NEW JERSEY LITTER SURVEY: 2004

A BASELINE SURVEY OF LITTER AT 94 STREET AND HIGHWAY LOCATIONS

PERFORMED FOR
THE NEW JERSEY
CLEAN COMMUNITIES COUNCIL

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January 28, 2005

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PREFACE

This report describes the results of a visible litter count survey performed at 94 sites in the State of New Jersey from April 2, 2004 through April 9, 2004. Of the 94 sites, 86 were selected using stratified sampling, while eight were special research sites located on routes adjacent to construction sites, downtown commercial sites and beaches\waterways, as requested by the New Jersey Clean Communities Council. This survey was the 62nd major litter study performed using the visible litter survey methodology developed by the Institute for Applied Research (IAR) in 1979 and was performed by Gershman, Brickner, & Bratton, Inc. (GBB), under contract to the New Jersey Clean Communities Council, with the assistance of the Institute for Applied Research. The purpose of the study was to characterize the litter in New Jersey and identify the principal sources of litter to be targeted in a state-wide litter-reduction effort.

The sampling and analysis plan, field survey and most of the basic data acquisition, reduction and spreadsheet analysis were performed by GBB staff. The key analyses relating to factors and the recommendations for a Media-Based litter reduction program were developed by Daniel Syrek of the Institute for Applied Research.

The purpose of this Visible Litter Survey was to conduct a statewide litter study for the New Jersey Clean Communities Council (CCC). The project surveyed and documented the current litter situation in New Jersey, including the composition of litter, litter rates, littering trends, litter quantities, quantities of recyclable materials littered, identification of problem areas, and comparisons of this data with surveys from other states and previous litter survey work done in New Jersey, if possible. All data was compiled by calculating the number of items littered rather than the weight of items littered. Since the impact of litter is primarily visual and thus volume-based rather than weight-related, calculating litter by weight would distort the visual impact of litter and would yield a higher margin of error.

The goals of the study were to: produce accurate, comprehensive data that reflected the overall quantification, distribution and composition of litter in New Jersey; examine litter composition and generation rates statewide; determine the sources of litter; identify and gain understanding of geographic trends in litter generation; gain information to develop effective litter prevention programs; and establish a baseline to develop a statewide litter reduction goal.

Based on the data gathered, GBB's proposed methodology provides CCC with information on who is producing the litter, allowing for the creation of a targeted, hence more effective, anti-litter campaign.

The study was conducted in both urban and non-urban areas, on roadways, interstates, and in public areas. These areas were subdivided into various sample sites. Roadways were divided into interstate highways, state routes, county roads, and city streets. Other Locales included roadsides adjacent to or leading to urban and rural parks, beaches, waterway shorelines, construction sites and landfills, as appropriate.

The results reflect the 90 percent probability that the established mean of the statewide averages for percent of the specified materials, falls within 10 percent of the true mean.

NEW JERSEY LITTER: 2004
EXECUTIVE SUMMARY

METHODOLOGY

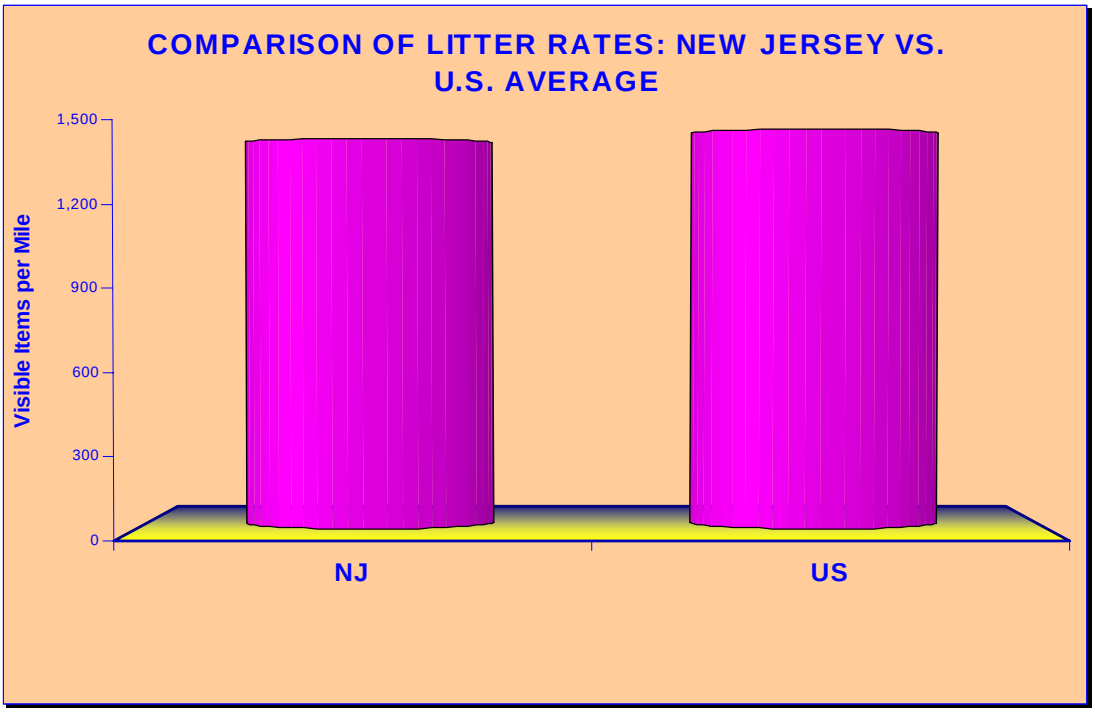
A survey of litter visible to a pedestrian walking along the side of the roadway was conducted at 94 randomly selected sites throughout the state. 37 of these sites were along urban and rural freeways, other rural state highways and rural local roads. The remaining 57 sites were along streets in cities and municipalities. Eight special sites, located on roadways adjacent to construction sites, downtown commercial sites and beaches\waterways were selected and sampled as part of the total 94 sites. To minimize the biasing effects of factors found to influence litter rates in seventy prior studies, the data were corrected to standardized levels of traffic volume, weather, county population, occupants per vehicle, household income (for urban sites) and miles to nearest city (for rural sites).

GENERAL FINDINGS

When corrected to the U.S. average for levels of traffic, county population size, income and weather, New Jersey's overall litter rates are close to the national average, as shown in Figure 1. However, if the litter rates are not adjusted for these impacts, New Jersey's actual litter rates appear significantly higher, particularly for urban streets as opposed to freeways/rural roadways.

Although New Jersey has been conducting a community-based litter program for some time with considerable efforts to picking up litter, the potential exists for achieving a significant reduction by instituting an advertising program targeted at the principal age groups that have been identified from this survey.

Figure 1



What Is This Litter Composed Of and Where Is It Coming From?

Deliberate litter comprises 55% of all litter in New Jersey. Deliberate litter rates are 35% higher in New Jersey than in other states. Data from this study and prior studies indicate that approximately 75% of the persons deliberately littering these products along urban streets are between the ages of 6 and 24 years and are predominantly male, while 60% of persons deliberately littering freeways and rural roadways are between the ages of 11 and 34.

Accidental litter, which stems from open bed vehicles, trashcan spills and human carelessness, comprised the remaining 45% of all litter. The age of persons responsible for accidental littering along urban streets is more diverse than that of deliberate litterers, with 67% percent between 11 and 44 years of age. Accidental litter was less diverse on freeways and rural roadways with 68% of the total coming from persons 18 to 39 years of age.

What Anti-Litter Programs Exist in the State and How Effective Are They?

An estimated 55% of the total state highway mileage in New Jersey is currently in the Adopt-a-Highway program compared to 45% nationally. Previous state surveys performed during February through April have shown adopted sites averaged only 9% cleaner than sites that were not adopted. Adopted sites from surveys conducted during June and July showed adopted sites were 15% cleaner than those sites not adopted because pickup activities are more prevalent during this period. This illustrates a fundamental problem with litter pickup programs, they must be sustained. Thus, after being cleaned, litter tends to build back up so quickly it is difficult to distinguish between cleaned and uncleaned sites. A cost effectiveness analysis has shown that it would typically take at least three more cleanings per year of all freeway and rural roadway miles and seven cleanings a year of all urban streets to achieve a year-round average 50% reduction in litter rates.

Because of the lack of historical data and uneven funding levels, it is not possible to accurately access the effectiveness of New Jersey's community-based programs. Only one Keep America Beautiful (KAB) program, Morristown (in Morris County), is currently active in any of the counties in New Jersey's population.

What Alternative Litter Control Programs Exist and How Effective Are They?

The two most expensive ways to remove or prevent litter from streets and roadsides are paid litter pick-up programs, which cost $1.29 to remove one item of litter, and beverage container deposits, which only reduce beverage container litter at a cost of $4.24 per item. Paid litter pickup programs immediately reduce litter by ninety percent, but litter builds back up again to near pre-cleaning levels within 7 to 31 weeks. Deposit programs immediately reduce fresh container litter, but have little effect on the major components of litter, such as Take-out Food Packaging.

Adopt-a-Highway programs and state-run comprehensive litter control programs are less expensive (about $0.18 to remove or prevent an item of litter) but have limitations. Adopt-a-Highway programs usually cover 35% or less of state maintained highways and do not affect most rural local roads or urban city streets. Comprehensive programs have proven effective

statewide, achieving statewide reductions in litter of more than 50%. It can take up to 15 years of aggressive and consistently well-funded anti-litter campaigns for a state to realize such significant results.

Paid advertising programs targeting the age groups identified as primarily responsible for causing litter are the most cost-effective. They prevent littering from occurring at a cost of $0.02 per item. They are flexible and quick to achieve results (70% reductions in litter in six years) but should be adequately supported and sustained to achieve good results. They are not as cost effective for smaller jurisdictions under 500,000 persons.

What Program Should New Jersey Adopt?

Because it is most cost-effective and fastest to produce lasting results, a media-based public information campaign should be implemented in New Jersey to deal with the State's litter problems. Optimally, it would feature an advertising program funded at a level of $0.30 per person per year. It would be administered by the Clean Communities Council, a qualified state-funded, non-profit organization with the goal of achieving a reduction in litter of 50% or more. Due to the importance of the educational component for anti-litter programs to be effective, the Adopt-A-Highway program should be included as part of the overall media program.

Follow-up litter surveys by an independent contractor should be performed two and five years after the media program inception to assess program effectiveness and to identify the need for shifts in program content, scope and direction. Members of the litter survey team and the litter program manager should meet to provide input on themes, direction and effectiveness. Initially the program should concentrate on reducing deliberate littering along urban streets. It should target 6 to 24 year-old persons. Subsequently, the focus of the program could be expanded to target 11 to 44 year olds, who do most of the urban street accidental littering. It will probably be necessary to develop separate advertising messages aimed at the diverse age groups involved as well as the industries and businesses transporting materials in open-bed vehicles.

Legislation should also be pursued to implement and enforce other litter control program recommendations, such as laws prohibiting the use of uncovered truck and trailer beds as depositories for paper and trash. Other non-advertising program elements should be implemented, including expanded litter hot line reporting; direct letters to owners of open bed vehicles and owners of businesses involved in transporting materials to landfills and other locations in open bed vehicles; and education of law enforcement agencies, construction industry officials, and trucking and tire industry managers regarding the scope and magnitude of the litter problem and how they can effectively address its impacts. A program to step-up the use of additional litter receptacles, where appropriate and cost-effective, should also be considered.

INTRODUCTION

KNOWLEDGE GAINED FROM PRIOR SURVEYS

While the knowledge gained from the survey of sites in New Jersey defines the current litter rate and composition of New Jersey, it is important to realize that much of what has been learned in 73 prior surveys in 26 other states and jurisdictions is applicable to New Jersey and helpful in understanding the results obtained. This section summarizes some of this information, while additional material is referenced in the remainder of the report.

These prior surveys were conducted using the techniques developed by the Institute for Applied Research (IAR). As described in Appendix B, Methodology, all the roadways in a jurisdiction are classified using a system which evaluates traffic, roadway mileage, and other data from federal and state transportation agencies to analyze the raw litter counts. These roadway classifications are called "Locales" in this report and are important to understanding where and why littering is taking place in New Jersey. The Locales are defined as follows:

1. **Rural Freeways and Tollways (RFT):** Interstate Highways, non-interstate toll roads and limited access highways located outside of urban areas.

2. **Other State Rural Highways (OSR):** U.S. and State highways located outside of urban areas without limited access.

3. **Rural Local Roads (RLR):** Public roads outside of an urban area that are maintained by a city, county, borough, township, etc.

4. **Urban Freeways and Tollways (UFT):** Interstate Highways, non-interstate toll roads and limited access highways located within an urban area.

5. **Vacant, Industrial or Un-maintained Street Frontages (VIU):** The edge of an urban street in front of a vacant lot, an un-maintained industrial site or a lot with a building and or landscaping which is run-down and receiving no upkeep.

6. **Commercial Street Frontage (COM):** The edge of an urban street in front of a store, mall, restaurant, or other place of business.

7. **Public Facility Street Frontage (PUB):** The edge of an urban street in front of a park, stadium, school, courthouse, public library, police station, or other government or quasi-public use building or facility.

8. **Residential Street Frontage (RES):** The edge of an urban street in front of residences, typically along neighborhood streets.

HOW SHOULD LITTER BE DEFINED?

Litter is frequently defined as “solid waste in the wrong place.” While this definition (See Appendix A, Glossary) applies to most litter, it fails to include some items that are not always considered litter, but are included as such in this study. Such items include vehicle debris and some things not typically considered “waste,” such as accidentally lost money, financial records, toys, clothing, tools, furniture, etc. A more inclusive definition of waste is “man-made or man-transported products or materials in the wrong place.” This covers a wide range of materials from manufactured goods to natural products such as lawn clippings and yard trimmings improperly disposed of. With this definition, the “wrong place" is usually defined by law or consensus of the community. Thus, pieces of wood and empty 55 gallon drums in the front yard of an Alaskan bush dwelling might be considered useful and even prized possessions, not litter. Litter usually excludes such things as road kill, natural flora and animal droppings. In some states, certain agricultural or mineral products that are littered while being transported are excluded by law from being considered litter.

The methodology used in this litter survey focuses on litter found in the public right-of-way along streets and highways. Littering which occurs within quasi-public or public property such as parks and recreation areas, parking lots, schoolyards, public stadiums and train stations are outside of the scope of this survey, although streets adjacent to such facilities are included in the survey scope. Prior survey results have revealed that measuring litter along streets and highways provides data that is statistically most significant, sufficient for determining the principal sources of litter and best reflects changes in litter rates occurring elsewhere.

The New Jersey statutes define litter in a manner consistent with the survey, as follows:

> “Litter” means any used or unconsumed substance or waste material which has been discarded, whether made of aluminum, glass, plastic, rubber, paper, or other natural or synthetic material, or any combination thereof, including, but not limited to, any bottle, jar or can, or any top, cap or detachable tab of any bottle, jar or can, any unlighted cigarette, cigar, match or any flaming or glowing material or any garbage, trash, refuse, debris, rubbish, grass clippings or other lawn or garden waste, newspapers, magazines, glass, metal, plastic or paper containers or other packaging or construction material, but does not include the waste of the primary processes of mining or other extraction processes, logging, sawmilling, farming or manufacturing.
>
> “Litter-generating products” means the following specific goods which are produced, distributed, or purchased in disposable containers, packages or wrappings; or which are not usually sold in packages, containers, or wrappings but which are commonly discarded in public places; or which are of an unsightly or unsanitary nature, commonly thrown, dropped, discarded, placed, or deposited by a person on public property, or on private property not owned by that person:
>
> 1. Beer and other malt beverages;
> 2. Cigarettes and tobacco products;
> 3. Cleaning agents and toiletries;

4. Distilled spirits;
5. Food for human or pet consumption;
6. Glass containers sold as such;
7. Groceries;
8. Metal containers sold as such;
9. Motor vehicle tires;
10. Newsprint and magazine paper stock;
11. Drugstore sundry products, but not including prescription drugs or non-prescription drugs;
12. Paper products and household paper, but not including roll stock produced by paper product manufacturers and wood pulp;
13. Plastic or fiber containers made of synthetic material and sold as such, but not including any container which is routinely reused, has a useful life of more than one year and is ordinarily sold empty at retail;
14. Soft drinks and carbonated waters; and
15. Wine.

New Jersey should consider adding non-carbonated beverages to this list. This would encompass the increased use of teas, new-age beverages and non-carbonated water, which this survey and industry data have shown, are a growing portion of beverage container litter.

WHAT IS LITTER COMPOSED OF?

In past litter surveys conducted in the United States using the methodology developed by IAR, the composition analysis found that 55% of all litter was of deliberate origin, consisting mostly of convenience packaging and products. The remaining litter was of accidental origin, resulting from uncovered trucks, unsecured loads, loss of vehicle parts, trash can spills and simple human carelessness.

The sources of litter vary greatly, depending on locale, defined as the type of street or roadway that provides the venue for litter, as noted above. In the U.S., for example, 50% of the litter found along urban freeways and 53% on rural freeways appeared to be of accidental origin. Along rural local roads and rural state highways, these accidental percentages were lower, 36% and 39%, respectively.

In conducting the New Jersey 2004 litter survey, the GBB field survey team collected data for the accidental and deliberate litter in twenty-two basic categories. An additional 15 subcategories of beverage container litter were added, which is discussed in more detail in Appendix B. The litter composition categories used in data collection are shown in Table 1.

Table 1 – Litter Composition Categories

Convenience Products (usually deliberately littered)
Beer and soft drink containers
Juice, wine, liquor, water and other beverage containers (e.g. milk and juice containers one pint or less)
Bottle caps, crowns, seals
Pull tabs
Beverage carriers, 6 ring binders, cartons, labels, etc.
Cups, lids, straws, straw wrappers
Candy, gum, snacks, nuts, chips, ice cream, cookies etc.
Other take out food packaging (bags, boxes, holders, condiment pkg.)
Napkins, tissue, small paper bags, picnic supplies, utensils, ice bags
Cigarette packages, matchbooks, tobacco pouches, lighters, pipe cleaners
Toiletries, sundries, drugs, clothing, recreational equipment, toys, games, cassettes, lottery tickets

Other Products/Packaging (usually accidentally littered)
Newspapers, magazines, books
Advertising leaflets, signs, cards
Home prepared food packaging, food remnants, bones, milk and juice containers over 1 pint
Vehicle parts, debris, supplies, forms, credit slips
Construction material, debris, sawn wood, cable, rope, cord
Miscellaneous paper, cardboard, cartons
Miscellaneous plastic
Miscellaneous metal, foil, appliances
Miscellaneous glass, ceramic
Yard trimmings, other un-sawn wood, furniture
Other (e.g. non clothing fabric, kapok, burlap bags, beeswax, animal pelts, ivory and otherwise unidentifiable

WHO IS RESPONSIBLE FOR LITTER?

In past litter surveys, persons observed in the act of littering were found to be in two distinctly different age groups, with 72% of all deliberate litterers being under the age of 30 and 71% of all accidental litterers age 30 or over. Nationally, males were found responsible for 72% of all deliberate littering and 89% of all accidental littering.

HOW DOES LITTER ORIGINATE?

Past surveys have revealed that four major origins of litter account for 97% of the total. Pedestrians were involved in 42% of the total observations of littering while vehicle occupants were involved in 20%. The remainder involved loss of material from moving vehicles, with 21% stemming from uncovered or unsecured loads on trucks and fourteen percent involving single items (mostly packaging) escaping from open vehicle beds where they had been improperly stowed or left. Male motorists driving pickup trucks were found to be a disproportionate source of litter, being responsible for almost a third of all littering by motorists and two-thirds of the escaping single items from vehicles.

Further, observations of pedestrian littering indicated that 22% involved persons on the job carelessly dropping or leaving waste materials, tools, etc. Another 16% of all pedestrian littering involved carelessness in putting litter in trashcans or in handling trash receptacles.

WHERE DOES LITTER GO?

Special studies and analysis of data from other surveys indicate that there are four major ways that littered items are eventually removed from streets and roadsides. It is estimated that about 41% of the litter generated is picked up by homeowners, street and highway crews, and Adopt-a-Highway and other volunteer groups. Another 24% (mostly in vacant lots and along low volume rural roads) is rarely picked up and either biodegrades or, if thin plastic, eventually photo degrades. Approximately 18% of all litter deposited is washed into streams, rivers, lakes and the ocean by storm water runoff. The remaining 17% (mostly non degradable) is gradually covered by soil buildup or decaying vegetation. This material is not actually gone but it is no longer visible.

SECTION ONE
LITTER RATES IN NEW JERSEY

CURRENT YEAR RATES

The litter rates in New Jersey were measured in April of 2004 using the visible litter count method. This method consists of a trained observer walking along the side of the street or roadway counting the number of items visible to the eye. Separate counts were made of the total vehicles and number of occupants, pedestrians and the number of items visible from the roadway of 37 categories of litter lying along the side of the roadway. This type of survey has been found to yield more accurate and reproducible results than picking up the items because accumulated litter typically consists of many very small items that are easily concealed by terrain and vegetation and easy to miss. Counting more visible items, those that are larger than 1 square inch in surface area, ensures that the most noticeable items are tallied, yielding a more accurate index of the visible offensiveness of litter.

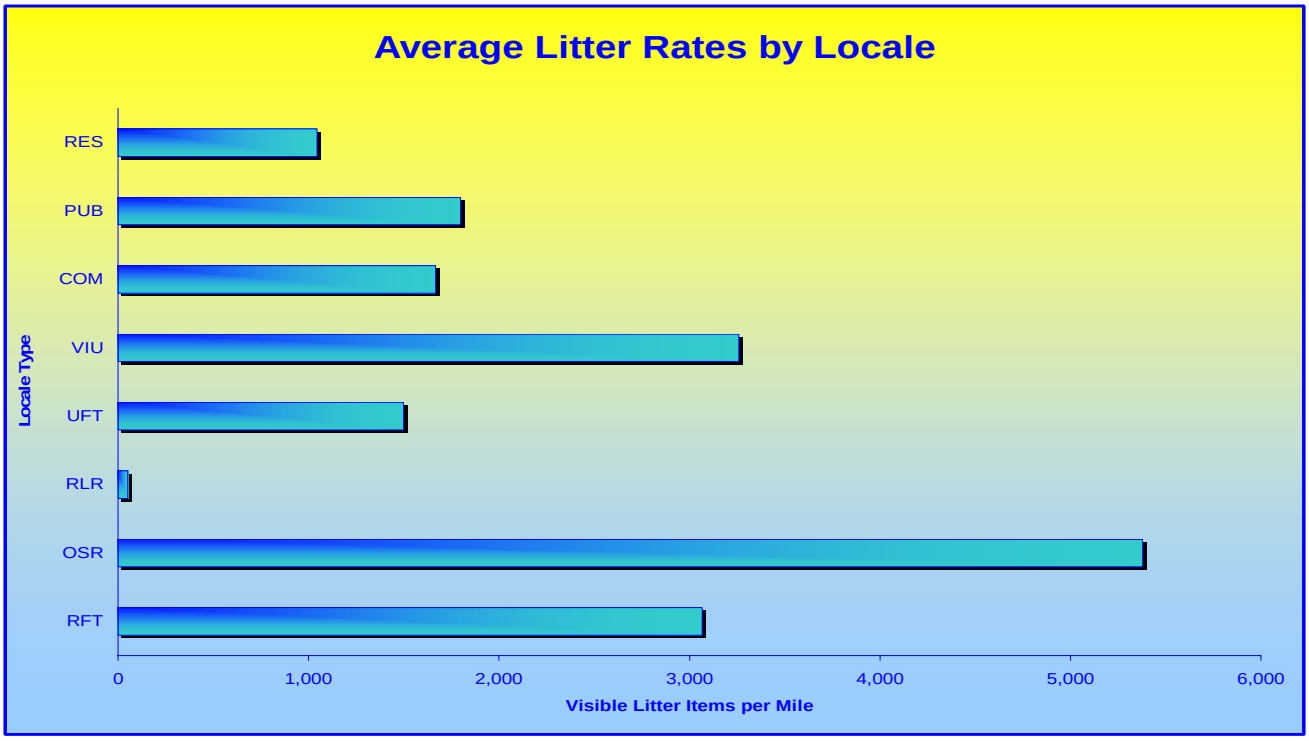
Figure 1 shows the visible litter density from the New Jersey 2004 survey, derived from measurements at 86 sample sites, which were randomly selected throughout the state together with an additional 8 specially selected sites at construction, downtown and beach/waterway locations. Note that in this and most of the subsequent figures and tables, the measured litter rates were corrected to reflect state average conditions of variables such as traffic, weather and other factors that have been found to affect litter rate. For instance, citizens tend to litter less in rainy weather and temperature extremes. If a litter survey is conducted after unusually rainy or cold weather, the litter surveyed would tend to be lower.

Where comparisons are made showing how New Jersey's litter rates and composition compare with the U.S. average, the rates are corrected to the U.S. average conditions of these variables. The methodology used for these corrections is discussed in Appendix B.

COMPARISONS OF LITTER GENERATION AND ACCUMULATION

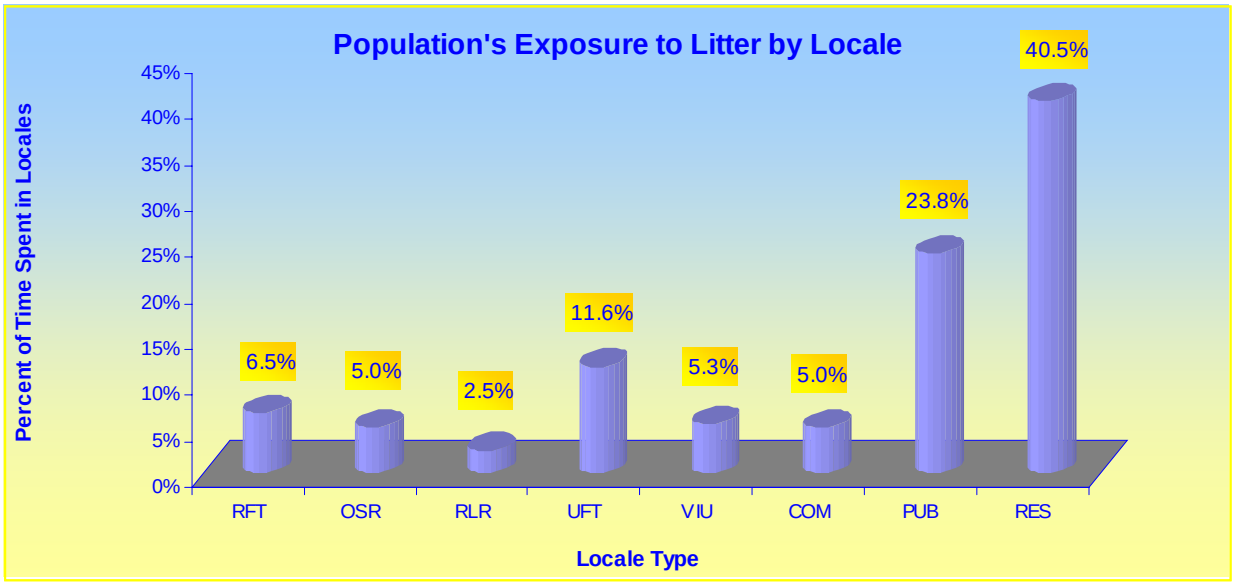
The visible litter rates presented in Figure 2 are a measure of how much fresh litter has built up over a period of time. Locales vary in the rate that litter is picked up, washed away, decomposed or buried. For example, the street in front of a courthouse is generally cleaned more often than a Rural Local Road. Figure 2 shows that Rural State Highways have the highest litter rate of the four Freeway and Rural Roadway categories, while of the four Urban Street categories, Residential Streets have the lowest.

Figure 2



While Figure 2 indicates the roadway types with the highest litter density per mile, it does not reveal which locales should have the highest priority for litter reduction efforts. A better measure for setting such priorities would be to concentrate initial efforts on those public locales where the population of the state spends most of its time as pedestrians or motorists.

Figure 3

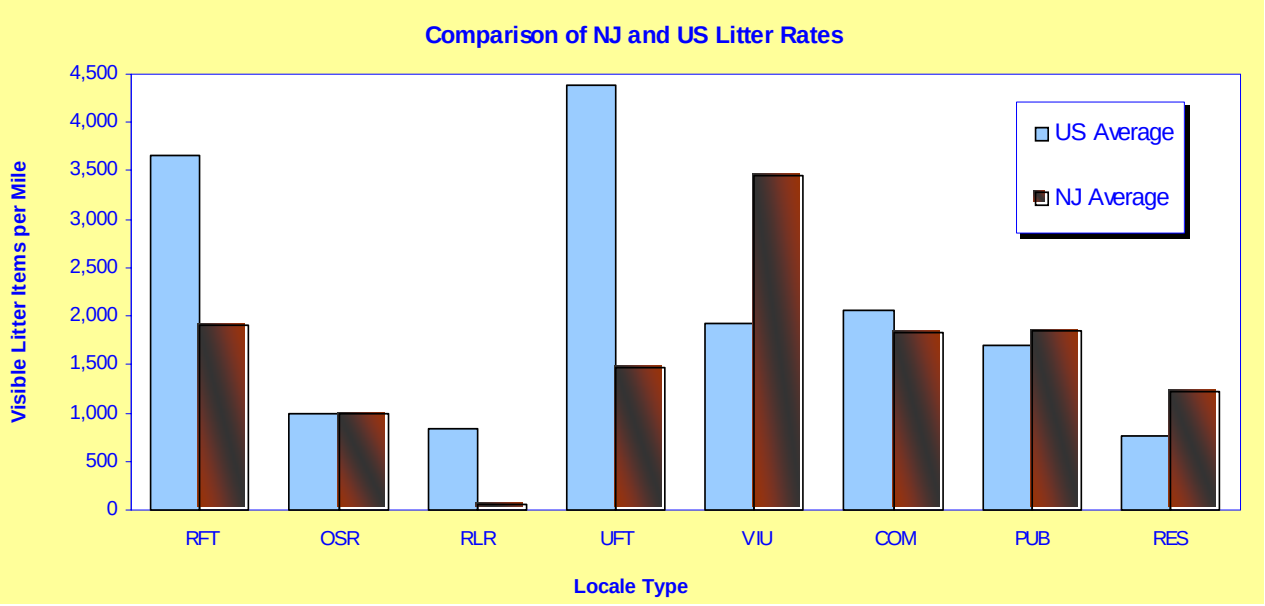


The relative degree of exposure to litter is calculated by combining roadway miles, vehicle and pedestrian daily traffic, and estimated vehicle and pedestrian speeds. These are shown for each locale in Figure 3 as percentage figures ranked in the order in which decreasing amounts of time is spent in the locales. As shown in Figure 3, about 75% of all exposure to New Jersey litter occurs in urban areas including 40% along residential streets. Nearly half of the remaining 25% exposure occurring along freeways and rural roadways is along urban freeways. Thus, while urban thruways are littered most, motorists are actually exposed to more litter in residential areas. This is due to two factors: (1) Pedestrians constitute 90% of the viewing of litter in residential areas, as they move at an average of 2 mph, while motorists are traveling at an average speed of 24 miles per hour; (2) The pedestrian traffic on an average residential street in New Jersey is about 50% higher than the daily vehicle traffic.

HOW NEW JERSEY COMPARES TO OTHER STATES

Similar variations in litter rates are found in other states throughout the country. To put New Jersey litter rates in perspective, Figure 4 shows a comparison with the U.S. average rates calculated from the 62 surveys conducted in other states using IAR's methodology. Although the overall litter rates in New Jersey are slightly lower than the US average, rural and urban freeways and rural roadways were significantly cleaner than the US average, while urban streets were considerably more littered (41%more) than the US average.

Figure 4



COMPARISON TO OTHER STATES' ADJUSTED LITTER RATES

The litter rates in Figure 4 were corrected to the same U.S average conditions of traffic, weather, income, population size, etc. to eliminate the biasing effect and enable a fair comparison between states of the natural rate of litter generation and accumulation. These corrections indicate that New Jersey's total litter rates are slightly below the national average and imply that,

on the average; litter is generated and cleaned up in New Jersey at about the same rate as in other states.

Unfortunately, New Jersey has much higher vehicle and pedestrian volumes, as well as much higher county populations than the national averages. This results in increased visible litter in the state. Thus when New Jersey is compared to other states with litter rates in each state corrected to that state's traffic, population and other factors as shown in Table 2, the comparison is not nearly as favorable.

Table 2 *

COMPARISON OF NEW JERSEY LITTER RATES WITH OTHER STATES									
Locales	**NJ**	**NY**	**PA**	**CA**	**NC**	**MS**	**KY**	**OK**	**6 States***
Freeway, Rural	2,515	3,609	510	2,851	1,916	2,167	4,335	1,923	2,284
Urban Streets	1,484	2,721	823	792	535	684	657	1,163	775
All Locales	1,746	2,841	1,333	1,071	1,077	1,529	1,570	1,505	1,347

* Average of Pennsylvania, California, North Carolina, Mississippi, Kentucky & Oklahoma.
* Visible litter items per mile, corrected to each state's average conditions.

While New Jersey's freeways and rural roadways now appear only 10% more littered than the sample of six other states, its urban streets would appear to have almost two times as much litter as in these other states. Thus, to a person traveling through urban streets in these six states, New Jersey would appear to have significantly more litter, eclipsed only by New York. This is due, in part, to higher vehicle and pedestrian traffic levels in New Jersey, as well as the fact that county population sizes average larger in New Jersey than in most other states.

Table 3 *

COMPARISON OF LITTER CONTROL EXPERIENCE			
Litter Control Program Type or Duration	**Freeways & Rural Roadways**	**Urban Streets**	**Wtd. Avg.**
0-5 Years	2,866	1,599	1,975
1 to 2 Years	2,586	1,428	1,797
2 to 5 Years	2,527	1,133	1,577
Beverage Deposits	2,109	1,283	1,546
> 5 Years	1,855	1,196	1,406
Advertising-Based Control	1,299	896	1,024
New Jersey	***1,056***	***1,647***	***1,459***

*Visible litter items per mile, corrected to the U.S. average conditions

Table 3 presents a comparison of New Jersey's litter rates measured in 53 prior surveys, grouped by litter program year or type of program. This table indicates that, on the average, beverage deposit programs cut total litter rates to a level that is only 22% below that of states with no litter programs, while conventional litter control programs have steadily reduced visible litter from

1,975 items per mile to 1,406 items per mile, a drop of about 29%. TV and radio advertising-based programs, by contrast have achieved an average reduction of almost 50% below uncontrolled states.

Note that New Jersey's ***urban*** street litter rates are 43% higher than states surveyed with no control programs in place. Experience with other states running an advertising-based program suggests that such an approach could cut these excessive rates by almost half. The increasing duration of litter control programs steadily lowers average litter rates and can produce significantly lower litter rates than beverage deposit legislation.

A discussion of how the weighted average of litter rates in different locales is calculated is discussed in the Analysis Plan section of Appendix B. Table 3 indicates that both conventional programs over 5 years in duration and advertising programs achieve greater reductions than beverage deposit legislation.

HOW NEW JERSEY 2004 COMPARES TO PREVIOUS SURVEYS

New Jersey has conducted one previous survey in 1989, which used a survey methodology that did not allow correcting for variables such as weather, demographics and traffic. Thus, no statistically valid trend comparisons can be made of changes between 1989 and 2004. However, the New Jersey 2004 survey can serve as a baseline for future surveys and as such can provide quantitative measures of effectiveness of changes in the anti-litter programs in the state.

SIGNIFICANT FINDINGS OF SECTION ONE
LITTER RATES IN NEW JERSEY

- While freeway & rural roadway visible litter rates in New Jersey are 70% higher per mile than those of urban streets, the urban streets rank higher on a priority for litter reduction efforts. This is based on the fact that 75% of the time spent as motorists and pedestrians encountering litter in New Jersey is in the 4 urban street locales.

- More than half of this exposure time in urban locales occurs along residential streets.

- When corrected to the U.S. average levels of traffic, income, weather, etc. New Jersey overall litter rates are close to the U.S. average. However, New Jersey's urban streets were 41% ***more*** littered than the U.S. average, while its freeways and rural roadways were significantly cleaner.

- If the rates are not adjusted to the national conditions of factors affecting litter, the actual litter rates along urban streets appear a lot worse than average due to New Jersey's higher traffic volume and greater average county population size. Thus to a person traveling through urban streets in a sample of other states, New Jersey would appear to have twice as much litter and would be eclipsed only by New York.

- Compared with other states surveyed, with adjustments to national conditions, New Jersey's current conventional litter control program has litter rates 27% lower than states surveyed with little or no litter control program experience.

- The data comparing states surveyed with varying types and duration of litter control program also indicate that the greatest reduction can be obtained with radio and television advertising based litter control programs. Thus, while states with deposit programs have average litter rates 22% lower than "no-control" states and conventional litter control programs average 29% lower litter rates, states with advertising-based programs average 48% lower litter rates.

SECTION TWO
EFFECTIVENESS OF CURRENT LITTER CONTROL MEASURES IN NEW JERSEY

EFFECTIVENESS OF THE ADOPT-A-HIGHWAY PROGRAM

The New Jersey Department of Transportation's Adopt-a-Highway program was established in 1991 and had 985 miles of state-maintained roads adopted by 2004. This constitutes 55% percent of the 1,766 miles of state-maintained roadways, compared to 45% based on a 1999 study. Of the total 94 sites randomly sampled in the New Jersey 2004 litter survey, only two were active Adopt-a-Highway sites. One additional site was identified as part of New Jersey's Sponsor-a-Highway program. This did not yield enough data to make a statistically significant comparison between adopted and non-adopted sites. According to the New Jersey Department of Transportation, one of the two Adopt-a-Highway sites collected 325 bags of litter and debris during four clean-ups in 2004 utilizing prison labor.

Figure 5

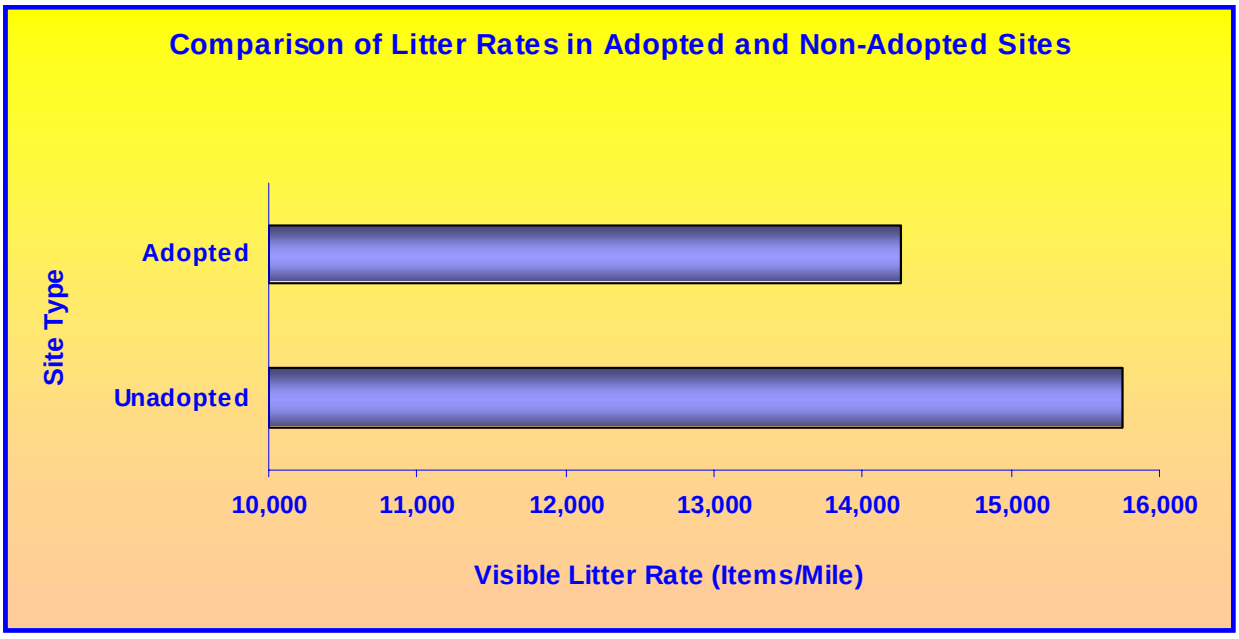


Figure 5 shows the litter rate totals for all adopted and non-adopted highway sites sampled from the most recent nine surveys including New Jersey. Adopted sites had litter rates that were 9.5% lower than non-adopted sites.

COMPREHENSIVE LITTER CONTROL PROGRAMS IN NEW JERSEY

Following the passage of the Clean Communities Act in 1986, staff was hired in the New Jersey Department of Environmental Protection, Solid Waste Division, to implement the Clean

Communities Program state-wide. An advisory committee was organized to provide guidance to the state and ensure that its litter abatement goals were achieved.

By the early nineties, budget cuts resulted in the elimination of the state-level unit. The advisory committee pursued and received non-profit status in September 1995 and became the New Jersey Clean Communities Council. By the fiscal year 2000, the Clean Communities Act had been amended to include funding as a non-profit organization with the directive to manage the statewide education component of New Jersey's litter abatement program. The law authorizing the Clean Communities Act sunset or expired December 31, 2000, but by 2002 funding had been reauthorized to oversee the implementation of local litter abatement programs.

Although no historical survey data was available concerning the effectiveness of New Jersey's community-based litter control program, the fact that New Jersey's roadways, as a whole, have slightly below the average U.S litter rate (when corrected to U.S. average traffic, weather, income, population etc.) would suggest that the State's Clean Communities program has been successful in certain areas. However the fact that ***urban*** streets currently exhibit almost 3 times the rate of a sample of other states when such corrections are not made indicates that there is considerable room for improvement.

Conducting a conventional program may work in states with lower population and traffic, but probably would not be effective in New Jersey. Experience in other states conducting successful comprehensive state run litter programs (e.g. Washington & Hawaii) indicate that just funding individual cities or counties to conduct their own programs will not work and that an experienced state litter program manager and staff that directs, monitors and evaluates local programs is required. As will be discussed in Sections Four and Five, a Media-Based advertising program is probably the most cost effective method of improving New Jersey's litter control efforts.

As shown in Table 3 in Section One, New Jersey's litter rate is 26% below the average of measured states that had no litter control program in place. States with 2-5 years of litter control program experience had litter rates that were 20% below states with no litter control programs. This would indicate that New Jersey's current program has achieved effectiveness better than states having litter control programs in place for 2-5 years.

EFFECTIVENESS OF THE KEEP AMERICA BEAUTIFUL PROGRAM

In surveys conducted in other states, comprehensive community-based KAB programs have been effective in reducing litter. Litter rate data for 5 surveys were analyzed and corrected to each state's average conditions. The sites in each survey were divided into 3 subgroups: KAB sites in counties with smaller populations (maximum 300-600 KCoPOP), larger populations (minimum 300-600 KCoPOP) and sites not in KAB jurisdictions. Because sites were not available for all locales, the averages for both KAB and non-KAB were calculated using weighting by the number of KAB sites.

The results for 272 combined small and large county samples showed the KAB sites were 8.5% cleaner than the non-KAB sites. When split into freeway/rural and urban street categories, the

urban KAB sites had a 10.3% lower rate contrasted to the Freeway/Rural sites which were 7.4% lower.

When a split was made dividing samples into those from counties with smaller versus larger populations, a greater reduction of 22% was measured in the samples from larger population counties. It is interesting to note that when divided into freeway/rural roadway and urban street categories, the freeway/rural sites exhibited a greater reduction of 33% compared to 11% for the urban streets. In prior analyses of this kind, it had usually been found that greater reductions were obtained in urban street litter, where the greatest emphasis of these central city based organizations were usually directed.

The recent introduction (post 1985) of Adopt-a-Highway programs, which are often strongly supported by KAB groups, appears to have changed the emphasis, with the results showing the other rural highways locale category having a 421% lower rate followed by rural local roads with a 90% lower rate. These two non-freeway locales, which are more likely to be adopted due to safety considerations, exhibited greater reductions than did those of rural freeways (7%) and urban freeways (1%).

ENFORCEMENT ACTIVITIES

Like many other states, law enforcement officials in New Jersey are encouraged to enforce laws prohibiting the littering on public lands. Although no trend data was available that would establish the effect of such actions, other states conducting comprehensive litter programs have instituted an 800-number litter hotline which allows ordinary citizens to participate in the litter-enforcement process without public exposure. In the State of Washington, calls to a litter hotline matched the percentage of materials found in litter. Different approaches could be utilized to realize this type of plan. For instance, letters signed by the head of State Troopers could warn citizens that an automobile with their license plate was observed littering and that, had an officer witnessed such an incident, the driver of the vehicle could have been issued a citation. This kind of approach advises the public about the importance and priority of maintaining clean communities.

What kind of effect can some degree of enforcement have? When one person makes a change, it tends to have a ripple effect that can become systemic. A number of others will tend to emulate or not emulate behavior depending upon the observed consequences of that behavior. The success of such a plan is not without precedent. Once the word gets out that officers are pulling drivers over regarding excessive speed, other drivers tend to slow down and become more aware of their speed. To address the disconnect between desired and observed behavior, even small, well-focused actions can produce significant, enduring improvements, when properly focused. The Clean Communities Council should leverage their efforts in order to maximize a positive ripple effect on the behavior of litterers.

CONTAINER LEGISLATION AS A LITTER CONTROL MECHANISM IN NEW JERSEY

While New Jersey does not currently have beverage container deposit legislation, previous “before and after” surveys indicate that such a system does not appear to have any significant

effect in reducing non-container litter and that it is an expensive system for reducing litter. As a consequence, the additional handling costs are absorbed solely by the reduction of littered containers that are encompassed by such legislation. This becomes problematic since it is estimated that less than 0.3% of all containers sold now are littered. Thus, if only one of every 164 containers sold end up as litter, the handling costs for 164 containers would be spent to prevent a single potential item of litter. Based on a revised estimate of slightly more than $0.025 per container to maintain such a container redemption program, preventing the littering of one container would now cost approximately $4.24 within the specific context of litter prevention.

These financial inducements implemented under container deposit legislation can modify littering behavior, but only with regard to containers covered under the program. Reductions have been found to be noticeably less effective in rural areas than in urban areas due to the travel times required to reach most rural areas. Additionally, when states with such legislation increase spending for litter cleanup, these additional expenditures will likely result in cleaner roadways, but the public will tend to credit the cleaner environment to container deposit legislation instead.

EFFECTIVENESS OF LITTER RECEPTACLES IN REDUCING LITTER

The effectiveness of litter receptacles in reducing litter was evaluated in an analysis of results obtained in eight different areas: (1) The states of Alaska, California, Hawaii, Mississippi, Nebraska and Washington; and (2) The cities of Philadelphia, PA and Richmond, VA. The data shows that litter receptacles are fairly effective in reducing litter, averaging 40% lower rates in both urban and rural locales. These results were exclusive of those from other litter programs and appear to reduce litter immediately without demonstrating the flux of litter pick-up programs which typically achieve litter reductions of 80% or more immediately after cleaning but regress back to the original levels after few months.

SIGNIFICANT FINDINGS OF SECTION TWO
EFFECTIVENESS OF LITTER CONTROL MEASURES IN NEW JERSEY

- Lacking historical data and because of uneven funding levels, it is not possible to accurately evaluate the effectiveness of New Jersey's community litter control program. However, New Jersey has appeared to have reduced its litter currently to 26% below the average measured in states without control programs.

- Approximately 55% of state-maintained highways are adopted through New Jersey's Adopt-a-Highway program (perhaps the highest percentage in the U.S.). Experience in other states indicates that Adopt-a-Highway sites yield a lower litter rate than non-adopted sites. Even so, litter tends to build back up after cleaning. Lasting litter reduction can be achieved only by integrating such programs with education and enforcement activities.

- The Clean Communities Council should consider focusing more efforts on the underlying causes of litter, the littering incidents themselves. The ability of an enforcement mechanism to significantly reduce littering should not be underestimated. Targeted enforcement activities with appropriate media advertising would likely improve current community-based program effectiveness by emphasizing New Jersey's priority for a litter-free environment.

- Litter receptacles have proved to be an effective means of reducing litter in both urban and rural areas, achieving an average reduction of more than 40%.

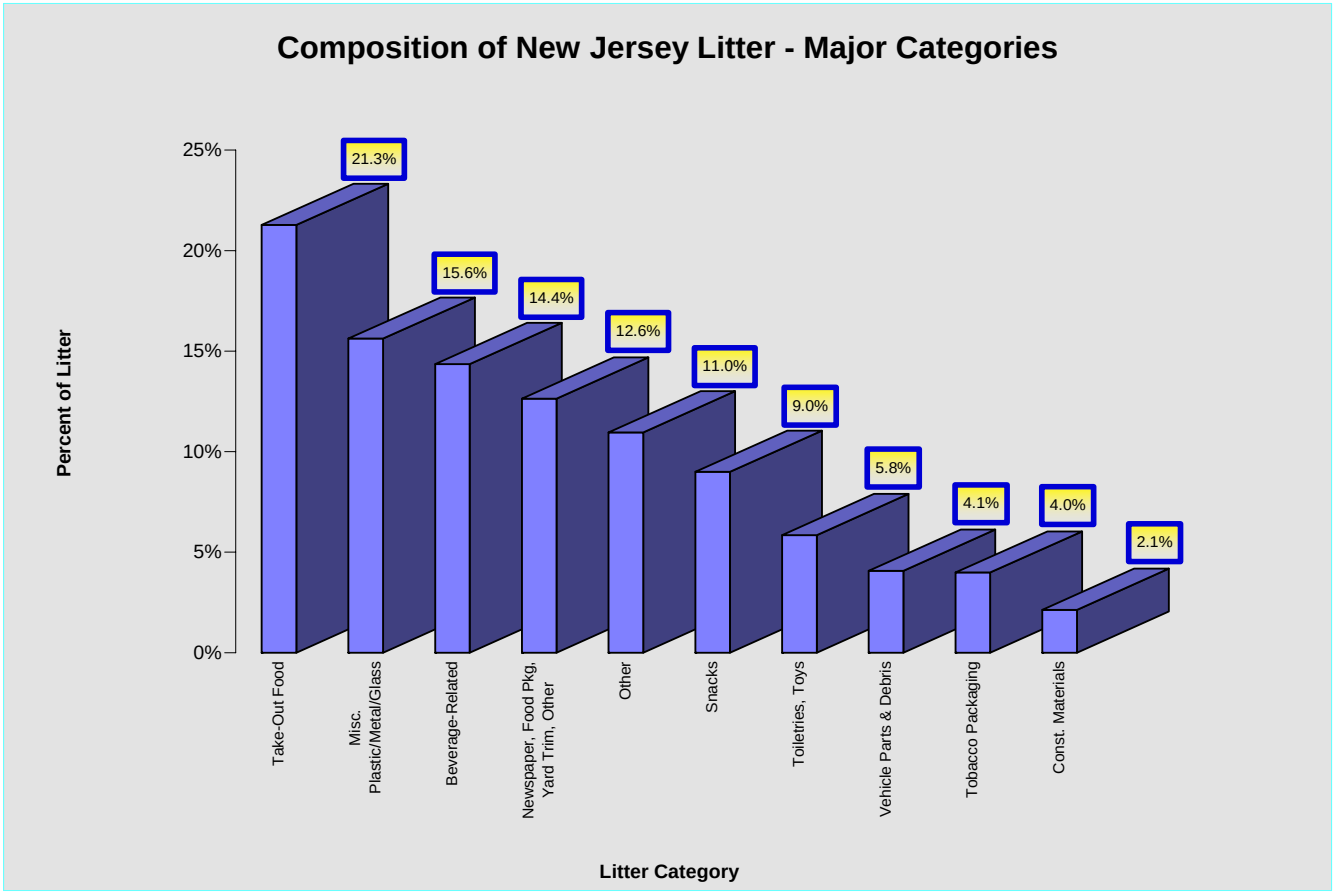
- Although New Jersey does not have a statewide beverage deposit program, such programs are generally not cost-effective because they affect only a small percentage of litter at a very high cost.

SECTION THREE
THE COMPOSITION OF LITTER IN NEW JERSEY

CURRENT COMPOSITION OF NEW JERSEY LITTER

Figure 6 shows the composition of visible litter observed in New Jersey with the components shown in decreasing order of their percentage of total items of litter counted. Note that, for simplification purposes, the thirty seven litter composition categories that were actually measured in the survey and discussed in Section One, have been consolidated into ten product/packaging groups. The more detailed listings of the survey items included in these groupings and the combination into the ten summary groups is discussed in Appendix B.

Figure 6



As shown in Figure 6, the largest category is Take-Out Food Packaging, which comprises 21.3% of all litter visible to New Jersey's pedestrians and motorists. This category, which includes items such as cups, lids, straws, condiments, bags, boxes, napkins and french-fry holders, has been increasing steadily in the last three decades. When Take-Out Packaging is grouped with the Candy/Gum/Snack Packaging category the combination accounts for almost 37% of all visible

litter. Other studies have also shown that, in the United States, these two categories have become a larger percent of the total over time, while tobacco-related products (which excludes cigarette butts) and beverage packaging categories have been declining more recently. In the New Jersey 2004 survey, litter related to beverage packaging items comprised 14.4% of the total litter. This category incorporates bottle caps, plastic cap wrappers, plastic six-pack carriers and paper cartons as well as the containers themselves, for beverages such as beer, hard liquor, juices, new age beverages, soft drinks, sports drinks, water and wine.

TOBACCO PRODUCTS PACKAGING AND CIGARETTE BUTTS

Tobacco Products and Packaging comprised four percent of the total litter in the New Jersey 2004 survey. As explained in the discussion of survey methodology found in Appendix B, the minimum size of litter counted includes only items greater than one square inch in area. This includes bottle caps and pull tabs, but excludes cigarette butts and the thousands of small pieces of paper and plastic resulting from mowing operations and the biodegradation and photo degradation of larger items. Thus, while the data in Figure 6 included Tobacco Products and Packaging such as cigarette packs, pouches, tins, cartons, lighters, and associated items, they do not include cigarette butts. Two studies conducted by others in Florida (1994) and in San Diego County (1973) included smaller items of litter such as cigarette butts. When the small items such as cigarette butts were included, they were found to comprise 29% of all items in the San Diego study and 31% of the items in the Florida study.

In the methodology applied in the New Jersey 2004 study, cigarette butts and other small items are excluded due to the difficulty in accurately counting them as they become partially buried, hidden by vegetation, or stained so they are indistinguishable from soil over time. It also becomes more difficult to classify material by product origin as size decreases, making it harder to determine the age groups of persons most responsible for littering, which is one of the primary objectives of the survey. In addition, litter is usually considered to be first and foremost a visual form of pollution where the larger items are more visible to pedestrians and doubly so to motorists. However the primary problem with including the small items is they bias the results towards the less visible components of litter.

Comparing the percentage of cigarette butts from the San Diego and Florida studies to the data in Figure 6 indicates that the number of cigarette butts, if included in this study, would be almost double the largest material category of New Jersey litter as shown in Table 4. Adding a cigarette butt category in to the Figure 6 data would also distort other categories, making them appear inappropriately smaller. In addition, visibility is one of the primary problems of litter. Larger items are more visible by both pedestrians and people in vehicles.

The magnitude of this distortion is demonstrated by adjusting the New Jersey composition which excludes items below 1 square inch in size to include all visible items. As shown in Table 4, this has the effect of giving the most weighting to the items that are the smallest and hardest to see. Thus cigarette butts plus pieces of plastic, paper, glass and metal are depicted as constituting more than 80% of all litter. Beverage container-related litter is cut in half from 14.4% to 7.0%. Take-out Food packaging, the largest component over 1 square inch, is reduced from 21% to 4%.

Table 4 *

EFFECT OF RESTRICTING SIZE ITEMS OF LITTER COUNTED		
Major Litter Category	**> 1 Inch^2**	**All Items**
Miscellaneous Metal, Plastic, Glass	15.6%	44.0%
Cigarettes, Packs, Matchbooks	4.0%	25.9%
Miscellaneous Paper, Cartons	12.6%	11.4%
Beverage Containers, Caps, Tabs, Cartons	14.4%	7.0%
Take-Out Food Packaging, Cups, Napkins	21.3%	3.3%
Snack Wrappers	9.0%	3.3%
Newspaper Ads, Food Packages, Yard Trim	11.0%	3.1%
Vehicle Debris, Parts, Fluid Containers	4.1%	1.8%
Building Material, Construction Debris	2.1%	0.1%
Toiletries, Toys, Cassettes, Recreation	5.8%	0.0%

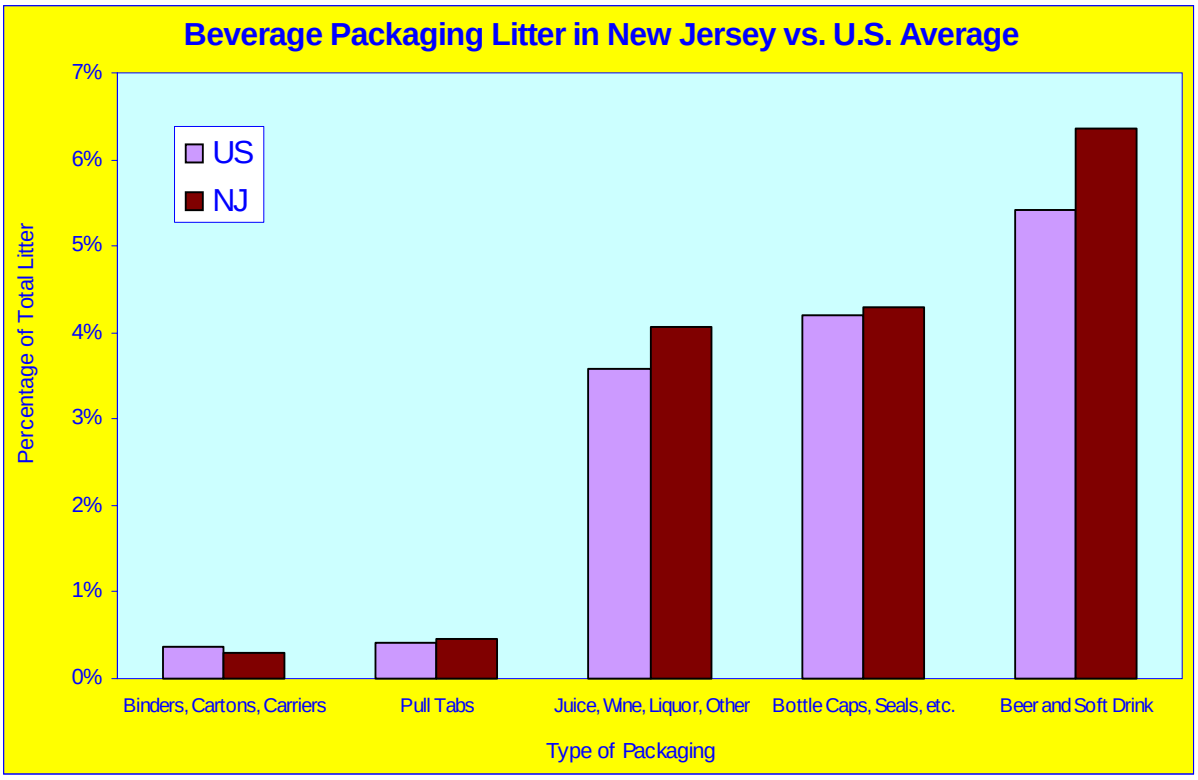
* Extrapolation based on data from surveys conducted in Florida and in San Diego, CA.

Beer and Soft Drink containers, a subset of Beverage Container-related litter (not shown in Table 4) would be reduced from 5.8% to 2.8%. Similarly, the percentages for Candy & Snacks, Home Trash (Newspapers, Advertising, Food Packaging, and Yard Trim) as well as Vehicle debris and packaging are reduced by half or more. Building material and Construction debris, often the largest and most visible items are cut from 2.1% to 0.1%

This estimate of the percentage of all litter was obtained by using data from a 1994 survey in Florida where, in addition to the traditional comprehensive survey, an additional count was separately made analyzing a subsample of litter items that are too small to be evaluated using this methodology. This yielded the ratio of larger to smaller items of litter for each category and established a correlation which was then applied to the New Jersey composition data to estimate its percentage of all litter.

Figure 7 shows the distribution of items observed in the beverage container and packaging category which includes bottle caps; pull tabs; binders, carriers and cartons; juice, wine, water, liquor and other containers; and beer and soft drink containers. All packaging related to beverage containers make up 15.5% of the visible litter in New Jersey. Beer and soft drink containers themselves constitute 6.4% overall, while juice, wine, liquor and other containers constitute 4.1% for a total of 10.5%. The percentage of beverage containers was found to vary within the locales.

Figure 7



Estimated on a population-weighted basis, New Jersey's various litter programs including Adopt-a-Highway, Clean Communities Program, KAB, etc., were equivalent to a program ranging from 1.0 years in urban areas to 3.9 years along rural state highways. As shown in Table 5, the total visible litter rate, when New Jersey data is compared with other jurisdictions, is comparable to those measured in other jurisdictions.

Table 5 *

Litter Program Duration and Type Versus Total and Beverage Container Litter						
Litter Program Duration	No. Of Surveys	Total Visible Items /Mile	BSD Cont./Mile	Other Cont./Mile	BSD Cont. %	Other Cont. %
0 to .5 Years	7	1,876	191.5	23.2	10.2%	1.2%
.5 to 2.0 Years	9	1,605	143.7	25.3	9.0%	1.6%
2.0 to 5 Years	6	1,505	88.7	17.1	5.9%	1.1%
Over 5 years	6	1,400	69.6	12.9	5.0%	0.9%
New Jersey 2004	***1***	***1,459***	***91.7***	***58.7***	***6.3%***	***4.0%***
Partial Beverage Deposits	4	1,404	81.3	12.5	5.8%	0.9%
Full Beverage Deposits	4	1,317	25.7	12.4	2.0%	0.9%

*** Notes**

BSD containers include beer and soft drinks.
Litter rates have been corrected to U.S. average conditions.
Other containers include juice, wine, liquor and water.
Partial deposits include coverage of beer containers only.

Table 5 shows a steady decline in both the rate and percentage of beer and soft drink containers with increased litter control program duration. This trend was less noticeable in juice, wine, liquor and other containers, where New Jersey's rate was significantly higher. This may be due to the increased consumption of new age beverages, sports drinks and water over the past four years.

HOW LITTER COMPOSITION VARIES BY LOCALE

One of the difficulties in developing programs to combat litter is that litter differs greatly by locale. Some litter reduction approaches are based on experiences in limited types of locales. Misperceptions of the actual nature of litter may lead to a failure to understand its diversity and the necessity to develop strategies that can successfully achieve its reduction in all locales.

Vehicle debris and related litter tends to occur at a much higher rate along freeways and rural highways. In New Jersey, that rate was 195 items per mile, compared to 29 items per mile for urban streets. A large part of this litter is tire remnants, a consequence of the higher truck speeds in those locales. Construction debris was found to have its greatest rate along urban vacant lots and other unmaintained properties. The dumping of demolition debris in vacant lots by contractors and individuals needs to be addressed by stepped-up law enforcement aided by portable surveillance cameras.

NEW JERSEY LITTER COMPOSITION VERSUS AVERAGE MEASURED IN OTHER SURVEYS

When considering litter composition, it is important to distinguish between products and packaging that are usually seen being deliberately littered and those that are accidentally littered. In general, convenience products and associated packaging intended for consumption or short-term use generally comprise deliberate litter items. Deliberate litter includes items such as take out food containers, snack packaging and beverage containers. Accidentally littered products and packaging are typically littered as a result of trashcan spills, unintentional loss of loads from trucks, and items escaping from vehicles that are not part of the load. As Table 6 shows, New Jersey has a higher rate of deliberate litter on urban streets than the average in other states surveyed corrected to national average conditions.

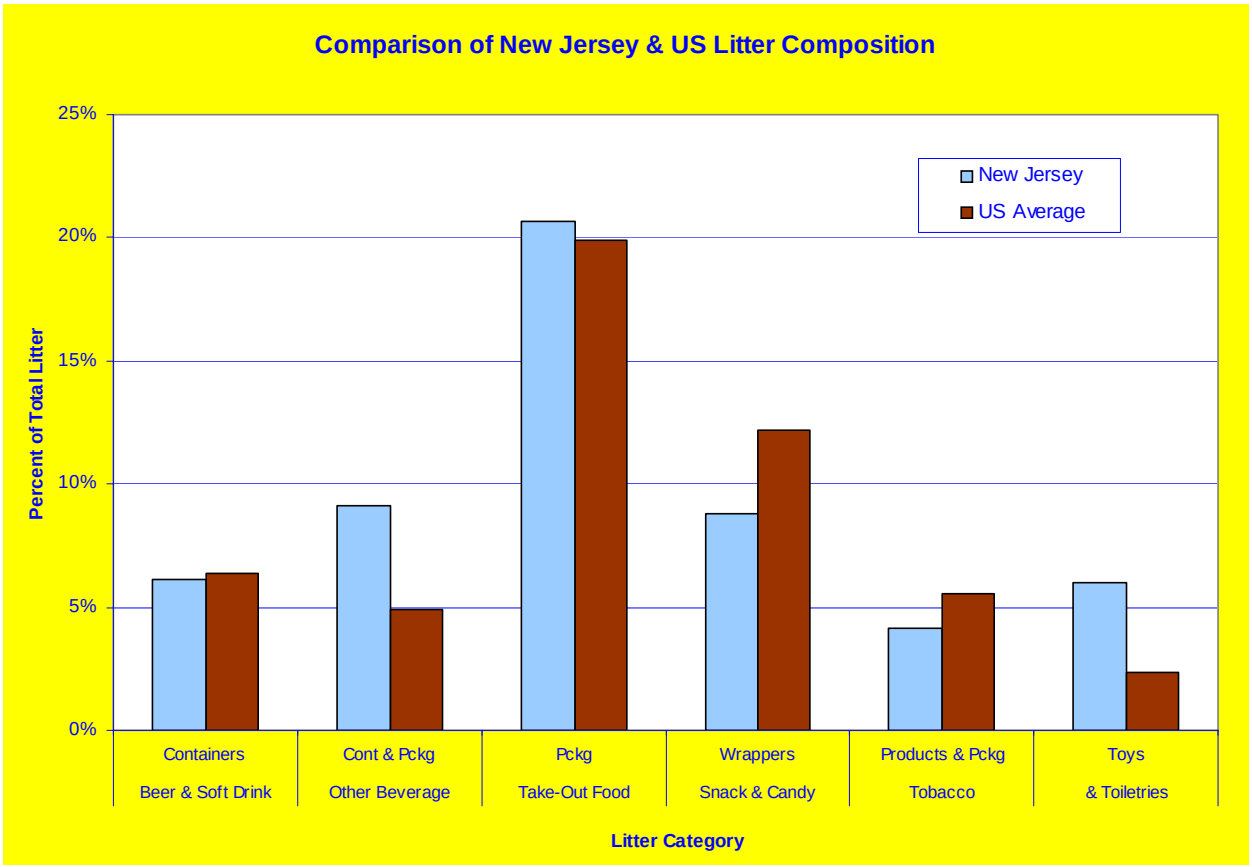
Table 6

Comparison of Deliberate and Accidental Litter Rates			
Type of Litter	Freeways/Rural Highways	Urban Streets	All Locales
Deliberate U.S. Average	961.5	675.1	766.2
New Jersey	609.7	933.9	830.7
Difference	***-57.7%***	***27.7%***	***7.8%***
Accidental U.S. Average	1,239.1	489.0	728.0
New Jersey	519.3	748.0	675.0
Difference	***-138.6%***	***34.6%***	***-7.9%***

In contrast, both deliberate and accidental litter is lower along freeways and rural roadways.

When the litter rates in New Jersey are examined by individual categories, they show lower rates of litter in half of the litter composition categories. However, some material categories show greater differences than do others. As Figure 8 shows, Other Beverage Containers and Packaging in New Jersey were found at a higher rate than in other states surveyed. This is due partly to a steady increase in the consumption of bottled water, teas and sports drinks over the past few years. Less Snack and Candy Wrappers were found, while Toys and Toiletries were more than twice the national average.

Figure 8



SIGNIFICANT FINDINGS OF SECTION THREE
THE COMPOSITION OF LITTER IN NEW JERSEY

- Take-out food packaging, including cups napkins utensils etc. is the single highest percentage category of litter, comprising 21.3% of the total litter observed in the New Jersey 2004 survey. This category has been found in increasing percentages in recent surveys even as beverage containers and Tobacco Products and Packaging are declining.

- 54% of all litter is of the type that is usually seen being deliberately littered. Consisting of convenience products, snack and beverage packaging and other disposable items, deliberate litter is a higher percentage than average of the total in New Jersey, while New Jersey Beer and Soft Drink container rates were found to be less than the U.S. average**.**

- Vehicle related litter in the form of tire remnants and other debris, is at a much higher rate along freeways and rural roadways than urban streets.

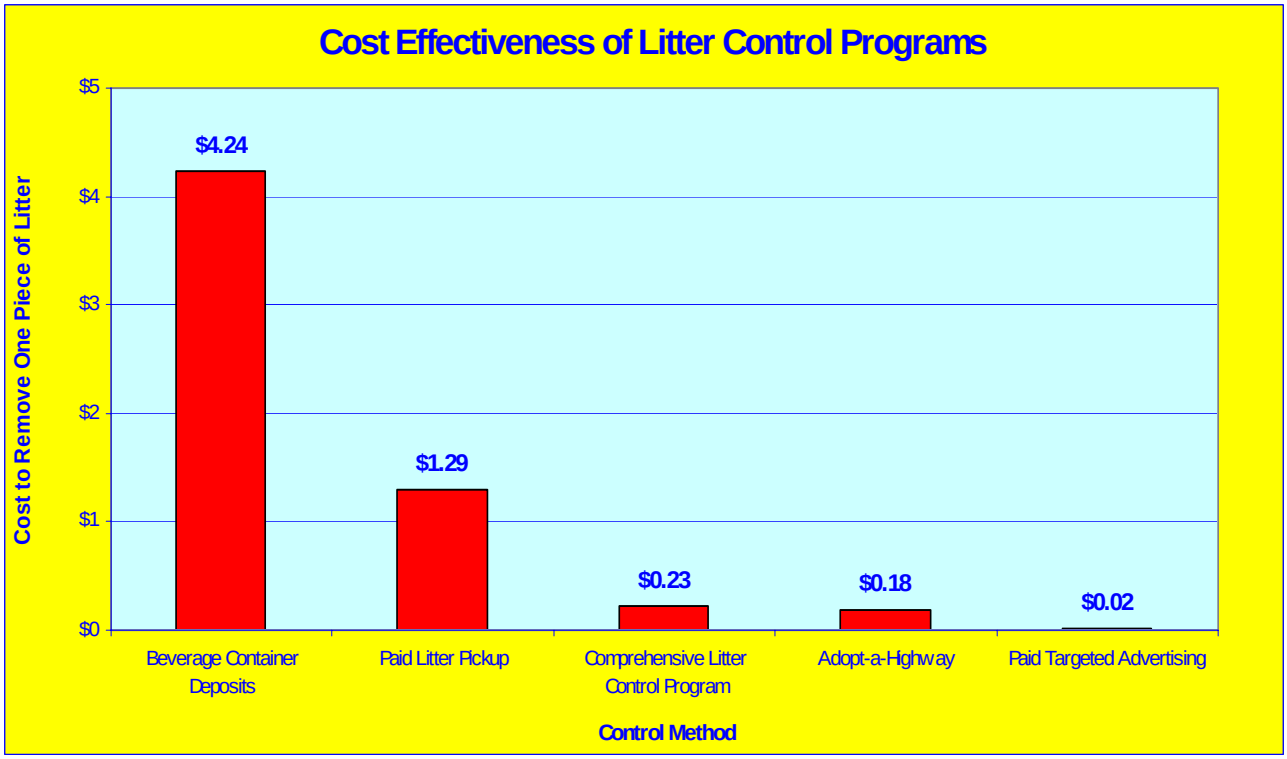
- Construction debris is found littered at a higher rate in New Jersey's vacant lots and other unmaintained areas than in any other locale.

SECTION FOUR
ALTERNATIVE LITTER REDUCTION PROGRAMS

COST-EFFECTIVENESS OF LITTER ABATEMENT METHODS

Before planning an effective abatement program, it is beneficial to review what past litter surveys and analyses have shown about ways to reduce litter. In the last thirty years, the Institute for Applied Research has conducted more than 61 litter surveys in 26 states, 6 Canadian provinces and Bermuda. In the process of doing these surveys, the IAR observed the successes and shortcomings of a variety of approaches to reducing litter. This experience has been summarized in an evaluation of the cost-effectiveness of five major methods or strategies for controlling litter. These five options are shown in Figure 9 in order of increasing cost to remove or prevent a single item of litter:

Figure 9



To calculate the cost effectiveness of a given litter abatement methods, the annual cost to operate the program was divided by the litter reduction obtained in a year. The original assumptions, data and spreadsheet analyses supporting the results shown in Figure 9 are available in a separate Institute report titled "*Cost Effectiveness of Litter Abatement Methods*," September 2002 and have been updated to account for the escalation of costs to operate these programs.

LITTER COLLECTION PROGRAMS

The cost for Paid Litter Pickup was estimated from IAR data on litter rate and time to clean typical stretches of streets and roadways, along with contemporary data on costs of labor, crew and litter transport, and disposal costs. The analysis assumed that, depending on the locale category, from two to eight cleanings per year were required to cut litter by 50%. This reflects the fact that picking up litter is essentially a self-defeating program since additional litter is constantly being generated. Studies show that litter will build back up to the same level it was before cleaning within an average of 7 to 31 weeks, depending on the street or roadway category. Further, there is some anecdotal evidence that the sight of organized groups picking up litter will convince some persons that littering is acceptable behavior since it appears to get picked up.

Note that while the Adopt-a-Highway option is able to remove an item of litter for $0.18 (compared to the cost of $1.29 for a paid crew), there are still limits to the number of miles that can be adopted, particularly in rural, sparsely settled counties. Currently, an average of 45% of the state highway systems, nationally, is adopted. Most rural local roads and urban streets, which constitute 90% of all U.S. street and highway mileage, are not affected.

BEVERAGE CONTAINER DEPOSITS

Beverage container deposit programs are an expensive way to reduce litter since they do not appear to have any significant effect in reducing non-container litter. As a consequence, the added handling cost of about $0.025 per container must be absorbed solely by the reduction of covered beverage containers in litter. Compared to the 1970's when a relatively large percentage of containers sold ended up as litter, data from recent IAR surveys indicates that without deposits, less than three-tenths percent of all containers sold now end up as litter. This means that since only one of 164 containers sold end up as litter, the handling costs for 164 containers is now being spent to prevent a single potential item of litter, at a cost of $4.24 per littered container. Note that this analysis is concerned only with litter reduction and ignores any impacts such a program might have on waste reduction or materials and energy conservation.

The case can be made that such a deposit program does change littering behavior, but it does so only with regards to containers and only so long as the financial inducement persists. Data from IAR studies indicate, incidentally, that the reduction effects are greater in urban areas than in rural as the decreasing percentage of containers being found in litter makes excursions to many rural areas to recover containers a losing proposition.

COMPREHENSIVE LITTER CONTROL PROGRAMS

Comprehensive litter control programs (along with paid advertising litter control programs) are oriented primarily towards preventing rather than removing litter. Most of the comprehensive control programs studied by IAR have operated on a statewide level and typically employed a variety of elements simultaneously, such as voluntary cleanups, elementary school education, enhanced litter law enforcement, litter hot lines, beautification projects, media events, etc. The data shows that such programs can be quite effective and have reduced total litter by as much as 74% in Hawaii and 76% in the state of Washington. Beverage container litter was reduced by 90% in both states.

The primary shortcoming of the above mentioned programs is that they took 15 and 8 years, respectively, to achieve these reductions and incurred large staffing turnover and other program costs in the process. The data from these two states, plus results from similar programs monitored for shorter periods in Kentucky, Alaska and Nebraska, showed that on the average, it required about $0.23 to reduce litter by one item using this approach.

The data also showed that such comprehensive litter control programs must be maintained continuously, particularly if population growth and migration into a state occur. In the state of Washington, for example, after a 76% reduction had been achieved, the program funding was cut back and shifted toward recycling. Subsequently, population and traffic growth occurred and within seven years the litter rate climbed back up again, wiping out a third of the litter rate reduction that had been achieved.

PAID ADVERTISING LITTER REDUCTION PROGRAMS

Publicly funded anti-litter advertising programs have been successful in reducing litter in five jurisdictions: Texas, Oklahoma, Newfoundland, Bermuda and Evansville, Indiana. Table 7 summarizes their per capita costs, the initial litter reduction rate and their cost to prevent one item of litter.

Table 7

ADVERTISING-BASED LITTER CONTROL PROGRAM EXPERIENCE						
Place	Time Span	Years	Annual Reduction in Litter Rate	Annual Cost Per Capita for		Cost to Prevent One Item of Litter
				Total	Advertising	
Population Over 500,000						
Texas	1985-87	2	-28%	$0.35	$0.19	$0.029
Oklahoma	1988-90	2	-34%	$0.41	$0.24	$0.013
Newfoundland	1994-96	2	-29%	$1.17	$0.47	$0.019
		Avg.	***-30%***	***$0.64***	***$0.30***	***$0.020***
Population Under 500,000						
Bermuda	1991-93	2	-5%	$1.20	$0.48	$2.311
Evansville, IN	1996-97	1	-39%	$1.22	$0.50	$0.256
		Avg.	***-22%***	***$1.21***	***$0.49***	***$1.283***

Notes:
[1] Bermuda and Newfoundland cost estimates incorporate adjustments for exchange rates and purchasing power
[2] Evansville advertising costs include in-kind contributions, but exclude donated airtime.
[3] Although Bermuda only averaged a 5.1% reduction per year in total litter, the reduction in and soft drink containers, one of the major goals of the program, was measured at 18.8% per year.

The above advertising based programs were spending less than half their budgets on radio and television advertising. In addition to the Adopt-a-Highway program, Texas also supported a statewide KAB program that was active in most of its larger cities. However, significant reductions were achieved in non-KAB cities as well and therefore it is reasonable to credit the

majority of the reduction impact to the advertising program.

Bermuda, Newfoundland and Evansville were also conducting other anti-litter programs as well. The important point however, is that many of these efforts had been in place before the advertising programs were started. It is also fair to note that advertising programs usually cost more per capita in jurisdictions with smaller populations. (Newfoundland, Evansville and Bermuda had populations of 575,000, 165,000 and 60,000, respectively, compared to 16.7 million for Texas and 3.4 million for Oklahoma). Although the broadcast costs may be about the same per capita, the up front costs of developing the commercials have to be spread over a smaller population base.

Reliance on radio and television messages targeted directly toward the primary littering age groups enables quick litter reduction from advertising based programs when compared to comprehensive litter control programs. This avoids the lengthy and inefficient grass roots process of involving large numbers of persons, many of who probably do not contribute significantly to littering, or who will not be effective as positive role models for those that do.

OTHER EXPERIENCE GAINED FROM ADVERTISING PROGRAMS

While the same approaches used in other states will not work in every jurisdiction, it may be helpful to understand some of the lessons that were gained from other programs. For example, it was found that several types of commercials were needed in Texas to achieve the 67% reduction in litter attained in the first six years. The initial ads, featuring football stars and country and western singers, were aimed primarily at deliberate littering on rural highways and freeways by males 20 to 34 years old. While they cut deliberate rural littering by 40% in one year, they did not reduce deliberate littering in urban areas or accidental littering in either urban or rural areas. In the second year, therefore, the commercials were directed more towards a younger urban audience and used a greater emphasis on rock stations and musicians. At the end of two years, both urban and rural litter rates were reduced by 54%, and in six years, by 67%.

The format of the video commercials portrayed mainly deliberate littering, resulting in a lag in accident litter reduction. A commercial showing a popular musician sitting in the back of pickup truck and lamenting its potential for causing litter was subsequently introduced. As a result, an increased rate of reduction for accidental litter was achieved and the overall litter rate was down 66% after four years. (The percentage of urban pickup trucks carrying potential litter in their beds decreased from 78% to 48% in the same four years). Many Texans commented that they had never realized how much litter came from the backs of trucks until they saw that commercial. In Texas, radio was also used to reinforce and supplement the message being delivered by television. The message was also delivered via bumper stickers, tee shirts, beautiful mural posters in airport lobbies, on the unused backs of thousands of bridge ice warning signs, and many other means.

Oklahoma started out with an advertising program similar to that used in Texas with the catchy colloquial theme of “Don’t Lay that Trash on Oklahoma”. Unfortunately, the program was eliminated due to budget constraints after several years of successfully reducing litter. As a consequence, the litter rate built backup again. The program was renewed after several years but

with a different advertising agency and a less effective theme. This experience is important as it indicates that a successful program requires a commitment of adequate funding over at least a five-year period.

SIGNIFICANT FINDINGS OF SECTION FOUR
ALTERNATIVE LITTER REDUCTION PROGRAMS

- The two most expensive ways to prevent or remove litter from streets and roadsides are paid litter pick-up programs, which cost $1.29 to remove one item of litter and beverage container deposits, which cost $4.24 to remove a single container or prevent one from being littered.

- Adopt-a-Highway programs and state-run comprehensive litter control programs are less expensive (about $0.18 to remove or prevent an item of litter) but have limitations. Adopt-a-Highway programs currently cover an average of 45% of state maintained highways nationally and do not affect most rural local roads or urban city streets. Comprehensive programs are effective statewide but can take from 8 to 15 years to achieve significant results by themselves.

- Paid advertising programs targeting the age groups identified as responsible for causing much of the litter are the most cost-effective. They prevent littering from occurring at the rate of $0.02 per item. They are flexible and quick to achieve results, but must be adequately supported ($0.30 per capita per year) and sustained to achieve good results. They are not cost effective for smaller jurisdictions under 500,000 persons.

SECTION FIVE
A MEDIA-BASED LITTER REDUCTION PROGRAM FOR NEW JERSEY

PLANNING THE SCOPE OF THE PROGRAM

Section Four has presented fairly convincing evidence that direct, paid advertising is not only the most cost effective method to attain litter reduction, but has the added advantage of focusing on changing behavior and seeking to prevent litter rather than endlessly cleaning it up. To implement such a program, the following decisions and actions must be made:

- Establish a funding level and time frame of commitment;
- Identify the agency that will conduct the program;
- Secure the services of a qualified advertising agency;
- Plan for follow up surveys to assess progress and identify new age groups to be targeted and new types of littering to be addressed.

Our recommendations are as follows:

- Secure a commitment for a funding level of $0.30 per capita per year for the advertising program alone. (This is the inflation adjusted average cost for successful programs in jurisdictions with populations of more than 500,000. See Table 7 in Section 4.)

- Plan on an intensive five-year program to achieve a reduction in litter of 50% or more, followed by a reduced program to maintain the level of reduction achieved. (Experience has shown that it is imperative to make a long-term commitment since new generations of potential litterers will invariably arrive and undo the work of even the most successful programs if anti-litter education is not continued.)

- Select an agency that has the interest, capacity and personnel to handle such a program. (Successful programs have been run by highway departments, environmental protection agencies and even public health departments. In the end it was committed, dedicated leadership and support of the Governor and legislature that was the most important.)

- Secure a professional advertising agency to plan the advertising, prepare the commercials, buy the air -time, and evaluate feedback and subsequent survey results.

- Plan for follow up surveys after two and five years. An independent survey agency should perform the studies and meet annually with the Litter Program Manager and the advertising agency to provide input on advertising themes, needed changes in targeting emphasis and the effectiveness of prior advertising efforts.

CALCULATING NEW JERSEY LITTER COMPOSITION

The next step is determining where to focus the media advertising program. Experience has shown that after a baseline survey has been made, the litter composition should be analyzed in two subgroups: freeways/rural roadways and urban streets. The freeways/rural roadways include roadways under the state jurisdiction such as urban and rural interstates, other freeways, and other rural state highways. Rural local roads are also included in this subgroup. Urban streets include all streets within cities and other local jurisdictions that maintain streets within urbanized areas. The litter rates for products and packaging materials contributing to each of these locale grouping litter types were calculated for the New Jersey 2004 survey and are shown in Table 8.

Table 8

COMPONENTS OF NEW JERSEY LITTER			
	Freeways & Rural Roadways	**Urban Streets**	**All Roadways and Streets**
Exposure Adjustment	25.5%	74.5%	100.0%
Product/Packaging Group	***Exposure Adjusted Visible Items Per Mile***		
Deliberately Littered Products			
Beverage Containers, Caps, Tabs, Cartons	83.9	160	243.8
Take-Out Food Pkg. Cups, Napkins, etc.	140.6	231.2	371.8
Candy, Gum, Snacks	26.1	97.7	157.2
Tobacco Products, Match Books	59.5	43.4	69.5
Toiletries, Toys, Clothing, Recreation	26.1	72.3	102.2
Subtotal	**344.6**	**609.1**	**953.8**
Accidentally Littered Products			
Vehicle Debris, Supplies	49.7	21.4	71
Construction Material, Debris	10.6	26.6	37.2
Miscellaneous Paper and Cartons	73.5	147.3	220.8
Miscellaneous Plastic, Metal, Glass	92.9	180	272.9
Newspaper, Advt, Food Pckg, Yard Trim, Other	69.1	122.4	191.4
Subtotal	**295.8**	**497.6**	**793.4**

In this table, the actual visible litter rates for each product/packaging component of freeway/rural and urban street litter were multiplied by the exposure weighting to highlight the actual contribution to the total litter from the two different locale groupings. The results show that urban streets contribute twice as much to total exposure to litter as freeways/rural roadways and probably should be the initial primary target for reducing litter in New Jersey. However, in order to achieve reduction goals of at least 50%, freeway/rural roadways must subsequently be addressed. They also show that deliberate litter is contributing only 20% more to the state litter problem than accidental litter, indicating **both** deliberate and accidental litter must be targeted. As will subsequently be discussed, it will be necessary to develop different advertising messages that address these different types of littering – urban street vs. freeway/rural roadway and accidental vs. deliberate – as well as the different age groups that contribute the most to these types of littering.

CALCULATING NEW JERSEY CONTRIBUTIONS TO LITTER OF THE DIFFERENT AGE GROUPS

The distribution of age groups of persons observed littering these kinds of products in other surveys was obtained. Based on 314 sightings in 22 states and 3 Canadian provinces, these age group distributions are summarized for the two subgroups of freeways/rural roadways and urban streets in Table 9.

Table 9

PERCENTAGE OF LITTERING BY AGE GROUP						
FREEWAY/RURAL ROADWAY				URBAN STREETS		
Age Group	Total Deliberate	Total Accidental		Age Group	Total Deliberate	Total Accidental
0-5	0.0%	0.0%		0-5	0.7%	2.5%
6-10	0.0%	0.0%		6-10	14.5%	6.3%
11-17	14.7%	1.6%		11-17	30.4%	12.7%
18-24	29.4%	14.3%		18-24	27.5%	16.5%
25-29	14.7%	11.1%		25-29	6.5%	10.1%
30-34	11.8%	22.2%		30-34	5.8%	8.9%
35-39	0.0%	19.0%		35-39	4.3%	8.9%
40-44	5.9%	15.9%		40-44	1.4%	8.9%
45-54	17.6%	11.1%		45-54	7.2%	15.2%
55&Up	5.9%	4.8%		55&Up	1.4%	10.1%

Notes:

1. Based on 314 observed acts of littering in prior surveys where item littered and age of litterer was determined witnessed between 1974 and 2004.
2. The percentage of product groups for each age group was calculated using a weighting method that gave more weight to total accidental or total deliberate distribution where less than 10 acts occurred.

The next step was to combine the litter product composition data for the state of New Jersey from Table 8 with the age group distribution for the same products obtained from prior surveys. Thus to calculate the percent of New Jersey litter contributed by each age group, the freeway/rural and urban weighted averages for each product from Table 6 were multiplied successively by each age group percentage from Table 9. The total for deliberate and accidental littering was then calculated as a weighted average using the visible items per mile rate for each product. The final result, as shown in Table 10, identifies the target age groups that were found to contain the bulk of the litterers in New Jersey.

Table 10

SUMMARY OF AGE GROUPS TO TARGET IN NEW JERSEY												
FREEWAYS AND RURAL ROADWAYS						URBAN STREETS					ALL LOCALES	
Age Group	% Of Delib. Litter By Age Group	Tot % Of Delib. Litter Targeted	% Of Accid. Litter By Age Group	Tot % Of Accid. Litter Targeted	Total Frwy/ Rural Litter	% Of Delib. Litter By Age Group	Tot % Of Delib. Litter Targeted	% Of Accid. Litter By Age Group	Tot % Of Accid. Litter Targeted	Total Urban Street Litter	% Of All Litter	% Of All Litter Targeted
0-5						0.5%		2.5%		1.3%	1.0%	
6-10						12.9%	T	8.0%		10.8%	8.0%	5.5%
11-17	13.9%	T	1.8%		8.3%	32.5%	T	14.6%	T	24.9%	20.7%	20.5%
18-24	31.6%	T	14.8%	T	23.9%	27.6%	T	14.0%	T	21.8%	22.3%	22.3%
25-29	14.2%	T	11.5%	T	13.0%	8.0%		8.4%	T	8.2%	9.4%	6.0%
30-34	11.9%	T	22.0%	T	16.6%	6.2%		9.0%	T	7.4%	9.7%	7.1%
35-39	0.0%		19.7%	T	9.1%	4.1%		11.4%	T	7.2%	7.7%	5.9%
40-44	6.9%		14.9%		10.6%	0.8%		9.0%	T	4.3%	5.9%	2.8%
45-54	16.8%		10.7%		14.0%	5.4%		15.3%		9.6%	10.7%	
55&Up	4.7%		4.6%		4.6%	2.1%		7.7%		4.5%	4.5%	
TOTAL %	100.0%	71.6%	100.0%	68.1%	100.0%	100.0%	72.9%	100.0%	66.5%	100.0%		
% Of All N.J. Litter	13.7%		11.8%			25.5%	43.0%	31.5%		74.5%	100.0%	
% Of Litter Targeted	9.8%		8.0%		17.8%	31.3%		21.0%		52.3%		70.1%

DECIDING WHICH AGE GROUPS TO TARGET

Table 10 indicates the different age group ranges that encompass 67% or more of the deliberate and accidental litterers in New Jersey for freeways/rural roadways and urban streets and which groups should be primary targets (T) for an educational media campaign. Experience has shown that to achieve the maximum impact from advertising, it is best to select from age group ranges that are as compact as possible. The smaller the age range, the easier it is to develop appealing advertising and to purchase airtime that has a higher probability of reaching the intended audience.

As Table 10 shows, the targeting of deliberate litterers in three age groups (6 to 24 years) will reach about 73% of the urban deliberate litterers. Similarly, targeting four age groups (11 to 34 years) will reach 72% of the rural deliberate litterers. Both of these groups are fairly compact when compared to the accidental litterers where six age groups (11 to 44 years) must be reached to get 67% of urban accidental litterers and four age groups (18 to 39 years) must be addressed to obtain 67% coverage of rural litterers.

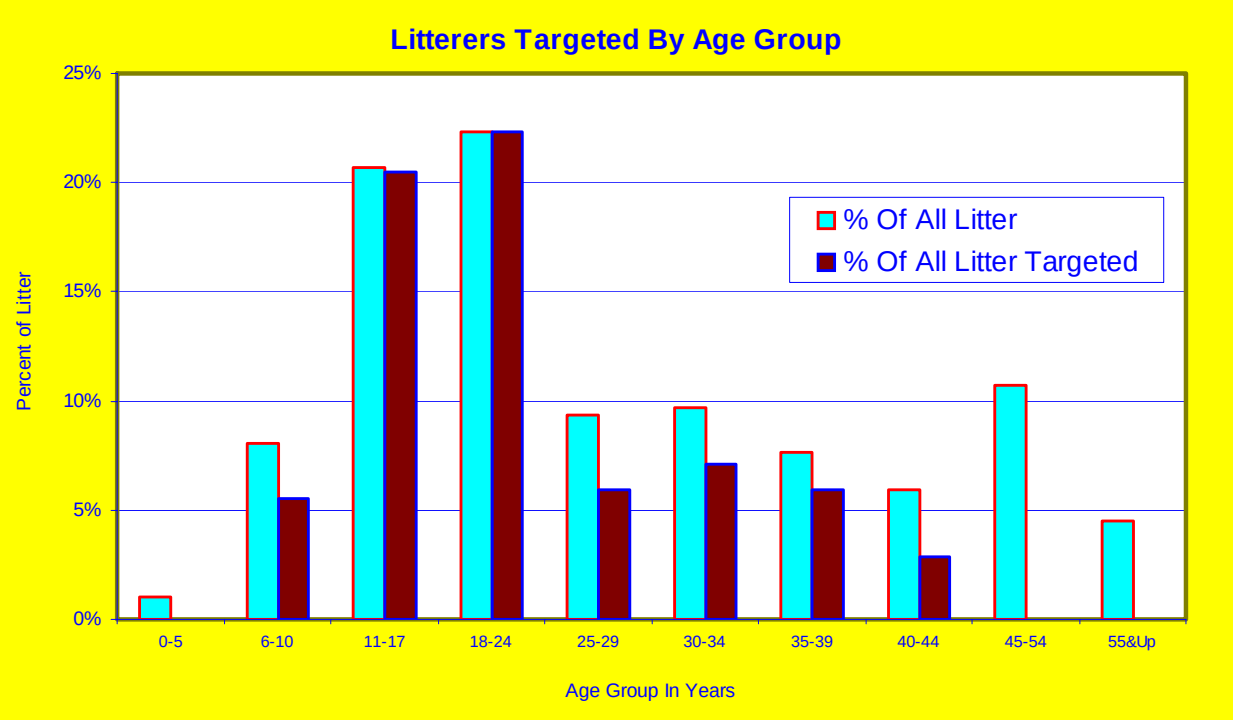
In a previous subsection, it was determined that the primary focus should be on urban litterers since they contribute almost twice as much to the total litter that the residents of New Jersey are exposed to than do rural litterers.

To begin with then, a television and radio advertising messages targeting 6 to 24 year olds should be planned to achieve a reduction in deliberate littering along New Jersey's urban streets. This should be followed with subsequent programs targeting the accidental urban litterers aged 11 to 44 years. As Table 10 illustrates, this targeting will include 52% of urban litterers and 18% of freeway/rural litterers for a total of 70% of all New Jersey litterers.

It is important to recognize that the age profiles for deliberate and accidental litterers are somewhat different and therefore may require two messages, one aimed at younger deliberate litterers 6-17 years and another aimed at the 18 to 34 year-olds. In contrast, the accidental litterers in both types of areas range in age and could probably best be reached with a single message.

Figure 10 shows the recommended age groups of litterers that should be targeted compared with the total percentage of all litter.

Figure 10



CONTENT OF ADVERTISING MESSAGES

It has been our experience that persons targeting and designing anti-litter advertising invariably portray acts of deliberate littering thereby ignoring the reality of the large amount of accidental littering that occurs. Because accidental littering is not intentional, it is necessary to show the various ways that accidental litter is caused in addition to saying, "don't do it." Thus, it might be best to develop one combined commercial, aimed at older male adults, that actually depicts five types of accidental litter in quick succession. These brief reenactments, stressing that carelessness can cause litter, could include: (1) a piece of cardboard box flying out of a pickup truck; (2) tree branches, shingles, and other construction debris falling off an uncovered trailer; (3) pieces of plastic tearing off of a flapping load cover; (4) newspapers falling from an overloaded uncovered trashcan or curbside recycling bin; and (5) a construction worker accidentally dropping some material in the gutter as he unloads a truck.

Such an advertisement could also stress that while accidental litter represents less than 50% of

the items generated, because of its generally larger size and lower degradability, a lot more of it may end up visible than deliberate litter. Accidental litter is also the most serious form of litter in terms of causing injuries and deaths from vehicles being hit by airborne litter or swerving to avoid it.

Web-based tools should be developed and utilized to reach both focused and broader audiences with messages about the problems associated with littering.

CHOOSING A LITTER PROGRAM SLOGAN

The choice of the theme or slogan for the anti-litter advertising program is very important. Unfortunately, many of the persons active in litter control program leadership fail to realize that many of the persons who are littering simply will not be motivated by appeals to make the world a better place. Indeed, most of the forty observed litterers talked to in the course of completing litter surveys were not concerned with the appearance or health of their environment. They are not likely to respond to words like “please,” “beautiful,” “clean,” “care” or “help.” Indeed, most of the advertising programs that have succeeded in reducing litter and were continued over a number of years had “tougher” themes and slogans that started with the admonition “Don't.” This correlation between slogan "toughness' and the fate of the program is illustrated by Table 11.

Table 11

ADVERTISING SLOGANS OR THEMES		
Jurisdiction	**Slogan**	**Program Fate**
Texas	Don't Mess with Texas	Continuing in 18th year
Oklahoma	Don't Lay That Trash On Oklahoma	Funding Cut after 3 Years
Bermuda	Don't Mess Around	Continuing in 11th year
Evansville, IN.	Don't Mess My Town, Clown	Continuing in 6th Year
Newfoundland	It's Yours, Keep It Clean	Terminated after 2 years
Florida 1989	We're Having A Neat Wave	Terminated after 1-2 yrs.
Louisiana 1989	We're Picking Up In Louisiana	Never Funded
Minnesota 1990	Don't Waste Our State	Terminated after 1 year
Seattle 1990	Slam Dunk The Junk	Terminated after 1 year

A good example is Oklahoma, which started out with a “tough” slogan, "Don't lay that trash on Oklahoma" and achieved a litter rate 69% below the baseline level after two years. Funding was cut and after three years, the litter rate had climbed back to its original level. Four years later, a new advertising program was implemented with a new (and in our opinion, weaker) slogan "Keep Our Land Grand". After one year an increase in litter of 15% had occurred.

OTHER LITTER CONTROL PROGRAM RECOMMENDATIONS

New Jersey 2004 survey results and IAR experience lead to the following recommendations for actions that would supplement the advertising program:

- Develop a stepped-up emphasis on litter law enforcement including:
  - Educating traffic officers on the serious traffic and economic consequences of littering and the deterrent value of issuing verbal warnings where they could not be certain which person in a vehicle was responsible for littering specific items.
  - Educating traffic officers on the value of issuing citations where they observe parked vehicles with obviously unsecured loads.
  - Educating other governmental officials such as building inspectors on the value of issue warnings when they observe obvious littering.
  - Setting up a litter hotline for the purpose of sending letters to owners of vehicles observed littering.
  - Developing a program of using portable surveillance cameras to deter and detect illegal dumping with emphasis on urban vacant lots and unmaintained areas.

- Modify existing school education programs to put more emphasis on 11-17 year olds instead of 6-10 year olds.

- Shift emphasis of clean-up programs away from rural roadways to adopt more urban streets and urban litter hot-spots.

- Covered load laws should be amended to include prohibition of using truck and trailer beds as depositories for paper and plastic trash that could become airborne when the vehicle is moving. Law enforcement officers and construction industry officials should be educated about the magnitude of the litter problem of escaping trash and unsecured loads and the officers should be encouraged to issue warnings about putting trash in the open beds of trucks and trailers.

- The trucking and tire industries should be informed about the high percentage of litter stemming from vehicle debris, particularly tire treads. In keeping with an emphasis on preventing litter rather than picking it up, a request should be made that they begin to study the problem with the objective of finding ways to reduce it.

- Since litter receptacles have been shown to reduce urban and rural litter by an average of 40%, develop a program to install more receptacles where appropriate and cost-effective. (See IAR Report S-4.8, Litter Receptacle Cost-Effectiveness.)

APPENDIX A
GLOSSARY AND ABBREVIATIONS

Accidental Litter
Material or products that are usually seen being deposited unintentionally, such as vehicle debris from accidents or wear, material that falls from loaded vehicles and items that fly out of open bed vehicles. It includes items that spill from overloaded or tipped trashcans and items dropped or left behind unintentionally by persons.

Accumulated Litter
The buildup of Items that have been littered in the past over an unknown period of time (see fresh litter).

ADT (Average Daily Vehicle Traffic)
Number of vehicles per day, as measured from short-term counts and expanded to 24 hour estimated volume.

ADDT (Average Dry Day Vehicle Traffic)
ADT adjusted for rainfall during time vehicle count was made to reflect vehicle traffic on dry days.

ADP (Average Daily Pedestrian Traffic)
Number of pedestrians per day, as measured, as measured from short-term counts and expanded to 24 hour estimated volume.

ADDP (Average Dry Daily Pedestrian Traffic)
ADP adjusted for rainfall during time the pedestrian count was made to reflect pedestrian traffic on dry days.

AMVM (Annual Millions of Vehicle Miles)
Used to derive mileage for use in Form 7b, which calculates the locale weighting factors (LWF). Data for AMVM is assembled from Federal Highway Statistics data and corrected for differences in databases to achieve estimates applicable to locale categories used in the litter survey.

BEDT (Before Daily Vehicle Traffic)
ADDT adjusted for a seasonal traffic factor (STF) and the percentage of days preceding the survey with total rainfall over 0.5 inch (RNAA). Adjusts observed counts for the historical month to month seasonal trends and actual percent of days of rainfall during time litter was building up

BEDP (Before Daily Pedestrian Traffic)
ADDP with adjustment equivalent to that for BEDT.

BSD
Beer and soft drink containers.

CDP (Census Designated Places)
Defined by the U.S. Census as a densely settled concentration of population that is not incorporated but which resembles an incorporated place in that it can be identified with a name.

COPOP (County Population in thousands)

Comprehensive Litter Control Program
A litter control program that incorporates a variety of activities and measures aimed at reducing litter. Typically includes education, public awareness, neighborhood or roadway cleanup, and promotion of anti -litter legislation and litter law enforcement, litter hot lines and beautification programs.

Contiguous Cities
A combination of urban areas (Cities, CDP's, Boroughs) greater than 1500 population whose boundaries touch each other or are no more than 3 miles apart.

Convenience Products
Products that are intended primarily for immediate consumption and limited reuse, as opposed to more durable products with longer intended lives. Includes snacks, beverages and take-out food (as opposed to home prepared food.) May also includes disposable lighters, film cassettes, disposable utensils, etc.

Deliberate Litter
Material or products that are usually seen being thrown, dropped, discarded or left behind intentionally in inappropriate locations.

Exposure (see Locale Weighting Factor)

Fresh Litter
Items that have been freshly littered or deposited during a specified preceding period of time since a prior cleaning, usually a two week period (see accumulated litter).

GBB
Gershman, Brickner & Bratton, Inc.

IAF (income Adjustment Factor)
Factor for correcting census income data for state-to-state differences in the cost of living.

IAR
Institute For Applied Research

INC (Neighborhood Income)
The median household income for a city, CDP, borough or census tract. (See MHI)

INCA (Adjusted Neighborhood Income)
INC corrected for state-to-state differences in the cost of living. Calculated in Form 3b.

IRT (index of Rainfall and Temperature)
Empirically derived factor reflecting the combined effects of rainfall and temperature on litter rate. Used for correcting litter rates for the effects of weather prior to the survey. Calculated from weather reporting stations in Form 5.

KAB (Keep America Beautiful)
Keep America Beautiful is a national non-profit public education organization, founded in 1953, that engages individuals to take great responsibility for improving their local community environments through the implementation of an effective, systematic strategy for education on and changing individual attitudes about beautification and community improvement, litter prevention, and waste reduction

Kv, Kp (Vehicle and Pedestrian 24-hour Expansion Factors)
Used to convert hourly vehicle and pedestrian traffic volumes to 24-hour volume estimates.

Kw, Kwp (Vehicle and Pedestrian Day-of-Week Correction Factors) Used to adjust traffic volumes for the day of the week on which the sampling was done.

Krs, Krsp (Vehicle and Pedestrian Rainfall Correction Factors)
Used to adjust traffic volumes for effects of rainfall at the time the traffic count was performed.

Litter

a. Solid wastes that are scattered about in a careless manner. (Source: www.dictionary.com)
b. Things lying about in disorder; rubbish. (Source: Webster's New Universal Unabridged Dictionary, 1983 Edition.)
c. As used in this report, litter is defined as solid waste in the wrong place. This includes both manufactured items and non-manufactured items, such as tree trimmings and lawn clippings which had been transported to litter site. It excludes liquids and naturally occurring litter such as leaves, branches, field crops, fruit, nuts and animal droppings. It includes illegally deposited items such as furniture, appliances and construction debris, as well as obviously abandoned vehicles. Accidentally dropped items such as combs, clothing, money, jewelry and tools are also counted as litter, even though they are not 'waste' per se. Children's toys on a front lawn and workers tools near a construction site or automobile location are not usually counted as litter, unless there is evidence of abandonment.

Locale
A type of roadway or street frontage along which litter is counted. Locales used in the New Jersey 2004 litter survey are listed below. The first four locales are sometimes referred to collectively as Freeways and Rural Roadways; the remaining four are referred to as Urban Street Frontages or Urban Streets.

1. **Rural Freeways and Tollways (RFT)** Interstate Highways, toll roads and limited access highways located outside of urban areas.

2. **Other State Rural Highways** (**OSR**) U.S. and State highways located outside of urban areas without limited access.

3. **Rural Local Roads (RLR)** Public roads outside of an urban area that are maintained by a city, county, borough, township etc. In New Jersey, most roads in this category are maintained by the state as Secondary State Highways.

4. **Urban Freeways and Tollways (UFT)** Interstate Highways, toll roads and limited access highways located within an urban area.

5. **Vacant, Industrial or Un-maintained Street Frontage**s **(VIU)** The edge of an urban street in front of a vacant lot, an un-maintained industrial site or a lot with a building and or landscaping which is run-down and receiving no upkeep.

6. **Commercial Street Frontage (COM)** The edge of an urban street in front of a store, mall, restaurant, or other place of business.

7. **Public Facility Street Frontage (PUB)** The edge of an urban street in front of a park, stadium, school, courthouse, public library, police station, or other government or quasi-public use building or facility.

8. **Residential Street Frontage (RES)** The edge of an urban street in front of residences, typically along neighborhood streets.

LWF (Locale Weighting Factor)
The proportionate amount of time people spend in a locale as motorists or pedestrians. It takes into account the amount and speed of traffic, occupancy rate of vehicles and the total length of road in a locale category. Derived in Form 7b from U.S. Department of Transportation data, current survey data, and empirically derived factors from surveys in other states.

MHI (Median Household Income)
Total income per household of tracts or cities that is exceeded by half of the households. Used as a more stable and representative parameter in place of average because incomes are usually skewed towards high values and averages are heavily influenced by outlying values. Derived in Form 4 from U.S. Census data.

MTC (Miles to City)
Distance from rural sites to the nearest urban area with a population of 1,500 or over. State average for rural roadways derived in Form 7d.

OCF (Observer Correction Factor)
Used in Form 9 to correct litter counts made by one observer to the detection level of another observer to allow comparison of results.

OPV (Occupants per Vehicle)
Number of persons in a vehicle.

OBV (Open Bed Vehicles)
Fraction of total vehicles that have passenger or cargo compartments that are fully or partially

uncovered. Includes towed trailers and uncovered boats.

Photo degradation
The process whereby inorganic materials (e.g. plastics) decompose due to the effects of sunlight or ultra-violet radiation.

POBV (Percent of Open Bed Vehicles)
Percent of open bed vehicles such as pick-up trucks on the roadways and byways.

PVI (Pedestrian Visible Items)
Littered items within a survey site that are larger than 1 inch in area (about the size of a soda bottle cap) and are visible to a pedestrian walking along the side of a street or roadway.

PVIM (Pedestrian Visible Items per Mile)
PVI expressed as rate per mile.

RNAA (Rain Adjustment Average)
The percentage of days in the litter build-up period prior to survey sampling in which .05 or more inches of precipitation occurred. Derived in Form 5.

Roadway
A public thoroughfare in a rural area. A generic term that includes rural freeways and tollways, other rural state highways, and rural locally maintained roads.

Street
A public thoroughfare in an urban area. A generic term used to designate municipally maintained streets, usually with curbs and or gutters.

STF (Seasonal Trend Factor)
Used in Form 3b to adjust the measured ADDT traffic volume to the average level during the one to four month litter build-up period. Derived in Form 7a from U.S. Department of Transportation data for the state.

Visible Litter
Items of accumulated litter 1 square inch or greater in size that can be detected by a person walking along the edge of a street or roadway at a normal gait (2 to 3 mph).

Weighted Average
An average of values adjusted to reflect the relative contribution of the individual sources of the values. I.e., a weighted average of the litter rates from all locales is calculated using the Locale Weighting Factors that reflect the relative amount of time people spend in each locale as motorists and pedestrians (See also: LWF).

APPENDIX B
VISIBLE LITTER SURVEY METHODOLOGY

INTRODUCTION

This document describes the visible litter survey and analysis procedures used in the 2004 New Jersey study. The purpose of this plan was to ensure that a properly designed litter survey was performed in New Jersey in 2004 to define and characterize the rate, composition and source of litter along public streets and highways in the state. This document consists of three main parts: [1] a sampling plan that describes how the 2004 survey was planned, [2] a field survey data acquisition procedure that describes how the survey data was acquired and [3] an analysis plan that summarizes how the data was analyzed using a set of spreadsheet forms.

SAMPLING PLAN PREPARATION

Sampling Plan Summary

The objective of the survey was to measure the rate and composition of visible litter along New Jersey's streets and highways. The intent was to identify the source and extent of litter in the state and to compare its rate with those measured in prior studies if any, in New Jersey and in other states. The 2004 survey will also provide a baseline against which subsequent surveys will be measured to assess changes in litter and the effectiveness of litter control efforts in the state.

To achieve these objectives, visible litter rate and composition was measured along 94 sites throughout the state (86 randomly selected and 8 special sites). The sites sampled were selected within two major strata that have been found to affect littering rates:

- County population size and
- Roadway type or adjacent land use locale category.

Experience has shown that sample size can be minimized and accuracy increased if a stratified sampling plan is used instead of selecting purely random samples.

ALLOCATION OF SITES BY COUNTY POPULATION SIZE

The sites were allocated into four major county population strata. The number of sites allocated to each stratum was in proportion to the percentage of the state's population residing within that stratum. For stratification purposes, two or more adjacent counties with a population of 500,000 or more were combined and treated as a single multi-county cluster. The strata selected for New Jersey are shown in Table B-1.

Table B-1

ALLOCATION BY SIZE OF COUNTY

NEW JERSEY LITTER SURVEY: SITE ALLOCATIONS						
Population Range	**Population**	**% of State Total**	**Total Sites**	**% of Sites**	**# of Counties**	**Counties Sampled**
0-50,000	0	0.00%	0	0%	0	0
50,000 -100,000	64,438	0.75%	1	1%	1	1
100,000 - 200,000	631,793	7.35%	6	7%	5	5
200,000 - 500,000	1,097,616	12.78%	11	13%	3	3
Over 500,000	6,796,453	79.12%	70	80%	5	5
STATE TOTAL	**8,590,300**	**100.00%**	**88**	**100%**	**14**	**14**

Following this plan, ten New Jersey counties were combined into three Multi-County clusters with populations in the Over 500,000 category. These clusters are included in Table B-2, which shows all county clusters with populations greater than 500,000.

Table B-2

COUNTIES GREATER THAN 500,000 POPULATION		
County	**2002 County Pop**	**# of Sites**
Ocean	537,065	6
Monmouth	629,836	6
Glouster / Camden / Burlington	1,211,877	12
Middlesex / Somerset / Union	1,616,198	17
Hudson / Essex / Passaic / Bergen	2,801,477	29
Total	**6,796,453**	**70**
# of Counties	*5*	*70*
Average POP	1,359,291	
State POP %	79.12%	

ALLOCATION OF SITES BY ROADWAYS AND HIGHWAYS

New Jersey is the fourth smallest state in the U.S., but boasts the ninth highest population, making it densely populated in the northeastern part of the state, but rural in the southern portion.

ALLOCATION OF SITES BY LOCALE CATEGORY

Within each of the four major county population size strata, sites were allocated to one of the eight locale categories as shown in Table B-2 (See Glossary). The number of sites allocated to each stratum was in approximate proportion to the daily exposure hours of motorists and pedestrians spent in the highway and street locale. Those locales with less than ten percent of the state AMVM were allocated a minimum of eight sites each to minimize sampling error as shown in Table B-3.

Table B-3

ALLOCATION BY LOCALE CATEGORY			
Locale Category	**Daily Total Exposure Hours**	**Percentage Total Exposure**	**Total Number of Sites**
Rural Freeways and Tollways - RFT	886,230	6.5%	9
Other Rural State Highways - OSR	675,524	4.9%	8
Rural County Roads - RLR	334,277	2.4%	11
Urban Freeways and Tollways - UFT	1,576,859	11.5%	9
Freeways/Rural Tollways Total	**3,472,890**	**25.3%**	**37**
Vacant, Unmaintained - VIU	748,200	5.5%	9
Commercial - COM	688,654	5.0%	11
Public Buildings and Facilities - PUB	3,257,954	23.8%	15
Residential - RES	5,543,241	40.4%	22
Urban Street Frontages Total	**10,238,049**	**74.7%**	**57**
Total Urban & Rural	**13,710,939**	**100.0%**	**94**

The distribution of sample sites using the estimated daily exposure hours, 25% for rural roads, freeways, toll ways and 75% for urban street frontages was selected because it approximates the amount of time pedestrians and motorists in New Jersey spend in these locales. This distribution, along with the allocation proportionate to county population size assured that the final survey results reflected the statewide exposure to litter in New Jersey. The allocation of the sites to counties is shown in Form 1-B.

SPECIAL RESEARCH STUDY SITES

Eight of the 94 sites were special research study sites. These site types were chosen by the Clean Communities Council. The specific sites sampled were a part of the methodology for identifying sites for sampling. In all, three construction sites (one VIU and two COM locales), three downtown commercial and two beach/waterfront sites were sampled. The litter rate in all of these special sites was not found to differ significantly from the eight basic locale categories.

DISTRIBUTION OF SITES WITHIN COUNTIES

The required number of sites for each selected county or Multi-County cluster was allocated to the eight basic locale categories in a random fashion (See Form 1b). Where two or more sites were to be allocated to a given county, they were split among the locale categories so that the county was assigned both rural and urban sites. Because smaller counties do not usually have cities with urban freeways or toll ways (UFT), such sites were usually assigned to the large counties or multi-counties. Conversely, some counties were so completely urbanized they have few areas where RFT, OSR or RLR sites could be found. Thus it was necessary to allocate a higher proportion of RFT, OSR and RLR sites to smaller county groups and a larger proportion of urban street and UFT sites to larger county groups.

SELECTION OF URBAN STREET SITES IN COUNTIES UNDER 200,000 POPULATION

The urban sites in counties with population less than 200,000, were located in the smaller cities, census designated places (CDP) and other municipalities (such as boroughs in New Jersey) with a population of 1,500 and over. This was done by accessing the U.S. 1990 and 2000 Census web site and downloading all the listed cities, CDPs and other municipalities. Each jurisdiction was assigned a sequence number in ascending order and by the use of the random number generator; three choices were made (one primary and two alternate). Maps were also printed of the selected cities using the mapping service of search engines. The final step was to select the specific site locations (block face). For residential sites this was to be done by randomly selecting segments of minor streets. Potential commercial areas were also selected using mapping data, as were public sites such as schools, churches, civic centers, hospitals, libraries etc. Vacant, Industrial sites were randomly selected as encountered.

SELECTION OF URBAN STREET SITES IN COUNTIES OVER 500,000 POPULATION

A similar procedure was followed for counties or Multi-Counties with populations over 500,000. The main difference was that census tracts were usually available in the larger cities and are used instead of cities, towns, etc. Census tracts in urban areas usually average around 3,500 persons and are apt to be more homogeneous in terms of income level than are large cities as a whole.

The same procedure in accessing the census data was followed except census tracts were selected instead of cities or towns. These tracts and their associated populations and incomes were printed out and those tracts with a population under 1,000 were deleted. For counties or multi-counties, the boundaries of the census tracts that where selected as primary and alternate choices were found and copied on a street map for locating in the field. As before, commercial, residential and public sites were selected before commencing the field survey, wherever practical.

SELECTION OF FREEWAY/TOLL WAY AND RURAL ROADWAY SITES

The RFT, OSR, RLR and UFT sites were located within counties in a random fashion. A theoretically “pure” random locating process would involve using random tables or random coordinate generators to locate random points within a county from which the nearest site on an

RFT, OSR, RLR or UFT would be determined. Other procedures could be used such as making or obtaining a list of all roadway segments in each locale category and selecting randomly within these lists. Experience has shown that the attainment of such a high level of randomness is extremely costly in terms of travel time since it frequently forces trips to remote corners of the state. Prior litter surveys have also shown that litter composition within a state usually does not vary significantly by region and that if traffic volume, county population size and distance to the nearest city are taken into account, litter rates for any given locale do not vary significantly within the state. Hence the selection procedure followed was to first randomly select the counties for sampling and then conduct sampling in randomly located urban areas in the county. Rural freeway and roadway sites were then randomly located near the route of travel between counties and the selected urban areas within the counties.

In establishing each RFT, OSR and RLR sample site, a random point on the highway or road was selected. For example, the RFT that passed through the county on the route of travel was identified and its total mileage within the county measured. After noting the starting point (usually the county line), the random number generator was used to calculate a random distance from the starting point which was plotted on the county map. In the field, the team started at the Start Point and drove the indicated number of miles, the nearest fixed reference point (mile post marker, sign, bridge abutment, OSR intersection, etc.) was located and became the start of the RFT survey site. Selecting landmarks to identify the boundaries of the sample site enables the site to be located for subsequent studies.

The random locating process was again repeated, noting the starting point, measuring the total OSR distance, selecting a randomized direction and distance, and, if required, taking an OSR sample. For RLR sites, the nearest RLR that intersected the OSR was identified and the process was repeated. A similar process was followed for UFT sites except that prior to randomly selecting the initial site, all UFT routes located in the county or Multi-County were listed. As before, the starting point was located, the total distance measured, and the site location established at a random distance from the starting point. Locating the freeway and rural roadway sites before the survey starts minimizes bias and assures a high degree of randomization while minimizing travel time and costs.

SURVEY DATA ACQUISITION

SITE IDENTIFICATION AND LOCATION

Survey sites were established as near as possible to the point determined in the site selection process. To ensure finding the sites during repeat surveys, the sites were started at permanent fixed features such as mile posts, directional or street signs, corner curbs, numbered utility poles, bridge abutments, guard rails, etc. Sites were located where it was safe and legal to do so, pulling the vehicle completely off the roadway if possible. Locations in road construction zones, on blind curves, adjacent to steep embankments, or on bridges were avoided. For safety reasons, litter counts were not made on median strips. Instead, the quantity of median litter was estimated using the count of litter on the outer roadside multiplied by an empirically derived adjustment factor dependent on median width. To facilitate this calculation, an index representing the median width was recorded during the litter count.

Determination of Site Length

The site length was determined by a single method. The site to be surveyed was measured using a Distance Measuring Wheel calibrated to the nearest foot. A single observer with the wheel determined the length of all sites in the New Jersey 2004 survey. The preferred approach was to end each site with an identifiable end point, as with the start point mentioned above, however this was not always possible. The sites averaged 689 feet with only four sites under 300 feet. The site length was recorded in feet along with a clear description of the starting and ending points. The name or number of street or highway the site was located on and the side or sides of the roadway where the count was taken was also recorded. For aid in relocating rural sites, the number of miles to the nearest state highway or other features depicted on a map was recorded.

Performing the Litter Count

The visible item count started at the beginning of the site and continued until an acceptable distance and/or number of items was counted. No site in the New Jersey 2004 survey had a length less than 300 feet. Selecting a site with at least fifty items enhances the ability to detect significant reductions in litter in future surveys. Except for a few cleaner urban sites, the minimum item count was 20 with an average of 84. When the observer reached the minimum number of items, the counting continued until another permanent fixture was reached, to provide an ending milestone.

The person conducting the count walked at a steady pace along the side of the road or street counting each visible item of litter between the center of the street and the public right of way limits (as defined by a wall, fence, hedge, building front, line of utility poles, etc.). Where no such defined limit existed as in residential lawns or vacant lots, the counting was limited to 15 feet in from the sidewalk or pavement edge. The observer walked more slowly where heavy concentrations of litter were found and where parked cars, shrubbery, or ground cover impeded visibility.

For the purpose of this study, litter is defined as “solid waste in the wrong place”. This includes

both manufactured items and non-manufactured items, such as tree trimmings and lawn clippings that had been transported to the litter site. It excludes liquids and naturally occurring litter such as leaves, branches, field crops, fruit, nuts and animal droppings. It includes illegally deposited items such as furniture, appliances and construction debris, as well as obviously abandoned vehicles. Accidentally dropped items such as combs, clothing, money, jewelry and tools are also counted as litter, even though they are not “waste” per se. Children's toys on a front lawn and workers tools near a construction site or automobile repair location are not usually counted as litter, unless there is evidence of abandonment.

Experience has shown that reliable and reproducible litter counts can best be made if small items are excluded. The cutoff point has been established at approximately one square inch, about the size of a bottle cap. Thus cigarette butts, small fireworks and small scraps of paper were not counted. Similarly, counting all fragments from a broken glass bottle or ceramic container as a single item has been found to greatly increase the accuracy and repeatability of litter trend measurements. In the New Jersey 2004 survey, a sub tally was also made of beverage cans and bottles in addition to the count of total items during the first pass walking at the edge of the site. These data were recorded using Form 2a.

LITTER COMPOSITION TALLY

After the first pass was completed and the visible litter counts recorded, a second pass of the site was made returning to the starting point. On this pass, a classification count was made meandering at a slower speed several paces in from the edge of the road where the litter density was greatest. As an item was encountered it was classified and counted as one of the composition categories show in Table B-4.

Items of unidentifiable product source or unlisted products were classified by their predominant material as other miscellaneous paper, plastic, metal and glass/ceramic. After counting the litter in the 22 categories, the data was recorded on Form 2b.

The division into deliberate and accidental litter was based upon over 400 acts of littering observed and recorded in prior surveys in the U.S. and Canada where, in many cases, the items were recovered. An analysis of this data established that 93% of the time items in the Convenience Products category were deliberately littered (thrown, tossed, pitched, discarded, left behind etc.). Similarly, items in the Other Products/Packaging category were observed blowing from the backs of trucks, escaping or falling from vehicles, or escaping from trash cans being transported or emptied 75% of the time. This category also includes trashcans tipped by animals, items unknowingly dropped by persons, workers etc., and lost vehicle parts (hubcaps, mufflers, tire shredding, etc.)

Table B-4

LITTER COMPOSITION CATEGORIES
Convenience Products (usually deliberately littered)
• Beer and soft drink containers • Juice, wine, liquor, water, other beverage containers (e.g. milk, juice containers one pint or less) • Bottle caps, crowns, seals • Pull tabs • Beverage carriers, six-ring binders, cartons, labels, etc. • Cups, lids, straws, straw wrappers • Candy, gum, snacks, nuts, chips, ice cream, cookies etc. • Other take out food packaging. (bags, boxes ,holders, condiment pkg.) • Napkins, tissue, small paper bags, picnic supplies, utensils, ice bags • Cigarette packages, matchbooks, tobacco pouches, lighters, pipe cleaners • Toiletries, sundries, drugs, clothing, recreational equipment, toys, games, cassettes, lottery
Other Products/Packaging (usually accidentally littered)
• Newspapers, magazines, books • Advertising leaflets, signs cards • Home prepared food packaging, food remnants, bones, milk and juice containers over one pint • Vehicle parts, debris, supplies, forms, credit slips • Construction material, debris, sawn wood, cable, rope, cord • Other miscellaneous paper, cardboard, cartons • Other miscellaneous plastic • Other miscellaneous metal, foil, appliances • Other miscellaneous glass, ceramic • Yard trimmings, other un-sawn wood, furniture • Other (e.g. non clothing fabric, kapok, burlap bags, beeswax, animal pelts, ivory, etc.

TRAFFIC COUNT

While the litter observer was counting and classifying litter, the assistant counted motor vehicles moving in the site using a mechanical counter for each category of vehicle. Pedestrians and cyclists in or near the site, passing by, standing, working, playing, crossing the street, getting out of cars etc., were also counted. The person counting traffic recorded start time on Form 2a, then counted the vehicles and placed them in four categories:

- Single occupant closed vehicles;
- Two occupant closed vehicles;
- Three or more-occupant closed vehicles, including busses; and
- Open-bed vehicles including convertibles and closed vehicles pulling open bed trailers or boats without covers.

Open bed vehicles are counted twice, once as open bed vehicles and once in the category with the appropriate number of occupants.

The count was made for a minimum of ten minutes, but was continued as long as the team was at the site since longer counts increase the accuracy of the traffic volume estimated from these counts. The time when the count was finished was also recorded on Form 2a. Every attempt was made to count vehicle traffic heading in both directions, however, in a few sites with heavy traffic volume or large medians, traffic was counted in one direction, then those results were multiplied by 2.

ADDITIONAL FIELD DATA

While at the site, data needed to expand the traffic count sample data into a 24-hour estimate was collected, including:

- Time of day site was surveyed;
- Date site was surveyed;
- Daily mileage;
- Weather during the time a site was being surveyed, particularly if it was drizzling or raining
- Median width (if any);
- Evidence of recent mowing or litter pick-up; and
- Designation as an Adopt-a-Highway area or SRS (landfill) site.

Other pertinent information was noted in the Comments section on Form 2b, including construction activity, vehicle breakdowns, traffic slowdowns or other situations in or near the site that may affect the counting of traffic or interpretation of data from that site.

ACTS OF LITTERING AND ILLEGAL DUMPING

While at the litter sample sites and driving between them, observed acts of littering and encounters with illegal dumps are to be recorded. For the purpose of this study, acts of littering are defined as any observed littering of objects included in the composition tally. In addition to the date, time, locale category and location, the sex and estimated age of the litterer and the number of additional persons accompanying the litterer were recorded. The source of the litter, the type of vehicle (if one was involved) and whether the act of littering was deliberate or accidental was also noted.

Instances of illegal dumps or abandoned vehicles were also to be recorded. In addition to the date, this includes the locale category of the dumpsite along with its location. The contents of the most visible items in the dump, such as household trash, yard trimmings, construction or vehicle debris, furniture, appliances, shopping carts, etc., would be briefly summarized. Additional notes would be made if the debris appeared to result from demolition of structures on the property or from improperly sized or contained trash being put out for pickup.

Abandoned vehicles are characterized by missing parts, signs of neglect, weed engulfment, vandalism etc. They include wrecks off rural roadways as well as obvious junker cars on urban streets in driveways or front yards.

ANALYSIS PLAN

Introduction

The analysis of the data from the New Jersey 2004 litter survey used a series of spreadsheets to bring together the various data elements from a variety of sources and calculate interim and final results. These are summarized in Table B-5 and discussed in the paragraphs following.

Table B-5

ANALYSIS SPREADSHEET FOR NEW JERSEY 2004 SURVEY	
FORM #	**DATA AND CALCULATION SUMMARY**
Form 3a,b	Data For Litter Rate, Traffic, Weather And Income
Form 4	Adjustment of 1980 MHI for 1980-90 Changes
Form 5	Index Of Rainfall and Temperature (IRT) and % Of Days With Rain (RNAA)
Form 6a,b	Litter Composition Data
Form 7	Constants and Coefficients Summary
Form 7a	Calculation of Seasonal Trend Factors (STF)
Form 7b	Calculation Of Locale Weighting Factors (LWF)
Form 7b1	Mileage, AMVM, and ADT
Form 7d	COPOP and MTC Summary
Form 7e	Calculation Of Litter Program Year (LPY)
Form 8	Calculation Of Litter Composition at Base, State, and U.S. Conditions, etc.
Form 9a,b, c	Correction Of Current Litter Rate to Base Year, State Average Conditions and U.S. Average
Form 9 e, f, g, h	Comparisons of Adopt-a-Highway, KAB vs. Non-KAB, Mow vs. Non-Mow, SRS vs. Non-SRS
Form 10	Targeting Analysis
Form 11	Estimate of Litter Encounters
Form 12	Illegal Dumps and Abandoned Vehicles seen during current and prior surveys
Form 13	Accuracy of Survey Results

During the field survey, the litter, traffic and other survey data from the Field Survey Log Sheets, Form 2a and Form 2b, were entered into a corresponding spreadsheet. These data were then sorted by locale and then transferred into Form 3a. The site weather index (IRT) was transferred from Form 5. Income data and the county population (COPOP) from Form 4 were also transferred into Form 3a. For rural sites, the miles to the nearest city (MTC) was derived from maps and input directly into Form 3a. The locations of existing Adopt-A-Highway and KAB programs and their starting dates were also obtained.

The calculations of the litter rate (PVIM), traffic volume (BEDT, BEDP), income adjusted for buying power (INCA), occupants per vehicle (OPV), and percent open bed vehicles (POBV) were accomplished by Form 3b for each site using the following formulas:

Litter Rate (PVIM)

$$PVIM = (PVI * MCF * 2) / [Lp/5280]$$

Where: PVI = Items visible to pedestrian counted at site
MCF = empirically derived median correction factor used to multiply litter on one side of

a highway to estimate litter on one side of the median.
Lp = Length of Site in feet
The factor 2 adjusts the count taken on one side of the road to obtain the rate per centerline mile for both sides of road.

Vehicle and Pedestrian Traffic Volume (BEDT, BEDP)

BEDT = Vc / ((Min/60) * Kv*Kw*Krs)]*STF*((1-RNAA)+Krs*RNAA)
BEDP = [Pc / ((Min/60) * Kp*Kwp*Krsp)]*STF*((1-RNAA)+Krsp*RNAA)

Where: Vc = total vehicles counted during sampling period
Pc = total pedestrians counted during sampling period
Min = duration of sampling period in minutes
Kv, Kp = vehicle and pedestrian 24-hour empirically derived expansion factors used to convert hourly vehicle and pedestrian traffic volumes to 24-hour daily total estimated volume.
Krs, Krsp = vehicle and pedestrian rainfall empirically derived correction factors used to adjust traffic volumes for effects of rainfall at the time the sampling was done.
Kw, Kwp = vehicle and pedestrian day-of-week empirically derived correction factors used to adjust traffic volumes for the day of the week on which the sampling was done to a weekly average.
STF = seasonal trend factor used to adjust the measured daily traffic volume to the average level during the one to four month litter build-up period. Derived from U.S. Department of Transportation data for the state.
RNAA = rain adjusted average or the percentage of days in the litter build-up period prior to survey sampling in which .05 or more inches of precipitation occurred.

Income Adjusted Buying Power (INCA)

INCA = MHI*IAF

Where: MHI = median household income for census tract, city etc.
IAF = income adjustment factor for correcting of census income data for state-to-state differences in the cost of living.

Occupants Per Vehicle (OPV)

OPV= (n1+n2*2+n3*3.416) / (n1+n2+n3+nu)

Where: n1 = number of vehicles counted with one occupant
n2 = number of vehicles counted with two occupants
n3 = number of vehicles counted with three or more occupants
nu = number of uncovered or open bed vehicles
3.416 is an empirically derived constant used to estimate average number of persons in a vehicle observed with 3 or more occupants

Percentage of Open Bed Vehicles (POBV)

POBV= nu / (n1+n2+n3+nu)

Where: n1 = number of vehicles counted with one occupant
n2 = number of vehicles counted with two occupants
n3 = number of vehicles counted with three or more occupants
nu = number of uncovered or open bed vehicles

The output from Form 3b contains a listing of all site output data plus the locale average and standard deviation of PVIM raw. This output data from Form 3b provides input into Form 6a, Form 8, Form 9 and Form 13. In addition, the averages of the output variables for four separate sub-categories of sites were calculated to make comparisons, as follows:

- Sites identified as being adopted and those not adopted;
- Construction vs. non-Construction sites;
- Downtown Commercial vs. Other Commercial;
- Beach/Waterfront vs. Other Public Facilities;
- The SRS (Landfill access route) sites.

INCOME DATA (FORM 4)

Income level is one of the key variables affecting litter rates on urban streets, as identified by a Multiple Linear Regression Analysis of 15 prior surveys conducted between 1978 and 1991. (See: Institute For Applied Research report S-8.16, *Analysis of Variables Affecting Litter Rate*, January, 1998). In this analysis, Median Household Income (MHI) was selected as the measure of income level. However, because some of the surveys used in the correlation were prior to 1990, a regression analysis was run between litter rates and the 1980 median household income (adjusted for buying power), along with other variables.

In developing the coefficients for neighborhood income, the 1980 census data was used for the fifteen surveys analyzed regardless of the survey year. Such a standard is necessary to measure the relationship of litter rate to the relative neighborhood wealth, not the actual income that tends to increase over time. Over time, incomes have tended to increase throughout the U.S. Using the income level of a standard year like 1980 gives valid results even if the survey was done in 1978 or 1985. Over longer periods of time, however, some regions (larger urban counties, for example) tend to have greater percentage increases than the state average. Smaller population counties, small cities and remote rural areas tend to have below average increases in income. To get an improved measure for relative neighborhood income for years after 1985, while still preserving the same average level as the 1980 census, it is necessary to adjust the 1980 income level up for individual census tracts and cities. This was done in Form 4 in the following manner:

1. Group the urban street sites into at least two groups according to county population size.

2. Obtain the 1980 and most recent census value for each census tract, city or town where

urban street sites were located.

3. Calculate the average 1980 and most recent MHI values for each of the two groups.

4. For each group, multiply the most recent value for each site by the 1980 group average and divide by the most recent group average.

The result is the 1980 MHI value for each site used in the analysis that is corrected for relative differences in income changes between 1980 and most recent data.

WEATHER DATA (FORM 5)

Prior research has shown that weather has a significant effect upon litter rates. (See the Institute For Applied Research Report A-17, *The Effect Of Rainfall And Temperature On Litter Rates,* Rev. Oct. 1999). This report shows that litter rates decline with increasing rainfall and increase linearly with temperatures up to 75 degrees F., after which they decline. Because rainfall and temperature during the period prior to the survey significantly affect behavior, including how many people have been outdoors or driving with car windows down, it is necessary to obtain weather data for the period during which the litter accumulates at a given site prior to a survey. Therefore, weather data was collected for a period of over 100 days prior to the start of the New Jersey 2004 survey. Report A-17 also showed that build-up periods varied among locales. These periods ranged from 37 days for most urban street sites to 81 days for urban freeways and vacant lot frontages, to 116 days for rural roads and freeways. These findings were applied using Form 5.

Weather Station Selection

For the New Jersey 2004 survey, the weather data was obtained from ten weather reporting stations chosen to be representative of the county and region where the litter survey sites were located. The station closest to the survey sample site was chosen. The climatological information that was required for each weather station included:

- Daily maximum temperature in degrees F;
- Daily total precipitation in inches.
- The number of days with precipitation of 0.05 inches or more.

The weather stations selected for the New Jersey 2004 survey are shown in Table B-6. All the data from these stations were obtained from the National Oceanic and Atmospheric Administration (NOAA). If sites in a region are sampled more than three days after the first date of sampling, a new period of 116 days prior to the second sampling was calculated.

Table B-6

New Jersey Weather Stations		
Station #	**Station Name**	**Counties Covered**
1	Aeroflex-Andover Airport	Warren / Sussex
2	Atlantic City International Airport	Ocean / Atlantic / Cape May
3	Newark Liberty International Airport	Morris /Essex
3b	Newark Liberty International Airport	Hudson/Union
4	Millville Municipal Airport	Salem
4b	Millville Municipal Airport	Cumberland
5	Somerset Airport	Somerset / Hunterdon
6	Teterboro Airport	Passaic / Bergen
7	Trenton Mercer Airport	Middlesex / Monmouth / Mercer
8	South Jersey Regional Airport (Mount Holly)	Gloucester / Camden / Burlington

Weather Data Processing

Once the weather data was acquired it was entered into the weather database sheet for Form 5. The appropriate accumulation period for the different locales varies, therefore, rainfall, temperature and the number of days with rain was indexed in the database sheet for different periods prior to the start of sampling, as shown in Table B-7. This data was brought into Form 5 for calculations.

Table B-7

Weather Data Periods By Locale		
Locale Group	**Locales**	**Accumulation Periods**
Rural	RFT, OSR and RLR	1 to 30 days 31 to 60 days 61 to 116 days
Urban – Group 1	UFT and VIU	1 to 30 days 31 to 60 days 61 to 81 days
Urban – Group 2	COM, PUB and RES	1 to 30 days 31 to 37 days

Form 5 calculated an index of average rainfall and average maximum daily temperature (IRT), and percent of days with at least a half-inch of rain and over during the build up period (RNAA). Form 5 then calculated the weighted average IRT and RNAA of the three periods. (The weighting factors reflect the estimated percent of litter found at the day of sampling that was deposited in each prior period.) The process was repeated for all weather stations and for each locale group where one or more sample sites were located. The data then was transferred into Form 3b.

LITTER COMPOSITION (FORM 6A, 6B)

During the field survey, the litter composition data was collected manually and transferred to computer versions of Form 2a and Form 2b. Form 2b was sorted by locale and linked to Form 6a for analysis. These two spreadsheets are included in a single Excel workbook. For each of the 22 basic product or packaging components, this form calculated the percent of the total visible items counted at each site. The locale arithmetic average (Xi) percentage for each component was then calculated by summing the Xi component percentages for all the sites in a locale and dividing by the number of sites.

The total raw visible litter rate (PVIMraw) for each site calculated in Form 3b was linked and transferred to Form 6b. Then, by multiplying each site's litter rate (PVIMraw) by the Xi % of each component, the visible litter rates for each component at a site were derived. These component litter rates for all sites in a locale were then summed and divided by the number of sites to obtain the rate weighted average component litter rates (Xr) for the locale. Dividing each of these component rates by the locale average total visible items per mile yielded the locale weighted average percentage (Xr).

Experience has shown that this rate weighted locale average percentage (Xr) is superior to the simple locale arithmetic average of the site percentages (Xi) because it is less subject to distortion by sites that have a small number of items. It is also better than the pooled average percentage (Xp) which is derived by pooling all the items from all the sites and calculating percentage of each pooled component of the grand total. This Xp can be distorted because it gives undue weight to sites with large numbers of items.

Both the locale average Xr component percentages and the subgroup component percentages were used as input for Form 8.

DERIVATION OF CONSTANTS AND COEFFICIENTS (FORM 7)

Constants are values used in data reduction calculations in Form 3 and Form 9 that remain the same for a given locale or locales, but vary from one survey to another. This is opposed to variables such as site litter rates, traffic volumes, miles to city, etc. that vary from site to site. Table B-8 shows the constants and their sources.

Table B-8

Constant or Coefficient			
Constant or Coefficient	Abbreviation	Source	Applicability
Seasonal trend factors	STF	Form 7a	State
Locale weighting factors	LWF	Form 7b	State & U.S
Before period average daily vehicle traffic	BEDT	Form 7b	State & U.S
Before period average daily pedestrian traffic	BEDP	Form 7b	State & U.S
Income adjusted for buying power	INCA	TABLE 7A	State & U.S
Index of temperature and rainfall	IRT	TABLE 7A	State & U.S
County population (state average)	COPOP	Form 7d	State
County population (average for all states in U.S.)	USCOPOP	TABLE 7A	U.S.
Occupants per vehicle	OPV	TABLE 7B	State & U.S
Miles to city	MTC	TABLE 7E	State & U.S
Litter program year	LPY	Form 7e	State & U.S

The derivation of these coefficients is discussed in Institute for Applied Research report S-8.16, *Analysis of Variables Affecting Litter Rates*, January, 1998.

LITTER COMPOSITION CALCULATIONS (FORM 8ABC)

Form 8a took the weighted average component percent (Xraw) for each locale from Form 6 and weighted them by the locale average litter rates calculated for baseline, state average and U.S. average conditions in Form 9. This weighting by rates corrected to different conditions of traffic, weather etc. adjusted the percentages and rates to more accurately reflect actual baseline, statewide or U.S. litter composition. The form also calculated the separate component percentages and rates for urban and rural locales. This was useful in presenting survey results in reports because of the significant differences of litter composition and control program effectiveness between the urban and rural locales.

Form 8 first combined the following beverage component percentages into a single “Beer and Soft Drink” category: Beer Bottles, Beer Cans, Soft Drink Bottles and Soft Drink Cans. The following other beverage categories were combined into a single “Juice/Wine/Liquor/Other” category: Glass Water Bottles, Plastic Water Bottles, Glass Wine Bottles, Glass Liquor Bottles, Plastic Sports Drink Bottles, Glass Sports Drink Bottles and Sports Drink Cans.

Form 8c then combined and consolidated the twenty-one basic product composition percentages from Form 8a into ten more basic summary sub groupings. The conversions were shown in Table B-9.

Table B-9

Grouping Of Basic Products Into Summary Sub-Groups	
Summary Sub Groupings	**Corresponding 21 Basic Product Groups**
Beverage containers and other packaging	Beer & soft drink containers
	Juice, wine, liquor, other beverage containers
	Bottle caps, crowns, seals
	Pull tabs
	6 ring binders, 6 pack cartons, labels
Takeout food, packaging, cups and napkins	Cups, lids, straws and straw wrappers
	Take out food pkg.; boxes, trays, clamshells
	Napkins, bags, utensils, napkins, tissue, ice bags
Candy, gum, and snacks	Candy, gum, and snacks
Tobacco products and packaging	Tobacco products and packaging
Toiletries, clothing, toys, recreational equipment	Toiletries, clothing, toys, recreational equipment
Vehicle debris, parts packaging, oil pkg.	Vehicle debris, parts packaging, oil pkg.
Building materials, debris and miscellaneous paper	Building materials, debris and miscellaneous paper
Miscellaneous paper, and cartons	Miscellaneous paper, and cartons
Miscellaneous plastic metal and glass	Miscellaneous plastic
	Miscellaneous metal and foil
	Miscellaneous glass and ceramic
Newspaper, advertising, other food, yard trimmings & Other	Newspapers, magazines and books
	Advertising signs, business cards, leaflets
	Other home food packaging and remnants
	Yard trimmings
	Other

CORRECTION OF LITTER RATES TO STATE AND U.S. AVERAGE CONDITIONS (FORMS 9 A,B,C)

These three forms: Form 9a, Form 9b and Form 9c, are very similar. They each correct the raw Litter rates, PVIM, as follows:

- Form 9a, corrects to the conditions of prior surveys;
- Form 9b, corrects for statewide average conditions; and
- Form 9c, corrects for United States average conditions.

Form 9a was not used for the New Jersey 2004 survey because there was no prior survey using comparable techniques. This made it impossible to ascertain how litter has changed over time in New Jersey. However, comparisons can be made of how the statewide average rates differ by locale category, and how the litter in New Jersey compares with the U.S. average. This correction process eliminates the effects of changes or differences in weather, traffic volume, incomes, population totals, and other variables that have been shown to affect litter rates.

Correcting Raw Data to Base, State Average or U.S. Average Conditions

The first step in using these forms was to transfer the constants, by linking the spreadsheets that reflect the statewide or U.S. average conditions listed in Form 7. The coefficients were input, and the raw litter rates (locale averages from Form 3b) were inserted.

The form then made the appropriate corrections using the following formula:

PVIMst = PVIMcu+ ((BEDTcy-BEDTst*CBEDT) +((BEDPcy-BEDPst)*CBEDP) +((INCAcy-INCAst)*CINCA) + ((IRTcy-CIRTst)*CIRT) + ((CoPopcy-CoPopst)*CCoPop) +((OPVcy-OPVst)*COPV) +((MTCcy-MTCst)*CMTC) + ((LPYcy-LPYst)*CLPY)

Where PVIM84 = Current Locale average litter rate corrected to state average survey conditions.
PVIMcu = Current Locale average litter rate
BEDT= Before period average daily vehicle traffic
BEDP= Before period average daily pedestrian traffic
INCA = Income adjusted for buying power
IRT = Index of temperature and rainfall
COPOP = County population
OPV = Occupants per vehicle
MTC = Miles to city
LPY= Litter program year
and suffix cy = current year (2001) conditions
suffix 84 = base year (1984) conditions
and CBEDT, CBEDP, CINCA, CIRT, CoPop, COPV,CMTC,CLPY = coefficient from MLR analysis.

Similar formulae were used to correct the current PVIM to U.S. conditions. These current corrected rates were then contrasted with the original base survey rates and the U.S. average rates.

Correcting for Observer Differences

After the raw litter rates for the eight locales were corrected to the 1984 state average or U.S. average conditions, they were multiplied by a set of observer correction factors that adjusted the observations to a standard detection level so results could be compared with other surveys conducted by different observers.

Calculating Weighted Average for Locale

The final litter rates for each locale were then weighted by each locale's weighting factor to derive a "bottom line" weighted average. The locale weighting factors, derived in form 7b, reflected the differing amounts of time that street and highway users spend in the various locales. This estimate of exposure to litter was based on a combination of mileage and vehicle travel data from the U.S. Department of Transportation publications combined with speed, occupancy and pedestrian volume data from the 2001 survey and prior Institute studies.

These results were then used in Form 6 and Form 8 (litter composition), Form 10 (targeting), and Form 13 (accuracy).

CORRECTIONS FOR CONTROLLED VERSUS UNCONTROLLED SITES (FORMS 9 E, F, G, H)

Further analysis was made to compare litter rates within the state by contrasting control sites that had been adopted or were within KAB jurisdictions with those that have not been subject to litter control efforts or measures, etc. Note that in these comparisons, the locale weighting factors used to weight both the control and non-control locale average rates were based on the number of samples taken in the control jurisdictions. Thus the bottom line weighted average for both control and non-control jurisdictions reflect the mix of samples taken in control jurisdictions. This departure from using the exposure weighted average was necessary because in most comparisons there were some locales in control jurisdictions that had no samples.

TARGETING ANALYSIS (FORM 10)

Form 10 was used to combine the litter composition data from Form 8 with acts of littering data from prior studies that showed the distribution of age groups associated with different kinds of litter. The resulting analysis made it possible to identify the age groups that were causing the preponderance of deliberate and accidental litter in both urban street and freeway / rural road locales.

In using Form 10, the average percent composition data for freeways, rural roadways, and urban street locales was transferred from Form 8. Similarly, the litter rates (corrected to state average conditions) were transferred from Form 9b.

The "Observed acts of Littering In Other Surveys, By Age Group" data had already been installed in Form 10. It was derived in Table 10a from 314 observed acts of littering where both the object littered and the age groups of the litterer, by locale category, were identified during

other litter surveys. Form 10 then combined the current survey composition data with this age distribution data from other surveys to produce a profile, by product group, of the age of persons associated with the littering of that product.

Form 10 results provided the basis for a targeting analysis section of the survey report. As such they provide some of the most important information gleaned from the survey.

SUMMARY OF ILLEGAL DUMPS & ABANDONED VEHICLES (FORM 12)

Form 12 is used to update summaries of sightings of illegal dumps and abandoned vehicles during prior litter surveys. Additions of the following data from a survey are made to Form 12.1 in the appropriate Litter Program Duration Group:

[1] Number of visits per survey. (This was 1 for visible surveys, 2 for surveys where two visits were made to pick up both fresh and accumulated litter)

[2] Survey name and year. Year MUST be at least two digits.

[3] Total number of miles driven during the survey. This includes miles between sites as well as side trips, visits to client, etc. (Available from Form 2a daily totals)

[4] Number of illegal dumps encountered from Form 2c.

[5] Number of abandoned vehicles encountered from Form 2c

The analysis then proceeds by calculating the number of sightings per 1,000 miles driven and then calculating the inverse; miles between sightings of illegal dumps and or illegal vehicles (No sightings of illegal dumps or abandoned vehicles were made during the 2004 New Jersey Survey).

Form 12 sorted the survey data into subgroups according to the duration of the litter program in the state being surveyed. It also performed a sub-analysis, splitting the surveys into two groups: those prior to 1985 and those in 1985 and following years.

CALCULATION OF SURVEY ACCURACY AND OPTIMUM SAMPLE SIZE (FORM 13)

Form 13 was used to calculate the accuracy of the survey results. The results from Form 3b that show the average and standard deviation of the raw litter rate (PVIM) for each locale were input into Form 13a along with the number of samples in each locale and the locale weighting factor (LWF). The program calculated the + or - 95% confidence limits for the weighted survey average, which are commonly referred to as the “accuracy” of the results. It also calculated the accuracy for each locale average, as well as the rural and urban sub-averages.

The calculation of survey accuracy required transferring results from Form 3b, including the sample size, locale average, and locale standard deviation for the litter rate for each locale. The locale weighting factors (LWF) from Form 7b were also entered. The program then calculated

the weighted average of all the locales combined, the standard error of the data, and the equivalent degrees of freedom. The program then looks up the associated “t” value for degrees of freedom and prints out the + or - 95% confidence interval for the weighted average of all locales. It also calculated similar confidence intervals for the urban and rural weighted sub-averages and the un-weighted individual locale averages.

The results showed the overall total litter rate had accuracy (95% confidence intervals) of 8.6% and the Urban Street subtotal of 5.1%. Because of the smaller number of samples, the accuracy of the freeway/rural roadway subtotal was 15.1%.