An Assessment of Impacts Associated With Implementation of the Suffolk County Plastics Law, Local Law 10-1988

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EXECUTIVE SUMMARY

In 1988, the Suffolk County Legislature passed the Plastics Law (Local Law 10-1988) with the intent that it reduce the amount of certain plastic materials from entering the municipal solid waste (MSW) stream. The law banned the use of plastic grocery bags, and polystyrene (PS) and polyvinyl chloride (PVC) food packaging at retail food establishments (see Table 1). Implementation of the ban is currently postponed by a legislative moratorium (LL 10-1993). At the request of the Suffolk County Executive, the Waste Management Institute (WMI) agreed to prepare this report, at no cost to the County, assessing some aspects of the goals of the legislative intent of LL 10-1988.

The stated purpose of the Plastics Law is "to incrementally, to the maximum extent practicable, eliminate the use of non-biodegradable packaging at retail food establishments." The Legislature held that the law would "result in [the following] beneficial environmental impacts:"

1) It will encourage recycling of solid waste products;
2) It will provide enhanced protection of groundwater quality;
3) It will slow down rapid filling of landfill space;
4) It will simplify the chemical composition of solid waste and thereby reduce the environmental hazards and toxicity associated with solid waste incineration; and,
5) It will reduce the cumulative impact of litter.

This study assesses the degree to which the stated purpose of the law would be fulfilled should the law be implemented, and investigates and quantifies some of the possible subsequent impacts. In addition to the environmental impacts identified

above, WMI has also analyzed other issues that have been raised, including effects on MSW compost characterization, effects on the marine environment, impact on public health, economic impacts to the people of Suffolk County, and possible changes in energy usage.

In fulfilling the stated purpose of the legislation -- to eliminate the amount of non-biodegradable packaging at retail food establishments -- the law would likely be successful to some degree. Plastic products would probably be replaced by paper products, which are more susceptible to degradation than plastic. Although PVC is specifically targeted by the legislation as an objectional component of the waste stream, the proposed ban of this plastic polymer is completely negated by an exemption written into the law.

The ban would appear to have mixed results with regard to encouraging and stimulating recycling endeavors. Although the original law was amended to promote reuse and recycling, most of the materials banned by LL 10-1988 are marginally recycled in Suffolk County. The percentage of the plastics waste stream affected by LL 10-1988 is estimated to be 0.44-0.75%; only 1.1% of the total U.S. MSW plastic waste stream is recycled. The Plastics Law would not meaningfully encourage recycling of solid waste products, and, in fact, may in some cases hinder recycling efforts. The kraft paper used in paper grocery bags, which would likely replace plastic bags, has limited potential for recycling, since it can only be used in the manufacture of brown paper products, and cannot be utilized in the manufacture of recycled newsprint and

stationery. To recycle newspapers back into newsprint, kraft paper must be removed by hand from the waste stream. At present, recycling programs for both paper and plastic bags are largely undeveloped, although both types are being collected in many supermarkets. However, the language of LL 10-1988 favors biodegradable wastes over strictly recyclable wastes, thus, the use of some plastic polymers would be precluded even though they are potentially recyclable. Implementation of LL 10-1988 may dampen fledgling PS recycling efforts by discouraging the expansion of PS collection programs for recycling by private citizens. Conversely, under an exemption to the ban, PS recycling may be encouraged among those school districts and businesses which choose to continue using PS food packaging.

Implementation of LL 10-1988 would have no effect on the rate at which landfill space in Suffolk County is utilized. Landfilling has been largely replaced by other waste disposal options since the mandated closure of most landfills in 1990 by the Long Island Landfill Law.

Although there is some ambiguity to the meaning of the phrase "simplifying the waste stream," it is clear that the legislation will neither eliminate nor significantly reduce the presence of any PS or PVC from the waste stream. These materials would still be there, as only a small percentage of the products made from PS and PVC are targeted by LL 10-1988. In fact, no PVC will be eliminated, as the primary PVC products used at retail food outlets

are exempted. Substitute products may actually be more chemically complex than plastic products.

With regard to incineration of MSW, LL 10-1988 will have a minimal impact. The material of greatest toxic concern addressed by the ban is PVC and its potential for chlorine release in the burning process. Since products made with PVC are exempt from LL 10-1988, there will be no change in the mass balance of PVC subject to incineration. It is also unclear whether chlorine released during the incineration process is a measurable and significant problem. New mass-burn technologies and air pollution control technologies used at the Huntington/Smithtown, Babylon, and Hempstead incineration facilities have reduced the risk of adverse environmental effects. Also, there is no scientific evidence to support the concern that ash generated from incineration of MSW is particularly more toxic or hazardous due to the presence of plastics in the waste stream. Considering this and the fact that landfilling is being phased out in Suffolk County, the ban would probably not enhance the protection of Suffolk County groundwater reserves.

The legislation would not reduce litter. Litter surveys conducted for this study by the WMI revealed that approximately 36.4% of the material collected, by count, was plastic and 8.8%, by count, of the total litter collected was plastic that would be banned under LL 10-1988. Less than 1%, by weight, of the litter collected was subject to LL 10-1988. If the ban is implemented, it is likely that the general character of roadside litter might

change in Suffolk County; however, the quantity of it probably would not -- substitutions for the banned products would most likely show up as litter. The weight of the litter would very likely increase by a small amount; however, the volume probably would be about the same. If products substituted for the banned plastic degrade more rapidly, there may be a slight decrease in the accumulation.

It is doubtful that the beach debris problem will be abated by the implementation of LL 10-1988. Most of the beach debris that washes up on Suffolk County beaches originates from outside Suffolk County. Much of it comes from areas that have combined sewer overflows (CSOs) -- particularly New York City. It is also unlikely that this ban will have any measurable impact on reducing the number of marine birds and animals that might be harmed by ingesting plastics or becoming entangled in them. Most entanglements are due to monofilament fishing line and lost nets which continue "ghost fishing." However, if the intent of the Legislature is to "Think Globally, Act Locally," the legislation may fulfill an appropriate local response to a global problem.

Local Law 10-1988 may benefit the aesthetic quality of MSW compost -- a very important consideration for gaining market share relative to yard waste compost or sewage sludge compost. Shredded plastic and plastic bits are common contaminants in MSW compost, and the materials targeted by the ban (grocery bags and PS pieces) have been identified as offending materials in MSW compost. Although composting of MSW is not currently practiced in Suffolk

County, several Towns are now considering the development of MSW composting programs. Plastic items identified in the legislation are not items that have been identified as contaminants in yard waste compost. The implementation of LL 10-1988 will therefore have little effect on the quality of yard waste compost produced in Suffolk County.

It is highly improbable that the Plastics Law would endanger public health in any way. There is no convincing evidence that the substitution of paperboard meat trays for foamed PS trays would increase the risk of disease transmission. Also, while leaching of styrene from foamed PS packaging may occur at high temperatures, there is no evidence that it results in any measurable health problems, although more research in this area is clearly warranted.

The total economic impact of the Plastic Law may be substantial; however, because the costs would be spread over the entire population of Suffolk County, individuals would probably not be significantly affected. Based on the experiences of other municipalities that have implemented similar legislation, it is apparent that retail food businesses are not failing because of plastic bans. Businesses and the public are adjusting to the requirement and in some instances do so with pride and innovation.

It is important to note, however, that the costs of alternatives to the plastics banned by the Law will probably be more expensive. Larger supermarket chains will undoubtedly pass the added expense on to the customer in some way. Small business owners who operate retail food establishments may handle increased

costs in a variety of fashions. It is not clear in what way price increases will be passed on, if at all. Also, businesses which ship food products into Suffolk County may have a slight competitive advantage over those operating in the County, as those outside the County are exempt from LL 10-1988 due to Interstate Commerce laws.

Changes in energy usage are inconsequential in this particular debate, and if one also considers the hypothetical nature of the life-cycle analyses used to assess the production systems and their associated markets, it is evident little weight should be given to this aspect of the study in formulating policy. In a life-cycle analysis of the comparative energy costs of plastic bags versus kraft paper bags, it was determined that implementation of the ban may, as an upper limit, save about 18,000 barrels of oil per year. The other extreme is that implementation of the grocery sack provision of LL 10-1988 could cost about 8,000 barrels. A good methodology for applying life-cycle analysis to the problem of comparing plastic products to alternatives does not exist. Too many poorly-specified assumptions must be made; thus, any outcome is filled with uncertainty.

The Plastics Law will probably make only a marginal contribution to reaching state goals concerning the management of MSW as specified in the New York State Waste Management Act of 1988.

The debate over the Suffolk County Plastics Law has increased public awareness of the intricacies surrounding the topic of MSW

management, particularly the problems relating to handling plastic wastes. The proposed legislation has spurred national debate on the topic and has catalyzed the proliferation of plastics legislation nationwide. A number of communities around the country have adopted or have considered adopting legislation to encourage reductions in the use of plastics, and many have modeled their laws after LL 10-1988, whether or not their stated goals and objectives are the same. The debate also seems to have increased local attempts to recycle plastics by precipitating active collection of plastics at retail businesses. Increasingly, local governments have joined the move toward recycling. In Suffolk County, the Towns of Brookhaven and Huntington have recently opened public PS drop-off sites. It now appears that, in general, communities are moving away from adopting bans toward legislation which more directly encourages recycling.

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ABBREVIATIONS

HDPE	high-density polyethylene
LDPE	low-density polythylene
LLDPE	linear low-density polythylene
NYSDEC	New York State Department of Environmental Conservation
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzo-p-dioxin
PCDF	polychlorinated dibensofuran
PE	polyethylene
PET	polyethylene terephthalate
PP	polypropylene
PS	polystyrene
PVC	polyvinyl chloride

Resin Acronym	Familiar Product Examples
PET	soft drink bottles, peanut butter jars, edible oil bottles, cleaner bottles
HDPE	milk, juice, water, and detergent bottles; household cleaners, personal care bottles
PVC	edible oil, household cleaner, and personal care bottles
LDPE	grocery bags, dry cleaner bags
LLDPE	grocery bags
PP	syrup bottles, yogurt tubs, margarine tubs
PS	foam cups, meat trays, packing materials

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I. INTRODUCTION

The plastics industry has grown prodigiously over the past 40 or so years and its products are ubiquitous. Many of the industry's products are now considered necessities (e.g., many medical supplies). They are a growing part of the waste stream by both weight and volume. The U.S. Environmental Protection Agency (U.S.EPA) estimates that in 1990 some 8.3% by weight of the national municipal solid waste (MSW) generated (before materials recovery) was plastics. Plastics, however, represented 9.8% by weight and 21.1% by volume of the materials discarded (after materials recovery) (U.S. Environmental Protection Agency, 1992). Plastics were also a dominant fraction, by count (numbers of items), of debris found as marine litter in the National Beach Cleanup in 1991 (about 66%) (Younger and Hodge, 1992) -- and probably a dominant fraction of terrestrial litter as well. Foamed plastic debris constituted 11%, by count, of all debris collected in the 1991 marine debris survey (Younger and Hodge, 1992). In Long Island Sound, 74% of the debris collected in a 1989 survey was plastics (Strieb, 1993).

Plastics -- "the materials we love to hate," the materials "we can't live with and can't live without," (Swanson, 1990) -- have become a public issue because of their proliferation in society and the environment. Some of the public's concerns include the apparent:

- excessive and unneeded use of plastics;
- excessive consumption of non-renewable petroleum products;
- minimal effort by the plastics industry to recycle post-consumer plastics, despite aggressive public relations efforts; and,
- inattention by industry and government to the mounting plastics waste stream and the adverse environmental effects plastics may cause.

Because of the above, consumer and environmental interest groups around the United States have employed various strategies to try to contain the apparent mounting plastics waste problem. Among these are advertising campaigns to persuade the plastics industry and businesses that rely on plastics to modify behaviors, efforts to encourage development of degradable plastics and grass roots efforts to initiate recycling programs. In some cases, product and material bans have been proposed and implemented by local governments.

The purpose of this study is to review one aspect of the many activities currently underway to help reduce and control the proliferation of plastics: the Suffolk County Plastics Law (LL 10-1988). This innovative law has inspired national debate about plastic product/material use limitations as one way to deal with the plastics problem.

Since the mid-1980s, a number of strategies have been developed and implemented to limit the quantities of plastics in the environment, and they have met with varying degrees of success. Plastics recycling programs have been initiated, and secondary materials made from post-consumer plastics have been developed with modest success. Plastics bans targeting similar materials and products to those proposed in the Suffolk County Plastics Law have been implemented or proposed in other communities, including Newark, NY, Berkeley, CA, Portland, OR and Minneapolis, MN. Many laws were modelled after the Suffolk Plastics Law.

A ban, which is a prohibition usually imposed by law or official decree, when applied to an environmental issue should be assessed considering a number of specific criteria. Among these are:

- **Need.** At times, the public interest can only be broadly served through enactment of recognized agreements or legal/regulatory policies.
- **Environmental impacts.** There should be a net benefit to the environment and not just a shifting of the problem of concern elsewhere (to a different environmental medium or geographic location).
- **Public health impacts.** Public health should not be compromised as a consequence of implementing a ban.
- **Alternatives.** Acceptable alternatives to existing materials and practices must be available.
- **Fairness.** As with any regulation, the imposition of a

ban will create winners and losers. Of course, it is always hoped that winners will outnumber losers.

- **Ability to be implemented and enforced.** To be effective, a ban, once enacted, must be capable of being enforced. The regulatory authority must have the ability and resources to assure that the impacted community is complying with the intent of the ban.
- **Affordability.** The overall cost of the ban, its implementation and the cost of using alternative products must be at a price the affected community is willing to bear.

If the environmental problem -- in this case control of the proliferation of specific plastic products -- meets these criteria, then it is perhaps appropriate to consider a regulation or ban as a control mechanism.

The Suffolk County Plastics Law should also be considered in the context of how it contributes to the priorities of the New York State Solid Waste Management Act of 1988 (New York State, 1988). These are:

- reduce the amount of solid waste generated;
- reuse material for the purpose for which it was intended, or recycle material that cannot be reused;
- recover energy from the solid waste that cannot be reused or recycled; and

dispose of, in an approved manner, that material that cannot be reused, recycled or from which energy cannot be extracted.

Ideally, LL 10-1988 would assist local governments in meeting the State-mandated goals.

At the request of the Suffolk County Executive, the Waste Management Institute (WMI) of the Marine Sciences Research Center, State University of New York at Stony Brook agreed to assess Local Law 10-1988 and to prepare a report summarizing that assessment (Schubel, 1992). The Suffolk County Legislature confirmed the County Executive's desire that WMI undertake the proposed study in March, 1993 (Local Law 10-93) and asked that it be completed by September 1993. This study examines several aspects of the potential effects of the Suffolk County Plastics Law on the environment, public health, and the local economy, along with the impact of similar plastics bans on other communities which have had such legislation in place for a few years.

In particular, this study examines critical issues raised in the Legislative Intent Section of LL 10-1988, the bases for the Law. Our intent is to quantify the measurable and significant impacts that the Plastics Law will have on these issues identified as the bases for the Law. Hopefully this information will be used to aid the decision-making process with regard to implementing LL 10-1988.

The report is a synthesis and analysis of existing scientific,

technical, and economic literature, recent research conducted by WMI on plastics and the municipal solid waste stream, a review of testimony presented over the years, litter surveys conducted over the summer of 1993, and interviews with concerned parties. Finally, other than commenting on the extent to which the premises of the Law might be achieved, the report takes no position on whether or not LL 10-1988 should be implemented.

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II. LEGISLATIVE REVIEW

The Suffolk County Plastics Law was the first legislation of its kind in the United States. It sought to ban the use of certain plastic resins in retail food packaging. Known as Local Law 10-1988 (LL 10-1988), it was introduced by Legislators Englebright, Nolan, Blass, D'Andre, Blydenburgh, Bachety, Romaine, Prospect, Caracappa, Foley, Levy, Schaffer, Postal, and Gaughran on 25 August, 1987, passed, and approved by County Executive Patrick Halpin on 29 April, 1988 (Appendix A).

The passage of LL 10-1988 resulted in a total of twelve subsequent introductory resolutions over the six-year period from 1988 to 1993. Including LL 10-1988, seven of these introductory resolutions were adopted into law. These are briefly summarized here. The remaining ones were either stricken from the record due to legislative inaction, and are included in the legislative history summary table (Appendix B).

Legislative Intent

Entitled "A Local Law to Simplify Solid Waste Management by Requiring Certain Uniform Packaging Practices within the County of Suffolk," the law's stated purpose was "to incrementally, to the maximum extent practicable, eliminate the use of non-biodegradable packaging at retail food establishments" (LL 10-1988). The legislation was to apply to retail transactions on or after 1 July, 1989.

The legislature believed passage of LL 10-1988 would:

a) Encourage recycling of solid waste products;

b) Enhance groundwater protection;

c) Slow down the filling of landfill space;

d) Simplify the chemical composition of solid waste, thus reducing the environmental hazards (and toxicity) associated with solid waste incineration.

e) Reduce the cumulative impact of litter.

Prohibitions and Exemptions

Plastic bags were targeted, as the Legislature believed them to be "an impediment to the development of efficient waste separation, recycling, or other waste management programs, and [they] are less desirable than paper bags because plastic bags are neither recyclable nor compostable" (LL 10-1988).

Local Law 10-1988 also specifically identifies the plastic resins PS and PVC as environmental threats, because neither of these resins was readily recyclable at the time of its passage.

Local Law 10-1988 requires retail food establishments to place, wrap or pack food in biodegradable packaging, and specifically forbids the use of PS and PVC for utensils and food container packaging.

Local Law 10-1988 exempts the following:

a) Any flexible transparent covering for uncooked or raw meat, poultry, fish, hard cheese, cold cuts, fruit and vegetable produce, baked goods, or bread;

b) Any food packaging used at hospitals or nursing homes;

c) Any paper or other cellulose-based packaging that is coated with polyethylene (PE) plastic on only one side;

d) Any plastic covers, covering material, food containers, lids, eating utensils, or straws that are not made of PS or PVC.

Table 1 summarizes these product and material bans, along with exemptions.

Enforcement

The Suffolk County Department of Health Services is charged with enforcement. The Commissioner of the Department of Health Services is responsible for drafting the rules and regulations necessary to implement and carry out the provisions of the law. Failure to comply with LL 10-1988 carries a civil fine of $500.00 for each violation.

Modifications to Local Law 10-1988

In mid-1991, Legislator Englebright introduced two resolutions to amend the Suffolk County Plastics Law. The first, which became LL 19-1991, served to clarify the process by which LL 10-1988 would be implemented. It extended and postponed the applicability date of LL 10-1988 to the ninetieth day after the Rules and/or Regulations for implementing the law were to be issued by the Suffolk County DOH, or to December 31, 1991, whichever date occured first (December, 1991 came first).

Secondly, the Legislature agreed that "certain technical changes [were] necessary to fine-tune the provisions of this law in

Table 1. Product and material bans, and exemptions.

PRODUCT / MATERIAL	PS	PVC	PP	LDPE/ LLDPE	PET	HDPE
grocery bags				*B		*B
cups	*B				x	
plates	*B					
cutlery	*B		x			
wraps		*Bx	x	x		
stirrers	*B					
straws			x			
meat trays	*B					
deli paper						x
hinged containers	*B					
covers, lids	*B		x			

*B = banned x= resin from which product is made
*Bx= banned, but exempted

WHAT'S EXEMPT:
Any flexible transparent covering, regardless of composition (*Bx, above).

Any polyethylene-coated paper, on one side only.

Any plastic covers, covering material, food containers, lids, eating utensils, or straws (provided coating is not PS or PVC).

Any food that is shipped to Suffolk County pre-packaged (for example, Holly Farms chicken products are exempt from any packaging restrictions).

WHO'S EXEMPT:
Hospitals, nursing homes, Meals on Wheels.

Schools & industrial cafeterias that recycle their PS.

order to ensure a smooth transition from nonregulation into full implementation of said legislation. . ." Thus, Local Law 34-1991 was passed. It states that:

a) Retail food establishments should be encouraged to recycle and reuse packaging;

b) Nutritional assistance homebound delivery programs are exempt from Local Law 10-1988;

c) Affected retail establishments would be allowed to use up preordered items; and,

d) A temporary delay [in the prohibition] is needed to address the food tray and lid cover issues, pending a formal study by the Suffolk County Department of Health.

The Commissioner for the Suffolk Department of Health was to assess 1) the use of biodegradable packaging for meat trays from a public health perspective, and 2) the availability of biodegradable packaging as a substitute for plastic lids or covers. The Commissioner was to report findings to the County Executive and Legislature no later than 1 October, 1992. The County Legislature then had until 30 November 30, 1992 to act on those findings.

Under LL 10-1988, point-of-sale packaging used for purchased goods and intended for reuse that is provided by the purchaser of the goods was exempted, in order to encourage reuse. To encourage recycling, food packaging used at a retail food establishment in which the waste plastic was separated on-site and conveyed to a recycling plant or reprocessing facility was also exempted.

After seven public hearings, LL 34-1991 passed, and was filed with the Secretary of State on 1 April, 1992. It took effect immediately.

Moratoria

On 28 February, 1989, Legislators O'Donohoe, Romaine, and Rizzo introduced Resolution Number 1204-1989, which established a "Moratorium on the Plastics Law to Encourage Development of [A] Plastics Recycling Commission." The purpose of this legislation was to impose a moratorium on LL 10-1988 "so as to allow a Plastics Recycling Commission. . .sufficient time to analyze the feasibility of developing a plastic packaging Recycling/Source Reduction Plan."

The moratorium would postpone the applicability date of LL 10-1988 to 31 January, 1990. Following a public hearing on 19 June, 1989, County Executive Halpin disapproved the moratorium on 7 July, 1989. At a Special Meeting of the Suffolk County Legislature on 18 July, 1989, Legislator O'Donohoe made a motion to override the County Executive's disapproval. Twelve legislators voted in favor; six opposed the motion. The motion to override was adopted and LL 22-1989 was filed with the Secretary of State on 14 August, 1989.

Local Law 4-1990 extended the moratorium on the Plastics Law. This law was introduced by Legislators O'Donohoe and Rizzo, to allow a Plastics Recycling Commission "sufficient time to analyze the feasibility of developing a Plastic Packaging Recycling/Source Reduction Plan, and to allow the appeal of the . . .[Society of the

Plastics Industry, Inc., et al. v. County of Suffolk, et al.] lawsuit against LL 10-1988 to be determined by the Appellate Division of the Supreme Court of New York State. The new applicability date of LL 10-1988 was postponed to 30 June, 1990, or until sixty (60) days after the Appellate decision. This law was filed with the Secretary of State on 11 April, 1990.

A third moratorium, Local Law 5-1992, was introduced by Legislator O'Donohoe, Presiding Officer Blydenburgh, and Legislators Rizzo and Caracappa in 1991. Its purpose was to ". . . allow sufficient time to analyze the feasibility of developing a comprehensive Plastic Packaging Recycling/Source Reduction Plan, and to alleviate the economic burdens that small businesses may experience if full implementation of the Plastics Law occurs prior to the development of a comprehensive. . .Plan, and also to clarify [the] application of [the] Plastics Law to individual franchises."

This moratorium extended and postponed the applicability date of LL 10-1988 to 31 December, 1992 for small businesses (that is, retail food establishments that employ no more than 100 full-time employees). Those businesses wishing to qualify had 45 days to file with the Suffolk County Department of Health after the effective date of the law. The law became effective upon filing with the Secretary of State's Office on 8 April, 1992.

The fourth and most recent moratorium to date (LL 10-1993) was introduced by the Presiding Officer at the request of County Executive Robert Gaffney on 9 March, 1993. In part, the Legislature approved this moratorium in response to the following

information: on 20 November, 1991, Ray E. Cowen, Regional Director of the New York State Department of Environmental Conservation, testified before the Energy and Environment Committee of the County Legislature on the need to delay implementation of LL 10-1988 in order to comprehensively examine alternatives to plastics and the effects of the Law on future recycling and solid waste control efforts.

Additionally, on 17 June, 1992, the Suffolk County Council on Environmental Quality (CEQ) underscored the need for a moratorium to study the Plastics Law and possible replacements of it. The Legislature concurred that changes in solid waste recycling and disposal had occurred in the years since LL 10-1988 passed, and agreed that the changes should be taken into account prior to implementation of the Law. The Suffolk County Recycling Commission (abolished in July, 1993) also recommended that a study be undertaken to examine the environmental impacts resulting from the use, recycling, and disposal of plastics, along with an examination of alternatives.

Implementation of LL 10-1988 was again delayed, pending a study "defining environmental problems associated with plastics and alternatives to plastics within the County's waste stream." This study was to be conducted at no cost to the County by the Waste Management Institute of the Marine Sciences Research Center, State University of New York at Stony Brook and was to be completed by 30 September, 1993.

Lawsuits

The Society for the Plastics Industry, Inc., et al., v. The County of Suffolk

The Society for the Plastics Industry, Inc., the Flexible Packaging Association, the Polystyrene Packaging Coalition, Dart Container Corporation of Pennsylvania, Kama Corporation and Lawrence Wittman & Co., Inc., plaintiffs, filed a lawsuit against Suffolk County on 14 July, 1988 (77 N.Y.2d 761, 573 N.E.2d 1034, 570 N.Y.S.2d 778 (1991)). They claimed five causes of action:

1) The Legislature failed to file an environmental impact statement (EIS), in violation of Article 8 of the Environmental Conservation Law (ECL), the New York State Environmental Quality Review Act (SEQRA) (N.Y. ECL, Sections 8-0101-8-0117);

2) Local Law 10-1988 places an undue burden on the capacity of companies to engage in interstate commerce by banning certain plastic products within Suffolk County;

3) Local Law 10-1988 is preempted by article IX of the New York State Constitution, and Section 27-0711 of Title 7, Article 27 of the New York State Environmental Conservation Law. These two laws delegate to the State the responsibility "to promote solid waste management planning and the development of solid waste management programs and facilities which will conserve natural resources, reduce the amount of solid waste generated, recover the maximum practical amount of materials and energy resources from solid waste, and dispose of non-recoverable wastes in an environmentally sound manner;"

4) Local Law 10-1988 violates the Equal Protection Clauses of the Fourteenth Amendment to the U.S. Constitution and Article I, Section 11 of the New York Constitution in that the law unfairly discriminates against certain classes of manufacturers and retailers and against certain classes of products; and,

5) Local Law 10-1988 violates the Due Process Clauses of the Fourteenth Amendment to the U.S. Constitution and Article I, Section 6 of the New York Constitution in that the law is unconstitutionally vague.

On 24 May, 1989, State Supreme Court Justice Cannavo granted a summary judgment on the EIS issue, and ruled against plaintiffs on all other claims.

Suffolk County then appealed the trial court decision to the Appellate Division of the Supreme Court, which ruled in plaintiffs' favor on the EIS issue. Suffolk County appealed again, to the New York State Court of Appeals, the highest court in the State. The Court of Appeals did not rule on the merits of the EIS argument. The authority of the Suffolk County Legislature to enact such legislation was upheld, as the Court of Appeals ruled that plaintiffs did not have legal standing to initiate the lawsuit.

The Sierra Club v. The County of Suffolk

On 30 June, 1992, the Sierra Club challenged Local Law 5-92, which imposed a moratorium on implementation of LL 10-1988, on the grounds that the Suffolk County Legislature failed to comply with

SEQRA. This law was adopted on 3 March, 1992 and filed with the NY State Secretary of State on 8 April, 1992). The Sierra Club petition sought to annul and vacate the determination to grant the moratorium.

Local Law 5-92 temporarily exempted "small businesses" which qualified and filed for an exemption from LL 10-1988 until 31 December, 1992. Since a "small business" was defined as any retail food establishment that provides food service and employs no more than 100 full-time employees, all retail food establishments in Suffolk County qualified to be exempted, as there are no retail food establishments in Suffolk County with more than 100 full-time employees (Ernst Dinda, Chief, Bureau of Environmental Protection, Department of Health Services, personal communication).

The moratorium contained a determination made pursuant to SEQRA that the law was a Type II action; that is, one which requires no further review under SEQRA (6 NY Code of Rules and Regulations, Sections 617.3(j), 617.5(1) and 617.13(a). The Sierra Club claimed that LL 5-92 should have been classified as a Type I or unlisted action, and that had the law been correctly classified, Suffolk County would have been required to prepare both an Environmental Assessment Form (EAF) and an EIS. The Sierra Club sought declaratory relief, preliminary and permanent injunctive relief, attorney and witness fees, and costs.

On 24 July, 1992, Suffolk County responded with a motion to dismiss, based on the following grounds:

1) The Sierra Club lacked standing to bring the challenge on SEQRA grounds;

2) The Sierra Club lacked standing to bring a taxpayer action;

3) The Sierra Club's papers failed to state a cause of action;

4) The Sierra Club did not properly request preliminary injunctive relief, and did not demonstrate entitlement to same;

5) The Sierra Club did not demonstrate a probability of success, a clear legal right or irreparable injury, or that granting the injunction would be equitable or serve the public interest; and,

6) The Sierra Club failed to enjoin a necessary party (meaning that the Sierra Club should have enjoined either the County of Suffolk or the Department of Health Services in their request for a preliminary injunction, since these would be the parties responsible for implementing the resolution.

On 8 December, 1992, the Honorable Justice H. Berler of the Supreme Court of the State of NY denied the Sierra Club's petition and granted Suffolk County a dismissal of the lawsuit. He found that the Sierra Club lacked standing because it did not allege injury-in-fact, and did not demonstrate a relationship to its members to support its standing. Injury-in-fact as it relates to a SEQRA claim contemplates an injury different in kind and degree from the community at large (see below).

The Sierra Club et al., v. The County of Suffolk

On 9 June, 1993, the Suffolk County Legislature was again served papers by the Sierra Club, seeking to void LL 5-1992. This time the Sierra Club joined with two persons who could allegedly claim individualized harm, because they live within 7-8 miles of the Huntington incinerator. The County's response was in the form of a Notice of Motion to Dismiss, dated 8 September, 1993, because, in the County's opinion "the injury claimed due to proximity to the incinerator is so marginally related to the moratorium that it cannot reasonably be claimed that [petitioners] have some concrete interest in prosecuting this action" (Notice of Motion to Dismiss, Supreme Court of the State of NY, County of Suffolk, Index No. 93-14953).

Finally, at the request of the Sierra Club and with the agreement of the Suffolk County Attorney's office, the return date for this matter was adjourned to 1 October, 1993, one day after the moratorium expires -- thus making this lawsuit moot.

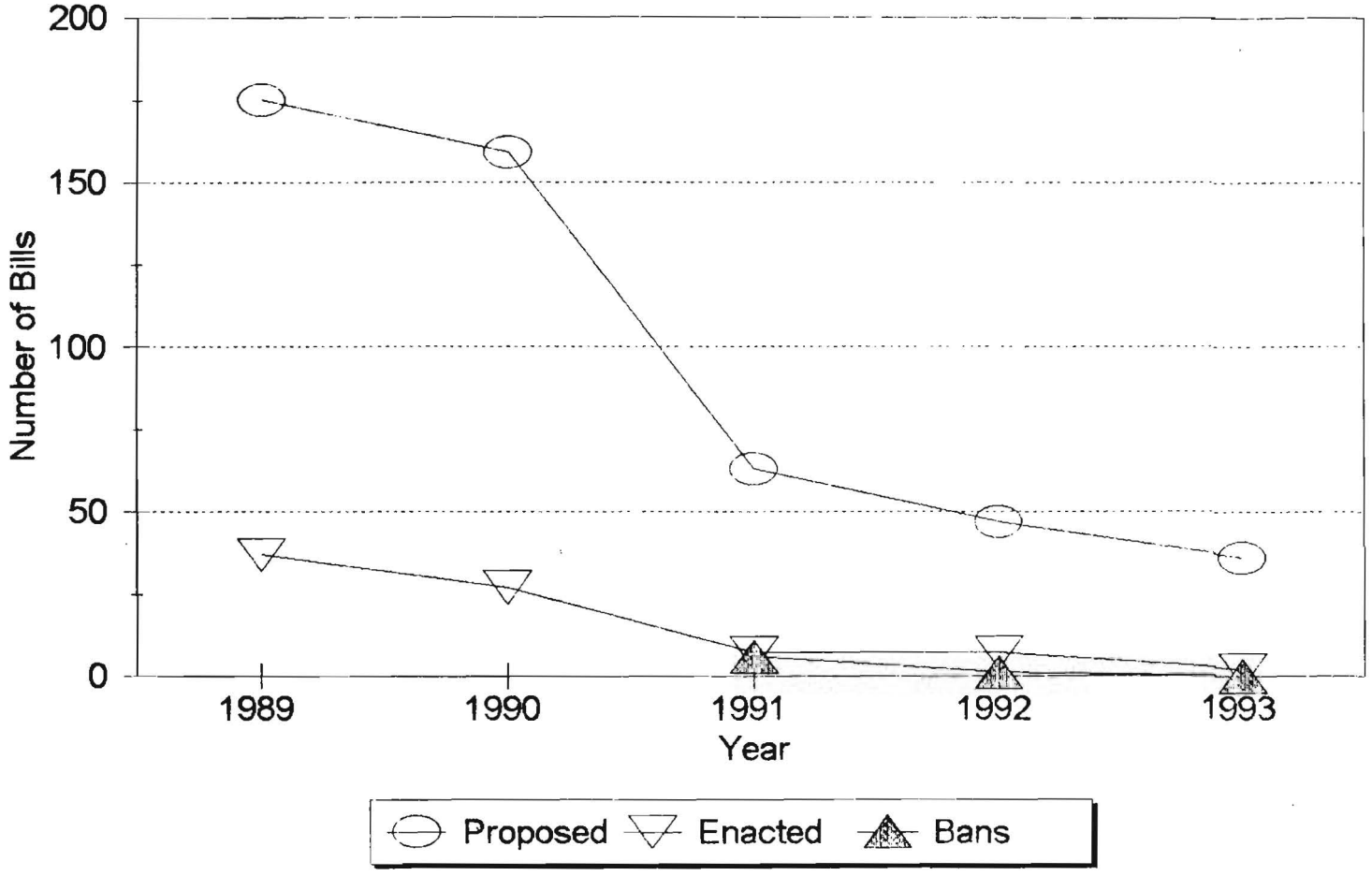
III. PLASTICS LEGISLATION IN THE UNITED STATES

Following passage of Suffolk County's Local Law 10-1988, a number of other communities around the United States passed similar legislation. A 1990 Polystyrene Packaging Council, Inc. survey indicated that approximately 84% of the U.S. public supported bans on PS used for fast food packaging (Modern Plastics, 1990). By 1990, 64 laws to ban or restrict the use of PS were in place (American Plastics Council, 1993).

Since then, there has been a shift from away from bans. After passage of the Suffolk County Plastics Law in 1988, U.S. legislation intended to address PS in the waste stream skyrocketed; however, only a fraction of the bills were enacted, and very few of the bills or ordinances enacted were outright bans (Figure 1). Similarly, proposed legislation to deal with plastic bags peaked within a few years of the passage of LL 10-1988 (Figure 2).

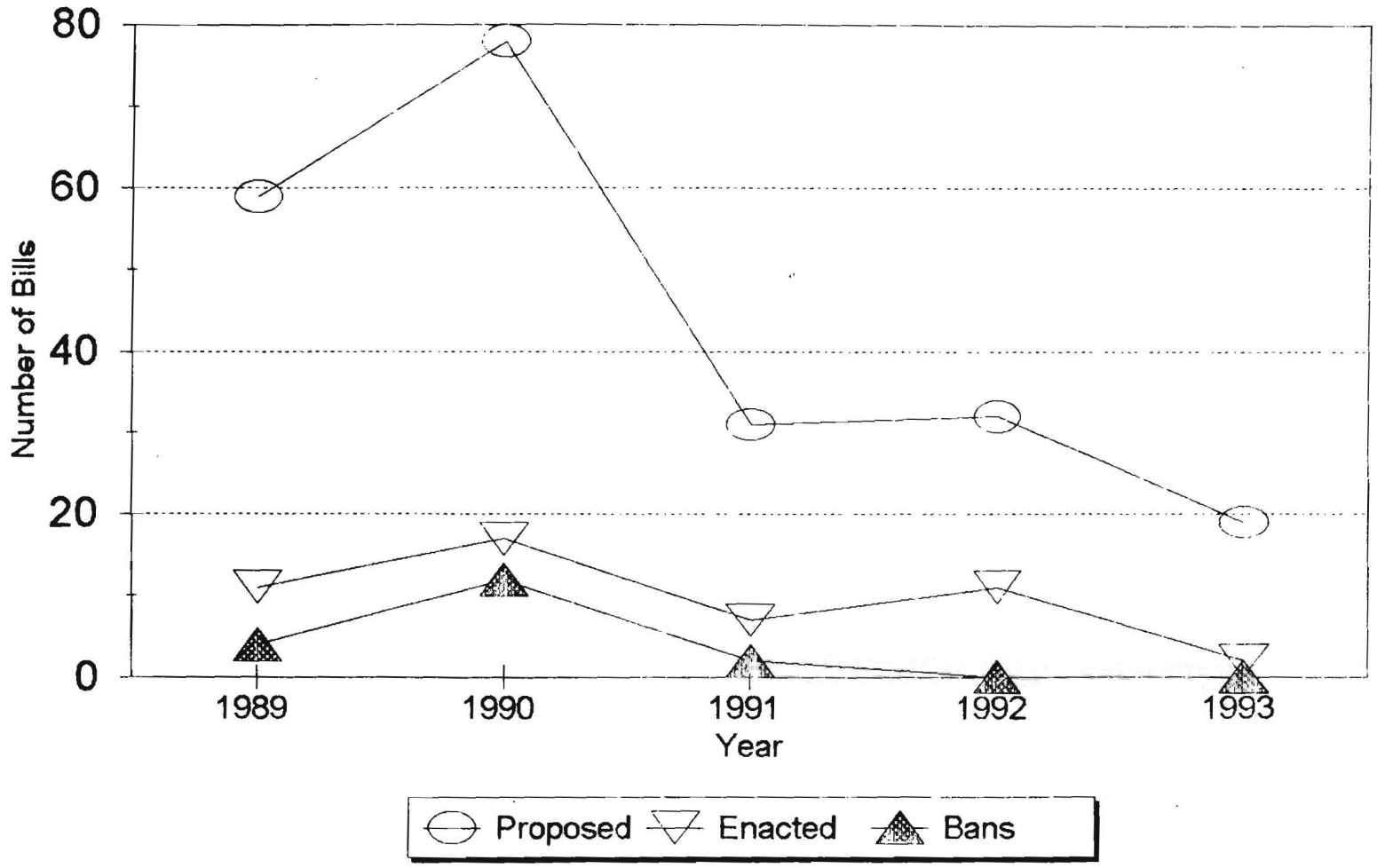
Since then, solid waste legislation across the U.S. has moved towards recycling mandates, which serve to place increasing amounts of secondary commodities on the market (Biocycle, 1993). In 1991, more than 500 solid waste management proposals affecting plastics were introduced in 48 state legislatures (Plastics Engineering, 1992). One hundred five (105) of the introduced bills required that plastics meet a recycling standard, and 42 bills mandated recycled content in packaging (Plastics Engineering, 1993).

Figure 1.
PS Legislation in the U.S.



Source: American Plastics Council and Society of the the Plastics Industry, Inc., August, 1993

Figure 2.
Plastic Bag Legislation in the U.S.



Source: American Plastics Council and the Society of the Plastics Industry, Inc., August, 1993

Information on a few of the communities which have had plastics legislation in place for several years is provided below. Waste Management Institute personnel telephoned these communities for follow-up information; additionally, personnel visited Minneapolis, MN, and Newark, NJ.

Portland, Oregon

On 21 July, 1988, City of Portland Ordinance 161061 established a ban on City purchases of polystyrene foam (PSF) products. Resolution 34448 appointed a task force to recommend policies, programs, and ordinances prohibiting the use and sale of particular PSF products in the City.

Subsequently, on 25 January, 1989, the City Council passed Ordinance 161573, which extended the ban to most food providers operating within the City limits -- including hospitals. Additionally, it provided for the establishment of a public/private task force for "recommending means to reduce disposable plastic products in landfills and litter" (Ordinance 161573).

In passing Ordinance 161573, the Council sought to reduce:

1) the amount of litter;
2) the annually-increasing contribution of disposable consumer plastic containers and wrappers to landfills;
3) the threat of chlorofluorocarbons to the earth's atmosphere; and,
4) the hazard of ingestion by wildlife of polystyrene foam particles.

Ordinance 161573 states:

> On and after 1 March, 1989, no restaurant, retail food vendor or non-profit food provider shall serve food and after 30 June, 1989 no food packager shall package meat, eggs, bakery products or other food in polystyrene foam containers, manufactured with chlorofluoro-carbons which do not reduce the potential for ozone depletion by more than 95 percent.

Polystyrene use was further restricted such that "on and after 1 January, 1990, no restaurant or retail food vendor shall serve prepared food in any polystyrene foam products" (Ordinance 161573).

Exemptions from the requirements were available "upon a showing by the applicant that the conditions. . .could cause undue hardship;" that is, where no acceptable alternatives to PSF were available and in situations where compliance "would deprive a person of a legally protected right."

There was no exemption available for the recycling of PSF in the strengthened version of the ordinance which became law (the original ordinance would have banned the use of PSF by food establishments unless the vendor had a recycling program). A brochure from the Bureau of Environmental Services for the City of Portland explains that "[r]ecycling of foam food containers is difficult because the product is hard to clean and its low density makes transportation costs uneconomical. Recycling programs for the foam are limited in the Portland area" ("Portland's Ban of

Polystyrene Foam Food Containers," Appendix C). Additionally, the Bureau of Environmental Services produced and distributed to grocery stores a simple, one-page summary of what was and was not acceptable for packaging in PSF (Appendix C).

Ordinance Number 161573 also provided for the appointment of an eleven-member task force, composed of persons having relevant expertise and representing a broad range of community interests. Task force duties included:

1) monitoring recycling projects, including research and demonstration projects intended to increase the percentage of disposable plastics products recycled (and/or decreasing the amount of MSW in landfills);
2) making recommendations with regard to public education and promotion, alternative product recycling/energy conversion, financial assistance (towards the goal of total elimination of PSF), and alternative products research.

This task force was to be formed by 1 April, 1989, and, after completion of two annual reports with recommendations to the City Council, was to disband on 31 December, 1990.

The Bureau of Environmental Services was charged with enforcement, and violations were punishable by civil fines, not to exceed $250 for the first violation in a one-year period, and not to exceed $500 for the second and each subsequent violation in a one-year period.

Waste Management Institute personnel spoke with Mr. Lee Barrett in August, 1993. Often referred to locally as Portland's "styro-cop," Mr. Barrett was hired as a consultant by the City to serve as an inspector and visit restaurants to determine whether PSF was being used. Unlike any of the other communities where WMI inquiries were made, Portland had allocated $10,000 for enforcement.

Mr. Barrett was hired in the fall of 1989 to begin his duties in January, 1990, when the ban was to take effect; however, he did not begin work until 20 February 1990, due to a lawsuit brought by companies engaged in plastics recycling, the manufacture of recycling equipment, and McDonald's restaurants. They filed a complaint in Multnomah County Circuit Court contending that the municipal ban violated statewide solid waste and recycling policies, and that the plaintiffs' federal and state constitutional rights to equal protection and due process would be violated. This lawsuit was decided by Senior Circuit Judge Douglas R. Spencer, who granted a summary judgment in favor of the City.

Enforcement efforts were as follows: county sanitarians, as they went about their routine inspections of restaurants, looked for evidence of non-compliance. They would then check off the appropriate box on their standard checklist. The City of Portland's Bureau of Environmental Services followed up by sending out letters informing the food establishments of the new law. Mr. Barrett would then receive a monthly printout from the City of those establishments. He, in turn, would visit those facilities

within 30 days to oversee compliance, explain the law and personally answer any questions, and submit an invoice to the City (he was paid by the hour).

Many local restaurants switched to alternative products in anticipation of the PSF ban, and did not wait for the outcome of the lawsuit to do so. One business manager, David Sink of At Honey's, a yogurt and sandwich shop, stated in a 3 January, 1990 article in The Oregonian that switching from PS to paper "has been only a 'minor glitch' in the store's operations." Mr. Sink also said that he believed the cost of using paper products [would] turn out to be essentially the same as using PS, because "the free market thing is working. . .I have three or four people after my business."

Of the 3,000-4,000 food establishments in the City of Portland (population approximately 470,000), about 200 were visited the first year by Mr. Barrett; of those, eight were still using PSF, and six or seven fines were levied. There was no noticeable price increase in fast food store prices; nor did any businesses fail because of the Ordinance (Lee Barrett, City of Portland Environmental Services, personal communication).

Mr. Barrett stated that "Today, virtually everyone complies. The compliance rate is so high (approximately 95%) that the City no longer allocates funds for enforcement." When asked whether any of the original goals of the Ordinance have been met, Mr. Barrett stated, "It is very common in Portland to see individuals carrying their own ceramic or plastic mugs with them, so yes, it did serve

to raise awareness. Did it make a difference in litter? No, we just traded one litter stream for another. CFCs are no longer an issue (due to federal legislation, not the ban). Overall, it was a largely symbolic gesture," -- a comment repeated, without prompting, by others with whom WMI personnel spoke.

One interesting note: Defenders of Wildlife, an environmental group that fights the entanglement of marine mammals in fishing nets and ingestion of foreign substances by wildlife was opposed to the ban in Portland. Sara Vickerman, Regional Director for the group stated that banning one product that is recyclable in favor of other products that are not recyclable makes no environmental sense (Daily Journal of Commerce, 12/12/89). In Suffolk County, however, Dr. Albert M. Manville, Senior Staff Wildlife Biologist for Defenders of Wildlife and Chair of The Entanglement Network Coalition, testified in favor of Local Law 10-1988. In a conversation with Dr. Manville in August, 1993, he stated that Defenders of Wildlife has no position on the polystyrene bans with regard to protecting marine organisms.

Minneapolis, Minnesota

Ordinance 89-Or-060, which went into effect on 1 July, 1990, was modeled on Suffolk County's Local Law 10-1988, but took a different tack. The Minneapolis City Council was concerned that plastic packaging used for food and beverages was rapidly replacing other packaging material, and was for the most part nondegradable, nonreturnable, and nonrecyclable.

The Ordinance restricts packaging of food products to those considered "environmentally acceptable," meaning either 1) degradable, 2) returnable, or 3) recyclable. Packaging "shall mean and include all food-related wrappings, adhesives, cords, bindings, strings, tapes, ribbons, bags, boxes, coverings and containers . . .cups, glasses. . .and plates and serving trays, but shall specifically exclude plastic knives, forms and spoons. . ." (89-Or-060). PET and HDPE were included under acceptable recyclable packaging.

Four exemptions to the Ordinance addressed both type of facilities and products. Any packaging used at hospitals or nursing homes is exempt. Any flexible packaging of 10 mils or less is exempt, along with any paper, cellophane, or other cellulose-based packaging that is plastic-coated. Finally, any packaging for which there is no commercially available alternative is exempt, as determined by the Health Department Commissioner, responsible for the enforcement of 89-Or-060.

Violation of any provision of the law is a petty misdemeanor, carrying a maximum fine of $50.00. Each day on which a violation occurs constitutes a separate violation.

Finally, the Minneapolis City Council legislation established an Advisory Committee on Environmentally Acceptable Packaging, by resolution. The membership was to be drawn from "affected governmental units, business and industry, trade associations, general business organizations, consumer groups, environmental

groups and others. . ." (89-Or-060).

Groups opposed to passage of 89-Or-060 staged a media campaign, flooding radio and television with advertisements which suggested that this legislation would result in increased costs to residents and the failure of businesses -- and the exodus of some businesses from the City to the suburbs. These groups included local companies such as General Mills and Quaker Oats, food retailers and manufacturers, soft-drink bottlers, and the plastics industry's Council for Solid Waste Solutions. The response of Minneapolis residents was also strong -- in favor of the legislation. City Council offices received many phone calls, according to Council Member Cramer. The ordinance unanimously passed on 31 March, 1989.

When the "Report of the Advisory Committee on Environmentally Acceptable Packaging for the Cities of Minneapolis and St. Paul," was published on 31 January, 1990, a fifth type of exemption was proposed, allowing an exemption of up to one year when, "in the judgement of the Commissioner/Director, more time is needed."

The enforcement provisions of the Advisory Committee report are briefly restated here:

1) Food safety is a crucial consideration for food packaging.

2) Voluntary compliance is key to successful enforcement.

3) The purpose of enforcement is to cause change consistent with the objectives of the Packaging Ordinance.

4) Enforcement should cause the most change of the most desired kind with the least consumption of resources by the Health Department.

5) Exemptions are the single most powerful enforcement tool available. They can be used to provide both time for those affected to make changes in a well-planned. . . manner and to provide unrelenting pressure on them to do so.

6) Control of the resources of the Health Department must remain with the Commissioner. . .Determination of priorities of the use of this resource must remain with the Commissioner. . .

7) Local retailers should not be subjected to undue hardship as a result of actions by sources of supply over which they have little practical control.

Enforcement methodology was based on a "hierarchy of tiered enforcement priorities based on packaging by product group," such that an exemption could range from three months to twelve months, depending on the packaging products, and was available as of the 1 July, 1990 effective date.

The idea of implementation was daunting. Plastics would somehow have to remain legal under the new law, or thousands of items contained or wrapped in plastic on supermarket shelves would be banned. The Advisory Committee agreed to defer the effective date for one additional year. The Council for Solid Waste Solutions set up several recycling pilot programs and loaned the City a $100,000 plastics-collection vehicle. After the pilot programs demonstrated that plastics were indeed recyclable, they became acceptable under the "environmentally acceptable" requirement of the Ordinance.

After several months of preliminary telephone conversations, WMI personnel visited Minneapolis on July 30-August 2, 1993. Meetings were held with Steven Cramer, the City Council Member who proposed Minneapolis' plastics legislation; John Schnickel,

Director of the Minneapolis Health Department; and John Edmunds, P.E., and Andrew Castellano, of the Solid Waste and Recycling Division of the Public Works Department.

Waste Management Institute personnel sought answers to the following questions, among others:

1) Did any of the predictions of the groups opposing the legislation come to pass?
2) Did the ban succeed in reducing the waste stream, and to what degree?
3) How did the Advisory Committee work?
4) Has enforcement been a problem? What percent of local food establishments are in compliance?

Mr. Schnickel was involved in the drafting of the ordinance. He stated that this ordinance was "not a ban -- the purpose. . .was to encourage recycling of plastics at retail food establishments. Nothing previously available has disappeared -- styrofoam products are still used; all kinds of plastics products are still in use."

This is not to suggest that the legislation has not made a difference, however. Prior to passage of the ordinance, there was no plastics recycling at the community level, and the curbside program covered only glass, metals, and paper. Today, the curbside program includes all rigid plastics except PS, for which there are about eighty drop-off locations in the Twin Cities area. The drop-off locations are conveniently located at gas stations, making it easy to drop off PS for recycling. Also, because residents collect it in their homes until they have a sufficient quantity to drop

off, it tends to be very clean PS (presumably because if it has to be stored in their homes, residents prefer to store the PS clean, after rinsing).

Although retail food establishments are not covered by the curbside recycling program, any take-out food packaging must be compatible with the ordinance since it is presumed that the waste packaging should be recycled, either curbside or via the PS bins.

Further, food service operators in the City were notified that they must provide "on-site recycling for plastic, glass, aluminum and other disposable food packaging. . .[They] must collect recyclable materials in containers that are clearly marked. . . .and are distinguishable from waste containers. [They] must deliver the materials to a recycling processor or contract with a licensed hauler to take them" (Undated letter sent to food service operators by John Schnickel, Director, Environmental Health Services).

Mr. Schnickel stated that "the ordinance served to close the gap between the price of paper and plastics for retail packaging. Prior to the ordinance, plastic products were much less expensive than paper; however, with mandatory recycling, the overall price of plastic products has approached that of paper products. Prices may have gone up a little (a few pennies to a nickel more for a cup of coffee, for example), but no one I know has closed their doors or left town as a result of this ordinance."

Restaurants have been slow to comply, and the Health Department has intentionally been slow to enforce. During the 1992 summer, 40-50 restaurants were surveyed as an informal check on

compliance -- results were disappointing, according to Mr. Schnickel. Approximately 50-75% of food establishments were in compliance. To date, no fines have been levied; however, Mr. Schnickel is considering changes to improve compliance. Citizen policing does not work well, because citizens are often confused about what is and is not covered by the Ordinance, along with what exemptions are available.

Nonetheless, both he and City Council Member Steve Cramer underscored their desire to work cooperatively with businesses rather than approach compliance with a heavy hand. Both were clearly proud of the success of the Advisory Committee on Environmentally Acceptable Packaging, whose disparate members represented such organizations as Plastics Incorporated, the Minnesota Grocers Association, Citizen's League, The Sierra Club, the League of Women Voters of Minnesota, and private citizens. The exclusions for PS utensils and polycoated paper products are examples of the work of the Advisory Committee, which was charged with creating plans for implementation of the law.

John Edmunds, P.E., and Andrew Castellano of the Department of Public Works, Solid Waste and Recycling Division, provided information on recycling: in the first quarter of 1993, 121 tons of plastics were collected and all but 10 tons were recycled. In the second quarter 1993, 158 tons of plastics were collected, and all but 7 tons were recycled. They are confident that the plastics are being recycled as they use contracts, maintain a paper trail, and they have received invoices from end users. All of the

plastics collected for recycling remain in the United States.

Waste Management Institute personnel observed that the streets of Minneapolis were very clean, despite there having been a "Ribfest" in the downtown area over the weekend. Visits to restaurants, however, offered a surprise. At one Chinese fast-food, cafeteria-style restaurant visited, WMI personnel watched a number of people deposit the contents of their entire luncheon trays into waste receptacles clearly marked for PS only. The restaurant had artfully arranged cutouts of PS products such as plates and cups on posterboard directly above the receptacle where the PS was to go. The waste receptacles were lined up in a row; however, instead of sorting their waste, person after person was observed to walk up, dump the entire contents of the his or her tray into any available receptacle, and leave. Although this restaurant would claim to be in compliance with the requirement to provide a separate waste stream for PS to be recycled, clearly no recycling would be possible, since all garbage was thrown into all containers.

The McDonald's restaurant in downtown Minneapolis creatively solved the separate PS waste stream contamination problem by offering cutouts of the shape and size of PS products directly on the waste receptacles. The hinged doors on front of the waste cans that normally would swing open to accept garbage were permanently closed, and the only way to dispose of waste would be to pick up one's PS cup, for example, and push it through the PS cup cutout on the front of the waste can.

It was evident in Minneapolis that smaller businesses could flagrantly violate the law, while the larger franchise businesses have too high a profile not to comply. This counters testimony given for the Suffolk County Plastics Law, where it was suggested repeatedly that the small stores would bear the brunt of the costs of compliance due to increased costs for replacement products combined with lack of volume discounts for them. It seems that if the PS products are readily available and compliance is lax, whether due to the desire to slowly foster cooperativeness or lack of personnel for enforcement, the lower-profile food establishments can ignore the law -- and clearly do so in Minneapolis.

Newark, New Jersey

Section 1, the "Findings and Purpose" of Newark's "Ordinance to Simplify Solid Waste Management by Requiring Certain Uniform Packaging Practices Within the City of Newark, New Jersey," is almost identical in wording to Suffolk County's Local Law 10-1988 (Ordinance of the City of Newark, 6S&FA 021589). The Definitions, Prohibition, and Exemption sections are also very similar. Clearly the intent in Newark was the same as that of Suffolk County's legislature -- that retail food packaging be either degradable or banned.

Newark's Ordinance 6S&FA passed unanimously and was adopted by the Newark Municipal Council of the City of Newark on 15 February, 1989. This ordinance was to take effect upon final passage and publication according to law, but was to apply to retail

transactions consummated on or after 1 September, 1989, thus allowing retail food merchants six months to deplete their supplies of PS and PVC food packaging.

Unlike Suffolk's LL 10-1988, many of Newark's municipal departments were involved in enforcement:

> The Director of the Department of Engineering, all employees of the Sanitation and Engineering Divisions, as well as the Water/Sewer Utility of the Department of Engineering so authorized by the Director of the Department of Engineering; the Director of the Department of Health and Human Services and all employees of Health and Inspection Divisions of the Department of Health and Human Services; the Director of the Department of Land Use Control and all employees so authorized by the Director of the Department of Land Use Control; the Director of the Department of Development and all employees so authorized by the Director of the Department of Development; all municipal elected officials and all law enforcement officers and all investigators, Alcoholic Beverage Control of the Department of Police, the Director of the Department of Fire and all employees so authorized by the Director of the Department of Fire... authorized and empowered to perform as Law Enforcement Officers solely with respect to the enforcement of the provisions of this ordinance by being empowered to issue summonses for any violations. . .(Ordinance 6S&FA).

Penalties are punishable by a fine of up to one thousand dollars ($1,000), with a minimum fine of one hundred dollars ($100).

On 6 September 1989, Ordinance 6S&FA was amended to allow for an exemption of recycled packaging not containing chlorofluorocarbons (CFCs). Ordinance 6S&FF required that "[a]t the minimum, the retail food establishment must monthly demonstrate that at least 60 percent of said total packaging utilized is being recycled. This would include in the total that packaging being used within the premises as well as that taken from the premises."

On 13 November, 1989, Ordinance 6S&FA was amended to exempt PS

packaging used for "meat, meat products, fish, poultry, dairy and produce packaged and sold in the City of Newark," and "[a]ny packaging which occurs within the City for sale within the City shall not include CFCs."

The latest amendment was added on 18 November, 1991, to make it illegal for distributors of PS or PVC food containers or eating utensils to provide these items to retail food establishments located in the City of Newark (Ordinance of the City of Newark, 6S&FG). All food packaging must be biodegradable and/or photodegradable.

Of the communities investigated by WMI personnel, Newark's enforcement is the strictest. No other community charges six City Departments with enforcement responsibility, and empowers so many personnel to issue summonses. In addition to this, citizens are welcome to call in their observations of non-compliance. During an 23 August, 1993 interview with WMI personnel, Frank J. Sudol, Manager, Division of Engineering and Contract Administration, held up a stack of notices of violation to be sent out, each carrying at least the minimum $100 fine. Tony Sanchez, a Health Department Inspector, stated that his department allows a retail food establishment which is found to be in violation 24 hours to replace its supply of PS and PVC with acceptable alternatives -- and stated that the Health Department did indeed go back the next day to follow up on compliance.

It was evident from a walk around the downtown area that PS and PVC were not a large part of the litter along sidewalks and

roadsides. In a several blocks' walk, WMI personnel identified one PS cup and one PS tray. Litter was composed primarily of plastic-coated paper cups and other paper fast food packaging. Although litter was ubiquitous (Figure 3), Mr. Sudol stated that litter has been measurably reduced in Newark since 1988. He attributed this to many factors, however, including an aggressive public education campaign and a change to private street sweepers (Figure 4). These two changes were both implemented prior to the ban; thus, it is not possible to directly tie the reduction in litter to the PS and PVC ban.

Mr. Sudol explained that there are no establishments that have opted to continue using PS via the recycling exemption, presumably because providing proof that at least 60% of total packaging is recycled would be onerous. Further, no one recycles PS in Newark.

As in Portland, it is more common now for a retail food establishment to offer an individual who brings in his own cup a nickel off the cost of a cup of coffee. This has been one surprise outcome of such legislation that was not foreseen in any public hearing testimony. It also counters the argument that costs to consumers inevitably will increase if businesses are forced to replace PS with more expensive alternatives. Aside from that, there was no noticeable change in the price of fast food or delicatessen items, according to Mr. Sudol.

Figure 3. Weekend litter accumulation, near City Hall. Broad Street, Newark, NJ. 1993.

Figure 4. After clean-up, near City Hall.
Green Street, Newark, NJ. 1993

Glen Cove, New York

Chapter 72 of the Code of Ordinance of the City of Glen Cove, Section 72.10, "Prohibition on the use of polystyrene and polyvinyl chloride in food packaging," is almost identical in wording to Suffolk County's LL 10-1988. The City Council intent is the same, with the substitution of City of Glen Cove for Suffolk County: ". . .to incrementally, to the maximum extent practicable, eliminate the use of non-biodegradable packaging originating at retail establishments within the City of Glen Cove, in order to protect the air, land, and waters of the City of Glen Cove against environmental contamination and degradation" (Chapter 72 of the Code of Ordinance of the City of Glen Cove, Section 72.10).

The Definitions, Prohibition, Exemptions, Enforcement, and Penalties sections of the Ordinance are identical to LL 10-1988. Enforcement is the responsibility of the City of Glen Cove, and the effective date was 30 June, 1989.

The City of Glen Cove allocated no additional funds for enforcement. Glen Cove counted on self-policing and citizen-policing efforts to ensure enforcement, and indeed self-policing seems to be working well. Conversations with the managers or owners of five delicatessens within the City of Glen Cove in August 1993 indicated that all of these businesses were in compliance (confidentiality on the part of WMI was assured; thus, these businesses are not named in this report). Four of the five now pay more for their food packaging as a result of the Ordinance; nonetheless, all five fully support the legislation. Several

indicated they were happy to comply with a law which would help the environment. Three managers stated the opinion that the Ordinance should be applied across the board; that is, that all -- not just retail food -- businesses should be required to comply. Four of the five had not received any customer feedback; however, customers expressed disappointment with the quality of the alternative products in one delicatessen.

In conclusion, with the exception of Portland, OR, none of the communities allocated funds for enforcement of their plastics laws; thus, enforcement is very much dependent on the desire of a business to comply, or citizen policing. The more complex a law, the likelier it seems that enforcement may be a problem -- both because without proper education, neither the public nor a business can easily understand what is and is not acceptable, and because exemptions may serve to complicate what falls under the category of acceptable packaging.

Judging from numerous conversations with individuals and businesses in these communities, while costs for alternative products do increase as a direct result of legislative action, the costs seem negligible when passed on to customers -- both to the business and the customer. Nowhere did WMI locate or hear of a business failure due to plastics legislation. Overall, there seems to be support for legislation which is believed to have a beneficial environmental effect.

During conversations with persons responsible for waste management or recycling for their communities, many stated that the

plastics legislation they adopted has held a primarily symbolic role in waste management. This was a comment heard repeatedly. However, none of the communities WMI researched had made efforts to obtain quantifiable data on whether the laws have been effective in meeting stated goals, making it difficult to ascertain with any confidence how successful the legislation has been overall.

One certain result of such legislation that was not mentioned in any community's Legislative Intent section is that such laws have contributed to public awareness of the complexity of plastics food packaging waste disposal issues.

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IV. PLASTICS IN THE WASTE STREAM

Many of the physical properties of plastics make them an ideal material for a wide variety of products and applications. In general, plastics are lightweight, inert, and resistant to breakage and environmental deterioration. With the use of additives, plastics can be manufactured to be rigid, flexible, insulating, breathable, impermeable, transparent, or opaque. As a result, plastics have replaced glass, paper, and metal in many products and packaging applications. Many plastic products, such as those used for food packaging, are single-use convenience products which rapidly become solid waste. Once discarded, the attractive physical properties of the plastics become a detriment. Resistance to degradation has resulted in plastics becoming a visible, widespread persistent contaminant.

This section of the report provides a series of estimations, based on recently published data, to determine the amount of plastics in the Suffolk County waste stream by weight. In addition, calculations are performed to determine the percentage of plastics in MSW which would be effected by implementation of LL 10-1988.

Percentage of Plastics in the Waste Stream

An estimated 391,400 million pounds (195.7 million tons) of MSW was generated in the U.S. in 1990 (U.S. EPA, 1992). The estimated quantity of waste generated in the U.S. results in a per capita waste generation rate of 4.3 lbs/person/day. Recent waste

generation estimates for Suffolk County show that 3,506 million pounds of MSW were discarded in 1991, resulting in a per capita waste generation rate of 7.3 lbs/person/day (Tonjes and Swanson, 1992). These waste generation rates show that Suffolk County residents dispose of a disproportionately high amount of solid waste when compared to national averages.

Data compiled by the Office of Technology Assessment (OTA) show that the largest categories of materials in MSW, by weight, are paper and yard wastes. From data compiled from 40 studies, estimates of the paper content of MSW ranged from 36.5%-54.7%, while yard waste content of MSW ranged from 0.4-25% (OTA, 1989). Results of these studies also showed that the plastics content of MSW ranged from 2.0-9.0%, by weight. The U.S. EPA (1992) estimated that in 1990, the plastics content of MSW was 8.3%, by weight.

Results of a waste stream study conducted on Town of Brookhaven solid waste showed that the plastic content of the waste was higher than U.S. EPA reported estimates. During 1986-1987, the Town of Brookhaven sampled its waste stream using waste categories similar to those used by the U.S. EPA. In the winter of 1986 and spring of 1987, results showed that plastics were 10.3% and 9.4%, by weight, of the solid waste stream, respectively (Dvirka and Bartilucci, 1989). During this same time period (1986), U.S. EPA estimated that plastics comprised 8.0% of the waste stream, by weight. Results of this study suggest that Suffolk County residents may dispose of a higher percentage of plastics when compared to national averages, by a factor of 1.2:1. To account

for these differences, the national estimate of 1990 plastic waste generation of 8.3% was adjusted to yield a plastics waste content of 9.9% for Suffolk County. As such, WMI estimates that the plastics content of Suffolk County MSW is within the reported range of 8.3-9.9% by weight (290-347 million pounds; 145-174 thousand tons).

Seven plastic resins account for about 80% of all plastic sales: low-density polyethylene (LDPE), high-density polyethylene (HDPE), polyvinyl chloride (PVC), polypropylene (PP), polystyrene (PS), polyethylene terephthalate (PET), and acrylonitrile butadiene styrene (ABS) (OTA, 1989; Modern Plastics, 1993; Table 2). About half of the plastics discarded in the U.S. were equally divided between containers and packaging. Typical post-consumer waste contains between 50-65% PP and polyethylene (PE), with varying percentages of PVC, PET, ABS and PS (Maczko, 1988).

Of the plastic resins shown in Table 2, PS, PVC, HDPE and LDPE are affected by LL 10-1988. These four resins accounted for 58% of the total sales of plastic resins in the U.S. during 1992. The assumption made in using the domestic sales data is that imports of these resins equals exports, and that these items are all ultimately disposed of in the MSW waste stream. The percentage, by weight, in MSW for each item in Table 3 was calculated using the U.S. EPA reported value of 391,400 million pounds of MSW generated in 1990.

Table 2. Selected U.S. Resin Sales, 1992.

	Amount (million lbs.)	% of Total
LDPE (incl. LLDPE)	12,307	18.81
HDPE	10,434	15.94
PP	8,502	12.99
PVC	10,053	15.36
PS	5,197	7.94
ABS	1,285	1.96
PET	3,934	6.01
Other Resins	13,728	20.98
Total	65,440	100.00

Source: Modern Plastics, January 1993.

Table 3. U.S. Packaging resin sales (Modern Plastics, Jan., 1993).

Packaging Resin	Amount (mill. lbs.)	% of Category	% of MSW
POLYSTYRENE			
Pkg & Disposables (molding)			
Closures	94	1.81	0.02
Rigid Pkg	85	1.64	0.02
Tumblers, glasses	76	1.46	0.02
Flatware, cutlery	88	1.69	0.02
Dishes, bowls, cups	55	1.06	0.01
Pkg & Disposables (extrusion)			
Oriented film & sheet	270	5.20	0.07
Lids	130	2.50	0.03
Plates and Bowls	48	0.92	0.01
Foam Polystyrene (extrusion)			
Plates	154	2.96	0.04
Hinged Containers	105	2.02	0.03
Cups	50	0.96	0.01
Packaging	104	2.00	0.03
Cups and Containers	153	2.94	0.04
Other	3785	72.83	0.97
Grand Total	5197	100.00	1.33
POLYVINYL CHLORIDE			
Packaging			
Film	244	2.43	0.07
Sheet	44	0.44	0.01
Other	9765	97.14	2.49
Grand Total	10053	100.00	2.57
HIGH DENSITY POLYETHYLENE			
Food Pkg Bags	163	6.32	0.04
Other	2417	93.68	0.62
Grand Total	2580	100.00	0.66
LOW DENSITY POLYETHYLENE			
Food Packaging			
Produce	193	2.80	0.05
T-Shirt sacks	192	2.79	0.05
Grocery Wetpack	96	1.39	0.02
Self-Service Bags	103	1.49	0.03
Misc.	563	8.17	0.14
Other	5484	83.36	1.40
Grand Total	**6894**	**100.00**	**1.69**

In 1992, 10,053 million pounds of PVC were sold in the U.S. (Table 2). Of those sales, 288 million pounds, or 2.87%, were used for the manufacture of packaging materials such as flexible wrap for meat and cheese (Table 3). On the basis of this data, the PVC content of MSW due to packaging is estimated to be 0.08%.

Polystyrene sales in the U.S. in 1992 totaled 5,197 million pounds, of which 1,412 million pounds were used to manufacture PS disposable food packaging items (Table 3). These items are estimated to account for 0.36% of MSW by weight. A 1989 study sponsored by the PS trade association estimated the annual food service PS waste in Suffolk County was composed of 1,937 tons per year foamed PS and 1,842 tons per year of solid PS (Moore Recycling Associates, 1989).

Low-density (LDPE and LLDPE) and HDPE are the resins most commonly used in the manufacture of food and grocery bags. Items identified as food and grocery bags accounted for 1,573 million pounds of these resins in 1992, an estimated 0.33% of MSW, by weight (Table 3). The items identified in Table 3 and included in the total HDPE and LDPE bags are not all necessarily grocery bags. A reliable estimate of the total number of grocery bags used in Suffolk County is not available.

Using existing national plastic data, WMI has estimated the contribution of plastic grocery bags to the solid waste stream in Suffolk County. Approximately 35 billion plastic grocery bags are manufactured in the U.S. each year (Modern Plastics, 1992). Assuming a distribution of grocery bags based on population alone

(Suffolk County's population is approximately 1.32 million or 0.54% of the U.S. total population), Suffolk County would use about 190 million plastic grocery bags per year. A second estimate may be made based on projected grocery bag use. Tom Cullen (Testimony to the Suffolk County Legislature, 1992) stated that the 33 King Kullen stores used 46.8 million plastic grocery bags in 1992. Suffolk County has an estimated 400 grocery stores (Dinda, personal communication). Assuming a comparable grocery bag usage rate for all stores in the county, the 400 grocery stores would use 567 million grocery bags per year. On the basis of these rough estimates, Suffolk County grocery stores utilize between 190-567 million plastic grocery bags per year.

Assuming 64 plastic grocery bags per pound, the total weight of plastic contributed to the Suffolk County solid waste stream due to discarded grocery bags ranges from 2.97-8.86 million pounds per year. Recent waste generation estimates for Suffolk County show that 3,506 million pounds of MSW was discarded in 1991 (Tonjes and Swanson, 1992). Thus, the plastic grocery bag contribution to the Suffolk County waste stream ranges from 0.08%-0.25%. This estimated total is less than the total of 0.33% estimated using the U.S. sales data for LDPE and HDPE resins. The discrepancy is probably due to the fact that Table 3, U.S. sales in 1992, contains items which are not grocery bags.

A summation of the PS, HDPE, LDPE and PVC plastic packaging content of MSW based on 1992 resin sales data yields a total ranging from 0.52%-0.69% by weight. If it is again assumed that

Suffolk County has a higher percentage of plastic waste as compared to the national average (1.2:1), the plastic packaging content of MSW estimate for Suffolk County may be increased to an upper limit, between 0.62%-0.83%. If there were no exemptions to the ban and all PS and PVC food packaging were used only by retail food establishments (none would be available for sale to consumers on grocery store shelves or to non-retail food establishments), then the preceding calculations show that 0.52% (low estimate)-0.83% (high estimate) of the waste stream in Suffolk County would be affected by LL 10-1988. Using 1991 data for Suffolk County, these percentages yield a range of 18.2-29.1 million pounds (9.1-14.6 thousand tons) of plastics targeted by the ban. The legislation, however, does contain several product and business exemptions which further reduce the percentage of the total waste stream which is actually affected by the ban.

Local Law 10-1988's Effect on Plastics Composition of MSW

Local Law 10-1988 specifically prohibits PVC and PS food packaging. The sale or distribution of the following items from retail food establishments would be prohibited under the current legislation: (1) PS cups, meat trays, clam shell food containers, plates, utensils, covers and lids; (2) PVC food wraps; and (3) HDPE and LDPE grocery bags. Although these items are banned in the legislation, there are several exemptions written into LL 10-1988 which will further reduce the percentage of these plastics impacted by the ban (see Table 1, Section II, for a summary).

Hospitals, Meals on Wheels, and nursing homes are exempt under the current legislation. Hospitals in Suffolk County were contacted by WMI personnel to determine the extent to which they use PS products. Results of the survey showed that several of the hospitals, including Brookhaven, Brunswick, Eastern Long Island and St. Johns Episcopal, do not use PS products in their food service operations (Table 4). At these hospitals, china cups and plates and metal utensils were used in place of disposable PS items. Mather Memorial, Southside, St. Charles and Stony Brook University Hospital use PS products in at least a portion of their food service operations. Central Suffolk Hospital uses reusable plastic (plastic sufficiently durable so that it can be reused) in its food service operations.

Schools and industrial cafeterias, such as Grumman and LILCO, that recycle their PS and maintain a separate waste stream are also exempt under Local Law 10-1988.

Items identified in the ban which enter Suffolk County as a result of interstate commerce are also exempt from the ban (Dinda, personal communication). The Long Island Railroad, airlines, car and passenger ferries (Orient-New London, Port Jefferson-Bridgeport, Montauk-Block Island), and busses (Greyhound) generate waste which ultimately becomes incorporated into the Suffolk County waste stream. The size of this waste stream is unknown but may contain a high proportion of disposable food packaging.

Table 4. Suffolk County Hospital Food Service Items.

Hospital	Plate Type	Cup Type	Utensil Type
Brookhaven	China	China	Metal
Brunswick	China	China	Metal
Central Suffolk	Reusable Plastic	Reusable Plastic	Reusable Plastic
Eastern Long Island	China	China	Metal
Mather Memorial	China	PS	PS
Southside	China	China	PS
St. Charles	China	PS	PS
St. Johns Episcopal	China	China	Metal
University Hospital	PS	PS	PS

Source: Representatives of the Food Service Department for each hospital, telephone interviews, 1993.

In addition to business exemptions, there are also several product exemptions. For example, any prepackaged food that is shipped into Suffolk County retail food establishments from outside the County is exempt. As an example, PS foam trays which are used to package Holly Farms chicken products would be exempt.

Local Law 10-1988 specifically identifies PVC as a threat to the environment in Suffolk County and presumably includes PVC items in the ban legislation. However, the legislation states that any flexible, transparent covering for uncooked or raw meat, poultry, raw fish, hard cheese, cold cuts, fruit and vegetable produce, and baked goods or bread is exempt. The primary use for PVC in food packaging is as a flexible transparent covering for uncooked raw meat, poultry, fish, cheese, vegetables and bread. Given this exemption, the total 288 million pounds of PVC identified for food packaging shown in Table 3 would not be banned. The WMI was not able to identify a single PVC item which would be banned under the current legislation.

As a result of these business and product exemptions, the legislation identifies the following items at retail food establishments: all plastic grocery bags and PS retail food packaging products. The legislation (LL 10-1988) does not, however, prohibit the sale of these products in Suffolk County stores -- a consumer could continue to purchase any of the banned food packaging products (for non-retail use, such as home use).

The cumulative effect of the exemptions contained in LL 10-1988, along with the fact that the ban targets only a few items which comprise a very small percentage of the total PVC, PS, PE, HPDE, and LDPE in the waste stream results in a minimal reduction in the weight of these plastics entering Suffolk County's solid waste stream. The complete exemption of PVC from the ban further reduces the estimated percentage of plastic waste targeted by LL 10-1988 by 0.08% (Table 3); thus revising the targeted MSW plastic content to a range of 0.44-0.75%.

It is difficult to quantify the plastic contributions to the waste stream due to the other exemptions stated in LL 10-1988. The percentage of the plastic waste stream affected by the legislation (0.44-0.75%) would be further reduced if the percentage of plastics exempted from the ban due to the various product and business exemptions could be quantified.

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V. MUNICIPAL SOLID WASTE TREATMENT TECHNOLOGIES

The implementation of LL 10-1988 is anticipated to have an impact on existing and proposed MSW treatment technologies. The legislation would result in removing a portion of the plastics component from the waste stream, primarily PS, LDPE, and HDPE, while increasing the percentage of alternative products, in particular paper products, entering the solid waste stream. The following section examines the effect LL 10-1988 may have on landfills, composting, degradable plastics, incineration, and plastics recycling.

Landfilling of MSW

The reliance on landfilling as a means of disposing Suffolk County waste has decreased dramatically over the past seven years (1986-1992). The Long Island Landfill Law, enacted in 1983, mandated the closure of Long Island landfills by 1990 (NYS ECL 27-0704, 12/17/90). As a result, Long Island towns have changed their methods for disposing of MSW. During 1986, greater than 90% of the MSW generated in Suffolk County was landfilled, while only 7% of the MSW was incinerated at waste-to-energy facilities (Tonjes and Swanson, 1992). During 1992, it was estimated that only 19% of the MSW was landfilled, while 36% of the MSW was incinerated. With the expected closure of additional landfills, the transport of MSW to out-of-state disposal sites, and an expanding recycling commitment, the use of landfilling in Suffolk County for MSW disposal is expected to continue to decrease.

A waste composition analysis was conducted on landfilled solid waste at the Brookhaven Town landfill on 19 April, 1990 (Breslin, 1993). The solid waste excavated from the landfill was hand-sorted into the following categories: paper, metal, glass, plastic, wood, textiles, rubber, ceramics, and soil. Paper accounted for almost 60%, by weight, of the excavated solid waste (Table 5). Plastics comprised 7.8%, by weight, of the solid waste excavated, with almost 70% of the plastic in the form of film or bags. Polystyrene foam comprised 0.2%, by weight, of the solid waste excavated, representing 3% of the plastic fraction of the waste stream. Previous landfill excavation studies have shown that fast food packaging comprised 0.3%, both by weight and volume, of excavated solid waste (Rathje et al., 1988). Polyvinyl chloride content of the plastics was not specifically identified in the solid waste.

One concern about plastics in landfills is that plastics, although lightweight, occupy a large volume of landfill space. Plastics are estimated to comprise approximately 2-9% of the total weight of MSW (Table 6). Although lightweight, plastics occupy a disproportionately large volume. It has been estimated that plastics may occupy up to 30% of the volume of landfilled MSW (Franklin and Associates, 1988). A similar study shows that the landfill space occupied by plastics may be overestimated (Rathje et al., 1988). Current landfill practices involve the compaction of MSW, including plastic containers, following placement in the landfill. The volume of plastics in compacted MSW has been estimated to be approximately 18% (Rathje et al., 1988).

Table 5. Brookhaven Town landfill composition study.

Material	% of Total Weight	% of Category
Paper	59.2	
Newsprint	41.2	70
Cardboard	10.3	17
Other Paper	7.7	13
Plastic (Except Diapers)	7.7	
Film, bags	5.4	69
Styrofoam	0.2	3
Bottles	1.3	17
Other plastic	0.8	10
Diapers	2.9	
Food, Grass, Leaves	1.0	
Wood	11.4	
Glass	1.0	
Metal	5.2	
Aluminum	0.2	4
Ferrous	4.5	87
Other Metal	0.5	9
Textiles	7.9	
Rubber	1.0	
Ceramics	0.0	
Composite materials	0.0	
Matrix (sand, soil, fines, sludge)	2.5	
Total	100%	

Table 6. Previously reported MSW landfill compositions (%).

Material	9 Studies Mean	9 Studies Range	40 Studies Mean	40 Studies Range
Total Paper	38.8	29.9-45.9	46.7	36.5-54.7
Newspaper	6.3	4.3-8.1		
Corrugated	7.9	4.7-13.1		
Mixed	21.9	19.6-25.2		
Magazines	0.7	0.7		
Total Metal	4.9	1.5-9.4	8.5	4.0-14.7
Aluminum Cans	0.9	0.8-1.0		
Other aluminum	0.7	0.2-1.6		
Non-ferrous	1.0	0.0-3.4		
Total Glass	7.8	3.6-12.9	8.4	6.0-13.7
Glass containers	6.4	6.1-6.6		
Total Plastic	8.8	5.3-12.6	5.3	2.0-9.0
Plastic film	3.1	3.1		
Plastic containers	0.9	0.7-1.0		
Yard Waste	18.2	0.0-39.7	9.5	0.4-25.0
Food Waste	14.7	1.3-28.8	7.8	0.9-18.2
Wood	2.6	0.7-8.2	2.6	0.5-7.0
Textiles	3.4	1.1-6.2	3.3	0.7-5.0
Rubber	0.4	0.0-1.0		
Diapers	0.0		1.5	0.5-2.9
Unclassified	9.2	3.8-16.6		0.5-10.0

Source: Office of Technology Assessment, 1989, weight % by category.

The overall rate of degradation of organic materials occurring in MSW sanitary landfills is slow. Recent studies have shown that food waste and newspapers excavated from landfills are readily identifiable following 20 years of burial (Kinman and Nutini, 1990; Suflita et al., 1992). The rate at which degradation of organic materials proceeds is a function of many environmental variables, including moisture content, pH, temperature, number and types of microorganisms present, and solid waste composition. Plastics in particular are resistant to degradation and are not likely to rapidly degrade in landfills.

Thus, LL 10-1988 will have a negligible impact on the waste composition and volume of solid waste entering Suffolk County landfills, given the small percentage of plastics targeted by the ban and the persistence of organic materials in sanitary landfills. Due to the persistence of organic materials in landfills, it is also unlikely that alternative paper and polyethylene-coated paper products will degrade rapidly in modern sanitary landfills. In addition, the decreased reliance on landfilling for the disposal of solid waste generated in Suffolk County will further minimize the ban's impact on landfilling of solid waste on Long Island. These arguments can be extended to include the fact that there will be no impact of LL 10-1988 on Long Island groundwater.

Composting of the Yard Waste Component of MSW

Landfills in Suffolk County currently do not accept yard waste materials, except in an emergency -- such as a hurricane -- in

which case approval to landfill yard wastes must be sought from the New York State Department of Environmental Conservation (NYSDEC). Yard wastes, primarily leaves, twigs, and tree branches, are separately composted at facilities located within most of the Towns. Currently, many Suffolk County communities discourage the collection of grass clippings for composting at Town facilities. Yard waste composting facilities located in Suffolk County include Holtsville, Islip, Manorville, Riverhead, Southold, Shelter Island, Southampton, and East Hampton. The compost is provided at no cost to Town residents. There are also private composting businesses, such as Long Island Composting (formerly Metski Composting), in East Moriches, NY, and Productive Recycling, in Kings Park, NY.

The use of film plastic bags for the collection and composting of yard waste has presented numerous obstacles for the operators of yard waste composting facilities. Since plastic film does not degrade as rapidly as the yard waste materials, care must be taken to remove the plastic from the compost, either prior to or following the composting process. Plastic film may be removed at the facility by either debagging the yard waste prior to composting, or screening the mature compost product to remove the plastic fragments. Neither of these techniques results in the removal of all plastic fragments from the mature compost. Debagging the yard waste is preferred, as plastic bags or fragments in the compost may interfere with the windrow turning machines and screening processes. The debagging process improves the quality of the compost, but may add to the cost of composting.

Some municipalities that collect yard waste for composting provide paper bags for collection on designated days. They discourage the use of plastic bags, as the presence of plastic fragments in yard waste compost detracts from the aesthetic quality of the compost, making it undesirable to the end user. A recent study of yard waste compost produced at the Islip and Holtsville composting facilities showed the presence of trace amounts (by weight) of plastic film fragments in the coarse size fractions (>4.75 mm) of the compost (Tisdell, 1993). Although present in trace amounts, the plastic fragments were visible. Several recent studies have shown that starch-plastic composites, so called "biodegradable plastics," do not deteriorate rapidly during the time interval (6-18 months) required to compost yard waste (Cole and Leonas, 1990; Breslin and Swanson, 1993). Clearly identifiable plastic fragments remained in the yard waste compost, following the composting of starch-plastic composite yard waste bags.

Plastic items banned in the legislation are not items that have been identified as contaminants in yard waste compost. The implementation of the legislation (LL 10-1988), therefore, will have little effect on the quality of yard waste compost produced in Suffolk County.

Composting of all MSW

In Suffolk County, MSW composting has been proposed as a means of reducing the volume of solid waste, while producing a marketable by-product. OMNI Technical Services Inc. of Westbury, NY, has

received a permit from the NYSDEC to construct and operate a municipal solid waste composting facility in Calverton, NY. Municipal solid waste composting facilities generally employ shredders, screens, trammels, density separation, and hand picking in an effort to remove non-compostable items, including plastics, from the waste stream prior to, during, or following the composting process. Despite these efforts, results of a recent study show that plastic fragments, primarily film, may comprise up to 2.0% of the total MSW compost weight, and up to 97% of selected coarse size fractions (>4.75 mm) (Tisdell, 1993). Although the weight of the plastic fragments relative to the total compost is low, the volume of plastic present is sufficient to result in its being a visible contaminant. The visibility of the plastic reduces the marketability of the compost product. Excess foreign matter, including glass and plastic, may restrict the use of the compost to non-food chain crops. At present, Minnesota and Florida include specific limits for compost foreign matter content (Tisdell, 1993).

As all of the items identified in LL 10-1988 become incorporated into the solid waste stream, it is likely that these materials will be found in compost produced at solid waste composting facilities. The plastic content of MSW is approximately 8%, by weight, while the resultant MSW compost plastics content was found to be 2% or less (Tisdell, 1993). Pieces of plastic film are the most common form of visible plastic in MSW compost. The presence of plastic in the MSW compost is primarily due to the resistance of plastic to degradation during the composting process

and the inefficiency of the screening processes at the facility to remove plastic fragments from the finished compost.

A recent study has shown that paper/paperboard products are generally susceptible to degradation following soil burial (Research Triangle Institute, 1990). Blotting paper completely deteriorated within two weeks of soil burial while wax-coated cold beverage cups lost almost all their initial strength within five weeks of burial. Results of outdoor soil burial studies showed that PE-coated paper/paperboard products underwent extensive deterioration within 15 weeks. However, while the cellulosic and lignin components of the paper/paperboard product were degraded by the soil microorganisms, the PE coating itself did not degrade (Research Triangle Institute, 1990). Under conditions encountered during composting -- high biological activity, sufficient moisture, and proper temperature control -- similar or more rapid deterioration of the paper products may occur. It is also likely, however, that the PE coatings on paper products would survive the composting process.

As the lignin and cellulosic content of paper products is compostable, the potential exists to compost food-contaminated fast food paper packaging waste. The MSW composting facility located in St. Cloud, MN, has conducted trial composting of paper packaging from Burger King restaurants to examine the potential for composting food and packaging from fast food restaurants (The Composting Council, Quarterly Newsletter, April 1993). The Burger King interim report concluded that "composting of food-contaminated

paper, along with food waste, is feasible and should be pursued." Similar pilot composting studies have been conducted using fast food packaging from McDonald's restaurants in New York State (Robert Langert, Director of Environmental Affairs, McDonald's Corporation, personal communication).

Degradable Plastics

Concern over the persistence of plastics in solid waste following disposal has resulted in the development of enhanced degradable plastics. For many solid waste disposal options, including landfilling and incineration, degradable plastics do not offer any measurable benefit. Recent studies have shown that the rate of solid waste degradation, including enhanced degradable starch-plastic composites, in landfills is slow (Breslin, 1993; Kinman and Nutini, 1990; Sulfita et al., 1992).

However, many identifiable plastic items contribute to litter, where they are visual contaminants, and marine debris, where they may pose a threat to marine organisms (Piatt and Nettleship, 1987; Carr, 1987; Swanson and Zimmer, 1990). In addition, if solid waste composting becomes a major waste treatment technology, rapidly degradable plastics may alleviate concerns about visible plastics in the resultant compost product.

The deterioration of plastics in the environment can be enhanced by incorporating additives to make the polymer (most frequently PE) more susceptible to photodegradation or biodegradation. Photodegradable plastics deteriorate in the

presence of ultraviolet (UV) light. Additives, including carbon monoxide, vinyl ketone, iron, manganese, cobalt, and nickel are incorporated into the polymer to make it sensitive to UV light.

Biodegradation studies indicate that the polymer deteriorates via the metabolic activities of microorganisms such as bacteria and fungi. The first generation of biodegradable plastic bags contained both prooxidant and biodegradable additives within a PE matrix (Griffin, 1991). The prooxidant additives were designed to initiate the deterioration of the polymer by either thermo-oxidative or photo-oxidative processes. The biodegradable additive, usually starch, was then consumed by microorganisms. Recent research, however, has shown that these first generation biodegradable plastics are unacceptable, as they did not deteriorate rapidly following disposal (Breslin and Li, 1993; Breslin and Swanson, 1993; Breslin, 1993).

Concern has been expressed over the possible by-products of plastics degradation, including small pieces of fragmented plastics or "plastic dust." The WMI conducted a series of bioassay experiments to determine the toxic potential of soluble components of degradable starch-plastic by-products developed by the Archer Daniels Midland Company of Decatur, IL, including plastic dust (Breslin et al., 1991). Bioassays were conducted using two representative marine organisms; the grass shrimp, Palaemonetes pugio, and the diatom Thalassiosira psuedonana.

The grass shrimp bioassays followed U.S. EPA protocols and consisted of placing grass shrimp in seawater:plastic suspensions

(containing from 0.1%-0.5% plastic dust <2.0 mm) for 72 hours. Each day for three days the aquaria were examined for shrimp mortality. Shrimp mortality was only observed in the unbuffered 0.5% starch-PE plastic dust suspensions, and was attributed to changes in aquaria pH due to the presence of the starch-plastic dust (Breslin et al., 1991). Gut blockage of the grass shrimp due to the plastic powder was not observed in any of the treatment aquaria.

The marine diatom, T. psuedonana, was exposed to seawater leachates prepared using photodegraded starch-plastic powder. The diatoms were cultured in 0%, 0.1%, 1.0% and 5.0% seawater leachates and the chlorophyll-a concentration, cell number and photosynthetic rate of the cultures were measured over a 96-hour period. Results showed a decrease in the chlorophyll-a content only for phytoplankton cultured in starch-plastic powder at leachate concentrations of 5.0% (Breslin et al., 1991). The cause for the decrease in chlorophyll-a content of the diatoms cultured in the 5.0% starch-plastic powder leachates was not determined.

Neither grass shrimp mortality nor decreases in the growth parameters for diatoms were observed in seawater cultures containing various concentrations of control PE plastic. Treatment effects were only observed in the cultures containing the starch-plastic composites.

Recently Developed Degradable Materials

Recent industrial efforts have focused on the development of both water-soluble and/or truly degradable polymers (Table 7). These polymers are designed to completely degrade via enzymes secreted by microorganisms, resulting in the cleaving of the polymer into smaller segments. The enzymes attack the polymer chains via hydrolytic and oxidative reactions. The enzymatic attack on polymer chains continues until the polymer segments are reduced to a low molecular weight molecule that can be metabolized by a particular microorganism.

Similar to any organic material, certain conditions must be present to allow for the rapid degradation of these polymers in the environment. These conditions include the presence of microorganisms, sufficient moisture and oxygen, temperatures generally within 20°-60°C, and pH between 5-8 (Huang et al. 1990; Kinman and Nutini, 1988).

Many of the recently developed truly biodegradable polymers continue to undergo development. These polymers are more expensive than currently-available polymers, and are most suitable as replacements for non-degradable polymers which frequently are identified as items present in litter and marine debris.

Products manufactured using truly degradable polymers include yard waste bags for composting, agricultural mulch, diaper films, grocery sacks, pharmaceutical capsules and product packaging. Much of what is known concerning the rate of degradation of many of these degradable products is based on research conducted by the

Table 7. Recently developed degradable polymers.

Supplier	Product	Capacity (10^6 lbs)	Cost (per lb)	Comment
Air Products & Chemicals Allentown, PA	Polyvinyl Alcohol	185	$2.50	Water soluble, compostable
Cargill, Minneapolis, MN	Polylactic acid		$1-3	Compostable, not soluble
ICI, Wilmington DE	Hydroxy-butyrate/ valerate (PHBV)	0.661		Moisture resistant, produced from natural feedstock
Novamont/Feruzzi New York, NY	60% starch-based thermo-plastic (Mater-Bi)	50	$1.60-$2.50	Improved melt flow values, improved heat and aging resistance
Union Carbide Danbury, CT	Polycapro-lactone (Tone Polymers)	<10	$2.70	Compostable, not soluble

Source: Modern Plastics, February, 1992, pp. 63.

companies which developed the products, and is contained in promotional brochures. Results of these studies show that these polymers will rapidly degrade if the proper conditions exist within a given disposal site (Novamont North America, Inc., 1992). Researchers at WMI at Stony Brook are currently evaluating the rate and extent of degradation of polycapralactone (Union Carbide) and Mater-Bi (Novamont North America, Inc.) polymers in the marine environment. These companies are not providing WMI with research funds. Industry support for this project has been in the form of providing samples of the film products. Further research is necessary to fully assess the degree to which these products will contribute toward solving problems associated with persistent plastic debris.

Of the polymers identified in LL 10-1988, the major items that have incorporated degradable additives are the HDPE, LDPE, and LLDPE grocery bags. Degradable utensils have been recently manufactured which may provide a replacement for HDPE or PS utensils. Degradable additives have not been added to PVC products or to PS foam cups and containers.

During the past two to three years, grocery stores in Suffolk County have offered these PE-based grocery bags, which contain either photodegradable or biodegradable additives, to enhance the deterioration process. The biodegradable grocery bags were starch-plastic composites, which were shown not to rapidly degrade in landfills following disposal (Breslin, 1993).

Grocery bags manufactured using the recently developed truly degradable polymers are not yet widely available commercially, and are costly (Table 7). Area grocery stores now typically provide both kraft paper bags and HDPE, LDPE, and LLDPE plastic bags (containing no degradable additives), and allow the consumer to choose either plastic or paper.

Recyclability of PVC, PS, and HDPE Grocery Bags

Post-consumer waste plastic recycling has focused primarily on two resins, HDPE and PET. The HDPE that is recycled is derived primarily from the curbside collection of bottles and containers, such as detergent bottles and gallon milk containers. Less than 200,000 tons of post-consumer plastic waste, about 1.1% of the plastic in MSW, was recycled in the U.S. in 1988 (OTA, 1989). Impediments to recycling higher amounts of post-consumer waste plastic include the inefficient collection, identification, separation, cleaning, and processing of commingled resins, necessary to the manufacture of useful plastic products. It is difficult to process post-consumer waste plastic to obtain a high-quality plastic resin, and do it profitably. Certainly, there are success stories in the plastics recycling industry; however, there have also been many failed attempts to recycle post-consumer waste plastic. More and more communities are offering curbside collection of plastics, which will result in larger amounts of resins available for recycling. In addition, technological

advances should result in improvements in all aspects of the recycling process.

In Suffolk County, curbside collection of HDPE and PET is available in many Towns. State-of-the-art materials recovery facilities (MRFs) are located in Brookhaven and Islip, and they accept and separate these resins for marketing to recyclers. Curbside collection of PVC and PS is not currently available. However, the Town of Huntington opened two PS drop-off sites for the public in June, 1993 (Samuel Kearing, Director, Department of Environmental Control, Town of Huntington, personal communication) (Figure 5). Additionally, the Town of Brookhaven opened three PS drop-off sites in August, 1993 (Figure 6).

Although selected polymers are collected and processed at MRFs in Suffolk County, little is known about the ultimate fate of the plastics recovered. Collection and separation of the polymers does not constitute recycling. The polymers must be reprocessed to form new products which can then be reused or sold. Recycled products can be identical to -- or different from -- the original products, and they may be of equal or lesser quality than the original products.

Environmental groups have tracked the shipment of waste plastic to foreign countries for reprocessing, including China, Indonesia, and the Philippines (Ann Leonard, International Toxic Trade Project, Greenpeace, personal communication). The WMI was unable to determine what percent of waste plastics shipped abroad return to the U.S. as recycled products, as the ports from which

Figure 5. Polystyrene drop-off collection site, Recycling Center on New York Avenue,Town of Huntington, 1993.

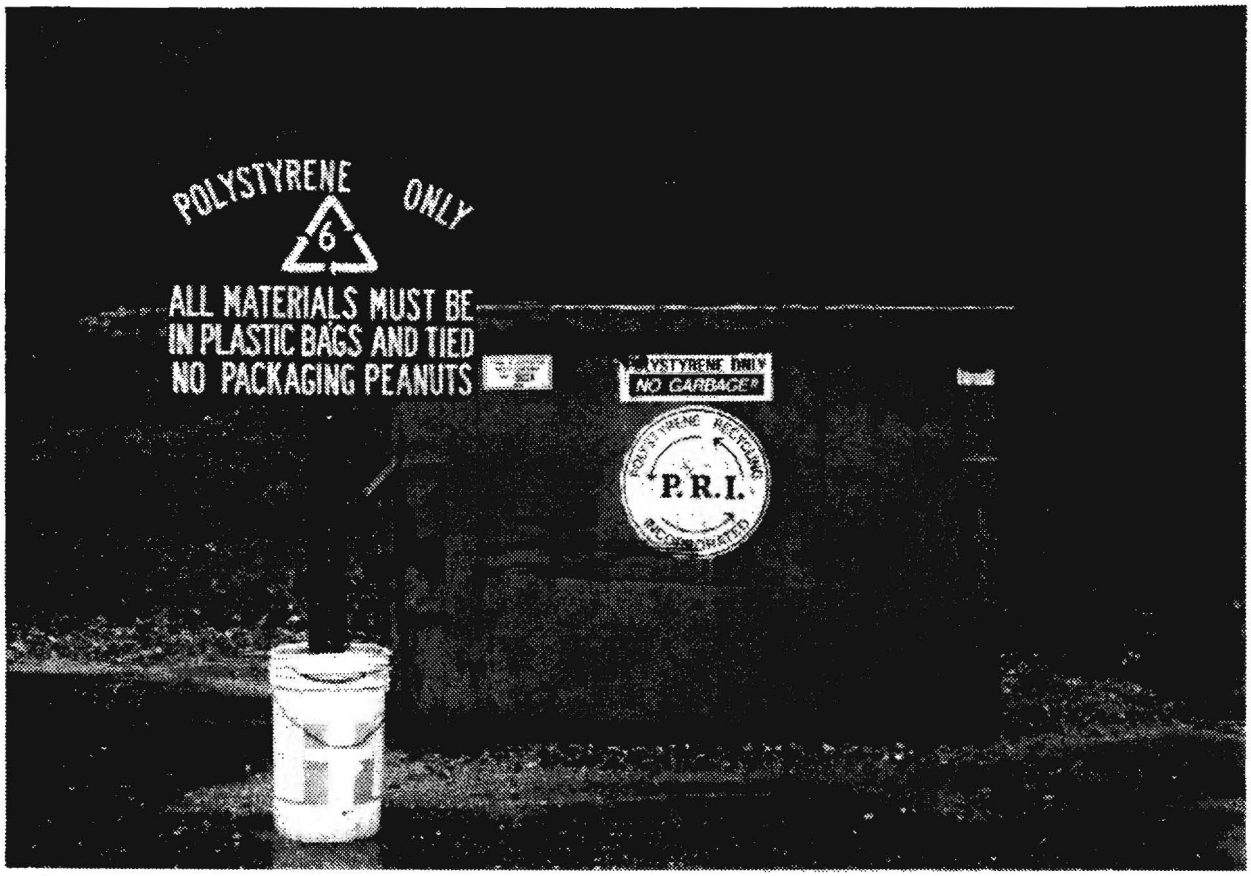


Figure 6. Polystyrene drop-off collection site, Holtsville Ecology Center, Town of Brookhaven. Model citizen Evan Schultz, 1993.

they are shipped do not distinguish recycled content in any exports or imports (Paul Druckenmiller, Foreign Trade Statistics, The Port of New York - New Jersey, personal communication).

Local Law 10-1988 identifies PVC and PS food packaging, and PE grocery bags as items which significantly contribute to environmental problems associated with solid waste disposal. Opponents of LL 10-1988 suggest that these materials and products may be successfully recycled, avoiding the need to landfill or incinerate these items. In lieu of providing an overview of the state of plastics recycling in the U.S., a study was initiated by WMI for this report, to examine efforts to recycle PVC, PS, and PE waste packaging in Suffolk County.

PVC Packaging Recycling

Of all the plastics used in packaging, the recycling rates for PVC are the lowest. Although little PVC is recycled nationally, efforts are underway to improve its recyclability. Sorting technologies for PVC are being developed which rely on identifying the chlorine atom. This will allow for an accurate identification of the polymer. Anticipated end uses for post-consumer scrap PVC include non-food bottles and coextruded pipe and tubing.

At present, PVC is not targeted for curbside collection in Suffolk County. Concern has been expressed about PVC products being incorporated into curbside collection programs, as a single PVC bottle may contaminate and/or impede the recyclability of PET and PE containers.

Grocery Bag Recycling

Polyethylene bags (LDPE, LLDPE, HDPE) are not collected at the curbside (presumably due to the difficulty in separating these bags from the other plastic items collected at the MRF). Many Suffolk County grocery stores which provide PE bags for bagging groceries, however, also provide bins for customers to return the bags for recycling (e.g. Edwards, King Kullen).

Grocery bags, primarily HDPE, collected at the stores are usually transported by the processor to a distribution center, where the bags are baled. Bales can range from 800-1,400 pounds depending on the baler type used. Bales are then shipped to a manufacturer to produce pellets. Prior to processing, the bales are disbanded and the bags are sorted by resin type, and to remove contaminants such as paper, cans, bottles, and trash. Following sorting, the bags are shredded, heated and either densified or extruded into pellets. The pellets are then used to produce a variety of products.

Pellets produced from the collected bags have been used to manufacture products including new grocery bags, oil bottles and Edgeboard, a protective cornerboard product used when stretch-wrapping pallets. As of 1990, Sonoco Products collected grocery bags from 6,732 stores nationally, with the percentage of bags returned ranging from 8-12% (Amidon, 1990).

Locally, WMI personnel have followed the trail of plastic bags which are collected in bins at Edwards Supermarkets (formerly Finast Supermarkets). The PE bags are picked up by First National

Supermarkets of Windsor Locks, CT. First National collects used kraft paper and plastic bags from 73 stores in the New England area, eight of which are located in Suffolk County.

Once every five to six weeks, Vanguard Plastics, a plastics manufacturer/reprocessor based in St. Louis, picks up about 20,000 pounds of cleaned and baled PE bags from First National (thus approximately 10%, or 2,000 pounds of the plastic bags are from Suffolk County Edwards stores).

Vanguard has Food and Drug Administration (FDA) approval to recycle these plastic grocery bags into new grocery bags. Of the shipments they pick up from First National and other businesses, approximately 85% of the bags are usable; the remaining 15% are contaminated. Their new, recycled bags, composed of blended HDPE and LDPE, contain approximately 10% post-consumer recycled content, on average -- although it can be as high as 85%. These bags then go directly back to grocery stores (John Meierhoffer, National Accounts Manager, Vanguard Plastics, personal communication).

Sonoco Products Company, Inc. of Hartsville, SC is the source of King Kullen Supermarkets' grocery bags. Sonoco is one of the four major suppliers of grocery bags to supermarkets in North America. It is estimated that 21 billion plastic grocery sacks are consumed by the grocery industry per year, representing about 60% of the total grocery bag market (Amidon, 1990). In recent years grocery bag recycling has been one of the fastest growing segments of recycling. As of 1990, over 10,000 supermarkets were participating in plastic grocery bag recycling programs.

PS Packaging Recycling

Polystyrene is collected and processed by Tri-State Recycling of Lindenhurst, NY, the only consolidator serving Suffolk County. Tri-State Recycling collects PS from the Town of Brookhaven and the Town of Huntington, from several Long Island school districts, and from industrial cafeterias such as those at Grumman (Calverton, NY) and Signal Technology, Inc. (Bohemia, NY). [Information on total volume collected and a complete customer list were unavailable from Tri-State Recycling].

Tri-State Recycling collects approximately 13 million pounds of PS waste from Long Island school cafeterias annually. They estimate that PS products account for 30% of the schools' solid waste by volume, and include trays, cups, soup containers, clear dessert cups, and lids (William Esposito, President, Tri-State Recycling, personal communication). Following PS collection and delivery to the Tri-State Recycling facility, the collection bags are opened, the material is manually sorted to remove non-PS products, and the PS is baled and placed on a trailer. When the trailer is fully loaded, the processed PS is shipped to the National Polystyrene Recycling Company (NPRC) in Bridgeport, NJ.

At the NPRC, the bales are opened and sorted once again to remove contaminants. The sorted PS is washed, ground, rinsed and dried, and put into silos for storage. The processed PS is then used to form PS pellets, which are then sold to product manufacturers. The NPRC has established markets for the PS pellets both in the United States and abroad. Several PS product

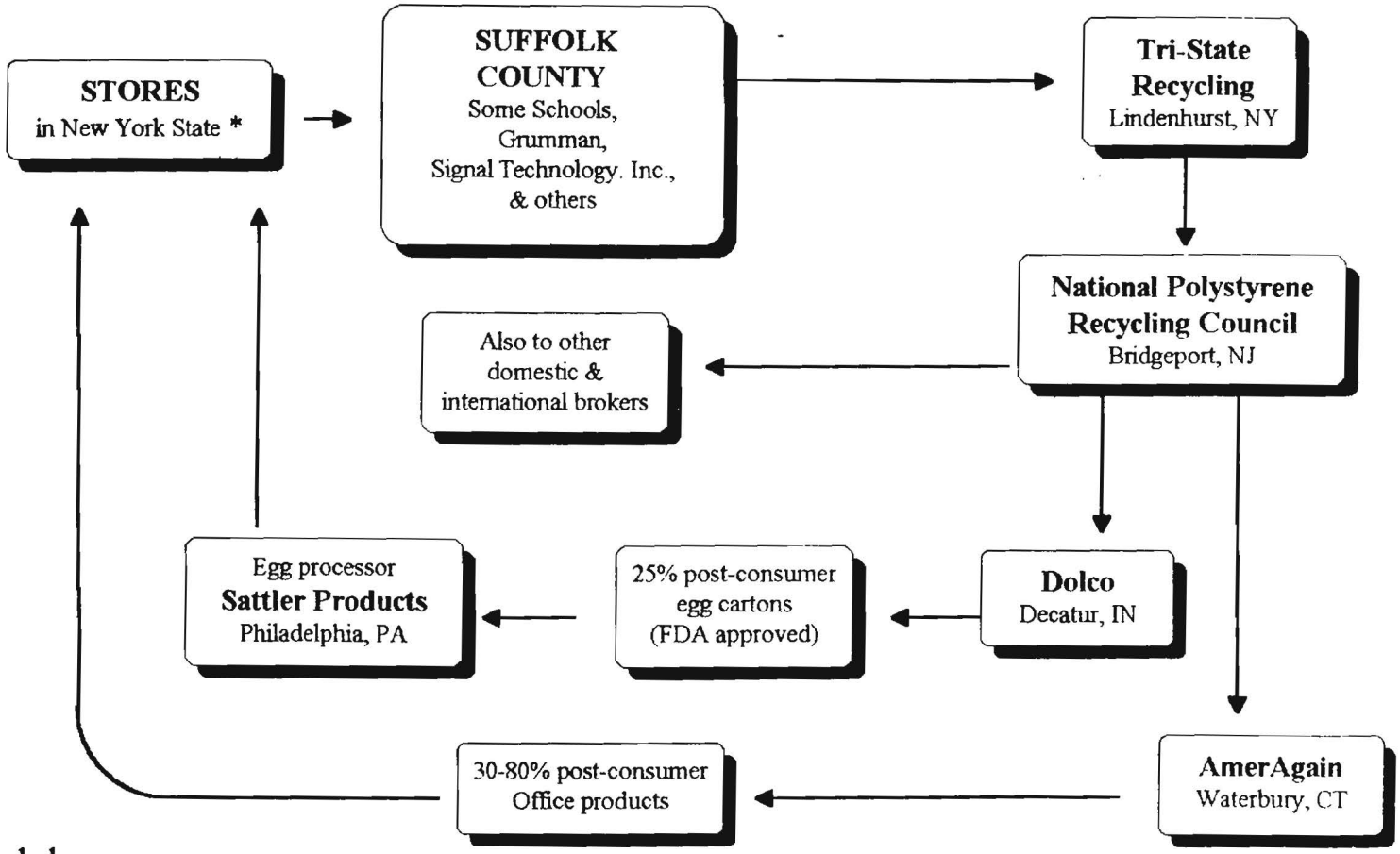
manufacturers supplied by the NPRC and contacted by WMI personnel are listed on the following flow chart (Figure 7). Products made by these companies range from food service products to rulers and business card holders. The PS post-consumer pellets may be used solely or, as is most common, in combination with virgin resin to manufacture the products. Many of these products are available for sale in New York businesses.

The WMI tracking of post-consumer PS foam and PE grocery bags demonstrates that the recycling of these materials, a portion of which originate in Suffolk County, results in the manufacture of products containing post-consumer waste plastic which are sold to New York consumers. This study was not successful in determining the amounts of material flowing through the system or in determining the costs associated with these processes.

Incineration of MSW: Dioxin and Furan Formation

Suffolk County currently has three operating mass-burn incinerators, located in Islip, Huntington, and Babylon, with a capacity for burning 550, 850, and 750 tons of MSW/day, respectively (Tonjes and Swanson, 1992). Incineration capacity has exceeded landfill capacity, and is now the primary means of handling MSW on Long Island (approximately 47% projected for 1992; 52% for 1993 -- by weight) (Tonjes and Swanson, 1992). Several specific concerns have been identified in LL 10-1988 relative to the combustion of plastics in MSW incinerators. These concerns

Figure 7. The loop of recycled polystyrene in Suffolk County



* These stores include:

A.I. Freidmann, NYC; Brooklyn Museum, Brooklyn; Inkwell, Warwick; Adhoc, NYC; Earth General, Brooklyn; Lynsey Department Stores, Cobleskill; New York State Correctional Facilities

Recycled New, Cyranac Lake; Boondocks & Pearl River, NYC; Persuasion Environmental, NYC;

relate primarily to the formation of toxicants as by-products of the combustion of plastics, most notably PVC. Local Law 10-1988 states that if PVC and PS are burned together at MSW waste-to-energy combustors they leave a heavier ash, and result in the formation of dioxins, hydrochloric acid, and other toxic chemicals which may be emitted to the atmosphere of Suffolk County. As such, it is important to fully consider the potential impacts of the ban on incineration and its by-products.

Sources of Dioxins and Furans

Polychlorinated dibenzo-p-dioxins (PCDDs), commonly known as dioxins, are a group of tricyclic, planar, aromatic organic compounds. Dioxins have a basic structure composed of two oxygen atoms linking two benzene rings. Chlorine atoms can be substituted for the hydrogen atoms on the rings producing chlorinated dioxins. Polychlorinated dibenzofurans (PCDFs) are similar in structure to dioxins, but possess only one oxygen atom between two benzene rings.

Sources of dioxins and furans to the environment are many and varied and include: 1) combustion sources including MSW, hazardous waste, and chemical incineration; 2) residential fireplaces and forest fires; 3) automobile exhaust; 4) high-temperature industrial processes (copper smelting and metal processing plants; 5) cigarettes; 6) chlorobleaching of wood pulp in paper mills; and 7) discharge from chlorination processes at waste water treatment

plants. Dioxins and furans are not intentionally manufactured except as reference standards for research.

Dioxins in MSW

Dioxins and furans have been identified in the stack gasses, emissions and ash residues of MSW combustors (Goldfarb et al., 1990; Hahn et al., 1992). There are several possible sources for the presence of dioxins and furans in MSW combustors. Dioxins, furans, and other organochlorine compounds have also been identified in different fractions of MSW (Wilkin et al., 1992; Visalli, 1987). Visalli (1987) measured dioxin and furan contents in MSW ranging from 3-5 parts per billion. Wilkin et al. (1992) analyzed four different waste fractions: 1) paper and cardboard; 2) plastics, wood, leather, and textiles; 3) fine debris; and 4) food and garden wastes. Results showed that dioxin and furan contents were highest in category 2 -- plastics, wood, leather, and textiles -- where PCDD and PCDF contents ranged from 29.1-1,370 picogram/gram (pg/g). The PCDD and PCDF contents were lowest in category 4) food and garden wastes, where concentrations ranged from 7.4-100 pg/g. A possibility exists that a fraction of the dioxins and furans present in MSW may not be destroyed in the furnace/boiler, and may be transported to the stacks in the flue gas.

Combustion Dioxin Formation

There are two generally accepted mechanisms for the formation of dioxins and furans in MSW combustors. The first mechanism, formation of dioxins during combustion, involves the de novo synthesis of PCDDs and PCDFs from unrelated chemical species (Stieglitz et al., 1989). The second mechanism for the formation of PCDDs and PCDFs in MSW combustors, catalysis on fly ash, involves the condensation of chemically-related precursors via a surface catalyzed process on the fly ash (Karasek and Dickson, 1987; Ross et al., 1990).

PVC and Dioxin

Concern has been expressed about the combustion of PVC and other plastics, as they contain large amounts of chlorine. In particular, approximately 50% of the molecular weight of PVC is chlorine. Plastics, including PVC, are not the only materials which are sources of chlorine in MSW. Wood, bleached paper, treated textiles, chlorinated solvents, and metallic chlorides are also sources of chloride in MSW. The combustion of PVC and other chloride-containing materials forms HCl, which is a component of acid rain and may be a precursor to PCDD and PCDF formation. Several studies, however, have shown that plastics do not play a major role in the formation of PCDDs and PCDFs within the MSW combustion chamber (Visalli, 1989; NYSERDA, 1987).

A research study was performed during June 1987 using the VICON MSW combustor facility in Pittsfield, MA. The New York State

Energy Research and Development Authority (NYSERDA) initiated the study, which was conducted under the technical auspices of the American Society of Mechanical Engineers (ASME). The PVC content of the MSW was varied prior to combustion by removing visible PVC items from the MSW, or by adding PVC pellets to increase the PVC content of the MSW. Results of the study showed that: 1) combustion temperature was the key determinant of the amounts of PCDDs and PCDFs released by incinerators [high PCDD/PCDF contents occurred at low (1,350-1,400°F) and high (>1,750°F) temperatures]; 2) PVC contents of the MSW were not correlated with the formation of, or concentration of, PCDDs and PCDFs at any measurement location; 3) dioxin concentrations increased as excess oxygen levels increased; and 4) varying moisture levels had no significant effect on dioxin concentrations.

A number of studies however, suggest a link between PVCs and dioxin and furan formation during MSW combustion. Several bench scale and laboratory studies have reported the formation of PCDDs/PCDFs following the combustion of chlorinated plastics or when PVC was added as a chlorine donor to combustion mixtures consisting of vegetable extracts (Markland et al., 1986; Liberti and Brocco, 1982; Yasuhara and Morita, 1988).

Recently, the Solid Waste Association of North America, Silver Spring, MD, under the sponsorship of the National Renewable Energy Laboratory (NREL), Golden, CO, and the U.S. Department of Energy (DOE), Washington, DC, examined the scientific evidence concerning the formation of dioxins and furans due to the combustion of MSW

containing PVC (NREL, 1993). On the basis of a review of the scientific literature, the study arrived at the following conclusions: "(1) Reported tests, which compare the PVC plastics waste content of MSW that is fed to combustors with observed emissions of dioxins, do not convincingly lead to a consensus view that removal of PVC from MSW will cause less dioxins to be emitted during MSW combustion; (2) evidence is available which indicates that regardless whether PVC plastics are present in MSW or not, when MSW is combusted, dioxins can be formed in amounts that presently are of regulatory concern, unless control measures to limit dioxin emissions are applied; and, (3) when MSW is combusted, control measures can limit dioxin emissions to levels that are below current regulatory concern, regardless of whether or not PVC is present in MSW."

Although the issue of dioxin and furan formation due to the presence of PVC in combusted MSW is addressed in this report, it is important to consider that WMI was not able to identify any PVC item that would be removed from the waste stream, should LL 10-1988 be implemented.

Effect of Plastics Combustion on Ash Residues

The combustion of MSW in waste-to-energy combustors results in the formation of combined ash residues consisting of both bottom ash and fly ash. Bottom ash consists of coarse ash aggregate that is removed from the grates at the base of the boilers, and accounts for about 85-90% of the weight of the ash generated. Fly ash is

the portion of the ash that becomes entrained and transported within the combustion gas stream, and is removed from the gasses by the pollution control devices. Fly ash is composed of fine particles and accounts for the remaining 10-15% of the weight of ash residue generated. The combustion of plastics in MSW may affect both the weight and volume of ash generated and its toxicity.

Volume of Ash Generated

Virtually all the carbon, hydrogen, nitrogen, and halogens in plastics combust to form gaseous by-products. Ash generation by plastics is primarily due to non-combustible additives present in the plastic products. These additives are primarily in the form of antioxidants, plasticizers, blowing agents, colorants, fillers, and flame retardants. Manufacturers produced 9.7 billion pounds of additives in 1982, a quantity equal to 17% of the weight of the polymers themselves (U.S. EPA, 1990). Based on the concentrations of additives in plastic, U.S. EPA concluded that plastics do not contribute disproportionately to the volume of MSW ash generated. In addition, U.S. EPA concluded that the relative volumetric plastic contribution to incinerator ash generation is less than plastics' contribution to the raw MSW waste stream (U.S. EPA, 1990).

Metals in MSW Ash Residue

Lead and cadmium-based stabilizers are not used in disposable PVC packaging materials, but they are used in most non-packaging applications of PVC (Modern Plastics, 1990). The PVC stabilizers are estimated to contribute 15% of the cadmium found in MSW in the U.S. (Franklin and Associates, Ltd., 1988). All plastics contribute about 28% of the cadmium and 2% of the lead in MSW in the United States. Industry is developing alternatives to heavy metal-containing additives in an effort to reduce the amount of lead and cadmium in MSW. Cadmium-containing heat stabilizers are being replaced by barium-zinc and calcium- zinc products (Modern Plastics, 1992). Alternatives to cadmium and lead pigments and colorants include a variety of organic compounds. These organic pigment products, however, are more expensive than the lead and cadmium pigments.

The combustion of plastics containing heavy metals in MSW combustors will result in the enrichment of these metals in the resultant ash residue, which is landfilled in Suffolk County. Lead and cadmium have been measured in high concentrations in fly ash and combined ash residues from MSW combustors (U.S. EPA, 1987; Sawell and Constable, 1988). Results of regulatory testing of combustor ash shows that lead and cadmium contents of Toxicity Characteristic Leaching Protocol (TCLP) leachates may exceed the regulatory limits for lead and cadmium (Roethel et al., 1991; U.S. EPA, 1990). Although metal contents of TCLP leachates at times exceed regulatory limits, with the exception of soluble salts, the

metal concentrations reported in ash monofill leachates are lower than regulatory limits, and are often lower than U.S. Drinking Water Standards (U.S. EPA, 1987).

Air Emissions of Dioxins, Acid Gasses and Metals

Air pollution control devices which remove particulate matter from the flue gasses control the emission of dioxins and furans, which condense on the surfaces of fly ash particles during the cooling of the gasses. State-of-the-art MSW combustion facilities which are equipped with dry scrubbers and fabric filters -- such as the Babylon and Huntington facilities in Suffolk County -- have low dioxin/furan emissions. Facilities equipped with acid gas scrubbers and fabric filters can remove 97-99% of the total dioxins and furans in the flue gasses. The U.S. standard for dioxin emissions from new MSW combustors, issued in February 1991, is equivalent to 1.0 ng I-TEF/dscm @ 7% O^2 (Toxic Equivalency Factors). The average of 80 test runs for dioxin emissions from twelve modern MSW combustors, including the Babylon facility, was 0.103 ng I-TEF/NM3 @ 12% CO_2 (Hahn et al., 1992). Much of this data, however, was collected during the permitting process, under optimum operating conditions. Concerns have been expressed about the ability of the facilities and pollution control devices to operate as efficiently following 10-20 years of operation.

Modern MSW combustors equipped with wet or dry scrubbers and fabric filters also possess a high efficiency for preventing the emission of acid gasses, including HCl, and particulate metals.

The HCl removal efficiencies for facilities equipped with wet or dry scrubbers are from 95-98.8% (Clarke, 1987; Gershman et al., 1988). Most trace metals that are volatilized during the combustion of MSW condense onto the surfaces of fly ash particles following the cooling of the flue gas. The fly ash particles are then removed from the flue gas at high efficiencies, at facilities equipped with scrubber/filter systems. Several studies have shown that in excess of 98% of the lead and cadmium are removed from the flue gasses of modern MSW combustors (Environment Canada, 1986; Clarke, 1987; U.S. EPA, 1988).

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VI. LITTER

One of the stated goals of LL 10-1988 is to "reduce the cumulative impact of litter." Litter, as defined by Keep America Beautiful, is "misplaced, improperly handled waste." Keep America Beautiful is a national, non-profit public education organization that recognizes litter to be a people problem, and that people litter where:

- "they feel no sense of ownership for the property;"
- "someone else will clean up after them;"
- "litter has already accumulated."

Information is not generally available assessing the amount and types of roadside litter. The Michigan Department of Transportation (as reported in U.S. Environmental Protection Agency, 1990) in the mid-1980s conducted a survey along state roadways. The results of their survey for litter collected show a variation of between 13.4% and 23.0% by count for all plastics (Table 8). Paper ranged between 51.4% and 81.5% by count. In the Michigan study, 38% of the plastic was identified as fast food containers and fast food drink containers. Thus some 5.1% to 8.7% of the Michigan roadside litter by count falls in the category of materials that might be banned in Suffolk County.

In order to better quantify the character of roadside litter, information has been synthesized from data collected in New York City as part of the City-Wide Floatables Study (HydroQual, 1992), and includes WMI surveys of roadside litter in Suffolk County.

Table 8.

COMPOSITION OF LITTER AT
VARIOUS MICHIGAN STUDY SITES
(1986)

	Percent of Items					
Litter Type	Highway	County Roads	City	State Parks	Roadside Parks	Rest Area
Cans	4.3	6.5	5.7	8.7	2.6	1.4
Glass	2.8	2.6	6.6	9.9	3.6	0.4
Plastic	21.1	13.4	14.9	23.0	15.6	15.3
Paper	51.4	73.1	66.6	53.5	78.2	81.5
Miscellaneous	20.4	4.4	6.2	4.9	0.0	1.4
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0

Original source: Department of Transportation 1986

New York City Streets and Sidewalks

The composition of street and sidewalk litter found in a survey of New York City streets during the mid-1980s is listed in Table 9. A conclusion of a 1986 study by Wiener (1986) was that some 60% of all the litter collected, by count, was food or food-related. Straws, napkins, candy wrappers and food wrappings were the most numerous of the food-related items. While the percentage of food-related litter did not change with proximity to food establishments, the quantity was greatest near such establishments. In these surveys, the only specific item listed that is covered by the Plastics Law is the general category of plastic bags (0.7% to 1.1%, by piece, of the total collected). Foamed cups were not specifically categorized. All cups, paper and plastic, constituted between 3.8% and 8.3% of the total items collected in the surveys.

Roadside Litter in Suffolk County

On 7 June 1993, WMI sampled several roadsides in the County to determine the types and quantities of materials discarded. The objective of the survey was to determine the composition of litter in Suffolk County. Consequently, WMI deliberately sought accumulations of litter and did not randomly sample on a spatial scale. Three collection transects through the Island from west to east were made -- along Route 25A, the Long Island Expressway (LIE), and Sunrise Highway (Figure 6). Along each thoroughfare, a strip of roadside (mean area of 585 yd^2, with a range of 85 yd^2

Table 9. Composition of typical New York City street litter

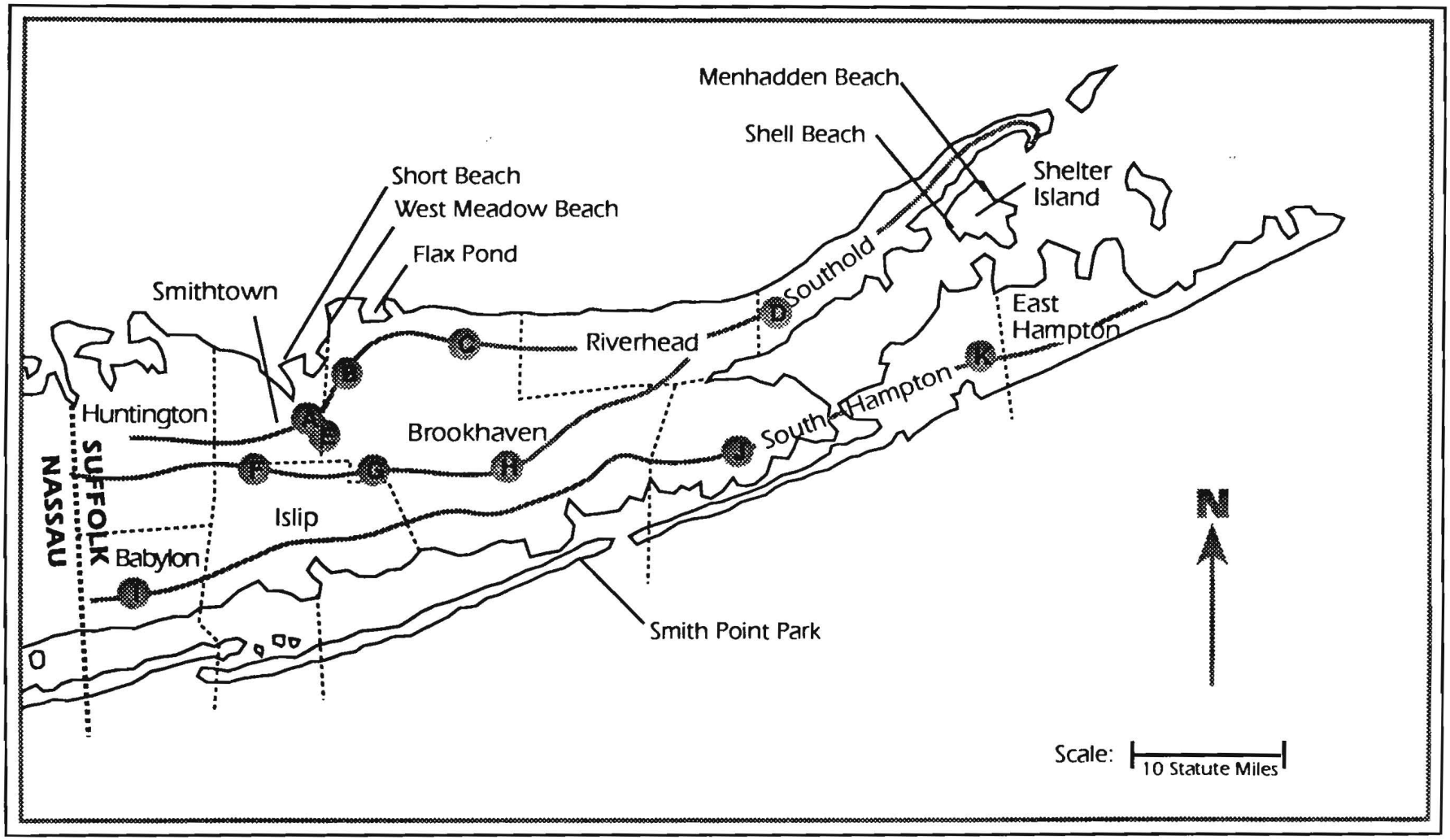
Street Litter Items	Percent of Total Litter Found on Streets[1]	Streets[2]	Sidewalks[2]
Candy wrappers	8.8	14.9	18.4
Napkins/tissues	11.1	10.5	6.1
Food wrappers	7.2	4.3	5.1
Food	1.0	0.9	0.7
Cups	3.8	8.3	5.6
Straws/wrappers	12.0	5.2	2.6
Cup tops	2.7	3.8	2.3
Soda/beer containers	1.9	8.9	8.8
Paper bags	2.4	8.2	7.9
Plastic bags	0.7	2.4	1.1
Paper (OTB stubs, etc)	24.8	10.2	18.0
Matches/cigarette pack	5.6	8.0	7.2
Cartons/delivery	3.0	3.1	3.3
Newspaper	2.1	1.7	2.9
Broken glass	0.9	1.6	1.2
Miscellaneous	12.0	8.0	8.8

Table adapted from HydroQual, 1992

[1]Data from 1986 (Wiener, 1986)
[2]Data from 1984 (Miller and Gewirtz, 1985)

Figure 8.

LITTER SURVEY LOCATIONS (ROADSIDE AND BEACH)



KEY

A. Rt. 25A & Lake Ave.
B. Rt. 25A @ Stony Brook R.R. Station
C. Rt. 25A, Rocky Pt.
D. Rt. 25A, Mattituck
E. Rt. 347 @ Smith Haven Mall
F. LIE @ exit 56
G. LIE @ exit 62
H. LIE between exits 67 & 68
I. Rt. 110 @ Rt. 27
J. Rt. 27 @ exit 64
K. Bridgehampton Commons

to 2350 yd^2) from the edge of the road to the demarcation in vegetative type was sampled. Cigarette butts were not collected as they were too numerous to count. The results of the survey are summarized in Table 10 (for complete data, see Appendix E).

There are no obvious trends in the data, although it is apparent that major roadsides on the east end of the Island are in general considerably cleaner than those in western Suffolk County. The amount and type of debris collected did tend to reflect the general type of retail activity closest to the sampling locations. For example, at Exit 56 on the south side of the LIE, foam cups were omnipresent, probably reflecting a relatively well-developed intersection and cup discards by commuters. Automobile parts from accidents and breakdowns were also prevalent.

Near the Stony Brook Railroad Station on Route 25A, paper food-related packaging was quite noticeable and most likely associated with the fast food establishment several hundred yards away.

Litter collected near malls (Smith Haven Mall, Rocky Point's Caldor Plaza, and Bridgehampton Commons) also generally characterized the businesses in the malls. Grocery store flyers, coupons and advertisements were quite prevalent at Rocky Point and Bridgehampton Commons.

In more isolated areas, there was much less litter, and it was of a more diverse nature, as might be expected. In some cases, such as along the stretch of Route 25 from Greenport to Mattituck,

Table 10. Total weight and counts of various categories of roadside litter collected in Suffolk County, June 1993.

Category	Weight (gms)	% Weight	Count Number	% Count
Non-banned plastic	9,941	18.1	1,296	27.6
Banned plastic	493	0.9	413	8.8
Glass	15,959	29.0	284	6.0
Rubber	6,116	11.1	134	2.8
Metal	7,006	12.8	424	9.0
Paper	12,087	22.0	2,068	44.0
Wood	929	1.7	21	0.4
Cloth	2,432	4.4	55	1.2
Total	54,929	100.0	4,695	99.8

there was not sufficient litter to warrant collection. On Route 25A, near St. James, glass was quite prevalent relative to other locations, perhaps reflecting that this stretch of highway is rarely cleaned because it is heavily wooded. Other than glass, much of the other litter did not get into the woods, or it had deteriorated.

In the WMI samples, paper was the most prominent material by count (44.0%). By weight, glass was the most predominent (23.9%). Total plastics represented 36.4% of the litter by count and 19.0% by weight. Banned plastics represented 8.8% of the total litter collected by count and less than 1% by weight. Overall, the weight per piece of banned plastics was 2.6×10^{-3} lbs/piece. Banned plastics may have fragmented considerably more than non-banned plastics.

Litter is more noticeable in the New York metropolitan area compared to other parts of the United States. This may reflect the high population density. Cleaning litter off the streets is often one of the first municipal budget items cut in New York City (Hicks, 1993; Swanson and Schubel, 1990) and may reflect a view that it is not a serious public issue.

Our survey indicates that by count, about 8.8% of the roadside litter is material that would be covered by the Plastics Law. This is consistent with the findings in Michigan in the mid-1980s. Food-related litter is a problem common to New York City streets and Suffolk County roadsides, but it is not possible to directly compare plastic products between the two areas using the existing

New York City data. Non-quantified observations made in Spring 1993 in Cambridge, MA, where retail food establishments have voluntarily stopped using foamed cups and dishes suggest that litter is still a major problem. Litter is also obvious in Newark, NJ, despite an ordinance restricting the use of PS and PVC associated with fast food packaging, and an aggressive street cleaning program (see Section III, pages 37-42). Therefore, litter on Suffolk County roads would probably not be significantly reduced by implementing a ban on certain plastic products. Alternative products such as paper cups and plates may only replace the banned materials as litter.

The toxicity/long-term effects issues of the decomposition of the banned products as litter as compared to other materials is not well known, and is discussed in Section V of this report.

Litter reduction in Suffolk County could probably be more effectively achieved by means other than banning materials that constitute a fraction of the total litter waste stream. Examples of programs might include:

- requiring malls and other significant centers of activity to take more responsibility for policing their own properties and surrounding areas. Much of the litter in these areas is comprised of flyers and other advertising materials that are instantaneously thrown away by customers.
- reducing paper coupon flyers for grocery stores -- a major component of litter. This could be done by adoption of

an automated coupon card system, whereby weekly grocery store specials are scanned right at the checkout counter. Waldbaums and A&P Supermarkets already use this system.

- developing better County- and Town-sponsored litter collection and street cleaning programs.

Keep America Beautiful suggests that its KAB System, first offered to communities in 1976, has been shown to reduce litter by as much as 49% after a few years' participation. The KAB System trains local leaders and residents to respond to improper solid waste handling practices, with a goal of sustained litter reduction (Marjorie Forbes, Director, National Training Services, KAB, personal communication). This system has been adopted by the Towns of Islip and Huntington in Suffolk County. The Huntington program has been certified for a year and as of July, 1993, did not have a fulltime coordinator or permanent office space; thus, measureable reductions in litter have not been identified yet (Rose Flynn, Huntington KAB, personal communication). Islip has had its "Keep Islip Clean," program in place since spring, 1989. Keep Islip Clean claims that it has conducted some 550 clean-ups, using 2,100 volunteers. Currently, 59 sections of highway (0.5 mi to 2 mi in length), 56 specific locations, and three waterways are included in the program (Darien Login, Keep Islip Clean Coordinator, personal communication). Volunteers agree to a two-year commitment and are required to clean their area at least once every three months.

The "Adopt a Highway" program, managed by the New York State Department of Transportation, also appears to be very effective in some areas. Volunteers who request to adopt a length of roadway make a commitment to clean their designated area four times a year for a period of two years.

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VII. MARINE DEBRIS

Floatable debris in the marine environment consists of a variety of materials such as plastics, rubber, wood, paper, cardboard, line, cloth, grease balls, tar balls, garbage and some medical-type wastes. "Floatables" have been a concern in New York marine waters for well over a century. Garbage and trash were commonly disposed of in the Hudson River and dumped outside the Harbor in the New York Bight until a Supreme Court decision ended the practice in 1934 (Swanson and Young, 1991).

By the 1960s, the volume of floatables increased, and its character had changed as well. Increased reliance on convenience products encouraged production of disposable items such as foamed cups and plastic diapers. Thus, more non-degradable items entered the waste stream.

According to the Center for Marine Conservation (Younger and Hodge, 1992), "plastics are the number one debris problem in the marine environment." About 66% (plastic + styrofoam, recalculated from Table 1 of Younger and Hodge) of all debris items collected as part of the National Beach Cleanup in 1991 were plastic. Foamed plastic pieces, cups, caps and lids, and food bags and wrappers were included in the twelve items most commonly found (Younger and Hodge, 1992). Plastic beverage bottles were among the top twelve in 1988 and have since dropped out -- perhaps the result of deposit laws and recycling programs.

In New York, 68.3% of the marine debris collected, by count, was plastics in 1991. Plastic food bags, plastic caps and lids,

and foamed plastic cups were part of the top twelve items found in New York making up 5.3%, 4.6%, and 2.6% of the total items found, respectively (Younger and Hodge, 1992). In Suffolk County, 69.4% of the reported debris was plastic, with plastic food bags and wrappers being the most prevalent materials (Roberta Weisbrod, New York State Department of Environmental Conservation, personal communication).

Sources of Floatables

Potential floatables in the New York coastal waters come from both sea and land, primarily from two sources: combined sewer overflows (CSOs), and disposal of trash on streets and in waterways. The most significant source of floatables to area beaches during major floatable washups is New York City and the surrounding communities that are served by CSOs (Swanson and Zimmer, 1990).

Some areas of Suffolk County are served by storm sewers so that litter, including materials covered by LL 10-1988, can be carried during wet weather flow to the marine environment. However, based on data from the National Urban Runoff Program and the Long Island 208 Study (Long Island Regional Planning Board, 1982) 38-75% of Suffolk County's drainage area is served by groundwater recharge basins. A considerable fraction of storm water and its associated load of litter is transported to these basins where it is trapped and can be eventually cleaned. Thus,

little of Suffolk County's storm water and associated litter is released to the marine environment.

Combined Sewer Overflows

Combined sewer overflow events occur because storm sewers and septic sewers were joined together many years ago in metropolitan New York and other older cities. During even moderate rainfall, the volume of storm water plus domestic sewage is too great for proper processing at sewage treatment plants. At these times, much of the combined flow (along with the street litter it contains) is released unscreened and untreated through CSOs directly into the New York Harbor and western Long Island Sound (Swanson and Zimmer, 1990).

In New York City, according to the City-wide Floatable Study (New York City Department of Environmental Protection, 1992) floatables in CSO and stormwater overflow were composed predominantly of plastics (including polystyrene = 68.2%, by count). Some 22.6% of this material was identified as styrofoam pieces, of which greater than 20% (of the total) were pieces less than one inch square. Plastic cups and food containers were 2.6% of total plastics, and plastic bags and pieces of bags (all types of plastic) were 4.1%.

Long Island's south shore is more susceptible to large-scale debris wash-ups than the north shore because of the prevalent meteorological and oceanographic conditions (Swanson et al., 1978;

Swanson and Zimmer, 1990). Certain areas along the north shore are prone to wash-ups because of local tides and currents, but no major wash-up events, such as those that took place on New York Bight beaches, have occurred along the north shore.

Improper Disposal by People

The ultimate cause of litter is people. People flush plastics down toilets; beach users throw disposable cups, bottles and eating utensils on the beach; and at sea, merchant ships, fishing boats, and recreational boaters often toss garbage and trash overboard. The non-fishing debris from vessels includes cargo-associated items such as containers, plastic strapping, sheeting, and pellets as well as crew-related items such as food scraps, disposable dishes, utensils, and six-pack rings. Fishing-related debris includes plastic nets, plastic pots and traps, and fishing line.

In 1988, the United States adopted an international protocol to prevent pollution by ships (known as MARPOL Annex V), making it unlawful for any U.S. vessel to discard plastics at sea. At the same time, dumping of other types of trash and garbage from vessels was restricted within a range of three to 25 nautical miles from land. Foreign vessels were restricted from dumping within 200 nautical miles of the U.S. coast, and ports were required to provide disposal facilities for ships' garbage. Time will tell how effective these rules and regulations, which are not easy to enforce, will be.

Effects of Floatables on Public Health, Economy, Environment

Although waterborne waste materials have been washing ashore on Long Island's beaches for many years, it was a major wash-up event in June, 1976 that first caught the general public's serious attention. The washing ashore of tar balls, grease balls, and other sewage-related debris (e.g. tampon applicators, condoms, and sanitary napkin liners) caused the closing of beaches along much of the south shore of Long Island. It was estimated that the Long Island beach-related recreational industry lost $15-$25 million during and shortly following that event (Swanson et al., 1978).

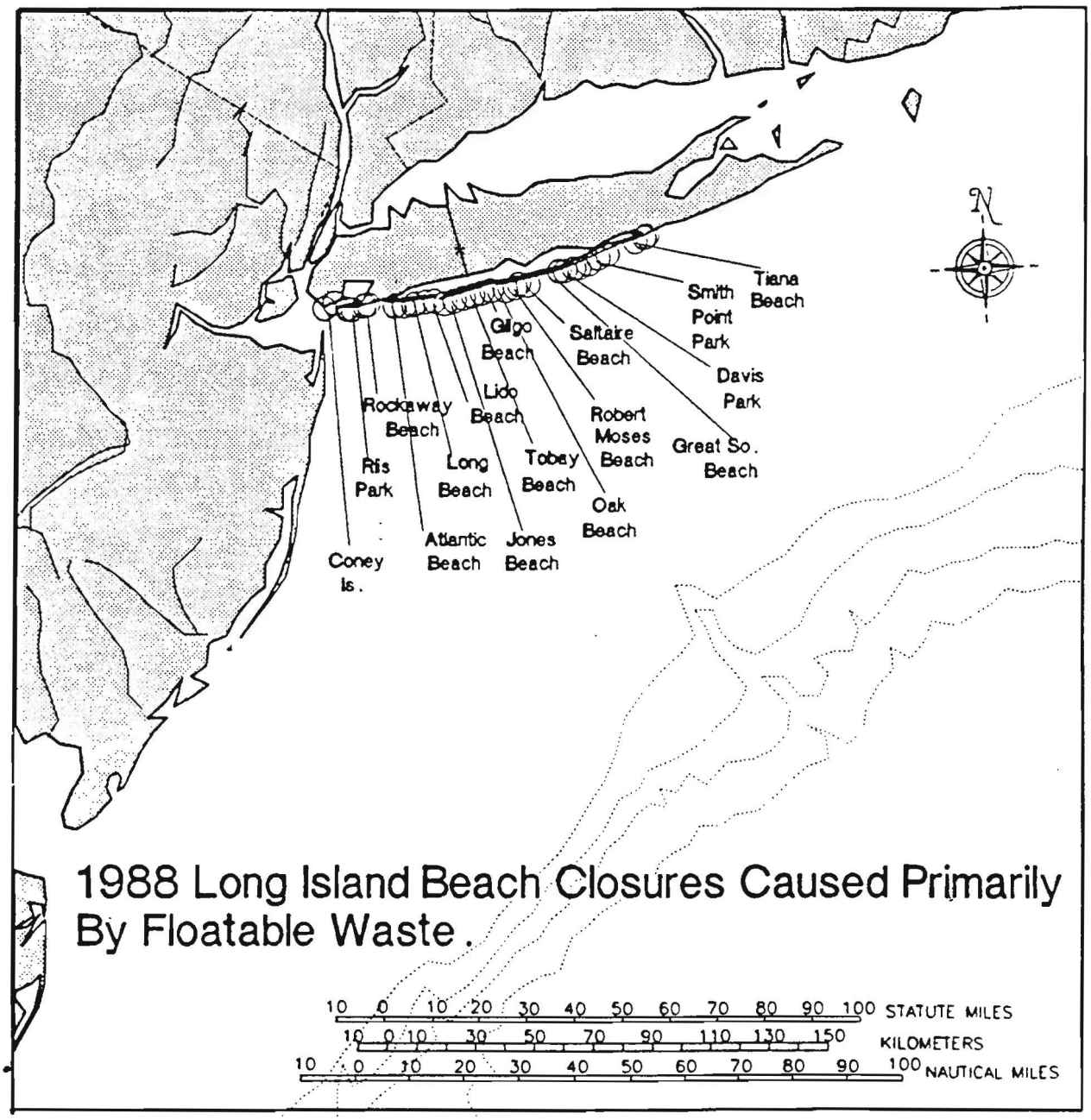
Floatable wash-ups along coastal New Jersey in 1987 and the south shore of Long Island in 1988 focused attention on a totally different set of waste products -- medical-type wastes (Swanson and Zimmer, 1990). Their volume was relatively small in comparison with other wastes (less than 1% of the total volume), but as with sewage wastes, people are concerned about public health. However, there is no evidence that these items have any effect on the safety of fishery products, or that they facilitate the transmission of AIDS or hepatitis. The potential for injury resulting from a puncture by a syringe needle is more realistic a concern than the threat to public health from disease-carrying floatables.

Certain floating plastics can also be harmful to marine animals. Plastic fishing line, packing straps, rope, and the like can entangle birds, turtles, fishes, and seals. Some animals, turtles for example, mistake plastic bags and balloons for the jellyfish and ctenophores that they eat. These plastic waste items

can block their digestive tracts and cause them to die. Foamed beads and pieces can also be mistaken for food by birds and some fishes. Thus some items targeted by LL 10-1988 pose potential ecological concerns. Additionally, bags and wraps can clog cooling water intakes of ships and boats.

The economic losses due to washups of floatable wastes can be extensive, based on an examination of the major floatable incidents of 1976 and 1988 on Long Island's south shore beaches. In both cases, some beaches were closed for short periods of time over the roughly 70 miles stretching from Coney Island to Tiana Beach (Figure 9). The loss in total expenditures in New York State as a consequence of the 1988 event is estimated to range from $0.75 - 1.8 billion (Swanson et al., 1991). The loss in user days at the beaches was estimated to be in the range of 30-90 million.
While these major floatable washups were significant, the plastics associated with the Plastics Law were clearly not the source of the public's concern. Concern and fear were generated primarily by the very small fraction of the total floatable load that was sewage-related and medical-type waste. The potential threat to public health through exposure to these materials was the cause of the public's unwillingness to use the beaches (Swanson et al., 1991). By 1991, based on attendance figures at Jones Beach State Park, the south shore beaches had completely recovered from the 1988 incident (Swanson, 1992).

Figure 9.



*Note Suffolk County line.

Source: Swanson and Zimmer, 1990

The economic losses associated with plastics and other debris clogging intakes and fouling propellers is not known, but not thought to be large (Swanson et al., 1991). However, these problems are apparently quite small compared to accidents associated with boats striking driftwood and caused by poor navigation.

Impacts to marine animals resulting from entanglement, gut blockage, or starvation by plastics does occur and is occasionally reported. During the September, 1991 beach cleanup in New York State covering some 142 miles of beaches, two crabs and two sea gulls were reported entangled in line and two crabs were reported entangled in styrofoam (Younger and Hodge, 1992). In 1992, a dead humpback whale washed ashore on Long Island's South Shore. It had ingested a plastic bag which may have contributed to its death (Master and Freeman, 1993). Over the period 1979 to mid-1988, there were 577 sea turtle strandings reported along the south coast of Long Island and the coast of New Jersey. Of these, 22 (16.9%) were reported as entanglement deaths and 4 (3.1%) as ingestion deaths (Waste Management Institute, 1989). Based largely on the same data, Sadove and Morreale (1990) reported that over the period 1979 through 1988, a gut content analysis of 88 cetaceans, 37 pinnipeds, and 116 sea turtles yielded 10, 0, and 14 animals, respectively, with ingested synthetics. Seventy-five animals were reported as entangled with debris or fishing gear. Of these, 17 were cetaceans and 58 were sea turtles.

While deaths of organisms are always of concern, certainly no marine-related species is being threatened in New York by the plastics covered by LL 10-1988. Ingestion and entanglement of marine organisms does occur, but certainly from limited observations does not appear to be a significant problem in the area. Fishing line and gear, and six pack rings -- products not targeted by this legislation -- may be of greater concern with regard to the entanglement issue than the banned products used for retail food packaging.

Recent Surveys of Marine Debris in Suffolk County

According to a Long Island Sound Study survey conducted by Masters and Freeman (1993), there was a dramatic decrease in floating marine debris in Long Island Sound when traveling from west to east. Recent beach clean-ups have also been conducted at several locations in Suffolk County (Figure 8, page 102). The character of the wastes collected is given in Tables 11 and 12. Complete data are in Appendix E. Additionally, on two occasions (March and June), South Shore beaches in the vicinity of Shinnecock Inlet to Westhampton were visited for the purposes of conducting a survey. In both instances, however, any survey would have been overwhelmed by debris associated with houses washed into the ocean during the winter's devastating beach erosion.

The composition of beach debris collected in spring and summer of 1993 at selected locations in Suffolk County parallels that collected during the fall, 1991, New York State beach debris clean-

up day (plastics, including styrofoam, were 66% of total debris in 1991, and 73% in spring and summer, 1993). The small differences, in part, may be attributable to the diversity of beach environments sampled in the spring, 1993 surveys (open beaches to closed embayments). Another possible explanation for some of the differences could be related to the timing of the surveys -- spring versus fall. The spring surveys reflect the accumulation of debris over the winter, whereas the summer and fall data are more reflective of beach and waterway usage during the beach season. Extensive clean-up operations in local waterways and on beaches by many governmental agencies also take place during the beach season, in general, changing the character of the uncollected debris.

In 1992, a Smithtown High School Marine Biology class under the direction of Mr. Wendelin Giebel sampled marine debris at selected locations along the north shore of Long Island between Northport and Wading River (Guarniere, 1993). The class found that 67% of the debris collected, by count, was plastic. Some 13% of the total debris collected was PS -- an unidentified portion of which was banned PS (under LL 10-1988). These data are quite consistent with the 1991 and 1993 data.

Table 11. Percent composition, by piece, of New York State's beach debris, 1991 survey.

Item	% of total
Plastic	68.3
banned plastic, including styrofoam pieces **14.1**	
Metal	9.0
Paper	8.9
Glass	8.7
Rubber	2.2
Wood	1.8
Cloth	1.0
Total	99.9

Source: 1991 International Coast Cleanup Overview, Center for Marine Conservation, 1992.

Table 12. DEBRIS BY PIECE COLLECTED AT SELECTED SUFFOLK COUNTY BEACHES, SPRING 1993.

Location	Smith Point[1] Park		Flax Pond[2]		Shelter Island[3] Menhaden Beach		Shelter Island[3] Shell Beach		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Date			1 May		5 June		5 June		Not counting Smithtown	
Length of Beach Cleaned			0.03 mi		0.48 mi		0.2 mi			
Non banned plastic	78	33.9	1261	91.6	669	59.8	181	63.3	2111	75.9
Banned plastic	5	2.2	13	0.9	40	3.6	23	8.0	76	2.7
Glass	15	6.5	24	1.7	59	5.3	22	7.7	105	3.8
Rubber	1	0.4	53	3.8	55	4.9	13	4.6	121	4.4
Metal	35	15.2	9	0.6	88	7.9	14	4.9	111	4.0
Paper	87	37.8	8	0.6	162	14.5	19	6.6	189	6.8
Wood	3	1.3	2	0.2	20	1.8	11	3.8	33	1.2
Cloth	6	2.6	6	0.4	23	2.1	3	1.0	32	1.2

1. Clean up by personnel of Smith Point Park
2. Clean up conducted by personnel of MSRC
3. Clean up organized by the Shelter Island Advisory Council

By count, some 27% of the total debris (including foam pieces) collected during the 1991 beach survey for New York State was plastic that would be covered by the Law (estimated from state data, pages 42, 43, Younger and Hodge, 1992). Of the debris collected in the 1993 surveys, a mean value of 3% (by count) would be covered by the Plastics Law. For the six beaches sampled, plastics covered by the legislation ranged from 0.5% to 8.0%. By weight, 0.9% of the material collected was identified as composed of the banned PS or PVC.

Some Solutions to the Floatable Problem

The most effective way to prevent the wash-up of floatable debris on our shores is to keep materials out of the marine environment. Numerous efforts have been implemented to realize this goal since the most recent major wash-up events in 1987 and 1988. Improved garbage handling operations such as covering barges which transport garbage to the Fresh Kills Landfill on Staten Island, and employing floating booms at transfer points to retain and recover lost waste have helped reduce the load entering the Hudson-Raritan Estuary and New York Harbor.

Some portion of the floatables that do escape into the estuary are removed by skimming boats before they can escape out into the Bight or the Sound. The U.S. Army Corps of Engineers estimates that they skimmed about 55 tons of garbage and trash (excluding wood) from the Hudson-Raritan Estuary during three summer months in 1989. Area beach operators have begun cleaning beaches daily to

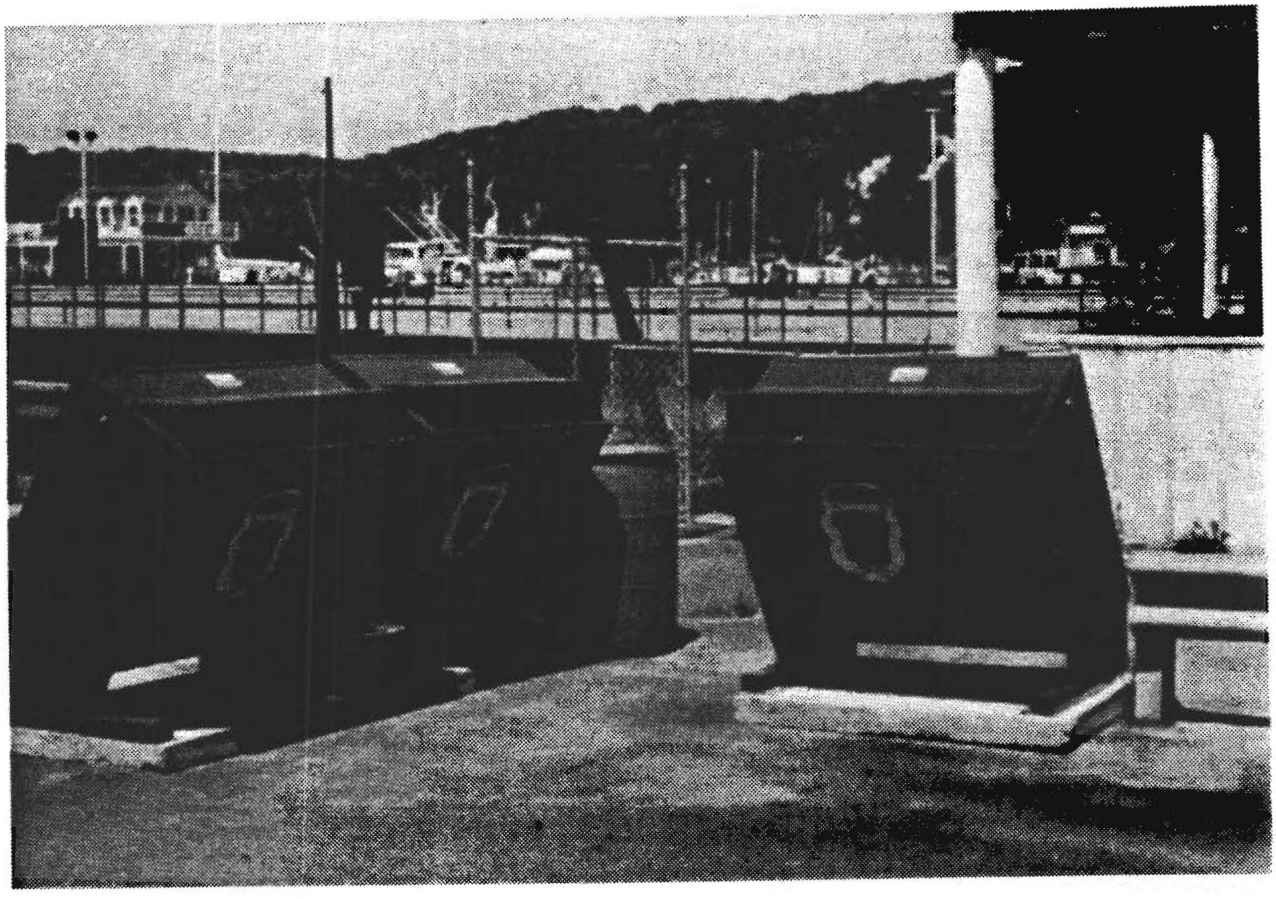
prevent litter and stranded floatables left on the beaches from being refloated by the tides. Stricter penalties for illegal dumpers have been enacted. Additionally, combined sewer overflow abatement programs in New York City are underway. However, CSO abatement and upgrading sewage treatment plants is expensive and will take years to complete.

The Town of Brookhaven has been very aggressive in placing recycling bins and disposal facilities at local marinas (Figure 10). More aggressive street cleaning programs, and programs for routinely cleaning storm sewers and catch basins would also be beneficial. New York State and U.S. EPA regulations covering storm sewer effluents are also being implemented at this time. The new storm sewer designs will reduce floatable as well as chemical pollutants entering coastal waters.

The New York Sea Grant Extension Program has instituted a program whereby storm drains are stenciled with a message intended to educate and remind the public to dispose of their waste materials properly. This message, stenciled on approximately 1300 storm drains in Suffolk County, states: "Don't Dump, Drains to _____," "Long Island Sound," "the Bay," or "the Ocean" (Kimberly Zimmer, Extension Aide, New York Sea Grant Extension Program).

The Waste Management Institute, the New York State Department of Environmental Conservation (NYSDEC), the New York Sea Grant Institute, and the U.S. Environmental Protection Agency have instituted a number of programs to educate boaters and the general

Figure 10. Recycling drop-off collection center at marina, Port Jefferson Harbor, Town of Brookhaven, 1993.



public on the importance of preventing wastes from entering the environment. For example, "The Great Garbage Chase," an audio/video update of a slide show originally produced by the National Oceanic and Atmospheric Administration, along with the New York and New Jersey Sea Grant Programs, has recently been completed. Its target audience is kindergarden through the 4th or 5th grades.

The Impact of Local Law 10-1988 on Marine Debris Problem

Anticipated substitute products (e.g., paper cups), not targeted by the legislation may not persist in the marine environment for as long as the targeted ones. Nevertheless, the substitute disposables will still reach the marine environment in roughly the same amounts unless more emphasis is placed in prevention and cleanup.

If the plastics targeted by the Plastics Law do persist longer in the marine environment than substitutes, there may be a gradual accumulation of debris in the ocean, and indeed there does seem to be some evidence of older plastics reaching the Sargasso Sea. There is also evidence that plastic bags exposed to sunlight do lose strength quickly, and, in some cases, accumulate marine growth and sink, so that these plastics are not able to impact organisms too long. Whether Suffolk County's Plastics Law will have any measurable effect in reducing the marine debris is open to debate. Prevention, education and clean-up programs may be more effective

tools than product bans to reduce Suffolk County's contribution to the marine debris problem.

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VIII. SANITATION AND PUBLIC HEALTH

The sanitary quality of disposable plastic food service materials, disposable paper food service materials and reusable food service materials has been raised as a concern in the plastics debate. Exposure to potentially toxic or carcinogenic materials via contact of food with various food service materials has also been identified as a concern. The Suffolk County Department of Health Services (1992) (DOH) reviewed several studies and their diverse results relevant to the meat/food tray issue, and also commented on the adequacy of the respective studies.

Sanitary Conditions

Hilbert and Henderson (1985) found that total microorganisms measured (Staphylococcus, streptococcus, and E. coli) were consistently lower on disposable food service items as compared to non-disposables. A distinction was not made between single service paper and plastic items. They suggest that increased handling, poor handling, and the cleaning and storage techniques used for the reusable materials contributes to these conclusions. There was, however, no attempt to examine the occurrence of disease in this study.

The Suffolk County DOH (1992) examined the available literature with the assistance of the Rutgers Cooperative Extension and concluded that there had not been much work done with regard to assessing the public health issues related to the use of either PS or pulp meat trays. WMI found this still to be the case in August,

1993 (Dr. George Hallock, Rutgers Cooperative Extension, personal communication). The conclusion of DOH remains valid:

> Professional staff of the department are not aware of epidemiological evidence of an illness risk associated with either type of meat tray material. Although a preference may exist in industry between the two types of materials, the choice is not one based on public health factors. Department staff do not believe there is any reason for public health concern involving the use of either pulp-based fiberboard material or polystyrene-based meat tray. This conclusion is further supported by the acceptance of both materials by the Food and Drug Administration, United States Department of Agriculture, New York State Department of Agriculture and Markets and the New York State Department of Health. (Suffolk County Department of Health Services, 1992).

Polystyrene Concerns

Styrene is listed by the U.S. EPA as one of the top 25 chemicals among more than 300 chemicals tracked in the Toxics Release Inventory of 1989 (American Petroleum Institute, 1992). The International Agency for Research on Cancer reclassified styrene as "possibly carcinogenic to humans" in the late 1970s but this was not based on new evidence of carcinogenicity. Instead, it had to do with revised definitions for the classification system (Rainey, 1989). "Polystyrene is considered physiologically inert" (Rainey, 1989).

The Food and Drug Administration regulates and approves the use of PS under conditions where it comes in contact with food. Till et al. (1987) investigated migration of monomer and oligomer residues from a variety of packaging materials, including impact PS and PS (styrene monomer). The accelerated studies were conducted to test for migration of monomer or oligomer in the presence of a

variety of liquids, foods, and food-simulating liquids. Thus in a sense they were worst-case studies. The migrant tested was BHT (3,5-di-t-butyl-4-hydroxytoluene) and styrene from impact PS and PS, respectively. Among the variables tested, the migrant (BHT, styrene) was found to increase with time, temperature and material concentration. Certainly these tests don't exactly simulate common usage of PS foam. But at 49°C, little evidence of diffusion of BHT was found.

In the case of migration of styrene in polystyrene, migration rates on the order of $10^{-12}cm^2$ per sec were found for 50% ethanol at 49°C. For foods held in products targeted by LL 10-1988 -- namely fast food containers that are disposed of normally within minutes, the maximum percent migration was on the order of 2%. Thus a small percentage of a very small quantity of styrene migrated (diffused), at a very slow rate.

Objective research along these lines is not being actively pursued at this time, according Dr. V. Anand, Consumer Safety Officer, Office of Premarket Approval, U.S. Food and Drug Administration (FDA). However, the authors of Till et al. (1989), which include a representative from the FDA, expressed no concern of a potential health hazard.

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IX. THE ECONOMIC IMPACT OF LOCAL LAW 10-1988

Legislation often results in multiple economic repercussions. Unfortunately, other communities which have had similar PVC and/or PS legislation in place for several years have not quantified in any way whether and to what degree their environmental goals have been met, or at what economic cost (personal communications with officials of Portland, OR, Minneapolis, MN, Newark, NJ, Glen Cove, NY).

Additionally, WMI is unaware of any published reports or journal articles which examine the economic impacts of such legislation after implementation. Thus, personal communication with City and Town officials, plastics and paper manufacturers, and trade organizations were relied upon for information for this section.

Finally, environmental effects also have economic value. Attempts to quantify environmental or ecological costs of a particular activity, however, are extremely difficult -- if not impossible. See for example discussions concerning the environmental cost valuation of the Exxon Valdez oil spill. Beyond the recognition that there are costs, their quantification is highly subjective; regardless, such an exercise is beyond the scope of this report.

The Impact on Businesses

The immediate repercussions of this legislation will affect food service establishments that currently use products which would

be banned by LL 10-1988. There are approximately 400 supermarkets and between 200 and 300 retail food stores within Suffolk County (Dinda, Chief, Suffolk County DOH, personal communication). These businesses will directly bear any increased economic burden, once the current stock of banned plastics is depleted and businesses turn to alternative products.

The timetable for this conversion to alternatives is of short-term economic concern. Supply and demand, combined with the potential of sudden enforcement, may influence the price of each substitute (Leftwich and Eckert, 1985). If the particular replacement item is readily available for local or regional distribution, and the only increase in cost is due to differences in material and manufacturing costs for the alternatives, then the economic impact may be minimal. However, if the regional supply of alternative products is limited and there is a sudden increase in demand for these products, the cost will be driven upward until such time as the supply matches the demand.

At present, there does not appear to be a shortage of raw materials to produce kraft grocery bags, according to Dave Stuck of the American Forest and Paper Association (personal communication). Kraft bags are the most costly substitute of all items banned under LL 10-1988.

According to the American Forest and Paper Association, the trade association that serves manufacturers of kraft and corrugated paper products, if there is a temporary market disruption in the short-term, the industry could switch from the manufacture of

corrugated paper to kraft paper -- also known as brown paper resources. Apparently there is also some additional capacity in existing manufacturing facilities, located primarily in the southeastern part of the United States.

In the long run, as supply meets demand, there should be a stabilization of prices for kraft bags, especially if there is no need for additional and major increases in capital investment to manufacture these kraft grocery bags. If the quantities of kraft bags needed exceed manufacturing capacity, there would need to be additional capital outlays to convert plants manufacturing plastic bags to the making of kraft bags (American Forest and Paper Association, personal communication).

When such items as plastic grocery bags (regardless of resin type), and PS cups, plates, cutlery, meat trays, hinged containers, covers and lids are banned, the present methods of doing business for food establishments may be altered, due to the changes in the price of materials and the differing storage capacity needed for the alternatives (New York State Food Merchants Association, personal communication). Many of these businesses operate on slim (<2%) profit margins, and LL 10-1988 may alter their profit/loss ratios considerably.

The replacement of PS products will increase food establishment packaging costs. Table 13 indicates the cost of various PS and PVC products, along with the cost of available, acceptable substitutes. The plastic products are those that would be banned under the present legislation. Although PVC is targeted

Table 13. Average cost, per unit, of various food packaging products

MATERIAL / PRODUCT	PS	PVC	PP	PET	HDPE	LDPE & LLDPE	KRAFT PAPER	PLASTIC COATED PAPER	CLAY/WAX COATED PAPER	FIBER PAPER
Grocery Sacks	NA	NA	NA	NA	*S* 1.33-1.5¢	*S* 1.33-1.7¢	*C,T* 3.7-4.0¢	NA	NA	NA
Trays 1 lb. size	1.6-2.3¢	NA	NA	NA	NA	NA	NA	*J* 2.9-3.1¢	*J* 2.9¢	*K,W* 2.1-3.6¢
Deli Containers 16 oz.	J 3.3-4.6¢	NA	NA	J 4.9-6.9¢	NA	NA	NA	J 7.3¢	NA	J 8.1-10.1¢
Plates 8 3/4"	See Note Below	NA	NA	NA	NA	NA	NA	*J* 5.1¢	NA	*J* 3.0¢
Hot Cups 8 oz.	*J* 1.3¢	NA	NA	NA	NA	NA	NA	*J* 4-5.2¢	*J* 3.0¢	*J* 3.5¢
Clam Shell Sm. Hamb	*J* 2.2-2.5¢	NA	NA	NA	NA	NA	NA	*J* 1.8-2.3¢	NA	NA
Teaspoon White	*J* 1.7-3.2¢	NA	*J* 1.4-8.8¢	NA	NA	NA	NA	NA	NA	NA

NOTE: Foam PS Plates = 2.0-2.3¢ (Source M) Firm PS Plates = 3.6¢ (Source D) NA = not applicable

Abbreviated source key (see end of this section for complete reference):

C - Cullen D - Dart Container D2 - Delivat F - Feeney
J - James River K - Keyes M - Mobil P - Plastic Groc. Sack Council
S - Sonoco T - Trunz W - W&R Grace

in LL 10-1988, the only food packaging items made from PVC -- wraps -- are exempt; thus, PVC is not included in Table 13.

As Table 13 indicates, alternative materials for products which are used for comparable purposes tend to be more costly. For instance, a switch from HDPE or LDPE plastic grocery bags to kraft grocery bags will increase a business' expenses for a carry-out bag approximately threefold (King Kullen, Trunz, personal communication) (Trunz grocery stores are in Nassau, not Suffolk County; however, Trunz was contacted as an impartial third party).

The additional expense of using kraft grocery bags may affect the profit margin of some businesses. In 1992, King Kullen Supermarkets estimated that their 33 Suffolk County stores used 31.2 million kraft bags and 46.8 million plastic bags. If LL 10-1988 is implemented, these stores estimate their use of kraft bags will total 78 million. Using data from Table 13, the cost of replacing the plastic bags with paper would be between $1.03 million and $1.25 million annually in the Suffolk County King Kullen stores.

In Section IV, it was estimated that between 190 million and 567 million plastic grocery bags are now used in Suffolk County. If these bags are replaced in a 1:1 ratio with kraft bags, the increase in cost for businesses would be on the order of $4.8 million to $15.1 million. If one kraft bag replaces 1.5 plastic bags, the range of costs are reduced to $3.2 million to $10.1 million, in 1992 dollars.

Some businesses might be able to share some of the increase in cost with their customers, by increasing the price of some items by a modest amount; however, smaller or less-efficiently run stores might not be able to share the added financial burden of switching to alternative products.

Some specialty food markets that charge a premium price to offer such services as delivery and phone-in ordering may be able to absorb some of this expense by reducing their profit. More likely, however, these specialty stores will, at a minimum, also share the added cost with their customers.

The net profit, after taxes, for the major supermarket chains is between 0.7% and 1% (Waldbaums, King Kullen, Trunz, personal communication). Therefore, they state they will find it necessary to increase the cost of food and/or food-related products to cover the expenses involved.

Clayton Environmental Consultants, in a 1993 report prepared for the American Plastics Council entitled, "Economic Analysis of the Suffolk County, New York Plastic Packaging Ban," estimated that replacing PS foam cups, containers, trays, plates, bowls, etc. would cost about $22,000 per delicatessen per year. However, most delicatessen owners surveyed were not able to estimate their actual usage of these items, so Clayton derived the information from the major suppliers of the banned materials and from the Polystyrene Packaging Council (Kevin Dietly, Principal, Clayton Environmental Consultants, personal communication).

As of January 1993, the Suffolk County Bureau of Environmental Protection had issued food service permits to 493 delicatessens. Thus the total cost of conversion to replacement products for the delicatessens would be approximately $10.8 million, according to Clayton Environmental Consultants. Their report does not include any costs for conversion from banned materials for other businesses such as bakeries, fast-food restaurants, ice cream and yogurt stores, schools, and business cafeterias; thus, even if individual store costs are high, overall costs to all Suffolk County businesses are underestimated.

The same plastics banned at food service establishments would be similarly banned at schools, employee cafeterias, and retail establishments that have luncheonettes and restaurants, whether or not they offer take-out service (Dinda, Suffolk County DOH, personal communication). For example, retail establishments such as K-Mart and Caldor which provide some food service, although it may not be their prime business, would have to comply. The impact of LL 10-1988 on these establishments is also variable, because these firms may use more limited quantities of the banned items, and may use more varied types of containers and bags than do supermarkets.

Any business which keeps the PS products used for food service packaging segregated from its normal waste stream and which sends the PS to a plastics recycler or processor can continue to use the banned products. However, the collection, segregation, storage and preparation for recycling adds to expenses, and may result in

additional economic implications for those who choose this exemption-through-recycling option (see Grumman Corporation, below).

According to Tri-State Recycling, in late summer, 1993, about a dozen school districts, individual schools and large businesses asked for proposals concerning the recycling of cafeteria PS materials. Some of these establishments have requested proposals (Carl Esposito, Tri-State Recycling, personal communication). If a great number of schools and businesses opt to recycle their PS food service materials, it is possible there will be an oversupply of PS for the recycled market, until other industries begin to use more post-consumer PS in the manufacturing of goods and the public increases its purchase of recycled-content plastic products. The market could become saturated in the short-term.

Businesses that choose to keep the banned materials segregated for collection and recycling will consider a number of factors in deciding if this is a cost-effective option. Their costs will include employee training, labor, containers for segregation, storage, and, possibly, costs associated with drawing up new garbage collection contracts. Salaries, overtime, fringe benefits, insurance, utility costs, and other expenses might be affected by the need to develop and manage a separate waste stream, although these factors were not raised as issues in Minneapolis, MN, which also exempts businesses that recycle their PS (Section III).

Beyond the primary financial consideration -- that of the value of goods and services -- the next largest expense is the cost

of floor space for the building and the storage space it contains. Storage space is usually at a premium for most food service establishments. According to the New York State Merchants Association, the value of one square foot of storage space ranges from $12-$20 per month for Long Island.

The ban on plastic shopping bags and their replacement by paper bags can result in costly increases for that limited storage capacity. Paper grocery bags, for example, occupy about six to thirteen times the volume of plastic ones (Plastic Grocery Sack Council, 1990; Feeney, 1987). In terms of space, switching from plastic to paper may take four to nine times the area (Cullen, 1992). Also, although most of the supermarkets were in business prior to the introduction of plastic grocery bags, the number and variety of items carried in these supermarkets has increased, so that shelf space and storage area is now at a greater premium (New York State Food Merchants Association, personal communication).

Table 14 compares the volume needed for both the banned materials and their possible substitutes. The profitability of every food service establishment is limited by the square footage allocated to service, storage and other space-taking needs, as well as aisle space and other areas needed for customers. The storage space needed for some of the banned items, such as PS cutlery, is about equal to the storage space needed for an equal amount of non-banned cutlery. While it is true that some of the banned items, such as PS trays, require more space than alternatives, such as plastic-coated paper or wax-coated paper, the total storage space

Table 14. Storage volume per 1000 units, in cubic feet, of various food packaging products

MATERIAL / PRODUCT	PS	PVC	PP	PET	HDPE	LDPE & LLDPE	KRAFT PAPER	PLASTIC COATED PAPER	CLAY/W COATED PAPER	FIBER PAPER
Grocery Sacks	NA	NA	NA	NA	S .65-.70	S .60-.61	C,P,F 4.5 - 9.4	NA	NA	NA
Trays 1 lb. size	2.9-4.1	NA	NA	NA	NA	NA	NA	J 0.9	J 1	K,W 3.2-3.3
Deli Containers 16 oz.	8	NA	8.2	8.2	NA	NA	NA	3.6	NA	NA
Plates 8 3/4"	See Note Below	NA	NA	NA	NA	NA	NA	J 1.2	NA	J 1.1
Hot Cups 8 oz.	J 3.4	NA	NA	NA	NA	NA	NA	J 2		J 3.2
Clam Shell Sm. Hamb	J 2.8	NA	NA	NA	NA	NA	NA	J, D 0.4 - 0.8	NA	NA
Teaspoon White	J 0.5 & up	J 0.6 & up	NA	NA	NA	NA	NA	NA	NA	NA

NOTE: PS Foam Plates = 4.2 cu. ft. (Source M) Firm PS Plates = 1.7 cu. ft. (Source D) NA=not applicable

Abbreviated source key (see end of this section for complete reference):

C - Cullen D - Dart D2 - Delivat F - Feeney
J - James River K - Keyes M - Mobil P - Plastic Groc. Sack Council
S - Sonoco T - Trunz W - W&R Grace

saved does not compensate for the storage area lost by switching from plastic to kraft bags. Additionally, storage costs for the paper grocery bags, in general, cannot be reduced through more frequent ordering and shipping because of delivery charges (Pat Brodhagen, New York State Food Merchants Association, personal communication).

Finally, supermarket chains are discussing two different price structures to address LL 10-1988, one for Nassau County and the other for Suffolk County (Waldbaums, King Kullen, personal communication). The two price indices are contemplated so that the added cost from LL 10-1988 will be paid only by Suffolk County consumers.

Grumman Corporation: A Suffolk County Recycling Case Study

Grumman Corporation initiated its PS recycling program at its Calverton and Great River facilities in 1989, in direct response to LL 10-1988. The program was established to demonstrate that viable alternatives existed to a complete ban (at the time, the Legislature had not yet added a recycling exclusion). Additionally, in 1990, Grumman instituted waste reduction measures which circumvented the use and disposal of over 2 million styrofoam cups, through the sale of reusable environmental coffee mugs in their cafeterias.

Receptacles for PS are located next to trash receptacles in the cafeterias. According to Jane Fenton, Manager, Environmental Affairs and Energy Planning for Grumman Corporate Operations, the

program is working very well: in 1992, 19 tons of PS were diverted from the Calverton and Great River waste streams. Employees have been cooperative about segregating food and other waste from the PS, and Tri-State Recycling has been pleased with the quality of the PS they pick up.

Additional labor to remove the segregated PS from the cafeterias is negligible, since the recycling containers are in proximity to the waste receptacles and do not require a separate collection route. Additionally, Tri-State's four cubic yard containers are located in the same area as the regular garbage roll-offs. Thus Grumman is pleased with the program; however, if LL 10-1988 were implemented and strictly enforced, requiring the segregation and collection of PS from office areas in addition to the cafeterias, Grumman would reconsider its PS recycling program (Fenton, personal communication). In this case, the collection could prove too expensive for the small fraction of PS that leaves the cafeterias.

Interestingly, unlike other recyling programs at Grumman (metal production scrap, office and computer paper, wood, cardboard, yard waste, industrial scrap), the cost of recycling PS has not only increased, but has marginally surpassed the comparable cost of disposal. Regardless, Grumman is committed to PS recycling. Their corporate plastics recycling policy statement states: "the promotion of source segregation and recycling, rather than selective product bans or taxes, represents the most effective element of [comprehensive solid waste] management programs."

Kraft vs. Plastic Grocery Bags

Plastic grocery bags were first introduced in the United States in 1981; today, roughly two out of every three bags used at the check-out counters of grocery stores are composed of plastic (Sonoco Products Company; Cullen, 1992). The trend toward using more plastic bags in grocery stores apparently continues. Thus, LL 10-1988 may be the signal to the grocery industry that the customer still wants to be able to have use of kraft bags, or at least a choice between kraft and plastic.

At present, Waldbaums Supermarkets in Suffolk County give customers two cents off their total bill for each grocery sack, composed of any material, that they return to the store for that customer's immediate reuse (in lieu of a new plastic or kraft bag). If, as LL 10-1988 states, no plastic grocery checkout bags will be allowed, the policy will probably continue, although a final decision has not been made (Bill Vitulli, Waldbaums, personal communication).

Edwards (formerly Finast Supermarkets), Waldbaums and King Kullen Supermarkets, among others, offer customers separate collection bins for plastic and paper returned bags. The plastic grocery bags are sent to recyclers for reprocessing, often into new, mixed-resin grocery bags.

Like plastic grocery bags, kraft bags often contain recycled content. The recycling label common on kraft bags refers to the manufacturer's use of pre-consumer as well as post-consumer material with virgin paper. Used kraft bags are combined with

corrugated packaging, baled and sold to a waste dealer who, in turn sells this paper to corrugated and kraft manufacturers (John Ball, Union Camp, personal communication). The combined kraft and corrugated papers (called brown paper by the industry) go to paper mills, where they are typically mixed with 75% virgin brown paper.

Increasingly, higher percentages of recycled brown paper are being used in the mix. A new European technique that can sort the long fibers from the short paper fibers is expected to increase the percentage of post-consumer paper in recyclable brown paper (Dave Stuck, American Forest and Paper Association, personal communication).

Under present recycling conditions, most kraft paper is recycled with corrugated. Market conditions for recycled corrugated paper vary widely. Most recycled brown paper is used in the manufacture of packing boxes -- not for kraft grocery bags (Stuck, American Forest and Paper Association, personal communication). A sudden increase in used kraft grocery bags could lead to an oversupply, such that existing mills might have to be converted to handle more brown paper. At this time, markets are not available for large increases in recyclable brown paper goods (American Forest and Paper Association, personal communication). The paper industry may find it needs to regear its factories in order to handle Suffolk County's additional kraft bags.

Currently, WMI is unaware of any community in the U.S. where plastic grocery bags have been banned. If other areas of the country decide to ban plastic grocery bags in favor of kraft, there

could be a huge demand relative to the supply of brown paper in the short-term. This would then lead to an oversupply of paper available for recycling, until markets adjust accordingly. Large fluctuations in the recycled paper market have occurred in the past.

The Impact on the Consumer

Although it is easy to show that food service establishments will experience a definite economic impact due to LL 10-1988, it is harder to estimate the financial impact on the consumer. The consumer will share in these additional costs when purchasing food and possibly non-food items in food and food-related businesses. Officials of several of the major supermarket chains claim that they cannot afford to retain their current pricing if LL 10-1988 is implemented.

Clayton Environmental Consultants (1993) show an increase in cost to 131 supermarkets of $7.1 million annually. The same report states that the annual cost to delicatessens will be approximately $10.8 million. These cost increases, totalling $17.9 million, represent the cost of replacing banned products, for these two categories of businesses (no estimate is given for other categories of affected businesses). To cover the increased costs resulting from this legislation, supermarkets and delicatessens will make adjustments to pass on the expenses to their customers (Waldbaums, King Kullen, personal communication).

Food establishments set their price structure according to

consumer buying habits (Pat Brodhagen, New York State Food Merchants Association, personal communication). Most consumers will be able to bear any increases brought about through this legislation. Clayton Environmental Consultants (1993) estimated the increased cost of LL 10-1988 to be $13.54 per person per year, or 0.9% of total food spending, based on a sampling of 131 supermarkets and 493 delicatessens in Suffolk County. This figure was based on a 1988 U.S. Department of Agriculture survey, indicating that the average Northeastern household spent $1,458 per person per year on food -- both away and at home.

People on fixed incomes, the unemployed, and people who are struggling to maintain a basic existence will more directly feel the ramifications of this legislation. People with budget restrictions whose funds are already limited for food, medicine, housing, and other necessities are least able to afford any increase in the price of food products.

Fast-food establishments will also experience increased costs from this legislation -- as much as a 50% increase on some packaging items, according to Robert Langert, Director of Environmental Affairs for McDonald's Corporation. However, WMI was unable to ascertain how much such price increases might increase the cost of a customer's meal.

Economic Impact on the Property Taxpayer: School Budgets

This legislation may also impact residents through their property taxes. Many of the school districts that currently use PS

have found recycling to represent an expense, rather than a savings. While it seems highly unlikely that the cost of recycling PS would play a role in driving property tax increases, combined with other, increasing expenses, PS recycling does affect each participating school's budget (Table 15).

The economic impact will vary for each school district, depending on its garbage contract. School districts which use PS products have two choices. They can either switch from the banned plastics to substitute products, or they can choose to continue using PS products. In the latter case, they will have to keep these products separate from the normal waste stream, so that the PS materials can be sent to a recycler. All schools offering food service, whether public or private, must comply with this legislation.

Schools that have their garbage contracts written so that they are dependent on a set pick-up schedule, regardless of whether their dumpsters are full, will pay more to recycle than those where pick-up occurs only after notification that the dumpsters are full. If there are existing garbage contracts in effect when compliance is scheduled to begin, schools which currently use PS products may seek to renegotiate their contracts, should they choose to continue using PS.

School districts that switch from disposable food service items to non-disposable ones might incur added costs for dishwashing equipment, dishes, and cutlery; however, the payback period for the cost of switching to these non-disposable products

may be relatively short. Over the long-term, non-disposables may be preferable, from both an environmental and an economic perspective. In a State University of New York at Stony Brook report to the campus President, a MSW/Recycling Committee whose task it was to find feasible means of reducing campus MSW estimated that if all disposable food packaging were eliminated on campus, the payback period would be just 1.5 years for the cost of dishwashing equipment, new dishes, and labor (this does not take energy costs into account, however). This assumes a 3% annual dish replacement rate (from loss and breakage) -- far more than the industry standard of 1.3% (Project Prometheus, 1991).

Local Law 10-1988 will have a lesser impact on school garbage contracts which refer to the number and capacity of dumpsters and/or garbage containers. Garbage contracts can list varying sizes of dumpsters, priced according to capacity, so that either recycling of PS or reduction in waste through the use of non-disposable dishes and flatware would reduce the volume and tonnage of a school's wastes. This reduction in total garbage would then result in a reduced price for garbage collection. A carefully written garbage contract that contains flexibility as to quantity, volume, and frequency of collection might even save the district a small amount of money if that school system opts to recycle. Such a contract can also be used to stimulate more on-site recycling of office paper, corrugated materials, metal cans, and other materials.

Table 15. School Districts that recycle PS.

School District	Students	Annual Savings/(Cost)
Amityville	3,000	($ 7,500)
Cold Spring Harbor	1,800	($ 400)
Copaigue	3,000	$ 2,000
Deer Park	3,400	($ 1,200)
East Islip	4,200	Break-even
Hauppauge	3,500	($13,600)
Longwood	10,000	($ 7,500)
Middle Country	10,000	($10,000)
Sachem	16,500	($10,000)
South Huntington	1,600 (2 out of 7 schools)	($ 5,000)
West Babylon	4,100	($ 6,000)
William Floyd	9,300	($ 6,000)

Source: August, 1993 telephone conversations with those in charge of the schools' PS recycling programs.

Schools that opt to recycle plastics must assure that PS items that are provided by the school as part of their food service are segregated. However, many students and faculty members purchase drinks and food items and then carry them out of the cafeteria or food service area to other parts of the campus. Under this legislation, it would be illegal for the PS items to end up with the regular garbage. Strict compliance with LL 10-1988 would require that someone sort through all garbage receptacles to save PS materials for shipment to a recycling facility.

In the Hauppauge Unified School District, students help with the sorting of PS in the cafeterias (however, the majority of the sorting is done by school custodians). Schools that have active environmental clubs and environmental curricula have helped educate their students on the environmental benefits of recycling. Sachem, East Islip, South Huntington, Middle Country, Hauppauge, Cold Spring Harbor, William Floyd, Longwood, Amityville, Copaigue, Deer Park and West Babylon schools are currently recycling their PS (Table 15). With the exception of the East Islip School District, which breaks even, the schools lose money on recycling; nonetheless, they are committed to it. Many of the persons with whom WMI spoke at these schools expressed the view that it is important for schools to set an example, and that the price is worth it in increased student environmental awareness.

These schools have the custodians sort through recycling bins for non-polystyrene and non-recyclable items. In addition to the cost for oversight by custodians, cafeteria workers and a minimal

expense for student education, there are some costs for storage space.

Enforcement Costs

All of the above impacts assume full compliance with the law. In reality, however, enforcement and its associated costs will be minimal, in part because the County is not allocating any funds for this purpose (Dinda, Suffolk County DOH, personal communication).

Of the approximately 6,500 retail food establishments in Suffolk County, about 5,300 are under a DOH permit. Of these, approximately 424 establishments (8%) will not be inspected in 1993 due to lack of sufficient field personnel (Dinda, Suffolk County DOH, personal communication). Additionally, since the Food Control Unit's 13 Public Health Sanitarians are charged with enforcing all DOH programs, they follow an enforcement hierarchy based on health and welfare concerns. Mr. Dinda stated in a July, 1993 interview with WMI personnel that there are no public health or welfare concerns surrounding LL 10-1988; thus, enforcement cannot be a high priority. Nonetheless, when health inspection field workers make their rounds of food establishments, they will look for compliance with LL 10-1988.

While it is true that no additional staff are contemplated, there will be some costs incurred. In addition to the minimal costs of preparing and mailing letters to establishments that have been reported as not being in compliance and the small amount of added time required of field personnel during inspections, the most

significant cost to DOH will be in processing variances, which require public hearings. These are time-consuming, for they require work on the part of DOH staff before, during, and after the hearings.

Enforcement of LL 10-1988 will depend primarily on public awareness. For the most part, adherence to this law will occur through self-policing on the part of food establishments, as now occurs in the City of Glen Cove (Section III). The Suffolk County DOH assumes that once a few establishments are fined for non-compliance and this information is made public, enforcement by example will prompt other establishments to follow the dictates of LL 10-1988 (Dinda, DOH, personal communication).

Although there have been no resources provided for public education in LL 10-1988 to encourage compliance, there should be public education for all establishments that will be affected, as well as for the general public. In Portland, OR, which boasts a 95% compliance rate with its PSF ban, the City provided both letters and brochures to businesses and interested individuals, informing them of the PS Ordinance (Appendices C and D).

Finally, while the Suffolk County DOH can levy fines of up to $500 for non-compliance, maximum fines are rarely levied against a business. Additionally, any monies collected go into the General Fund and cannot be put towards additional field personnel for enforcement, unless the Legislature decides to allocate the funds for that purpose. It is not anticipated that fines will accrue due

to non-compliance, as DOH guidelines for fines are based on public health concerns.

It is difficult to forecast how market forces will evolve to affect the businesses and the citizens of Suffolk County if LL 10-1988 is implemented. There are a variety of alternatives to plastics available, and at least one manufacturer is eager to fill the demand for substitute products (Michael Levy, President, Delivat, personal communication). It is interesting, however, that with McDonald's precipitous change to non-plastic alternatives, they have not found, in their judgment, an adequate substitute for the PS foam hot cup -- in terms of cost and customer satisfaction.

Certainly the examination of costs for a variety of plastic products versus their alternatives would argue that plastics are considerably cheaper, and that implementation of LL 10-1988 would be expensive. This seems to be particularly the case with substitutes for plastic grocery bags and foam cups.

The evidence from other municipalities in the United States where plastic bans have been imposed, however, whether legislatively or voluntarily, suggests otherwise. It appears that the economic impact of the bans has been hardly noticeable to consumers. Businesses have experienced a price increase; however, in no case did WMI learn of a business failure as a consequence of a plastics ban. Indeed, it is common for a business to pass any cost increase on to consumers, and if the cost amounts to a few dollars a month per consumer (as both Clayton and WMI estimates indicate), both businesses and consumers may consider it

inconsequential, or may feel that the price is worth the environmental benefit perceived (see Section III, the Portland, OR, and Glen Cove, NY subsections)

None of the municipalities contacted by WMI had a ban on plastic grocery bags. Suffolk County may be the test. Supermarkets, however, did make money only a few years ago prior to the introduction of the plastic grocery bag, and in all likelihood they will survive if they have to do without them again.

Delicatessens, coffee shops, and other businesses in other municipalities seem to have adapted without foamed coffee cups, and in Cambridge, MA, it is a matter of pride to not use plastic -- and without a law. Businesses may choose to absorb the additional cost of the paper coffee cups because profit margins on coffee are already high. In some cases, it appears that the consumer is not particularly concerned with the price of a cup of coffee. Quite innovatively, many coffee shops and delicatessens offer reduced rates for coffee if the customer provides the cup. This incentive to save a few pennies has led some people to carry non-disposable coffee mugs with them -- it is not uncommon to see someone carrying a coffee mug on the streets of Portland, OR, for example. In the long term, the marketplace will probably adjust to the perturbations caused by LL 10-1988 without any great impact.

Persons Contacted

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X. LIFE-CYCLE ENERGY, RESOURCE, AND ENVIRONMENTAL IMPACTS

Questions about energy impacts figure prominently in deliberations about the Plastics Law. Do the throwaway plastic products covered by the ban -- single-use items with very short service lives -- waste energy because they needlessly deplete precious stocks of nonrenewable petroleum (and natural gas) energy sources? Will the replacement products for those banned by LL 10-1988 actually use more energy cradle-to-grave than do the originals? "Cradle-to-grave" refers to the overall net or life-cycle energy it takes to obtain raw materials, process them and make the final product, use the product, and recycle, burn, bury, or compost it -- and for transportation between all of these stages. Life-cycle assessments ideally also take into account energy saved by not making a product in the first place and energy associated with preventing or reversing environmental impacts associated with the product. All stages can significantly affect the overall energy costs.

These questions are examined:

(1) Do the banned plastic items use more or less energy than paper alternatives?

(2) Do the banned plastic items use more or less nonrenewable energy than paper alternatives?

(3) Do options to recycle, and to use reusables (for example, cloth grocery bags and ceramic mugs), affect energy use?

(4) How might any energy differences affect Suffolk County?

(5) Do the banned plastic items have better or worse

environmental, natural resource, and energy impacts overall than do their alternatives, in light of debates over recent life-cycle studies?

Limitations of Life-Cycle Energy and Environmental Studies

Life-cycle studies of modern production systems and products burgeoned during the energy crisis of the 1970s. Several studies have examined energy impacts associated with plastic and paper products such as soft drink containers and plastic/wood lumber.

These studies are of limited applicability here, because it has become very clear during the last decade that energy studies of one product are not generally comparable to those of other products made of the same material, or to the same product, made of the same material but used in a different application, or with a different disposal fate. Life-cycle energy (and environmental) assessments must be tailored to the specific material, product, application, and disposal history under consideration.

Such studies are costly and time-consuming. There is longstanding disagreement on fundamental procedures for conducting them -- for example, on what energy flows should and should not be counted, whether or not such assessments can be made in the first place, and how they can be consolidated so as to arrive at a figure for total system energy cost -- or savings. Some of this debate has been conducted in scholarly energy and environmental journals; other discussions have occurred among various environmental and industrial organizations, and within and among government agencies

(Reaven, 1984, 1985, 1986, and 1993; Pira International, 1992; Environmental Action Foundation 1990, 1991; Fava, et al., 1990; Lubkert, et al., 1991; Sauer, et al., 1990; Thomas, 1977; Maddox, 1978; Perry et al., 1977; Tellus, 1992; Schall, 1992). It should not be assumed that the question "which product uses the least energy?" (or has the least environmental impact) is one that has a clear meaning or that has a definitive, even if unknown, answer.

Further complicating the analysis is the fact that life-cycle assessment results can be packaged in many ways. For example, energy use can be portrayed on a per-item, per-each-use-of-the-item, and per-pound-of-material-in-the-item basis. When the basis of comparison is changed, so can the verdict as to which product is most advantageous from the energy or environmental standpoint. Stakeholders on all sides have proven adept at selecting the format that reinforces their own views.

This investigation reviews the recent studies and other information bearing most directly on the energy impacts associated with the items affected by LL 10-1988, and includes an examination of the energy aspects of recycling, the use of nonrenewable energy resources, etc.

Energy studies of grocery bags

Roughly 190 million plastic grocery bags and 127 million paper grocery bags are used annually in Suffolk County, using the estimates in Section IV, based on a pro-rating according to population of national production figures for a 60% plastic/40% paper bag mix, by count (Leaversuch, 1992; Grocery Industry Committee on Solid Waste, 1991). The bags are mainly in 1/6-, 1/7, and 1/8-barrel sizes. Assuming the same numbers are discarded annually in Suffolk County, these 317 million bags generate some 3,092,000 pounds (1,546 tons) of plastic waste and 16,976,000 pounds (8,488 tons) of paper waste in the County. The total is 0.6 % of the County MSW waste stream of 3.4 billion pounds (1.7 million tons) per year (Tonjes and Swanson, 1992). These 317 million bags also comprise 11% of the estimated 187,200,000 pounds (93,600 tons) per year of grocery packaging in MSW generated each year in the County (based on Franklin, 1990a and 1993; Grocery Industry Committee on Solid Waste, 1991).

If all plastic bags were replaced by paper bags, County discards would be 254 million paper bags annually if one paper bag replaces 1.5 plastic bags, and 222 million paper bags if one paper bag replaces two plastic bags. Corresponding annual paper waste generation would be 33,886,000 (16,943 tons) and 29,620,000 pounds (14,810 tons), respectively. Franklin Associates studied 1.5:1 and 2:1 replacement ratios; Fenton (1992) adopts the 1.5:1 ratio.

Two major recent comparisons of cradle-to-grave energy consumption of paper and plastic grocery bags were examined: a

Franklin Associates study paid for by the Council for Solid Waste Solutions, a plastics industry association (Franklin, 1990a), and a study by Germany's Federal Office of the Environment (Federal Office of the Environment, 1988).

The assumptions of the Franklin Associates and German government studies were applied to Suffolk County conditions, correcting for certain differences in methodology so as to make the studies as comparable as possible. As explained in Appendix F and later in this section, these assumptions concern:

(1) whether or not to count the inherent energy in the paper bags;

(2) how many plastic and paper bags it takes to carry a given quantity of groceries;

(3) differences between European and American bag sizes and weights;

(4) differences between European and American resource extraction, transportation, and processing technologies;

(5) energy recovered from incineration of bags;

(6) use of self-generated energy in manufacture of paper and plastic product;

(7) accounting for secondary packaging;

(8) the level of recycling of paper and plastic bags;

(9) the nature of the recycled product, including its recyclability; and,

(10) whether or not the recycled product replaces a product, especially one that otherwise would have been made of another material.

Inherent energy refers to the energy locked up in the item itself, as measured by the energy that would be obtained if the product were used as fuel.

When the assumptions of the Franklin Associates (1990a) study are applied to the Suffolk County discard estimates calculated above, grocery bags in Suffolk County use as much energy as is contained in 34,120 barrels of oil: 38% is associated with the plastic bags; 62% with the paper. Barrels of oil are used as units of measurement for illustration: it is important to bear in mind that the actual energy expenditures vary in form (heat, electricity) and source (coal, nuclear, oil, hydro, solar).

If all plastic grocery bags are replaced by paper ones, life cycle energy costs in the Franklin Associates model increase 25% (energy equivalent to 42,720 barrels of oil) if one paper bag replaces 1.5 plastic bags, and increase 10% (energy equivalent to 37,380 barrels) if one paper bag replaces two plastic ones. This assumes that neither kind of bag is recycled.

These estimates represent additional energy expenditures overall. There may be increases or decreases at individual stages (such as manufacture, or disposal). Energy advantages at one stage (for example, trucking plastic bags is much more energy-efficient than trucking paper bags) may be offset by disadvantages at another. The additional overall energy expenditures need not occur in Suffolk County. It is not feasible to determine how these energy impacts of the ban would be distributed geographically or temporally.

More ambiguous results are obtained when the assumptions of the German cradle-to-grave study of grocery bags are applied to local conditions (Federal Office of the Environment, 1988). Supposing that the bags examined in that study were currently discarded in the County in the same numbers as estimated above (190 million plastic, 127 million paper), life-cycle energy costs become energy equivalent to 69,300 barrels of oil (41,580 for the plastic bags; 27,720 for paper).

If these plastic bags were replaced by paper bags, at a 1:1 replacement ratio, there would be no change in life-cycle energy use. If, as discussed in Appendix F, energy embodied in the paper is counted, the switch to paper would, according to the assumptions of the German study, lead to a net loss of energy equivalent to 30,020 barrels of oil.

However, at a 1.5:1 plastic-to-paper bag ratio, the replacement of plastic bags would save energy equivalent to that in 13,860 barrels of oil. If the energy embodied in the paper is counted, the switch to paper would lead to a net loss of energy equivalent to 10,150 barrels of oil.

It is difficult to assess the ambiguous evidence concerning the energy impacts of replacing nondegradable plastic grocery bags at the point of sale with paper bags.

No one can say with confidence whether compliance with this aspect of LL 10-1988 would save energy or cost energy. That is because the analysis is too sensitive to variations in specific assumptions about replacement ratios, and about energy costs and

savings, to count. Other factors affect the analysis, such as collection regimes (curbside or in-store; separate or commingled; particular densification techniques) and recycling rates. The complexities associated with such variations appear to swamp estimates of the overall energy costs or savings associated with compliance to LL 10-1988. Furthermore, the required well-founded methodologies and reliable data that might enable a more definitive judgment simply do not exist. For many plastic products not covered by the Plastics Law, the use of plastics appears to be associated with significant energy savings overall. For grocery bags specifically, an unambiguous determination is difficult to attain.

If one adopts the extreme values computed above as best- and worst-case limits on the energy impacts of LL 10-1988, one might argue that compliance with the grocery bag provisions could cost, at most, the energy equivalent of 30,020 barrels, and could save, at most, the energy equivalent to 13,860 barrels. This corresponds to an energy impact of compliance lying somewhere between energy equivalent to an increase of one gallon of gasoline consumption per person per year in Suffolk County and energy equivalent to a decrease of 2/5 of a gallon of gasoline consumption per person per year in Suffolk County.

Reusable carryout bags appear to offer the clearest and greatest energy savings. For example, the German study (Federal Office of the Environment, 1988) claims that polyamide bags used 100 times reduce total energy consumption by 90% compared to PE

bags, and that jute bags used 50 times reduce total energy consumption 95% compared to paper bags. The Suffolk County Plastics Law specifically provides for the use of reusable bags at the point of sale. Strong carryout bags are made of polyamide, nylon, and other plastics -- and of jute, cotton, and other organics. Any of these appear to offer drastic energy savings over both paper and plastic bags.

The German study concluded that "for ecological reasons, it is not sensible to change from polyethylene to paper carrier bags," and that "any relief of the strain on the environment worth mentioning is only achieved when a carrier bag is used which can be used repeatedly, whether it is made of natural fibres such as jute or of synthetic fibres such as polyamide" (Federal Office of the Environment, 1988).

Fenton (1992) reaches similar conclusions in an energy impact study comparing a permanent, 1.3-ounce, 15-liter capacity ripstop nylon bag, a 1.3-ounce, 23-liter capacity LDPE bag used 25 to 40 times, a 0.3-ounce, 15-liter capacity LDPE one-trip bag, and a 1.9-ounce, 23-liter capacity kraft one-trip bag. Energy consumption was examined for 0%, 50%, and 100% recycling levels. The energy effects of using the plastic one-trip bag 5 times and the one-trip kraft bag 10 times also were calculated. It was estimated that if the permanent nylon bag is used 12 or more times, overall energy consumption per trip is less than that for the one-trip PE bag, even at a 75% recycling rate for the one-trip PE bags. The calculations in Fenton (1992) were based on Franklin Associates

(1990a) and Federal Office of the Environment (1988) life-cycle studies.

Source reduction programs in grocery stores also are promising routes to energy savings. The Environmental Defense Fund (1990) estimates that supermarkets can readily cut bag use by 20% (reaping significant savings) by reusing bags and avoiding double-bagging. A variety of source reduction strategies and case studies are outlined in Environmental Defense Fund (1990), Grocery Industry Committee on Solid Waste (1991), and Fenton (1992). Energy use associated with grocery bags is summarized in Table 16.

Energy studies of polystyrene foodservice products

The estimated 290,000,000 pounds (145,000 tons) of plastic discarded annually in Suffolk County include approximately 16,056,000 pounds (8,028 tons) of PS, of which some 9,144,000 pounds (4,572 tons) is PS used in foodservice applications (cafeterias, fast-food and other restaurants, supermarkets). These estimates apply percentages of PS and foodservice-PS in Suffolk County's waste given in Moore Recycling Associates (1989) to the yearly tonnage of discards for all plastics, as estimated in Tonjes and Swanson (1992), and adjusted in Section IV of this study.

The Moore Recycling Associates (1989) study was sponsored by the Council for Solid Waste Solutions (CSWS), a plastics industry group. The relative amount of discards in each PS category are taken from that study but applied to the 290,000,000 pounds (145,000 tons) per year of plastic discards in Suffolk County

(145,000 tons) per year of plastic discards in Suffolk County estimated in the present report.

Table 16. Estimates of life-cycle energy use of LL 10-1988.

Without the ban	Life-cycle energy use *
(Franklin Associates' assumptions)	
0% recycling of affected products	base case
25% recycling of paper and plastic bags	down 11%
50% recycling of paper and plastic bags	down 22%
25% recycling of foam PS foodservice items	down 8.5%
(Federal Office of Environment assumptions)	
Replacement of PE bags by polyamide bags used 100 times each	down 90%
Replacement of paper bags by jute bags used 50 times each	down 95%
With the ban	
without recycling	
Switch to all paper grocery bags	
(Franklin Associates assumptions)	
1.5/1 replacement ratio	up 25%
2/1 replacement ratio	up 10%
(Federal Office of Environment assumptions)	
excluding energy content of plastic:	
1/1 replacement ratio	no change
1.5/1 replacement ratio	down 20%
including energy content of plastic:	
1/1 replacement ratio	up 43%
1.5/1 replacement ratio	up 15%
Elimination of foamed PS items	
(Franklin Associates assumptions)	
replacement by LDPE-coated paper	up 70%
replacement by wax-coated paper	up 60%
(Hocking 1991a assumptions)	
replacement by uncoated paper	up 62% from extra electricity use + other increases
(van Eijk et al. 1992 assumptions)	
replacement by PE-coated paper	up between 18% and 117%

with recycling	Life-cycle energy use *
(Franklin Associates assumptions) Switch to all paper grocery bags at 1.5/1 replacement ratio 25% recycling of paper bags	up 15% from base case; up 29% from 25% recycling case without ban
50% recycling of paper bags	down 1% from base case; up 20% from 50% recycling case without ban

* Assumptions in text and Appendix F. Increases or decreases refer to life-cycle energy consumption associated with the items listed in each row.

Assuming the 4,688,000 pounds (2,344 tons) of foamed foodservice PS were all 16-ounce capacity, 0.16 ounce weight cups, the discards would correspond to nearly 490 million PS foam cups/year (Table 17).

Some studies have compared energy and environmental impacts of PS foodservice products with those of alternatives. A study by Franklin Associates (1990b), paid for by the Council for Solid Waste Solutions (CSWS), compared PS cups, hinged containers, and plates with paperboard alternatives. (This study is distinct from the Franklin Associates grocery bag study discussed above, although the methods and data base employed were largely identical). Hocking (1991a) compared PS and paperboard cups. Van Eijk et al. (1992) compared PS foodservice items with paperboard and porcelain analogues for the Dutch Ministry of Housing, Physical Planning, and Environment. Keoleian and Menerey (1991) measured direct (not life-cycle) energy impacts of substitution of disposable (mostly PS) dishware in a hospital by reusable ceramics. Tellus (1992) ranked life-cycle environmental impacts of several packaging materials, including boxboard, PS, and PVC, by means of a scoring technique that amalgamates energy, resource, and environmental costs in monetary terms. Funding was by the Council of State Governments, the New Jersey Department of Environmental Protection, and the U.S. EPA.

Table 17. Polystyrene discards, Suffolk County, in pounds/year.

	Foamed
1,346,000	hinged containers
1,428,000	plates/trays
394,000	cups (extruded)
1,520,000	cups/containers (expandable bead)
4,688,000	pounds total foamed

	Solid
1,012,000	lids
532,000	bowls/plates
1,168,000	glasses
1,234,000	flatware
510,000	dishes/bowls
4,456,000	pounds total solid

The Franklin Associates, Hocking, and Tellus studies have generated worldwide debate concerning their assumptions and methodologies, as noted in the discussion of grocery bags. Although they have earned praise as pioneering efforts, all such studies are open to legitimate fundamental criticisms. However, several of these criticisms are germane only to the analysis of life-cycle environmental impacts, as opposed to the life-cycle energy costs. The Franklin Associates and Hocking studies, in particular, repeatedly have been appealed to in the legislative history of LL 10-1988. The recently-issued Tellus packaging study has been cited in the more recent discussion concerning the Plastics Law.

Cradle-to-grave energy/resource/environmental studies applicable to PVC products affected by LL 10-1988 were not found.

Franklin Associates/CSWS Study

Applying the Franklin Associates (1990b) results to Suffolk County discard estimates, the foamed PS foodservice discards would consume, during their life cycles, energy equivalent to that in approximately 43,700 barrels of oil. This assumes no recycling of PS.

The Franklin Associates report compared 0.16-ounce PS foam cups with LDPE-coated bleached paperboard cups weighing 0.36 ounces (including 0.09 ounces coating) and wax-coated bleached paperboard cups weighing 0.46 ounces (including 0.14 ounces coating). With no PS recycling, if all Suffolk County foodservice PS were PS foam

cups (this assumption has a minuscule effect on the energy calculations), and if they were replaced by the same number of LDPE-coated paperboard cups, life-cycle energy requirements increase 70% (by some 30,600 barrels). Again without any PS recycling, if the substitute product is wax-coated paperboard cups, energy use increases approximately 60% (by approximately 25,900 barrels). These are maximum estimates of energy impacts (based on Franklin Associates data), since these calculations assume that all foam foodservice PS is replaced, ignoring product, material and business applications exempted under LL 10-1988 (see Table 1, page 11).

The Franklin study also covered 4-inch hinged PS containers (clamshells) and 9-inch PS plates (and alternatives). Its conclusions concerning the energy impacts of these products are similar to those for cups, inasmuch as the same analytical framework and data base were applied.

The Hocking Study

Hocking (1991a) examined life-cycle energy and environmental impacts of 0.05-ounce PS and 0.36-ounce paper (without plastic or wax coatings) hot drink cups. Hocking's study was not sponsored by the plastics industry. Hocking's energy data were expressed in terms of kg of steam, kwh of electricity, and m^3 of cooling water, all of which use large quantities of energy. Hocking's data as published does not allow derivation of combined, overall energy requirements. For this and other reasons (see Appendix F and the

section on life-cycle environmental comparisons), direct comparisons to Franklin Associates results must be interpreted carefully.

Following Hocking's analysis, if all foamed PS foodservice discards in Suffolk County, including items not covered by LL 10-1988, were replaced by (uncoated) paper analogues, overall steam energy requirements would increase by 1300% (to 150 x 10^6 kg), overall electricity requirements would increase by 4,300% (to 14 x 10^6 kwh), and overall cooling water requirements would increase by 120% (to 0.7 x 10^6 m^3). This assumes that differences between paper and plastic products in energy requirements per pound of material are the same, on average, for hot drink cups as for plates, hinged containers, etc.

It is not possible to convert these numbers to their equivalents in barrels of oil without additional assumptions. If such assumptions are made, however, one finds that, following Hocking's analysis, replacement of foamed PS foodservice items by paper analogues could cost as much energy as is contained in 27,163 barrels of oil, just from extra electricity consumption. This alone is comparable to the entire energy cost of switching to wax-coated paper cups (25,900 barrels) or LDPE-coated paper cups (30,600 barrels) when calculated on the basis of Franklin Associates data.

The Van Eijk, et al. Study

Van Eijk et al. (1992) examined energy and environmental impacts of PS, paper (paper/cardboard), and porcelain crockery for the Dutch Ministry of Housing, Physical Planning, and Environment. The study was primarily intended to determine how many times a porcelain cup and saucer would have to be reused (with and without a refill) for the energy, resource, and pollution impacts to be less than they would be from using a functionally equivalent number of paper and PS cups. The study examined 0.16-ounce PE-coated paper cups, 0.58-ounce PE-coated paper plates, 0.14-ounce PS cups, 0.53-ounce PS plates, 15.8-ounce (combined weight) common restaurant-grade (i.e., not fine china) cups-and-saucers, and 17.0-ounce common restaurant-grade porcelain plates. The information in the study is presented in such a way that the ratio of foamed PS (hot drink) to solid PS (cold drink) cups, and of foamed PS plates to solid PS plates is unclear, although the implication is that the energy analysis was made either for solid PS products alone or for a mix, with a high fraction of solid PS products. Life-cycle energy differences between the solid and foamed PS are likely to be minor. This is because energy associated with foaming processes is less than 1/50 of the life-cycle energy, and because energy associated with plastics collection is a small fraction of life-cycle energy even for foamed PS (Office of Federal Environment, 1988; van Eijk, et al., 1992; Tellus, 1992; Franklin Associates, 1990).

Van Eijk et al. (1992) conclude that net energy use associated with the PS foodservice items is 29,132 BTU/lb. This is approximately equal to the energy content of 22,385 barrels of oil for the estimated 4,456,000 pounds (2,228 tons) of solid PS discarded in Suffolk County in 1991. The study calculated that PS cups use 46% and PS plates use 85% of the energy associated with the use of the paper alternatives (elsewhere the same report suggests a ratio of 89%). It is reasonable to assume that similar ratios would apply to the PS eating utensils affected by LL 10-1988 that have comparable paper (paper/cardboard) alternatives. Van Eijk et al. (1992) did not evaluate non-PS plastic substitutes for PS products.

Assuming that the Dutch estimates apply to all solid PS foodservice items in the County, it is calculated that switching to paper substitutes would increase total energy costs by 18-117%. This corresponds to the energy consumed if every resident of Suffolk County were to drive between an extra 1/8-4/5 mile per year. The calculations include replacement of 584 tons of solid PS glasses (it could not be determined how much represented thin drink cups outlawed by LL 10-1988 and how much represented thick, permanent cups permitted by the ban), and do not discount for foodservice PS applications exempt under the law (hospital, bulk purchases, home use, retail food establishments with on-site PS recycling programs). Therefore the energy impacts estimated in this paragraph are maximum impacts (for van Eijk et al. 1992 data).

As has been mentioned, van Eijk et al. (1992) compared paper and plastic products to reusable porcelain crockery. They conclude that a porcelain cup and saucer would have to be used 640 times before overall energy costs become lower than the energy costs of using 640 disposable PS cups, and 294 times before overall energy costs become lower than the energy costs of using 294 disposable paper cups (van Eijk et al., 1992). This assumes that the porcelain crockery is washed after each use. If the cup is refilled once during each use, the analogous transition numbers are 114 for PS, 96 for paper. With or without refills, these transition numbers reflect the high energy costs of dishwashing and drying.

Evidence suggests that 2-5% of porcelain crockery is replaced annually due to loss and breakage in restaurants and cafeterias (Reaven, 1990; Reaven and Tonjes, 1991; Keoleian and Menerey; 1991). This, in turn, suggests that the use of permanent porcelain crockery may not lead to energy savings where restaurant or cafeteria size and patronage patterns are such that on average, crockery breaks before transition numbers are reached. This contrasts to the significant energy savings realizable from the use of reusable grocery carryout bags noted before.

Impacts of the Plastics Law calculated according to assumptions in Franklin (1990a), Hocking (1991a) and van Eijk et al. (1992) are summarized in Table 16.

The Keoleian and Menerey Study

Keoleian and Menerey (1991) studied electricity, steam, water, labor, economic, and waste generation impacts of replacement of disposable (largely foamed PS) food serviceware in a large hospital by reusable ceramic items. Direct impacts on cafeteria energy use were measured (that is, a life-cycle analysis was not made). Although cafeteria waste generation decreased 99.5%, electricity and steam use rose 1,635% and 500%, respectively, reflecting increases in dishwasher use and the use of heated, self-leveling dispensing racks. The fact that rinsing water use and washing water use increased 1,685% and 356% is an additional consideration in assessing the advantages and disadvantages of the ban in Suffolk County restaurants and institutional cafeterias.

Energy Impacts of Recycling, Incineration, and Other Factors

The energy impacts of the advent of significant levels of recycling of products affected by LL 10-1988 cannot be determined from available literature, but appear to be insignificant. Plastics recycling was not modeled in Tellus (1992) and van Eijk et al. (1992). The Franklin Associates (1990b) study claimed that hypothetical 100% recycling of the foamed PS foodservice discards studied would reduce life-cycle energy draw by 26% (and proportionately less for lower, more practically realizable levels of recycling). This suggests that a 25% recycling rate for Suffolk County foodservice PS products might save energy equivalent to that in 2,840 barrels of oil (compared to no PS recycling). The energy

costs incurred by switching to LDPE-coated and/or wax-coated paperboard products (instead of retaining PS products and recycling the PS products at a 25% level), would increase correspondingly. Either way, this suggests that the energy impacts of recycling PS are modest.

Energy impacts of any recycling of the paper foodservice products that replace plastic products covered by LL 10-1988 cannot be determined, and depend on whether or not the paper products are source-separated or commingled with other paper recyclables, on the degree of contamination, and on what the recycled materials are made into. Food contamination of paper items is likely to preclude dedicated recycling, since paper cannot be washed (unlike PS). Food-contaminated PS and food-contaminated paper products might marginally reduce the energy efficiency of recycling separation and reclamation processes.

Comparable remarks apply to the Franklin Associates (1990a) assessment of the energy impacts of recycling (both kraft paper and PE) grocery bags. At a 25% level of recycling for both the paper and plastic grocery bags presently discarded in the County, overall energy costs would decrease 11% (energy equivalent to that in 3,680 barrels of oil); at 50% recycling rates, energy costs would decrease 22%. If one paper bag replaces 1.5 plastic bags, at a 25% paper bag recycling rate, overall energy costs would be 15% higher under the ban than they are now, and would be 29% higher under the ban than they would be at a 25% recycling rate for currently discarded bags (paper and plastic). If one paper bag replaces 1.5

plastic bags, at a 50% paper bag recycling rate, overall energy costs would be 6% lower under the ban than they are now. Yet energy costs would be 20% higher under the ban than they would be at a 50% recycling rate for currently discarded bags (paper and plastic).

These computations suggest that for grocery bags, the ban is likely to increase energy costs if recycling rates would have increased anyway, with or without the ban, and that the ban is likely to decrease energy costs if recycling rates rise solely because of the ban. To put the point another way, these computations suggest that if significant levels of grocery bag recycling can be achieved anyway, through other means, the imposition of the ban is likely to increase overall energy use. In any event, it is fair to say that the absolute amounts of energy at stake are very small compared to overall energy consumption in modern society.

It has been envisioned that kraft grocery bags would increasingly be used as containers for newspapers set out for recycling. If this role (rather than the recycling of the grocery bags themselves) leads to significant increases in the level of newspaper recycling, energy impacts could be significant. The probability that such indirect impacts would develop is unknown. Moreover, estimates of the amount and even the direction (up or down) of life-cycle energy impacts of newspaper recycling vary considerably (see, for example, Tellus, 1992; Alexander, 1993; Virtanen and Lubkert, 1991; Reaven 1993).

Any energy savings from increased levels of newspaper recycling may somewhat be offset by energy costs incurred in de-bagging the collected newspaper, if the newspaper is recycled into newsprint, rather than into boxboard.

Both Franklin Associates studies (1990a, 1990b), the German study (Federal Office of the Environment, 1988), Hocking (1991a), and van Eijk et al. (1992) incorporate energy credits from incineration in their analyses, albeit in different ways. Evidence in all of these studies indicates that removing energy credits from plastics incineration, or comparable impacts from paper incineration where applicable, does not reduce the life-cycle energy costs, or increase any life-cycle energy savings incurred by replacing plastic items banned by LL 10-1988 with comparable paper (or other plastic resin) products (see Appendix F). Tellus (1992) claims that for all materials, the energy and environmental costs of disposal options, including incineration, are 1% or less of total impacts.

Implications for Use of Renewable Resources

The complex picture of the energy impacts outlined to this point do not take into account how, and how much, the ban might reduce or increase use of nonrenewable natural resources, including energy resources. This section addresses the important contention that although many plastics products are claimed to use less total energy, as measured by studies like the Franklin study, the plastic

products deplete scarce nonrenewable resources more than do their analogues.

One rationale for the replacement of many plastic products by paper products has been the contention that oil and natural gas that could have been used as fuel, or for essential plastic items such as medical prostheses, or could have been conserved altogether for future generations, instead is locked up in the physical plastic products themselves (or is used up as energy expended to make them, dispose of them, or control adverse environmental effects connected with them).

Do the plastic products banned under LL 10-1988 use more nonrenewable energy and resources than do the paper alternatives? There are evidence to support that paper products use up at least as much nonrenewable resources as do the plastics.

Perhaps 40% of the life-cycle energy associated with paper production and use comes from coal, crude oil, natural gas, and other nonrenewable fossil fuel sources (Virtanen and Lubkert, 1991). Federal Office of the Environment (1988) estimates that 55% of the life-cycle energy use associated with unbleached kraft paper is from fossil fuels.

These percentages are despite the considerable use of self-generated energy in the paper and lumber industries (see Appendix F and Reaven, 1993). This refers to heat and/or electricity produced by burning mill residues, harvesting residues, wood grown specifically as fuel, or process byproducts such as black liquor. Plastics production also uses self-generated energy from fuel gas

(Franklin Associates, 1990a). The resource requirements of European forest and paper industry systems examined in Virtanen and Lubkert (1991) are comparable overall to those in North America.

Franklin Associates (1990a) estimates that total fossil fuel (natural gas, petroleum, coal) requirements for kraft bags are 3% higher than for PE bags for delivery of the same quantity of groceries, if one paper bag substitutes for 1.5 PE bags, with 0% recycling. However, if one kraft bag replaces two PE bags, with 0% recycling, fossil fuel resources for the kraft bag are 23% lower than for PE. Franklin Associates (1990b) estimates that total fossil fuel requirements for wax-coated paper cups and LDPE-coated paper cups are 22% and 1% higher, respectively, than for PS cups (at 0% recycling).

These fossil fuel figures should be interpreted with care, since they are derived from industry-wide economic data that may not fit the specific manufacturing processes, and since an ounce of natural gas, coal, and petroleum need not represent the same depletion of nonrenewable resources. Franklin Associates 1990a and 1990b tabulate energy requirements for each energy source, and do not use the aggregated presentation used here.

Hocking (1991a) estimates that the production of a paper cup consumes between 0.10 and 0.19 ounces of hydrocarbon raw material, compared to 0.11 ounces for a foam PS cup. It has been suggested that these figures are based on old and incorrectly interpreted data (McCubbin, 1991; Wells, 1991). However, when allowances for this possibility are made, the net nonrecoverable petroleum for the

foam PS and paper cups are approximately the same (Hocking 1991b). According to a representative of the James River Corporation, which makes a wide variety of both paper and plastic products, including cups and kraft bags, the total petroleum fractions contained in a one-sided PE-coated paper cup equals that in the equivalent PS cup (Suffolk County, 1992, page 117). It also is of interest that many kraft bags contain approximately 3% polyvinylacetate glue -- a plastic -- by weight (other bags use starch-based glues) (Federal Office of the Environment 1988).

The evidence outlined suggests it is plausible that paper products affected by LL 10-1988 deplete nonrenewable resources at least as much as their plastic analogues.

Paper recycling may further deplete nonrenewable resources. At the highest recycling rate considered in a life-cycle energy and environmental study of paper recycling, methane (a greenhouse gas) emissions rise three- to five-fold over their levels at 0% recycling; SO_2 and NO_x emissions also increase; and the overall fuel inputs, mostly gasoline, fuel oils, natural gas, and coal, increase 72% in weight (Virtanen and Lubkert 1991).

> Although it is evident that recycling saves energy, a simple conversion of the benefit of using recycled fibres to an equivalent amount of unused oil...gives a distorted view to policy makers and consumers. In fact, as calculations show, recycling might add to the consumption of unrenewable energy sources at present. (Virtanen and Lubkert, 1991).

For paper, increased recycling reduces the quantities of wood used at the pulp mill and increases the relative fraction of

nonrenewable resources used (substitutes for bark, for instance); for PE, recycling increases the fraction of electricity (derived from coal, hydroelectric, or nuclear sources) in overall energy costs.

Technology changes also affect the use of nonrenewables. For example, McDonald's and the Environmental Defense Fund claim that conversion from chemical to mechanical pulping processes in paper product production conserves trees by using more wood from each tree (McDonald's Corporation/Environmental Defense Fund, 1991, page 52; also, interview with R. Langert, July, 1993).

It is not clear precisely how plastics take away nonrenewable resources at all, since much of their embodied energy may be recovered by converting them to heat (in waste-to-energy plants) or to liquid or solid fuel (by pyrolysis or tertiary recycling), and much of their physical matter can be transformed into another product (by recycling). Seen from such a perspective, plastics conveniently store, rather than deplete, nonrenewable resources, and serve many useful functions in modern life at the same time.

On the other hand, it is also fair to say that storing oil and natural gas in the ground may be preferable in various respects, and that the bulk of the plastic made in the U.S. is unlikely to be recycled (although the chance seems higher for grocery bags, beverage containers, and other common post-consumer products than it does, say, for plumbing pipes or computer cases).

There is some question about the justification for regarding trees as paradigms of renewable resources. Trees and products made

from trees are often regarded as renewable, although their use may adversely affect ecosystem energy flows (e.g., by increasing soil erosion, or by the use of young farm trees for pulp), and although renewing them may involve large energy and resource expenditures (e.g., as fertilizer). On the other hand, it may be that better forestry practices can significantly reduce such impacts.

There is disagreement about the remaining amount of petroleum (and other fossil fuel) resources in the U.S. and on the planet that can be extracted with existing or emerging technology. If petroleum runs short, it is feasible to make plastics from many forms of biomass.

Assessments of what would happen to society's production system if (say) kraft bags replace PE, or in assessing what would have happened otherwise, are fraught with dilemmas. If PE bags are not eliminated, it does not follow automatically that the corresponding amount of PE will not be made anyway but used elsewhere in society, or that the fossil fuel resources will be turned into another plastic, just not PE. A crucial problem is to evaluate possible effects on purpose-grown renewables (a tree farm, for example). While they may be renewable, such trees would not be grown at all without the demand for forest products in the first place. Recycling paper made from such trees may just mean that fewer trees would be grown, not that more trees would be saved.

Finally, it may be inconsistent for a life-cycle assessment, on the one hand, to count the energy content of a plastic product as an energy cost,because it depletes a resource that otherwise

would have been made into fuel, and, on the other hand, not to count the energy content of paper because otherwise the wood would have been used as lumber in society. The following section elaborates on this issue.

Environmental Defense Fund (1990) maintains that "under no circumstances should 'degradable' bags be used" -- whether kraft or degradable plastic --on the grounds that they undercut incentives to recycle, and to reduce the use of virgin materials (wood, petroleum, or natural gas) -- renewable or nonrenewable.

For the reasons cited, it is not possible to determine how the ban would affect nonrenewable resources.

The Debate over Life-Cycle Comparisons: the Tellus Packaging Study, the Hocking Study, and the Franklin Associates Studies

Tellus (1992), Franklin Associates (1990a and 1990b), and Hocking (1991a) have often been cited in support of claims made by various parties about the potential impacts of the ban.

The Franklin Associates studies (1990a, 1990b, and others) have been criticized for characterizing overall environmental impacts of the products studied in terms of the total weight of atmospheric emissions, total weight of waterborne wastes, and total weight of solid wastes associated with each product's life-cycle (Environmental Action Foundation 1990, for example). This approach does not take into account that one pound of pollutant A in the atmosphere may have a far different impact on ecological or human health than one pound of pollutant B in the atmosphere (or one pound of pollutant A in water). This point is not in dispute.

Concerns also have been raised about the use of proprietary data, treatment of recycling impacts, and whether, for example, a flower pot made of recycled foodservice PS avoids the production of a flower pot made from virgin PS, a flower pot made from clay, or any flower pot at all (Environmental Action Foundation, 1990). The primary criticism of the Franklin Associates approach, though, has been that it aggregates pollutants by weight.

The Tellus Packaging Study (Tellus, 1992) emerged partly in response to the call for cradle-to-grave environmental and resource assessments that could be used for overall comparison of products, materials, or applications in a way that would not be open to this basic criticism of the conclusions of the Franklin Associates study.

Tellus Institute (1992) compares life-cycle energy, resource, and environmental impacts of unbleached coated folding boxboard, folding boxboard made from waste paper, unbleached kraft paper, PS, PVC, and several other packaging materials. The study developed a novel technique: environmental emissions associated with production and disposal of each material, including emissions associated with energy used in production and disposal, are tallied and converted to dollar equivalents based on estimates of the costs of controlling each pollutant that, Tellus (1992) argues, take toxicities into account. For each material, these monetary equivalents are totaled and in turn added to the actual dollar costs associated with conventional means of disposal. The resulting grand score in some respects may be thought of as a rough

initial ranking of life-cycle environmental merit. Tellus (1992) acknowledges that its method is problematic, but maintains that it is the least problematical method available, and that it represents a marked advanced over the life-cycle inventories of pollutants and wastes provided in the Franklin Associates studies. The U.S. EPA, the Council of State Governments, and the New Jersey Department of Environmental Protection commissioned the study to try to improve the methods and broaden the scope of life-cycle analysis. How successful Tellus (1992) may have been in this regard is addressed below.

Many of the materials and applications examined, such as PET soft drink containers or PVC hardware blisterpacks, are not covered by LL 10-1988. However, PS and boxboard clamshells, and paperboard and LDPE hardware bags, were compared.

If all foam PS discards in Suffolk County were 0.18-ounce clamshells and if they were replaced by 0.52-ounce folding boxboard clamshells, the full environmental costs as measured by the Tellus score rise 177%. This calculation assumes that the bleached LDPE-coated paperboard clamshells studied in Franklin Associates (1990b) are comparable to Tellus' unbleached coated folding boxboard clamshells.

Comparable calculations for the effect of substituting kraft for PE grocery bags cannot be made with available information. Tellus (1992) asserts that "[non-PVC hardware] plastic or recycled paper containers were somewhat lower in cost than virgin paper

boxes or bags," and that "the paper [hamburger] wrapper is clearly preferable: the polystyrene clamshell has a full cost 1.6 times as great as the wrapper, while the boxboard clamshell cost is over three times that of the wrapper."

This suggests that paper wrappers may offer the greatest environmental advantages of the three sandwich wrap materials studied. Franklin Associates (1991) compared layered wrap (bleached tissue and paper layers surrounding an LDPE layer) and standard wrap (wax- and/or LDPE-coated bleached paper) in a report for Perseco, the company which produces McDonald's foodservice packaging. These results have limited significance under LL 10-1988 because many of the relevant applications are exempt, and because the results in any case do not apply to the bulk of the materials and applications that LL 10-1988 does cover.

Tellus (1992) calculated that the full environmental cost scores (environmental production cost + environmental disposal cost + conventional disposal cost) of recycled corrugating medium -- the middle layer in corrugated cardboard -- was 220% of that for virgin corrugating medium. However, when the outer linerboard layers are added, full environmental costs become lower overall for the recycled product.

Full environmental cost scores for PVC, PS, LDPE, and HDPE were $5,288, $620, $580, and $537 per ton, respectively. The PVC cost primarily reflects vinyl chloride emissions in production and the PS cost primarily reflects styrene emissions in production. The LDPE and HDPE costs reflect other volatile organic compound

(VOC) emissions in production. Nearly all of the applications fall outside the scope of LL 10-1988.

There are substantial questions concerning the derivation of these scores and their import for deliberations concerning LL 10-1988, and for packaging, waste and environmental policy generally.

For example, the Tellus study (1992) did not model recycled plastics production; it excluded impacts from transportation and final package forming and filling steps in the product life cycles; it omitted industrial solid waste impacts not reflected in MSW data; it did not incorporate certain ecological impacts on virgin forests, including ones that may affect their renewability; and some data used may be too old, or inappropriately aggregated.

These points are acknowledged in Tellus (1992), and reflect generic difficulties in life-cycle analysis: limited, nonexistent, or incommensurable data, and recalcitrance to quantification or measurement of many ecosystem impacts.

However, fundamental issues of theory and consistency also are raised by the general assumptions of the Tellus (1992) approach. For example, Tellus (1992) ranks pollutants according to the dollar costs of currently required control measures, on the assumption that existing regulations reflect society's judgments of the relevant risks and the value of reducing them. Yet this approach is open to the possibility that regulatory perceptions of environmental harm can grossly underestimate or over-exaggerate the actual harms, and assumes that those perceptions truly represent society's values.

Tellus (1992) also assumes that if chemical A has ten times the health impacts of lead, society should be willing to pay ten times as much to control pollution from chemical A than it does to control lead pollution. This assumption is debatable.

Finally, while Tellus (1992) adopts pollution control dollar costs as representing the value society places on controlling environmental impacts of production and use, the study does not assume that conventional garbage disposal costs reflect the value society places on the environmental impacts of disposal. This raises questions of consistency.

For these reasons, it can be argued that the rankings of materials in Tellus (1992) are constructions that beg the issue of whether the environmental harm justifies the pollution control or disposal costs. Discussions of such issues in energy, life-cycle, and economic analysis have gone back and forth for many years. Tellus (1992) presents itself as an experimental advance over existing methodologies of life-cycle analysis. Whether this is so, and in just what way, is unclear; it may be that the methodological challenges in comparing products or materials according to some overall, life-cycle figure of merit are insuperable. In any event, appeal to Tellus (1992) to support claims as to the impact of LL 10-1988 is not justified.

Hocking (1991a) also has elicited debate. In addition to the energy comparison of the paper and foam PS cups, Hocking (1991a) concluded that on a per-cup basis, air emissions, water use, water contamination levels, raw material use, and inorganic process

chemical use are substantially higher for paper cups than for PS foam cups.

These criticisms were leveled against Hocking (1991a) by Environmental Action Foundation (1991); Wells (1991); McCubbin (1991); Cavaney (1991); and Camo (1991):

(a) that Hocking (1991a) overestimated the amount of hydrocarbons used to make a foam PS cup. As noted earlier, when allowances are made for this possibility, the paper and foam PS cups require roughly the same quantity of nonrecoverable petroleum (Hocking 1991b), and so cause roughly the same depletion of fossil fuel resources. This assumes that after use, the foam PS is recycled, converted to styrene, or used as fuel.

(b) that Hocking (1991a) did not take into account the self-generated energy used in the paper industry. This charge is wrong: for example, Hocking (1991a) assumed that 50% to 70% of the steam energy in paper manufacture is derived from self-generated biomass.

(c) that paper manufacture from purpose-grown trees reduces atmospheric CO_2 levels overall, and that Hocking (1991a) did not correctly factor in carbon fixation by trees supporting paper production. Hocking (1991b) acknowledges that this question was not considered in Hocking (1991a) and notes that in any event it is an open question whether or not CO_2 uptake by replanted trees offsets CO_2 releases from pulp and paper operations. Hocking (1991a) did consider releases of methane and pentane -- both are greenhouse gases -- associated with the life-cycles of paper and

foam PS cups, respectively. It was concluded that if a paper cup undergoes more than 2% of its maximum possible biodecomposition, the paper cup has the greater greenhouse effect.

(d) that Hocking (1991a) does not identify styrene monomer emissions associated with manufacture of foam PS cups. Styrene releases to the environment in 1988 were second-highest among the top 25 carcinogen in 1988, according to Caveney (1991) and Environmental Defense Fund (1990). Hocking (1991b) replied that these emissions are comparatively small (5.3 kg per ton of styrene processed), and, especially on a per-cup basis, are offset by organochlorine emissions in paper manufacture.

(e) that Hocking (1991a) adds up the weights of (say) the inorganic chemicals used to make paper and PS foam cups, but does not attempt to assess the relative impacts of each. That is to say, the toxic or ecological effects of one pound of aluminum chloride are not distinguished from the effects of one pound of sulfuric acid. As noted earlier in the discussion of Franklin Associates (1990a and 1990a), this point is not in dispute. All parties acknowledge that a full-dress life-cycle assessment would have to try to take differential risks into account.

(f) that Hocking (1991a) ignores industrial solid waste, including solid or liquid hazardous wastes. Evidence on this score is ambiguous, and it was not possible to confirm or refute this charge.

Some of the above criticisms of Hocking (1991a) appear to be unsupported. The verdict is out on the others; it is not obvious

that, if valid, they would significantly alter Hocking's general conclusions.

Despite their wide currency in discussions of the advantages and disadvantages of LL 10-1988, it is clear that available life-cycle comparisons of the paper and plastic products covered do not justify a definitive judgment as to which material or product or application creates the least pollution, uses the least amount of natural resources, or causes the least harm to humans or to the ecosystem. Individual environmental impact questions associated with disposal of the items covered by LL 10-1988 are evaluated in Section V of this report. This section summarizes difficulties in rendering overall judgments.

The main problem is brought out by Environmental Defense Fund in a discussion of the relative merits of plastic and paper grocery bags:

> However, trade-offs in the kinds of environmental impacts associated with these two materials makes the choice less than straightforward. For example, paper production consumes trees, generates sulfur dioxide that contributes to acid rain, can emit dioxins and other chlorinated organics into the water, and is energy-intensive. Plastics production consumes petroleum or natural gas, generates hazardous waste during production and emits toxics to air and water through the production of both the plastic resins and other chemical additives (e.g., polyethylene, the plastic used for shopping bags, uses cumene hydroperoxide, chromium oxide, and other chemicals during production). Environmental Defense Fund, 1990

There simply is no suitable common yardstick for comparing the merits of each impact. For example, how does one judge whether sulfur dioxide emitted over Canadian paper mills near small towns to make grocery bags used in Suffolk County is preferable to

increased use of Suffolk County groundwater for washing permanent cups or to removal of crude oil from Saudi Arabia and associated refinery emissions in New Jersey? Choosing the best of these three options calls for difficult judgments. Even if trustworthy methods were available for adding up the system risks, system dollar costs, or other system characteristics of interest, the fact that these risk or economic impacts fall across different locations, generations, occupations, species, and so on, means that ethical and other societal considerations become paramount.

When one adds the dozens of other environmental, energy, and resource tradeoffs associated with the use of life-cycle studies as policy guides, the judgments required become well-nigh imponderable, intractable.

A second major difficulty facing life-cycle analysis is that many impacts are recalcitrant to quantification because measurements are either difficult or in some cases impossible in principle. This concern particularly applies to energy, resource, and environmental impacts associated with ecosystem health and with global impacts: the greenhouse effect, acid rain, oil spill pollution, impacts of persistent environmental poisons and groundwater contamination, exhaustion of raw material sources, erosion and soil depletion, changes in forest streamflow, ecosystem energy production, irreversible changes in biodiversity (see for example, van Eijk et al., 1992).

There also are several major schools of thought about the proper way to measure individual flows of energy and materials, how

to add them up, where to set boundaries of the system under study, the validity of the use of econometric production and input-output data, and many other issues (Reaven 1984, 1985, and 1986).

A third major difficulty is that every new discovery, or suspicion, of a (favorable or unfavorable) environmental impact of a product requires a new evaluation of its life-cycle impacts. For example, one study suggests that effluents from forest products industries can harm offshore marine organisms and habitats (Waldichuk, 1988); another suggests that using mulched newsprint on farmland may cause cancer (Bukowski, 1993); a third suggests that chlorinated organic chemicals, including some associated with plastics, threaten the ecosystem of the Great Lakes (International Joint Commission, 1992). Each new life-cycle assessment may upset the findings of the last one. This can reduce confidence in the value of life-cycle analysis as an instrument for making policy.

The fourth big problem with life-cycle analysis is conceptual, a matter of what options are to be compared in the first place (rather than of how to compare them). The point may be brought out by extending an example given by the Environmental Action Foundation (1990). Suppose that a flower pot is made from recycled foodservice PS. Do we reason that we have prevented (a) the production of the virgin PS flower pot that would have been made instead? or (b) the production of the clay flower pot that would have been made instead? or (c) the extraction of the oil and natural gas that would have turned into a virgin PS flower pot? Or do we say (d) the PS that would have been made into the virgin PS

flower pot still is going to be produced, but will be made into some other product that would (or wouldn't) be recycled? or (e) the oil and natural gas still would be extracted and refined, but would be used as fuel? Or do we say that the flower pot is not needed and that without the recycling of foodservice PS, no flower pot would have been made at all?

Similar questions also arise in determining the impact of replacing PE bags with kraft bags or carryout bags, of replacing PS cups with paper or permanent cups, or of increasing the level of paper recycling. The question "what would happen otherwise" plausibly can be answered in many different -- and mutually incompatible -- ways.

The same philosophical question (what would happen otherwise?) underlies the arguments for and against counting energy content of paper and/or plastic products in life-cycle energy studies. Here the salient issue has been: would the matter (and energy) embodied in a particular product have been made into a different product, or used as a fuel, or conserved altogether but offset by the manufacture of a product made from another material? The convoluted reasoning generated by this issue is discussed in Reaven (1993, 1985).

Life-cycle environmental, resource, and energy assessments provide valuable knowledge of impacts arising at each stage of a product's life cycle. These assessments often bring heretofore invisible environmental, resource, and energy considerations to light. Nevertheless, they do not easily lend themselves to overall

judgments of environmental merit. Claims that any of these studies offer a sound basis for policy are seldom warranted. That appears to be the case for the life-cycle studies that have played a role in the controversy over the Suffolk County Plastics Law.

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XI. CONCLUSIONS

Assessing the significance and potential for significance of LL 10-1988 is extremely complex. There will be consequences that are not foreseen in this report, in the testimony on the legislation, or elsewhere.

There are many tangential but important issues associated with assessing the merits of the law. Potential benefits that are often cited with regard to LL 10-1988 include:

- it will encourage the plastics industry to be more responsible with regard to materials and product formulation, use and management;
- it will encourage other U.S. communities to more effectively manage their use and disposal of plastic; and
- it is the first in a suite of legislative measures that will lead to reduction and better management of Suffolk County's waste stream.

For the most part, these potential benefits are not quantifiable. However, even if they were, they are not identified as intentions or goals of LL 10-1988 and so should not be primary measures of the potential impact of the law. Certainly other communities have been influenced by Suffolk County's lead in exploring plastics legislation.

This study has tried to avoid debating the tangential issues. Instead, an attempt was made to quantify those impacts of the law, pro or con, that are measurable and significant. This study has

attempted to investigate a number of issues and concerns that have been raised with regard to LL 10-1988 so that the ultimate decision concerning implementation of the law can be made with the best and most up-to-date information available.

Plastics Legislation in the United States

A number of communities around the country have adopted or considered legislation to encourage a reduction in the use of plastics. Many have modeled their laws on LL 10-1988, whether or not their stated goals and objectives are the same.

It would appear that, in general, communities are now moving away from adopting such bans, often in favor of ordinances and regulations that encourage or require recycling.

Most of the municipalities that have adopted plastic bans have not evaluated their effectiveness. Not one community contacted by WMI could provide any quantifiable data on whether the laws are meeting stated goals.

Newark, NJ, has been the most aggressive with regard to enforcing their law. Other than Portland, OR, where $10,000 was allocated for enforcement the first year, resources for enforcement have generally been lacking in the communities WMI contacted. It is also not clear whether these communities would actively pursue enforcement even if resources for vigorous enforcement were available. Genuine concern was expressed everywhere that local government did not want to harm business people.

Public education was also not a high priority in other

communities, although in Portland, the consultant hired by the City to serve as an enforcement inspector certainly served in this capacity also. Newark was another possible exception.

Despite lack of enforcement and education, there does seem to be a sense that people are trying to comply. In some cases in other municipalities, the law and its caveats are sufficiently confusing that interpretation is difficult. This may be the case in Suffolk County as well.

Plastics in the Waste Stream

Implementation of LL 10-1988 without exemptions would affect 0.52% - 0.83%, by weight, of the Suffolk County waste stream -- an equivalent of 9,100-14,600 tons per year based on 1991 waste generation rates in Suffolk County. However, if the exemptions to the legislation are considered, the law applies to less than 0.44% to 0.75% by weight of the waste stream (7,700-13,100 tons per year). The ban would not reduce the waste stream by even this amount, as non-recyclable substitute products would replace that portion of the waste stream. The total waste stream will actually increase, by weight, assuming paper products are the substitute of choice. In terms of volume, the products targeted by the ban are for all practical purposes equivalent to the replacements. In fact, there is such a disparity between the volume of the equivalent number of kraft bags and plastic bags that there may be a slight volume increase.

It is not clear what the legislation means by the terminology

"simplifying the waste stream." However, it is clear that the legislation will neither eliminate nor significantly reduce the presence of any particular materials such as PS or PVC from the waste stream. These materials will still be there, as only a small percentage of the products made from PS and PVC are targeted by LL 10-1988. In fact, no PVC will be eliminated, as PVC food packaging products -- plastic wraps -- are exempt. Substitute products could be more chemically complex than those comprised of PS and PVC; however, this issue was not examined by WMI.

Municipal Solid Waste Treatment Technologies

Implementation of LL 10-1988 will have no impact on landfilling in Suffolk County. Landfilling is no longer used to any great extent in the county because of the implementation of the Long Island Landfill Law (ECL 27-0704, 1983). By extension, groundwater will also not be impacted.

With regard to incineration of MSW, LL 10-1988 will have a minimal impact. The material of greatest toxic concern addressed by the ban is PVC and its potential for chlorine release in the burning process. Since products made with PVC now fall under exemptions to LL 10-1988 (see Table 1, page 11), there will be no change in the mass balance of PVC subject to incineration. Moreover, it is unclear whether chlorine released during the incineration process is a measurable and significant problem. New mass-burn technologies and air pollution control technologies used at the Huntington/Smithtown, Babylon, and Hempstead incineration

facilities have reduced the risk of adverse environmental effects. The Islip plant is scheduled for renovations, to come into compliance with the Clean Air Act of 1990.

There is no scientific evidence to support the concern that ash generated from incineration of MSW is particularly more toxic or hazardous because plastics are present in the waste stream. Regardless, since PVC products are exempt, the debate is largely philosophical.

Composting of MSW is not practiced in Suffolk County at this time, although there are several Towns exploring the possibility of developing MSW composting programs. Local Law 10-1988 may benefit the aesthetic quality of MSW compost -- an important consideration for gaining market share relative to yard waste compost or sewage sludge compost. Shredded plastic and plastic bits are common contaminants in compost, and the materials targeted by the ban (grocery bags and PS pieces) have been identified among offending materials in MSW compost.

The ban would appear to have mixed results with regard to encouraging and stimulating recycling endeavors. Most of the materials banned under LL 10-1988 are only marginally recycled in Suffolk County. Polystyrene is being collected in some school districts, commercial establishments and, as of July 1993, at two drop-off centers in the Town of Huntington. As of September, 1993, the Town of Brookhaven is initiating a PS recycling program and providing residents with three drop-off centers -- at the landfill, the Holtsville Ecology Site, and Manorville. This material, while

being collected in relatively small amounts, can be tracked full circle from Suffolk County through collection, reprocessing, reformulation into secondary materials, and return of some small fraction of secondary materials back to Suffolk County (Figure 7, page 84).

Implementation of LL 10-1988 may discourage expansion of PS recycling by private citizens (i.e., elimination of fledgling drop-off centers and the potential for curbside collection). Paradoxically, the ban may also serve to encourage PS recycling among those school districts and businesses which choose to continue using PS food packaging. Depending on a business' or school's garbage contract, it is possible that choosing to recycle rather than replace PS products would result in a cost savings. Additionally, the PS school recycling programs could be developed into excellent interactive/hands-on educational programs.

Plastic grocery sacks are being collected for recycling in many supermarkets, as are kraft paper grocery bags. The plastic grocery sacks are made from LLDPE, LDPE, HDPE, all of which are desirable polymers to recycle but awkward and expensive to collect and transport. Neither plastic nor kraft bags are being recycled in quantity, relative to what is manufactured. However, both products are being used in the recycling process and are showing up in supermarkets as recycled content in plastic and paper bags, respectively. If the ban is enacted, the plastic grocery sack recycling endeavor would cease. In any case, it is not clear that recycling of the plastic grocery sacks will ever be considered a

major success, due to low participation rates by consumers, and sortation and contamination problems. In Atlantic County, New Jersey, where participation rates are high because plastic grocery

sacks are collected curbside, other problems arise. Often the bags end up contributing to roadside litter, due to the difficulty of containing them (Elizabeth Terenik, Atlantic County Utilities Authority, personal communication).

Litter and Marine Debris

In the litter surveys conducted by WMI for this study it was found that 36.4% of the material collected, by count, was plastic, and 8.8% of the items were of plastic that would be banned under LL 10-1988. Less than 1%, by weight, of the litter collected was subject to LL 10-1988.

If the ban is implemented it is likely that the general character of roadside litter might change in Suffolk County; however, the quantity of it probably would not -- substitute products for the banned products would most likely show up as litter. Litter is not a matter of product or material -- it is a matter of educating that portion of the populace that is thoughtless, taking little pride in its community.

The weight of the litter would very likely increase by a small amount; however, the volume probably would be about the same. Overall, the change in the character of roadside litter would be

measurable and probably significant, but in this study's estimation, the quantity of litter as measured by weight or volume would probably neither be measurable nor significant. This assessment is generally consistent with the comments of officials from other municipalities where plastic bans have been implemented and from casual observations as well.

By count, plastics covered by LL 10-1988 amounted to about 8% of litter collected at Suffolk County beaches in spring and early summer, 1993. This compares to about 27% of the litter for the New York State survey in Fall 1991. Most of the beach debris that washes up on Suffolk County beaches originates from outside Suffolk County. Much of it comes from communities that have CSOs -- particularly New York City.

It is unlikely that the beach debris problem will be measurably lessened by enactment of LL 10-1988. It is also unlikely that this ban will have any measurable impact on reducing the number of marine birds and animals that might be harmed by ingesting plastics or becoming entangled in them, since many of the plastics of greatest threat to marine animals, such as fishing line and ghost nets, are not covered by LL 10-1988.

Sanitation and Public Health

Public health and sanitation should be a primary consideration in the implementation of this legislation. Two issues in particular have been raised -- health effects associated with substituting paperboard meat trays for PS meat trays, and the

leaching of styrene from foamed PS packaging.

With regard to meat trays, there is no convincing evidence that there is an increased risk of transmitting disease through use of the standard paperboard meat trays as compared to PS meat trays.

Leaching of styrene may occur to some degree in foamed PS packaging. There is no good evidence that this leaching is causing a measurable health problem. Clearly more research is warranted on this topic. However, the Food and Drug Administration and other regulatory agencies currently endorse the use of PS foam fast food packaging.

The Economic Impact of Local Law 10-1988

There are alternatives to plastic products covered by LL 10-1988. Depending on the particular product and its intended use, the alternative may have advantages or disadvantages. In the near future it would appear that the costs of alternatives to banned plastics will be more expensive -- assuming that disposables will be substituted for disposables.

Undoubtedly, the larger supermarket chains will pass the added expense on to the customer. Small businesses, retail food establishments and delicatessens may handle increased costs in a variety of fashions. It is not clear in what way price increases would be passed on, if at all, or if the magnitude of the increase would be measurable.

However, based on observations in other municipalities, it is apparent that retail food businesses are not failing because of

plastic bans. Businesses and the public are adjusting to the requirement -- in some instances with pride and innovation.

Life-cycle Energy, Resource, and Environmental Impacts

Life-cycle analyses are useful means to organize data and information for the purpose of assessing production systems and their associated products. However, the analyses are only as good as the assumptions applied to them. A good methodology for applying life-cycle analysis to the problem of comparing plastic products to alternatives does not exist. There are too many poorly specified assumptions made, and any outcome is filled with uncertainty.

Waste Management Institute did, however, examine two well known life-cycle analyses to compare energy costs of the plastic bag with the kraft paper bag, primarily because they have been used for this debate elsewhere. A similar assessment was made comparing PS foam cups with paper cups.

In the case of the grocery sack comparison, implementation of the ban may, as an upper limit, save about 18,000 barrels of oil per year. The other extreme is that implementation of the grocery sack provision of LL 10-1988 could cost about 8,000 barrels. Thus, energy is inconsequential in this particular debate and if one also considers the hypothetical nature of the analyses, it is evident little weight should be given to this aspect of the study in formulating policy.

Life-cycle environmental assessments appear to be even more problematical than those of energy. While the environmental benefits of using life-cycle analyses to evaluate LL 10-1988 appear neutral, the uncertainties are too great to have much meaning.

Finally, it is also important to consider the issue of LL 10-1988 in the context of the State's waste management hierarchy, established by the Solid Waste Management Act of 1988. Seemingly, LL 10-1988 will make some small change in the chemical composition of the waste stream, and will probably increase the weight and volume of the waste stream. The law may also be responsible for initiating some recycling endeavors, for those who seek to qualify for an exemption to the law. Major recycling endeavors within the County, however, will not result because of the law. Some change in the chemical composition of materials to be incinerated will also occur; however, since PVC products are exempt, this issue is inconsequential.

It would appear that LL 10-1988 has had a considerable impact across the country. Indeed, other communities have used Suffolk's law as a model or perhaps a beginning to develop their own laws. In some cases, the wording of other communities' laws is almost identical to that of Suffolk County's LL 10-1988 (see Section III, Newark, NJ, and Glen Cove, NY). Additionally, the plastics industry has taken notice of the law and, at least on the surface, made some effort to deal more effectively with the post-consumer plastic problem.

Despite the above benefits, there are a number of points to be considered in making a final decision about implementation of LL 10-1988.

1. The law may not achieve many of its stated goals as enumerated in the findings.
2. There now may be greater benefits to encouraging the recycling of materials of concern. In fact, LL 10-1988 is already having a small effect in that regard, as some schools and institutional cafeterias have initiated PS recycling programs which meet the requirements for exemption to LL 10-1988. Major recycling endeavors are unlikely.
3. The law may give businesses which ship food products into Suffolk County a slight competitive advantage over those which operate within the County, as businesses outside Suffolk County are exempt from LL 10-1988 due to Interstate Commerce laws.
4. Public education will be needed.
5. If enacted, resources to enforce the Plastics Law should be provided.
6. Follow-through is needed in order to assure Suffolk County citizens that LL 10-1988 is meeting its stated goals.

Appendix A.
The Suffolk County Plastics Law, Local Law 10-1988
See Article II, Uniform Packaging Practices for Retail Food Establishments.

Chapter 301

FOOD LABELING AND PACKAGING

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Labeling of Perishable Foodstuffs

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[HISTORY: Adopted by the Suffolk County Legislature: Art. I, 10-9-1979 as L.L. No. 29-1979; Art. II, 3-29-1988 as L.L. No. 10-1988. Amendments noted where applicable.]

GENERAL REFERENCES

Caterers — See Ch. 237.
Item pricing — See Ch. 328.
Recycling — See Ch. 399.
Vending and peddling — See Ch. 475.
Sanitary Code — See Ch. 760.
Vending machines — See Ch. 850.

ARTICLE I
Labeling of Perishable Foodstuffs
[Adopted 10-9-79 as L.L. No. 29-1979]

§ 301-1. Legislative findings.

At present, Suffolk County residents are not protected by a perishable dating law. And although both Nassau County and New York City have perishable dating laws, a Suffolk County shopper is the victim of potluck as to whether or not they are purchasing fresh foodstuffs. Consumers are entitled to the absolute right to know, at the time of purchase, that foodstuffs will be fresh for a reasonable period of time past purchase. Today's inflationary spiral for food prices makes it that much more important that Suffolk County has some regulations concerning open dating.

§ 301-2. Definitions.

As used in this Article, the following terms shall have the meanings indicated:

PERISHABLE FOOD PRODUCTS — All shell eggs, baked goods with a moisture content exceeding eighteen percent (18%), including bread and roll products, cake and pastry products, muffin products, cheese, milk and milk products, cultured milk and milk products, yogurt, cultured cream, sour cream, half-and-half, dairy dressings

and dips, nondairy coffee creamers, refrigerated prepackaged foods, meat and poultry.

§ 301-3. Dating requirements.

It shall be unlawful to sell or offer for sale any perishable foodstuffs unless there appears conspicuously on the package a day or date indicating the last day or date of sale. Said marking shall be clear and readable.

§ 301-4. Sale of products after perishable date.

A foodstuff may be sold past its perishable date only if it is sold in a separate section of the establishment and the items are clearly marked as outdated perishable products.

§ 301-5. Penalties for offenses.

Any food store found violating this Article shall be subject to a fine not to exceed one hundred dollars ($100.) for each offense. An offense would apply to each package not properly marked.

§ 301-6. Enforcement.

This Article shall be enforced in its entirety by the Suffolk County Office of Consumer Affairs.

ARTICLE II
Uniform Packaging Practices for Retail Food Establishments
[Adopted 3-29-88 as L.L. No. 10-1988[1]]

§ 301-7. Legislative intent.

A. This Legislature finds that discarded packaging constitutes the largest single category of waste within Suffolk County's

[1] Editor's Note: The applicability date of L.L. No. 10-1988 was postponed by Local Law No. 22-1989, adopted 7-18-1989; by L.L. No. 4-1990, adopted 1-30-1990, and by L.L. No. 19-1991, adopted 6-13-1991. See note following § 301-15.

waste stream and is, therefore, a necessary focus of any effort to reduce the filling of the municipal landfills within Suffolk County, as well as to reduce the economic and environmental costs of waste management for the citizens of this county.

B. This Legislature also finds that discarded nonbiodegradable packaging and plastic contained within the waste stream of Suffolk County is a fundamental cause of problems associated with municipal waste disposal.

C. This Legislature further finds that landfill space within Suffolk County is diminishing rapidly; that state law currently in effect precludes the establishment of new landfills on Long Island within deep-flow recharge areas after 1990 and mandates closure of existing ones in these groundwater-sensitive areas by that date; that solid waste receiving areas outside of Long Island are becoming increasingly uncertain and expensive; and that, for both economic and environmental reasons, measures to simplify the chemical complexity of solid waste and, thereby, streamline solid waste management must be vigorously pursued.

D. This Legislature hereby finds that the chemical composition and ability of a substance to biodegrade are meaningful and useful criteria to focus upon when establishing public policy that is intended to improve the management and disposal of solid waste, reduce the cumulative impact of litter, encourage composting and other forms of recycling, minimize the potential for toxic substances to form if solid waste is burned, reduce the volume of ash by-products that may be created by any burning of waste plastic packaging and otherwise anticipate environmental problems that may be caused by municipal solid waste disposal programs.

E. This Legislature also hereby finds and determines that the use of plastics and other nonbiodegradable packaging has become widespread throughout the County of Suffolk and that the resulting mixed substance waste stream is a serious impediment to many solid waste management programs that are being considered for this county.

F. This Legislature further finds that the widespread use of plastics, especially polystyrene and polyvinyl chloride, poses a threat to the environment in the County of Suffolk by causing excessively rapid filling of landfill space or, if incinerated, by the possible introduction of toxic by-products into the atmosphere and general environment of Suffolk County.

G. This Legislature finds that the economic and environmental problems associated with Suffolk's mixed-substance waste stream are so severe that a program to incrementally simplify the chemical composition of solid waste, thereby reducing environmental hazards and toxicity associated with solid waste incineration and encouraging the composting of putrescible biodegradable wastes and encouraging other forms of recycling of solid waste substances, is hereby determined to be a policy goal of Suffolk County.

H. This Legislature determines that the waste stream within Suffolk County is so large and diverse that any program to establish policies and laws conducive to any waste management program in lieu of landfilling must identify and set new policy for those specific sources of waste packaging which originate within this county.

I. This Legislature determines that certain retail establishments within Suffolk County are points of origin for a substantial volume of packaging waste and, therefore, are particularly susceptible to actions which have significant potential for simplifying the chemical composition of this portion of Suffolk's solid waste stream, thereby improving solid waste management within this county.

J. This Legislature finds that the use of polystyrene and polyvinyl chloride for food packaging is problematical because neither of these plastic species is readily recyclable; their abundant commercial use in lieu of other plastic species such as polyethylene or polypropylene unnecessarily complicates the overall chemical composition of municipal waste and subtracts from the possible emergence of a viable plastic recycling market for this region; and, if burned together, polystyrene and polyvinyl chloride leave a relatively heavier and therefore more expensive ash residue to dispose of which may also create

dioxin, hydrochloric acid or other toxic chemicals that could be emitted into the general environment of Suffolk County.

K. This Legislature finds that there are readily available plastic and/or paper product substitutes for most of the polystyrene and polyvinyl chloride retail food packaging now being used in Suffolk County, the use of which alternatives would be environmentally and economically advantageous to the people of Suffolk County.

L. This Legislature finds that plastic bags in the waste stream constitute an impediment to the development of efficient waste separation, recycling or other waste management programs and are less desirable than paper bags because plastic bags are neither recyclable nor compostable.

M. This Legislature finds that plastic bags used by retail establishments selling food constitute the largest single retail source of plastic bags in the waste stream.

N. Therefore, the purpose of this Article is to incrementally, to the maximum extent practicable, eliminate the use of nonbiodegradable packaging originating at retail establishments within Suffolk County in order to protect the air, land and waters of Suffolk County against environmental contamination and degradation.

§ 301-8. Definitions. [Amended 12-4-1991 by L.L. No. 34-1991]

NOTE: Local Law No. 34-1991 also amended §§ 301-9, 301-11, 301-12 and 301-13 of this chapter and provided as follows:
Section 1. Legislative intent.

This Legislature hereby finds and determines that Local Law No. 10-1988 was enacted as a first step in what will be an incremental process of comprehensively regulating the disposal of solid waste products and encouraging the use of biodegradable products in order to reduce the number of toxic or long-lived products in the wastestream within the County of Suffolk.

This Legislature also finds and determines that certain technical changes are necessary to fine-tune the provisions of this law in order to ensure a smooth transition from nonregulation into full implementation of said legislation, now that the authority of the County Legislature to enact such legislation has been upheld by the New York State Court of Appeals.

This Legislature further finds and determines that retail food establishments should be encouraged to recycle and reuse packaging.

This Legislature further finds and determines that, for nutritional assistance homebound delivery programs, the use of packaging, otherwise prohibited under said local law, is necessary.

This Legislature further finds and determines that affected retail establishments should be allowed to use up preordered items because, in the absence of their ability to do so, these items would, in any event, be disposed of and ultimately placed into local landfills.

This Legislature also determines that additional retail establishments have sprung up since enactment of Local Law No. 10-1988 which are engaged in retail transactions that affect products covered by the original "Plastics Law."

The Legislature further finds that this local law will prevent needless economic harm to affected business establishments in Suffolk County, and allow such establishments to become familiar with the rules and regulations being promulgated by the County Department of Health Services and to identify and purchase alternate replacement items.

This Legislature also finds that a temporary delay in addressing the food tray and lid cover issue pending a formal study and assessment by the County Department of Health Services would be desirable.

Therefore, the purpose of this law is to clarify and enact technical modifications to Local Law No. 10-1988 for its smooth implementation, to encourage recycling and reuse of plastic packaging and to allow retail food establishments to exhaust existing inventories over a reasonable period of time, including an expansion of the scope of the law to conform to changes in the marketplace and to afford a reasonable transition period for the implementation of the food tray and lid cover provisions.

Section 3. Applicability.

A. This law shall apply to all transactions occurring on or after January 1, 1992.

B. Section 301-9B of the Suffolk County Code shall not apply to food trays prior to January 1, 1993. The Commissioner shall conduct an assessment and evaluation of the issue of using biodegradable packaging for meat trays from a public health perspective only and report his or her findings to the County Executive and County Legislature no later than October 1, 1992. The County Legislature may then act on such findings no later than November 30, 1992.

C. Section 301-9B of the Suffolk County Code shall not apply to lids or plastic covers prior to January 1, 1993. The Commissioner shall conduct an assessment and evaluation of availability of biodegradable packaging as a substitute for plastic lids or plastic covers and report his or her findings to the County Executive and County Legislature no later than October 1, 1992. The County Legislature may then act on such findings no later than November 30, 1992.

D. Enactment of this law shall not affect the validity of any fines or sanctions imposed prior to the effective date of this law for violations of Local Law No. 10-1988.

As used in this Article, the following terms shall have the meanings indicated:

BIODEGRADABLE PACKAGING — Packaging made of cellulose-based or other substances that undergo significant changes in its chemical structure as a result of the action of naturally occurring microorganisms such as bacteria, fungi and algae. The ultimate products of this process should be carbon dioxide, water and compost (humus). This biodegradation process does not generate any intermediate or final products that would be detrimental to public health.

COMMISSIONER — The Commissioner of the Suffolk County Department of Health Services.

PACKAGING — All food-related wrappings, adhesives, cords, bindings, strings, bags, boxes, containers and disposable or nonreusable plates, cups, eating utensils or drinking utensils intended for use within Suffolk County.

RETAIL FOOD ESTABLISHMENT — Each sales outlet, store, shop or other place of business located within the County of Suffolk which operates primarily to sell or convey food directly to the ultimate consumer, which foods are predominantly contained, wrapped or held in or on packaging. "Retail food establishment" shall include, but not be limited to, any place where food is prepared, mixed, cooked, baked, smoked, preserved, bottled, packaged, handled, stored, manufactured and sold or offered for sale, including but not limited to each fixed or mobile restaurant, drive-in, coffee shop, cafeteria, short-order cafe, delicatessen, luncheonette, grill, sandwich shop, soda fountain, tavern, bar, cocktail lounge, nightclub, roadside stand, prepared-food takeout place, industrial feeding establishment, catering kitchen, commissary, grocery store, convenience store, public food market, food stand or similar place in which food or drink is offered for sale or for service on the premises or elsewhere, and any other establishment or operation, including homes, where food is processed, prepared, stored, served or provided for the public for charge. **[Amended 3-3-1992 by L.L. No. 5-1992[1]]**

SMALL BUSINESS — Any retail food establishment that provides food service and employs no more than one hundred (100) full-time employees. **[Added 3-3-1992 by L.L. No. 5-1992[1]]**

§ 301-9. Biodegradable packaging required. [Amended 12-4-1991 by L.L. No. 34-1991[2]]

A. No retail food establishment located and doing business within the County of Suffolk shall sell or convey food directly to ultimate consumers within the County of Suffolk unless such food is placed, wrapped or packed in biodegradable packaging at the conclusion of a sales transaction for the purchase of such food which takes place on the premises of such a retail food establishment at or near a sales counter or equivalent customer purchasing station but prior to removal of such food

[1] Editor's Note: See note regarding L.L. No. 5-1992 following § 301-16.

[2] Editor's Note: Local Law No. 34-1991 also amended §§ 301-8, 301-11, 301-12 and 301-13. See note in § 301-8.

from the premises of such retail food establishment. This section applies to packaging commonly known as "grocery bags."

B. No retail food establishment located and doing business within the County of Suffolk shall sell, give or provide individual eating utensils, individual food containers or other packaging to any consumers within the County of Suffolk if such individual eating utensil or individual food container is composed of polystyrene or polyvinyl chloride. Nothing contained herein shall, however, prohibit a retail food establishment from selling or offering for sale to consumers commercially prepackaged eating or drinking utensils sold in bulk, food containers sold in bulk or other packaging sold in bulk. This Subsection B applies only to eating utensils, food containers or other packaging which is added to or placed with a food product at the site of the retail food establishment. This subsection does not apply to packaging which is governed by Subsection A of this section.

§ 301-10. Rules and regulations.

The Commissioner of the Department of Health Services shall issue and promulgate such rules and regulations as may be necessary to implement and carry out the provisions of this Article.

§ 301-11. Variances. [Added 12-4-1991 by L.L. No. 34-1991[3]]

The Commissioner may issue and grant such variances from the provisions of this Article as he or she shall deem appropriate, subject to the following requirements:

A. A written application for a variance shall be submitted to the Commissioner.

B. A copy of each variance application shall be submitted to the Clerk of the Suffolk County Legislature upon receipt by the Commissioner.

[3] Editor's Note: Local Law No. 34-1991 also amended §§ 301-8, 301-9, 301-12 and 301-13 and renumbered §§ 301-13 – 301-15 as §§ 301-14 – 301-16. See note in § 301-8.

C. The Commissioner may, in his discretion, request additional information from the applicant. No public hearing regarding the variance shall be held prior to receipt of such information.

D. A public hearing regarding the proposed variance shall be held upon appropriate notice to the public and to interested parties. The Commissioner shall maintain a list of environmental organizations and other parties who have indicated a desire to be notified of all requests for variances. At a minimum, the Commissioner shall notify the applicant and those parties on the list described above for a variance by mail. The Commissioner shall notify additional parties upon request. The Commissioner may, in his discretion, supplement these notice provisions.

E. The Commissioner shall approve or disapprove the application, in writing, within thirty (30) days after the public hearing. The Commissioner's decision to approve a variance shall expressly be made subject to review by the Suffolk County Legislature, as set forth below.

F. The Commissioner's decision to approve a variance shall immediately be filed with the Clerk of the Suffolk County Legislature. The decision to approve shall not take effect until sixty (60) days after such filing.

G. Within forty-five (45) days after receipt of the Commissioner's decision by the Clerk of the County Legislature, the County Legislature may, by duly enacted resolution, disapprove of the variance. Such resolution shall be subject to the approval and veto powers of the Suffolk County Executive.

H. The variance or any renewal thereof shall not exceed a period of one (1) year at a time.

I. The circumstances under which a variance may be granted shall be limited to the following:

(1) A variance may be granted either packaging utilized by one (1) or more retail food establishments or on a product-wide basis for a particular type of packaging utilized by one (1) or more retail food establishments.

(2) A variance may be granted where the Commissioner is provided with satisfactory written evidence and finds and determines that a substitute product compatible with the requirements of this law is not commercially available to retail food establishments located and doing business within the County of Suffolk.

§ 301-12. Exemptions. [Amended 12-4-1991 by L.L. No. 34-1991]

Section 301-9 of this Article shall not apply to the following items:

A. Any flexible transparent covering for uncooked or raw meat, poultry, raw fish, hard cheese, cold cuts, fruit and vegetable produce, baked goods or bread.

B. Any food packaging used at hospitals, nursing homes or not-for-profit nutritional assistance programs, such as Meals-on-Wheels or similar homebound delivery services.

C. Any paper or other cellulose-based packaging that is coated with polyethylene plastic on only one (1) side.

D. Any plastic covers, covering material, food containers, lids, eating utensils or straws that are not made of polystyrene or polyvinyl chloride.

E. Point-of-sale packaging used for purchased goods that are intended for reuse and provided at the point of sale by the purchaser of the goods (carry-out grocery bag).

F. Any food packaging that is used at a particular retail food establishment or other such self-contained site in which all of the particular waste plastic does not leave the confines of the building, is on-site separated from the other portion of the establishment's waste and is conveyed without being remixed with any part of the wastestream to an appropriate recycling plant or reprocessing facility.

(1) This exemption may be utilized in a retail food establishment which meets the requirements of Subsection F, provided that the owner or operator submits a written assurance verifying that the requirements of Subsection

F are and will be complied with. Such written assurance shall be submitted to the Commissioner on an annual basis.

(2) The Commissioner shall file with the Clerk of the County Legislature no later than December 31 of each year a list of all retail food establishments that have been granted exemptions pursuant to this section. The list shall also be provided to any party upon written request.

§ 301-13. Enforcement. [Amended 12-4-1991 by L.L. No. 34-1991]

A. This Article shall be enforced by the Suffolk County Department of Health Services in accordance with the provisions of Article II, § 760-200 et seq., of the Suffolk County Sanitary Code.

B. Any retail food establishments covered by § 301-9 of this Article may use, sell, donate, provide or convey existing supplies of products or materials, the use of which would otherwise constitute a violation of this Article, through the 90th day after the rules and/or regulations implementing said law are finally issued and formally promulgated by the County Department of Health Services. The Commissioner shall promulgate such rules and/or regulations on or before December 31, 1991.

§ 301-14. Penalties for offenses.

Willful failure to comply with § 301-9 and/or the regulations of § 301-10 of this Article shall constitute a violation punishable by a civil fine of five hundred dollars ($500.) for each violation.

§ 301-15. Determination of environmental impact.

A. This Legislature, being the State Environmental Quality Review Act (SEQRA) lead agency, hereby finds and determines that this Article constitutes an unlisted action pursuant

to Section 617.2 of the New York Codes, Rules and Regulations (NYCRR) and will not have a significant adverse impact on the environment within the meaning of § 8-0109, Subdivision 2, of the New York Environmental Conservation Law for the following reasons:

(1) Enactment of this Article will not exceed any of the criteria in Section 617.11 of Title 6 of NYCRR, which sets forth threshholds for determining significant effects on the environment.

(2) The Article will mainly result in beneficial environmental impacts, including the following:

(a) It will encourage recycling of solid waste products.

(b) It will provide enhanced protection of groundwater quality.

(c) It will slow down rapid filling of landfill space.

(d) It will simplify the chemical composition of solid waste and thereby reduce the environmental hazards and toxicity associated with solid waste incineration.

(e) It will reduce the cumulative impact of litter.

B. Furthermore, in accordance with § C1-4A(1)(d) of the Suffolk County Charter and § 279-5C(4) of the Suffolk County Code, the Suffolk County Council on Environmental Quality (CEQ) is hereby directed to prepare and circulate a SEQRA notice of determination of nonsignificance in accordance with the law.

§ 301-16. Preemption.

This Article shall be null and void on the day that statewide legislation goes into effect incorporating either the same or substantially similar provisions as are contained in this Article or in the event that a pertinent state or federal administrative agency issues and promulgates regulations preempting such action by the County of Suffolk. The County Legislature may determine via mere resolution whether or not identical or substantially similar statewide legislation has been enacted for the purposes of triggering the provisions of this section.

Note: Local Law No. 4-1990, adopted 1-30-1990, delayed the effective date of the law appearing as this Article and provided as follows:
Section 1. Legislative intent.

This Legislature also hereby finds and determines that the use of plastics has become widespread throughout the county.

This Legislature finds that recycling and/or source reduction of packaging can have a beneficial impact in reducing the problems associated with municipal waste disposal.

This Legislature also finds that plastic packaging, including polystyrene and polyvinyl chloride, can be recycled into useful products or can be reduced through source reduction.

This Legislature further finds that development and implementation of sound recycling and/or source reduction programs for plastic packaging materials can have a major beneficial impact in reducing the problems associated with municipal waste disposal in this county.

This Legislature further finds and determines that the imposition of a moratorium on the implementation of Local Law No. 10-1988 through January 30, 1990, does not provide sufficient time for the appeal of a lawsuit against Local Law No. 10-1988, entitled Society of Plastics Industry, Inc., et al., v. County of Suffolk, et al., to be determined nor sufficient time to establish a Plastics Recycling Commission to study the feasibility of developing a plastic packaging Recycling/Source Reduction Plan.

Therefore, the purpose of this law is to extend a moratorium on the implementation of Local Law No. 10-1988 so as to allow a Plastics Recycling Commission, to be created by law, sufficient time to analyze the feasibility of developing a plastic packaging Recycling/Source Reduction Plan and to allow the appeal of the above-described lawsuit against Local Law No. 10-1988 to be determined by the Appellate Division of the Supreme Court of the State of New York.

Section 2. Definitions.

A. PLASTIC PACKAGING shall mean all food-related plastic wrappings, adhesives, cords, bindings, strings, bags, boxes, cups, containers and disposable or nonreusable plates.

B. FOOD-RELATED PLASTIC PACKAGING shall mean plastic packaging used in retail food establishments.

Section 3. Moratorium.

The applicability date of Local Law No. 10-1988 to retail transactions is hereby extended and postponed to June 30, 1990, or until sixty (60) days after the Appellate Division of the Supreme Court of the State of New York (2nd Department) issues a formal written decision in a case entitled Society of Plastics Industry, Inc., et al., v. County of Suffolk, et al., whichever date occurs first.

Local Law No. 19-1991, adopted 6-13-1991, provided for the subsequent implementation of this Article and reads as follows:
Section 1. Legislative intent.

This Legislature hereby finds and determines that the use of plastics has become widespread throughout the county.

This Legislature further finds and determines that the New York State Court of Appeals' decision in a lawsuit against Local Law No. 10-1988, entitled, "Society of Plastics Industry, Inc., et al. v. County of Suffolk, et al.," has upheld the validity of Local Law No. 10-1988 which would result in immediate implementation of said law.

Therefore, the purpose of this law is to clarify the process of implementation.

Section 2. Moratorium.

The applicability date of Local Law No. 10-1988 to retail transactions is hereby extended and postponed to the ninetieth day after the rules and/or regulations impementing said law are finally issued and formally promulgated by the County Department of Health Services or December 31, 1991, whichever date occurs first.

Section 3. Applicability.

Enactment of this law shall not affect the validity of any fines or sanctions imposed prior to the effective date of this law for violations of Local Law No. 10-1988.

Local Law No. 5-1992, adopted 3-3-1992, Section 3 of which amended § 301-8 of this chapter, postponed the applicability of this Article and provided as follows:
Section 1. Legislative intent.

This Legislature hereby finds and determines that the use of plastics has become widespread throughout the county.

This Legislature finds that recycling and/or source reduction of packaging can have a beneficial impact in reducing the problems associated with municipal waste disposal.

This Legislature also finds that plastic packaging, including polystyrene and polyvinyl chloride, can be recycled into useful products or can be reduced through source reduction.

This Legislature further finds that development and implementation of sound recycling and/or source reduction programs for plastic packaging materials can have a major beneficial impact in reducing the problems associated with municipal waste disposal in this county.

This Legislature further finds and determines that the imposition of a moratorium on the implementation of Local Law No. 10-1988 through December 31, 1992, for small businesses would provide sufficient time for a study of the feasibility of developing a comprehensive Plastic Packaging Recycling/Source Reduction Plan.

Therefore, the purpose of this law is to impose a moratorium on the implementation of Local Law No. 10-1988 so as to allow sufficient time to analyze the feasibility of developing a comprehensive plastic packaging Recycling/Source Reduction Plan and to alleviate the economic burdens that small businesses may experience if full implementation of the Plastics Law occurs prior to the development of a comprehensive Plastic Packaging Recycling/Source Reduction Plan and also to clarify application of Plastics Law to individual franchises.

Section 2. Definitions.

A. PLASTIC PACKAGING shall mean all food-related plastic wrappings, adhesives, cords, bindings, strings, bags, boxes, cups, containers and disposable or nonreusable plates.

B. FOOD-RELATED PLASTIC PACKAGING shall mean plastic packaging used in retail food establishments.

Section 4. Moratorium.

The applicability date of Local Law No. 10-1988 to retail transactions of small businesses is hereby extended and postponed to December 31, 1992. A retail food establishment that wishes to qualify under the provisions of this section shall file with the Department, no later than forty-five (45) days subsequent to the effective date of this law, written documentation establishing its status as a small business signed and sworn to by the payroll officer and/or owner.

Section 5. Applicability.

Enactment of this law shall not affect the validity of any fines or sanctions imposed prior to the effective date of this law for violations of Local Law No. 10-1988.

Appendix B. Legislative history summary table.

Introductory Resolution Number/Year	Action	Public Hearing Dates	Purpose
1869/1987	Adopted as LL 10-1988	9/8/87 9/11/87 3/29/88	To incrementally, to the maximum extent practicable, eliminate the use of non-biodegradable packaging originating at retail establishments
1204/1989	Disapproved by Cty. Exec.; overridden & adopted as LL 22-1989	3/14/89 3/28/89 4/11/89 4/24/89 5/9/89 6/6/89	To impose a moratorium on the implementation of LL 10-1988 so as to allow a Plastics Recycling Commission. . . sufficient time to analyze the feasibility of developing a Plastic Recycling/Source Reduction Plan
1609/1989	Stricken	6/6/89 6/20/89 8/15/89 9/12/89	To enact technical modifications to LL 10-1988 for the smooth implementation of the Plastics Law

Introductory Resolution Number/Year	Action	Public Hearing Dates	Purpose
1037/1990	Adopted as LL 4-1990	1/30/90	To extend a moratorium . . .so as to allow a Plastics Recycling Commission. . . sufficient time to analyze the feasibility of developing a Plastic Packaging Recycling/Source Reduction Plan & to allow the appeal of . . .the lawsuit against LL 10-1988 to be determined by the Appellate Division of the Supreme Court of the State of NY
1438/1990	Vetoed	5/15/90	To empower & direct the Suffolk County Dept. of Law to withdraw the appeal filed by the County in connection with The Society of the Plastics Industry, inc., et al., v. The County of Suffolk
1501/1991	Stricken	6/11/91	To impose a moratorium on the implementation of LL 10-1988 so as to allow the business community a sufficient transition period to adjust to the new requirements of the Plastics Law

Introductory Resolution Number/Year	Action	Public Hearing Dates	Purpose
1576/1991	Adopted as LL 19-1991	6/13/91	To clarify the process of implementation of LL 10-1988
1566/1991	Adopted as LL 34-1991	8/27/91 9/11/91 10/2/91 11/13/91 12/4/91	To clarify & enact technical modifications to LL 10-1988 for its smooth implementation, to encourage recycling & reuse of plastic packaging & to allow retail food establishments to exhaust existing inventories over a reasonable period of time, including an expansion of the scope of the law to conform to changes in the marketplace and to afford a reasonable transition period for the implementation of the "food tray" & "lid cover" provisions
1955/1991	Adopted as LL 5-1992	12/17/91 1/22/92 2/4/92	To impose a moratorium. . . so as to analyze feasibility of developing a comprehensive plastic packaging Recycling/Source Reduction Plan & to alleviate the economic burdens for small businesses

Introductory Resolution Number/Year	Action	Public Hearing Dates	Purpose
1163/1992	Stricken	3/24/92	To amend LL 10-1988 for the purpose of exempting retail food establishments from the Plastics Ban in those towns which have a comprehensive recycling program in place
1987/1992	Stricken	12/15/92 1/26/93 2/23/93 3/9/93	To reduce the volume of packaging now disposed of as solid waste; to encourage the continuation & expansion of recycling; to eliminate the economic burden of LL 10-1988 by repealing it; & to encourage the use of recycled material
1989/1992	Stricken	12/15/92	To amend LL 10-1988 for the purpose of exempting retail food establishments . . .in those towns which have a comprehensive recycling program in place that provides for the recycling of at least 75% of the plastic waste stream generated by the business sector
1001/1993	Adopted as LL 10-1993	3/9/93	To extend the moratorium on the applicability date of LL 10-1988, as amended for small businesses, to permit completion of the WMI study

Reasons Polystyrene Foam Products Were Banned

In passing the ordinance restricting use of polystyrene* foam the Portland City Council found that:

- Foam products are not biodegradable and projections indicate significant growth in the use of this material, particularly in readily disposable food containers and wrappers.
- Because foam products are not biodegradable, they are a major contribution to litter and will take up more and more valuable landfill space. Paper products are biodegradable and can also be composted.
- There is general agreement that certain chlorofluorocarbons (CFC's) which are used to manufacture some foam products, are very damaging to the earth's ozone layer. The effect on the atmosphere of alternative gases now being substituted by the industry is unknown.
- Recycling of foam food containers is difficult because the product is hard to clean and its low density makes transportation costs uneconomical. Recycling programs for the foam are limited in the Portland area.
- Foam products, when littered, can break into small pieces and when eaten by birds and other wildlife can cause death by starvation.

Polystyrene foam is defined as any material composed of polystyrene having an "air" content of 25 percent or more. Consult your container supplier if you have questions about products subject to the ban.

ENVIRONMENTAL SERVICES
CITY OF PORTLAND
1120 SW 5th, Room 400
Portland, Oregon 97204

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Portland's Ban of Polystyrene Foam Food Containers

Restaurants and retail food vendors in the City of Portland are prohibited from serving prepared food and beverages in polystyrene foam food containers.

ENVIRONMENTAL SERVICES
CITY OF PORTLAND

Definition

Polystyrene Foam is defined as any material composed of polystyrene having an "air" content of 25 percent or more. Consult your container supplier if you have questions about products subject to the ban.

Background

In January 1989, the Portland City Council passed Ordinance No. 161573 banning use of polystyrene foam containers for take-out food as well as food served on restaurant or retail food vendor premises.

Why was this ordinance passed?

In response to growing concern over:

- diminishing landfill space,
- litter problems,
- lack of recycling programs,
- and the potential threat to wildlife when foam is ingested.

Polystyrene foam is not biodegradable and projections indicate significant growth in the use of this material, particularly in readily disposable food containers and wrappers.

Alternatives

City Council encourages the use of non-plastic items that may be re-used or that are biodegradable.

Some acceptable alternatives include:

- washable ceramic or glass,
- wicker plates covered with thin paper,
- or biodegradable (uncoated or thinly coated) paper or cartons.

Contact your supplier about alternative products.

Exemptions

Non profit tax exempt organizations are excluded from the ban. The City Council may exempt a business from the polystyrene foam restriction if it results in an undue hardship.

"Undue hardship" includes instances where there is no acceptable alternative to a product, or where the action would deprive someone of a legally protected right.

Requests for exemption should be addressed to the Bureau of Environmental Services.

Enforcement

County Sanitarian restaurant inspection reports and citizen complaints will provide the City with information on violations of the ordinance.

You may be fined.

Restaurants or retail food vendors in violation of the ordinance after a first notice may be fined up to $250, and $500 for subsequent violations.

For more information:

If additional clarification is needed you may call 823-7007

or write:
Bureau of Environmental Services
1120 S.W. Fifth Ave., Room 400
Portland, OR 97204

CITY OF
PORTLAND, OREGON
BUREAU OF ENVIRONMENTAL SERVICES

Earl Blumenauer, Commissioner

1120 S.W. 5th, Rm. 400
Portland, Oregon 97204-1972
(503) 796-7740
FAX: (503) 796-6995

CITY OF PORTLAND
POLYSTYRENE FOAM (PSF) FOOD CONTAINER BAN
APPLICATION TO GROCERY STORES

Generally if you prepare or process the food in the store, to make it ready for the customer to consume, straight out of the package, then you may not put it into a PSF package in the store.

The following ***MAY NOT*** be packaged in/on PSF:

- Bakery products baked, assembled, packaged or prepackaged in the store
- Deli items dispensed from a larger container to a smaller container for the customer (eg., salads, pasta)
- Deli items assembled in the store (eg., sandwiches)
- Meats that have been cooked, smoked, sliced, or otherwise prepared or served in the store (regardless of size of meat portion)
- Cheese sliced in the store
- Fruits or vegetables washed, cooked, cut, squeezed, or otherwise prepared in the store
- Dried fruits and vegetables packaged in the store
- Frozen yogurt or ice cream dispensed into containers for the customer at the store
- Coffee, tea, soft drinks or other ready to drink beverages served at the store
- Sample "tasting" foods prepared and served in the store
- Salad or other "bar" foods where the customer serves him/herself

The following ***MAY*** be packaged in/on PSF:

- Bakery goods that have been prepackaged outside of the store
- Deli items that have been prepackaged outside of the store
- Raw eggs
- Ready to cook items (eg., stuffed potatoes, chicken kiev)
- Raw meat, including fish and seafood regardless of preparation in the store,
- Uncooked or instant foods (eg., cup of soup)
- Fruits and vegetables that are not prepared in any way in the store
- Meats smoked, cooked or otherwise prepared and packaged outside of the store, not repackaged in the store
- Unprepared fresh fruits and vegetables packaged in store for sale in units (eg., box of mushrooms)
- Beverages packaged outside of the store (eg., NY Seltzers)

For more information call 796-7010

7/90

Engineering
Bill Gaffi
796-7181

Business Operations
Bob Rieck
796-7133

Wastewater Treatment
Ross Peterson
285-0205

Customer/Employee Affairs
Karen Kramer
796-7062

Appendix D. Roadside litter collected by WMI in Suffolk County, June 1993, by count and percent by count.

NORTH SHORE

	A		B		C		D		E	
	#	%	#	%	#	%	#	%	#	%
plastic	48	28.92	136	35.32	107	28.01	133	31.29	110	32.54
banned	12	7.23	4	1.04	14	3.66	12	2.82	21	6.21
glass	45	27.11	34	8.83	37	9.69	64	15.06	1	0.30
rubber	0	0.00	7	1.82	3	0.79	1	0.24	0	0.00
metal	14	8.43	20	5.19	20	5.24	70	16.47	18	5.33
paper	47	28.31	171	44.42	199	52.09	140	32.94	186	55.03
wood	0	0.00	9	2.34	0	0.00	1	0.24	0	0.00
cloth	0	0.00	4	1.04	2	0.52	4	0.94	2	0.59
total litter	166	100	385	100	382	100	425	100	338	100
site size (sqyd)	111.111		556		333		556		83	
items/sqyd	1.49		0.69		1.15		0.77		4.06	

KEY
A - Rt. 25A & Lake Avenue
B - Rt. 25A @ Stony Brook R.R. Station
C - Rt. 25A, Rocky Point
D - Rt. 25A, Mattituck
E - Rt. 347 @ Smith Haven Mall
F - LIE @ exit 56
G - LIE @ exit 62
H - LIE between exits 67 & 68
I - Rt. 110 & Rt. 27
J - Rt. 27 @ exit 64
K - Bridgehampton Commons

MID-ISLAND

	F		G		H	
	#	%	#	%	#	%
plastic	142	25.31	61	25.52	94	26.55
banned	54	9.63	21	8.79	32	9.04
glass	9	1.60	12	5.02	2	0.56
rubber	77	13.73	10	4.18	8	2.26
metal	32	5.70	25	10.46	54	15.25
paper	236	42.07	106	44.35	143	40.40
wood	9	1.60	1	0.42	0	0.00
cloth	2	0.36	3	1.26	21	5.93
total litter	561	100	239	100	354	100
site size (sqyd)	139		139		667	
items/sqyd	4.04		1.72		0.53	

SOUTH SHORE

	I		J		K	
	#	%	#	%	#	%
plastic	157	27.69	210	32.16	98	15.68
banned	76	13.40	147	22.51	20	3.20
glass	9	1.59	38	5.82	33	5.28
rubber	11	1.94	17	2.60	0	0.00
metal	76	13.40	73	11.18	22	3.52
paper	225	39.68	164	25.11	451	72.16
wood	1	0.18	0	0.00	0	0.00
cloth	12	2.12	4	0.61	1	0.16
total litter	567	100	653	100	625	100
site size (sqyd)	500		2347		1000	
items/sqyd	1.13		0.28		0.63	

Appendix D. Roadside litter collected by WMI in Suffolk County, June 1993, by weight (lbs.) and percent by weight.

NORTH SHORE

	A		B		C		D		E	
	wt.	%	wt.	%	wt.	%	wt.	%	wt.	%
plastic	1.99	10.24	1.08	9.07	0.70	17.43	1.03	28.25	1.66	39.34
banned	neg.	0.00	neg.	0.00	neg.	0.00	0.18	4.83	neg.	0.00
glass	12.42	63.91	2.96	24.72	0.89	22.26	1.19	32.53	neg.	0.00
rubber	0.00	0.00	0.95	7.98	neg.	0.00	neg.	0.00	0.00	0.00
metal	2.47	12.72	0.42	3.49	0.72	17.98	0.36	9.78	0.30	7.09
paper	2.56	13.18	4.48	37.49	1.70	42.32	0.90	24.63	1.78	42.16
wood	0.00	0.00	0.11	0.96	0.00	0.00	neg.	0.00	0.00	0.00
cloth	0.00	0.00	1.95	16.28	neg.	0.00	neg.	0.00	0.48	11.41
total litter	19.43	100	11.96	100	4.01	100	3.65	100	4.22	100
total bag wt.	20.76		12.51		5.29		7.54		4.71	

KEY
A - Rt. 25A & Lake Avenue
B - Rt. 25A @ Stony Brook R.R. Station
C - Rt. 25A, Rocky Point
D - Rt. 25A, Mattituck
E - Rt. 347 @ Smith Haven Mall
F - LIE @ exit 56
G - LIE @ exit 62
H - LIE between exits 67 & 68
I - Rt. 110 & Rt. 27
J - Rt. 27 @ exit 64
K - Bridgehampton Commons

MID-ISLAND

	F		G		H	
	wt	%	wt	%	wt	%
plastic	2.50	21.43	1.14	7.40	6.74	43.53
banned	0.18	1.58	0.09	0.62	0.11	0.74
glass	3.44	29.50	5.43	35.42	0.64	4.15
rubber	2.80	24.02	0.99	6.43	0.33	2.10
metal	0.82	7.01	0.58	3.80	5.10	32.95
paper	1.61	13.76	4.63	30.19	1.19	7.70
wood	neg.	0.00	1.93	12.58	0.00	0.00
cloth	0.32	2.71	0.55	3.56	1.37	8.86
total litter	11.67	100	15.34	100	15.49	100
total bag wt.	12.82		17.63		15.96	

SOUTH SHORE

	I		J		K	
	wt	%	wt	%	wt	%
plastic	1.99	16.74	2.44	16.0	0.82	10.36
banned	0.04	0.37	0.33	2.2	0.14	1.78
glass	2.59	21.74	3.17	20.8	2.31	29.09
rubber	4.64	38.96	3.75	24.6	0.00	0.00
metal	1.14	9.55	3.32	21.8	0.18	2.28
paper	0.82	6.89	2.44	16.0	4.48	56.50
wood	neg.	0.00	0.00	0.00	0.00	0.00
cloth	0.07	0.58	neg	0.00	0.00	0.00
total litter	11.91	100	15.23	100	7.92	100
total bag wt.	14.06		20.98		9.43	

Appendix E. Beach litter collected by WMI at Suffolk County Beaches, June and July, 1993, by count and by percent count.

NORTH SHORE

	Flax Pond		Short Beach		West Meadow	
	#	%	#	%	#	%
plastic	1261	91.64	96	45.28	208	60.29
banned	13	0.94	1	0.47	11	3.19
glass	24	1.74	7	3.30	3	0.87
rubber	53	3.85	1	0.47	14	4.06
metal	9	0.65	50	23.58	90	26.09
paper	8	0.58	46	21.70	18	5.22
wood	2	0.15	11	5.19	1	0.29
cloth	6	0.44	0	0.00	0	0.00
total litter	1376	100	212	100	345	100
site size (sqyd)	4083		111		111	
items/sqyd	0.34		1.91		3.11	

SHELTER ISLAND

	Menhadden Beach		Shell Beach	
	#	%	#	%
plastic	669	60.93	181	16.48
banned	40	3.64	23	2.09
glass	59	5.37	22	2.00
rubber	55	5.01	13	1.18
metal	88	8.01	14	1.28
paper	162	14.75	19	1.73
wood	2	0.18	11	1.00
cloth	23	2.09	3	0.27
total litter	1098	100	286	100
site size (sqyd)	14667		7040	
items/sqyd	0.07		0.04	

SOUTH SHORE

	Smith Point	
	#	%
plastic	78	33.91
banned	5	2.17
glass	15	6.52
rubber	1	0.43
metal	35	15.22
paper	87	37.83
wood	3	1.30
cloth	6	2.61
total litter	230	100
site size (sqyd)	20000	
items/sqyd	0.01	

Appendix E. Beach litter collected at Suffolk County Beaches in June and July, 1993, by weight (lbs.) and by percent weight

NORTH SHORE

	Flax Pond		Short Beach		West Meadow	
	wt.	%	wt.	%	wt.	%
plastic	33.67	74.26	1.61	55.30	1.89	34.34
banned	0.09	0.19	0.02	0.68	0.00	0.00
glass	5.53	12.19	0.48	16.35	1.01	18.43
rubber	1.43	3.14	neg	0.00	neg.	0.00
metal	0.74	1.63	0.27	9.34	0.35	6.45
paper	2.59	5.70	0.30	10.17	0.92	16.83
wood	0.97	2.15	0.24	8.14	1.31	23.92
cloth	0.33	0.72	0.00	0.00	neg	0.00
total litter	45.34	100	2.92	100	5.49	100
total bag wt.			3.66		7.88	

SHELTER ISLAND

	Menhadden Beach		Shell Beach	
	wt.	%	wt.	%
plastic	27.17	40.58	7.08	45.48
banned	0.42	0.62	0.07	0.00
glass	10.56	15.77	3.85	24.76
rubber	4.90	7.31	neg.	0.00
metal	3.55	5.30	0.16	1.02
paper	4.59	6.86	0.18	1.14
wood	14.24	21.27	4.23	27.17
cloth	1.52	2.27	neg.	0.00
total litter	66.95	100	15.57	100
total bag wt.	97.19		22.75	

SOUTH SHORE

	Smith Point	
	wt.	%
plastic	3.68	19.79
banned	0.03	0.00
glass	3.15	16.97
rubber	0.58	3.12
metal	3.62	19.50
paper	2.88	15.51
wood	0.00	0.00
cloth	4.64	24.98
total litter	18.57	100
total bag wt.	22.71	

Appendix F. Notes on Section X Assumptions.

Franklin Associates (1990a) (i) compares 1/6 barrel polyethylene bags weighing 0.26 oz. each and 2.14 oz. 70-lb. base weight single-ply unbleached paper bags; (ii) assumes that 15% of bags are incinerated with energy recovery for both paper and plastic (paper yields more energy than plastic bags on an equivalent use basis, less on a per-pound basis); (iii) counts the energy content, or inherent energy, of hydrocarbon feedstocks in the plastics (55% of total life cycle energy costs at 0% recycling, 42% at 100% recycling -- these figures in turn imply that process and transportation energy accounts for from 45% to 58% of total energy); (iv) does not count energy content for paper -- this assumption (one not followed in the Federal Office of the Environment 1988) increases the life-cycle energy consumption of plastics relative to paper (life-cycle energy for paper increases by 43%); (v) credits paper products with extensive amounts of self-generated energy in paper mills -- as much as 37% in North America (compared to 45% in Europe in Office of federal Environment 1988; also see Reaven 1993); (vi) credits plastics products with self-generated energy from other refinery byproducts or operations; (vii) counts the impact of secondary packaging for paper and plastic bags; (viii) calculates plastic bag impacts based on average market-share fractions of high molecular weight HDPE and LLDPE bags.

The main differences between the analytical frameworks in Franklin (1990a) and in Federal Office of the Environment (1988)

are (i) the German study counts the energy embodied in both the paper and plastic bags themselves, while the Franklin Associates study counts only the energy embodied in the plastic bags, as noted; (ii) differences in assumptions as to replacement ratios (that is, how many plastic and paper bags it takes to carry a given quantity of groceries); (iii) European and American bag size and weight differences (the German study compared 0.63-ounce PE and 1.34-ounce unbleached kraft paper bags, both 12-liter capacity, with design capacity of approximately 11 pounds of groceries) . The PE bags are 250% heavier and the paper bags 40% lighter than the corresponding bags examined in Franklin Associates (1990a). Much of this difference is offset by differences in replacement ratios and other factors.

Calculations following the Franklin Associates (1990a) and (adjusted as just noted) Federal Office of the Environment (1988) approaches yield remarkably close estimates (for net energy analyses, that is) of the total energy associated with the current mix of paper and plastic bags in Suffolk County -- energy equivalent to that in 34,120 and 41,603 barrels of oil, respectively.

The differences in analytical framework have been corrected for in the estimates given herein. Most importantly, the energy content in the paper as estimated in the German study is deducted in the present report from the total energy, in order to make the German study as comparable as possible with the Franklin Associates studies. This deduction increases the estimates of energy (and

environmental) impacts of plastics compared to those of paper.

Production technology and distribution system differences between Europe and North America do not significantly affect the overall energy costs (but do affect the allocation of those costs from one stage to another. For instance, Europeans use more naphtha in making ethylene than in the United States; differences in average amounts and distances for oil imports lead to differences in energy use and in environmental impacts of oil spills.

For the bags in the German study, the energy saved by not making a PE bag almost exactly equals the energy needed to make the corresponding paper bag.

Paper and plastics bags also were studied by the Midwest Institute, a precursor of Franklin Associates, in 1974 (Midwest Research Institute 1974). These results are not discussed in the main text, since considerable changes since 1974 have affected energy impacts of these products (light-weighting, increased LLDPE use, changes in additives and production technology). The 1974 study examined one-gallon capacity produce bags. However were these bags to be used in Suffolk County in the same numbers as Suffolk paper and plastic grocery bags, then switching the plastic bags to paper would increase life cycle energy costs by the energy equivalent of 1420 barrels of oil, according to Midwest Research Institute (1974).

The assumptions of Franklin Associates (1990b) are similar to those catalogued above for Franklin Associates (1990a). In

addition, Franklin Associates (1990b) (i) did not consider the impact of differential rates of refilling and other reuse for paper and plastic foodservice items (these rates are higher for plastic cups); (ii) for the products studied, credits for energy recovered by incineration range from 1% to 6% for PS and 5% to 6% for paper.

Franklin Associates (1990a) and (1990b) disaggregate total energy use associated with the products studied according to the source of energy (coal, nuclear, etc.). This analysis is based on highly aggregated sector-wide industrial data that itself embodies many assumptions.

Hocking (1991a) gives upper and lower estimates of steam requirements for paper cups and of electricity requirements for PS cups. In each case, the mean is used here.

The Environmental Action Foundation (1990) endorses the Franklin Associates practice of counting the energy content for plastics, on the grounds that making the plastics physically diverts or locks up energy resources that could be used elsewhere in society, or conserved. The idea is that this argument does not work for paper products -- i.e., that the pulp would be used elsewhere in society in the form of some other wood product (not as energy). As indicated, Federal Office of the Environment (1988) does count inherent energy for paper products. These issues are discussed in detail in Reaven (1993 and 1985). Reaven (1993) concludes that the rationale for the Franklin Associates/ Environmental Action Foundation approach is invalid, and that both approaches overlook crucial distinctions.

Suffolk County waste generation figures are derived from weighted-mean estimates in Tonjes and Swanson (1993).

Appendix G. Persons and Organizations Contacted

Anand, V., U.S. FDA, Washington, DC

Ball, J., Kraft Paper, Wayne, NJ

Barrett, L., City of Portland, Portland, OR

Biggers, B., Flexible Packaging Association, Washington, DC

Bredes, N., Suffolk County Legislator, 5th District, Setauket, NY

Brodhagen, P., NY State Food Merchants Association, NYC, NY

Broyhill, J., The Society of the Plastics Industry, Inc., Statistics Department, Washington, DC

Canterbury, J., Environmental Protection Agency, Solid Waste Division, Washington, D.C.

Castellano, A., Solid Waste Division, Department of Public Works, Minneapolis, MN

Cava, T., New York State Department of Environmental Conservation, Stony Brook, NY

Center for Marine Conservation, Washington, DC

Charno, M., The Society of the Plastics Industry, Inc., Government Affairs, Washington, DC

Conklin, E., McDonald's Corporation, Oak Brook, IL

Cramer, S., Council Member, Eleventh Ward, Minneapolis, MN

Cullen, T., King Kullen Grocery Company, Westbury, NY

DeRiggi, D., City of Glen Cove, NY

Dinda, E., Bureau of Environmental Protection, Suffolk County Department of Health Services, Hauppauge, NY

Donahue, McDonald's Corporation, Oak Brook, IL

Edmunds, J., Solid Waste and Recycling Division, Department of Public Works, Minneapolis, MN

Esposito, C., Tri-State Recycling, Lindenhurst, NY

Esposito, W., Tri-State Recycling, Lindenhurst, NY

Environmental Action, Takoma Park, MD

Environmental Defense Fund, Washington, DC

Farber, L., Sierra Club

Fenton, J., Grumman Corporate Operations, Bethpage, NY

Forbes, M., Keep America Beautiful, Inc., Stamford, CT

Formato, L., NYC, NY

Franklin, M., Franklin Associates, Prairie Village, KS

Fritzpatrick, R., New York State Department of Economic Development, Plainview, NY

Goldstein, H., Finkel, Goldstein and Berzow, NYC, NY

Greenpeace, USA, Washington, DC

Hallock, G., Rutgers Cooperative Extension, Rutgers, NJ

Householder, R.W., Market Manager, Hartsville, SC

Huntley, J., American Plastics Council, Washington, DC

Johnson, C., Obex, Stamford, CT

Johnson, J., Polystyrene Packaging Council, Inc., Washington, DC

Johnson, N., Perseco, Oak Brook, IL

Kast, S., Shelter Island Conservation Advisory Council, Shelter Island, NY

Kearing, S., Director, Department of Environmental Control, Town of Huntington, Huntington, NY

Kietly, K., Northbridge Environmental Consultants, Cambridge, MA

King, J., Signal Technologies Inc., Bohemia, NY

Kohn, J., County Attorney's Office, Hauppauge, NY

Kouchoukos, D., Perseco, Oak Brook, IL

Kramer, K., Mobil Chemical Company, Plastics Division, Macedon, NY

Langert, R., McDonald's Corporation, Oak Brook, IL

Larkin, J., W.& R. Grace & Co., Reading, PA

Leonard, A., Greenpeace, International Toxic Trade Project, Washington, DC

Levy, M., DeliVat, Hackensack, NJ

Liblit, E., Long Island Regional Recycling Cooperative, Lindenhurst, NY

Login, D., Keep Islip Clean

Madelmayer, G., Ogden Martin Systems of Huntington, E. Northport, NY

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