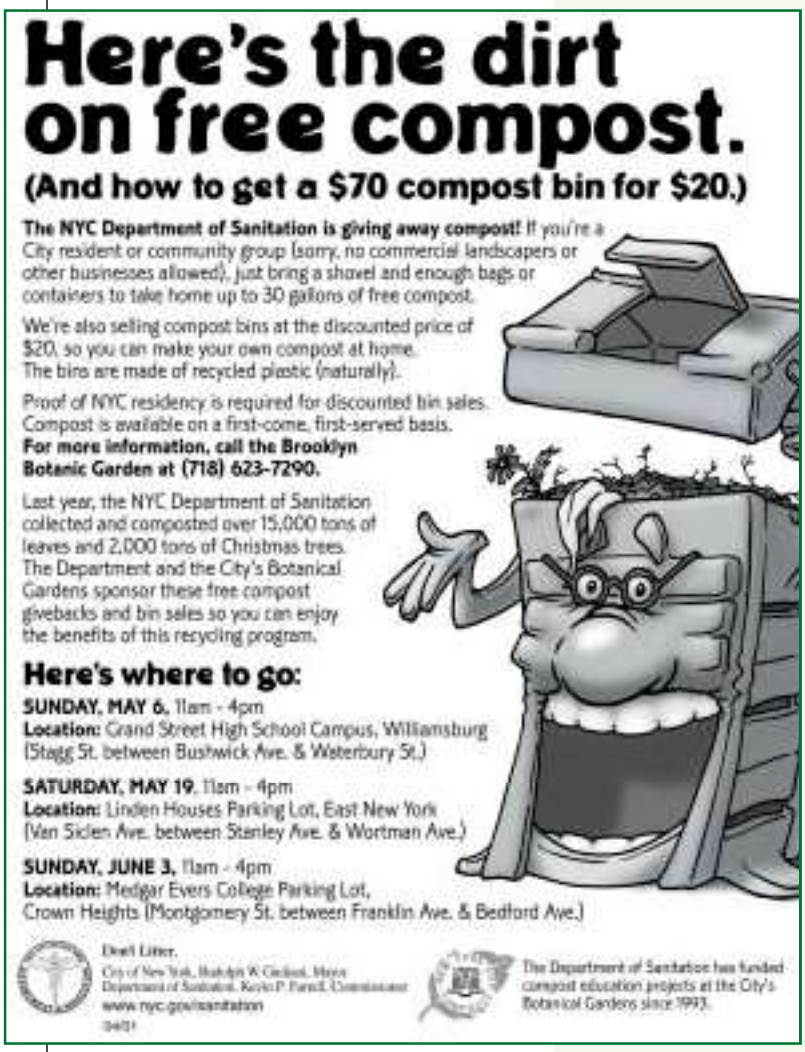
This model of free compost coupled with a bin sale was piloted citywide in 1998 in an effort to encourage as many NYC residents as possible to compost their food and yard waste at home. In 1999 the Department initiated a campaign to promote the givebacks and bin sales. The campaign involved a mailed flyer, cable TV ads, and starting in 2000, local print ads as well. Depending on available funding, the Department continues to promote the givebacks and bin sales using some or all of these elements:

- **Mailed Giveback Flyer.** This flyer lists the dates of all the givebacks and is mailed every spring and fall to the growing mailing list compiled by the Compost Project staff at the City's four Botanical Gardens. The first giveback flyer featured the Department's recently developed Compost Project logo—*New York City Composts*. This logo is based upon the Department's recycling logo and was developed to provide a unified look among the various Compost Project programs. Starting in 2000, the giveback flyers also featured the Department's compost bin cartoon character. This character was designed to match the Department's other recycling program cartoon "mascots" such as the blue and green recycling bins.
- **Giveback Cable TV Commercials.** A standard commercial was produced

for the spring givebacks that shows the various uses for compost. An end screen is added to promote the dates and locations of specific giveback events. A week before each scheduled event, a commercial promoting the event is run on local cable stations.

- **Giveback Print Ads.** An ad featuring the compost bin character was developed which explains the giveback and bin sale program and lists the event dates for each borough. This ad is run in local community papers in the four outer boroughs.

A "still" from the spring giveback cable TV commercials. The commercials explain the various uses for compost and provide the date and location for each giveback event.



Here's the dirt on free compost.

(And how to get a $70 compost bin for $20.)

The NYC Department of Sanitation is giving away compost! If you're a City resident or community group (sorry, no commercial landscapers or other businesses allowed), just bring a shovel and enough bags or containers to take home up to 30 gallons of free compost.

We're also selling compost bins at the discounted price of $20, so you can make your own compost at home. The bins are made of recycled plastic (naturally).

Proof of NYC residency is required for discounted bin sales. Compost is available on a first-come, first-served basis. **For more information, call the Brooklyn Botanic Garden at (718) 623-7290.**

Last year, the NYC Department of Sanitation collected and composted over 15,000 tons of leaves and 2,000 tons of Christmas trees. The Department and the City's Botanical Gardens sponsor these free compost givebacks and bin sales so you can enjoy the benefits of this recycling program.

Here's where to go:

SUNDAY, MAY 6, 11am - 4pm
Location: Grand Street High School Campus, Williamsburg (Stagg St. between Bushwick Ave. & Waterbury St.)

SATURDAY, MAY 19, 11am - 4pm
Location: Linden Houses Parking Lot, East New York (Van Sicklen Ave. between Stanley Ave. & Wortman Ave.)

SUNDAY, JUNE 3, 11am - 4pm
Location: Medgar Evers College Parking Lot, Crown Heights (Montgomery St. between Franklin Ave. & Bedford Ave.)

Don't Litter.
City of New York, Rudolph W. Giuliani, Mayor
Department of Sanitation, Kevin P. Farrell, Commissioner
www.nyc.gov/sanitation
04/01

The Department of Sanitation has funded compost education projects at the City's Botanical Gardens since 1993.

Each spring and fall, the Compost Project holds compost "givebacks" and subsidized bin sales at different locations in each borough. The Department promotes these events through ads in local papers, mailed flyers, and cable TV commercials.

*The Department developed a Compost Project logo—**New York City Composts**—to provide a unified look among the various Compost Project programs. This logo is a variation of the Department's recycling logo—**New York City Recycles**.*

Each spring and fall, two or three giveback and bin sale events are run by Compost Project staff in each borough. (See Table 11 on page 53 for a summary of the number of events held in each borough since 1999.) The program operates as follows:

1. About six months prior to the giveback events, Compost Project staff secure donated locations for the events in each borough. The events are generally held in parks, parking lots, or other open spaces that can accommodate several hundred cubic yards of compost and hundreds of people. The Compost Project tries to locate events in different parts of each borough so that the program reaches a wide audience.
2. In days prior to the event, the Department delivers between 75 and 300 cubic yards of compost made from fall leaves to the giveback site (the amount depends on the site size and anticipated demand).
3. On the day of the event, the compost bin vendor arrives with a truckload of compost bins. Compost Project staff and Master Composters set up demonstration bins and compost information tables.
4. When the public arrives, residents are allowed to take up to 30 gallons of finished compost (free of charge) and may also buy backyard compost bins for $20 (the bins normally retail for $70–$80). Master Composters are available to discuss how to set up and use the bins.

At "compost giveback" events, the Department, through the Compost Project, distributes free compost and makes available backyard compost bins at a subsidized rate of $20. Givebacks are held spring and fall in all five boroughs.

Every year the program has grown as more and more people find out about the events. A recent article in the *New York Times* ("A Land Rush for Compost in the City," Sunday, June 17, 2001, City Section) highlighted the diversity of attendees at the compost givebacks, noting that a Crown Heights Brooklyn event "looked like a gathering of the nations." Compost is a resource that people from all ethnic and socio-economic backgrounds appear to appreciate, and the giveback program's goal is to get this resource into as many different NYC neighborhoods as possible.

In addition to distributing compost to residents, a regular compost distribution program for nonprofit community organizations was established at the Queens Botanical Garden in July 2000. Through this initiative, DOS provides for the delivery of its finished compost to community gardens and other nonprofit greening organizations in all five boroughs. A total of 988 cubic yards was delivered to 146 groups in 2000, including member gardens of the City Farms project—a program that seeks to improve the availability of fresh food in NYC's low-income neighborhoods.

Outreach Materials

The year 2001 saw the launch of the Compost Project website, www.nyccompost.org—a valuable resource for compost enthusiasts in NYC, providing illustrated, step-by-step instructions for setting up and maintaining a compost bin or a worm bin. The website covers many topics, from the basics of compost science to a more natural approach to lawn care. Links to compost-related organizations in the City as well as links for teachers are available.

The website also serves as a paperless way to keep City residents informed of upcoming events, like compost givebacks and compost workshops. Through the Compost Project website, the Department can present in one central location the many composting-related programs run through the City's four Botanical Gardens.

*The year 2000 saw the launch of the Compost Project website at **www.nyccompost.org**. The site provides a paperless way for New Yorkers to learn about composting and compost resources in the City.*

In 2001, the Compost Project and the Department of Sanitation also completed updates to its composting publications and produced a new brochure focusing on indoor composting. The publications are described in detail below. The development of the new brochures allowed the Department to disseminate updated information on NYC composting programs, promote the new Compost Project website, as well as present a unified look for the program.

Table 11

Summary of NYC Compost Giveback and Bin Sale Events 1999

Borough	Location	Date	Attendees	Compost Distributed (cubic yards)	Compost Bins Sold
Bronx	Pelham Bay Park	04/18/1999	170	20	90
Bronx	Riverdale Metro North Station	05/15/1999	142	20	125
Bronx	Sammy's Fish Box Parking Lot	05/22/1999	119	20	60
Bronx	Van Cortland Park	06/12/1999	120	25	59
Bronx	JFK High School	09/18/1999	104	25	50
Bronx	Seton Fall Park	10/30/1999	165	20	90
Brooklyn	Lincoln Terrace Park, Crown Heights	04/24/1999	550	45	184
Brooklyn	Van Dyke Street, Red Hook	05/23/1999	600	60	246
Brooklyn	Linden Houses, East New York	06/26/1999	400	60	113
Brooklyn	Dyker Heights Golf Course	09/25/1999	267	50	158
Brooklyn	Marine Park	11/07/1999	500	75	218
Manhattan	Union Square Greenmarket	06/16/1999	225	1.2	15
Manhattan	Washington Market Park Greenmarket	06/19/1999	93	0.54	7
Manhattan	97th Street Greenmarket	07/09/1999	110	1.2	10
Manhattan	Tompkins Square Park Greenmarket	07/25/1999	46	1.2	5
Queens	Queens Botanical Garden	04/17/1999	463	54	118
Queens	Forest Park	04/24/1999	208	30	86
Queens	Kissena Park	05/16/1999	176	38	76
Queens	Alley Pond Park	06/06/1999	256	39	97
Queens	Astoria Park	07/10/1999	118	20	30
Queens	Garden World	10/02/1999	210	15	160
Queens	Cunningham Park	10/03/1999	393	45	194
Staten Island	High Rock Park	04/25/1999	300	30	150
Staten Island	Snug Harbor Cultural Center	05/01/1999	900	60	400
Staten Island	New Dorp High School	05/22/1999	750	60	513
Staten Island	Wolfe's Pond Park	09/26/1999	475	120	303
Staten Island	Midland Beach Park	10/23/1999	530	100	375
	TOTAL		**8390**	**1035.14**	**3932**

Table 11 (continued)

Summary of NYC Compost Giveback and Bin Sale Events 2000

Borough	Location	Date	Attendees	Compost Distributed (cubic yards)	Compost Bins Sold
Bronx	Public School #97	10/14/2000	236	70	91
Bronx	Lehman College	10/29/2000	150	70	88
Bronx	Pelham Bay Park	04/16/2000	164	30	110
Bronx	Bissell Garden, Wakefield	05/13/2000	287	60	110
Brooklyn	Pier 41, Red Hook	09/09/2000	369	100	78
Brooklyn	Dyker Beach Golf Course	09/24/2000	479	100	122
Brooklyn	Sears Parking Lot, Flatbush	10/14/2000	808	100	128
Brooklyn	Marlborough Houses, Gravesend	04/29/2000	1089	120	308
Brooklyn	McCarren Park, Greenpoint	05/21/2000	689	120	188
Manhattan	Riverside Park	05/20/2000		Cancelled*	
Manhattan	Tompkins Square Park	10/14/2000	119	90	36
Queens	Garden World Parking Lot, Bayside	03/29/2000	742	30	416
Queens	Beach 96th St., Rockaways	05/07/2000	562	75	258
Queens	Cunningham Park	10/10/2000	442	90	309
Queens	Forest Park	10/16/2000	330	90	163
Staten Island	Mount Loretto Campus	09/17/2000	351	70	116
Staten Island	Historic Richmondtown	10/21/2000	187	40	211
Staten Island	Midland Beach Parking Lot	05/20/2000	517	120	292
Staten Island	Michael J. Petrides School	06/11/2000	492	120	143
	TOTAL		**8013**	**1495**	**3167**

* Cancelled due to heavy rain.

Table 11 (continued)

Summary of NYC Compost Giveback and Bin Sale Events 2001 (Spring Only)

Borough	Location	Date	Attendees	Compost Distributed (cubic yards)	Compost Bins Sold
Bronx	Van Cortlandt Park	05/12/2001	345	100	120
Bronx	Riverdale Metro North Station	05/20/2001	240	90	84
Brooklyn	Grand St. High School, E. Williamsburg	05/06/2001	851	100	153
Brooklyn	Linden Houses, East New York	05/19/2001	900	100	107
Brooklyn	Medgar Evers College, Crown Heights	06/03/2001	700	80	192
Manhattan	Abingdon Square Park, West Village	05/26/2001	125	1	26
Manhattan	Pier 84, West Side Highway	06/17/2001	200	30	72
Queens	Forest Park	04/28/2001	798	120	466
Queens	Shea Stadium	04/29/2001	914	120	468
Staten Island	Midland Beach Parking Lot	04/28-29/2001	2058	300	1096
Staten Island	Fresh Kills Landfill, Composting Facility	05/20/2001	1134	220	138
	TOTAL		**8265**	**1261**	**2922**

Screen versions of the new brochures can be downloaded from the Sanitation website (www.nyc.gov/sanitation); hard copies can also be ordered through this website. The composting publications are distributed through the following ways:

- Giveback events.
- Compost Project workshops, classes, and presentations.
- Information tables at Greenmarkets, street fairs, and special events.
- Mailed out in response to calls to the Sanitation Action Center or the help lines staffed by the Compost Project.
- Orders placed through the Sanitation website.

New York City composting guide

The *New York City composting guide* (an update to the *Urban Home Composting Guide*) provides simple and clear instructions for using a compost bin, what materials to add, and how to use finished compost. It provides troubleshooting tips and addresses concerns unique to composting in an urban environment. Questions frequently asked of Compost Project staff have been highlighted and answered in an easy-to-use format.

Cover of the newly updated ***composting guide****.*

Cover of the updated version of the ***Leave it on the lawn*** *brochure.*

Cover of the new ***Indoor composting with a worm bin*** *brochure.*

Leave it on the lawn **brochure**

An introduction to mulch-mowing or grass recycling, the *Leave it on the lawn* brochure also outlines general lawn care tips to make this practice easier and more visually attractive. A natural lawn care calendar details what steps should be taken during each season to make leaving clippings on the lawn something all New Yorkers and their landscape professionals can do.

Indoor composting with a worm bin **brochure**

For those City residents and schoolteachers with a lot of dedication and no access to an outdoor composting area, the *Indoor composting with a worm bin* brochure provides all of the information necessary to set up and maintain an indoor composting system with worms. Troubleshooting tips as well as resources for ordering worms are also provided.

Table 12

Summary of NYC Compost Project Activities: Number of Events and Participation Levels

FY94–FY97	Event	Number of Events	Attendees
	Classes, workshops, and presentations	284	15,000
	Student workshops in NYC schools	200	6,000
	Fairs, tabling, and special events	186	24,000

FY99	Help Line Calls	Outreach Events	Number of People Reached	Workshops	Attendees	Teacher *Wormshop* Participants	Bins Sold
BBG	1427	19	3340	37	636	84	242
NYBG	465	18	1269	26	1080	83	46
QBG	1246	25	2154	20	457	52	84
SIBG	670	5	2100	11	117	47	53
Total	**3,808**	**67**	**8,863**	**94**	**2,290**	**266**	**425**

FY00	Help Line Calls	Outreach Events	Number of People Reached	Workshops	Attendees	Teacher *Wormshop* Participants	Bins Sold
BBG	1748	28	5933	30	515	61	1222
NYBG	806	15	1769	32	391	124	429
QBG	2640	16	3278	33	560	37	1504
SIBG	833	16	2906	20	200	12	1056
Total	**6,027**	**75**	**13,886**	**115**	**1,666**	**234**	**4,211**

FY01	Help Line Calls	Outreach Events	Number of People Reached	Workshops	Attendees	Teacher *Wormshop* Participants	Bins Sold
BBG	2,162	37	28,703	25	279	279	1,242
NYBG	722	33	2,249	17	202	202	439
QBG	3,265	18	3,757	33	1,508	231	1,772
SIBG	1,588	23	8,468	26	293	293	1,711
Total	**7,192**	**108**	**44,483**	**89**	**1,943**	**936**	**5,045**

Notes:
- **FY** stands for Fiscal Year, which in New York City runs from July 1 to June 30.
- **BBG** stands for the Brooklyn Botanic Garden, **NYBG** stands for The New York Botanical Garden, **QBG** stands for the Queens Botanical Garden, and **SIBG** stands for the Staten Island Botanical Garden.
- **Help Line Calls** is the number of telephone calls received by each borough on the Compost Help Line.
- **Outreach Events** include such activities as setting up a table at street fairs, Parks Department events, Greenmarkets.
- **Number of People Reached** is an estimate of the number of people impacted by the outreach event.
- **Workshops** include all workshops (such as "Indoor Composting with a Worm Bin," "Leave it on the Lawn," "Backyard Composting," etc.), except the "**Teacher Wormshops**," which are listed separately.
- The **Attendees** column indicates the cumulative number of people attending the workshops.
- **Bins Sold** indicates the number of compost bins sold both at the Botanical Garden and at compost giveback events.

General Outreach

Since the Compost Project first started in 1993, the number of programs it offers has expanded tremendously. Table 12 on page 57 tracks the increasing reach and effectiveness of the various Compost Project activities.

Backyard-Composting Pilot

In 1999, The Department of Sanitation concluded a pilot study to assess the effects of backyard composting on the City's waste stream. The purpose of the pilot was to answer the following question: "If New Yorkers know about the benefits of composting food and yard waste, and the City makes it easy for them to do it, could this make a significant dent in the over three million tons of residential and institutional waste generated here each year?" The complete report on the backyard pilot, *Backyard Composting in New York City: A Comprehensive Program Evaluation*, is available on the Department's website at www.nyc.gov/html/dos/html/recywprpts.html.

A complete summary of the backyard-composting pilot is provided in the Department's 1999 report, ***Backyard Composting in New York City: A Comprehensive Program Evaluation****. The report can be viewed from the Department's website.*

The pilot had four distinct components:

- Intensive, "user-friendly" promotion of a backyard-composting program, including the distribution of subsidized compost bins.
- Market research about participation and effectiveness of outreach and education to residents.
- State-of-the-art, waste-composition analysis to directly measure program effects on trash and recycling.
- Estimation of program effects, costs, and benefits.

Promoting the Program

To publicize backyard composting in the most appealing, convenient, and efficient way possible, the Department worked with Compost Project staff at the City's Botanical Gardens. These individuals were already trained in all aspects of composting, and were familiar with the neighborhoods in each of their respective boroughs. The Department drew on their expertise to select four neighborhoods (one each in Brooklyn, the Bronx, Queens, and Staten Island) in which to evaluate the impacts of a backyard-composting program.

A staff member from the Compost Project helps a Brooklyn resident set up a backyard bin as part of the Backyard Composting Pilot. This formal investigation by the Department attempted to determine the waste-diversion potential of backyard composting.

During the summer of 1997, Compost Project staff sent letters, made phone calls, and even went door-to-door to the roughly 1,000 residences with backyards in these neighborhoods, in order to encourage the maximum possible participation. Interested households were sold a bin at a nominal fee, provided extensive information about what and how to compost, and given a free Botanical Garden membership. There was a "Compost Help Line" set up for questions and comments. And Compost Project staff made follow-up visits to each household to answer questions and check bins.

Interpreting Participation: Market Research

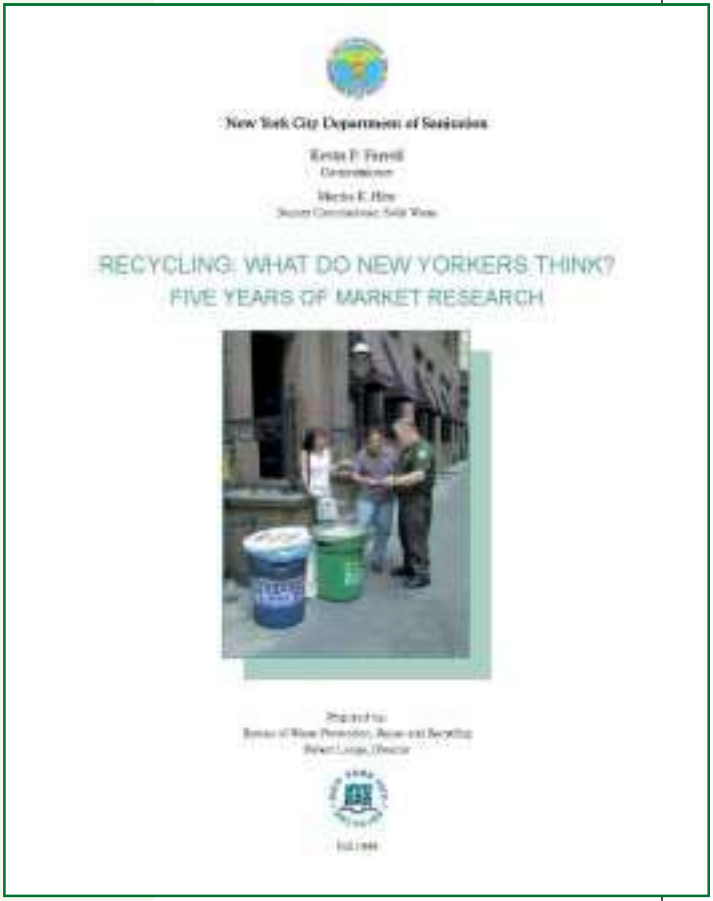
Despite extensive outreach, only 9.4 percent of qualifying households (i.e., those with backyards) in the test areas elected to join the program. This result is impressive in terms of a promotional effort, as many such promotions for commercial products are judged as successful with much lower participation rates. However, in terms of trying to establish a new waste management method, this result was somewhat disappointing. Prior citywide surveys had shown that as many as one-third of NYC households had some outdoor area in which a bin could be placed. *All* the homes targeted for outreach in the test neighborhoods were one- or two-family houses with backyards. The question was then asked, "Why did less than 10 percent of these households choose to participate?"

The Department selected one neighborhood in Brooklyn, Queens, Staten Island, and the Bronx to target for extensive backyard-composting promotion. Of those households with backyards, 9.4 percent chose to purchase and set up a bin. Surveys and focus groups helped to clarify that composting appeals primarily to the minority of New Yorkers who are already active gardeners.

A series of telephone surveys and focus groups helped to clarify the relatively low turnout. They revealed that composting only appealed to that minority of householders who were active gardeners and could envision actually *using* the compost themselves. This was so despite intense efforts on the part of Compost Project staff to explain the benefits of compost for overall lawn care, as a gift for neighbors, or for general neighborhood beautification. It seemed that environmentalism, a sense of civic duty, concern over litter and landfills, or other attributes that make residents generally "waste conscientious" did not translate into a desire to compost at home.[9] It became clear that additional education and outreach was not the solution, since some of the households who had opted not to volunteer for the program felt that outreach had been, if anything, too insistent. In everyone's opinion, providing basic information and bin subsidization was enough to foster composting among those who would actually do it—an estimated 10% of those households with access to a backyard.

The market research found strong approval of the program among those who did volunteer. Nearly all praised the thoroughness of the Compost Project's education and support efforts. The vast majority reported really enjoying composting, citing its benefits for gardening and waste reduction. Nine months after receiving their bins, 92% of volunteers were actively composting. Yet despite their overwhelming support, relatively few of them (only around one-quarter) believed that the City should make the practice mandatory for NYC residences with backyards.

In addition to the market research completed as part of the Backyard-Composting Pilot, the Department conducted additional research to assess what NYC residents think about backyard composting, source separation of food waste, and in-sink garbage disposals. The Department's 1999 report, *Recycling: What Do New Yorkers Think? Five Years of Market Research* presents the results of this research, as well as the findings from other market research the Department conducted on New Yorkers' recycling and waste-prevention attitudes.



This report describes the extensive market research the Department has completed to assess what New Yorkers think about recycling, composting, and waste prevention.

[9] It is interesting to note, however, that in a survey of those 174 households who *did choose* to participate in the pilot, more people cited "waste reduction/environmental concerns" as the number one reason they decided to join the backyard-composting program.

Waste-Composition Analysis

Most cities evaluate the success of backyard-composting programs with surveys, asking residents not only about their opinions, but eliciting self-reported estimates of how much they are putting into their bin each week. A few jurisdictions have made efforts to get volunteers to weigh what they place in the compost bin. Sanitation's program evaluation was unique in that it *directly measured* the impact of program participation on residents' trash and recycling, taking into account additional, outside influences on waste generation and composition.

This was achieved by collecting, sorting, and weighing samples of the waste residents in the test areas set out at curbside once before, and twice after, the backyard program was instituted. With the aid of an expert consultant in waste analysis, the Department assessed waste-composition changes before and after the program had been implemented, among those who agreed to compost and those who did not, as well as in a fifth "control' neighborhood with similar characteristics to the test area (but in which there was no program publicity). The latter allowed for control of outside effects on waste generation and composition that were not related directly to this project.

The Department conducted detailed waste characterizations in the targeted neighborhoods (as well as in a fifth "control" neighborhood) to see if the backyard composters were making an impact on the waste stream.

With these data, the Department was able to apply statistical techniques to pinpoint significant composting program effects. Results were mixed. Among program volunteers, food waste in the trash fell by 2.5 pounds per week over the course of a year. On the other hand, changes in yard waste varied so much from house to house that no significant impact of composting could be calculated. In addition, there were some effects that were seen among both volunteers *and* non-volunteers. Several of these results were unlikely to be related to the program, such as a decrease in non-volunteer food waste, or an overall increase in "residual" waste (i.e., materials other than yard/food waste, bulk, or designated recyclables).

One additional finding, however, was especially interesting. Recycling improved *overall* (i.e., among composters and non-composters in the target area and among residents in the control area) by 21.5 percent from the baseline measure in the test areas. This rather significant increase might be attributed to the visible presence of Sanitation personnel, who drove around the pilot neighborhoods putting waste into specially marked yellow bags for the waste-characterization component of the pilot. Perhaps the additional Sanitation cars and workers made residents more diligent about source separation. This might explain why

the increase was found in both target and control areas. If this was in fact the reason, similar results could not be expected if backyard composting became a standard program citywide, since waste-composition analysis with an additional Sanitation neighborhood presence would not be part of any ongoing program.

Estimation of Program Effects

The outreach, market research, and waste-composition results provided some realistic numbers with which to start estimating potential impacts of backyard composting on NYC's waste stream. Prior market research had established that at a maximum, one-third of the 2.9 million households in the City had backyards (census data on single- and two-family homes put this number lower, at around one-fourth). The Department had directly measured a participation rate of 9.4 percent, and for these participants, a 2.5-pounds-per-week drop in food waste in the trash.

What kind of dent could backyard composting make in New York City's waste stream? It's a matter of doing the math. One-third of NYC households represents 930,402 residences. A participation rate of 9.4 percent of these would yield a turnout of 87,458 households. A more hopeful estimate of 20 percent participation would include 186,080 homes. What if these households composted so that 2.5 pounds per week were diverted from their trash? This would save in total for the City per year: 5,685 tons of waste at 9.4 percent participation (or 12,095 tons at 20 percent participation).

And what if the composters doubled their diversion from 2.5 pounds per week to 5 pounds per week? At 5 pounds per week, a 9.4 percent participation rate would divert 11,370 tons; and a 20 percent rate would divert as much as 24,190 tons per year. With an annual waste stream of 3.5 million tons per year, this would mean diversion of between .15 percent and .66 percent a year. In other words, not even 1 percent of New York City's waste would be diverted from disposal, even under very ambitious estimates. As good as an idea as backyard composting might be for other reasons, the results made it clear that it could not be counted on as a major waste-minimization strategy.

Costs and Benefits

These results do not mean, however, that promoting backyard composting is a useless endeavor. Outreach for the pilot program was particularly intensive, which made it somewhat expensive. Weighing the pilot program expenses against the negligible benefits of waste diversion (in terms of saved export costs) showed a $90.00 cost to the Department per composter (assuming the household used the compost bin for a total of five years). But if the diversion measured from the pilot were weighed against "normal" outreach costs (such as those routinely used by the Compost Project), backyard composting turned out to be quite efficient, costing the City only about one dollar per bin. Add the "intangible" benefits of environmental education and recycling awareness that go along with backyard composting, and it's fair to conclude that promoting backyard composting in New York City is still a good idea all around.

In-Sink, Food-Waste Disposals

Another means for households and institutions to handle their food waste on-site is through the use of in-sink, food-waste disposals (also known as "insinkerators" or "garbage

grinders"). These are simple, electric motorized grinders that are attached under the counter to the kitchen sink drain. When the disposal is switched on, it minces items such as food preparation scraps and plate scrapings as they flow down the drain with the sink water.

In-sink, food-waste disposals are simple, electric, motorized grinders that mince food preparation scraps and plate scrapings emptied down the drain. While widely used in the rest of the country, disposals were only legalized for use in all parts of New York City in 1997.

Background

In most of the United States, the use of food-waste disposals has allowed households to efficiently remove household food waste from the solid waste stream. Their popularity is due in part to the fact that food waste, which is typically wet and quick to form odors, is readily disposed through the sewer system instead of being stored inside houses or buildings and placed on the curb to await collection. In addition, the separation of biodegradable from nondegradable solid waste makes the remaining solid waste drier and easier to handle throughout the solid-waste management system.

In the context of composting and food-waste recovery, disposals effectively allow residents to source separate organic waste and "handle" them on site, without requiring any specialized knowledge. In many cities, New York City included, sewage treatment plants now recover sewage sludge (also known as "biosolids") for beneficial reuse. As a result, disposals are one way of diverting food scraps to a system where nutrients and organic matter are recovered. However, there were certain concerns that needed to be addressed before the Department and the City could allow or encourage the use of disposals by City residents.

Movement to Lift Disposal Ban

Until 1997, disposals were banned for use in New York City, except in areas where household sewage drains are separate from storm drains. This was due to a historical concern about the capacity of the sewer system to handle this waste stream, both in terms of sedimentation in the pipes, and (perhaps more importantly) overflow of the combined sewers during heavy rains. Even in areas with noncombined sewers, where disposals are legal (Staten Island and parts of Queens and Brooklyn), they were installed in far fewer than 25 percent of the households.[10] As a result, many New Yorkers are unfamiliar with disposals, even though their use has been prevalent throughout the rest of the country for many years.

Food-Waste Disposal Pilot Project

While not strictly falling under the purview of the Department's Compost Program, the Department helped the NYC Department of

[10] *The Impact of Food Waste Disposers in Combined Sewer Areas of New York City*, New York City Department of Environmental Protection, June 1997, p. E'S-2.

Environmental Protection (DEP) to conduct a pilot to analyze the potential effect of disposals on the City's waste stream. After years of lobbying from the plumbing trade association and disposal manufacturers, the City Council passed Local Law 74 of 1995. This law permitted DEP to install a limited number of disposals in various neighborhoods for pilot purposes.

Upon completion of the pilot, DEP issued a report that assessed the projected impact of disposals on the sewer system and on sewage treatment costs. Despite the potential for increased costs to the City, the DEP recommended that the ban on disposals be lifted. The Department of Sanitation conducted a limited study linked with the DEP pilot to gauge the impact disposals could have on solid-waste diversion. Though the study was not extensive enough to be statistically conclusive, the Department agreed with DEP's recommendation to lift the ban.

The Impact on New York City's Waste Stream

Based on the DEP report and recommendations, the City Council repealed the portion of Local Law 74 of 1995 that restricted the use of disposals to pilot areas only. The installation of disposals in all New York City residences was legalized as of October 11, 1997. Using DEP projections of Total Suspended Solids (TSS), the Department estimated the effect of the diverted waste on its operations. For example, under the scenario based on the data from Manhattan and Queens pilot areas, DEP projects that in the year 2035, the additional TSS due to kitchen food-waste disposals will be 143,967 pounds per day (on a dry-weight basis). Assuming that the TSS weight represents 30 percent of the original wet food waste weight, the resulting calculation is that 87,580 tons per year of wet food waste would be diverted from the Department's collection and disposal system.

This number (87,580 tons) accounts for approximately 3 percent of the Department's current total household refuse collection. This relatively small percentage reduction in tonnage is not readily converted to a reduction in weekly truck shifts in typical Department collection districts, as a 3 percent reduction equates to less than one truck per district per day. However, while 87,000 tons makes up only 3 percent of the total residential waste stream, it amounts to 20 percent of the food waste stream.

Disposals represent a promising technology for separating food waste in order to recover nutrients and organic material, and "sanitize" the remaining waste stream. As such, the City offers tax incentives to builders who choose to install them. The Department of Sanitation is not involved with the installation of disposals, nor in determining their long-term impact on the City's sewer system. However, as increased disposal use would mean a drier, less putrescible waste stream, the Department continues to advocate their use when possible.

Future Directions

In evaluating the Department's composting program over the past ten years, it is important to keep in mind that controlled composting on a large, municipal scale is really only decades old. Despite many obstacles unique to New York City, the Department's efforts in this field (especially in the case of the Riker's Island food-waste-composting facility) have been at the forefront of this technology.

As New York City looks ahead and assesses how composting fits into the larger picture of waste management, it will be useful to leverage the Department's understanding of the three essential "levels" of composting: residential, institutional, and municipal.

Residential Composting

The residential level is what most commonly comes to mind when people think of composting: a bin set up in a homeowner's backyard to handle some or all of the household's kitchen and yard waste. The Department's experience (including intensive measurement) to date demonstrates that while this type of composting does have some impact on the waste stream, it could never be enough to significantly alter the way the Department manages the City's waste.

Among the people who do it, backyard composting creates an increased awareness of recycling and solid-waste issues in general, at minimal cost. Therefore, the Department is firmly committed to promoting residential composting through its subsidized bin sales at the compost giveback events, and its outreach and education work through the Compost Project.

The Compost Project, the unique partnership program between Sanitation and the City's four Botanical Gardens, allows the Department to introduce the benefits of composting to a wider array of New Yorkers. This past year, the Department formalized an outreach program targeting Manhattan residents (the Manhattan Compost Project is run out of The New York Botanical Garden in the Bronx). Next year, the Department hopes to increase staff levels at this program to match the programs in the other boroughs.

Institutional Composting

The Department has gained significant experience with composting at the institutional level over the past decade, both through managing its own facility, as well as through its involvement in various pilot projects around the City. Institutions in this case are public or nonprofit organizations, such as schools, museums, and City agencies. Given the density of NYC, composting food waste at this level requires an enclosed, or "in-vessel" system. In-vessel, institutional composting is appealing because larger amounts of organic material can be diverted from the waste stream at a single site.

However, the Department has time and again run into several, key operational obstacles which have prevented this type of composting from taking off in the City. For future applications of this approach to institutional composting, the following checklist should be used to assess the potential for project success and sustainability:

- Is there enough outdoor space at the institution, such that in-vessel units may be set back from critical odor receptors?

- Is there a readily available (preferably free) source for woodchips or other bulking agents?
- Is there staff available to load food waste and bulking agents; monitor moisture, temperature, and odor levels; and perform any tasks associated with unloading finished compost?
- Is the necessary equipment available to load and haul away material (such as a small, front-end loader)?
- Is there commitment on the part of management to make the system work, including proper training on source separation and how to manage the compost system?

In addition to operational obstacles, there are also economic obstacles, as noted elsewhere in this report. Most in-vessel composting units require significant up-front investment both in terms of equipment purchases and site preparation (such as utility and waste water hook-ups). Operational costs are also high relative to current waste-hauling costs, unless labor can be allocated from other tasks at no additional cost. Consequently, unless the cost of waste management in the City increases dramatically, or the cost of installing and operating these systems decreases dramatically, the Department does not anticipate making significant future investments for on-site, in-vessel composting at institutions.

Nevertheless, the Department will continue to support in-vessel initiatives at institutions with educational missions. For example, the Department recently helped to fund the installation of two, small-scale, in-vessel composting units at The New York Botanical Garden to handle the food waste from their catering operation. Not only does the NYBG meet all of the operational requirements listed above, but also clearly has an educational mission. The NYBG envisions using the composting units as both waste management *and* teaching tools for classes and touring groups.

Municipal Composting

The final "level" of composting—municipal composting—is a strategy for composting all, or a significant fraction of the Department-collected organic-waste stream. The Department already has one program on the municipal level—namely, fall leaf and yard-waste collection. While this program could potentially be expanded to include a special collection for spring yard waste, as well as more material year-round from residential landscapers, it could not be expanded to handle food waste. This is due to permit and land-use restrictions at the yard-waste-composting sites, their proximity to neighbors, and a general assumption that large-scale, food-waste composting will have to occur in an enclosed system.

In order to compost *all* organic material at the municipal level, several centralized facilities would need to be sited and built in, or near, New York City. Due to the density of the metropolitan region, these facilities would need to be fully enclosed, and employ state-of-the-art odor control. These facilities would also need to be able to handle mixed waste since a certain amount of contamination is inevitable (even if the Department required City residents and institutions to source separate their organic waste).

Since facilities must be able to process mixed material, the question is whether to require source separation of organic waste,

or to continue the current mixed-waste-collection system (trash collected separate from recyclables) and to achieve organics separation at the composting facility. There are three important variables that the Department needs to consider in order to answer this question: collection efficiency, capture rate, and resulting compost quality.

Collection vehicles must collect large quantities of material without traveling great distances in order for the Department's routes to be efficient. If a truck is only picking up small amounts of material, it is not an efficient use of Department labor, vehicles, fuel, etc. It was the Department's experience during two previous organic-waste-collection pilots that it is very difficult to achieve an efficient truck route when collecting only organic material. Even with extensive education, residents simply did not place enough organic material at the curb to justify the cost, not to mention the environmental impact, of putting another truck on the collection route.[11] Institutions, while generating greater quantities of organic material, were in many instances unable to house another dumpster due to space constraints.

Capture rate represents the second variable that the Department needs to consider with regard to a separate organics collection. The capture rate is the percentage of a designated recyclable item that people are "capturing" out of the possible total of that item known to be in the waste stream. Again, the Department's two pilots demonstrated that even in "environmentally conscious" neighborhoods, the capture rate for organic material was only 40 percent. This is not too surprising, as 40 percent is the average capture rate for all items in the City's current recycling program. As the Intensive Zone Pilots highlighted, even expanded education might not increase the capture rate for organic material because people may not want to separate certain materials like used diapers or spoiled food.

If the Department can only expect to capture less than half of the City's organic waste through source-separated collection, it might not make sense to collect the material this way. This is especially the case when taking into account the time and expense associated with putting an additional collection vehicle on the road (or retrofitting a portion of the Sanitation fleet) and educating New Yorkers to separate an additional material from the waste stream.

The compost quality resulting from mixed-waste collection—the third and final variable that the Department needs to consider—does potentially provide a reason not to rule out the source-separation option.

It seems intuitive that compost made from non-source-separated (NSS) material will inherently make a poorer quality product than compost made from source-separated material. From the standpoint of pure compost quality this is undoubtedly true. However, as the Department's NSS-composting pilot showed, it is possible to make acceptable, *usable* compost from non-source-separated material.

The pilot involved the Department sending 260 tons of NYC waste to a NSS-composting facility in Massachusetts. The preliminary laboratory tests conducted on the final compost produced from this material

[11] It should be mentioned that this problem might be overcome by using a "dual-bin" or split body truck so that two separate streams could be collected at once (e.g., organics on one side and refuse on the other). However, this would not address the issue of "capture."

showed that it would receive a Class I rating from the New York State Department of Environmental Conservation. While the Department of Sanitation would not distribute this compost for use on residents' vegetable gardens, it is conceivable that the City could use the material for such projects as final landfill cover or highway planting work. It could also potentially be blended with sand to make a finer, loam product for more general landscaping applications, as is currently done at the facility in Massachusetts.

While important questions remain with regard to NSS composting, this technology appears to be the most practical, economical way to recycle the City's organic waste. The Department will seek to answer as many of these questions as possible in its forthcoming final report on the NSS-composting pilot and through future pilots it may conduct.

Appendix I

CDM Camp Dresser & McKee

Staten Island Botanical Garden

Waste Characterization for Composting Pilot Study

March 2001

Report

Section 1
Introduction

As part of a pilot study of municipal solid waste composting, the New York City Department of Sanitation (NYCDOS) sent approximately 300 tons of residential refuse to a composting facility operated by Bedminster Bioconversion, Inc. in Marlboro, Massachusetts. The Staten Island Botanical Garden, Inc. retained Camp Dresser & McKee Inc. (CDM) to characterize the residential refuse sent to the Marlboro facility. NYCDOS collected the waste in its Staten Island District 2 on Saturday, February 24, 2001, and Monday through Thursday, February 26 through March 1, 2001. A total of 37 truckloads of residential refuse from preselected collection routes were sent to Marlboro. Prior to being shipped to Marlboro, each truckload was dumped on a paved area at the leaf composting facility at the Fresh Kills landfill on Staten Island. CDM performed the characterization work at the leaf composting facility at Fresh Kills from Monday, February 26 through Friday, March 2.

Assisted by a front-end loader and operator from Organic Recycling, Inc. and temporary workers supplied by Labor Ready, Inc., CDM collected a total of 70 samples from the 37 truckloads of waste and sorted them into 13 primary categories and 14 secondary categories. The material in each category was weighed and the resulting data analyzed to estimate the composition of the waste and the statistical reliability of the results. The average weight of the 70 samples was 313 pounds and the total quantity of waste sorted was 11 tons.

Section 2 of this report describes the procedures used in characterizing the residential refuse. Section 3 presents the results.

Section 2
Study Procedures

This section describes selection of collection trucks for sampling, sampling procedures, and sorting and weighing procedures. In addition, this section provides definitions of the waste categories used in the study.

2.1 Selection of Collection Trucks to Include in the Study

The New York City Department of Sanitation (DOS) selected Staten Island District 2 (SI2) as the source of the residential refuse to be included in the composting pilot study. DOS selected SI2 because it is adjacent to the waste transfer point at the Fresh Kills landfill and because it had the same residential recycling rate in 2000 as New York City as a whole, 23.4 percent. SI2 has four largely separate collection areas called sections, designated 21, 22, 23 and 24.

DOS informed CDM that collection trucks from Staten Island District 2 (SI2) would be sent to the Marlboro, Massachusetts composting facility as follows:

- 8 trucks collecting on Saturday, February 24 (to be sent to Marlboro on Monday)
- 7 trucks collecting on Monday, February 26 (to be sent to Marlboro on Tuesday)
- 7 trucks collecting on Tuesday, February 27 (to be sent to Marlboro on Wednesday)
- 7 trucks collecting on Wednesday, February 28 (to be sent to Marlboro on Thursday)
- 8 trucks collecting on Thursday, March 1 (to be sent to Marlboro on Friday)

Thus, a total of 37 trucks would be sent to the Marlboro composting facility during the 5 days of the portion of the pilot study devoted to residential waste. CDM allocated these 37 trucks among the four sections of SI2 as shown in Table 2-1. Based on the relative quantities of residential waste generated in the four sections during 2000, the target number of trucks from each section was as follows:

- 10 trucks from Section 21
- 9 trucks from Section 22
- 8 trucks from Section 23
- 10 trucks from Section 24

DOS provided detailed descriptions of 105 collection routes used in SI2 during a week at the time of year when the study occurred. CDM determined that among these 105

routes were 61 distinct routes (see Table A-1 in Appendix A). A route was classified as distinct if more than half of the lines in its description did not appear in the description of any other route.

CDM allocated the 37 trucks among the 61 distinct collection routes so as to include the right number of trucks from each section and the right number of routes for each day of the study. None of the 61 distinct collection routes had more than one truck included in the study. (See Table A-1 in Appendix A.)

For each census block group in SI2, CDM collected data on population, level of education, median household income, and per-capita income. Eight block groups were identified that had significantly higher or lower income and/or educational level than the others. CDM made adjustments in the list of 37 selected collection routes to avoid over- or underrepresentation of these eight block groups.

The final list of collection routes selected for inclusion in the study is shown in Table 2-2.

Table 2-2 also includes two alternate collection routes for each of the 5 days of the study. The alternate routes were selected using the same basic procedure used to select the preferred routes. A degree of overlap in the alternate routes proved to be unavoidable, however, and the first alternate for Thursday is almost the same route as the second alternate for Monday.

CDM collected and sorted 70 samples from the 37 trucks directed to the transfer point. Therefore, two samples were collected from all but four of the 37 trucks. Little could have been gained from further analysis aimed at identifying which four routes should be sampled only once. Within the limits of the target number of samples from each section shown in Table 2-1, therefore, the four truckloads to be sampled only once were chosen at random. The number of samples collected from each of the 37 truckloads is shown in Table 2-2.

In addition to showing the target number of samples from each section of SI2, Table 2-1 shows the actual number of samples from each section. DOS sent all of the primary targeted truckloads of waste to the transfer point except one. On Friday of the week of field work, DOS substituted a designated alternate collection route in Section 21 for the target route in Section 22. As a result, the total number of samples from Section 21 was approximately 1.5 more than its theoretical share and the total number of samples from Section 22 was approximately 1.5 less than its theoretical share.

2.2 Sampling Procedures

The selected truckloads of residential waste were dumped on a paved area at the leaf composting facility during the night prior to each day of field work. The truckloads were kept separate from each other. Each morning of the 5 days of field work, the CDM sampling coordinator was given a diagram indicating the section of SI2 and the

Table 2-1
Distribution of Truckloads and Samples
Among the Sections of Staten Island District 2

Section	Annual tonnage in 2000	Percentage of total tonnage in 2000	Theoretical share of 37 truckloads	Target number of truckloads	Actual number of truckloads	Theoretical share of 70 samples	Target number of samples	Actual number of samples
21	13,968	26.4%	9.78	10	11	18.49	18	20
22	12,467	23.6%	8.72	9	8	16.51	17	15
23	12,113	22.9%	8.48	8	8	16.04	16	16
24	14,322	27.1%	10.02	10	10	18.96	19	19
Total	52,869	100.0%	37.0	37	37	70.0	70	70

Table 2-2
Collection Routes Selected for Inclusion in Study

CDM route desig-nation	Section in which route begins	Day of week	Date	NYCDOS route designation			Actually included in study?	Number of samples collected
				Days of week	Number of trucks	Route number		
Selected Routes for Saturday								
26	21	Sat	2/24/01	Wed/Sat	4	2	Yes	2
28	21	Sat	2/24/01	Wed/Sat	4	4	Yes	1
50	22	Sat	2/24/01	Wed/Sat	4.5	1	Yes	1
53	22	Sat	2/24/01	Wed/Sat	4.5	4	Yes	2
75	23	Sat	2/24/01	Wed/Sat	3	1	Yes	2
77	23	Sat	2/24/01	Wed/Sat	3	3	Yes	2
102	24	Sat	2/24/01	Wed/Sat	3.5	1	Yes	2
104	24	Sat	2/24/01	Wed/Sat	3.5	3	Yes	2
Alternate Routes for Saturday (in this order)								
52	22	Sat	2/24/01	Wed/Sat	4.5	3	No	0
105	22	Sat	2/24/01	Wed/Sat	4.5	4.5	No	0
Selected Routes for Monday								
3	21	Mon	2/26/01	Mon/Thu	5.5	3	Yes	2
5	21	Mon	2/26/01	Mon/Thu	5.5	5	Yes	2
31	22	Mon	2/26/01	Mon/Thu	4.5	3	Yes	2
55	23	Mon	2/26/01	Mon/Thu	5	2	Yes	2
79	24	Mon	2/26/01	Mon/Thu	7	2	Yes	2
81	24	Mon	2/26/01	Mon/Thu	7	4	Yes	2
83	24	Mon	2/26/01	Mon/Thu	7	6	Yes	2
Alternate Routes for Monday (in this order)								
56	23	Mon	2/26/01	Mon/Thu	5	3	No	0
2	21	Mon	2/26/01	Mon/Thu	5.5	2	No	0
Selected Routes for Tuesday								
8	21	Tue	2/27/01	Tue/Fri	4.5	2	Yes	2
10	21	Tue	2/27/01	Tue/Fri	4.5	4	Yes	2
34	22	Tue	2/27/01	Tue/Fri	5	2	Yes	2
37	22	Tue	2/27/01	Tue/Fri	5	5	Yes	2
59	23	Tue	2/27/01	Tue/Fri	4	1	Yes	2
62	23	Tue	2/27/01	Tue/Fri	4	4	Yes	2
87	24	Tue	2/27/01	Tue/Fri	3.5	3	Yes	2
Alternate Routes for Tuesday (in this order)								
7	21	Tue	2/27/01	Tue/Fri	4.5	1	No	0
86	24	Tue	2/27/01	Tue/Fri	3.5	2	No	0
Selected Routes for Wednesday								
12	21	Wed	2/28/01	Wed/Sat	5	1	Yes	2
15	21	Wed	2/28/01	Wed/Sat	5	4	Yes	2
38	22	Wed	2/28/01	Wed/Sat	6	1	Yes	2
40	22	Wed	2/28/01	Wed/Sat	6	3	Yes	2
43	22	Wed	2/28/01	Wed/Sat	6	6	Yes	2
65	23	Wed	2/28/01	Wed/Sat	4	3	Yes	2
89	24	Wed	2/28/01	Wed/Sat	4	2	Yes	2
Alternate Routes for Wednesday (in this order)								
91	24	Wed	2/28/01	Wed/Sat	4	4	No	0
64	23	Wed	2/28/01	Wed/Sat	4	2	No	0
Selected Routes for Thursday								
17	21	Thu	3/1/01	Mon/Thu	4	1	Yes	2
20	21	Thu	3/1/01	Mon/Thu	4	4	Yes	2
45	22	Thu	3/1/01	Mon/Thu	3	2	No	0
67	23	Thu	3/1/01	Mon/Thu	4	1	Yes	2
69	23	Thu	3/1/01	Mon/Thu	4	3	Yes	2
92	24	Thu	3/1/01	Mon/Thu	6	1	Yes	2
94	24	Thu	3/1/01	Mon/Thu	6	3	Yes	1
96	24	Thu	3/1/01	Mon/Thu	6	5	Yes	2
Alternate Routes for Thursday (in this order)								
18	21	Thu	3/1/01	Mon/Thu	4	2	Yes	1
44	22	Thu	3/1/01	Mon/Thu	3	1	No	0

collection route from which each truckload had come. The diagram was in the form of a table with a column for each row of loads on the pavement.

Under the direct supervision of the sampling coordinator, an employee of Organic Recycling, Inc. collected the samples using a front-end loader. The bucket of the front-end loader was large enough to hold large items of waste such as mattresses and sofas.

As indicated above, two samples were collected from 33 of the 37 truckloads of waste (a total of 66 samples) and one sample was collected from each of the remaining four truckloads. When two samples were collected, they were collected from different places in the load. The target sample size was 250-to-300 pounds.

For each sample, the sampling coordinator recorded the following at the top of a data form like that shown in Figure 2-1:

- The sample number (1 for the first sample collected on Monday through 70 for the last sample collected on Friday)
- The date the sample was collected from the load of waste
- The number of the section of SI2 in which the load of waste was collected
- The number of the collection route

The date the load of waste was collected and the DOS truck identification number for each sampled load were added to the data forms later.

The front-end loader deposited each sample on a 9-by-12-foot tarp outside the maintenance building at the leaf composting facility. The sampling coordinator maintained a diagram of the sample storage area indicating the number and location of each sample. When sampling was complete, netting was placed over the samples to minimize the amount of waste removed by wind and seagulls.

2.3 Sorting Procedures

Sorting proceeded as follows for each sample:

- The sampling coordinator gave the CDM sorting supervisor a data form with information identifying the sample filled in at the top (see Section 2.2 and Figure 2-1).
- The tarp and sample were dragged into the maintenance building.
- Large items (e.g., mattresses, furniture, carpeting) were removed from the sample and set aside for weighing.

Figure 2-1
Data Form

Sample #:	Section:	Route:	Truck #:
Collection date:	Sorting date:	Sorting team:	

Paper	Food waste	Yard waste	Other degradables	Bulk wood
Total:	Total:	Total:	Total:	Total:

Plastic	Textiles	Glass & ceramics	Large composites	Nondegrad. fines	Unclassifiable fines
Total:	Total:	Total:	Total:	Total:	Total:

Metal	Subsort of metal (does not add to total for metal)				
	Aluminum	Brass	Copper	Lead	Other (specify)
Total:	Total:	Total:	Total:	Total:	Total:

Other nondegrad.	Subsort of other nondegradables (does not add to total for other nondegradables)				
	Electronics	Other electrical	Insulated wiring	Batteries (specify)	Other (specify)
	Total:	Total:	Total:		
	Light bulbs	Fluorescent tubes	Gypsum board		
Total:	Total:	Total:	Total:	Total:	Total:

Notes	Total weight of sample

- The remainder of the sample was moved by increments into one of the two sorting boxes. The sorting boxes are 4 feet wide, 6 feet long, and 10 inches deep, and sit on stands approximately 33 inches high.

- Containers for 12 of the 13 primary sorting categories (see Section 2.4 below) were arranged around the sorting box and the waste was sorted into the containers. The sorting supervisor and the CDM field supervisor checked the containers periodically for accuracy of sorting.

- When a relatively small quantity of small pieces of waste remained on the half-inch mesh screen mounted 1.5 inches off the bottom of the sorting box, sorting became unproductive and was called to a halt. The sorting box was dumped in such a way that the material that had fallen through the screen was kept separate from the material that had remained on top of the screen. The two piles of material were placed in separate containers. The material from above the screen was categorized as "unclassifiable fines," the 13th primary sorting category. The material from below the screen was categorized as food waste, "other degradables," "other nondegradables," a combination of these, or unclassifiable fines, based on the judgement of the sorting supervisor.

- The containers were brought to the scale, checked again for accuracy of sorting, and weighed.

- The scale was set at minus the tare weight of the containers, each container was placed on the scale, and the weight shown on the scale's digital display was recorded as the weight of the waste in the container.

- The containers were dumped in a rolloff container provided by DOS.

When the primary sorting was complete, the CDM field supervisor sorted the metal and "other nondegradables" categories into the 14 secondary categories (see Section 2.4.2 below).

2.4 Waste Category Definitions

This section defines the 13 primary waste categories and 14 secondary waste categories used in the study. The results of the study should not be interpreted without reference to the category definitions.

2.4.1 Primary Categories

Paper. All paper, including plastic-coated paper and paper in bulky items such as paperboard barrels and thick-walled paperboard tubes.

Food Waste. All items produced or gathered for use as food, including the inedible portions, except large bones and shells. Includes the contents of beverage containers, including water. Includes coffee grounds. In practice, some food waste becomes part of the fines category.

Yard Waste. Leaves, grass clippings, shrub and garden trimmings, weeds and wild grasses, pine needles and cones, twigs, vegetative ground litter, small uprooted plants, and dirt that cannot readily be separated from the plant material. Also includes fruits, nuts, flowers and seed casings fallen from trees. Does not include cut flowers. Does not include uprooted shrubs or tree parts more than one half inch in diameter.

Other Degradables. Includes all small, readily biodegradable items that do not fit the definition of paper, food waste or yard waste. Includes disposable diapers and their contents, sanitary napkins, animal feces, cut flowers and dryer lint.

Bulk Wood. All plywood, chipboard, and particle board. All wooden and wicker furniture. All dimensional lumber with two dimensions greater than one half inch. All uprooted shrubs and all tree branches greater than one half inch in diameter. On a weight basis, this category includes almost all wood in residential refuse.

Textiles. Includes all separate items consisting of woven fabrics. Includes rugs, carpeting, and woven carpet padding. Includes towels and washcloths, cloth napkins and cloth place mats. Includes woven curtains and drapes, awnings, tents, and tarpaulins. Includes bed pillows, comforters, and quilted jackets and coats.

Plastic. All items consisting primarily of plastic. Includes polyethylene of all densities, polyethylene terephthalate (PET or PETE), polystyrene (both solid and foam), polypropylene, polyvinyl chloride (PVC), acrylonitrile butadiene styrene (ABS), polyurethane (both solid and foam), and a variety of other polymers.

Metal. All items consisting primarily of metal.

Glass and Ceramics. Items consisting primarily of glass or ceramics. Includes glass mirrors. Does not include light bulbs or fluorescent tubes, which are included in "other nondegradables." In practice, does not include broken beverage containers, because the broken pieces are too dangerous to handle. Broken beverage containers tend to end up as "unclassifiable fines" (see below).

Large Composite Items. All large items consisting of material from more than one of the other waste categories. Includes mattresses, box springs, and stuffed furniture, including large cushions.

Nondegradable Fines. All inorganic materials that can be separated from the other categories of waste and that consist of or will break down to small particles that are generally not objectionable in compost. Includes dirt, sand, ashes, and cat litter. Does not include broken glass.

Other Nondegradables. All materials that are not readily biodegradable and that do not fit any of the waste categories defined above. Includes wood that does not fit the definition of "bulk wood" above. Includes leather items. Includes gypsum board, bricks, cinder blocks, concrete, asphalt, stones, and gravel. Generally includes small

and medium-sized items consisting of materials from more than one other waste category. Includes all footwear not primarily composed of plastic. Includes lightbulbs, fluorescent tubes, batteries, electronic and electrical devices, and insulated electrical wiring and cables.

Unclassifiable Fines. Includes material that passes through the half-inch wire mesh screen mounted 1.5 inches above the bottom of the sorting box (bottom fines), if this material can not be classified as food waste, other degradables, classifiable fine inorganics, or other nondegradables. Also includes small pieces of material left on top of the screen at the point when sorting becomes too inefficient to justify continuing (top fines). Generally includes pieces of broken beverage containers.

2.4.2 Secondary Categories

2.4.2.1 Subcategories of Metal

Aluminum. All items consisting primarily of aluminum, including but not limited to aluminum beverage cans, aluminum foil and disposable pans, aluminum pet food containers, aluminum cookware, aluminum aerosol spray cans, and aluminum lawn furniture. Does not include bimetal (aluminum and steel) cans.

Brass. All items consisting primarily of brass, including but not limited to brass plumbing fixtures and parts, keys, antennas, and decorative items. Brass is an alloy that is typically about two-thirds copper and one-third zinc but often contains up to 2 percent lead and occasionally contains 5 or 10 percent lead.

Copper. All items consisting primarily of copper, including but not limited to copper tubing, uninsulated copper wire, and U.S. coins other than nickels. Does not include the copper in insulated copper wiring, electronic devices, electric motors, or other electrical devices.

Lead. All items consisting in substantial part of lead, including but not limited to wheel weights, ceiling fan balancing weights, lead-acid batteries, lead wine bottle caps (wrapped around the bottle mouth), and tin-lead solder. Includes tin-lead solder if separate in the sample, but does not include the lead in soldered devices such as circuit boards (see "electronics" below).

Pot Metal. All items consisting primarily of die-cast, nonmagnetic, silver-gray metal. Largest component is generally zinc. The term "pot metal" is also used to refer to alloys of copper and lead used for bearing surfaces, but that is not the type of pot metal typically found in residential refuse.

Ferrous Metal. All items consisting primarily of iron and steel. This category typically includes essentially all of the metal that does not fit any of the subcategories described above.

2.4.2.2 Subcategories of "Other Nondegradables"

Electronics. Devices that contain a circuit board of significant size relative to the size of the device, and insulated wiring attached to such devices. Includes computers, computer monitors and printers, touchtone telephones, boom boxes, radios, calculators, microwave ovens, video cameras, and stereo components other than speakers.

Other Electrical Devices. Electrical devices other than electronics, light bulbs, and fluorescent tubes. Includes insulated wiring attached to such devices, but does not include extension cords or other detached wiring (see "insulated wiring" below). Includes mechanical devices with electric motors such as vacuum cleaners and garbage disposals. Includes speakers, power tools, lamps, flashlights, and most toasters and toaster ovens. Includes electrical fixtures such as switches, receptacles (outlets), and lighting fixtures.

Insulated Wiring. All wire covered with plastic or other insulation, except such wiring attached to electronics or electrical devices. Includes electrical cable and extension cords, cable television wiring, and telephone wire. Includes printer cables and other detached wiring associated with computers.

Light Bulbs. All incandescent light bulbs except those inside electrical devices. Includes the bases of broken light bulbs.

Fluorescent Tubes. All lighting tubes and bulbs based on fluorescent technology.

Gypsum Board. Wallboard with a layer of gypsum sandwiched between two thin layers of paper.

Batteries. All batteries except lead-acid batteries, which are included in the metal category and the lead subcategory of the metal category.

- The standard deviation is the square route of the mean of the squares of the differences.

The standard deviation is a standard function in spreadsheet programs and many calculators.

Confidence interval. The range of values, centered on the mean, that has a specified statistical probability of including the true value of the parameter being sampled. The 90-percent confidence interval has a 90-percent statistical probability of including the true value.

Confidence level. The likelihood that the actual value falls within the corresponding confidence interval. A 90-percent confidence level corresponds to a 90-percent confidence interval. The confidence level is selected in advance based on a tradeoff. The tradeoff is between great confidence that the true value lies within a wide range and lower confidence that the true value lies within a narrow range.

Student t value. A standard statistical value corresponding to a specific number of samples and a specific confidence level. Most basic statistics books have tables of Student t values. These values were first calculated in the early 1900s by W. S. Gossett, who used the pseudonym "Student" at that time.

Uncertainty value. The absolute difference between the mean and either the upper or lower limit of the confidence interval. It is the product of the Student t value and the standard deviation, divided by the square root of the number of samples. Each waste category in each group of samples has its own distinct uncertainty value.

Precision level. The uncertainty value divided by the mean. Note that the "precision level" decreases as precision increases, so a lower precision level is better. Each waste category in each group of samples has its own distinct precision level.

Weighted-average precision level. An overall precision level for a group of samples and waste categories, calculated by weighting the precision levels of the individual waste categories in proportion to the relative abundance of the individual waste categories.

3.2 Results of Sampling and Sorting

This section, together with Appendix B, presents the results of the waste sampling and sorting. Table B-1 in Appendix B shows the weight data for the primary waste categories for each sample. In addition to the quantity of paper shown in Table B-1, the sorted refuse contained at least $45 in paper currency.

Table B-2 in Appendix B shows the composition of each waste sample based on the weight data for the primary waste categories shown in B-1. The mean (average) values across the bottom of Table B-2 are the average composition of the 70 samples,

based on the primary waste categories. Just below the mean composition values are the standard deviations for the percentages in each column.

Table B-3 in Appendix B shows the weight data for the secondary waste categories for each sample (the raw results of subsorting the metal and "other nondegradables" categories). Table B-4 in Appendix B shows the percentage of each secondary waste category in each sample, based on the weight data in Table B-3. As in Table B-2, average percentages and standard deviations for each secondary category are shown at the bottom of Table B-4.

A waste composition study is essentially a statistical exercise, and statistical analysis requires that the samples have equal statistical weight. Because the samples have different numbers of pounds, the pound data (tables B-1 and B-3) are converted to percentage compositions (tables B-2 and B-4) to give the samples equal statistical weight.

Tables 3-1 and 3-2 show the average percentages and the standard deviations from across the bottom of tables B-2 and B-4. In addition, tables 3-1 and 3-2 show the derivation of uncertainty factors and precision levels for the sorting results, as well as the 90-percent confidence interval for each waste category. Note that in Table 3-1 the sum of the uncertainty values for the individual waste categories is the same as the overall (weighted average) precision level. This is always true for data sets of this type.

3.3.1 Results of Primary Sorting

During the 5 days of field work, 70 samples totaling 21,934 pounds were sorted into 13 primary categories. The average sample size of 313 pounds exceeded the guaranteed average by 63 pounds.

The weighted average precision level for the 13 primary waste categories was 9.4 percent at 90-percent confidence. This is an excellent level of precision in waste characterization work. It indicates that there is a 90-percent probability that the true composition of the loads of waste sent to the Marlboro composting facility was within 9.4 percent of the composition presented in Table 3-1.

Combining the 13 primary waste categories into only three categories—degradables, nondegradables, and unclassifiable fines—improves the weighted average precision level to 3.2 percent at 90-percent confidence.

As shown by Table 3-1, the degradable categories totaled 55.5 percent of the sorted waste, the nondegradable categories totaled 40.2 percent, and the unclassifiable fines accounted for the remaining 4.3 percent. In considering the feasibility of composting in light of these values, the following should be kept in mind:

- Most of the nondegradable fines (3.5 percent of the total and 8.7 percent of the nondegradables) will become part of the compost.

Table 3-1
Composition of the Sorted Samples with Statistical Analysis

Waste category	Average percentage in the 70 samples (x)	Standard deviation (s)	Student t value (t*) for 70 samples (n) and 90% confidence	Uncertainty value for 90% confidence ($U_{90}=t^*s/n^{1/2}$)	Precision level at 90% confidence (U_{90}/x)	90% confidence interval ($x-U_{90}$ to $x+U_{90}$)
Paper	32.1%	5.2%	1.668	1.0%	3.2%	31.0% to 33.1%
Food waste	15.9%	4.5%	1.668	0.89%	5.6%	15.0% to 16.8%
Yard waste	1.6%	3.4%	1.668	0.67%	41.6%	0.94% to 2.3%
Other degradables	6.0%	3.5%	1.668	0.69%	11.6%	5.3% to 6.7%
Total degradables	55.5%	7.1%	1.668	1.4%	2.5%	54.1% to 56.9%
Bulk wood	3.4%	3.0%	1.668	0.60%	17.7%	2.8% to 4.0%
Plastic	15.4%	3.4%	1.668	0.68%	4.4%	14.8% to 16.1%
Textiles	5.3%	4.3%	1.668	0.86%	16.3%	4.4% to 6.2%
Glass and ceramics	3.3%	2.5%	1.668	0.50%	15.2%	2.8% to 3.8%
Metal	3.1%	1.4%	1.668	0.28%	9.0%	2.9% to 3.4%
Large composite items	1.0%	4.5%	1.668	0.90%	91.4%	0.084% to 1.9%
Nondegradable fines	3.5%	3.8%	1.668	0.76%	21.7%	2.7% to 4.2%
Other nondegradables	5.1%	6.0%	1.668	1.2%	23.4%	3.9% to 6.3%
Total nondegradables	40.2%	7.3%	1.668	1.5%	3.6%	38.7% to 41.6%
Unclassifiable fines	4.3%	1.7%	1.668	0.34%	7.9%	4.0% to 4.7%
Total of 13 individual categories	100.0%	---	---	9.4%	---	---
Weighted-average precision level based on the 13 individual categories	---	---	---	---	9.4%	---
Weighted-average precision level based on degradables, nondegradables, and unclassifiable fines	---	---	---	---	3.2%	---

Table 3-2
Composition of Subsorted Waste Categories with Statistical Analysis

Waste category	Average percentage in the 70 samples (x)	Standard deviation (s)	Student t value (t*) for 70 samples (n) and 90% confidence	Uncertainty value for 90% confidence ($U_{90}=t^*s/n^{1/2}$)	Precision level at 90% confidence (U_{90}/x)	90% confidence interval ($x-U_{90}$ to $x+U_{90}$)
Aluminum	0.75%	0.40%	1.668	0.080%	10.6%	0.67% to 0.83%
Brass[1]	0.039%	0.078%	1.668	0.015%	39.7%	0.024% to 0.055%
Copper	0.0047%	0.017%	1.668	0.0033%	69.7%	0.0014% to 0.0080%
Lead	0.0020%	0.012%	1.668	0.0025%	121.0%	0.000% to 0.0045%
Pot metal[2]	0.010%	0.039%	1.668	0.0077%	74.1%	0.0027% to 0.018%
Ferrous metal	2.3%	1.4%	1.668	0.28%	11.8%	2.1% to 2.6%
All metal (from Table 3-1)	3.1%	1.4%	1.668	0.28%	9.0%	2.9% to 3.4%
Electronics	0.52%	1.4%	1.668	0.28%	52.5%	0.25% to 0.80%
Other electrical devices	0.70%	1.8%	1.668	0.35%	50.4%	0.35% to 1.0%
Insulated wiring	0.10%	0.3%	1.668	0.055%	54.4%	0.046% to 0.16%
Light bulbs	0.046%	0.13%	1.668	0.025%	54.6%	0.021% to 0.071%
Fluorescent tubes	0.00%	0.00%	1.668	0.00%	---	0.00% to 0.00%
Gypsum board	1.3%	3.1%	1.668	0.62%	47.5%	0.68% to 1.9%
Batteries	0.11%	0.12%	1.668	0.024%	22.2%	0.085% to 0.13%
Other "other nondegradables"	2.4%	4.8%	1.668	0.95%	40.2%	1.4% to 3.3%
All "other nondegradables" (from Table 3-1)	5.1%	6.0%	1.668	1.2%	23.4%	3.9% to 6.3%

[1]Alloys of copper and zinc with some lead
[2]Primarily zinc

- A substantial portion of the unclassifiable fines (4.3 percent of the total) is small pieces of paper and food waste that will become part of the compost. The abundance of broken glass in the unclassifiable fines was relatively low.

- On the other hand, the degradable waste categories are not completely degradable. Some paper is resistant to composting, food waste contains bones, yard waste contains twigs that resist composting, and "other degradables" include the plastic covers of diapers.

3.3.2 Results of Secondary Sorting

Table 3-2 shows the results of subsorting the metal and "other nondegradables" categories.

3.3.2.1 Subcategories of Metal

Almost three fourths of the metal was ferrous metal, most of which can be removed from the composting process using magnets. Almost one fourth of the metal was aluminum. Brass, copper, lead and pot metal (primarily zinc) accounted for a total of less than 2 percent of the metal. A small percentage of the ferrous metal was plated with brass, but quantifying the brass plating was beyond the scope of this study.

With respect to composting, the most significant object in the subsorted metal was half a pound of fine tin-lead solder on a light plastic spool. If the solder broke into small pieces that all ended up in the compost, the solder could contribute 86 parts per million of lead (dry basis) to the compost derived from 5 tons of refuse. New York's lead standard for Class I compost is 250 parts per million. The estimate of 86 parts per million is based on the solder being 40-percent lead, the refuse being 30-percent moisture, and the 5 tons of refuse yielding one third as much compost (both refuse and compost on a dry basis). Because the size-reduction process at Bedminster Bioconversion composting facilities does not include violent shredding, it is unlikely that all of the solder would become part of the compost from a Bedminster facility.

The copper in the metal category included at least 35 pennies, 6 dimes and a quarter.

In Table 3-2, the 90-percent confidence interval for lead extends to zero. This does not mean it is possible that the residential refuse sent to Marlboro contained no lead. The fact that the confidence interval extends to zero is an indication that the standard statistical formulas do not work well for waste categories that appear in only a few samples. The means for these waste categories are low compared to their statistical variability, so the confidence intervals for these categories are large compared to their means. Because the means are low, the large confidence intervals may extend to zero, or even below zero.

No lead-acid batteries were found in the samples. Other types of batteries are addressed in Sections 3.3.3 and 3.3.4.

3.3.2.2 Subcategories of "Other Nondegradables"

The great majority of the insulated wiring was copper wiring. Almost all of the electronics, other electrical devices, and insulated wiring are large enough to be pulled out or screened out during either the material preparation or compost refinement process.

The majority of the light bulbs in the samples were broken, and the broken glass could not be recovered for weighing with the light bulbs. This reduced the result for this subcategory significantly.

A significant portion of the gypsum board category could break down into pieces small enough to be included in the compost. On the other hand, the facility operator might prefer to pull the gypsum board out prior to composting to remove the potential for the sulfur in the gypsum to cause odor problems. Gypsum is hydrous calcium sulfate, which is 18.6 percent sulfur by weight.

Batteries are addressed in sections 3.3.3 and 3.3.4.

The 90-percent confidence interval for fluorescent tubes in Table 3-2 begins and ends at zero. This does not mean the residential refuse sent to Marlboro contained no fluorescent tubes. It means only that the 11 tons of sorted refuse contained no fluorescent tubes. Because none of the 70 sorted samples contained a fluorescent tube, the variability among the samples in each season was zero and the statistical confidence interval is zero. This is another illustration of the fact that statistics are not reality. Rather, statistics are a mathematical tool used to estimate how close to reality the results of a study are likely to be. Although we know there are fluorescent tubes in residential refuse, the results of this study indicate that their number is small.

3.3.3 Results of Examination of Bottom Fines

The bottom fines are the small pieces of waste that fall through the half-inch mesh ("hardware cloth") mounted 1.5 inches above the bottom of each sorting box. The CDM field supervisor thoroughly stirred and sifted through the bottom fines from each sample using a pair of permanent disk-shaped magnets approximately 2 inches in diameter (one magnet in each hand). The purpose of this exercise was to find objects that could contaminate compost.

Eight button batteries were found in the bottom fines. Button batteries are the very small batteries used in watches, calculators and hearing aids. They are magnetic and were found on the magnets used to stir the fines. Seven of the button batteries appear to be of the silver oxide type and the seventh is a zinc-air battery. It is significant that no mercury (mercuric oxide) batteries were found. Battery manufacturers have discontinued many mercuric oxide batteries.

No other objects with particular significance for composting were found in the bottom fines.

3.3.4 Overall Results for Batteries

Table 3-3 presents an accounting of the loose batteries found in the 11 tons of refuse sorted during the 5 days of field work. Sixty-eight percent of the 304 batteries found were AA batteries of the alkaline and zinc-carbon types.

In New York State, the particle size of Class I compost must not exceed 10 millimeters (0.39 inches). The diameter of AA, C, D and 9-volt batteries, as well as the nickel-cadmium and "other" batteries shown in Table 3-3, is 0.5 inches or greater, and the batteries do not degrade during composting. Therefore, none of these batteries should be present in compost qualifying as Class I. Most of the AAA batteries should be screened out as well.

If not screened out, the nickel-cadmium batteries could contribute 7 parts per million of cadmium (dry basis) to the compost derived from 5 tons of refuse. New York's cadmium standard for Class I compost is 10 parts per million on a dry basis. The estimate of 7 parts per million is based on the batteries being 17.5-percent cadmium, the refuse being 30-percent moisture, and the 5 tons of refuse yielding one third as much compost (both refuse and compost on a dry basis). It is unlikely that the three nickel-cadmium batteries, which were combined in one plastic-wrapped battery pack, would not be screened out of the compost.

3.3.5 Summary of Results

Table 3-4 summarizes the results of the primary and secondary sorting. Each value in Table 3-4 is the same as the corresponding value in Table 3-1 or Table 3-2.

Table 3-3
Loose Batteries Found in the Sorted Refuse

Configuration	Total number	Number per ton of refuse	Percent of total number of batteries found	Average weight (lbs)	Total weight (lbs)	Weight per ton of refuse (lbs)	Percent of total weight of batteries
AAA	27	2.5	8.9%	0.026	0.71	0.065	3.0%
AA	207	18.9	67.9%	0.05	10.4	0.94	44.0%
C	24	2.2	7.9%	0.15	3.6	0.33	15.3%
D	23	2.1	7.5%	0.31	7.2	0.66	30.5%
9V	14	1.3	4.6%	0.096	1.3	0.12	5.7%
3x1.2V NiCd	1	0.091	0.33%	0.094	0.094	0.0085	0.40%
Button	8	0.7	2.6%	0.0026	0.021	0.0019	0.089%
Other	1	0.091	0.33%	0.24	0.24	0.022	1.0%
Total	305	27.8	100.0%	---	23.5	2.1	100.0%

Table 3-4
Summary of Results

Waste category	Average percentage in the 70 samples	90% confidence interval
Paper	32.1%	31.0% to 33.1%
Food waste	15.9%	15.0% to 16.8%
Yard waste	1.6%	0.94% to 2.3%
Other degradables	6.0%	5.3% to 6.7%
All degradables	55.5%	54.1% to 56.9%
Bulk wood	3.4%	2.8% to 4.0%
Plastic	15.4%	14.8% to 16.1%
Textiles	5.3%	4.4% to 6.2%
Glass and ceramics	3.3%	2.8% to 3.8%
Metal		
Aluminum	0.75%	0.67% to 0.83%
Brass[1]	0.039%	0.024% to 0.055%
Copper	0.0047%	0.0014% to 0.0080%
Lead	0.0020%	0.000% to 0.0045%
Pot metal[2]	0.010%	0.0027% to 0.018%
Ferrous	2.3%	2.1% to 2.6%
Total metal	3.1%	2.9% to 3.4%
Large composite items	1.0%	0.084% to 1.9%
Nondegradable fines	3.5%	2.7% to 4.2%
Other nondegradables		
Electronics	0.52%	0.25% to 0.80%
Other electrical devices	0.70%	0.35% to 1.0%
Insulated wiring	0.10%	0.046% to 0.16%
Light bulbs	0.046%	0.021% to 0.071%
Fluorescent tubes	0.00%	0.00% to 0.00%
Gypsum board	1.3%	0.68% to 1.9%
Batteries	0.11%	0.085% to 0.13%
Other	2.4%	1.4% to 3.3%
All "other nondegradables"	5.1%	3.9% to 6.3%
All nondegradables	40.2%	38.7% to 41.6%
Unclassifiable fines	4.3%	4.0% to 4.7%
Total	100.0%	---

[1]Alloys of copper and zinc with some lead
[2]Primarily zinc

Appendix II

MEMORANDUM OF UNDERSTANDING

Memorandum of Understanding entered into this 28th day of October, 1997, between the Department of Sanitation (Sanitation) and the Department of Parks & Recreation (Parks) of the City of New York.

WITNESSETH

WHEREAS Each day, Sanitation must dispose of an average 13,000 tons of solid waste at Fresh Kills landfill, or otherwise export it from New York City; and

WHEREAS Contained within this solid waste are leaves and yard trimmings, which are valuable resources; and

WHEREAS The City of New York has resolved that such resources should be separated from the waste stream, as practicable, to be recycled as mulch and compost; and

WHEREAS Sanitation will accordingly collect such leaves and yard trimmings separately, as practicable, so they can be recycled as mulch and compost; and

WHEREAS Sanitation seeks locations within New York City where composting and mulching sites may be established; and

WHEREAS Parks controls parklands within New York City where such composting and mulching sites can ideally be established; and

WHEREAS Composting and mulching leaves and yard trimmings is an activity consistent with usage of parklands; and

WHEREAS Parks furthermore has need of mulch and compost for parkland enhancement, beautification, and remediation;

NOW, THEREFORE,

Sanitation and Parks, in order to benefit the City of New York, jointly agree that Parks shall make parklands available to Sanitation for the establishment of composting and mulching sites, providing that:

1. Sanitation will furnish all labor and materials necessary to process leaves and yard waste, and to utilize the mulch and compost produced in parkland remediation, including plant material for enhancement and restoration;

2. The provision of such sites is considered temporary, and is subordinate to Parks needs and community objectives;

3. The use of such sites will follow all applicable laws, rules, regulations, and Parks guidelines:

Before any site is designated and utilized for composting and/or mulching, Parks and Sanitation shall jointly prepare an Appendix to this Memorandum of Understanding, which shall include, but not be limited to: a map or plan locating the site; a description of the site; all terms governing use and operation of the site, including the expected quantity of material to be composted or mulched each year, the duration of the site use, the specific end uses for the compost or mulch produced, and the allocation of all responsibilities. A separate Appendix shall be prepared for each site that is designated for composting and/or mulching. No site shall be used for mulching and/or composting until such Appendix is prepared. Such Appendices shall be prepared, reviewed, and signed by designated liaisons at the Natural Resources Group at Parks, and the Bureau of Waste Prevention, Reuse and Recycling at Sanitation.

IN WITNESS WHEREOF,

the parties have caused this Memorandum of Understanding to be executed by their duly authorized representatives.

City of New York
Department of Sanitation

By: _____
John J. Doherty
Commissioner

City of New York
Parks & Recreation

By: _____
Henry J. Stern
Commissioner

Appendix III

Intensive Waste Prevention, Reuse, and Recycling Program

Interim Report: March 1992

Prepared by:
New York City
Department of Sanitation
Recycling Programs & Planning Division

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The Department of Sanitation has been running an "Intensive Recycling Program" in Brooklyn Community Board Six since January 1991. The program involves the curbside collection of mixed paper and film and foam plastics, in addition to the materials collected under the Department's standard Curbside Program. The program also involves curbside collection of food waste for composting.

To maximize participation and diversion rates, the Department has been experimenting with new methods of collection. The Department has also been working closely with the Queens Center for the Biology of Natural Systems and the Park Slope Community Recycling Campaign, augmenting its own public education efforts with a locally-based recycling campaign, and providing a level of outreach the Department would otherwise be unable to support.

In addition to curbside collections, the Intensive Program has included a household hazardous waste (HHW) collection day, a home composting pilot project, and waste prevention education and outreach to residents and businesses.

The Intensive Program is still underway, and the full results from some aspects of the program are not ready to be reported. In addition, there are aspects that remain to be implemented, including a dry-cell/household battery collection program, a second waste composition study, and a waste prevention outreach campaign to small businesses. Thus, further recommendations and reports on the Intensive Program will be made in the future. To date, the principal findings of the Intensive Program are as follows:

PAPER RECYCLING

Participation - Paper tonnage has been significantly increased by providing buildings with rigid containers, paper bags, and/or allowing people to use their own containers for loose paper, rather than requiring that paper and corrugated be bundled. Paper tonnage from one of the two routes included in the program has increased 20.5% since the start of the program, tonnage in the second route has increased 11.4%. Only 32% of the increases are attributed to the addition of mixed paper, 59% is due to increased newspaper recycling, and 8% and 1% to corrugated and magazines respectively. Paper tonnage increase in the Intensive area is in contrast to a 10.8% drop in paper tonnage in the control area. In the area where both paper bags and rigid containers have been tested as collection methods, the methods appear equally effective in increasing participation;

Markets - Preliminary feedback from the paper broker is that our mixed paper is marketable. However, it is questionable

whether the volume we are collecting has truly begun to test the market. A significantly larger quantity will have to be collected to answer this question.

METAL/GLASS PLASTIC RECYCLING

Participation - Metal, glass and plastic tonnage has been significantly increased by ensuring residents are informed about the program and have adequate container capacity (whether in a DOS blue bucket or garbage can with decals). Decals for m/g/p cans were distributed to between 200 and 250 buildings, meaning that at the start of the Intensive Program, as much as 14% of the buildings in the collection area no longer had adequate or any container capacity for recycling. Tonnages for m/g/p are up 14.8% since the start of the program, less than a third of which is attributed to film and foam plastics. This is in contrast to a 4% increase in tonnage from the control area;

Film & Foam Markets - Film and foam plastics as sorted from the Intensive loads do not, at this point in time, present a marketable product.

FOOD WASTE COLLECTION & COMPOSTING

Collection - Food waste collection is proceeding to date without an odor problem at the curb or complaints by residents. Tests during the Summer will determine the impact of temperature and different collection methods (cellophane-lined paper bags versus plastic bags) on odor generation;

Diversion - New Yorkers are separating food waste from the rest of their trash. The average weekly food waste collection is 4.1 tons, equivalent to approximately 41% of the food waste generated in the collection area. In the food waste collection area, the average total diversion rate [food waste plus recyclables as a fraction of all material (food waste, recyclables and waste) generated in the area] is 33.8%)

Composting Process - To date there have been no serious problems at the Compost Facility. Having developed and implemented proper handling protocol, Facility personnel and the technical consultant can compost the food waste without substantial odor or bird problems;

Compost Quality - Finished compost is not currently available. However, the quality of incoming food waste indicates that finished compost will be of a high quality. Food waste delivered to the site is relatively free of physical contaminants, and test results show it to be low in chemical

contaminants.

HOME/SMALL-SCALE COMPOSTING

Demand - New Yorkers are interested in learning about composting at home. This pilot project attracted hundreds of people to the training workshops and demonstration site. Schools in the area also repeatedly requested presentations on the subject, and on several occasions brought large groups of students to the demonstration site;

Participation - Although the program did attract and interest many people, it did not result in a significant increase in the numbers of people composting a significant portion of their organic waste, although increases did occur. The principal reason for this would appear to be the relative scarcity of large backyards in the area;

Target Audience - Future programs should focus on low density districts, which comprise approximately 13% of the city's population, and generate roughly 100,000 tons of food and yard wastes a year. Diversion of one-quarter of this material through home composting would result in savings of more than half a million dollars in landfill operating costs alone. Future programs should also continue to involve community gardens, which offer natural sites for composting systems to serve residents of the surrounding neighborhood.

HOUSEHOLD HAZARDOUS WASTE

Demand - New Yorkers will participate in a HHW collection day. This collection day had more than 450 participants, who brought enough HHW to fill 222 drums. Nearly all participants said they would like access to an HHW collection at least once per year, close to half would like collections to be held every six months;

HHW Management - Based on collection day results, future programs should continue to target all types of household hazardous waste. Materials brought to the collection included paint, cleaning products, household batteries, pesticides, hobby products, motor oil and other types of HHW. Recycling of collected HHW should continue to be a priority for future programs, particularly for the following materials: motor oil, paint, paint cans, anti-freeze, and automotive and certain household batteries;

Waste Prevention - Citizens were educated and encouraged to reduce the amount of HHW they generate. The Department's direct mailings and others publicity materials included

information on source reduction. At the collection day, the Department provided free samples of baking and washing soda, with literature explaining why and how to use these as substitutes for hazardous cleaning products. Future programs should continue to stress source reduction opportunities;

Siting - HHW collections in high and medium density areas should be accessible to pedestrians (only 56% of the participants at the collection day arrived by car). In low density areas, car use will be more common. According to participant surveys, HHW collections should be held in all five boroughs, and at more than one location per borough (70% of the participants resided in the two zip code zones immediately surrounding the collection site). For future programs, Borough and/or Community Board officials should be responsible for selecting and obtaining approval for sites. Arranging for the site was among the most time consuming tasks of this program;

Publicity & Outreach - The most effective form of publicity for this collection day was direct mailing of a brochure. Posters, newspaper advertisements, word of mouth, newspaper and newsletter articles, environmental-group promotion and volunteer outreach were also important methods for publicizing the program;

Funding - It is estimated that it would cost a total of $300,000 to $400,000 for a citywide program that included a one-day collection in each Borough each year. Cost will therefore be a limiting factor in the Department's ability to provide an expanded program. Outside funding and in-kind contributions can be obtained, and corporate support should continue to be sought;

Collection Options - Collection days are not the only method for collecting HHW. There are other options that should be explored, including permanent HHW collection centers, mobile collection facility(s), and curbside pick-up of certain HHW materials.

I. INTRODUCTION & BACKGROUND

In Fiscal Year 1990 (FY'90), the Department of Sanitation, Recycling Programs & Planning Division (RPPD), the Manhattan Borough President's Office, the Manhattan Solid Waste Advisory Board (SWAB) and a consortium of environmental groups began a cooperative planning effort for an Intensive Recycling Program. The goal behind the "Intensive" concept is to determine the maximum extent to which New York City can reduce, reuse, recycle or compost its residential waste stream. In FY'91, the City Council approved funding for the City's first Intensive Program, currently underway in Brooklyn Community Board Six (CB6).

There were several reasons for choosing CB6. First, local political officials welcomed the idea of hosting this program. Second, CB6 is demographically classified as medium income and medium density, the classification into which 17 of the city's 59 community boards and 30% of its population fall, making CB6 representative of much of the city. Third, CB6 was already recycling the six materials targeted by the standard Curbside Program, allowing for the recycling of additional materials at minimal extra cost. Finally, we anticipated that CB6 residents, who had proven themselves receptive to the City's Curbside Program, would be receptive to an Intensive Program.

Within CB6, an area of slightly less than 40 square blocks in the Park Slope neighborhood (Sanitation District BKW6, Section 65) (see **Appendix A. Intensive Zone Map**) was selected to be what is known as the Intensive Recycling Collection Zone. It is in the Collection Zone that we are operating the recycling and food waste collection portions of the Intensive Program. The Collection Zone contains approximately 5,900 households, and is made up of two independent curbside collection routes, one in which recyclables are collected on a Tuesday and the other where they are collected on a Wednesday.

This division within the Collection Zone has allowed us to experiment with different collection strategies and compare the results. It has also allowed us to note the difference in responses received from groups with different demographic characteristics. Although CB6 as a whole is characterized as a medium income/medium density district, there are differences within the district, which are noticeable at the Sanitation collection route level.

In addition to this Collection Zone, we established a larger area, encompassing the Collection Zone, in which we would operate other aspects of the Intensive Program, including a household hazardous waste collection day, a home composting education and demonstration project, and waste prevention education and outreach. This larger area is referred to as the Intensive Waste Prevention, Reuse & Recycling Zone, or the Intensive Zone (approximately 22,000

households). (See **Appendix A**)

Dr. Barry Commoner and his staff at the Queens College Center for the Biology of Natural Systems (CBNS) assist the Department with an intensive, community-based outreach effort in the Collection Zone. The Park Slope Community Recycling Campaign (PSCRC) was developed under the direction of CBNS. PSCRC has leased and staffed a storefront in the Collection Zone for outreach activities.

The Intensive Program, fully implemented and combined with the pre-existing Curbside Program, targets more than 70% of the residential waste stream for recycling or composting, identifies numerous materials and products for reduction or elimination at the source, and has begun to address the issues surrounding the collection and disposal of household toxics.

II. METAL, GLASS, PLASTIC & PAPER RECYCLING

As mentioned in the introduction, one of the principal goals of the Intensive Program is to explore ways to increase the amount of material being diverted from the waste stream for recycling. To do this, two methods are employed. The first is increasing the percentage of the waste stream targeted for recycling. The new materials we chose to target were "mixed paper" and film and foam plastics.

The second method for increasing the diversion of recyclables from the waste stream is to increase participation rates. This is done through public education (mailings, literature drops, door-to-door outreach, etc.), and the provision of containers to facilitate recycling. Decals are also printed for residents to use in designating their own containers as recycling receptacles.

A. Metal, Glass & Plastic

In April 1990, Curbside collection of metal and glass began in CB6. In October 1990, rigid plastics were added to the program. Recycling of these materials is now mandatory in the area. Residents are instructed to place the materials into 32- and 20-gallon blue buckets, which were provided to each building in April 1990. All blue bucket contents are collected in a single packer truck once a week, and taken to the East Harlem Intermediate Processing Center (IPC), a City-owned, privately operated facility, for processing and marketing.

The week of January 21, 1991, with the onset of the Intensive Program, residents were requested to begin recycling their film and foam plastics.

Film and foam were chosen for the following reasons:

Waste Composition Data - Film (primarily) and foam comprise as much as 78% of all plastic remaining after removal of the rigid plastics included in the standard Curbside Program (see **Appendix B. Brooklyn CB6 Waste Composition**);

Markets - They were materials for which markets theoretically existed. But whether those markets existed for the quality of material collected in New York City, had not been tested;

Collection & Processing Costs - We could target these additional materials at minimal extra cost. The IPC is capable of processing film and foam that arrives commingled with glass, metal and other plastics, thus avoiding the need for an additional truck to collect the material separately.

Beginning the week of January 21, 1991, residents in the Intensive Collection Zone received a brochure in the mail directing them to put all clean film and foam plastics in their blue bucket. The brochure also listed materials that are and are not part of the standard Curbside Program, reminded residents of their collection day, and provided the number of the Intensive Recycling Hotline, which they can call to get decals for new containers, more literature, or information regarding any aspect of the Recycling Program (see **Section VII. Outreach & Education**).

In addition to the flyer, a poster was produced for building lobbies, and a concerted effort was made to reach the public through meetings, forums, local press and the newsletters of local political and environmental organizations. (See **Section VII. Outreach & Education**)

Through the Intensive Hotline and outreach work conducted by PSCRC and RPPD staff we distributed between 200 and 250 sets of decals to residents willing to convert garbage cans into new "blue buckets". In most cases these were buildings that had lost, either through breakage or theft, their blue can and had not replaced it. In some cases, the original blue can distribution did not provide adequate capacity for the building's recyclables.

At the IPC, metal, glass and plastics are sorted and marketed by the IPC operator, Resource Recovery Systems (RRS). Plastics are sorted into the following categories: PETE Containers; HDPE Containers; Film; Polystyrene Foam, and "Mixed Plastics" (all the rest).

RRS reports consistent markets for the PETE and HDPE containers that come in as a part of the standard Curbside Program. The mixed plastics are given, when clean, to a Long Island company, for use in plastic lumber. Dirty mixed plastics are landfilled with the IPC residue.

The film plastics collected in the Intensive Program were taken to Union Carbide in N.J. at the start of the program. After a month, Union Carbide decided that they were unable to use the film due to problems with sorting films of different resins, and garbage contamination. Film is now either landfilled with IPC residue, or, if it's clean, baled up with "Mixed" loads and shipped to Long Island.

Polystyrene foam was separated for several weeks at the IPC. Potential buyers came in to inspect it, and all found it too contaminated. Currently, the foam is not going to a foam recycler, and the L.I. lumber manufacturer does not want it in its loads either.

RRS reports that the lumber manufacturer is already taking more material than it wants (i.e., the market for "Mixed" is highly limited at this point). RRS also expects to have problems marketing film for the foreseeable future. Unless that forecast changes, the collection of film and foam plastics will be phased out.

B. Paper

CB6 residents first began recycling paper in April 1989 with curbside collection of newspapers, magazines and corrugated. Recycling of these materials is now mandatory in the area. Beginning the week of January 21, 1991 residents of the Collection Zone were instructed to begin separating mixed paper along with their newspapers, magazines and corrugated cardboard. Mixed paper includes "junk mail" (including envelopes), non-corrugated cardboard (shoe and cereal boxes, paper towel rolls, etc.), colored paper, paper bags (white and brown), and all other clean, uncoated paper, with the exception of books and phone books. (Phone books have since been added to the standard Curbside Program citywide.)

As with the film and foam plastics, mixed paper was targeted for three reasons:

Waste Composition Data - According to the waste composition study (**See Appendix B**) mixed paper accounts for as much as 16.51% of the waste stream in medium income/medium density neighborhoods. (Note: this figure includes some paper grades not included in the Intensive Program, i.e. books, plastic-coated paper and food contaminated paper);

Markets - Consultant reports conducted for RPPD, along with calls by RPPD staff to area paper brokers, indicated a potentially viable market for mixed paper;

Collection & Processing Costs - There were paper brokers who claimed they would be willing to accept loads of newspaper,

magazines, corrugated and mixed paper combined, thus avoiding the need for a separate truck.

In addition to flyers, posters and outreach, the Department distributed two different types of recycling receptacles for mixed paper. 2,400 households (the Tuesday route) received 10-gallon, wet-strength brown paper bags to be used indoors for collection of mixed paper, and then put at the curb. The remainder of the households (3,500 in the Wednesday route) received 17- or 32-gallon green plastic buckets for their building's mixed paper (to be kept in a common area, and then placed curbside for collection). A 17-gallon bucket was given to every building of one to three units; a 32-gallon can was distributed to buildings with four to nine units; an additional 32-gallon can was given out for every additional five units in any given building.

Residents were also instructed that they no longer needed to bundle their newspapers and magazines, but that these materials could be placed in their bags/buckets, along with mixed paper. We provide green decals when a green can is stolen or too small. In some cases, where we have miscalculated the number of units in a building and the container is far too small, we have provided an additional container.

In mid-August, we distributed green cans to the Tuesday area because we wanted to determine, given the demographic differences between the two collection areas, whether or not we would see the same change in participation rate in the Tuesday area as we saw in the Wednesday area. These demographic differences consist of somewhat lower incomes and higher numbers of non-English speaking residents in the Tuesday area than in the Wednesday area. **Table 4** below, indicates that there has not been a great change in participation in the Tuesday area since the green can distribution.

Accompanying the Tuesday area can distribution was a survey of resident attitude's towards the two different collection methods. The results of the surveys are summarized in **Appendix C. Tuesday Area Survey.** They show, among other things, that there are those residents who prefer a rigid container and those who prefer bags.

All paper grades are collected weekly in dedicated vehicles and delivered to a paper broker in Brooklyn. The broker reports that the Intensive loads are kept separate from other City paper, and baled, unsorted, as #6 grade News, which is shipped overseas. He reports that the paper is very clean (few contaminants). The bags used in the Tuesday route required extra work, because each one had to be emptied by a worker to inspect for contaminants. Mixed paper collection is still underway.

C. Tonnage Evaluation & Composition

We have been using a control area to compare to the Intensive Collection Zone. This comparison allows us to control for seasonality, and such factors as the news that the Recycling Program was ending citywide at the end of FY'91. Our control area consists of six routes in the same Sanitation District (BKW6) as the Collection Zone.

For control routes, we chose only those routes that were recycling at approximately the same level as the Collection Zone prior to the start of the Intensive Program. These routes represent our best estimate as to how the Collection Zone would have acted over time without the intervention of the Intensive Program. Routes in the same Sanitation District were picked to prevent any differences that might result from any variations in work practices at different garages. Data from the control routes is averaged to provide average control route data.

Table 1 below shows the difference between the average weekly recyclable tonnage collected in the two areas of the Intensive Collection Zone compared to the average control route. The "before" period we examined extends from the week ending October 13, 1990, through the week ending January 19, 1991. The "after" period included weeks ending January 26, 1991 through November 23, 1991.

TABLE 1. CHANGE IN TONNAGE AFTER INTENSIVE RECYCLING

Average Tons	Intensive Tuesday	Intensive Wednesday	Average Intensive	Average Control	Number of Percent. Pts. Difference
PAPER					
Before	6.44	10.13	8.29	10.04	
After	7.18	12.20	9.69	8.96	
% Change	11.4%	20.5%	16.9%	-10.8%	27.8
METAL/GLASS/PLASTIC					
Before	3.08	3.80	3.44	4.26	
After	3.62	4.28	3.95	4.43	
% Change	17.6%	12.6%	14.8%	4.0%	10.8

The average amount of paper picked up in the Collection Zone each week increased from 17.5 to 19.4 tons per week after the Intensive Program began. This 17% increase is even more dramatic when compared to the 11% drop in tonnage collected from the control area.

During the same period, the average amount of metal, glass and

plastic picked up in the Collection Zone each week increased from 3.4 to 4.0 tons per week, while the average tonnage collected from the control area changed only from 4.3 to 4.4 tons. These figures represent a 14.8% increase in the Collection Zone versus a 4.0% increase in the control area. The increase in metal, glass and plastic tonnage was thus proportionately smaller than the increase in paper tonnage. One explanation for this is that the film and foam added to the blue bucket account for 3.5% (an unknown, but certainly large part of which is unrecoverable plastic bags used for garbage) of the waste stream by weight, while mixed paper comprises nearly 14% of the waste stream by weight.

The fact that the paper tonnage dropped in the control area is not surprising either. Newspaper makes up the majority of paper weight citywide, and newspapers are heaviest in the Fall (our "before" period) due to advertising pages added for the holiday shopping season. During our "after" period, there was a Daily News strike, a recession (which decreased advertising pages in newspapers and magazines) and announcements in the late Spring and early Summer that the City's Recycling Program was ending. What is remarkable in this context is the 17% increase in Intensive paper collection. Because the Collection Zone's tonnage increased while the control area's tonnage decreased, we can conclude that the pilot area is performing against a seasonal (or other) trend.

We wanted to know how much of it was made up of more of the same materials we had been collecting before - newspapers, magazines and corrugated cardboard - versus the new materials we were collecting - junk mail, bags, wrapping paper, gray cardboard and other clean uncoated papers.

To answer this question, we worked with CBNS to conduct a waste composition sort on the recyclables and garbage collected from the entire Intensive Collection Zone and one route of the control area. **Table 2** below shows the breakdown of the differences between the recyclables collected from the Collection Zone and the control area. (A complete report on this waste sort forms **Appendix D** of this report.)

Table 2 shows that the majority of the difference in pounds of paper per household between the Intensive Zone and the control area was due to increased newspaper collection. Only a third of the difference was due to the new material, mixed paper.

The increase in newspaper recycling could be attributed to at least three factors: the fact the residents no longer need to bundle newspaper and magazines, thanks to our provision of reinforced bags and buckets; increased outreach, in which regular RPPD outreach was supplemented by local volunteers of PSCRC; and/or the creation of an "intensive effect", which, because they can recycle a greater part of their trash, encourages residents to take recycling more seriously for all materials.

The latter two factors should apply to metal/glass/plastic recycling also, but tonnages for these materials did not increase nearly as much as paper recycling did (see **Table 3** below). Therefore, we can conclude that much of the increase in newspaper recycling was due to greater convenience for residents.

TABLE 2. SHARE OF INCREASED RECYCLABLES DUE TO EACH MATERIAL*

% of Difference Between Intensive Zone & Control Area Due to:

All paper		100%
Newspaper		59%
Magazines		1%
Corrugated		8%
Mixed Paper		32%
M/G/P		100%
Glass		52%
Metal		-3%
Plastic		52%
- Rigid	15%	
- Film	28%	
- Other	7%	

*** numbers may not add up to 100% due to rounding**

TABLE 3. DIFFERENCE IN THE AVERAGE HOUSEHOLD'S AMOUNT OF RECYCLING

	Lbs/Household/Week		
	Control	Intensive	% Difference
All Recyclables	6.65	8.84	32.9%
All paper	4.17	6.03	44.6%
Newspaper	3.23	4.32	33.7%
Magazines	0.74	0.76	2.7%
Corrugated	0.16	0.30	87.5%
Mixed Paper	0.05	0.65	1200.0%
All m/g/p	2.48	2.81	13.3%
Glass	1.92	2.09	8.9%
Metal	0.38	0.37	-2.6%
Plastic	0.18	0.35	94.4%
- Rigid	0.15	0.20	33.3%
- Film	0.00	0.09	-----
- Other	0.03	0.05	67.0%

As with the paper, in the metal/glass/plastic category only a

portion (one-third) of the difference in metal/glass/plastic pounds per household was due to new Intensive materials, which means that two-thirds of the increase was due to increased outreach and/or an "intensive effect".

Notably, the volunteer outreach effort succeeded in increasing the number of metal/glass/plastic recycling buckets in the Collection Zone. The CBNS/PSCRC storefront office was staffed with a full-time employee. She cooperated with RPPD in keeping that office stocked with decals residents could use to designate their own buckets as "blue" metal/glass/plastic recycling buckets. The volunteers she organized, while going door-to-door to speak to tenants, noted addresses where blue buckets were lacking and later delivered decals to them. (Volunteers distributed approximately 150 to 200 sets of blue can decals, and RPPD, through the Intensive Hotline, sent sets of blue can decals to an additional 50 or so buildings.)

Figure 1 on the following page shows that Tuesday area's tonnage increase was concentrated in metal/glass/plastic, while Wednesday area's tonnage increase came mostly from paper. This is consistent with what we know about the demographics of the two Collection areas. The Tuesday area has residents with lower incomes, who have proportionately more metal/glass/plastic in their waste stream, while the higher-income residents of the Wednesday area have more paper in their waste stream.

The difference in paper tonnage increase could also have been caused by the different containers we gave the two areas. In fact, the initial reason for giving out both reinforced bags and green cans, was to see which were more successful as containers.

To answer this question, as described above, we distributed green cans in the Tuesday area in mid-August, after those residents had been using reinforced bags for seven months. **Table 4** below indicates that there has not been much change in the Tuesday area's participation rate since then, when compared to the increased Wednesday tonnages that occurred over the same period.

TABLE 4. THE EFFECT OF GREEN CAN DISTRIBUTION IN THE TUESDAY AREA
(Also see Appendix C)

Average weekly paper tonnage	Tuesday	Wednesday
Before*	6.8	11.8
After**	7.5	12.7
Percent Change	9.8%	8.2%

* "Before" period extends from March 30, 1991 to August 10, 1991.
** "After" period extends from August 17, 1991 to February 1, 1992.

FIGURE 1

% Change in Amount Recycled Since the Intensive Program Began

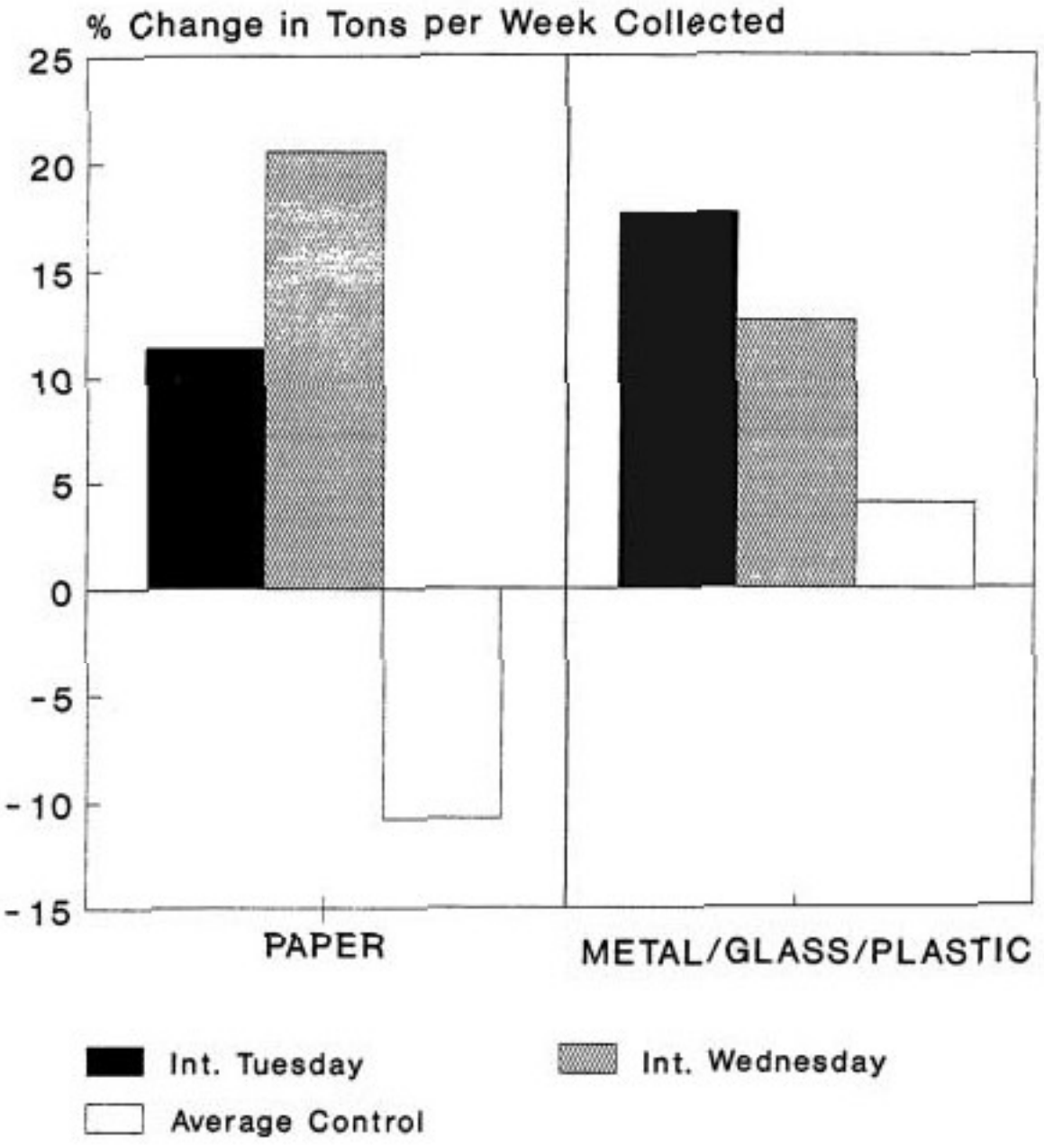


Figure 2 on the following page shows a low tonnage point for the Tuesday area in July, when PSCRC volunteers were not working on the Intensive Program due to a flurry of other recycling activity in the city. Because PSCRC volunteers were involved in keeping residents supplied with bags, this dip may have resulted from residents not having enough recycling bags at that time.

D. Conclusions

Conclusions that we can draw to date from the paper, metal, glass and plastic recycling aspects of the Intensive Program are as follows:

PAPER:

The Impact of Containers - Paper tonnage (particularly newspaper tonnage) has been significantly increased by providing buildings with containers, and/or allowing people to use their own containers for loose paper, rather than requiring that paper and corrugated be bundled;

Rigid Container Size & Weight - 32-gallon containers, when full of newspapers and magazines, are too heavy for Sanitation workers to comfortably lift. Any program designed to encourage people to use containers for set out of paper should limit container size to 22-gallons or less;

Recycling Bags - Residents are willing to use bags, at least when they are provided to them. However, a bag system that depends on distribution by the Department is too labor intensive and complicated to maintain on an ongoing basis;

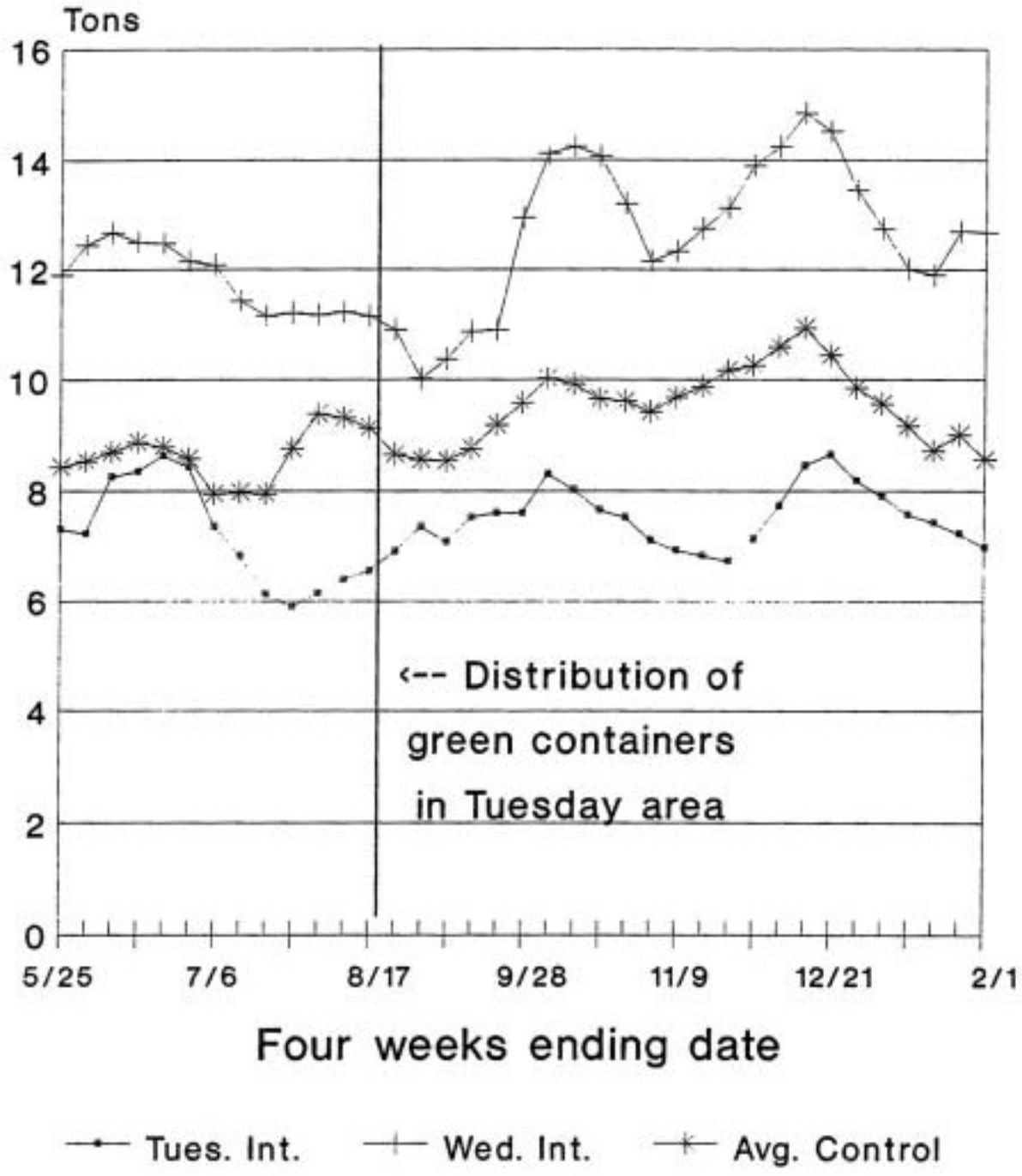
Per Household Volume - For participating households, the weekly volume of newspapers, magazines, corrugated and mixed paper generated appears to be about 10-gallons;

Markets - Preliminary feedback from the paper broker is that our mixed paper is marketable. There remains, however, a big question as to whether the volume we are collecting has truly begun to test the market. We will have to collect and attempt to market a significantly larger quantity than we are now to begin to answer this question.

METAL, GLASS & PLASTIC:

Participation - We can significantly increase participation in metal, glass and plastic recycling by ensuring residents are informed about the program and have adequate container capacity (whether in a DOS blue bucket or garbage can with decals);

FIGURE 2


Paper - 4-Week Rolling Average
Tons
16
14
12
10
8
6
4
2
0
<-- Distribution of
green containers
in Tuesday area
5/25
7/6
8/17
9/28
11/9
12/21
2/1
Four weeks ending date
Tues. Int.
Wed. Int.
Avg. Control

Container Capacity - Decals for m/g/p cans were distributed to between 200 and 250 buildings, meaning that at the start of this program, as much as 14% of the buildings in the Collection Zone did not have adequate or any container capacity for recycling;

Film & Foam - While film and foam plastics can be successfully added to the blue can and processed at the IPC, they do not significantly increase the tonnage collected, and they do not, at this point in time, present a marketable product.

E. Future Work

There will always be experimental work to be done in terms of testing markets, collection containers, outreach methods and so on. However, within the scope of the Park Slope Intensive Program and regarding the recycling of paper, metal, glass and plastic, we plan the following:

Recycling Container Capacity - There is a certain fine tuning that needs to be done to assure that every building has adequate container capacity for all its recyclables. By mid-May, we hope to have maximized participation to the extent that it can be maximized through ensuring adequate container capacity;

The Effect of Food Waste Collection - We have recently begun food waste collection in the Wednesday area of the Collection Zone (see below). We will monitor recyclable tonnages in order to determine if there is an "intensive effect", and food waste separation results in greater awareness and participation with other recyclables;

Waste Composition Study - A second waste composition study will be conducted in the Spring of 1992. The objectives of this study will be to confirm what the breakdown is of the recyclables by material, and what amount of recyclables/compostables remain in the trash fraction.

III. FOOD WASTE COLLECTION & COMPOSTING

Food waste, including all food scraps, food contaminated paper, houseplants and yard waste, is the last new material to be collected curbside as part of the Intensive Program. Food waste has been targeted because:

Waste Composition - In Brooklyn CB6, it comprises a full 13.15% of the waste stream, the largest single, non-targeted component of the waste stream, while yard waste accounts for

an additional 3.32% (note that 13.15% is the figure assigned by SCS Engineers to food waste, which does not include food contaminated paper accepted in this program);

Markets - It can be converted into a useful soil product, for which the Department has a need that will, for the foreseeable future, far outstrip the supply we will generate with all our composting programs;

Composting Costs - The Department has a large, under utilized Compost Facility at Fresh Kills Landfill, where composting of food waste on this pilot scale can occur without capital expense or a large operating budget.

A. Collection Method

In order for the Department to collect source-separated food waste, residents of the Wednesday area of the Intensive Collection Zone (3,500 households) have been asked to separate all of their food waste and soiled paper and place it into biodegradable, leak-proof, cellophane-lined paper bags that have been provided to each household by the Department. Each building received black buckets, to be stored in a common area of the building. One to three unit buildings received an 8-gallon bucket; four to 10 unit buildings received a 20-gallon bucket; and still larger buildings received one extra 20-gallon bucket for each additional 10 units.

Residents place their food waste bags whenever they are full into the black buckets. The black bucket is to be set out curbside for collection along with other recyclables. A dedicated rear-end packer collects the food waste once a week on the regular recycling day. When the recycling day falls on a holiday or snow day, food waste is picked up the following day, unlike other recyclables, which are not collected until the following week.

Each household was supplied with a bundle of 25 bags, which was estimated to be a three-month supply for the average household. Those households using them faster than anticipated are directed to call the Intensive Hotline or the PSCRC office, and volunteers or RPPD staff drop off another bundle.

B. Composting Method

The food waste is delivered each week, on the day of collection, to the Fresh Kills Composting Facility, where it is composted in open windrows. The Department has contracted with a consultant, Compost Futures, Inc., to provide technical and on-site management assistance for this project. The protocol outlined below has been developed in conjunction with the consultant.

At the Compost Facility an area has been designated for the food waste composting. Leaves and woodchips have been piled there to use as a bulking agent, cover material and for constructing a tipping pad for the food waste. Each week, prior to delivery, a tipping pad of leaves is spread out by a front-end loader. The packer dumps the food waste onto this pad. The load is inspected for contaminants, and the consultant takes a sample of unbroken food waste bags.

The loader adds more leaves and/or woodchips. The Scarab windrow turner then mixes and turns the material. The consultant again takes samples, this time of the bulking agent/food waste mix, and the loader finishes the process by covering the pile with a layer of leaves. Samples taken are sent out for laboratory analysis. Ongoing monitoring of the piles is carried out by both the consultant and Compost Facility personnel.

Working with the consultant, the Department is experimenting with a variety of recipes, mixing the food waste with different ratios of leaves and wood chips. Both the tipping pad and the leaves used to cover the piles after turning, are measured and calculated into the recipe formulations in order to gather consistent data. Altering the mix of the piles and the frequency with which they are turned affects such factors as carbon:nitrogen ratio, particle size, air and water content and temperature. By adjusting these parameters we hope to control any potential odor or vector problems.

C. Preliminary Results

New Yorkers are separating their food waste from the rest of their trash. The cellophane-lined paper bags distributed are working as planned. At the household level they appear not to be leaking; in the collection vehicle, the bags plus other compostable paper appear to be absorbing most of any excess liquid; and at the site, the bags are decomposing along with the food scraps. However, some residents are using bags at a faster pace than anticipated, necessitating regular deliveries by volunteers and RPPD. A second distribution of bags, to last for the second three months of the project, was undertaken in early February.

The buckets distributed are adequate for most buildings. In several cases people have complained, or we have noticed through field observations, that buildings have inadequate capacity. This is either remedied through exchanging a smaller for a larger container, providing an additional container, or providing decals.

Using Brooklyn CB6 waste composition data compiled by SCS Engineers and tonnage information on waste and recyclables collected in the Wednesday area, we estimate that on average, we are capturing 41% of the food waste generated there. (Note that

for this calculation, compostable paper was not included because compostable paper was not a category in SCS study, thus the estimated diversion rate for food waste is somewhat higher than is actually the case.) Weekly tonnages are provided in Table 1 below, along with tonnage figures for the other three fractions (paper, metal/glass/plastic, and trash) currently collected in the Wednesday area, as well as calculated recycling rates for the weeks from November 20, 1991 to January 1, 1992.

The material delivered to the site is relatively uncontaminated. Two likely reasons are: 1) the bags have instructions printed on the outside, and 2) they are too small to be practical for most regular trash.

TABLE 1. RECYCLING RATE IN THE WEDNESDAY INTENSIVE ZONE SINCE FOOD WASTE COLLECTION STARTED

Recycling rate = recyclables / (trash + recyclables)

WEEK	TONS				RECYCLING RATE	
INCLUDING	PAPER	M/G/P	FOOD	TRASH	W/FOOD	WO/FOOD
11/20	14.2	4.5	1.5	50.4	28.6	26.5
11/27	15.3	4.7	4.6	44.6	35.5	28.9
12/04	14.8	5.5	4.8	44.2	36.2	29.3
12/11	15.1	4.7	4.2	43.3	35.7	29.4
12/18	12.9	4.6	4.0	42.4	33.6	27.4
12/26	11.0	4.5	3.7	38.4	33.3	26.9
01/02	12.0	4.9	4.4	42.2	33.5	26.6
01/08	12.1	4.9	3.6	46.6	30.7	25.3
01/15	12.5	5.1	3.9	41.2	34.3	28.1
01/22	14.2	4.8	3.9	46.8	32.9	27.3
01/29	11.9	4.6	3.8	39.9	33.7	27.4
02/05	11.7	4.5	3.6	39.9	33.2	27.1
02/13	12.5	4.3	4.2	holiday		
02/19	12.6	4.4	3.6	47.1	30.4	25.1
02/26	14.1	5.0	4.7	42.6	35.8	28.8
AVERAGE*	13.1	4.8	4.1	43.0	33.8	27.5

*** Average does not include the week of 11/20 because it was only a partial week for food waste collection. Nor does it include the holiday week of 2/13, for which it was not possible to determine the trash weight for the area.**

The composting process is moving ahead without serious problems. There have been some odors generated within the immediate vicinity of the pile after it is turned, and birds have not been as effectively deterred by the leaf cover as hoped. On the other hand, birds seem no more attracted to the food waste windrows than they are to the leaf windrows, where they look for nuts opened by the Scarab. As mentioned above, both odor and bird

problems are being addressed through changes in the turning frequency, leaf and wood chip to food ratio in the pile, and depth of the covering layer of leaves.

All Compost Facility activity, as well as chemical and physical analysis of the incoming material and compost are described in regular reports from the consultant. (**Appendix G. Food Sample Test Results**, extracted from the consultant's first report, contains the laboratory results on the first four samples of food waste taken.)

D. Future Work

Food waste collection, originally scheduled to continue through the middle of May, has been extended until September. During that time, we will continue to work with PSCRC to ensure that residents have adequate capacity for their food waste, and, as we move into Spring and Summer, their yard and garden wastes. We will also attempt to increase awareness of the program through continued press releases and outreach work by PSCRC volunteers. In these ways we should achieve the maximum participation rate possible. As mentioned earlier in this report, a waste composition study, to be conducted this Spring, will indicate how much food waste is not being separated by residents.

The extension of food waste collection has been tentatively approved by the N.Y.S. Department of Environmental Conservation (DEC), which granted the Department a six month Research & Demonstration Permit for this project. The extension will do much to determine the types of problems one can anticipate in collecting and composting food waste during hot Summer months. In addition, an extended program will allow the Department to experiment with different types of collection bags. This is important because of the high cost and logistical problems associated with distributing the cellophane-lined bags now in use, and because of the questions surrounding odor and compost quality as they relate to different collection methods.

Activity at the Compost Facility will extend past the final collection, as the compost matures and testing and analysis continues. Reports will be made to the DEC, and interim reports from the consultant will be complied into a final report along with a program evaluation and recommendations.

IV. HOME & SMALL-SCALE COMPOSTING

A. Introduction & Objectives

The Intensive Program was designed not only to experiment with

the collection of additional recyclables, but to develop and evaluate waste prevention projects. In the Spring of 1991, we administered a pilot program promoting home composting to residents of the larger Intensive Zone (see **Appendix A**). The Department considers small-scale, on-site composting a form of waste prevention because it reduces the need for municipal collection and management of organic wastes.

The pilot's first goal was to encourage Zone residents to develop food and yard waste composting practices that reduce the fraction of such wastes requiring DOS collection. Secondly, as befits a pilot, we sought to evaluate the effectiveness of the outreach and demonstration techniques employed in the pilot, and determine the feasibility for replication of similar programs elsewhere in the city.

Three other goals that we had initially identified, but dropped when it became apparent that funds were inadequate, were: 1) to encourage residents to leave grass clippings on the lawn; 2) to encourage small institutions (churches, schools, community gardens) to compost on site; and 3) to reduce or eliminate the use of toxic chemicals in lawn and garden care.

Three features of the Intensive Zone make it similar to much of the city, and led us to distinguish our home composting program from others around the country. First, the waste stream there is composed of more than 13 percent food waste, compared to less than four percent yard waste. Thus we wanted our program to emphasize composting of food waste over more conventional yard waste composting.

Second, the Zone, like much of the city, is largely of medium density housing stock, meaning most potential composters have only a small area in which to compost. In the pilot, we attempted to demonstrate composting systems that take into account odor, space, and vector problems that may arise in this context.

Third, a significant part of the city and the Zone population is Hispanic, so we sought ways of reaching out to the Hispanic community.

B. Regulatory Environment

New York State Codes, Rules, and Regulations governing solid waste management facilities (NYCRR Part 360) require permitting for all compost facilities, with the exception of those handling only food processing wastes and/or less than 3,000 cubic yards of yard waste per year. Therefore, presumably any compost pile of any size that includes organic waste other than yard or food processing waste is regulated by DEC's NYCRR Part 360. Nevertheless, the DEC has stated that it does not regulate home composting of wastes

generated on site, and in fact encourages this practice. DEC does, on the other hand, view community garden composting of food wastes that are generated off-site, as requiring a DEC permit. Although the size of composting bins and piles built in community gardens make them unlikely targets of a DEC crack-down, an exemption for composting facilities of a limited size is one recommendation the Department should make the next time DEC revises its regulations.

New York City health regulations do not explicitly address either home or community-garden composting. Under the zoning amendment being proposed by City Planning, residential and community garden composting will be considered an "accessory use", and thus exempted from zoning laws.

C. Contractors

We decided to procure outside services to conduct this pilot because the Department had neither the staff, nor a neighborhood site, nor the extensive contacts in the community that the project required.

These services were divided into two distinct scopes of work. The first contract, for $9,990, was for on-site technical assistance and demonstration of home composting at one or more community gardens within easy walking distance of Zone residents. The second contract, for another $9,990, was for a Zone-wide community awareness campaign to educate local residents and to recruit an audience for the demonstration program.

In selecting contractors, we were particularly interested in: an ability to provide Spanish-speaking staff and recruit a Hispanic audience; accessibility of proposed demonstration site(s) to Zone residents; a close relationship with the community; and potential for carrying on home composting education and demonstration after the termination of the contracts.

In March 1991, the technical assistance and demonstration project contract was awarded to the Garden of Union (Union), a longstanding, highly successful non-profit community garden within the Zone that has been composting food wastes from a nearby food cooperative for many years, and has an extensive network of participants who regularly bring their food waste to the Garden's three-bin system. Union offered plenty of room at its own garden and at a satellite site, the Bears Garden, to demonstrate a variety of compost systems, along with a dense and varied schedule of workshops.

The contract for conducting a community awareness campaign was awarded to the Brooklyn Center for the Urban Environment (BCUE), a 13 year-old non-profit environmental education group located in Prospect Park, directly adjacent to the Intensive Zone. BCUE has

an extensive local network of schools and civic associations to whom they could immediately turn to conduct composting outreach.

In awarding contracts to these local groups, with their history of interaction in the neighborhood and thorough knowledge of area resources, we hoped to catalyze long-term community commitment to home and small-scale composting.

D. Garden of Union: Workshops & Demonstration

In all, more than 400 people visited the Garden of Union during the contract period (April to June), although not all of these came or stayed for the compost project. Union calculates that 360 people visited the site specifically to learn about composting. While it is not known how many people compost at home in the vicinity, Union notes that more people are coming to the Garden on a regular basis to drop off food scraps for composting in the Garden's own composting bins.

The main demonstration site at the Garden of Union included 12 different home composting systems (many of which were donated by vendors) with explanatory signs. At the Bears Garden satellite site on Flatbush Avenue there were four systems. At both sites the different composting systems were in use, so that visitors would see the various stages of the composting process, and the types of organic waste to which each system was best suited. (An ancillary site with two composting bins was established at the Prospect Park Tennis House where BCUE is headquartered.)

Signs in Spanish and English were installed at both gardens, announcing the project, with site hours, sponsors and information such as "What Is Compost?" and "What is Sustainable Gardening?" There were also racks with literature on where to buy commercially available units, composting instructions, and DOS and community notices.

Union held an opening party for the compost project on a sunny Saturday in April. 40 people attended, bringing with them a week's food waste to feed the compost. This event served to publicize the project, and bring participants to the workshops. In the succeeding months, Union conducted 19 hour-long basic composting workshops, 14 in English and five in Spanish. "Make your own worn box" and "make your own compost bin" sessions were also held, both in English. The workshops ran from early April until the end of June, and were held on weekends and weekday evenings. The Union volunteer coordinating the compost project conducted half the workshops, recruiting a Cornell Extension agent to conduct the other half. A Spanish speaker active with the local hispanic community was recruited to conduct both the Spanish language workshops, and outreach to the Hispanic population residing nearby.

Attendance at English-language workshops varied from three to 15 people. The workshops held in Spanish were more sparsely attended - some sessions went unattended altogether. The weekday evening sessions consistently drew six to eight people. While only 30 individuals filled out surveys during the entire three month period of the program, Union claims that 110 people participated in the workshops; at least one-half of these were from the Intensive Zone. In addition, through BCUE's outreach efforts (see below), several school groups came to visit the site on weekends.

Union designed their own flyer advertising the demonstration site and schedule of workshops. Separate versions were produced, one in English, one in Spanish. The Department mass-produced thousands of these flyers; more than 2,000 copies in each language were distributed in the neighborhood and at street fairs. This flyer was not in Union's scope of work, but they thought it important to augment BCUE's promotion of the demonstration site.

The permanent composting bins at the Garden of Union and the Bears Garden are now used by several new, non-garden member households, who come weekly to drop off their food scraps. The Garden of Union claims that ten families in the neighborhood, who were not composting prior to the pilot, are now doing so as a result of the workshops and demonstrations.

E. BCUE: Community Awareness

Since BCUE had not previously included composting in their education programs, the first thing they did was to bring themselves up to speed on the issues, and compile information into outreach packets.

BCUE then printed an article about the project in the Spring edition of their newsletter, CityGreen, which is sent to 1,400 BCUE members. BCUE also issued a press release, which was picked up by two local papers in early May, and in the May 5 Brooklyn edition of Newsday.

In April, BCUE produced a flyer to promote their composting presentations. A Spanish version was made and 600 copies distributed to Hispanic merchants and the public. However, it was not professionally produced, and appeared to receive little attention. The English version was distributed to more than 60 civic associations and churches, in and outside of the Intensive Zone. Follow-up phone calls encouraging groups to sign up for a composting presentation received little interest. Most groups reported that composting was not high on their agenda. Ultimately, BCUE made six composting presentations to civic associations, none of them Hispanic.

In addition to civic associations, BCUE made 21 composting

presentations to school classes and assemblies in May and June. BCUE also incorporated home composting information and the schedule of workshops into their booth at three street fairs held in the area. BCUE reports that 210 people were reached at talks to civic groups; 1400 school children participated in the assemblies and classroom sessions; and an estimated 700 people received information about composting at BCUE's street fair booth. In all, BCUE calculates that more than 2,300 people received information about home composting and the demonstration site directly through their presentations.

Virtually no follow-up was done to determine if this outreach was successful in bringing people to the workshops or either demonstration site. No one who filled out a survey at the Garden of Union indicated that they had attended a BCUE-sponsored presentation. However, several stated they had found out about the project from an announcement, generated by BCUE, in the local paper. And, as stated above, BCUE brought several school groups to tour the Garden of Union.

F. Conclusions & Recommendations

Based on the experiences of this program, we have drawn the following conclusions and recommendations, some of which may be applicable to the design of future home-composting promotional efforts.

It should be pointed out that although this program did not result in a significant increase in the number of people composting their organic waste at home, the concept of home composting in New York City should not be rejected as an element of the Department's waste management strategy. New Yorkers are interested in learning about composting at home. The program did attract hundreds of people to the training workshops and demonstration site. Schools in the area also repeatedly requested presentations on the subject, and on several occasions brought large groups of students to the demonstration site.

Contractors - The most persistent problem with this pilot was managing two different contractors who cooperated little with each other. One contractor should be responsible for all aspects of a home composting education and demonstration program;

Outreach & Public Education - This pilot needed to be better publicized. The relatively scant publicity for the workshops and demonstration site did not draw nearly the kinds of crowds the sites and workshop schedule could accommodate. Outreach to the Hispanic community by BCUE was disappointing. Union helped to engage this population by hiring a Spanish-language coordinator, who publicized the program in Spanish and

conducted workshops. However, Hispanic outreach was a specific requirement of our contract with BCUE and they performed unsatisfactorily in this respect. RPPD had no money for advertising, but it is likely that neighborhood papers would have run an advertisement with graphics had a mechanical been available. In addition, more press releases, aside from the single one issued by BCUE, would have helped to promote this program.

Home composting requires an professional, cohesive and well run publicity campaign to create visibility for it, draw people to a demonstration site, and make it seem fun, easy and worthwhile. Greater emphasis needs to be placed on this in future programs;

Food Waste - Most of the units on display at the Garden of Union were specifically designed for leaf and yard waste. Although many could be adapted to accommodate kitchen waste, more emphasis should have been given to dealing with this part of the waste stream, since it is the largest fraction of residential organics in the city;

Collective, Neighborhood-level Solutions - It is not realistic to expect the majority of New Yorkers, who do not have yards, to compost at home. However, in many areas of the city community gardens exist, which can offer a collective composting option for their neighborhoods. The Garden of Union provides an excellent model for how such a system could work;

Target Audience - Although the program did attract and interest many people, it did not result in a significant increase in the numbers of people actually composting, although increases did occur. The principal reason for this would appear to be the relative scarcity of large backyards in the area. Future programs should focus on low density districts, which comprise approximately 13% of the city's population, and generate roughly 100,000 tons of food and yard wastes a year. Diversion of one-quarter of this material through home composting would result in savings of more than half a million dollars in landfill operating costs alone. Future programs should also continue to involve community gardens, which, as mentioned, offer natural sites for composting systems to serve residents of the surrounding neighborhood.

G. Aftermath

There have been several developments as a result of this project.

Composting in the Intensive Zone - Several new, non-garden member households come weekly to leave their food scraps in the permanent composting bins at the Garden of Union. According Union, there are also a handful of people in the neighborhood now composting, who were not prior to the pilot;

Public Education - BCUE has incorporated home composting into their environmental outreach program to schools. This means that every year, through a contract with School Board District 15 and the Board of Education, about 1,200 schoolchildren in Brooklyn will receive information about home composting through BCUE's efforts alone;

The Staten Island Greenbelt - RPPD was contacted by staff of the Staten Island Greenbelt. They were interested in developing a permanent home composting demonstration site at the Greenbelt High Rock Visitor's Center. We provided the Greenbelt with examples of the publicity materials that had been produced for the Brooklyn program, and, after the conclusion of the Brooklyn program, with some of the home compost units that had been donated. During the Fall, the Greenbelt ran several workshops for S.I. residents at the High Rock demonstration site. Starting this Spring, the Greenbelt plans to run home composting workshops every weekend there. They also plan to integrate composting into their environmental education programs;

DOS Compost Bin Construction - The Department's carpentry shop built three home compost units of wire mesh and wood, to determine the cost of constructing them in-house. Unfortunately the cost amounted to about $100 per bin, comparable to compost units bought at retail. If the cost had been reasonable, we had thought to supply bins to the Greenbelt program to give away to residents through a lottery. The bins DOS did construct are now in use at the High Rock site.

V. HOUSEHOLD HAZARDOUS WASTE

A. Introduction & Objectives

Household hazardous waste (HHW) is a small but toxic portion of the waste stream, including such things as motor oil, paint, batteries, pesticides, solvents, cleaning products, photographic chemicals and art supplies. When disposed of in the trash or down the drain, HHW can pollute the ground, air and water. Sanitation workers can be injured if aerosol cans are punctured when garbage is compacted in refuse vehicles, or if they are splashed by hazardous chemicals discarded in the trash.

A HHW Collection Day was the Department's first step in testing the collection, recycling and safe disposal of HHW. The program demonstrated that a HHW program can be implemented effectively in New York City. Participation in the Collection Day was comparable to first-time programs held in other parts of the country. Significant quantities of HHW were collected, much of which was recycled, and the educational component of the program provided the public with information about the hazards of household products and methods for reducing the generation of such wastes at the source.

The objectives of the HHW pilot were as follows:

HHW Prevention - To reduce the use of hazardous household products, and promote the use of safer, alternative products;

HHW Diversion - To divert HHW from the municipal solid waste stream by applying a waste management hierarchy, in order of preference, of reduction, recycling, treatment and disposal;

Data Collection - To provide the Department with experience, and to generate data necessary for developing an expanded, citywide education and collection program.

B. Targeted Wastes & Generators

The HHW collection was designed to accept unwanted hazardous household products including: automotive products (brake and transmission fluid, batteries, carburetor cleaner, anti-freeze, gasoline, kerosene, motor oil); kitchen products (bug sprays, floor care products, drain cleaner, furniture polish, metal polish, maintenance chemicals, oven cleaner, window cleaner, corrosive cleaners); bathroom products (cleaning solvents, pharmaceuticals, nail polish and nail polish remover), gardening products (fungicides, termiticides, herbicides, rodenticides, insecticides, disinfectants); home maintenance products (paints, paint thinners and strippers, turpentine, varnish, wood preservatives); hobby/recreation products (chemistry sets, photographic chemicals, art supplies, household batteries); miscellaneous products (mothballs, lighter fluid, rug and upholstery cleaners, spot removers, smoke detectors); and other household products which are flammable, corrosive, reactive or poisonous.

Only residential waste was targeted. Commercial, industrial and institutional generators were excluded from participation. Collection Day participants were required to state that their waste was residentially generated, and the contractor was instructed to turn away "suspicious" waste. The Program specifically targeted residents of Park Slope, but all New York City residents were permitted to participate.

C. Regulatory Requirements

Wastes generated by households are exempt from Federal hazardous waste regulations, but the DEC has established requirements for conducting HHW collections. DEC required submission of a written plan (see **Appendix E. Written Plan for June 1, 1991 HHW Collection Day**) 60 days in advance of the collection, in accordance with DEC's Guidelines for Household Hazardous Waste Collection Day Programs. DEC also sent a staff person to observe the Collection Day.

Sponsors of HHW collections are required by DEC to hire a New York State licensed hazardous waste contractor. The Department issued a Request for Proposals (RFP) to hire such a contractor in December 1990. The RFP solicited a contractor to receive, package, and transport off-site HHW brought to the Collection Day. The RFP also emphasized the importance of recycling collected HHW. Through the RFP process, the Department hired Radiac Research Corporation.

A community relations issue arose as a result of this selection. Radiac's facility is located in Williamsburg, Brooklyn. There has been community opposition to the facility primarily because of concerns about radioactive and hazardous waste stored in buildings abutting a residential community. Although the Department was sympathetic to community concerns, Radiac was selected because the company submitted the highest ranked Technical Proposal and lowest Cost Proposal. The DEC informed the Department that Radiac was in compliance with its permit. Therefore, there were no legal grounds for the Department to reject Radiac.

D. Waste Management Planning

The Department sought to follow a waste management hierarchy, in order of preference, of source reduction, recycling, treatment, and then disposal. The public was encouraged, through outreach, publicity materials and Collection Day hand-outs, to reduce the amount of HHW that they generate.

The contract with Radiac specified that the following materials would be targeted for recycling: motor oil, paint, paint cans, anti-freeze, automotive batteries and button cell and nickel-cadmium household batteries. Motor oil would be re-refined unless contaminated and not accepted by the re-refiner, and anti-freeze would be recycled unless contaminated and not accepted by the recycler. If contaminated, these wastes would be fuel blended. The contract specified that halogenated and non-halogenated solvents and contaminated paint would also be fuel blended.

Acids, bases and oxidizers would be treated at EPA licensed facilities. PCB waste, reactives, aerosols and pesticides were destined for incineration. The only materials that Radiac planned

to landfill were asbestos and radioactive waste (smoke detectors), which would be buried at a Nuclear Regulatory Commission approved radioactive burial site.

As requested in the RFP, a special plan was submitted by Radiac for handling paint. All liquid paints were separated at the Collection Day by their classification (latex or oil) and pigmentation (light or dark), and consolidated into 55-gallon drums. The paint was brought to Radiac's facility, and tested at an EPA-certified laboratory. Latex paint was tested for lead and mercury; oil paint was tested for lead and PCBs.

Test results on the paint were as follows:

Mercury - Mercury ranged from 7.8 to 23.2 ppm, significantly less than the 200 ppm which would trigger labeling of paint for external uses only;

Lead - Samples tested for lead ranged from 6.2 ppm to 817 ppm. Only one sample exceeded the 600 ppm limit set by the N.Y. State Health Department and the N.Y.C. Health Department's Lead Abatement Program for paint that can be used in residences. The drum exceeding 600 ppm was sent for fuel blending.

PCBs - Detectable levels of PCBs were not found in any of the samples.

With the exception of the lead contaminated drum, the paint was sent to Allied Paint in the Bronx, where it was blended, smoothed and packed in five-gallon pails. 725 gallons of usable paint were made available to the Department.

All 310 gallons of latex paint (beige in color) were quickly claimed by groups including: the Fifth Avenue Committee of Brooklyn, the United Federation of Black Community Organizations (UFBCO), and Materials for the Arts. The Transit Authority also expressed interest in the paint.

It was more difficult to give away the 415 gallons of oil-based paint generated by the Collection Day. The oil-based paint, grey-green in color, was suitable as a primer. 100 gallons were claimed by the Lower East Side Catholic Area Conference, 50 gallons by Materials for the Arts, and 15 gallons by UFBCO. A paint contractor in Brooklyn took the remaining 250 gallons. The Transit Authority, the Human Resources Administration, the Brooklyn YMHA-Head Start, the South Brooklyn Local Development Corporation, and other groups were only interested in latex paint. Rikers Island officials inspected the paint and determined that it was too thin and would take too many coats to be worth using. The Department of Housing Preservation and Development stated that the paint did not meet their strict specifications. Habitat for Humanity already had

more paint than they could use. The Department of General Services agreed to distribute the paint for use by City agencies only if DOS would store it and distribute it in small batches upon request, a task considered too problematic for Sanitation to oversee.

E. Site Selection

RPPD sought a Collection Day site that was centrally located, easily accessible, well known to the community, and of adequate size for the contractor to work effectively and handle a large flow of traffic. The Department contacted community leaders and agencies during the early planning stages of the program in order to inform them of the City's plans and to seek input on site selection.

Approximately one dozen locations were considered, including those suggested by the local Community Board. All of the sites had disadvantages: several sites were located outside of Park Slope; some had small entrance ways that the contractor's truck could not enter; some were too small for the contractor to set up equipment.

The parking lot at the PS 282 school yard (6th Avenue and Berkeley Place) was selected as the best site (see **Appendix A**). The disadvantages of the site were that the entrance was on a fairly narrow residential street, and that it was not large enough (only about 150' x 100') to allow participants to enter the lot, since it would be almost completely filled by the contractor's vehicles, equipment and work area.

Repeated efforts were made, beginning on October 12, 1990, to gain permission from the school principal to use the PS 282 site. Permission was also sought for several alternative locations. The Principal of PS 282 eventually agreed to use the site contingent upon the approval of the PTA. A meeting was arranged for the PTA to express their concerns, such as the potential for spills and contamination of the school yard, security to keep kids from the adjacent playground away from the parking lot, and the potential for people dropping off waste at other than the official Collection Day hours.

Arrangements were made with the Department of Sanitation Police and local police to ensure security before and during the Collection Day. The contractor's safety and contingency plans addressed the other concerns. Learning of these measures, and following a show of support from Dr. Barry Commoner and the Council on the Environment of N.Y.C. (CENYC) for the program, the PTA Committee voted unanimously to allow the collection to take place at PS 282, and written permission was obtained on March 19.

Because permission was obtained only 10 weeks before the Collection Day, the Department was left with little time to produce

publicity materials (brochures, posters and newspaper advertisements) that included the location of the collection.

F. Outreach & Public Education

An extensive public education and publicity effort (see **Section VII. Outreach & Education**) was undertaken to raise awareness and ensure a large turnout at the Collection Day. In our promotional efforts, we followed a two-stage approach:

Sensitization/Persuasion - From October until April, efforts focused on educating people on what HHW is, why they should be concerned about HHW, and what they can do to reduce HHW generation. They were also informed about what the Department intended to do (general information about the Collection Day), and instructed to save their waste for the Collection Day.

Instruction - Beginning in April, efforts shifted to focus on instructing residents on what wastes they should bring where and when, and how HHW should be transported.

Outreach, education and publicity efforts focused primarily on Park Slope, but also informed the public citywide (via radio PSAs and environmental group newsletters). Participants came from all five boroughs, indicating that there was at least some level of awareness of the program citywide.

To publicize the program, RPPD produced and distributed a flyer, a preliminary brochure, a final brochure and a poster. RPPD conducted direct mailings and door-to-door outreach (in conjunction with PSCRC), produced press releases, supplied brochures at public events and locations, spoke at public meetings, provided sample articles and announcements to environmental and community groups and the local press, paid for newspaper advertisements, developed a radio PSA, and provided information to the public through the Intensive Hotline.

G. Corporate Involvement

Following approaches by the Department, the public relations firm representing Church & Dwight Co., Inc. (parent company of Arm & Hammer) agreed to pay for $1,500 worth of local newspaper advertising. In addition, Arm & Hammer donated 500 boxes each of baking soda and washing soda for the Collection Day, as well as brochures explaining how to use these products as substitutes for hazardous cleaning products.

Murphy's Oil Soap (represented by the same firm as Church & Dwight) approached the Department about handing out soap at the Collection Day. The company later decided not to participate, but

expressed interest in assisting in future collection programs.

The Brooklyn Phoenix/Serif Press donated advertising space, allowing the Department to run advertisements for four weeks for $1,500 - a discount of $1,159.

H. The Collection Day

The Household Hazardous Waste Collection Day was held on Saturday June 1, 1991. The contractor arrived at 6:00 a.m. to set up the site. This involved placing a tarp over the work area and a berm around a drain in the parking lot, setting up a tent, work stations and emergency equipment, and unloading empty drums. The parking lot was completely filled with the contractor's equipment, which included a tractor trailer to be loaded with filled drums. Unfortunately, noise generated during site set-up disturbed some of the neighbors.

"NO PARKING" signs had been posted along one side of the street the evening before, in order to allow for two lanes of traffic to pull up to the parking lot. The signs had all been ripped down during the night, and cars were parked along the restricted area. The contractor was able to work effectively, nonetheless, with just one receiving lane.

Participants were received on the road or sidewalk at the parking lot entrance - participants were not permitted to enter the parking lot. As cars pulled up, Radiac personnel identified the materials and loaded them onto hand carts. People arriving on foot or by bicycle were serviced in a similar manner as they approached the parking lot entrance.

Radiac personnel rolled the handcarts to their work stations where materials were separated by hazard class, and either lab packed or emptied into consolidated drums. Trash, such as empty plastic containers and bags, was placed in dumpsters provided by the Department. Clean corrugated cardboard was picked up at the end of the day by a Department recycling truck.

Several participants arrived between 8:00 a.m. and 9:00 a.m., although collection did not officially open to the public until 9:00. The flow of traffic was steady throughout the day, however, there were never more than four or five cars at a time waiting to drop off their waste. Participation was greater from noon to 5:00 p.m. (63%) than in the morning (37%). The contractor agreed to continue accepting HHW until 5:00 p.m., beyond the 4:00 p.m. closing time that was advertised. Several participants arrived during this hour. The contractor completed closing down the site by 7:00 p.m.

RPPD staff and volunteers surveyed 449 participants who

brought waste to the site. It is estimated that 10-20 participants slipped through without filling out a survey. Many people brought waste from their friends and neighbors, so a total of at least 695 households were actually serviced. Participants came by car, on foot, by bicycle and by subway. Almost as many people arrived on foot or bicycle (44%) as by car (56%). Two people came in taxi cabs. A total of 222 drums of waste (including emptied paint cans) were collected.

A Sanitation Police Officer and several local police were on hand for security purposes. The N.Y.C. Bomb Squad was notified that explosive wastes (e.g., fire works, picric acid) might be brought to the collection. They did not attend the collection, but were prepared for the Department to call them if necessary. A meeting had been held with CB6 District General Services in April to inform the police, fire and transportation departments about the collection, and to secure their cooperation.

I. Conclusions & Recommendations

The pilot program provided the Department with vital experience and information for determining how the City should proceed with HHW management in the future. Surveys of participants were particularly useful in generating information for future program planning (see **Appendix F. HHW Collection Day Survey Results**). What follows are the conclusions and recommendations derived from this experience.

Demand for a HHW Program - Participant surveys showed New Yorkers are concerned about the generation and disposal of HHW. Although many participants (24.3%) were not sure exactly which household products are hazardous, 95% of them knew that HHW can harm people and the environment. 75% of participants were conscientious enough to store HHW in their homes for more than one year, rather than dispose of it in the trash or down the drain. Most of them encouraged the Department to continue sponsoring similar programs;

Benefits to the Department and the City - The program results indicate that the Department can gain numerous benefits from sponsoring future programs. 222 drums of HHW were collected, and hence diverted from the municipal solid waste stream. If the collection had not been held, 91% of the participants would have ultimately disposed of at least some of their waste. 83% of the waste would have gone in the trash, and 8% down the drain.

A HHW program has the potential of reducing injuries to Sanitation workers. From September 1, 1989 to November 20, 1990, 28 Sanitation workers were injured in 22 separate HHW-related incidents. This represents 1.4% of the total 2,016

injuries reported during this period. HHW-related incidents have included explosions and fires in Sanitation trucks, injuries to eyes, skin and lungs from splashing and inhalation of chemicals, and exposure to battery acid.

HHW education for reduction and collection also reduces the threat of poisonings in the home. In 1989, 17,000 poisonings, resulting from exposure to hazardous household products, were reported to the N.Y.C. Poison Control Center. More than half of the victims were children under the age of five;

Siting Issues - It is critical to obtain the location for a HHW collection as early as possible. The special siting needs for a collection day are limiting factors, and the potential for community opposition must be considered. Although most obstacles can be overcome, a HHW collection plan needs to be sensitive to community concerns. The site should be finalized at least three months before the event is scheduled.

The participant surveys indicate that it is essential for HHW collections to be accessible to pedestrians - only 56% of the participants arrived by car. (Clearly, in high density areas pedestrians would play an even greater role, while in low density areas, cars would be more predominant.)

The surveys indicated that, in general, people will not travel great distances to participate in a collection day. Although participants came from the five boroughs, 70% resided in the two zip codes immediately surrounding the site. More brochures were mailed to Brooklyn Heights than to Prospect Heights/Park Slope, however, significantly fewer participants came from Brooklyn Heights, which is further away than Prospect Heights/Park Slope. Thus, it is clear that in order to service the entire city and gain widespread participation, there is a need to hold HHW collections in all five boroughs, and at more than one location per borough.

The most demanding and time consuming tasks associated with the pilot Collection Day were to site and publicize the program. It would not be practical for these tasks to be undertaken entirely by Department staff for a citywide program. For such an expanded program, the Department could provide the guidelines for selecting appropriate Collection Day or permanent program sites, while borough or local Community Board staff actually select and obtain approval for such sites;

Frequency of Collections - 97% of the surveyed participants would like access to an HHW collection at least once per year. 44.6% would like collections to be held every six months. Thus collection opportunities provided in each borough at least

once or twice per year would appear to satisfy most of the demand;

HHW Waste Management - The pilot demonstrated that future programs should continue to target all types of household hazardous waste. Although most people brought paint (64.2%), between 10% and 43% of the participants also brought each of the following: cleaning products, household batteries, pesticides, hobby products, motor oil and other types of HHW.

In addition, the program demonstrated that significant quantities of materials collected at a N.Y.C. HHW collection can be recycled. Recycling of collected HHW should continue to be a priority for future programs. Finally, any future HHW program should continue to stress source reduction opportunities;

Publicity & Outreach - The participant surveys indicate that by far the most effective form of publicity for this Collection Day was direct mailing of a brochure. Posters, newspaper advertisements, word of mouth, newspaper and newsletter articles, environmental-group promotion, and volunteer outreach were also important methods for publicizing the program.

Starting publicity efforts many months in advance of the Collection Day was critical to sensitize the public to the issue, and to provide people the time to store up their waste.

Publicity materials should not have directed people to travel by subway as an option. The Transit Authority does not want hazardous materials to be transported via public transportation.

Media coverage of the Collection Day was overwhelmingly positive. Coverage was obtained in some of the Brooklyn papers; however, there was little coverage in the citywide media. Nearly all coverage occurred leading up to the event. There was little Collection Day or post-collection coverage. Future HHW programs should recruit greater involvement and coverage by the major newspapers, magazines and local TV stations.

For a citywide program, the Department should provide the Boroughs and Community Boards with educational and publicity materials, and should set up a speakers bureau, but the bulk of the local publicity efforts should be coordinated by the Boroughs and Community Boards. Community Boards have established ties with local groups and the media, and are therefore better equipped to promote local programs. Their involvement would also demonstrate local endorsement of the program, which could lead to greater local acceptance and

participation than would otherwise be the case.

Finally, education on HHW should be incorporated into the Department's recycling outreach and education program. Outreach staff should be trained on HHW issues, and Sanitation Action Center staff should also be able to answer questions about the Department's HHW program once a network of collection programs are established;

Contractors - Although the Department was careful in reviewing references and in verifying that the selected contractor was currently in compliance with its permit, it would also have been useful to identify contractors' previous regulatory violations in assessing reputability. Future RFPs should require that contractors provide a detailed list of state and local violations and enforcement actions during the previous two years.

The Department included provisions in its contract with Radiac specifying how the waste was to be managed, and requiring post-collection data. The contractor, however, did not comply with several important provisions of the contract. Oil was not re-refined as required, at least some waste was stored at the contractor's facility in excess of the maximum storage limit, and post-collection data required by the contract, was never received by the Department. The contractor also attempted to charge the Department for drums of waste that were not filled to capacity. As a result of these failures on the part of Radiac, the Department withheld $13,265 in payment.

At future collections, it is advised that the Department inspect each drum before it is sealed, and verify that the contents of each drum match the shipping manifest prepared by the contractor;

Public-Private Partnerships - This pilot demonstrated that outside funding and in-kind contributions can be obtained. Corporate support should continue to be sought;

Funding - The HHW pilot program cost the Department close to $70,000 (see **Section VIII. Program Costs**). It is estimated that it would cost a total of $300,000 to $400,000 for a citywide program that included a one-day collection in each Borough each year. Cost will therefore be a limiting factor in the Department's ability to provide an expanded program.

One approach to securing adequate funding might be City or State legislation similar to that enacted in Vermont and Iowa. Laws in these states require retailers selling hazardous household products to pay a permit fee (as well as to comply with mandatory shelf labelling requirements and to

disseminate information on HHW). These laws serve to raise monies dedicated for HHW collection.

The Department should also work with other City agencies such as the Health Department and Department of Environmental Protection, which have a vested interest in addressing HHW concerns. These agencies might be persuaded to provide funds jointly with Sanitation to underwrite HHW efforts. An interagency HHW Task Force should be established to explore such interagency cooperation.

The Department might also be able to design a program that is more efficient for servicing the public than one-day collections. Permanent and mobile HHW collection programs have been developed throughout the country, in part as a means of reducing program costs.

J. Scenarios for a Citywide Program

Assuming the recommendations made above can be successfully followed, addressing the issues of siting, funding and public education, the following programs, either alone or in concert, could be pursued as a means of diverting HHW from the waste stream citywide:

Collection Days - Hold at least one HHW collection in each borough on the same day, or on a fixed schedule. In some parts of the country, in order to service large populations and/or large geographic areas, collections have been held at multiple locations on the same day(s). King County, Washington has used this approach in order to service several thousand households at a single event. At its June 1989 HHW "roundup", four sites received 4,733 households on a single day. A major advantage to the multiple site approach is that a large-scale publicity program can be undertaken, whereas more localized events generally only attract the attention of local media.

Alternatively, the Department could schedule collections on different days to provide more flexibility for participants unable to attend on a given day, but willing to travel to a different Borough to participate. The Department could then publicize a citywide HHW "Collection Month", and a schedule for HHW collections in the different Boroughs.

In order to ensure Borough and Community Board involvement, it is recommended that the Department consider choosing collection day and/or permanent program locations through a proposal process. Each Borough would be informed of the Department's interest in funding programs in every Borough. The Department would select the dates (or range of

dates) for collections to be held. Boroughs would be required to submit to the Department the sites where collections would be held, and a plan that commits staff and/or other resources to publicize the programs locally. The Department would then select the best proposals, funding a given number of programs.

Since the Boroughs would be expected to commit time and resources, and in order to ensure full support for the program, an HHW Advisory Board should be established which includes Borough and environmental group representatives. This Board should provide input and review the RFP for the hazardous waste contractor, and advise the Selection Committee during the contractor selection process;

Permanent HHW Collection Centers - Approximately 50 communities have permanent HHW collection facilities. Advantages of these programs are that they provide an on-going opportunity for people to rid their homes of HHW, and they can be more cost effective than one-time events. Many permanent programs service households by appointment only. This allows for greater interaction between the sponsor and the public, helps prepare the sponsor to receive specific problem wastes, and enables the sponsor to inform households about ways to re-use, recycle or dispose of wastes without having to bring them to the collection center. Barriers to permanent programs in New York City are the initial capital costs, and anticipated difficulties in securing sites. It is recommended that the Department pursue permanent programs after gaining more experience in successfully siting and implementing one-day events;

Mobile Facility(s) - King County, Washington developed what it calls a "mobile" program for collecting HHW. A mobile trailer is placed at approximately 24 sites for two week intervals. Hazardous wastes are not transported in the trailer - a licensed hazardous waste hauler picks up the waste before the trailer is moved to the next location. Advantages of the program are that it allows for temporary storage of waste and equipment while serving multiple communities. Such a program should also be considered in the future;

Curbside Pick-up of HHW - Curbside pick-up is another option, but it has proven extremely expensive in other communities, and would be problematic in N.Y.C.. The Department could consider, however, testing the feasibility of collecting a few specific wastes at the curb, such as button batteries, which are small, recyclable and account for a significant portion of the mercury in the waste stream. Such a collection would be in conjunction with an existing recycling or trash collection, and would involve developing stringent safety protocol.

VI. WASTE PREVENTION

In addition to the home composting program described above, the Department is piloting the following waste prevention programs in the Intensive Zone.

A. Residential Outreach

We are currently undertaking to educate Intensive Zone residents about waste prevention opportunities. At the same time, we are attempting to learn about the effectiveness of our education materials and strategy, in order to determine the feasibility of replicating these citywide.

In the Fall of 1991, we produced a reuse guide and map for the area encompassing the entire Intensive Waste Prevention, Reuse & Recycling Zone (approximately 22,000 households). The guide, called Don't Throw It All Away!, identifies area merchants and organizations who support the reuse of household products. These include second-hand stores, non-profit charities, and repair and refurbishing shops. Thirty-nine stores, schools, thrift shops, used goods exchanges, and other groups are identified.

RPPD outreach staff distributed the guide, in bundles of fifty, to all merchants listed, and to other local stores and organizations for free disbursement to interested customers, patrons or clients. More than 60 locations in and near the Zone accepted a total of 6,000 copies in December, 1991. At the same time, the guide was distributed to all 3,500 households in the Wednesday Collection area. The latter was carried out in conjunction with door-to-door outreach being conducted by PSCRC for the food waste program.

In addition to Don't Throw It All Away!, we have been taking advantage of PSCRC outreach to distribute to Zone residents New York City's Waste Reduction Handbook, also prepared by RPPD.

Realistically, door-to-door outreach is not replicable citywide. Nor is it feasible for RPPD, given staff constraints, to develop a reuse guide for every neighborhood in the city. However, the personal outreach conducted in the Intensive Zone, to both merchants and residents, has been useful in obtaining feedback on the effectiveness of our outreach materials.

We are currently in the process of investigating ways of leveraging intern and corporate support for the preparation and production of Borough-wide reuse guides.

B. Commercial Outreach

We are currently expanding the scope of waste prevention projects in the Intensive Zone, to target businesses as well as residents. As with the residential pilot described above, a principal goal of the commercial pilot is to provide us with information on how best to conduct a merchant-oriented waste prevention program citywide. Broadly conceived, the intent of such a program is:

Education - To educate merchants about the need for waste prevention and the cost savings they might realize from a successful program;

Assistance - To provide assistance in developing educational materials that promote waste prevention with retailers' employees and customers, and to provide technical information on such things as bulk buying/delivery systems and innovative packaging;

Promotion - To promote retailers' efforts and cooperation with the City.

In the Intensive Zone, we plan to obtain feedback from a wide variety of merchants in order to determine what types of stores are suitable for outreach citywide, and to help us shape our educational materials in order to maximize their effectiveness and responsiveness to the needs of merchants and customers.

New York City is probably unique both in its concentration of very small retail shops and in the fact that many are owned and/or managed by first and second-generation immigrants for whom English is a second language. For these reasons, we are focusing on small retailers in order to understand, while we are still working at the neighborhood level, what is effective with such businesses.

Nevertheless, it should be mentioned that there is a separate project in the Intensive Zone that aims to create a waste prevention and recycling model out of a mid-size grocery store (D'Agostino's), located on 7th Avenue - one of the two commercial strips in the Intensive Zone.

Initially, outreach to small-merchants will entail distributing copies of the sign, "take a bag only if you need one, or bring your own bag". The sign will serve as an awareness-raising tool, and as a conversation piece about waste prevention and management in general. Follow-up discussions with individual merchants should expand to embrace a range of waste prevention opportunities. Specifically, we plan to:

Design of a survey instrument to be used both before and after bag sign distribution, to monitor the numbers of customers and

the quantities of bags taken;

Meet with the Zone merchants' association to explain the project, and to solicit participants in the survey (there are currently 13 merchants committed to cooperate on this project, and another seven that have expressed interest);

Solicit additional merchants individually for participation in the survey, if the volunteers recruited at the meeting are not adequately representative;

Conduct the "before" survey;

Develop and administer a questionnaire for participating merchants;

Distribute bag signs and questionnaire to participating merchants, and do a follow-up check to ensure that signs are put up;

Conduct the "after" survey;

Tabulate and analyze survey and questionnaire results;

Share the results with the merchant association, and conduct an informal focus group (host a lunch or breakfast) to discuss other educational materials, waste prevention measures in general, and obstacles to implementing them.

The time frame for the above project is seven and one half months - December 15, 1991 through the end of August, 1992. Following the completion of the project, we should be able to present a series of recommendations for proceeding with citywide retail-based outreach.

VII. OUTREACH & EDUCATION

As described in the introduction of this report, one goal of the Intensive Program has been to maximize public participation in all of our programs. To achieve this end, extensive outreach has been conducted in conjunction with the program's various aspects. Numerous public education pieces have been produced, and the Department has cooperated with CBNS, PSCRC, local political leaders and organizations, teachers, environmental groups and the press in order to inform the public about the program.

A. RPPD Outreach

The Department's plan to add new materials to the Curbside

Program was first brought before the residents of the Intensive Zone through community meetings in the Fall of 1990. RPPD staff made presentations to CB6, the Environmental Committee of CB6, Revitalization of the Southern Area of the Slope (ROSAS), the Brooklyn Borough President's Office, Council Member DiBrienza's staff, the Brooklyn Solid Waste Advisory Board (SWAB), Brooklyn Recyclers Against Incineration (BRAGI), One Earth, the Park Slope Civic Council, and at a public forum arranged by Assemblyman Brennan.

The program was covered in The Park Slope Courier, Brooklyn Heights Paper, The Park Slope Paper, and the Brooklyn Phoenix. In addition, Council Member DiBrienza described the program in his "Special Year-end Report" mailed to his constituents. The Council Member also sent a "Special Recycling Report" to the Park Slope neighborhood, and his staff distributed a flyer on the program at a subway station located within the Collection Zone.

In the Fall of 1991, RPPD and PSCRC promoted the food waste program to Collection Zone residents via public meetings, press coverage and a "Special Recycling Report" sent out by Council Member DiBrienza's Office. In addition, the food waste program has received press in BioCycle magazine, Newsday, the Wall Street Journal and The New York Times. Announcements about bag re-distributions have been made through articles in the local press.

Door-to-door distribution has been employed for some educational materials and surveys, and for all containers, including green "Mixed Paper" cans, "Mixed Paper" recycling bags, black "Organic Waste" buckets and "Food Scraps" bags. This distribution is generally accomplished through the combined efforts of Operations personnel and RPPD Staff, utilizing blockface data prepared by RPPD and PSCRC.

In the months leading up to the HHW Collection Day, RPPD made presentations on the topic to: The Committee to Preserve Manhattan Brighton Beach; N.Y.C. League of Women Voters; Park Slope Civic Council; ROSAS; CB6 Environmental Subcommittee; CB6 District General Services (police, fire, etc.); Brooklyn and Manhattan SWABs; the Manhattan SWAB Source Reduction Subcommittee; Garfield Place Block Association; Sierra Club; PS 282 PTA; and One Earth.

RPPD also sent sample articles and announcements about the HHW Collection Day to environmental and community groups, and citywide and local papers. Although the Department was not made aware of everything appearing in newspapers and newsletters, it is known that the program was covered in the following: Park Slope Courier (mid-April); Park Slope Paper (week of May 24); Bay News (February 18, 1991); New York Newsday (May 2, City Living Section); Bayridge Paper; Manhattan Borough Watch (newsletter of Manhattan Borough President); CENYC Environmental Bulletin; Natural Resources Defense Council WasteWatch newsletter (Spring issue); New York League of

Women Voters newsletter; Council Member Stephen DiBrienza's newsletter; One Earth newsletter (May 1991); Environmental Action Coalition (EAC) newsletter (Spring 1991); Sierra Club newsletter (Spring issue); N.Y.C. Audubon, The Urban Audubon (April issue); Mayor's Community Assistance Unit newsletter; Park Slope Food Co-op newsletter; Center for Safety in the Arts, Art Hazards News (Spring 1991).

In Park Slope, two and a half weeks before the HHW Collection Day, RPPD staff put up 100 posters along the two main commercial streets (5th and 7th Avenue). Three weeks before the collection, RPPD staff and volunteers put up approximately 125 posters in Park Slope, Brooklyn Heights and Manhattan. Several hundred more were put up on Flatbush Avenue, in Brooklyn Heights, at Kings Plaza, and on 3rd Avenue between 75th and 86th streets several days before the Collection Day. On the day of collection, RPPD staff and volunteers handed out brochures produced by the Department, an Environmental Protection Agency source reduction handbook, and free samples of baking soda and washing soda with information on how to use these products as substitutes for hazardous cleaning products.

As a part of its Intensive outreach, RPPD, in conjunction with the New York City Board of Education, sponsored an all day recycling workshop for teachers on March 13, 1991. In attendance were teachers from elementary and junior high schools in Brooklyn School District 15 (Park Slope, Sunset Park, Windsor Terrace, Kensington, Cobble Hill and Carroll Gardens).

The purpose of the workshop was to provide teachers with background information on solid waste management, with an emphasis on waste prevention, recycling and composting, in order to enable them to incorporate lessons and experiments on these topics into their classroom work. Teachers were provided with sample lessons on recycling and composting, and lists of additional available resources.

A staff person from the Cornell Waste Management Institute oversaw the workshop, beginning the day at 8:30 a.m. with an overview of the solid waste crisis. Following this introduction, teachers rolled up their sleeves to make paper from old newspapers, and to learn how to use worms to compost food waste. In the afternoon, several RPPD staff informed teachers about the specifics of the City's Recycling Program. Teachers were informed of the Department's school assembly program, about how to start recycling in cafeterias and classrooms, and about the Curbside and Intensive Programs.

The day concluded with a trip to a nearby buy-back center, recently opened under a contract with the Department. Teachers were invited to schedule class trips to the center. Unfortunately, due to budget cuts, this center has since shut down.

B. Educational Materials

For paper, glass, metal and plastic collection, RPPD prepared a Spanish/English brochure instructing residents on what new materials were being added to the Curbside Program, how and when to participate, and where to call for more information. This brochure was direct mailed to all residents of the Collection Zone.

RPPD also prepared bilingual posters to be posted in building lobbies. The posters were distributed with the green cans and brown paper bags. For the paper bags, RPPD prepared English and Spanish instructions on their use. These were printed onto each side of the bag by the manufacturer.

For food waste collection, RPPD also prepared English and Spanish instructions to be printed onto the bags by the manufacturer. A food waste brochure describing the program was prepared and distributed along with the bags and black buckets. The brochure listed what materials to and not to include, and gave the number of the Intensive Hotline for residents needing decals, information or more bags. RPPD prepared a food waste "teaser" flyer, which was distributed by PSCRC the week prior to black bucket distribution. The one page flyer was designed to alert residents that they would be receiving a bucket and bags the following week, and that food waste separation and collection would begin immediately after that.

To address the problem of lost, stolen or broken containers, RPPD produced large, green "Mixed Paper" and large, black "Organic Waste" decals.

As described in **Section IV. Home & Small-Scale Composting**, promotion of the home composting project was primarily the responsibility of BCUE under its contract with the Department. RPPD assisted in promoting the demonstration site and composting workshops by mass-producing a flyer designed by the Garden of Union. Separate versions were produced, one in English, one in Spanish. More than 2,000 copies in each language were distribute in the neighborhood and at street fairs.

The HHW involved the production of several flyers, brochures, posters and advertisements. In October 1990, a double-sided flyer announcing the program and including source reduction tips was developed and mailed to environmental groups, and federal, state and local agencies, and distributed at meetings attended by RPPD staff.

A preliminary brochure was produced in February 1991 to create awareness of HHW concerns and to encourage people to store HHW for the upcoming Collection Day. This brochure was also mailed to environmental groups, agencies and public officials, and was distributed at meetings and public events. 900 brochures were

mailed by CENYC to its members. Brochures were also handed out by EAC at small workshops on HHW that were presented in Brooklyn as part of a New York City DEP contract.

A second brochure was produced in April, which included the reasons why HHW is a concern, a list of HHW that could be brought to the collection, directions to the collection location and instructions for transporting waste. This brochure was direct-mailed to 53,547 households living in Park Slope, Prospect Heights and Brooklyn Heights. More than 3,000 brochures, with cover letters, were mailed to environmental groups and government agencies. An additional 1,000 brochures were sent to Park Slope block associations and community groups. Each City Council Member was mailed 10 brochures, and was encouraged to announce the Collection Day in their newsletters. Council Member DiBrienza mailed 250 brochures with a cover letter to his "environmental contacts." Brochures were also handed out at recycling drop-off centers (e.g., Village Green, Upper West Side, Prospect Park) and at public events such as Earth Day. (Due to budget and time constraints a Spanish version brochure was not produced.)

RPPD also produced HHW posters in early May, with the time and place of the collection, and the Intensive Hotline number. To hand out at the Collection Day itself, RPPD produced a final brochure focusing on reduction, reuse and recycling options for HHW.

Throughout April, paid advertisements were placed in the Park Slope Paper (circulation 36,000); throughout May, advertisements were run in both the Park Slope Paper and the Brooklyn Phoenix (circulation 15,000).

A 30 second radio PSA was developed by RPPD and mailed to 31 radio stations in N.Y.C. Ten stations aired the announcement, including WBLS, WEVD, WINS, WNCN, WNEW, WNYC, WQXR, WXRK, WSKQ and WFUV (which also aired a two minute radio interview with the Project Coordinator on 5/30-31). CENYC also circulated a PSA to several radio stations.

C. Queens Center for the Biology of Natural Systems & the Park Slope Community Recycling Campaign

In January 1991, with a grant from the Pew Foundation, CBNS approached the Department to develop a plan for cooperating on its Intensive Program. Through a series of meetings, it was determined that CBNS could make the most significant impact on the Intensive Program by augmenting the Department's outreach efforts, and in helping to monitor and evaluate the success of various aspects of the program.

In February 1991, CBNS organized the creation of the Park Slope Community Recycling Campaign, a coalition of environmental

and community groups and interested local residents. In March, CBNS opened the Campaign office at 453 6th Avenue (in the Tuesday area of the Intensive Zone). A CBNS staff person was assigned to organize volunteers and staff the office.

Since that time, PSCRC has become an important and active force in promoting recycling in the Collection Zone. Since April 1991, approximately 70 volunteers, trained by other PSCRC volunteers and CBNS staff people, have been conducting door-to-door outreach in the Collection Zone, talking with residents and distributing their own and RPPD literature, such as HHW brochures and the New York City's Waste Reduction Handbook. The week immediately prior to food waste container distribution, PSCRC went door-to-door, distributing the food waste "teaser" prepared by RPPD.

The Campaign office serves as a meeting place for volunteers, and a store front where residents can, at designated hours, come by for information, decals or bags (both those used for the mixed paper program and the food waste program). The office also maintains an answering machine, where residents can leave requests for information or recycling materials.

PSCRC has produced its own literature explaining to residents the Intensive Program, and has organized local public forums and produced press releases for the local media.

Aside from disseminating information and educating the public, PSCRC has played an important role in ensuring that residents have the necessary recycling equipment. For metal/glass/plastic recycling, PSCRC staff and volunteers have identified building with inadequate blue bucket capacity or no blue bucket altogether, and provided decals to the buildings (PSCRC estimates that the have distributed between 150 and 200 sets of blue bucket decals). In the case of paper recycling, the PSCRC office provided a space where RPPD could stock bags in the Collection Zone, from which residents could either pick them up, or volunteers could deliver them. PSCRC has identified buildings where RPPD projections on paper generation rates were exceeded, and green containers are overflowing. In these cases, RPPD has attempted to work with PSCRC to provide an additional container. Alternatively, PSCRC has provided residents with green decals produced by RPPD (PSCRC estimates that they have handed out 300 to 400 sets of green decals). The food waste program has relied on considerable outreach from PSCRC, especially in the area of providing bags to those residents who have run out prior to the second distribution.

D. Intensive Hotline

Prior to the start of the mixed paper and film/foam plastic program in January 1991, a "Hotline" for the Intensive Zone was

established and promoted through public education materials to all Zone residents. During the initial four months of the program, we were receiving an average of 19 calls per week. Questions focused on HHW, paper bags and green cans. Whether it was due to the reminder of a fresh piece of educational material, or the availability of a "Hotline", there was also a considerable demand for decals for metal/glass/plastic buckets.

The two tables below show the frequency and distribution of telephone calls to the Intensive Hotline. Calls attributed to a given month were logged in that month, from 0-14 days after they were received by an answering machine.

Table 1 shows total calls logged. The attribution of calls to each month is accurate, but for exact distribution of callers' subject(s) to a month see **Table 2**, which double-counts calls with more than one subject.

The greatest number of calls - 174 out of 464 - concerned a need for more recycling capacity, reflected in three subjects of calls: needing more recycling cans, needing decals to designate cans as recycling containers, and needing more brown paper bags (between January and August, when they were used for mixed paper in the Tuesday area).

The other major subject of calls was HHW, which accounted for 117 of the 464 total calls. This reflects the fact that the HHW Collection Day, on June 1, 1991, was the only aspect of the Intensive Program for which we took out newspaper advertisements, sent a mailing and posted signs in the neighborhood. Many of the calls on this subject were made by residents living outside the Intensive Zone. It is reassuring that 100 of the 120 mentions of HHW occurred in calls made before the Collection Day.

Only 8.4% of the calls involved questions as to what materials go in which container. However, this does not necessarily mean that there is little confusion about what materials go where. In fact, our observations and those of the PSCRC volunteers are that residents make many mistakes in sorting materials. What this number does tell us, is that for the vast majority of people who read the literature carefully enough to find the Hotline number, the literature is adequate in terms of explaining what materials go where.

A major finding from the Hotline data is that residents have a lot of questions about recycling just after a new material is added. 50% of all non-HHW calls were logged in January and February, when mixed paper and film/foam plastics were added to the Curbside Program. An additional 16% were logged in November, when food waste was added. Only 2% of the non-HHW calls were logged in August and September, after the publicity effort that accompanied distribution of green cans in the Tuesday area.

The only other month with many non-HHW calls was April, during which residents of the Intensive Zone, like all New Yorkers, were receiving much pro-recycling publicity leading up to Earth Day. There was also a small blip in the low level of summer calls in July, when many residents were confused about the announced end of the City's Recycling Program.

TABLE 1. TOTAL CALLS TO THE INTENSIVE HOTLINE
(Where callers mentioned more than one subject, the call was arbitrarily assigned to one subject. See Table 2 for "Total Mentions")

SUBJECT OF CALL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC*	TOTAL	%
Need recycling can	6	17	3	6			1	1	1		7	2	44	9.5
Need decals	31	15	4	9	5			1	3		14	2	84	18.1
Need paper bags**	8	25	9	2	2						12	3	61	13.1
Household hazardous waste	2	11	5	40	40	6	9	2			2		117	25.2
What materials go where	12	5	1	8	2	1			1		8	1	39	8.4
Missed pickup		3		2			1					2	8	1.7
Int. plastic not taken	2	2		1									5	1.1
Looking for dropoff				2	1								3	0.6
Other	28	22	9	15	4	1	7		1		13	3	103	22.2
Total	89	100	31	85	54	8	18	4	6	0	56	13	464	100
%	19.2	21.6	6.7	18.3	11.6	1.7	3.9	0.9	1.3	0	12.1	2.8		100
% of non-HHW calls	25.1	25.6	7.5	13.0	4.0	0.6	2.6	0.6	1.7	0	15.6	3.7		

* Data for December runs only through December 12.
** From January - August, paper bags were used in mixed paper collection.
From November on, paper bags were used in food waste collection.

TABLE 2. TOTAL MENTIONS ON THE INTENSIVE HOTLINE
(when caller has more than one subject)

SUBJECT OF CALL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC*	TOTAL	%
Need recycling can	9	11	3	7			2	1	1		7	2	43	9.1
Need decals...	33	11	8	10	6		6	3	2		14	2	95	20.1
for a BLUE can	15	9	5	4	6		5	2	1		6	1	54	11.4
for a GREEN can	18	11	8	6	5		1	3	1		12	1	66	14.0
Need paper bags**	8	18	9	2	2						12	4	55	11.7
Household hazardous waste	2	12	5	41	40	6	9	2			3		120	25.4
What materials go where	15	5	1	8	2	1			1		8	1	42	8.9
Missed pickup		4		2			1					2	9	1.9
Int. plastic not taken	2	1		1									4	0.8
Looking for dropoff				2	1		1						4	0.8
Other	28	17	9	15	5	1	7		2		13	3	100	21.2
Total	97	79	35	88	56	8	26	6	6	0	57	14	472	100
	20.6	16.7	7.4	18.6	11.9	1.7	5.5	1.3	1.3	0	12.1	3.0		100
% of non-HHW calls	27.0	19.0	8.5	13.4	4.5	0.6	4.8	1.1	1.7	0	15.3	4.0		

* Data for December runs only through December 12.
** From January - August, paper bags were used in mixed paper collection.
From November on, paper bags were used in food waste collection.

VIII. PROGRAM COSTS

The following pages list expenditures for the Intensive Program from January 1991 to June 1992 (unless otherwise indicated). All costs have been rounded to the nearest $500.

In interpreting these costs there are several considerations to keep in mind. First, they do not include RPPD staff time or Department Print Shop time and materials.

Second, the costs of the Intensive Program cannot be entirely distinguished from those of the standard Curbside Program. For example, the addition of film and foam plastics to the blue bucket incurred no new collection costs and little or no extra processing costs, above and beyond the costs of the Curbside Program, thus there are no costs listed for these items. Mixed paper on the other hand, although it is collected in the Curbside paper trucks, does incur additional collection costs. This is because the Wednesday area fills one and a half trucks, and prior to the Intensive Program, the second truck was shared with another Sanitation Section of CB6. Because of the need for discreet data from the Wednesday collection area, this truck is no longer shared, thus there is the cost of one-half a truck shift assigned to the mixed paper program. As for the processing of paper, for the first nine months of the program, this was a cost born entirely by the Intensive Program, even though most of the tonnage being processed was paper that would have been generated anyway, as part of the Curbside Program. At the conclusion of that paper processing contract, the paper broker currently processing Brooklyn Curbside paper, agreed to accept the "Intensive" paper loads under his existing contract. Thus from December 1991 onwards, the costs of paper processing have been born by the Curbside Program.

Further identifying the costs of individual aspects of the Intensive Program will become useful as plans for expansion are developed with concomitant collection, processing and marketing scenarios.

A. **Program Planning** (conducted 01/90-01/91)

Consultant Contracts	
Mixed Paper Studies	
Collection	$ 10,000
Marketing	$ 10,000
Processing	$ 10,000
Mixed Plastics Study	$ 10,000
Food Waste Studies	
Collection	$ 10,000
Composting Technologies	$ 10,000
Planning & Implementation	$ 21,000
TOTAL PLANNING COSTS	**$ 81,000**

B. **Metal, Glass, Plastic & Paper** *

Collection Containers	
17-gallon Green Buckets	$ 10,000
20-gallon Green Buckets	$ 10,000
32-gallon Green Buckets	$ 10,000
10-gallon Paper Bags	$ 10,000
Public Education	
Design	
Decal, Brochure, Bag, Poster	$ 7,500
Printing	
Decals	$ 8,000
Brochures	$ 9,000
Poster	$ 3,000
Direct Mail	
Brochures	$ 10,000
Collection	
One-half Truck/Week	$ 30,000
Processing	
01/91-12/91	$ 10,000
TOTAL METAL/GLASS/PLASTIC/PAPER COSTS	**$ 117,500**

* Costs associated with the Metal/Glass/Plastic program are only those for the poster and brochure, all other costs are for paper alone.

C. Food Waste Collection & Composting

Collection Containers	
20-gallon Black Buckets	$ 10,000
8-gallon Black Buckets	$ 4,500
Cellophane-lined Paper Bags	$ 65,000
Technical Assistance Consultant	
On-site Management, Testing & Reporting	$ 55,000
Public Education	
Design	
Decal, Brochure, Bag	$ 3,000
Printing	
Decals	$ 8,000
Brochures	$ 3,000
Collection	
One Truck/Week (6 months)	$ 20,000
TOTAL FOOD WASTE COSTS	**$ 168,500**

D. Home & Small-scale Composting

Composting Equipment	
Building Materials & Commercial Units*	$ 500
Consultants	
Demonstration Site & Workshops	$ 10,000
Community Awareness	$ 10,000
Public Education Materials	
Slide Show, Manuals, Posters	$ 500
Home Composting Brochure (20,000)	$ 3,500
TOTAL HOME COMPOSTING COSTS	**$ 24,500**

* Most commercial composting units used in this program were donated by vendors.

E. Household Hazardous Waste

Contractor Costs	
Site Set-Up	$ 1,500
Equipment	$ 2,000
Testing	$ 5,000
Waste Management	$ 19,000
Public Education	
Newspaper Advertisements	$ 8,000
Design	
First Brochure (flyer)	$ 500
Second Brochure, Poster, Ads	$ 4,500
Third Brochure	$ 1,500
Printing	
First Brochure	$ 1,000
Second Brochure	$ 12,000
Third Brochure	$ 3,000
Posters	$ 1,000
Mail Brochures (53,547)	
List and Insert	$ 2,000
Postage	$ 7,000
TOTAL HHW COSTS	**$ 68,000**
Donated Funds	
Arm & Hammer for Print Ads	$ 1,500
Brooklyn Phoenix/Serif Press Ads	$ 1,000

F. Miscellaneous Costs

Teacher Training Workshop	$ 500

G. Total Program Costs

TOTAL PLANNING COSTS	**$ 81,000**
TOTAL METAL/GLASS/PLASTIC/PAPER COSTS	**$ 117,500**
TOTAL FOOD WASTE COSTS	**$ 168,500**
TOTAL HOME COMPOSTING COSTS	**$ 24,500**
TOTAL HHW COSTS	**$ 68,000**
TOTAL MISCELLANEOUS COSTS	**$ 500**
TOTAL INTENSIVE PROGRAM COSTS	**$ 460,000**

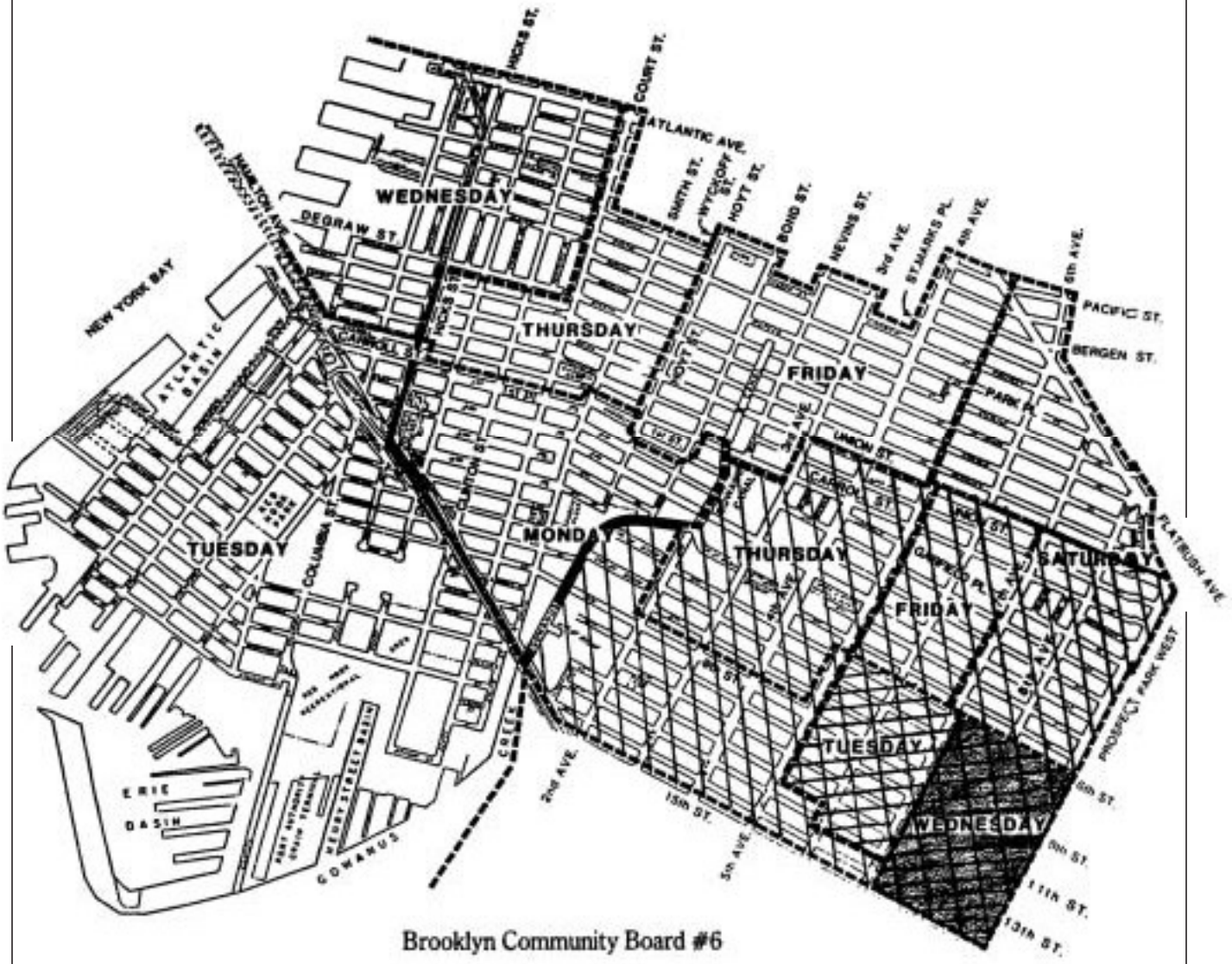
APPENDIX A. INTENSIVE ZONE MAP

Key:

Intensive Waste Prevention, Reuse & Recycling Zone
(22,000 households)

Intensive Collection Zone
(Tuesday & Wednesday Areas - 5,900 households)

Food Waste Collection
(Wednesday Area only - 3,500 households)



Brooklyn Community Board #6

APPENDIX B. BROOKLYN CB6 WASTE COMPOSITION

Percent of Waste Stream Made up of the Following Materials:

	Summer	Fall	Winter	Spring	Average
Paper	35.75	38.52	35.66	33.22	35.79
News	11.30	11.91	10.35	9.53	10.77
Mag	4.04	3.27	2.88	2.67	3.22
Corr	5.21	6.59	5.06	4.30	5.29
Other	15.20	16.75	17.37	16.72	16.51
All M/G/P	20.75	19.10	18.58	19.18	19.40
Metal/Glass	10.37	10.12	9.73	10.64	10.22
Glass	5.57	4.68	4.68	5.19	5.03
Aluminum	1.01	1.24	0.92	0.82	1.00
Other metal	3.79	4.20	4.13	4.63	4.19
Plastic	10.38	8.98	8.85	8.54	9.19
Rigid	2.28	1.97	1.90	1.56	1.93
Misc.	2.68	2.32	2.51	2.40	2.48
Film	5.42	4.69	4.44	4.58	4.78
Food/Yard	15.61	19.54	15.59	15.15	16.47
Food	13.52	12.40	13.60	13.09	13.15
Yard	2.09	7.14	1.99	2.06	3.32

Source: SCS Waste Composition Study: Waste Composition in Sanitation Districts, Residential Sector: Preliminary Results. Memo From Valeria Scioscioli to Alex Prutkovsky; 08/06/90.

APPENDIX C. TUESDAY AREA SURVEY

Among Zone residents, there seems to be a general preference for the green containers over the paper bags, although some people do like the bags because they also serve as indoor collection receptacles. It also appears that the 17-gallon containers provided are often too small; 32-gallon containers, on the other hand, can be too heavy when loaded with straight newspaper. Sanitation workers seem to prefer the bags over the containers, because they are easier to pick-up and throw. The paper broker, on the other hand, does not like the bags because a worker has to empty each one to inspect for contaminants.

INTERPRETATION OF RESPONSES TO SURVEY DISTRIBUTED WITH GREEN CAN

In mid-August, 1991, when we distributed green buckets to the buildings in the Tuesday Collection area which had previously been using brown bags for mixed paper, each bucket contained a copy of a questionnaire (see below), stapled to an educational flyer.

The questionnaire was intended to give us feedback, with the understanding that the self-selected sample that would respond would consist of those individuals most eager to communicate with the Department of Sanitation. We expected those to be people either very dedicated or very opposed to the Recycling Program.

Respondents had to take the initiative to return the survey by mailing it to our office, 'faxing' it to our office, or hand-delivering it to the office of the PSCRC. Of the roughly 900 questionnaires that were distributed, we received 38 replies. A summary of responses to the questionnaire can be found below.

Of the 31 respondents who wrote comments in answer to our open-ended request for them, 27 were positive and four wer negative towards recycling. Of the 36 completed questionnaires, 25 were from residents in one to three unit buildings. This is an over-representation of low-density residents, as would be expected, because they tend to be highest in income and/or most knowledgeable about Sanitation regulations in general.

The majority of even the highly motivated recyclers who returned this survey thought they are recycling more newspaper and magazines now that they no longer have to bundle and tie them. Sixteen of 26 respondents preferred the green cans to the brown bags, for such reasons as their constant availability and the freedom from having to store newspapers indoors until a bag fills up.

The 10 respondents who preferred bags liked having them as a container to fill indoors and to help carry the paper outside. Most of those who preferred bags said they would be willing to buy

them, while most who preferred cans said they would not be willing to buy bags.

Almost half of the 36 respondents had run out of bags earlier in the program, and most of those had not known how to get more bags (by calling our Hotline or contacting the PSCRC). About half of those who had known how to get more bags did not run out of them. Almost half of the respondents have had to bundle and tie paper when their bags were too full.

More than a third of the respondents to questions nine and 10, which asked whether their blue and green containers were large enough, had on some occasions had too much material for the container. Only one of the respondents whose blue can was too full used decals to mark a new container. Their most common response was to put the extra materials in a bag on or next to the can.

In addition to 14 questions, the survey had a short quiz, in which respondents were asked to assign objects to the container to which they should be discarded - green can, blue can or trash. An answer key was provided, to maximize the educational potential of the interaction. A summary of responses to the quiz is given below.

Most of the objects listed in the quiz were named in the flyer attached to the questionnaire. Of the 119 incorrect assignments of objects to containers, 100 were non-recyclable items that overeager recyclers assigned to their green or blue cans. Of the 19 recyclable items assigned to the trash container, 18 were plastic, and nine of those were new plastics added through the Intensive Recycling Program (foam and film).

It was encouraging that the items most frequently assigned to the wrong container - wire coat hangers, clean paper cups,and tissue papers - were not mentioned in our reminder list on the flyer. On the other hand, respondents to the survey were probably the people most likely to read flyers, and in that light, the evidence shows that we should not assume that even the most avid recyclers understand the complexities of our existing program.

Attempting to apply some of these findings to the general public, it seems that less enthusiastic recyclers and flyer-readers would be even more likely to: 1) assign plastic objects to the trash; 2) not to know where to get more recycling bags; 3) not to know where to get decals or how to use them to designate a new recycling bucket; and 4) be unwilling to pay for recycling bags.

People equally willing to recycle but less willing to read flyers would be more likely to assign non-recyclables to recycling containers than our respondents. They would be equally likely to have too much material for their containers and less likely to know how to get more recycling bags and decals.

People less willing to recycle would be less likely to need more bags and decals. They might, however, recycle even more paper once freed from the tying and bundling obligation. They would be less willing to buy bags, and to tie and bundle paper that overflowed their container or bag.

The preference for cans over bags expressed by respondents might hold true for the general public; there is no obvious reason to assume it would not. However, there was enough division of opinion to suggest that the Department would please the most residents by allowing them a choice of paper recycling modes: a green can (or can marked with a green decal), a reinforced paper bag, or tying and bundling could all be options. If this were done, restrictions would have to be placed on the can size, because 32-gallon cans full of paper can exceed union limits on what Sanitation workers must lift.

SUMMARY OF RESPONSES TO SURVEY DISTRIBUTED WITH GREEN CAN

Total number of responses = 38.

Awareness of what goes in each container:

Total number of responses = 30.
Underlined items were specifically mentioned in the reminder attached to the questionnaire.

All respondents correctly placed gift-wrapping paper, newspaper, rinsed tuna can, unopened junk mail; corrugated cardboard, coffee can, magazine, brown paper bag, and shoe box.

Incorrect responses were as follows:
a. Wire coat hanger = 18 in blue can.
b. Plastic coat hanger = 5 in trash.
e. Clean paper cup = 27 in green can.
f. Broken hair dryer = 1 in blue can.
g. Used paper towel = 3 in green can.
j. Disposable razor = 5 in blue can.
k. Clean plastic wrap = 4 in trash.
m. Clean styrofoam cup = 3 in green can; 2 in trash.
n. Tissue paper = 17 in green can.
o. Light bulb = 4 in blue can.
q. Broken china = 5 in blue can.
u. Phone book = 7 in green can.
v. Milk carton = 4 in green can.
w. Aluminum foil = 1 in green can; 1 in trash.
x. Waxed paper = 3 in green can.
y. Plastic bag = 3 in trash, 2 in blue can.
z. Plastic fork = 4 in trash.

Questions 1 - 13:

Closed-ended questions:
Q 1. (Were bags received?) Yes = 36; no = 2.
Q 2. (Knew their purpose?) Yes = 37; no = 0.
Q 3. (Knew about junk mail?) Yes = 36; no = 2.
Q 4. (Ran out of bags?) Yes = 17; no = 19.
Q 5. (Knew how to get bags?) Yes = 17; no = 18.
Q 6. (Had to bundle paper?) Yes = 17; no = 19.
Q 7. (Prefer bags or cans?) Bags = 10; cans = 16.
Q 8. (Recycling more now?) Yes = 22; no = 15.
Q 9. (Green can big enough?) Yes = 23; no = 9.
Q 10. (Blue can ever too full?) Yes = 13; no = 25.
Q 11. (Knew about decals?) Yes = 29; no = 9.
Q 12. (Willing to buy bags?) Yes = 15; no = 15.
Q 13. (Number of units in building) 1-3 = 25; 4-8 = 10; 12+ = 3.

Open-ended questions:
Q 7. (Why did you prefer bags or cans?)
Reasons for preferring bags: Can keep in apartment and fill as needed; can is too heavy when full; cans must be put away and are sometimes left far from building; like to have a bag in each room; easier to carry paper out.
Reasons for preferring cans: More convenient; paper doesn't get wet in rain; don't run out of bags; can is re-useable; easier to fill; bags are hard to close; don't have to store "trash" inside, inviting roaches; doesn't rip; don't have to keep it inside until full; neater at curbside awaiting pickup; can discard advertising circulars without carrying them inside.

Q 10. (What was done with overflow for blue can?)
Put in a bag or box next to or on top of blue can; put in an unmarked pail which was not picked up; used neighbor's can; saved material for next week.

Q 14. (Other comments on recycling)
Positive toward recycling: Keep up the good work; non-compliers should be fined; too many people are not recycling; incentives and more public education are needed; sets a good example; teaches responsibility; should use square cans for paper; information on decals and bags is hard to get; advertising circulars should be banned; batteries, paint, solvents, phone books, paperbacks, china, and milk cartons should be collected; do materials really get recycled, because "garbage men" said they go to the dump; was given wrong information on holiday makeup collection; had a good experience correcting a missed pickup situation.
Negative toward recycling: Unfair to ticket neighborhood when other areas do no recycling at all; program is hard to understand, too many buckets; when pickup is missed it's hard to bring stuff back inside.

INTENSIVE RECYCLING PROGRAM SURVEY - GREEN CAN DISTRIBUTION

Now that you have been recycling your mixed paper using special brown paper bags for over seven months, the Intensive Recycling Program is providing your building with a green recycling container to learn which method works better. After you have used your green can for a few weeks, please fill out this survey to help the Recycling Office learn from your experience.

Please check off below the container in which you would put each of the following discarded items: (Correct choices are at the bottom of the other side of this page)

Item	Green Can	Blue Can	Trash	Item	Green Can	Blue Can	Trash
a.Wire coat hanger	___	___	___	n.Tissue paper	___	___	___
b.Plastic coat hanger	___	___	___	o.Light bulb	___	___	___
c.Gift-wrapping paper	___	___	___	p.Coffee can	___	___	___
d.Newspaper	___	___	___	q.Broken china	___	___	___
e.Clean paper cup	___	___	___	r.Magazine	___	___	___
f.Broken hair dryer	___	___	___	s.Brown paper bag	___	___	___
g.Used paper towel	___	___	___	t.Shoe box	___	___	___
h.Rinsed tuna can	___	___	___	u.Phone book	___	___	___
i.Unopened junk mail	___	___	___	v.Milk carton	___	___	___
j.Disposable razor	___	___	___	w.Aluminum foil	___	___	___
k.Clean plastic wrap	___	___	___	x.Waxed paper	___	___	___
l.Corrugated cardboard	___	___	___	y.Plastic bag	___	___	___
m.Clean styrofoam cup	___	___	___	z.Plastic fork	___	___	___

In January and March, the Intensive Recycling Program gave out brown paper recycling bags so that you could recycle other kinds of paper -- junk mail, envelopes, wrapping paper, gray cardboard, paper bags -- along with your newspaper, magazines, and corrugated cardboard.

1. In the past 8 months, did you receive brown paper recycling bags (probably in your building entrance)? ___Yes ___No

2. Did you know what they were for? ___Yes ___No

3. Did you know that you can recycle your junk mail with your newspapers (only in this neighborhood, as part of the Intensive Recycling Program)? ___Yes ___No

4. If you received the brown bags, did you ever run out of them? ___Yes ___No

5. Did you know how to get more recycling bags? ___Yes ___No

6. Have you ever had to bundle your newspaper because you had too much for the recycling bags? ___Yes ___No

7. Which do you prefer for recycling paper: ___brown bags, or ___green cans? Why?_____

C-5

8. Do you think you are recycling more newspapers and magazines now that you don't have to tie them in bundles? ___Yes ___No

9. Is your green can big enough? ___Yes ___No
   If not: Is it the ___large size ___small size?
   How many green cans do you have? ___

10. Have you ever been unable to put out your bottles, cans, and plastics because your blue bucket was full? ___Yes ___No
    If so, what did you do with them?_____

11. Do you know how to get decals that can turn a regular trash can into a "blue" or "green" recycling can? ___Yes ___No

12. If the brown paper recycling bags were for sale in a local store for 20 cents each, would you be willing to buy them for recycling your mixed paper?

13. How many apartments are in your building?_____

14. Do you have any other comments on recycling? _____

_____

_____

_____

_____

_____

The Intensive Recycling Program is an experiment in cooperation between the Department of Sanitation and a small section of Park Slope, to see what happens when New Yorkers try to recycle new materials. This survey is your opportunity to tell us what you think of this experiment.

To learn as much as possible from this program, we need your feedback. Please fill out this survey and return it one of these 2 ways:

Deliver it in person to:

Park Slope Community Recycling Center
453 Sixth Avenue
(between 9th and 10th Streets)

Office open 5pm - 8pm, Mon. - Fri.
Mail slot in door always open.

Mail it to:

Intensive Recycling Program
44 Beaver Street
6th Floor
New York, NY 10004

Answers to where your discarded items go: GREEN CAN: c, d, i, l, r, s, t. BLUE CAN: b, h, k, m, p, w, y, z. TRASH: a, e, f, g, j, n, o, q, u, v, x.

TO: Marcia Bystryn

FROM: Linda Ostreicher

DATE: November 13, 1991

SUBJ: Results of the Waste Composition Sort in the BK 6 Intensive Recycling Zone

==========

During the last week in June, 1991, we conducted a sort of the separated recyclables in the Intensive Zone in Brooklyn 6 and in a control area, also in BK6. We worked in cooperation with staff from Barry Commoner's Center for the Biology of Natural Systems (CBNS), who did their own sort of the trash from the buildings we sampled in the Intensive Zone.

SUMMARY:

Households in the Intensive Zone recycled 33% more pounds per week than those in the control area. They recycled 45% more paper and 13% more metal, glass, and plastic (m/g/p). Table 1 shows that 59% of the increase in paper per household was due to newspaper.

PROTOCOL OF THE STUDY

On Tuesday, June 25, and Wednesday, June 26, all recyclables were collected from buildings sampled in three areas. These were the Tuesday route in the Intensive Zone, the Wednesday route in the Intensive Zone (both in Section 65), and a control area -- a Wednesday route in Section 62 that is recycling the 6 standard materials (newspapers, magazines, corrugated, metal, glass, and rigid plastics).

In each of the 3 areas, two samples of buildings were chosen: 3 or 4 high-density buildings (10 or more units), and 10 medium-density buildings (3-9 units).

Recyclables were sorted by RPPD staff at the Hamilton Avenue IPC site, according to categories that included all those used by SCS in their Waste Composition Study, plus a more detailed breakdown of some categories.

On Tuesday and Wednesday, CBNS collected about 2/3 of the garbage from each of the buildings sampled in the two Intensive areas. They did not collect material from the control area. They collected one 36-gallon bag from buildings with under 5 units, 2 bags from buildings with 6-12 units, and 3 bags from buildings with over 12 units.

Their sorting categories were less detailed than the recyclables sort. Categories were: compostables (including soiled paper), m/g/p recyclables (except plastic film), plastic film, paper recyclables, and non-recyclables.

NEWSPAPERS, MAGAZINES, AND CORRUGATED CARDBOARD

Previous analysis of the recycling tonnage in BK6 from January to June showed a marked increase in paper tonnage in the Wednesday Intensive area, compared to other routes in BK6 which had similar recycling rates before the Intensive began. A major goal of this waste sort was to determine whether the increase was due to more of the original materials (newspapers, magazines, and corrugated) being recycled, or to the added material being collected (mixed paper).

Table 2 shows that the extra paper collected from the Wednesday area is mostly composed of newspaper: 5.5 pounds/household/week versus 3.2 pounds/household/week in both the control and the Tuesday Intensive areas. Both Intensive areas had over .6 pounds/household/week of mixed paper, and more corrugated than the control area. However, the amount of corrugated is so small that the difference could easily be due to chance.

There are two likely explanations for the newspaper increase that occurred in the Wednesday area, but not the Tuesday area. One is that the Wednesday area has wealthier people, who read more papers; the other is that it uses green buckets (1 or more per building) to collect mixed paper, rather than the brown paper bags used in the Tuesday area (distributed in 8-bag batches per household).

The cans and the bags both make newspaper recycling easier for the resident, who does not have to tie the paper in bundles any more. However the bags have two disadvantages compared to the green buckets. 1) Residents run out of them, and must make a special effort to find out how to get more. 2) Unlike the green buckets, the brown bags are not left outside the building as a constant reminder to recycle.

The success of the green cans shows their superiority to tying and bundling in terms of increasing resident participation. The control area was recycling 70% of the amount of the newspaper that the SCS Waste Composition Study predicted in the waste stream, while the Wednesday Intensive area was recycling 118% (Table 3). Some of that 118% must be due to higher than average presence of newspaper in the waste stream.

Table 2 shows that the Wednesday area recycled 71% of the targetted paper we found in their waste stream that day. This indicates that, when we do a follow-up composition study during the food waste collection, we should look at the trash fraction from sample buildings in the control area as well as the Intensive Zone. This will tell us if the control area has more or less paper in its waste stream than the Intensive Zone.

MIXED PAPER

The fact that the Tuesday area recycled slightly more mixed paper than the Wednesday area (.67 lbs/unit/week vs. .62), while with respect to newspaper it did no better than the control, might indicate that more of them learned to add the new material (Table 2). It is possible that the brown recycling bags used by the Tuesday area were more effective than the green cans with regard to mixed paper, because they listed on their sides the specific categories (junk mail, gray cardboard, etc.) to be recycled, whereas the green cans only said "Mixed Paper Only", which is not as informative.

SCS's subsort of the high-rise buildings in the Intensive Minipilot conducted last year in Manhattan East 8 included a waste composition sort which separated clean paper (junk mail, noncorrugated cardboard, and white paper bags) from other mixed paper. It suggests that 3.06 lbs/unit/week would be the expected quantity of clean paper, other than newspaper, magazines and corrugated cardboard. If this is true, the Brooklyn Intensive program is capturing only about 1/5 of the mixed paper in the waste stream. This indicates we need more emphasis on such a new material in our educational materials and outreach.

CONTAMINATION

More contamination was found in the green buckets than in the brown bags, probably because the cans are left outdoors all the time, while the bags are only outside on collection day. The only "contamination" found in the control area's paper bundles was a few bundles of books.

Less contamination of the blue buckets was found in the Intensive areas than in the control area, possibly due to the increased educational efforts in the Intensive Zone.

Much of the contamination in both fractions was material that could have resulted from ill-informed attempts to recycle either materials not being collected (soiled paper) or the right material in the wrong color bucket (particularly in the case of paper and plastic bags).

METAL/GLASS/PLASTIC

Metal and glass did not appear to be much increased by the Intensive program. Plastic film was increased, but not as much as Table 2 implies. There were plastic bags in the blue recycling bins in the control area, but they were so soiled that they were unrecyclable and thus were counted as regular trash, whereas the bags in the Intensive Zone that were counted as plastic film were clean. Thus we learned that improved recyclability of plastic film was a result of the Intensive program, but we did not learn whether increased amounts of captured film also resulted.

Even in the Intensive Zone, most plastic film ended up in the trash fraction (Table 2). However, that includes plastic bags used by residents to contain the garbage.

Table 4 shows, predictably, that glass bottles are not being returned for the deposits at anything like the rate for aluminum and plastic. According to Table 3, 92% of the glass predicted by the SCS study showed up in the Intensive recyclables, as opposed to 22% of the plastic containers and 7% of the aluminum. This suggests that a dropoff collection for glass might not be successful: scavengers rarely take glass returnables because they are heavier and more breakable than plastic and aluminum. It seems likely that residents would have similar objections to carrying their glass returnables to dropoffs, with distance a crucial factor in their willingness to do it.

COMPOSTABLES

CBNS found 19 pounds of compostables per household in the waste stream (Table 2). This was higher than the SCS study's finding of 6 pounds per household for the category "food/yard waste". One factor contributing to this is that "food/yard waste" did not include soiled paper and the CBNS compostables did.

LIMITATIONS OF THE STUDY

1. It was planned and executed in less than 2 weeks, when it appeared that the recycling program (including Intensive) might end on July 1.

2. Data was collected for only one week, from small samples of buildings. While there were high and medium-density samples in each area, there were no low-density samples.

3. On Wednesday, in the control area, DOS personnel on regular recycling trucks collected materials from half the buildings in the medium-density sample before the special waste-composition truck could get there. This changed our household count in that sample to 19 for paper and 27 for m/g/p, instead of our planned count of 37, which would have given us a larger, more reliable sample.

4. CBNS took only one of each 5 bags of garbage (minimum 1 bag per building) from each building sampled in the Intensive Zone. This means we only have percentages, not quantities, of materials found in the trash. We must therefore rely on a total household waste production figure from the SCS study. I do not have a number for Brooklyn 6, so I have used the figure for medium income, medium density residences, which is 41 pounds per household per week.

5. CBNS did not take trash samples from the control area, so we were not able to calculate separation efficiencies from the sample control buildings. In the Intensive Zone, trash samples enabled us to do so as a check against separation efficiencies calculated on the basis of the overall waste composition study for Brooklyn 6.

TABLE 1: SHARE OF INCREASED RECYCLABLES DUE TO EACH MATERIAL

	Lbs/Household/Week Control	Intensive	% Difference
All Recyclables	6.65	8.84	32.9%
All paper	4.17	6.03	44.6%
Newspaper	3.23	4.32	33.7%
Mag	0.74	0.76	2.7%
Corr	0.16	0.30	87.5%
Mixed Paper	0.05	0.65	1200.0%
M/G/P	2.48	2.81	13.3%
Glass	1.92	2.09	8.9%
Metal	0.38	0.37	-2.6%
Plastic	0.18	0.35	94.4%
Rigid	0.15	0.20	33.3%
Film	0.00	0.09	--
Other	0.03	0.05	80.0%

% of Difference Between Intensive Zone & Control Area Due to:

All paper	100%
Newspaper	59%
Mag	1%
Corr	8%
Mixed Paper	32%
M/G/P	100%
Glass	52%
Metal	-3%
Plastic	52%
Rigid	15%
Film	28%
Other	7%

TABLE 2: BROOKLYN 6 INTENSIVE RECYCLING SEPARATION EFFICIENCY

Pounds/Unit

Material:	Fraction Found in:	Intensive Both	Intensive Tues.	Intensive Wed.	Control	SCS Waste Comp. BK6 (Summer)
All Met/Glass/Plas	M/G/P	2.80	2.33	3.27	2.49	8.49
Glass	M/G/P	2.09	1.73	2.44	1.92	2.28
Aluminum	M/G/P	0.03	0.02	0.04	0.03	0.41
Other metal	M/G/P	0.34	0.25	0.43	0.35	1.55
Rigid Containers	M/G/P	0.20	0.17	0.24	0.15	0.93
Plastic film	M/G/P	0.09	0.09	0.08	0.00	2.22
Other Plastic	M/G/P	0.05	0.07	0.04	0.03	1.10
Met/glass/plas (exc. film)	PAPER	0.06	0.02	0.10	0.00	6.27
Met/glass/plas (exc. film)	TRASH (1)	4.48	5.84	3.12		6.27
Plastic film	PAPER	0.01	0.00	0.01	0.00	2.22
Plastic film	TRASH	1 00	1.00	0.99		2.22
METAL/GLASS/PLASTIC	ALL	8.34	9.19	7.50	2.49	8.49
% Recycled Properly		33.6%	25.3%	43.6%		
					Control	
All Paper	PAPER	6.04	4.81	7.27	4.45	14.70
News/Mag/Corrug	PAPER	5.38	4.12	6.65	4.13	8.43
Newspaper	PAPER	4.32	3.18	5.46	3.23	4.63
Magazines/glossy	PAPER	0.76	0.55	0.97	0.74	1.66
Corrugated/Kraft bags	PAPER	0.30	0.39	0.21	0.16	2.14
Mixed Paper	PAPER	0.66	0.70	0.62	0.32	6.27
Targetted Mixed Paper	PAPER	0.65	0.67	0.62	0.05	3.06
Non-targetted paper	PAPER	0.01	0.02	0.01	0.28	3.21
Int. recyclable paper	M/G/P	0.03	0.03	0.03	0.21	11.49
Int. recyclable paper	TRASH	3.62	4.35	2.89		11.49
TOTAL PAPER	ALL	9.70	9.20	10.20	4.66	14.70
% Recycled Properly		62.2%	52.1%	71.3%		
Compostables (2)	TRASH	18.70	17.57	19.83		6.40
Nonrecyclables	TRASH	4.27	4.93	3.60		11.39
Mixed-material objects	M/G/P	0.01	0.02	0.00	0.00	11.39
Regular trash	M/G/P	0.09	0.05	0.12	0.66	11.39
Regular trash	PAPER	0.04	0.02	0.06	0.02	11.39
TOTAL NONRECYCLABLES	ALL	23.10	22.59	23.61		17.79
TOTAL RECYC. & NONRECYC.	ALL	41.14	40.98	41.30		40.98

(1) No trash fraction was sorted in the Control area.

(2) Includes soiled paper, which was not included in the SCS Waste Comp. fraction called "food/yard waste".

TABLE 3: AMOUNT FOUND IN EACH FRACTION AS A PERCENT OF WHAT THE SCS WASTE COMP. STUDY PREDICTS IS IN THE WASTE STREAM

Material:	Fraction Found in:	-------- Intensive -------- Both	Tues.	Wed.	Control	SCS Waste Comp. BK6 (Summer)
All Met/Glass/Plas	M/G/P	33.0%	27.4%	38.5%	29.3%	8.49
Glass	M/G/P	91.6%	76.1%	107.2%	84.4%	2.28
Aluminum	M/G/P	7.2%	5.5%	8.8%	7.8%	0.41
Other metal	M/G/P	22.0%	16.1%	27.9%	22.7%	1.55
Rigid Containers	M/G/P	21.9%	18.3%	25.8%	16.1%	0.93
Plastic film	M/G/P	3.8%	3.9%	3.8%	0.0%	2.22
Other Plastic	M/G/P	4.7%	6.1%	3.4%	3.0%	1.10
Met/glass/plas (exc. film)	PAPER	0.9%	0.3%	1.6%	0.0%	6.27
Met/glass/plas (exc. film)	TRASH (1)	71.5%	93.2%	49.8%		6.27
Plastic film	PAPER	0.4%	0.1%	0.6%	0.0%	2.22
Plastic film	TRASH	44.9%	45.0%	44.7%		2.22
METAL/GLASS/PLASTIC	ALL	98.3%	108.3%	88.3%		8.49
All Paper	PAPER	41.1%	32.7%	49.5%	30.3%	14.70
News/Mag/Corrug	PAPER	63.9%	48.9%	78.9%	49.0%	8.43
Newspaper	PAPER	93.4%	68.7%	118.0%	69.7%	4.63
Magazines/glossy	PAPER	45.8%	33.1%	58.4%	44.8%	1.66
Corrugated/Kraft bags	PAPER	14.0%	18.1%	10.0%	7.4%	2.14
Mixed Paper	PAPER	10.5%	11.1%	9.9%	5.2%	6.27
Targetted Mixed Paper	PAPER	21.1%	22.0%	20.2%	1.5%	3.06
Non-targetted paper	PAPER	0.4%	0.7%	0.2%	8.7%	3.21
Int. recyclable paper	M/G/P	0.3%	0.3%	0.3%	1.8%	11.49
Int. recyclable paper	TRASH	31.5%	37.9%	25.2%		11.49
TOTAL PAPER	ALL	66.0%	62.6%	69.4%		14.70
Compostables (2)	TRASH	292.1%	274.5%	309.8%		6.40
Nonrecyclables	TRASH	37.5%	43.3%	31.6%		11.39
Mixed-material objects	M/G/P	0.1%	0.2%	0.0%	0.0%	11.39
Regular trash	M/G/P	0.8%	0.4%	1.1%	5.8%	11.39
Regular trash	PAPER	0.4%	0.2%	0.5%	0.2%	11.39
TOTAL NONRECYCLABLES	ALL	129.8%	127.0%	132.7%		17.79
TOTAL RECYC. & NONRECYC.	ALL	100.4%	100.0%	100.8%		40.98

(1) No trash fraction was sorted in the Control area.
(2) Includes soiled paper, which was not included in the SCS Waste Comp. fraction called "food/yard waste".

TABLE 4: RETURNABLES COUNT

	Tuesday (65)		Wednesday (65)		Wednesday (62)	
	Dens=Hi	Medium	Dens=Hi	Medium	Dens=Hi	Medium
Units =	58	43	54	47	49	27
Plastic bottles	5	0	2	2	5	9
% of total	17.9%	0.0%	3.3%	14.3%	10.9%	16.4%
Glass bottles	20	8	54	10	37	33
% of total	71.4%	72.7%	88.5%	71.4%	80.4%	60.0%
Metal cans	3	3	5	2	4	13
% of total	10.7%	27.3%	8.2%	14.3%	8.7%	23.6%
Total	28	11	61	14	46	55

THE CITY OF NEW YORK Department of Sanitation

RECYCLING PROGRAMS AND
PLANNING DIVISION
44 Beaver Street, 6th Floor
New York, NY 10004
(212) 837-8163

APPENDIX E.

Written Plan for June 1, 1991 HHW Collection Day
Submitted March 8, 1991

Sponsor: NYC Department of Sanitation,
Recycling Programs and Planning Division

Contact: David Kleckner, HHW Project Coordinator
212-837-8169

1.0 Site Specifics

The NYC Department of Sanitation, Recycling Programs and Planning Division is sponsoring a one-day household hazardous waste (HHW) collection day on Saturday, June 1, 1991 from 9 AM to 4 PM. The collection will be held at the PS 282 school yard at 180 6th Avenue in Park Slope, Brooklyn.

Only residential waste will be accepted at the collection. Commercial, institutional, and industrial wastes are specifically excluded, as is noted in publicity materials. To verify eligibility, participants will be required to sign a statement certifying that the waste was residentially generated, and the contractor is instructed to refuse any "suspicious" waste, such as wastes delivered in 55-gallon drums.

The HHW contractor (Radiac Research Corporation) will oversee traffic control with the assistance of Department personnel and police. Walk-in residents will receive priority service. Vehicles and walk-in participants will be received at several receiving lines serviced by Radiac personnel. Traffic cones will be provided by Radiac to facilitate traffic control.

Site security will be maintained by Radiac. The number of residents on site will be maintained at a minimum at all times. No residents will be permitted beyond the designated reception area, nor will drive-through residents be permitted to leave the immediate vicinity of their automobile.

An aggressive public education/publicity effort will accompany the collection day. Brochures, direct mailed to about 60,000 households, will provide instructions on how to package and transport HHW safely to the collection day. Instructions will include the following:

- Bring products in original, labeled containers. If this is not possible, be sure to label containers with contents or as

Help Reduce
New York's Waste.
Please Recycle.

"unknown."

- Do not mix different or unknown materials together.

- Check containers to make sure lids are tight. If they are leaking, pack in a larger container and use an absorbent material, such as cat litter or newspaper, to soak up excess fluid.

- If you are driving, stand containers upright in a sturdy box inside your trunk or in a shopping cart. Do not place containers on car seats.

2.0 Personnel

The sponsoring organization is the New York City Department of Sanitation, Recycling Programs and Planning Division. There are no co-sponsors. The sponsoring organization's HHW Project Coordinator in charge at the site is David Kleckner. Radiac Research Corporation will be the contractor. Radiac's EPA ID Number is NYD049178296. Radiac's NY State DEC Permit Number is 2A-004.

The on-site contractor supervisor is anticipated to be either John Tekin, President; or Francis McKenna, Compliance Officer.

Additional workers will include at a minimum the Project Director, Chemist, Environmental Scientists, and 12 technicians. Volunteers will be utilized to fill out participant surveys, hand out informational materials, and possibly to assist in directing traffic.

3.0 Waste Handling

Residents arriving on site in automobiles will be requested by the contractor to open the trunk of their car, at which time material will be inspected and loaded by the contractor onto hand-carts. The handcarts are chemical resistant, extremely stable, and provide two recessed shelves to contain any spillage in the event that a container breaks during transfer to the sorting area. Only compatible wastes will be placed on each handcart. Any waste removed from a resident which is an unknown waste or which is not compatible with other wastes on a handcart will be handled separately.

When a handcart is reasonably full, it will be transferred to the sorting area where a second team will empty the hand-cart onto the appropriate tables. This sequence of events of having one team fill the hand-carts and a second team emptying the hand-carts will provide minimum delay.

Radiac will immediately service "walk-in" residents upon their arrival. These residents will be serviced by several four-wheeled handcarts.

Types of wastes accepted are only those hazardous wastes generated by households. Commercial, institutional and industrial wastes are excluded. Wastes anticipated at the collection include: automotive products (brake and transmission fluid, batteries, carburetor cleaner, gasoline, kerosene, motor oil), kitchen products (bug sprays, floor care products, drain cleaner, furniture polish, metal polish, maintenance chemicals, oven cleaner, window cleaner, corrosive cleaners), bathroom products (cleaning solvents, pharmaceuticals, nail polish remover, gardening products (fungicides, termiticides, herbicides, rodenticides, insecticides, disinfectants), home maintenance products (paints, paint thinners and strippers, turpentine, varnish, wood preservatives), hobby/recreation products (chemistry sets, photographic chemicals, art supplies, household batteries), miscellaneous products (moth balls, lighter fluid, rug and upholstery cleaners, spot removers), and other household products which are flammable, corrosive, reactive, or toxic. Smoke detectors can also be handled by Radiac.

Participants will be asked to limit quantities brought to the collection to 10 gallons or 100 pounds. Wastes specifically refused include explosives, fireworks, ammunition, and infectious waste.

The contractor is willing to accept unlabeled or unknown wastes. Liquid or solid unknowns will be analyzed for the following: flashpoint, PH, solubility, color, viscosity, air/water reactivity, oxidizer screen, cyanides and sulfides. All of these tests will determine the hazard characteristics for disposal.

Waste determination and segregation procedures include the following: The chemist or environmental scientist will inspect the container's label and determine the hazard classification of the waste. If the waste is not an "excluded" waste and is confirmed to be household waste, the waste will be accepted from the resident.

The segregation of waste will primarily be according to Department of Transportation waste hazard classifications. Additional segregation may be required pursuant to ultimate site criteria, if applicable. All segregation commences upon receipt from the resident and is ultimately finalized at the sorting area. The segregated waste will be classified, packaged, labeled and removed in accordance with the requirements of 6NYCRR Part 372.2 and 372.3.

On-site waste handling procedures include placing waste in handcarts (see above), bringing waste from the handcarts to the

waste sorting area, identifying and segregating wastes by hazard class and placing them onto the appropriate tables, and placing identified wastes into DOT-approved 55 gallon drums. Drums will be labeled and waste will be manifested in accordance with NY State and federal laws, regulations, and requirements.

Paint will be handled in the following manner: usable, oil-based and latex paint will be segregated; sorted by light and dark pigment; blended; tested for contaminants; and made available to the Department. At the collection, all liquid paints will be separated by their classification (latex or oil) and pigmentation (light or dark) and consolidated into bulk containers (55 gallon drums) on the collection day. Lead paint and paint that appears to be contaminated will be screened out and managed as hazardous waste. Containers of non-recyclable solid paint or resins which cannot be consolidated will be loose packed and sent for fuel blending.

The potentially re-usable product will be taken to Radiac's licensed storage facility upon completion of the collection day. The paint will be tested for contaminants at an EPA certified testing laboratory, and will be stored at Radiac's facility until results of tests for contaminants are received. Radiac will send one sample for testing from each 55 gallon drum of consolidated paint. Latex paint exceeding Toxic Substance Control Act (TSCA)/Resource Conservation and Recovery Act (RCRA) limits for lead, PCBs, or mercury will be managed as hazardous waste. Latex paint that exceeds 200 ppm of mercury must be labeled "For external use only." Oil-based paint must be tested for lead and PCBs, and must be managed as hazardous waste if it exceeds TSCA/RCRA limits. The Department's HHW Project Coordinator will be sent copies of the test results and documents certifying that the tests were conducted by an EPA certified laboratory.

Paint that does not test hazardous will be brought to Allied Paint in the Bronx for processing. It will then be made available for distribution by the Department. Radiac will provide a truck and driver for one day to pick up the paint and bring it to a location(s) specified by the Department.

The contractor will provide instruction for those who bring unacceptable material. Generators who bring non-household generated waste will be instructed to contract with a DEC licensed hazardous waste transporter to take such wastes. Residents bringing unacceptable household waste will be informed by the contractor of the hazard characteristics associated with the waste; why the waste is unacceptable; and what recommended safety precautions should be taken.

All collected HHW will be packaged, labeled, and manifested in accordance with all federal and state laws, regulations and requirements. Consolidated wastes will include oil paints, latex

paints, motor oil, antifreeze, and some non halogenated solvents (gas, thinner, and kerosene). Loose-packed/containerized wastes will include aerosols, asbestos, adhesives/resins, and household batteries. Lab-packed wastes will include reactives, acids and bases, oxidizers, pesticides and poisons, halogenated solvents, and some non-halogenated solvents (toluene, xylene). Palletized wastes will be automotive/lead-acid batteries.

The minimum number of drums on sight will be 60. Since Radiac's facility and the collection day are both in Brooklyn, Radiac can easily bring additional drums to the collection if quantities received proves greater than anticipated.

All waste will be transported pursuant to Radiac's NYSDEC and New York City Fire department permits for transportation of flammable liquids. All Radiac Drivers are NYCFD certified.

Radiac will bring collected wastes to facilities for recycling, fuels blending, treatment, incineration, and landfill disposal.

The contractor anticipates completing site cleanup and removing all wastes by 6:00 PM on the collection day. Radiac does not anticipate that unforeseen circumstances would prevent the removal of all HHW before midnight on June 1. Based on Radiac's close proximity to the site location, additional employees can be readily attained. Radiac will not vacate the site without having all hazardous waste packaged in DOT containers.

4.0 Safety

In the unlikely event of an on-site spill, most spills will be limited to small containers. Depending upon the severity of the incident, Radiac will implement the following contingency/emergency procedures:

- The on-site coordinator may request evacuation. If downwind of incident, evacuation will be perpendicular to the wind direction over the most accessible route. If upwind of incident, evacuation will be in the upwind direction.
- If evacuation is not required, all non-emergency response personnel will be requested to leave the immediate spill area, whereupon Radiac personnel will commence spill containment and decontamination procedures.
- Upon donning full personal protective clothing and appropriate respiratory equipment (if necessary) the

residual hazardous material will be removed from the spill area in a procedural manner suitable to the chemical and physical characteristics of the spilled material.

- After removal and re-packaging of the waste, the containment area will be decontaminated. All decontamination agents and/or spill-cleanup supplies will be packaged and disposed as hazardous waste.

- EPA, DEC, and the NYC Department of Environmental Protection will be notified in the event of a spill.

Health, safety, spill prevention and control planning includes the following:

- Traffic cones and stanchions will be placed on-site to direct pedestrian and traffic flow. NYC Department of Sanitation, police, and/or contractor personnel will instruct and direct the flow of residents and automobiles.

- Local emergency officials are being notified of the event, including the NYC Department of Environmental Protection Hazardous Materials team, the local bomb squad, police department, and fire department.

- The number of residents on site will be maintained at a minimum at all times. No residents will be permitted beyond the designated reception area, nor will drive-through residents be permitted to leave the immediate vicinity of their automobile.

- All hazardous waste will be removed from the resident or automobile with four-wheel, chemical resistant carts having a gross capacity of 400 pounds and a containment capacity of 4.5 gallons for spillage.

- A team consisting of a graduate chemist or environmental technologist and a chemical technician will interview, evaluate, receive, and transport all hazardous waste upon receipt from the resident.

- A designated Emergency Response Cart will be assigned to the reception area and will contain the following supplies: absorbent material, fire extinguisher, small shovel and broom, mercury vapor absorbent kit, acid spill kit, caustic spill kit, chemical respirators, rubber gloves, protective clothing, plastic bats, first aid kit.

- No smoking will be permitted in the designated receiving or waste storage area.

- HHW shall be packaged, segregated, labeled, and manifested in accordance with Federal and New York State law for handling hazardous materials, and in accordance with Occupational Safety and Health Administration regulations, under the supervision of the State Department of Environmental Conservation.

- An impermeable ground covering barriers (5 mil impervious line) will be placed over the entire packaging area to ensure that any leaking containers brought by participants do not leak onto yard, and to safeguard against ground contamination in the unlikely event of a spill.

- A 3" chemical absorbent berm will be constructed with respect to ground slope to protect surrounding area from any spill runoff.

- To assure that non-compatible wastes are stored apart from one another, there will be a separate sorting table for each hazard classification in the packaging area.

- All employees involved with the collection event will wear safety glasses, steel-tip safety shoes and chemical resistant gloves. Any employee involved with consolidating will wear Hepa-filter equipped respirators, full body-suit tyveks along with a full-face safety shield.

- A portable and/or mobile phone will be available on-site to contact outside emergency support personnel, such as police, fire, medical and emergency response teams, if necessary.

- Radiac will provide a bilingual employee to communicate with Hispanic residents.

The following safety equipment will be provided: full face mask respirators with air purifying canister (NIOSH approved); self contained breathing apparatus; chemical resistant clothing - tyvek and/or acid suit (full body); disposable chemical resistant rubber gloves and leather work gloves; chemical resistant disposable booties; steel toe and shank boots; hard hats; face shield/safety glasses; emergency eye wash; safety goggles; fire extinguishers; first aid kit; mobile telephone; spill neutralization kits; emergency oxygen; absorbent pads and drum booms; plastic ground covering; portable and/or mobile phone; traffic cones; drums and labels.

In the draft contract specifications with Radiac, the Department is requesting that Radiac provide insurance in the

amount of $1 million or more for any accident or incident while operating the HHW collection; and $5 million of in-transit insurance covering the transport of hazardous materials. Radiac's workers must be covered by workers compensation. Radiac shall provide certificates of insurance naming the City and its Department of Sanitation as additional insureds, and the insurer shall provide the City with thirty (30) days prior written notice in the event of the cancellation of Radiac's insurance policies.

5.0 Additional Provisions

All wastes will be removed from the site within three days of collection. Radiac plans to remove all collected waste by 6 PM on the day of the collection. Wastes will be packaged, labeled, and manifested in accordance with the requirements of sections 372.2 and 372.3 of 6 NYCRR Part 360, and the requirements of 6 NYCRR Part 617 will be met. All transportation of the wastes from the collection point will be done in accordance with Radiac's permit issued pursuant 6 NYCRR Part 364.

Site security will be maintained on the collection day by Radiac in cooperation with local police and Department of Sanitation personnel. Radiac
does not anticipate that unforeseen circumstances would prevent the removal of all HHW before midnight on June 1. Based on Radiac's close proximity to the site location, additional employees can be readily attained to ensure a speedy close-down/clean-up of the collection. However, in the even that all hazardous waste is not removed before midnight on June 1, Radiac will not vacate the site without having all hazardous waste packaged in DOT containers, regardless of how much time it will take to complete all containment. Radiac will engage the services of a private security company to protect the site after all hazardous waste has been containerized and it is not reasonably feasible to remove the containers from the site. Radiac will also have an employee on site.

NYC Department of Sanitation, Recycling Division
Household Hazardous Waste Collection Day Survey Results
Park Slope, Brooklyn, June 1, 1991

1. Number of Participants

449 participants were surveyed. They brought waste for a total of 695 households.

2. Time of Day Participants Arrived

9 AM - 12 PM:	167 participants	= 37 %
12 PM - 5 PM:	282 participants	= 63 %

3. Borough Where Participants Live*

Brooklyn:	416 participants	= 92.7%
Manhattan:	18 participants	= 4.0%
Queens:	12 participants	= 2.6%
Bronx:	2 participants	= 0.4%
Staten Is.:	1 participant	= 0.2%

4. Zip Code Where Brooklyn Participants Live (as % of participants from entire city)*

11215:	46.0%
11217:	24.9%
11231:	6.0%
11238:	2.2%

*Participants came from at least 19 zip codes in Brooklyn, and 41 zip codes in the five boroughs. Many participants did not provide their zip code (only 313 out of 449). Brochures were direct-mailed to zip codes 11215 (26,517), 11217 (10,654), and 11231 (16,429).

5. How did you hear about this collection day?*

Received Brochure in Mail:	42.3%
Saw Poster:	18.9%
Newspaper Ad:	15.1%
Word of Mouth:	14.3%
Newspaper/Newsletter Article	13.4%
Environmental Group:	11.8%
Government Agency:	8.5%
Radio PSA:	3.6%
Saw it Happening:	0.9%
Other (e.g., picked up brochure at recycling center, retail store, etc.)	7.1%

* Exceeds 100% because many people heard about program from more than one source.

6. How did you arrive at the collection day?

Car*:	56.3%
On Foot**:	37.4%
Subway:	3.3%
Bicycle***:	2.9%

* Includes 2 taxi cabs.
** Includes people with shopping carts, luggage carts, and shopping bags.
***Includes people with backpacks and crates on bike racks.

7. What is the longest amount of time you stored any of your waste prior to the collection day?*

0 - 1 month:	2.5%
1 - 6 months:	8.8%
6 months - 1 year:	10.3%
1 - 5 years:	42.5%
More than 5 years:	32.4%

*Some people brought paint 20-30 years old, including paint inherited from grand-parents.

8. What would you have done with your waste if this collection had not been held?*

Dispose in Garbage:	83.1%
Dispose Down Drain:	8.5%
Store It:	96.0%

*Total exceeds 100% - participants gave multiple responses.

9. How often do you think household hazardous waste should be collected?

Every 6 months:	44.6%
Once/month:	29.0%
Once/year:	16.1%
Quarterly:	5.0%
Weekly:	2.5%
Daily:	0.5%
Other:	1.6%

10. Before hearing about this collection, did you know which household products were hazardous?

Yes:	75.7%
No:	24.3%

11. Before hearing about this collection, did you know that household hazardous waste can harm people and the environment?

Yes:	94.9%
No:	5.1%

12. Which hazardous household wastes did you bring to the collection*

paint**:	64.2%
cleaning products:	43.0%
household batteries:	31.3%
pesticides:	28.4%
hobby products:	15.2%
motor oil:	10.5%
auto batteries	4.5%
other:	30.2%

*Sum of percentages exceed 100% because many people brought more than one type of waste.

**780 gallons of paint were collected; 55 gallons were lead-contaminated, and the remaining 725 gallons were processed and donated to local groups.

***Pesticides collected included DDT, which was banned in the 1970s.

APPENDIX G. FOOD SAMPLE TEST RESULTS*

2 FRESH FOOD SCRAP SAMPLES†

..... FOOD WASTE				
WERL Sample ID #	2251.0	2261.1	2273.0	2288.0
Density, lbs/cu.ft.	51	45	50	48
Moisture%	69.2	62.1	66.7	62.1
pH (1:1 H_2O)	5.01	5.36	4.40	5.66
Organic Matter %	86.6	94.1	93.9	91.3
Conductivity, mmhos/cm $^{-1}$	8.3	5.6	4.4	5.8
Carbon:Nitrogen (C:N) Ratio	16.0	19.0	43.1	38.8
Carbon loss per day %	–	–	3.47	1.24
Oxidation/Reduction (ORP) Value	med.	low	low	med.
..... Mineral Nutrients				
Total Nitrogen %	2.919	2.670	1.176	1.269
Organic-N %	2.877	2.602	1.140	1.166
:Ammonium-N (NH_4-N) ppm	389	496	341	1024
:Nitrate-N ppm	35	183	16	<2
:Nitrite-N ppm	–	–	–	<2
Chloride (Cl) ppm	6810	5742	8749	7895
Sulfate (SO_4-S) ppm	84	457	163	161
Phosphorus (P) %	0.558	0.218	0.130	0.475
Potassium (K) %	1.260	0.896	0.505	0.398
Sodium (Na) %	0.469	0.256	0.369	0.036
Calcium (Ca) %	3.465	0.166	0.909	2.386
Magnesium (Mg) %	0.098	0.115	0.078	0.099
..... Metals				
Copper (Cu) ppm	10.2	8.4	10.1	9.9
Manganese (Mn) % ppm	16.1	13.5	16.7	13.1
Iron (Fe) % ppm	72.0	193.8	89.3	151.1
Zinc (Zn) % ppm	31.1	109.7	35.7	36.6
Lead (Pb) % ppm	<7.9	25.6	11.7	55.7
Chromium (Cr) %	<2.0	<0.4	<2.7	11.9
Cadmium (Cd) %	<0.6	1.1	<0.2	<0.4
Nickel (Ni) %	13.8	9.1	<2.3	9.9

†all readings except Density, Moisture, Conductivity and pH on a dry basis

* From: New York City Department of Sanitation, Food Waste Composting Pilot Program, Status Report, November/ December 1991. Prepared by Compost Futures, Inc., & Woods End Research Laboratory.