EXAMINING SOLID WASTE MANAGEMENT ISSUES IN THE CITY OF BRYAN

A Dissertation

by

DHANANJAYA MARIGOWDA AREKERE

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

December 2004

Major Subject: Agricultural Economics

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Approved as to style and content by:

James W. Mjelde (Chair of Committee)	Robert B. Ditton (Member)
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ABSTRACT

Examining Solid Waste Management Issues in the City of Bryan. (December 2004)

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Economic aspects of household recycling behavior and attitudes in City of Bryan are examined to improve solid waste management policies in the city. Using survey data collected by mail and personal interviews, residents' attitudes towards solid waste management are analyzed, in general, and specifically, the factors influencing recycling behavior examined using logistic regression. In addition, three alternative policies are presented to respondents. First, support for an additional drop-off recycling center (Policy I) is examined. Second, WTP for two different recycling programs, curbside recycling service (Policy II), and curbside recycling with a drop-off recycling center (Policy III), as a function of socio-economic factors thought to influence WTP are computed using contingent valuation method, an indirect valuation tool. Finally, preference for a particular policy among the three alternatives presented to the residents of Bryan is explored. Because of the different data collection modes and assumptions on the bid prices two logit models are estimated to examine recycling behavior, and Policy I and two multinomial logit models for the most preferred policy, whereas four logit models are estimated for Policy II and III.

The estimated models are similar both within the Policies and between the Policies in terms of the affects of variables, significance of coefficients, and consistency with previous studies indicating a potential set of factors that can be used to explain WTP for recycling services. Bryan residents that are female, white, employed, have higher incomes, have children, own a house, and are self-perceived environmentalists tend to recycle more. Similarly, males, non-whites, older respondents, students, non-environmentalists and non-recyclers are more likely to support an additional drop-off center. WTP for Policy II is positively influenced by males, whites, respondents who are employed, low-income respondents, environmentalists, non-recyclers, and those who support Policy I. In comparison, WTP for Policy III is positively influenced by females, whites, respondents who are employed, younger respondents, environmentalists, non-recyclers, and those who support Policy I. In the case of both Policies I and II, the bid price negatively influences WTP as expected. While the WTP for Policy II is slightly higher than the estimated cost of a curbside recycling service ($2.50), the WTP for Policy III is lower than the estimated cost. No consistent pattern emerges across most of the coefficients and the four possible alternatives, three proposed policies and the current situation. However, probabilities computed using the multinomial logit results is the highest for Policy II, followed by either Policy III or no change to the existing solid waste management policy.

For

My Parents and Mentors

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I would like to express my sincere appreciation to my advisor, Dr. James W. Mjelde. During both my master's and doctoral programs Dr. Mjelde was a constant source of support and motivation, taking my side in spite of my repeated, disappointing failures. His interest in improving my research, the format, style, and contents and particularly, his meticulous editing have resulted in the improved quality of this otherwise run of the mill dissertation. I would also like to thank the members of my committee, Drs. George C. Davis, Richard T. Woodward and Robert B. Ditton, for their advice and assistance, and especially for their cooperation, and patience. I am forever indebted to Dr. Mjelde, my committee chair, and my committee members for not giving up on me and giving me chances and big breaks. Special thanks to all my teachers, Dr. David Leatham, and Dr. Gene Nelson for their assistance and counsel. Gratitude must also be extended to students, Jason Due, Shannon James, Stacey James, Courtney Williamson, and Monica Wofford, who assisted with data collection and compilation.

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of thanks to my wife Asha for standing by me despite my flaws and failures, being a source of strength, and precluding me from becoming a professional student.

Writing this dissertation is a process of documenting ideas; sometimes new, many times not. I have tried to remain original in my efforts giving credit where due. I apologize for not giving credit to those who developed ideas and concepts used herein. This is simply an oversight. As always, all errors in this dissertation are my sole responsibility.

TABLE OF CONTENTS

CHAPTER Page

LIST OF FIGURES

LIST OF TABLES

TABLE Page

TABLE Page

TABLE Page

CHAPTER I

INTRODUCTION

Solid waste management (SWM) is an important issue facing municipalities (U.S. Environmental Protection Agency (U.S. EPA) 2002). Most SWM strategies designed and implemented by municipalities around the nation follow for the most part the waste management hierarchy developed by the U.S. EPA (1989). This hierarchy includes decreasing waste generation at the source (source reduction strategies) and increasing resource recovery (recycling and composting programs), thereby decreasing the amount of waste disposed in landfills and through incineration. Households are being offered alternatives to conventional disposal methods, such as recycling programs, to alter their waste disposal behavior. These efforts have led to mixed results (Ackerman), partially because the marginal cost of waste disposal for many households is close to zero (Fullerton and Kinnaman; Kinnaman 1994, 2000; Jenkins; Wertz).

In addition, most SWM activities, such as waste collection, disposal and collection of recyclables, are centralized. Because of the centralized nature of SWM, well-developed recycling markets are non-existent in most communities. Further, depressed demand for recycled products has contributed to the under-development of markets for recyclables; prices have been very low (Ackerman). Appropriate economic incentives and price signals, therefore, do not exist for households to alter their waste disposal behavior when there is no incremental increase in cost of disposing additional waste. Given this nature of SWM, questions relating to the type of recycling program that will yield the best recycling rates persist.

This dissertation follows the style of *American Journal of Agricultural Economics*.

Many cities around the nation, including the City of Bryan (henceforth Bryan), Texas, have made voluntary commitments to increase recycling rates. Bryan, for example, set a target of achieving a 40 percent recycling rate by the year 2000 when it became part of the Clean Cities initiative in 1998. Despite various efforts, recycling rates in Bryan remain low. In 1999, only about 20-25 percent of the residential solid waste was either composted or recycled (Snider). Bryan currently does not operate a curbside recycling collection service. A pilot curbside program, which was operated for three years beginning in 1991, was discontinued because it did not yield the required participation or recycling rates. Bryan, however, does operate a drop-off recycling center that is subsidized by the municipality (Snider). Many other communities also operate successful recycling programs, including curbside pick-up service (Ackerman; McClain).

The success of centralized recycling programs depends on high participation rates, high recycling rates, and / or a combination thereof. Determining the various levels of participation and recycling rates before a program is implemented is difficult if not impossible. Alternatively, the feasibility of a program may be assessed by undertaking a cost-benefit analysis of a program or policy using market data, a revealed preference method. This is difficult to undertake for recycling programs because of the centralized nature of the programs, rudimentary nature of the recycling markets, and the non-market nature of many of the recycling benefits. Despite the lack of well-developed markets for recycling, there exists a tendency among some households to recycle; there is a demand for recycling. But, as previously noted, assessing the demand is problematic. This is one problem facing solid waste division of Bryan. There are, however, solutions to this problem. One such solution is to use indirect valuation tools to assess the willingness-to-pay (WTP).

WTP can be estimated directly using expressed preference methods, like contingent valuation method (CVM), even in the absence of market data. Such indirect evaluation techniques can and have been used to estimate a WTP for recycling (Aadland and Caplan; Huhtala; Lake, Bateman, and Parfitt; Stock; Tiller, Jakus, and Park). This study uses CVM to estimate WTP for two different SWM policies in Bryan, in addition, to characterizing recycling behavior and examining the most preferred policy.

Objectives

The primary objective of this study is to analyze economic aspects of household recycling behavior and attitudes in Bryan to improve its SWM policies. To achieve this broad objective, three sub-objectives are addressed. First, residents' attitudes towards waste management and recycling, factors influencing recycling behavior, and support for an additional drop-off recycling center are examined. Second, WTP for two different recycling policies as a function of socio-economic factors thought to influence WTP are determined. Finally, preference for a particular policy among the three alternatives presented to the residents of Bryan is explored. Information on household demographics, solid waste and recycling related attitudes, and WTP associated with recycling programs was obtained using mail and on-site surveys. CVM, an indirect method of valuing goods and / or services, is used to estimate the WTP for different recycling policies.

Although similar studies have been undertaken, there are four contributions this study makes to the existing knowledge of recycling behavior and valuation of alternative recycling programs. First, WTPs for different recycling programs using survey data are estimated, instead of just estimating a WTP for a single recycling program or for a disposal

and / or recycling option. Second, in addition to WTP questions, respondents were given the opportunity to choose the program they most prefer from four alternative policies. No previous study has examined if respondents prefer other recycling programs when eliciting a WTP for a particular program. Third, information regarding recycling benefits and costs is provided to familiarize respondents with the contingent commodity for which a WTP is being estimated. Arrow et al. emphasize the importance of providing relevant and adequate information regarding policy or good being valued, especially when respondents are likely to be unfamiliar with the policy or good. Fourth, the impact a transitory population, college students, may have on SWM, in general, and on WTP for recycling programs, in particular, are examined.

Dissertation Organization

The dissertation consists of six chapters. An introduction to the dissertation is presented here. In Chapter II, brief reviews of SWM, recycling, contingent valuation, and WTP for recycling literature are presented. Chapter III contains a discussion on methodology used in conducting the survey and estimation procedure used to obtain the objectives of the dissertation. Findings of the study are presented in two chapters. In Chapter IV, summary statistics of the survey data are presented. Estimation results of the recycling behavior, referendum on an additional drop-off recycling center, WTPs for the two different recycling programs, and of the most preferred policy are presented in Chapter V. In Chapter VI, a summary of the research, implications for policymaking, limitations of the study, and ideas for further research are presented.

CHAPTER II

LITERATURE REVIEW

As recycling is becoming more widespread and popular, it is leading to substantial amounts of waste diversion (U.S. EPA 2002). The number of recycling programs, and the type and quantity of recyclables recovered has increased steadily. Publicly sponsored recycling programs, such as curbside recycling and drop-off centers, still remain the most prevalent type of recycling programs. Privately operated recyclable collections, such as buy-back centers, deposit-refund programs (bottle bills), and volunteer recycling collection centers, although many predate curbside recycling programs, have yet to lead to sizable waste diversions (Ackerman). A majority of communities in the U.S. continue to have a fixed disposal fee and operate publicly supported recycling programs (U.S. EPA 2002). Thus, the nature of publicly sponsored programs and motivations to participate in such programs are the focus of the discussion here. Further, the economics of estimating a willingness-to-pay (WTP) for recycling programs given the nature of the programs and the underlying motivations to participate are presented. Specifically, three aspects of recycling are discussed in the succeeding sections: (i) types and nature of recycling programs; (ii) the underlying motives of the private provision of recycling when private costs are usually greater than private benefits; and (iii) the WTP for recycling programs.

Recycling Programs

Municipal solid waste recycling, primarily post-consumer waste recycling, has been going on for many decades, albeit at a small scale (Strasser; Woodward). However, current trends in recycling differ both in scale (quantity recycled is higher) and in nature (more widespread).

Resource recovery began as a waste diversion mechanism to primarily conserve landfill space and reduce environmental risks. More recently, recycling has evolved to be symbolic of an environmentally sustainable way of living (Ackerman; Denison and Ruston; Waite). Recycling is more popular than fulfilling basic civic responsibilities according to Jerry Powell. He notes that recycling, "Is more popular than democracy," observing that more people recycled than voted in the general election during November of 1992 (Ackerman p. 8). Recycling programs being implemented by communities around the nation are increasing steadily (Ackerman; Texas Natural Resource Conservation Commission (TNRCC, renamed as Texas Commission on Environmental Quality, September 1, 2002) 1997; U.S. EPA 1998b).

Institutional focus on resource recovery is even more recent, beginning in the 1980s. Two contributing factors are the cost of landfill space, owing to space shortage, and growing environmental awareness, especially perceptions regarding environmental risks of landfilling. Two incidents drew citizen's attention to landfilling and prompted policymakers' to evaluate waste management policies. Two communities in the vicinity of closed landfills, Love Canal, NY, and Times Beach, MO, reported higher incidences of health ailments. The ailments were linked to closed landfills in the communities (Denison and Ruston; Levine; U.S. EPA 1982). Subsequently, both landfills were designated as superfund sites and added to the national priority list, Love Canal site in 1985 (U.S. EPA 1985) and Times Beach site in 1984 (U.S. EPA 1984). Additionally, the communities were relocated at considerable costs. Although the two sites contained hazardous wastes, landfilling generally evokes a negative response because of the associated environmental disruptions and adverse health effects (Levine). The U.S. EPA introduced stricter requirements for landfills to avoid

such incidents and ensuing expenditures. Attempts to reduce waste at the source and divert the amount going to landfills were also stepped-up.

Most SWM policies are aimed at improving diversion rates by recycling and composting. Illustrated in figure 2.1 are policy approaches to increase recycling and composting participation rates. Two broad categories are government regulations and voluntary programs. Government regulations are either to adopt a command and control (mandatory) approach or create incentive mechanisms. Command and control approaches stipulate certain activity or levels of activities to evoke desired outcomes. Incentives provide some encouragement to induce a certain behavioral outcome. Voluntary programs rely on households to provide recyclables and are sponsored by local governments or non-government entities. Government sponsored programs, the most prevailing of policies, provide recycling related services using public funds.

Mandatory programs offer a disincentive for non-recycling communities or households by taking legal or administrative actions against violators. The City of Bloomsburg, PA, for example, made recycling mandatory in 1983. Individuals failing to recycle can be sentenced to prison and / or have to pay a fine under this law (Pennsylvania Department of Environmental Protection (PDEP)). In 1988, the State of Pennsylvania enacted the "Municipal Waste Planning, Recycling and Waste Reduction Act" (Act 101) (PDEP). The Act mandates local recycling programs, county waste plans, and strengthens the environmental protection standards for new municipal waste facilities. Only large municipalities, over 10,000 people or more than 300 people/square mile, are subject to the law. Similarly, Wisconsin mandated recycled fiber (post consumer) content for newsprint requiring a 10 percent recycled content in 1992 which increased incrementally to 45

percent by 2000. Twenty-four newspapers and printers were fined for failing to meet the 35 percent recycled fiber content in 1997 (Raymond Communications).

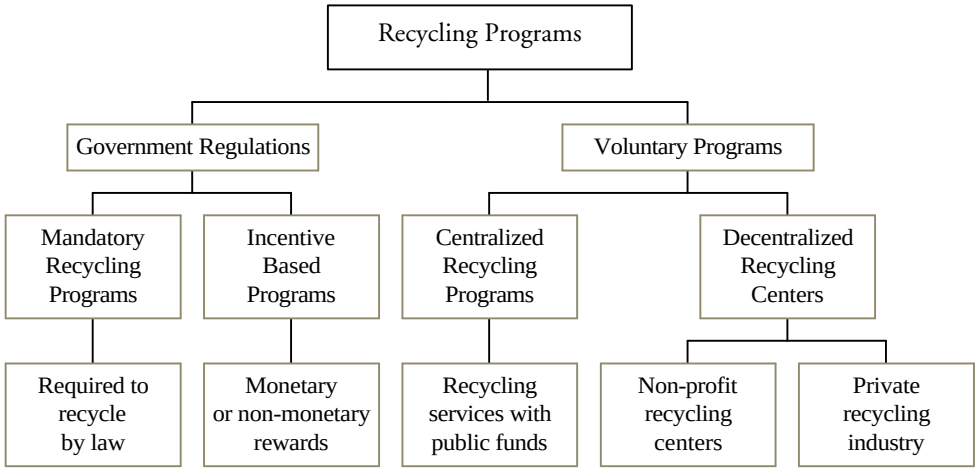

Figure 2.1 Recycling programs in the U.S.

Programs or legislation corresponding to the various policies outlined in figure 2.1 are presented in table 2.1 are examples of. Examples of command and control policies include mandatory recycling laws, procurement policies, minimum recycled contents, and packaging requirements. Incentives to recycle range from those with a broad approach, such as charging disposal fee for all products sold, to ones which are much narrower and targeted, such as deposit refund schemes for specific recyclables. Examples of policies based on incentives are deposit-refund schemes and unit-price garbage fees. Curbside and drop-off recycling centers can be operated by government or other entities.

The amount of recyclables (including community composting) recovered was estimated at 24 percent in 1999 (U.S. EPA 2002). There were about 9,250 curbside recycling programs reported to be operating in the U.S. serving nearly 49 percent of the

population in 2000 (U.S. EPA 2002). The estimated number of drop-off centers is 10,436 (Goldstein). Nearly, 30.1 percent (69.9 million tons) of the municipal waste was recovered in 2000 (U.S. EPA 2002). In Texas, there were an estimated 175 communities with curbside recycling programs and 140 with drop-off centers (TNRCC 1998). The total number of different recycling programs increased from 45 in 1990 to 250 in 1996, serving approximately 60 percent of the Texas population (TNRCC 1997).

Table 2.1 Types of Recycling Policies and Programs

Government Regulations		Voluntary Actions
Mandatory [Command & Control]	Incentive Based	
• Set Recycling Rates • Recycled Products Procurement • Policies (Purchasing Preferences) • Landfill Bans • Packaging Mandates • Newspaper Mandates • Mandatory Curbside Recycling. For ex. o Mandatory Source Separation & Recycling Act (NJ 1987) o Municipal Waste Planning, Recycling & Waste Reduction Act (PA 1988)	• Bottle Bill — Deposit-Refund Scheme • Tax Incentives • Pay-as-you-Throw • Volume-Based Fee • Variable Rates • Unit Pricing • Business Grants & Loans for Recycling related enterprises • Buy-Back Centers	• Drop-off Recycling Centers (community) • Drop-off Containers (offices, businesses, schools & universities) • Curbside Recycling • Formation of Recycling Coalitions (community, schools & offices)

Most current recycling programs are implemented and operated by local communities using public funds. Economically viable recycling programs generate net benefits in terms of achieving targeted diversion rates or revenues from sale of recyclables exceeding the cost of the program, while unsuccessful ones continue to depend on public funds. It is important to note recycling programs sponsored by public funds and operated by municipalities are especially likely to be inefficient (Fullerton and Kinnaman). For instance, curbside recycling programs that cost communities more than the net benefits (sum of net revenues and cost savings) can be a drain on public funds. One possible way to increase efficient levels of recycling is to establish market mechanisms that provide

incentives that promote recycling. A possible means of achieving this end is to pass legislation(s) akin to the bottle bill or deposit-refund scheme where administrative costs are lower than for curbside programs (Ackerman).

In 1997, there were nine states that had deposit-refund schemes or some variation thereof. Most states with deposit refund schemes have reported appreciable recycling rates (Ackerman; McClain). These programs, however, collectively account for only an estimated four percent of the total waste stream (U.S. EPA 1998b). Local governments, Ackerman notes, have not been very supportive of bottle bills because the impact they may have on local recycling programs. At worse, bottle bills eliminate the need for local recycling programs and at least, reduce revenues generated. Without such legislative initiatives to create some market mechanism for recycling, local buy-back centers are the only place households can sell their recyclables. Not only are prices of recyclables frequently changing, they are usually low, and more important, households have to store recyclables for a considerable amount of time to make their trip to buyback centers worthwhile. Additionally, providing incentives to recycle may not work when households face a solid waste fee that offers no incentive to minimize waste disposed.

Kinnaman (2000) argues most cost-effective incentives to recycle pale in comparison with the alternative of disposing. Because most households pay a flat fee for garbage disposal, the marginal cost of disposal is zero. Some communities are, however, experimenting with policies that simultaneously provide incentives to decrease disposal and increase recycling. One such approach is the "pay-as-you-throw" (PAYT) policy that attempts to not only internalize the costs of SWM, but simultaneously adopt a marginal cost pricing (U.S. EPA 1998c). The unit pricing program based in the PAYT approach,

charges households based on the amount of waste generated, volume or weight based (for various aspects about unit pricing systems and community experiences (see Miranda and Aldy; Miranda and Laplme; Miranda, Bauer, and Aldy). In 1999, nearly 4,033 communities in the U.S. had a PAYT program (U.S. EPA 2003). While waste disposed has decreased in majority of these communities, resource recovery rates have been mixed (Fullerton and Kinnaman).

Additionally, incentives provided by the U.S. EPA and state environmental agencies also prompt local communities to consider recycling programs of their own. In Texas, for example, TNRCC provided solid waste management implementation grants to various public entities considering waste reduction and diversion projects that are consistent with the regional SWM plans. The regional plans are prepared by Councils of Governments in Texas. Policies and programs implemented by the cities have to conform to these plans.

Both recycling programs and recycling rates across the U.S. and Texas are increasing. Government sponsored voluntary recycling programs such as curbside recycling lowers the private cost of recycling when compared to recycling at a drop-off recycling centers. Both recycling at drop-off centers or curbside are usually voluntary or private activities. Local governments only provide related services or access to facilitate the private provision without offering any explicit monetary incentives to households. In such instances, the monetary cost of recycling is typically higher than monetary benefits realized by households (Ackerman).

Recycling Behavior and Motives

Because monetary benefits, like earnings from selling recyclables, are rarely correlated with recycling behavior, it is important to recognize aspects regarding recycling behavior and monetary gains. First, while monetary benefits may not be correlated with recyclers' behavior, non-recyclers rank it as one of the reasons for not recycling (DeYoung 1989). Second, higher rates of increases in recycling are seen in the presence of non-monetary incentives than monetary incentives (Goldenhar and Connell). Third, states with "bottle bills" (deposit-refund schemes), where consumers pay a deposit for bottles and aluminum cans reimbursed upon return, have produced substantially higher rates of recycling (Ackerman). The second and third aspects are not of particular interest in the current context because the focus here is government sponsored voluntary programs such as curbside recycling and drop-off recycling centers that do not have built-in incentives. Curbside and drop-off centers rarely offer households explicit monetary incentives.

It is clear that despite the lack of monetary incentives, recycling at the curb and at drop-off centers has increased substantially. The underlying motives of such recycling behavior are of considerable interest. Oskamp and Vining, and Ebreo (1990, 1992) among others have attempted to characterize recycling behavior using a varied range of approaches. Most studies find individual's general environmental awareness and concerns to be correlated with recycling behavior (DeYoung and Kaplan; Gamba and Oskamp; McGuinness, Jones, and Cole; Nielson and Ellington; Oskamp; Oskamp et al.; Schultz, Oskamp, and Mainieri; Vining and Ebreo 1990, 1992).

In general, recyclers tend to be older, better educated, have higher incomes, possess a better understanding of recycling costs and benefits, and are better informed about local

recycling programs than non-recyclers. Additionally, a desire to conserve natural resources and energy are also found to be correlated with recycling behavior. Other crucial findings include the importance of personal satisfaction gained by recycling and the apparent lack of motivation to seek monetary gains (Davidson-Cummings; De Young 1989; De Young and Kaplan). Similarly, Hopper and Nielsen; Jakus, Tiller, and Park 1996, 1997; Kinnaman 2000; and Tiller, Jakus, and Park argue individuals derive utility from environmental protection provided by recycling. Given the general finding that individuals and / or households invest time and effort to undertake activities that have positive externalities, some authors have argued that recycling behavior is altruistic (Ackerman; Hooper and Nielson).

Willingness-to-Pay for Recycling

There are no well-developed markets for most recyclables in Bryan. Estimating a demand (WTP) for different recycling program, therefore, has to utilize an indirect economic valuation technique. Given the public nature of recycling benefits, the non-economic motives underlying recycling behavior, and the unlikelihood of private markets for household-level recycling developing any time soon, the most appropriate tool to use is the contingent valuation method (CVM) (for background information on CVM recycling studies see Arekere 1999). One elicitation mechanism currently being used is the dichotomous choice-with-follow-up (Mitchell and Carson). Not only is the DCFQ format easier for subjects to understand (Bishop, Champ, and Mullarkey), but it also may produce better estimates of WTP than open-ended questions (Hoehn and Randall). The Blue Ribbon Panel (Arrow et al.) and the Environmental Economics Advisory Committee (U.S.

EPA 1994) both recommend the use of the DCFQ format. DCFQ is superior to dichotomous choice questions without follow-up because DCFQ increases sample efficiently and the efficiency of estimation (Mitchell and Carson).

Estimation of a WTP for recycling programs using CVM has been undertaken previously (Aadland and Caplan (1999, 2003); Huhtala; Lake, Bateman, and Parfitt; Stock; Tiller, Jakus and Park). A discussion of these previous studies is presented below. The details of the studies are summarized in tables 2.2a and 2.2b. The first application of CVM to estimate a WTP for curbside recycling was undertaken by Lake, Bateman, and Parfitt in Hethersett, U.K. During the study period there was an ongoing pilot curbside recycling program in the region. Face-to-face interviews of 285 households were conducted to obtain their views on recycling and elicit a WTP. The authors note that the hypothetical nature of the good was minimal as the respondents were familiar with recycling activities. Additionally, motivated in part by the ongoing recycling program, the authors assume that the respondents had sufficient knowledge regarding the costs and benefits of recycling. A pre-test survey with an open-ended WTP question was used to determine the lower and upper bounds of the bids for the WTP question. A dichotomous choice (DC) format of framing the WTP question was chosen to minimize confusion. The added benefit of a DC format is that it ensures full acceptance and rejection at the lower and higher bounds. Nine bid levels ranging from £1 to £100 were used. Information regarding thirteen factors (that included demographic variables) was obtained to examine which factors influence the probability of paying for recycling programs. Three factors were eventually used in the estimation; the others were discarded because of multicollinearity.

Table 2.2a Contingent Valuation Studies Estimating a Willingness-to-Pay for Recycling

Authors	Recycling program and *mean WTP*	WTP question and elicitation mechanism	Description of recycling benefits and costs	Sample size and *population size*
Aadland and Caplan	Curbside service *$7.00*	"Would you be willing to pay $t for the service?" Follow-up question depending on response; higher bid price for a yes and lower bid price for a now.	None	876; *na*
Huhtala.	Recycling program *$14.00*[a]	"We said above that the best estimate currently is that either option will cost roughly the same. However, there is still some uncertainty about the costs of recycling. It is possible that recycling may end up costing a bit more, if, for example, the quality of sorted waste material proves adequate and its value as a raw material is low. Recycling may cost about FIM—per month (FIM—per year) per household, while incineration is likely to cost about FIM 40 per month (FIM 480 per year). Would you still vote for incineration instead of recycling, or would you now vote for recycling?"	Only cost of recycling to the household (described in terms of separation and storage efforts)	1166; *na*
Lake, Bateman, and Parfitt.	Curbside service $5.00[b]	Introduction regarding recycling programs followed by: "Would you be in favor of increased spending and therefore local taxes, in order to continue the recycling scheme?"	None	285; na
Stock	Curbside service $3.88	Suppose that a firm in Ogden institutes a curbside recycling service. The service would provide a large plastic bin in which to place your unsorted but clean recyclable materials and would pick up the materials from your curbside every other week. The service would collect plastic, glass, newspapers, tin, cardboard, magazines, catalogs, and aluminum (but you would not be required to put aluminum in the bins if you choose to sell it on your own). Would you be willing to pay $X per month for the service?	None	139; 64,000
Tiller, Jakus, and Park.	Recyclable Drop-off center $11.74—urban recyclers Combination of recyclable and garbage drop-off center $4.05—rural non-recyclers	Williamson County currently operates a county-wide recycling program. This system consists of 7 drop-off sites at convenience centers and 6 sites at other public locations. The county delivers the recyclable material to the local processing center where it is processed and sold to are buyers. The revenues received from the sale of material collect at each site are then given to a community group located near the collection site. Public funds are needed to maintain and operate this program. One way a county might provide such public funds is through a surcharge on each household's monthly utility bill. If a surcharge of $X per month were added to your utility bill in order to continue the current program, would you support such a surcharge?	None	481; na

a) Converted using an exchange rate of 1FIM=0.2USD of FIM70 per month in 2002.
b) Converted using an exchange rate of 1£=1.68USD of £35.69 per year ($59.95 per year or $5 per month).

Table 2.2b Methods Associated with Contingent Valuation Studies Estimating a Willingness-to-Pay for Recycling

		Data		Econometrics	
Source	Method	Place	Variables	Question Format	Estimation
Aadland and Caplan	Mail survey	Utah, USA	Reason for recycling (three levels), Recycler (binary), age (binary), male, education (four levels), Household Size, Environmentalist, Income (binary), Cheap talk (Hypothetical bias), Fee knowledge (three levels), bid price, and surety of response (three levels).	DBDC[a]	Maximum Likelihood Estimator (Non-linear optimization)
Huhtala	Mail survey	Helsinki, Finland	Income, Recycling experience, number of children, recycles paper, waste disposal not a problem, disposal a problem, old (over 65), close to incineration plant, difficult to chose between incineration and recycling, and confident about choice	DC[b]	Logit
Lake, Bateman, and Parfitt	Face-to-face survey	Hethersett, South Norfolk, U.K.	Bid price (log), and Recyclable Type (binary).	DC	Logit
Stock	Face-to-face survey	Ogden, Utah, USA	Currently Recycle, Recyclable Type, Recyclables Weight, Price of Recyclables, Age, Number of Children, Annual Earnings, and highe level of education completed (binary).	$DCQF_c$	Bivariate Probit
Tiller, Jakus, and Park	Mail survey	Williamson County, Tennessee, USA	Income, Education, Age, Recycling Helps, and Bid price	DCQF	Bivariate Probit

a) Double bounded dichotomous choice.
b) Dichotomous choice.
c) Dichotomous choice question with follow-up.

Results indicate that expressed WTP was associated with recycling patterns and income. Higher income households were not only more likely to pay for recycling programs, but were also likely to agree to higher bid amounts. Households that generated more recyclables and were already recycling four of the five recyclables considered were also more likely to pay. Interestingly, having a child also increased the likelihood of recycling and WTP. The mean WTP for curbside recycling was £35.69 per year ($59.95 per year at an exchange rate of 1.68 in 1994) or about $5 per month. Household's mean WTP estimate was close to what household in the ongoing pilot program was being charged (the authors did not indicate the precise amount being charged).

Similarly, a WTP for curbside recycling was estimated by Stock for Ogden, UT. Ogden operated several drop-off recycling bins across the city, but had no curbside program during the survey period. A telephone survey of 139 households was conducted. Respondents were briefed about the study, asked general questions regarding recycling, recyclable generation, their willingness to participate in a curbside program, and a WTP for the curbside service.

Households can sell recyclables at buyback centers and earn money. Thus, there may be households that have to be paid to pick up recyclables. In other words, it is likely that there exists a negative WTP for recycling. Indeed Stock allows for this possibility in the survey instrument. Respondents who declined to participate in the curbside service were asked a follow-up question regarding household's willingness to accept a payment for the recyclables. Respondents were older, more educated, and had more children than the general population. Results indicate age to be negatively correlated with WTP. Stock attributes the inverse relation between age and WTP to the fixed income of older

individuals. Stock conjectures that the WTP may be downward biased because of the large proportion of older aged respondents. The estimated the mean WTP was $3.88 per month.

An interesting aspect of Stock's study is the comparison between the expressed and actual payments and participation. Following the study, a voluntary curbside recycling program was implemented in Ogden. While the study predicted a 57 percent participation rate at $3.00 per month, the actual participation rate was approximately 0.78 percent at a monthly charge of $1.00. Stock attributes the discrepancy between the participation and estimated rates to four factors: (i) an initial start-up cost of $10 per recycling bin; (ii) a lack of publicity to inform and motivate households about the curbside service; (iii) an overstatement of WTP; and (iv) a non-representative sample.

Tiller, Jakus, and Park obtained WTP estimates for a drop-off recycling center in Williamson County, TN. At the time of the survey, there were seven attended centers accepting both garbage and recyclables and six unattended centers accepting only recyclables. Similar to Lake, Bateman, and Parfitt, the respondents were familiar with recycling programs. Information regarding the benefits and costs of recycling was not provided as the focus group and pilot survey participants indicated their awareness of the major benefits of recycling.

The WTP question, more elaborate than in previous two studies, included a description of the recycling services and a discussion noting residents needed to pay for the continuation of the service. Additionally, the WTP question included the statement, "The revenues received from the sale of material collected at each site are then given to a community group located near the collection site" (Tiller, Jakus, and Park, p. 313). This latter information was incorporated to explain the fact that revenues would be used locally

for a good cause and to test the impact of the donation mechanism on recycling behavior and WTP.

Estimated WTPs ranged from a low of $4.00 per month, for rural nonrecyclers to $11.74 per month, for urban recyclers. Tiller, Jakus and Park tested the significance of the influence of revenue donations on WTP by incorporating it as a dummy variable in their models. Results indicate that revenue donation did not induce respondents to express a higher WTP. It is not entirely clear how the authors used the dummy variable to examine the revenue donation information on WTP, because it appeared all the respondents were asked the same set of questions. Because they do not offer any additional information, nothing more can be said about their estimation procedure or outcome.

In contrast to the Lake, Bateman, and Parfitt; Stock; and Tiller, Jakus, and Park estimate WTPs for a drop-off center. The cost of operating a drop-off center is cheaper than curbside service (Ackerman). For instance, in Bryan the cost of operating a drop-off center is estimated to be approximately $0.30 per month per household compared to about $2.50 for curbside service (Snider). The mean WTPs for the curbside service from the Lake, Bateman, and Parfitt and Stock studies are close to each other ($5 and $3.88). Interestingly, the WTP for the drop-off center is higher for urban recyclers in the Tiller, Jakus, and Park study than for curbside recycling in the pervious two studies ($11.74). This is an anomaly of sorts given that the cost of operating a curbside recycling program for municipalities and the household cost, effort to store and transport, are higher, yet respondents perceive the benefits from the latter as being greater. One apparent explanation for the anomaly is the difference between the respondents' socio-demographic characteristics. Also, it is important to note the studies had different sets of explanatory

variables that may contribute to the differences. Variables common to the three studies are income, age, and education. Stock and Tiller, Jakus, and Park had an additional variable each beyond those used in Lake, Bateman, and Parfitt. The variables were number of children per household (Stock) and revenue from earnings (Tiller, Jakus, and Park). Alternatively, it is plausible that the higher WTP for drop-off center may be upward biased because of the revenue donation mechanism included in the question.

Another intriguing result obtained by Tiller, Jakus, and Park is the nearly three fold increase in WTP by urban recyclers over rural non-recyclers. Not only does the former group have to pay for garbage collection, they have to expend time, effort, and money to recycle at the drop-off recycling center. This is yet another paradoxical result given that urban recyclers obtain less service at the drop-off center compared to rural recyclers, who can drop both garbage and recyclables at the same place. Of the 13 drop-off centers at which on-site interviews were conducted, seven, all rural, collected both garbage and recyclables. Rural residents, therefore, did not have to make an additional trip to recycle, unlike urban residents recycling at the other six (recycle only) drop-off centers. The paradox, rural respondents were WTP less for more service, while urban respondents were WTP more for less service, may be explained in part by the income and education effect. Income was found to be insignificant for urban recyclers, but significant in the case of rural recyclers. Moreover, rural respondents' household income on an average is nearly one-half that of urban respondents. Education is significantly related to WTP for rural non-recyclers. Thus, the level of education and income, may help explain some of the discrepancy between WTP among rural non-recyclers and urban recyclers.

Huhtala evaluates the WTP for two waste disposal options, recycling and incineration, in Finland. A random sample of 2,000 households in Helsinki, Finland, yielded a total of 1,116 usable surveys. Respondents were asked if they preferred recycling or incineration and subsequently asked how much more they were willing to pay over current rates to implement their preferred disposal option. A discrete and double-bounded question format was administered. The mean WTP was FIM (Finnish Mark) 70 per month for recycling (equivalently $14.00 per month at exchange rate of 1FIM=0.2USD in 2002) and FIM 60 for incineration per month (equivalently $12.00 per month). All the explanatory variables, bid price, income, gender, number of children, difficulty of sorting and storing recyclables, confidence in recycling benefits, were found to be statistically significant.

Aadland and Caplan (1999) estimate a WTP for curbside recycling based on a survey of 401 residents in Ogden, UT, using an approach different from three previous studies discussed above. First, in addition to eliciting WTP for the curbside recycling program, Aadland and Caplan (1999) also obtain information on willingness to participate in a curbside recycling program. Second, the bid prices are assigned across the respondents in an ordered interval format rather than randomly. Third, Aadland and Caplan (1999) incorporate the responses to the willingness to participate in the estimation of WTP by following a recursive simultaneous system of equations approach. The estimated mean WTP is $2.05 per month and participation rate of 72 percent for the curbside recycling program. One of reasons for the lower WTP than the four previous studies discussed is the use of ordered interval approach to elicit respondents' WTP. Aadland and Caplan (1999) find that females, younger respondents, college-educated, respondents with high income,

recyclers, and respondents regarding recycling as a beneficial to the society are willing to pay the most for curbside recycling.

In a more recent paper, Aadland and Caplan (2003) also estimate a WTP for the state of Utah residents form a survey of 876 households. They use twelve explanatory variables to estimate the WTP model, one of the most comprehensive models to date. In addition to the socio-demographic variables they include three variables thought to motivate recycling, two variables to identify presence of drop-off recycling center in the area and capture recycling at the drop-off center, one variable to identify the degree of surety of response, and another to identify knowledge of the cost of a recycling program.

There are two methodological departures in Aadland and Caplan (2003) compared to previous studies estimating a WTP for recycling programs. Including a follow-up question to the double-bounded dichotomous-choice (DBDC) question to examine negative WTP for recycling programs is the first methodological departure in Aadland and Caplan (2003). Instead of the four possible valuations regions a DBDC question format yields, allowing for negative WTP values increases the valuations regions to five. Therefore, the authors use a nonlinear optimization technique to generate estimates using the (log) likelihood function as against bivariate probit for DBDC. The mean WTP estimated was $7.00 per month.

The second methodological departure deals with methods employed to detect and mitigate hypothetical bias, a limitation in CVM studies (see Arrow et al.; Diamond and Hausman). Bias can result because of the hypothetical nature of the environmental good being valued thus leading to a discrepancy between actual and expressed WTP. The authors compare the stated preference data obtained from households with recycling program to the

revealed preference data from households without recycling program to detect hypothetical bias. Results show that there is statistically significant positive hypothetical bias in the stated preference data, households without recycling program overstate their WTP. Second, Aadland and Caplan (2003) try to mitigate the bias by using a short-scripted statement (referred to as cheap talk) to remind a subset of the respondents that they are valuing a hypothetical recycling program and could misstate their true WTP. The authors find that such reminder statement is partially able to mitigate hypothetical bias.

The study to be undertaken in Bryan differs in several aspects compared to the previous studies. First, the study is designed to simultaneously estimate WTPs for two different recycling programs as opposed a recycling program (Aadland and Caplan (1999, 2003); Lake, Bateman, and Parfitt; Stock; Tiller, Jakus and Park), or recycling and disposal mechanism (Huhtala). One of the advantages is the resolution of ambiguity because of lack of information. A positive WTP for one recycling program does not imply that WTP for alternative recycling program is non-existent or is higher / lower than for alternative programs. A knowledgement of the WTP for the different recycling programs resolves some of the information paucity. Yet another advantage is the comparison of benefits of recycling programs a simultaneous estimation of WTP lends itself to.

Second, in addition to expressing their WTP, respondents are given an opportunity to indicate if they support a drop-off recycling center at no explicit financial burdens to households in addition to choosing the program they most preferred from the four policy alternatives, three proposed policy changes and the current situation. An expression of WTP for a particular program is neither necessarily indicative of a willingness to participate in the program nor a stated preference over all other alternatives because of potential

hypothetical bias in CVM studies (Arrow et al.; Diamond and Hausman; and Habb and McConnell). As noted earlier, since WTP includes both use and non-use values, respondents who may not participate in the program may also express a WTP. Hence, obtaining information regarding the range of residents' preferences regarding recycling programs is beneficial.

Third, information regarding the costs and benefits of recycling is provided in the survey to ensure that all respondents have adequate knowledge of the contingent commodity. In fact, studies examining recycling behavior find that recyclers are more environmentally sensitive, highly educated, and have better information regarding recycling benefits and costs (see DeYoung 1989; Nielson and Ellington; Vining and Ebreo 1990, 1992). Providing such information is useful for the respondents when valuing a non-market good or an unfamiliar contingent commodity (Arrow et al.). Including a comprehensive listing of benefits and cost of recycling prepares respondents to answer the valuation question more accurately.

Fourth, given the substantial student population in Bryan, an examination of the effect a transitory population can have on WTP for recycling is undertaken. A transitory population, compared to the resident population, may neither have a long-term interest in the SWM issues in a given city in general nor be willing to pay for policies in particular. This issue has not been explored sufficiently in the literature. It is possible to assume without prejudice that a transitory population imposes externalities on the resident population. For instance, a transitory population may neither minimize waste generation nor the amount of waste disposed since the garbage fee may not change sufficiently to affect their behavior in the short period of their residence.

CHAPTER III

METHODOLOGY

Changes in individual welfare represent benefits derived or costs incurred to obtain goods and services. Only when benefits gained by individuals are greater than the costs incurred, does a good have positive economic value. Goods sold in the marketplace are expressed in terms of individual's and society's willingness-to-pay (WTP), i.e., a demand for the good. True market goods, therefore, can be valued directly in terms of their prices and quantities sold. Welfare is then measured using a schedule of prices and quantities sold in the market.

Markets are rarely present for environmental goods and services. When prices of goods containing environmental services exist, the prices usually do not reflect the environmental component. In such cases, when well-defined markets are absent, alternative methods of valuations are used. One such indirect valuation technique is the contingent valuation method (CVM), an expressed preference method (Habb and McConnell; Mitchell and Carson). CVM is based on the assumptions that individuals have full knowledge of the substitutability between various goods and services, both market and non-market, and their preferences associated with the goods and services (Mitchell and Carson). Surveys are usually used to obtain information about the environmental goods and / or services. Individuals are asked to explicitly place values on environmental goods and / or their services.

The underlying premise of the CVM technique is that the WTP amounts stated by respondents correspond to their actual valuation of the good(s) and / or services. WTP among consumer to see a change in the quantity of good(s) consumed without any change in their welfare or utility is the essence of the analysis being pursued here. Estimating a

WTP for a recycling program yields, therefore, the maximum amount an individual will pay rather than have no program at all. A WTP can be estimated using a survey that describes the proposed recycling program and elicits the value individuals place on the specified change in the program(s). The provision of a recycling program is equivalent to a change in quantity. Such a change in welfare resulting from a change in quantity is given by the surplus measure, specifically compensating surplus (CS) (Freeman III).

Survey respondents are asked to indicate if they are willing to pay a certain bid amount in a closed-ended question format or express their WTP in an open-ended question format. CS can then be derived to reflect the change in income associated with a different level of a particular good that would leave his / her utility unchanged. Thus, CVM survey instrument yields CS for a quantity increase that can be represented in terms of a difference between two expenditure functions (Freeman III; Mitchell and Carson). In terms of expenditure functions, CS is given by:

(1) $CS = [e(p_0, q_0, U_0) = Y_0] - [e(p_0, q_1, U_0) = Y_1] = Y_0 - Y_1$

where $e(\cdot)$ is the household's expenditure function, p_0 is the price of the commodity, q_i represents the quantity consumed, U_0 is the level of utility, Y_i is the minimum income needed to maintain the initial or subsequent utility level, and i=0 or 1 represents the initial and subsequent levels. For the provision of a recycling program, CS is the household's maximum WTP for the recycling program while leaving the consumer's utility unchanged. If CS is positive, there exists a WTP for the recycling program, otherwise not.

In figure 3.1, the ordinary Marshallian demand curve (D), Hicksian compensated demand curves (H_0: before change in quantity and H_1 after change in quantity) are illustrated for a change in quantity, in this case a new recycling program. The shaded region

below the Hicksian compensated demand curve (H_0) represents the CS for a change in quantity. This is the region being estimated using CVM.

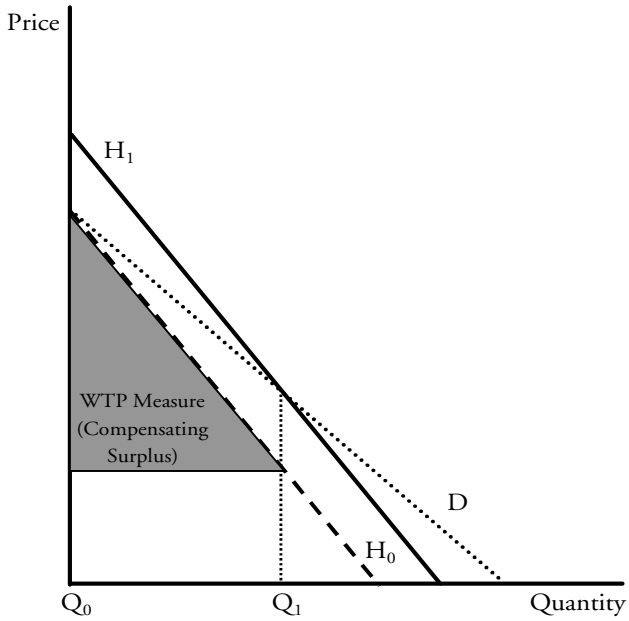

Figure 3.1 Welfare measure for the provision of recycling program

Survey Instrument for Bryan

Survey Setting

A survey of residents of Bryan, TX, is used to elicit a WTP for different programs. The survey was administered by mail to a randomly selected sample of Bryan utility household customers and using face-to-face interviews of residents using the drop-off center for non-hazardous recyclables. In 1999, Bryan operated one drop-off center for non-hazardous recyclables and two for hazardous recyclables.

Bryan is situated in Brazos County in central Texas. It is 32.3 square miles with a population of approximately 65,660 in 2000 (U.S. Census Bureau 2000). The student population in Bryan is of considerable interest to contrast preferences between the student and non-student populations. In Bryan, the 2000 census provides the following population distribution, 18 percent of the population was in the 18-24 years old category, typical college students' age. Two other age groups, under 18 years (27 percent) and 25 to 39 years (30 percent), make-up slightly more than half of Bryan's population. Females comprised of 50 percent of the population, while males constitute the rest. Nine percent of the population was 65 or older.

The average household size was 2.65 with 74 percent of the households having one or more children. Bryan has a diverse ethnic mix comprised of 52 percent whites, 28 percent Hispanics, and 17.5 percent blacks. The annual median household income of the Bryan was $31,672. Unemployment rate was 3.2 percent and the poverty rate 15.5 percent. Twenty-three percent of the residents had at least a high school (including equivalency) education, while 15 percent had a college education. Eleven percent had a graduate or professional degree.

Format of the Survey

The survey was in a booklet form with the following format: title/cover page; general information regarding the survey and terms used on the inside cover; two questions regarding solid waste management (SWM); demographic questions; questions related to SWM practices (with emphasis on recycling); 1999 situation; and the policy changes and

associated WTP questions. Appendix A contains the survey and the accompanying cover letter.

The three policy changes were examined. Policy I dealt with the establishment of an additional drop-off center. The question was framed to obtain a yes or no response, a referendum style format. Policies II and III were the establishment of a curbside recycling program and a combination of curbside recycling program and an additional drop-off recycling center. Both Policies II and III were WTP questions. The three policies were administered as mutually exclusive alternatives. Because a higher WTP does not necessarily mean that individuals prefer the associated policy, respondents were provided the opportunity to indicate their most preferred policy from the four options, the three proposed changes and the Current Situation.

The contingent commodity was described in the recycling benefits and costs, current situation, and policy changes sections. Specifically, the attributes of recycling (benefits and costs), availability of the service (curbside or drop-off), time and frequency of availability of service (weekly pick-up for curbside and hours of operation for drop-off), and likelihood of the policy change actually occurring (WTP and preference) were described. Both, the payment vehicle (utility bill) and the frequency of payment (monthly) are also explicitly identified. In addition, the decision-making unit responsible for the payment, the household, is clearly stated.

One problem of CVM studies is the incremental provision of the contingent commodity. That is will the description of the contingent commodity adequately inform the respondents regarding the quantity of the good provided? This is not an issue in the present context because the provision of recycling is not a divisible good, but rather binary

choice. Households either accept or reject the recycling service. Unlike many other environmental goods, recycling is usually not provided in incremental amounts.

The elicitation mechanism chosen is the dichotomous choice-with-follow-up question (Mitchell and Carson). Dichotomous choice questions may be easier for subjects to understand (Bishop, Champ, and Mullarkey) and, more importantly, may produce efficient estimates when compared to open-ended questions (Hoehn and Randall). Further, the dichotomous choice WTP questions are also found to be incentive compatible (Cummings, Harrison, and Rutstrom). The National Oceanic and Atmospheric Administration Blue Ribbon panel (Arrow et al.) and the Environmental Economics Advisory Committee (U.S. EPA 1994) also recommended the use of the dichotomous choice with follow-up format over other forms of elicitation mechanisms.

The prevailing SWM situation in Bryan is described under Current Situation before the three policy changes are outlined. Because the three policy options are equally viable, all three are included on each questionnaire, thereby reducing to some extent the hypothetical nature of the contingent commodity. Additionally, this format enables comparison of the WTP for different recycling programs.

Dillman and Zeisel both note the importance of creating an appropriate questionnaire structure and guiding respondents through the survey in a systematic manner. Zeisel suggests requesting information regarding general impressions and simple demographics in the beginning. It should be noted that Bradburn and Mason and Sudman and Bradburn do not find any significant impact of responses caused by question order. But, they do point out to the possibility of fatigue setting in if the questions in the

beginning are hard and / or lengthy. Given that the WTP questions are relatively lengthier than the other questions, they are placed towards the end of the questionnaire.

Demographic information plays a crucial role in the estimation and discussion of WTP results. Moreover, they are relatively easier to answer because of the respondents' familiarity with such information. At the same time, it is important not to appear intrusive by asking personal information without setting a context. Keeping these issues in mind, the first two questions seek generic information regarding SWM. This provides the respondents a flavor of the central theme of the questionnaire. Following these generic questions, demographic information is obtained (questions 3-10).

Questions regarding recycling attitudes follow (questions 11 and 12). The next set of questions (questions 13-19), dealt with the current non-hazardous drop-off center Bryan operates. These questions were designed to obtain information about factors that may influence participation rates at the drop-off center. The survey instrument was designed such that non-recyclers will potentially answer seven fewer questions that recyclers. Before presenting the policy change questions, recycling benefits and costs were outlined followed by questions that seek to increase the respondents' understanding of the information, while at the same time obtaining respondents' impressions about the benefits and costs (question 20). There was not much latitude in terms of sequencing the reminder of the questions, concerning policy changes. The three scenarios had to be sequenced to maintain consistency. Upon describing the Current Situation, the referendum question dealing with the first proposed change (additional drop-off center) was posed. Next the two WTP questions regarding the remaining two policy changes (curbside and a combination of

curbside and drop-off center) were asked. A question designed to obtain the respondents' most preferred policy ended the formal part of the questionnaire.

The first policy change was comprised of three questions. The first question (21) was related to preferences regarding different features a new drop-off center should include. Question (22) sought to obtain the most preferred area to locate the additional drop-off center. A yes / no referendum-type question to establish an additional drop-off center comprised the third question (question 23). The cost of establishing another drop-off center is going to be minimal when spread across all households, about $0.30 per month in Bryan. Bryan obtained an external grant (from Texas Natural Resource Conservation Commission) to establish the existing drop-off recycling center. Operating costs are covered by SWM funds. The additional drop-off center may be financed in a similar fashion (Snider).

The second policy change dealt with curbside recycling (questions 24 and 25). Respondents were informed of the service offered and were asked if they were WTP a randomly assigned bid amount. Bid amounts ranged from a low of $0.25 to a high of $20.25 for Policy II for the question dealing with curbside program (question 24). As noted earlier, a dichotomous choice with follow up format was used. Respondents' had to indicate their reason(s) for not accepting any bid amount in question 25, an attempt to filter out protest bids.

The third policy change presented was a combination of the first and the second policies (questions 26 and 27). Respondents were asked to express a WTP for a combination of both curbside and drop-off center. Bid amounts ranged from a low of $0.50 to a high of $22.00 for Policy III (question 26). In the follow-up question, the

second set of bid amounts was presented. The rationale behind implementing a combination of programs was to ensure access to recycling programs for all households. A curbside service may not be offered to all households to begin with and it may not cover all households at any given point of time. Question 27 was designed to obtain additional information (protest responses) regarding motivations underlying responses to the WTP question for the third policy. In question 28, respondents were asked to indicate the policy change they most preferred among the three that were presented and the Current Situation.

Pretesting

The survey went through several rounds of expert reviews followed by three focus group meetings. Seven students and two staff members at Texas A&M University made up the first focus group. The second group was comprised of five Bryan Public Works staff members and two students from Texas A&M, whereas the third group consisted of 12 staff members at Texas A&M.

The focus group members were briefed about the purpose of the study, their role in the preparation of the instrument, and were requested to complete the survey as if they received the survey in the mail. Average time taken by the three focus groups to complete the survey was approximately 14 minutes. After all members completed the questionnaire, they were asked if they encountered any difficulty. Following their general comments, members' opinion regarding each question was solicited. They were asked to indicate if the questions were meaningful, simple, and unambiguous. Further, they were asked if they understood the questions. Their responses were compared with the original intent of the questions.

All groups found the description of the three proposed policy changes and the associated questions to be clear and contain adequate information. Responses from the first focus group indicated that the format of the follow-up questions on the second and third proposed changes led to a great deal of confusion. Some chose the initial bid amount and subsequently, picked the lower bid amount on the follow-up question intended for those rejecting the initial bid. Further, respondents choosing a WTP value on both the initial and follow-up bid also answered questions 25 and 27. Changes were made after the first focus group meeting to distinguish the bid amounts and to the wording on questions 25 and 27. Following the changes to improve the WTP question format, the second and third focus groups answers were consistent.

The length of the questionnaire was a major concern of the experts and most members in all the three focus groups. Two questions dealing with composting were eliminated from the survey to reduce the number of questions from 30 to 28. It was not possible to further reduce the number of questions without compromising on the information necessary to satisfy the objectives of this study and other objectives Bryan had for conducting the survey. Much of the information provided in the survey was crucial to educate respondents regarding recycling to reduce limited information biases.

Administering the Survey

Determining the sampling technique and size is crucial to obtaining a sample representative of the population. Only representative samples provide meaningful estimates of the characteristics of the population. In determining the sample size, it is important to factor

the response rate, because an allowance has to be made for non-responses. Mitchell and Carson indicate that response rate for CV studies using mail surveys range between eight and 93 percent.

The survey is designed to elicit attitudes of households and households' WTP rather than individual's WTP. There are concerns regarding individual respondents' ability to take into account each member of the households' preferences and more importantly, whether individual respondents are able to accurately "value" an unfamiliar environmental good for each member of the household. Given that Bryan services each household as a single unit and is eventually going to consider each household as one decision-making unit for policy purposes, households are thought to better reflect the entire population of Bryan rather than individuals.

When a margin of error is reported for a survey, it is a statement of the confidence level in the data collected. The lower the margin of error, the more representative the sample is of the population. A margin of error has a confidence interval, typically 95 percent. If a question from a survey were asked 100 times, 95 of those times the results would be within three percentage points of the original answer. For instance, if 50 percent of a sample of 1,000 randomly selected Americans said they favor recycling laws, in 95 cases out of 100, 50 percent of the entire population in the U.S. would also have given the same response had they been asked, give or take three percentage points (i.e., the percentage is between 47 percent and 53 percent). The bigger the sample, the smaller the margin of error, but once the sample is greater than a particular size, additional improvements in accuracy are very small.

Mitchell and Carson outline a method to obtain the sample size required to improve the reliability of CVM studies. The authors provide sample size tables based on the precision level given by the CoV. CoV is S_P / X_1, where S_P and X_1 are the weighted standard error and the mean of the first experiment. The tables give the minimum number of observations needed for different levels of α (Type I Error probability) and ß (Type II Error probability) in terms of CoV and §, where § is defined below. The difference between the mean of first (X_1) and the second experiments (X_2) expressed as a percent of the first experiment's mean (X_1), detectable with a and ß is given by §. § is, therefore, § =(X_1-X_2)/X_1. There exists a trade-off between CoV and §. A CoV and § closer to 2 and 0.10 (smaller difference between the first and second experiments) are preferred (see tables C-2 to C-3 in Mitchell and Carson, p. 365). The total number of observations needed for a two-tailed t-test is 543, as a function of CoV (1.25) and § (0.2) given a and ß = 0.05 and 376 for a one-tailed t-test. Note that tables give the total number of observations (usable responses). Approximately 545 usable household responses are necessary using the Mitchell and Carson CoV approach for a survey with 0.05 probability of Type I and II errors.

A systematic sampling method was used to select the study subjects. In systematic sampling, every k^{th} element from a list of the population is selected in the sample. The first sample unit was randomly selected to avoid possible bias. There were a total of 19,200 complete and usable residential addresses obtained from the Bryan Public Utilities Office. Beginning at the randomly chosen 3^{rd} address, every 12^{th} residential address was selected from the total of 19,200 households yielding 1600 addresses. Seventy of the selected addresses had to be discarded yielding a total of 1,530 addresses. Primary reasons for these

addresses being unusable were property owners not residing in Bryan at the time of the survey and the address was a commercial property (apartment owner / realtor) incorrectly noted as a residential address in the public utilities records.

A modified version of the total design method proposed by Dillman was used to administer the mail survey. The first mailing was undertaken on March 3, 1999, in which 1,530 surveys were mailed out. A reminder postcard (see Appendix A) was mailed to non-respondents on March 19, 1999. Approximately, 19 percent, 285 households responded prior to the second mailing. The second mailing of the survey was undertaken to non-respondents on March 29, 1999, 10 days after mailing the reminder postcard. A reminder letter (see Appendix A) was included with the re-mails. Households responding to the surveys before the second mailing were removed from the mailing list.

In addition to the mail survey, data were collected by approaching people using the Bryan drop-off recycling center. Trained personnel visited the drop-off center over a one and one-half month period during the months of April and May. A total of 583 patrons using the drop-off center were approached. Three hundred and six patrons agreed to either take the handout and return them by mail or participate in a face-to-face interview. Nine patrons were unwilling to participate in the study; eleven had already received the survey at their place of residence through the mail survey. A substantial number, 257 (44 percent of the users) reported that they were not residents of Bryan or were in the process of some transition. Of the 214 patrons who took the survey home, 190 mailed them back, a response rate of approximately 89 percent. Ninety-two people were interviewed.

The survey was modified for the face-to-face interview (for the modified survey see Appendix B). Sensitive socio-demographic questions relating to age, employment, and

education were removed. Because the participants were using the drop-off center to recycle, questions dealing with recycling behavior were removed. Studies have shown that recyclers are generally more environmentally aware and informed regarding recycling benefits as compared to non-recyclers (DeYoung and Kaplan 1985-86; Gamba and Oskamp; McGuinness, Jones, and Cole; Nielson and Ellington; Oskamp; Oskamp et al.; Schultz, Oskamp, and Mainieri; Vining and Ebreo 1990, 1992). Therefore, the section on recycling benefits and costs was also removed. Bryan wanted specific information regarding the drop-off center. Two additional questions, not a part of the mail survey, were included. These two questions dealt with closing the drop-off center on Sundays and the additional recyclables that should be accepted at the drop-off center. With the inclusion of these two questions and elimination of twelve questions, the face-to-face survey contained a total number of 18 questions (the mail survey had 28 questions). The time required to complete the survey was estimated at 12 to 15 minutes.

The number of usable responses from the three modes of surveys ranged from 610 to 892, a response rate ranging between 40 and 58 percent, depending on responses to individual questions. The combined usable responses for estimating the WTPs for Policy II and III ranged between 618 and 759; well above the required sample size computed using the Mitchell and Carson's CoV approach.

Estimation Procedure

The question dealing with Policy I was framed as a referendum, while questions for Policies II and III were designed to elicit respondents' WTP. Because the policies were presented as mutually exclusive alternatives, responses to these questions do not necessarily indicate

which policy is preferred. Moreover, discrepancies exist between expressed WTP and actual payment (Cohen and Zilberman; Frykblom; Getzner; Johannesson, Liljas, and O'Connor; List, Margolis, and Shogren) and expressed WTP and participation rates in a recycling program (Stock). Therefore, an additional question to elicit information regarding the respondents' preferred policy was administered.

A closed-ended question format is recommended in the elicitation of WTP because this format may provide more accurate estimates of WTP (Arrow et al.). Closed-ended questions can be framed either as a dichotomous choice question (DCQ) or as a dichotomous choice with follow-up question (DCFQ). Respondents indicate yes or no to a specified question in the case of a DCQ. In the DCFQ format, respondents indicate yes or no to a first question and then depending on their response to this first question, they are directed one of two second questions. In this study, responses to the WTP questions were framed as DCFQ because such a format yields potentially more accurate and efficient measures of the WTP (Arrow et al.; Cameron and Quiggin; Carson; Langford et al.).

Random Utility and Discrete Choice Models

The random utility model forms the underlying theory that enables the formulation of econometric analysis of binary choice questions, including WTP. Hanemann (1984) develops this theory, by relating the statistical logit model to the economic model of utility maximization utilizing random utility maximization (RUM) theory. A stochastic component in the indirect utility function is encapsulated in the theory of RUM. An individual consumer knows her / his preferences with certainty and does not consider them stochastic. But to the researcher, the individuals' preferences are comprised of some

components that are unobservable. These unobservable components are treated as random in the RUM model (see Greene; Griffiths, Hill and Judge; Haab and McConnell).

Following Haab and McConnell, if U_0 and U_1 denote individual's utility associated with two choices y_0 and y_1, the observed choice will indicate which utility level is higher.[1] But nothing is revealed about the absolute or marginal levels of the unobserved utilities. Based on this formulation, an individual agrees to the stated bid amount in the CVM questionnaire for the recycling program if utility from the implementation of the program is greater than utility of the status quo. Probabilistic statements can be made about the random utility components, which provide an intuitive basis for analyzing individuals' binary responses, to accept the bid amount or not. The probability (p) that an individual (i) agrees to pay the stated bid amount is probability that he / she perceives that $U_{j1} > U_{j0}$ given by

(1) $p(yes_i) = p(U_{i1} > U_{i0})$.

This model can be specified in terms of an indirect utility function as additively separable in deterministic and stochastic preferences as follows

(2) $U_{ik} = V_{ik} + e_{ik}$

where k equals 0 or 1, V is the deterministic component of utility, and e is the stochastic component of utility. This formulation forms the basis of association between economic theory and econometric modeling. The binary response models as described above can be statistically estimated using maximum likelihood estimation techniques, assuming a specific distribution on the stochastic component. Two commonly assumed distributions are

[1] The arguments of utility such as income, household characteristics, etc., have been suppressed for simplicity.

normal or logistic distribution. The logistic (normal) model is easily estimated using logit (probit) model commands in most statistical software (more on the logit model below).

Econometrics of Discrete Choice Models

As noted, two commonly used techniques to handle qualitative data, such as responses from the DCQ format are logit and probit models (Greene). Bivariate probit is normally used in the case of the DCFQ format (Cameron and Quiggin). However, bivariate probit cannot be used when the responses to the initial and follow-up questions are highly correlated (see discussion below).

In the case of the DCQF format, a follow-up bid is offered to improve the estimation efficiency of the model (Hanemann, Loomis, and Kanninen). The formulation of the second bid response distributions is assumed to be similar to the first bid. Bid value for the follow-up question depends on the individuals' responses to the first bid. The probabilities of the four potential pairs of responses in the case of the DCQF are

(3) $p_{yy}(yes_1 \mid bid_1, yes_2 \mid bid_2) = 1 - G(\beta_2' x_2)$
$p_{yn}(yes_1 \mid bid_1, no_2 \mid bid_2) = G(\beta_2' x_2) - G(\beta_1' x_1)$
$p_{ny}(no_1 \mid bid_1, yes_2 \mid bid_2) = G(\beta_1' x_1) - G(\beta_2' x_2)$
$p_{nn}(no_1 \mid bid_1, no_2 \mid bid_2) = G(\beta_2' x_2)$

where p represents probability, $G(\cdot)$ is the normal cumulative density functions (cdf) in the case of a bivariate probit model, β is the matrix of coefficients associated with the matrix of explanatory variables (x), the subscripts 1 and 2 refer to the original WTP question and the follow-up question.

In the bivariate probit model, the four WTP equations are estimated jointly using a single distribution function. This allows the estimation to take into account both bid

distributions. Estimates are obtained of the marginal distributions and the error correlation. Cameron and Quiggin develop this model in detail. The authors use bivariate probit estimates to examine three different effects: (i) a range of different assumptions on bid coefficients and other parameters, (ii) first-response effects, and (iii) starting point effects. They find the bivariate probit results to be efficient and consistent.

The probabilities of the outcomes can be expressed using the bivariate probit model as follows

(4) $p_{yy}(yes_1 \mid bid_1, yes_2 \mid bid_2) = \Psi(wtp_1 > bid_1, wtp_2 > bid_2, \rho)$
$p_{yn}(yes_1 \mid bid_1, no_2 \mid bid_2) = \Psi(wtp_1 > bid_1, wtp_2 < bid_2, \rho)$
$p_{ny}(no_1 \mid bid_1, yes_2 \mid bid_2) = \Psi(wtp_1 < bid_1, wtp_2 > bid_2, \rho)$
$p_{nn}(no_1 \mid bid_1, no_2 \mid bid_2) = \Psi(wtp_1 < bid_1, wtp_2 < bid_2, \rho)$

where p is the probability, Ψ is the joint bivariate normal cdf, y and n represent yes and no responses, and ρ is the correlation parameter between the responses on the original WTP question and the follow-up questions.

The respondent evaluates the contingent good as one of four possible combinations dichotomous outcomes $\{(yes_1, yes_2)\ (no_1, yes_2)\ (yes_1, no_2)\ (no_1, no_2)\}$. In the DCQF format, the log-likelihood function (lnL) is estimated as

(5) $$\ln L = \sum_{i=1}^{N} n_{yy} \ln(p_{yy}) + n_{yn}(p_{yn}) + n_{ny} \ln(p_{ny}) + n_{nn} \ln(p_{nn})$$

where arguments are suppressed for simplicity, N is the total number of observations, n_{yy}, n_{yn}, n_{ny}, n_{nn} are the number of respondents in the sample who answer with the four alternatives to the first and second bid offers and ln is the natural logarithm. When all respondents agree (disagree) to the first bid offer and also to the second offer, the responses are perfectly correlated. Specifically, only two pairs $\{(yes_1, yes_2)\ (no_1, no_2)\}$ of the four

possible pairs of responses {(yes_1, yes_2) (no_1, yes_2) (yes_1, no_2) (no_1, no_2)} will have been given by the respondents when the responses are perfectly correlated. The underlying choice model reduces to binary model rather than a bivariate model. Statistically, perfect correlation between responses has implications for the estimation of the joint density function of the bivariate model, which is given by

$$(6) \qquad \Phi(u_1, u_2) = \frac{1}{2\pi\sigma_{u_1}\sigma_{u_2}\sqrt{1-\rho^2}} \exp\left[-\frac{1}{2}\left(\frac{u_1^2 + u_2^2 - 2\rho u_1 u_2}{1-\rho^2}\right)\right]$$

where u_1 and u_2 are random variables, and s is the standard deviations of the marginal distributions of the random variables, and ρ the correlation parameter (Greene). Obviously, with the correlation parameter equaling one, (6) is undefined. The responses may not be perfectly correlated, but they are highly correlated in empirical studies. When the responses are highly correlated, the correlation parameter (ρ) approaches one. With a correlation parameter approaching one, the density function in (6) may become undefined when using numerical techniques to estimate the bivariate probit model. The function can not be estimated because of the high correlation between the first and the second responses. Unfortunately, in this study of WTP for recycling in Bryan, TX, there was a very high correlation between the responses on the original WTP question and the follow-up questions. Therefore, bivariate probit models could not be estimated. All WTP functions in this study are estimated using the logit estimation procedure.

Logit Estimation

Given the previous discussion on the inability to estimate the bivariate probit, logit estimation procedures are used. For the referendum on a new recycling center and WTP functions binary choice logit models are used. Multinomial logit is used to analyze the most preferred policy. Logit analysis assumes the cdf is a logistic distribution. The logit regression is a weighted regression of a dependent variable that is transformed into the unit normal deviate that generates the proportion as the area under the unit normal curve (Cramer; Finney).

The logistic regression model is a non-linear transformation of the linear regression. The objective of logit model is to estimate the values of the coefficients, which maximize the likelihood of correctly predicting which category the binary dependent variable belongs. Logit estimation is based on maximizing the log of the likelihood function with respect to the parameters. Following the notation used earlier and drawing from Greene, the likelihood function for a sample of n observation used in the logit estimation by the maximum likelihood method is given by

(7) $$p\left(Y_1 = y_1, Y_2 = y_{2,}..., Y_N = y_N\right) = \prod_{y_i=0}[1 - F(b'x_i)]\prod_{y_i=1} F(b'x_i)\text{, or}$$

(8) $$L = \prod_{i=1}^{N}[F(\beta' x_i)]^{y_i}[1 - F(\beta' x_i)]^{1-y_i}$$

where $F(\cdot)$ is the logistic cdf, and $Y_1 = y_1$ is the individual's choice of alternative one and so on for n alternatives. The log likelihood function is obtained by taking the natural logarithm of (7)

(9) $$\ln L = \sum_{i=1}^{N} [y_i \ln F(\beta' x_i) + (1 - y_i) \ln(1 - F(\beta' x_i))].$$

This log likelihood function is estimated using a nonlinear, iterative algorithm in SPSS (Norusis). The logit model is based on the logistic cdf given by

(10) $p_i = p(I_* = ß'x) = F(ß'x) = 1/[1+\exp(-ß'x)]$

where $I_* = ß'x$ is the unobservable index variable, linear in ß, such that the larger the value of I_* greater the probability of the individuals accepting the stated bid amount. The odds ratio (p/1-p) of the logit can be obtained from the sample proportions using a Taylor series expansion that yields (Norusis)

(11a) $\ln(p/1-p) = \ln(p/1-p) + e/(p/1-p)$

(11b) $\ln[p/(1-p)] = ß'x + e$ or

(11c) $[p/(1-p)] = e^{ß'x} \cdot e^{e}$

where ln is the natural logarithm, e the base of the natural logarithms, p and (1-p) are the probabilities that the respondent accepts and does not accept the bid amount, [p/(1-p)] is the odds ratio, ln[p/(1-p)] is the log-odds ratio or logit and since ln[p/(1-p)] = ß'x, x is a matrix of explanatory variables, ß is a vector of associated coefficients to be estimated, and e is a random error term.

The estimated probability of an event occurring is

(12) $p = [e^{(ß' x)}]/[1 + e^{(ß'x)}]$.

The estimated coefficients are interpreted as follows. When x increases by one unit, the odds [p/(1 - p)] changes by $e^{ß}$, where n represents an independent variable. If ß is positive, $e^{ß}$ will be greater than 1, and the odds of the event will increase. If ß is negative, $e^{ß}$ will be

less than 1, and the odds of the event will decrease. If ß is zero, $e^{ß}$ will equal 1, and the odds of the event will remain unchanged.

Because the coefficients of the logits are log-odds ratio they cannot be readily interpreted as marginal effects. The marginal effects can be obtained, however, to examine the affects of the explanatory variables on the dependent variable (Greene). In general, the marginal effects are

$$(13) \qquad \frac{\partial F(\beta' x)}{\partial x} = f(\beta' x)(1 - f(\beta' x))\beta$$

where F(·) is the logistic cdf, and f(·)the associated probability density function (pdf) (Greene).

Mean Willingness-to-Pay

Mean WTP can be estimated using two common approaches, a utility difference approach (Hanemann 1984) or a variation function approach (Cameron). These two approaches are shown to be equivalent with linear specifications of the RUM and constant marginal utility of income (McConnell). Hanemann's (1984) approach is employed here as a matter of computational convenience. CVM respondents are seen as using a utility difference approach when deciding whether to accept or reject the stated bid amount Hanemann (1984). A logit model of the probability of a yes response is related to the respondent's bid amount and socio-demographic variables as follows

$$(14) \qquad \ln[p(yes)/(1-(p(yes)] = f(\beta' x).$$

WTP is the area under the pdf (f(β'x)) between zero and infinity given by

$$(15) \qquad WTP = \int_{0}^{\infty} [1-f(\beta' x)]d\beta_{ß} \text{ when WTP}>0$$

where $\beta_{ß}$ is the coefficient associated with the bid. The mean WTP form the logistic distribution is calculated at the means of the explanatory variables using the formula developed by Hanemann (1989)

(16) Mean WTP = $1/\beta_{ß} \cdot (\ln(1+\exp(\beta' x)))$,

where $\beta_{ß}$ is the coefficient associated with the bid variable.

Standard Errors

The standard errors for the mean WTPs are calculated using the delta method following Greene. The estimator of the asymptotic covariance matrix is given by

(17) Est. Asy. Var[g(b)] = M[I(β)]]M'

where g(b) is a set of continuous functions of b, M is the matrix of partial derivatives of the function g(b), [I(β)] is the information matrix of the estimated logit function which is given by

$$(18) \quad I(\beta) = -E\left(\frac{\partial^2 \ln L}{\partial \beta d\beta'}\right) = \sum_{i=n}^{n}\{F(\beta' x_i)[1-F(\beta' x_i)]\}\ x_i' x_i$$

where E is the expectation operator.

The partials derivatives of the mean WTP (17), equivalently g(b) in (18), that make-up the matrix M are given by

$$(19) \quad \frac{\partial WTP}{\partial \beta_{ß}} = -\frac{1}{\beta_{ß}^2}\left(\ln(1+e^{\alpha+\sum_n \beta_n x_n})\right)$$

$$(20) \quad \frac{\partial WTP}{\partial \beta_n} = \frac{1}{\beta_{ß}}\left(\frac{e^{\alpha+\sum_n \beta_n x_n}}{1+e^{\alpha+\sum_n \beta_n x_n}}\right) x_n$$

$$(21) \qquad \frac{\partial WTP}{\partial \alpha} = \frac{1}{\beta_{ß}} \left(\frac{e^{\alpha + \sum_n \beta_n x_n}}{1 + e^{\alpha + \sum_n \beta_n x_n}} \right)$$

While (19) is the partial derivative with respect to the bid coefficient, (20) is the partial derivative for all other coefficients except the bid coefficient and (21) is with respect to the constant. These derivative form the components of M the matrix of partial derivatives of the WTP function. The information matrix is readily obtained from the SPSS output. Standard errors for the mean WTPs are then calculated using (18) by substituting the coefficients from the logit estimation in (19) through (21) and the information matrix in a spreadsheet.

Multinomial Logit Estimation

When the categorical dependent variable has more than two possible values, multinomial logit regression, an extension of the binary logit regression model, can be used (Greene). The counts of the dependent variable are assumed to have multinomial distribution for each combination of explanatory variable values hence the name. The multinomial logit is based on a logit model with the addition of more then two choices. The multinomial likelihood function is a generalization of the logit model given in (9). Defining $c_{ij} = 1$, for J+1 possible choices, if alternative (j) is chosen by individual (i) and 0 otherwise, the log likelihood is given by

$$(22) \qquad \ln L = \sum_{i=1}^{N} \sum_{j=0}^{J} c_{ij} \ln p(Y_i = j) .$$

Equation (17) is estimated using SPSS (Norusis).

Results of multinomial logit provide J non-redundant logits for J+1possible values of the dependent variable. In the survey of households in Bryan, TX, the question relating to the most preferred policy has four possible responses. This produces three non-redundant logits. Each of the three logit is compared to baseline category. Following the notation described earlier, the general form of the multinomial logit is

(23) $p(\text{choice j}) = [e^{(ß_j'x_i)}] / [\sum_{j=1}^{J+1} e^{(ß_j'x_i)}]$.

The coefficients from the multinomial logit are used to compute probabilities associated with the most preferred policy (Greene). Greene assumes $\beta_0 = 0$ as a normalization to solve (24) to give the probabilities of the choices as follows

(25) $p(\text{choice j}) = [e^{(ß_j'x_i)}] / [1 + \sum_{j=1}^{3} e^{(ß_j'x_i)}]$ and

(26) $p(\text{baseline}) = 1 / [1 + \sum_{j=1}^{3} e^{(ß_j'x_i)}]$.

Probabilities for the coefficients of the three logits and the baseline category are computed at the means of continuous variables and included variables in the case of categorical variables. Using the estimated coefficients from the multinomial logit, the probability of respondents' preference for each policy is calculated over the reference policy.

CHAPTER IV

SUMMARY STATISTICS

Two distinct samples were surveyed using three modes of survey (for details see Chapter III). First, a systematic sampling technique was used to select a representative sample of Bryan households which were administered a mail survey. Second, recyclers using the drop-off center were either interviewed (face-to-face) or handed the survey to complete and mail back (handout). Summary statistics are provided in tables 4.1 through 4.16 for the pooled data using all the three modes of survey (see Appendix C for summary statistics by mode of survey). It is important to note three aspects of the data. First, because only a sub-set of the mail questionnaire was administered to those interviewed at the drop-off center, the number of observations ranges from 610 to 892 (total number of observations in the pooled data set, includes mail, face-to-face, and handout responses). Second, depending on respondents' recycling behavior, observations may not always sum up to 892. Where applicable, these discrepancies in the data are noted. Third, each question is summarized individually. Item non-responses may also cause the number of observations not to sum to 610 or 892.

Demographics

A total of nine demographics related questions were asked. Slightly more males (54 percent) responded than females (46 percent) (table 4.1). The majority of the respondents are white (79 percent), followed by Blacks (8 percent), and Hispanics (6 percent) (table 4.2). The mean age of the respondents is 49 years. The youngest respondent was 17 years old and the oldest 96. A substantial number of respondents, 90 percent, belonged to households with either one (59 percent) or two (31 percent) individuals (table 4.3). More than half, 53

percent of the respondents have post-secondary education, having completed a bachelor/associate degree or a graduate degree (table 4.4). A majority of the respondents, 46 percent, are employed full-time. Approximately, 8 percent of the respondents reported are students (table 4.5). A majority of the respondents, 71 percent, earned more than $25,000 annually (table 4.6). Approximately 76 percent of the respondents owned the property at which they resided (table 4.7). Over 61 percent of the respondents reported being environmentalists (table 4.7).

The gender, age, household size, and income levels of the respondents are reflective of the general Bryan population. But, the racial make-up, employment status, and education levels are not necessarily representative. Whites are over-represented. Black, Hispanic and student populations are under-represented in the sample. In addition, the highly educated and retired are over-represented.

Table 4.1 Gender of Respondents

Category	Frequency	Percent
Female	403	46.32
Male	467	53.68
Total	870	100.00

Table 4.2 Racial Background of Respondents

Category	Frequency	Percent
White	692	79.09
Black	70	8.00
Hispanic	55	6.29
Native American	7	0.80
Multiracial	32	3.66
Asian	11	1.26
Other	9	1.03
Total	875	100.00

Table 4.3 Household Size of Respondents

Household size	Frequency	Percent
1	523	58.63
2	280	31.39
3	67	7.51
4	7	0.78
5	1	0.11
Total	878	100

Table 4.4 Education Level of Respondents

Category	Frequency	Percent
Elementary school	11	1.25
Junior high or middle school	21	2.39
High school or equivalent	167	19.00
Some college	209	23.78
Bachelor / Associate degree	243	27.65
Post Bachelor	229	26.05
Total	879	100.00

Table 4.5 Employment Status of Respondents

Category	Frequency	Percent
Employed full-time	407	46.62
Employed part time	61	6.99
Full time homemaker	71	8.13
Unemployed	16	1.83
Retired	251	28.75
Student	74	8.48
Total	873	100

Table 4.6 Household Annual Before Tax Income

Category	Frequency	Percent
Under $10,000	83	9.98
$10,001 - $15,000	58	6.97
$15,001 - $25,000	103	12.38
$25,001 - $50,000	285	34.25
$50,001 - $75,000	186	22.36
$75,001 - $100,000	68	8.17
Over $100,000	54	6.49
Total	832	100

Table 4.7 Residential Status and Environmentalism of Respondents

Category	Frequency	Percent
Residential Status		
Own property	662	75.57
Rent property	214	24.42
Total	100.00	100.00
Environmentalist		
Yes	521	61.36
No	328	38.63
Total	100.00	100.00

Solid Waste and Recycling Attitudes

A majority, 88 percent of the respondents, indicated that SWM was as either more (41 percent) or equally important (47 percent) as other environmental issues in Bryan. Only a fraction, 3 percent of the respondents, felt that SWM issues were "less" or "not important" (table 4.8). In general, respondents ranked the five SWM alternatives consistent with the U.S. EPA's (1989) and TRNCC's (1995) SWM hierarchy[2] (table 4.9). A majority of the respondents, nearly 70 percent, identified recycling as the alternative that should be given

[2] SWM hierarchy is a guideline established by U.S. EPA (1989), and subsequently endorsed by the Texas Natural Resource Conservation Commission (1995), that requires waste management policies to conform to the following five alternatives in stated order of importance–source reduction, recycling, composting, landfilling, and incineration.

more emphasis in future SWM policies, followed by source reduction (47 percent) and composting (46 percent).

Seventy-eight percent of the respondents recycle (table 4.10). It is important to note that the high proportion of recyclers is a consequence of pooling the data from the three sub-samples. The overall recycling rates manifested by the data are high because all the respondents using the drop-off recycling center sub-sample recycle. If only the mail sample is considered, only about 37 percent of the respondents recycle.\

Table 4.8 Importance of Solid Waste Management Issues Relative to Other Environmental Issues

Category	Frequency	Percent
More Important	323	40.90
Equally Important	368	46.70
Less Important	22	2.70
Not Important	5	0.60
Do Not Know	70	8.80
Total	788	100.00

Table 4.9 Preference for Solid Waste Management Alternative

	Source Reduction		Recycling		Composting		Landfilling		Incineration	
Category	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
More emphasis	333	46.64	513	69.99	325	45.84	160	22.41	164	23.30
Equal emphasis	275	38.52	181	24.69	312	44.01	309	43.28	257	36.51
Less emphasis	44	6.16	25	3.41	46	6.49	200	28.01	190	26.99
Undecided	62	8.68	14	1.91	26	3.67	45	6.30	93	13.21
Total	714	100	733	100	709	100	714	100	704	100

Recyclers identified the following factors, in descending order of importance, as best describing their motivations for recycling, good for the environment, conserves landfill

space, benefits future generations, and conserves resources (table 4.11). These factors are consistent with earlier research findings. In contrast to previous research, peer pressure (most people I know recycle) appeared to have little to do with recycling behavior among Bryan residents. Earning money through the sales of recyclables was identified only 12 percent of the respondents as the reason for recycling. Recyclers consistently identified benefits to society over personal ones (table 4.11). Coupled with the apparent unimportance of economic incentives and the lack of social confirmation, the motivation to classify recycling activities as an altruistic activity is strengthened.

Almost an equal proportion of non-recyclers identified the lack of information (21 percent), and convenient drop-off center (20 percent) and excessive time and effort (21 percent) as reasons for not recycling (table 4.11). Slightly more than a quarter of non-recyclers (27 percent) did not know anybody that recycled. Approximately, 15 percent of the non-recyclers identified the absence of a curbside program as a reason for not recycling.

Table 4.10 Respondents' Recycling Behavior

Category	Frequency	Percent
Recycles	696	78.00
Recycles at drop-off center		
Yes	487	55.53
No	390	44.47
Recycles at work		
Yes	299	38.14
No	485	61.86
Recycles at buyback center		
Yes	167	21.30
No	617	78.70
Recycles at drop-off center and work	157	42.09
Recycles at drop-off center and buyback center	83	22.25
Recycles at work and buyback center	92	24.66
Recycles at Drop-off center, work and buyback center	41	10.99

The altruistic nature of recycling may be further evidenced by the respondents' views regarding recycling benefits and costs. The benefits the general public derives from recycling are consistently ranked higher than individual costs of recycling (table 4.12). Revenues one can earn from selling recyclables was ranked as very important by only 9 percent of the respondents, while 62 percent ranked it as being not important. The cost of collecting, sorting and storing recyclables was ranked very important and somewhat important by 31 percent and 41 percent of the respondents. The cost of transporting recyclables to a recycling center was ranked as very important by 22 percent of those surveyed, while an equal proportion, nearly 36 percent of the respondents, identified it as somewhat or not important. To summarize, it appears concerns regarding the private cost of recycling are higher than the private revenues that a can be generated. These trends are consistent with earlier findings, for instance Jakus, Tiller, and Park (1996).

A majority of the respondents consistently ranked recycling benefits to society as either important or somewhat important, while only a fraction ranked them as not important (table 4.12). Approximately 80 percent of the respondents identified benefits from avoided costs, conserving resources and energy, and decreased pollution, as being either important (66 percent, 63 percent, and 70 percent) or somewhat important (26 percent, 29 percent, and 26 percent). Only about 3 percent, 4 percent, and 5 percent of the respondents ranked the three benefits as not important. These responses are further indication of the altruistic nature of recycling behavior.

Table 4.11 Respondents' Motivations Underlying Recycler's and Non-recycler's Behavior

Category	Frequency	Percent
Recycles [a]		
Makes me feel good	366	41.03
Earn money	112	12.55
Good for the environment	569	63.78
Benefits the general public	435	48.76
Most people I know recycle	60	5.60
Conserves resources	488	54.70
Conserves energy	384	43.04
Conserves landfill space	524	58.74
Benefits future generations	488	54.70
Do Not Recycle[b]		
No information on recycling	191	21.41
No curbside recycling	136	15.24
No convenient drop-off center	182	20.40
Takes too much time & effort	184	20.62
Nobody I know recycles	241	27.01

[a] A maximum of 580 respondents (recyclers)

[b] A maximum of 312 respondents (non-recyclers)

The additional pollution that recycling related activities may contribute is of concern among critics of recycling programs, especially curbside recycling (Bailey 1995). A majority, 79 percent of those surveyed, also viewed the increased pollution from recycling to be very important or somewhat important. This suggests attention should be paid to increased pollution resulting from recycling activities when designing recycling programs.

Table 4.12 Perceptions Regarding Recycling Costs and Benefits

Category	Frequency				Percent			
	1[a]	2[b]	3[c]	4[d]	1[a]	2[b]	3[c]	4[d]
Importance of Benefits and Costs to Individual								
Cost of	240	320	167	55	30.69	40.92	21.36	7.03
Collecting, sorting and storing	171	281	281	49	21.87	35.93	35.93	6.27
Transporting recyclables	69	178	481	46	8.91	23.00	62.14	5.94
Benefit—earnings from recyclable sale								
Importance of Benefits and Costs to Public								
Benefits from								
Avoided costs	521	206	20	37	66.45	26.28	2.55	4.72
Conserving resource and energy	493	228	31	31	62.96	29.12	3.96	3.96
Decreased pollution from recycling	549	166	42	27	70.03	21.17	5.36	3.44
Cost of increased pollution	310	302	89	68	40.31	39.27	11.57	8.44

[a] Very important; [b] Somewhat important; [c] Not important; [d] Undecided

Recycling Programs

Respondents were also asked to identify their preferences for different features of a new drop-off recycling center. A majority of respondents consistently ranked all features of the drop-off center as most preferred or somewhat preferred (table 4.13a). A facility that is easy to use and clean was ranked first and second as the most preferred feature by 74 percent and 67 percent, of the respondents (table 4.13a). A majority of respondents ranked Area ④ as their first or second preferred area and Area ② as the least suited for a new drop-off center (table 4.13b).

The lowest non-response question is the one eliciting information on the most suitable area to locate a new drop-off center. There appeared to be some confusion regarding the ranking method. Several respondents wrote in comments regarding the usefulness of ranking the areas because their ability to use the drop-off center would depend on its proximity to their residence, immaterial to the boundaries marked by the four areas given in the map of Bryan contained in the questionnaire. For instance, a household in the

south-west region of Area ① maybe closer to a drop-off center in the south-west region of Area ② or Area ④ than a center located in the south-east corner of Area ① (see question 22 and accompanying map included in the questionnaire in Appendix A). While respondents were unsure where the drop-off center should be located, a large majority (78 percent) of the respondents expressed support for an additional drop-off center that would be financed through revenues generated either by diverting solid waste revenues or by obtaining grants.

Table 4.13a Preferences Regarding Features of an Additional Drop-off Center

	Frequency			Percent		
Category	1[a]	2[b]	3[c]	1[a]	2[b]	3[c]
Features at drop-off center						
Credit toward garbage fee	399	180	159	54.07	24.39	21.54
Accept both non-hazardous recyclables & motor oil	382	197	157	51.90	26.77	21.33
Manned (help unloading)	384	201	151	52.17	27.31	20.52
Cleanliness	497	197	49	66.89	26.51	6.59
Easy to use (drive through)	551	134	59	74.06	18.01	7.93
Extended hours of operation	364	210	162	49.46	28.53	22.01
Close to shopping center	271	210	256	36.77	28.49	34.74
Close to major street	344	219	173	46.74	29.76	23.51

[a] Most prefer; [b] Somewhat prefer; [c] Not an issue

Table 4.13b Preferences Regarding Location of an Additional Drop-off Center

	Frequency				Percent			
Category	1[a]	2[b]	3[c]	4[d]	1[a]	2[b]	3[c]	4[d]
Area for locating new drop-off center								
Area ① Southeast Bryan	201	128	119	183	31.85	20.29	18.86	29.00
Area ② West-central Bryan	170	91	136	235	26.90	14.40	21.52	37.18
Area ③ North Bryan	198	138	170	130	31.13	21.70	26.73	20.44
Area ④ East-central Bryan	207	206	122	90	33.12	32.96	19.52	14.00

[a] 1st rank; [b] 2nd rank; [c] 3rd rank; [d] 4th rank.

As noted earlier, three recycling programs were outlined: additional drop-off center, curbside recycling service, and a combination of a drop-off center and curbside service.

Question 26 asked respondents to identify the most preferred policy or combination of policies. Of the three recycling programs outlined, nearly 27 percent of the respondents reported that an additional drop-off center was their most preferred program, followed by 24 percent identifying curbside recycling service (table 4.14). Twenty-three percent of the respondents were happy with no changes to the current recycling programs. About 102 respondents, 11 percent preferred a combination of the four alternatives, although this was not an option on the questionnaire. These respondents checked more than one preferred program.

Table 4.14 Most Preferred Program

Category		Frequency	Percent
Proposed Change I:	An additional drop-off recycling center.	247	26.82
Proposed Change II:	Implement curbside recycling service.	217	23.56
Proposed Change III:	Combination of curbside and drop-off center.	142	15.42
Current Situation:	No changes to current recycling programs.	213	23.13
Proposed Change III and Current Situation		89	9.66
Proposed Change I and Current Situation		7	0.76
Proposed Change II and III		4	0.43
Proposed Change I and II		2	0.22

Drop-off Recycling Center

Bryan is interested in obtaining information regarding factors that motivate residents using the drop-off recycling center. One-hundred and sixty-one of the respondents recycling reported that they do not use the drop-off center (table 4.15). Primary among reasons for not recycling at the drop-off center were, in order of importance are too much traffic (56 percent), not in a convenient location (48 percent), did not know about the drop-off center (43 percent), took too much time and effort (43 percent), and lack of economic incentives (23 percent). Economic incentives play a minor role in terms of motivating recycling

behavior among both recyclers and non-recyclers. Both recyclers' and non-recyclers' behavior appears to be motivated more by non-economic factors than economic.

Table 4.15 Recycling at Drop-off Center

Category	Frequency	Percent
Recycle at Wal Mart		
Yes	477	74.76
No	161	25.24
Reasons for not recycling[a]		
No economic incentive	37	22.98
Not in convenient location	77	47.83
Too much traffic	90	55.90
Didn't know about it	70	43.48
Takes too much time & effort	70	43.48

[a] Only respondents not recycling at the drop-off center

Respondents reporting that they recycled at the drop-off center were asked three additional questions. A majority, 72 percent of the respondents using the drop-off center, reported combining their trip with other errands (table 4.16). Twenty-one percent reported that their trips were only to recycle and 7 percent reported doing a combination of the two. Nearly 39 percent of the respondents reported visiting the drop-off center at multiple time periods depending on their convenience. A majority, 25 percent of the respondents, reported using the drop-off center between 9 a.m. and noon on Mondays through Thursday.

All features of the drop-off center were generally perceived positively (table 4.17). A majority of the non-recyclers identified cleanliness followed by credit towards their garbage bill as preferred features. The drive-through feature at the drop-off center was identified by a majority of the respondents (85 percent) most positively, followed by help unloading the

recyclables (75 percent). An important aspect to note is that approximately 46 percent of the respondents reported credit towards garbage fee as being important, the lowest preferred among all the features. Additionally, 35 percent of the respondents identified credit toward garbage fee as being not important, the highest not preferred compared to other features.

Table 4.16 Preferences Regarding Drop-off Center Timing[a]

Category		Frequency	Percent
Trips to drop-off center			
Only to recycle		85	21.41
Combined with errands		284	71.54
Both		28	7.05
Hours of operation			
Monday	7-9 a.m	16	4.3
to	9 a.m.-12	100	25.19
noon		37	9.32
Thursday	12-3 pm	30	7.56
	3-6 p.m.	13	3.27
	6-9 p.m.	5	1.26
Friday	7-9 a.m	33	8.31
to	9 a.m.-12	25	6.30
noon		19	4.79
Saturday	12-3 pm	5	1.26
	3-6 p.m.	6	1.51
	6-9 p.m.	2	0.50
Sunday	12-3 pm	81	20.4
	3-6 p.m.		
	6-9 p.m.		

[a] 477 respondents recycling at the drop-off center

The face-to-face sub-sample (n=92) from the drop-off recycling center were asked two additional questions of interest to Bryan. A majority, 87 percent of the respondents, reported as not being inconvenienced if the drop-off center were closed on Sundays. Nearly 34 percent were satisfied with the recyclables being collected at the drop-off center. About 24 percent and 22 percent wanted the drop-off center to accept all types of plastics and

corrugated cardboard. During the time of the survey, only opaque, narrow-mouthed plastic (numbers one and two), and narrow-mouthed clear and brown glass bottles were being accepted.

Table 4.17 Preferences Regarding Drop-off Center Features

	Frequency				Percent			
Category	1[a]	2[b]	3[c]	4[d]	1[a]	2[b]	3[c]	4[d]
Features at drop-off center								
Credit toward garbage fee	158	59	7	121	45.80	17.10	2.03	35.07
Location convenience	272	74	23	14	71.02	19.32	6.01	3.66
Cleanliness	260	84	5	25	69.52	22.46	1.34	6.68
Easy to use (drive through)	328	39	9	11	84.75	10.08	2.33	2.84
Manned (help unloading)	284	70	4	22	74.74	18.42	1.05	5.79
Hours of operation	185	123	29	35	49.73	33.06	7.80	9.41

[a] Most like, [b] Somewhat like; [c] Dislike; [d] Undecided

CHAPTER V

RESULTS AND DISCUSSION

Five different logit-based analyses are conducted to determine socio-economic factors influencing recycling in Bryan, TX. The first analysis identifies characteristics associated with respondents more likely to engage in recycling behavior. Next, characteristics of respondents more likely to support the establishment of a new drop-off recycling center are determined. Establishment of a new drop-off center is Policy I. Estimation of WTP as a function of socio-economic characteristics for a curbside recycling service (Policy II) and a curbside service with a new drop-off recycling center (Policy III) comprise the third and fourth analyses. WTPs for each of these two policies are calculated. Questions associated with Policies I, II, and III were presented to respondents as mutually exclusive policies. Because support for a policy or a higher WTP does not necessarily indicate the most preferred policy, the final analysis examines the respondents' most preferred policy, including no additional recycling services (Current Situation).

Data, Model, and Diagnostics

Logit models are estimated using maximum likelihood technique (Greene). Fourteen logit models are estimated for the five analyses. The fourteen models arise because of different assumptions pertaining to the bid price used and the pooling of survey data collected by different sources. For the first four analyses, the dependent variable is the yes / no response to whether the respondents recycle or not, support a new drop-of center, and if they are willing to pay the stated bid price. The dependent variable in the fifth analysis is the stated preferred policy alternative. In this analysis, a multivariate dependent variable is used to

indicate one of the three policy alternatives (I, II, or III) or the current situation. Multinomial logit models are estimated in the fifth analysis.

Two different data sets are used to estimate logit models to examine recycling behavior, for Policy I, and for the most preferred policy (table 5.1a). Four models are estimated for Policies II and III based on the two data sets and two assumptions on the bid price (table 5.1b). The first data set (mail) comprises responses from the mail surveys and surveys handed out at the drop-off center that were mailed back. The second data set (pooled) combines the data from all three modes, mail survey, surveys handout at the drop-off center, and face-to-face interviews. The shorter questionnaire used in the face-to-face interviews did not include questions concerning age, employment, and household size. Therefore, the models estimated using the pooled data have fewer explanatory variables, but more observations.

In the two aforementioned data sets, mail and pooled, two assumptions are made concerning the bid prices used, unconsolidated (Bid) and consolidated (CBid). The combination of the two data sets and two bid price assumptions result in four logit models being estimated for Policies II and III, mail-unconsolidated, mail-consolidated, pooled-unconsolidated, and pooled-consolidated. Different assumptions on the bid prices are made for the following reasons. The survey instrument contained the dichotomous choice with follow-up question (DCFQ) format for eliciting the WTP. The pretest data showed no problems using bivariate probit estimation. However, the data from the survey posed problems. Specifically, responses to the WTP questions are highly correlated. Both parametric and non-parametric tests showed that the responses to the initial and follow-up WTP question are significantly correlated. The Pearson correlation value (0.998) and a

paired sample test of responses were both significantly correlated at the at the one percent level. The bivariate probit algorithm failed to converge because of this high correlation between responses in the DCFQ data. Therefore, the WTP for the policies are estimated as a dichotomous choice models using logit regression.

Table 5.1a Number of Observations Used in Estimating the Logit Models Based on Data Source

Data Source	Recycling Behavior	Policy I	Most Preferred
Mail	620	620	616
Pooled	797	759	753

Table 5.1b Number of Observations Used in Estimating the Logit Models Based on Data Source and Bid Price

Data Source	Policy II	Policy III
Mail Unconsolidated Bid Price	618	618
Mail Consolidated Bid Price	620	620
Pooled Unconsolidated Bid Price	757	757
Pooled Consolidated Bid Price	759	759

Unconsolidated bid prices simply uses the bid price associated with the first question of the DCFQ format. The dependent variable in this case is the yes / no response associated with this first question. Consolidated bid prices are generated as follows. When respondents agree to pay the lower bid amount on the first question, but not the higher bid amount on the follow-up question, the lower bid amount is used along with the associated yes response. Regardless of the respondents' answer to the first question if the respondents agree to pay the higher bid on the follow-up question, the higher bid amount and the

associated yes response is used. Similarly, when the respondents did not agree to pay both bids, the lower bid amount and the associated no response is used.

As shown in tables 5.1a and 5.1b, a different number of observations are associated with each data set and dependent variable. Two reasons for this are (i) pooling the data, which adds observations and (ii) within the survey, some respondents answered some questions and not others. The number of missing observations for the dependent variable, therefore, varies. For each analysis, the most observations possible are used

Explanatory variables used in the estimation process are (*reference category* of categorical variable in italics):

Continuous Variables

Age	Respondents age in years, and
Bid	Bid amount in dollars / month (suffixes II and III indicate Policy II or III, and a prefix C indicates consolidated bid prices).

Categorical Variables

Gender	Female or *Male,*
Race	Non-whites and *Whites,*
Employ	Employed, Retired and *Students*,
Income	<25,000; 25,001-50,000; 50,001-75,000; 75,001-100,000 and *>100,001,*
Kids	Households without kids and *with kids,*
Residence	Non-Homeowner and *Homeowner,*
Enviro	Non-environmentalists or *environmentalist,*
Recycler	Non-recycler or *recycler,*
Support	Does not support a drop-off center (no support) and *support*, and
Source	Mode of survey, mail, *handout* (mail data) and *face-to-face* (pooled data).

The most general analyses use all the above independent variables. Exceptions to this generality are as follows. In the pooled data set, the explanatory variables age, employ, and kids, are excluded, because the relevant data were not collected in the face-to-face interviews. The categorical variable, source, is two categories in the mail data set (mail or handout), but is three categories in the pooled data set (mail, handout, or face-to-face). Bid

price is only relevant when estimating the WTP models. The variable recycler (support) is the dependent variable in the first (second) analyses. They are used, however, as explanatory variables in the WTP estimations. Recycler is also an explanatory variable in the most preferred policy estimation.

Only summary statistics and diagnostic testing for the mail data set are presented because it contains all explanatory variables used in the analyses. Summary statistics of the explanatory variables used in the estimation are presented in table 5.2. A test of normality of the dependent variables indicates the variables are not statistically different from normally distributed variables at an a-level of 0.15 because the skewness statistic values are less than two (table 5.3). Another potential problem with the use of numerous explanatory variables and survey data is multicollinearity. Multicollinearity cannot be directly checked in a logit regression, as is the case when using ordinary least squares (OLS). Because OLS estimation using binary dependent variables provides unbiased estimates, the collinearity statistics, tolerance and variance inflation factor, from OLS regression can be used to check for collinearity. The tolerance statistics for the coefficients from the OLS regression are less than one and the variance inflation factors range between 1.519 and 1.023 (table 5.4). These values indicate an absence of multicollinearity. In addition, the simple correlation matrix presented in table 5.5 does not indicate high simple correlation between any of the explanatory variables. Multicollinearity, therefore, does not appear to be a problem.

Table 5.2 Summary Statistics of Explanatory Variables Used in the Estimation

Variable	Minimum	Maximum	Mean	Standard Deviation
Female	.00	1.00	.5385	.49880
Non-Whites	.00	1.00	.6929	.46155
Employed	.00	2.00	.4715	.24183
Income	.00	4.00	2.0561	1.26640
Age	17.00	96.00	48.5028	17.89427
No Kids	.00	1.00	.2575	.43753
Non-Homeowner	.00	1.00	.7560	.42975
Non-Environmentalist	.00	1.00	.6051	.48911
Non-Recycler	.00	1.00	.7838	.41190
No Support	.00	1.00	.1575	.36451
BidII	.25	20.00	8.8140	5.29004
BidIII	.50	22.00	9.8457	5.33520
CbidII	.25	20.25	8.5436	5.23911
CbidIII	.50	22.00	9.4989	5.31689
Source	1.00	3.00	1.4212	.67194

N=618

Table 5.3 Normality Test of Dependent Variables

	Min.	Max.	Mean	Standard. Deviation	Skewness Statistic	Skewness Standard Error
Responses to Recycling	.00	1.00	.7838	.41190	-1.381	.082
Responses to Policy I	.00	1.00	.1575	.36451	1.884	.084
Initial Responses to Policy II	.00	1.00	.2593	.43850	1.100	.082
Follow-up Responses to Policy II	.00	1.00	.3153	.46490	.796	.082
Initial Responses to Policy III	.00	1.00	.1763	.38127	1.702	.082
Follow-up Responses to Policy III	.00	1.00	.2252	.41797	1.318	.082
Responses to Most Preferred Policy	.00	3.00	1.4005	1.16070	.162	.085

N=618

Table 5.4 Ordinary Least Square Estimates to Check for Multicollinearity

Variable	Standardized Coefficients	Standard Error	t-statistic	p-value	Collinearity Statistics Tolerance	VIF
Constant		.080	8.115	.000		
BidII	-.282	.003	-7.398	.000	.975	1.026
Female	.021	.035	.539	.590	.954	1.048
Non-whites	.035	.043	.899	.369	.934	1.071
Education	-.029	.015	-.773	.440	.978	1.023
Employment	-.033	.027	-.836	.403	.896	1.116
Income	.108	.015	2.521	.012	.771	1.298
Age	-.165	.001	-3.789	.000	.743	1.346
No Kids	-.041	.041	-1.045	.296	.895	1.117
Non-Homeowner	-.047	.047	-1.018	.309	.659	1.519
Non-Environmentalist	.100	.037	2.421	.016	.822	1.217
Non-Recycler	-.043	.044	-1.041	.299	.810	1.234
Supports	-.100	.050	-2.596	.010	.944	1.059

N=618

Recycling Behavior

Mail Data

Results of the logit estimation and calculated marginal effects using the mail data investigating factors underlying recycling behavior are presented in table 5.6. The null hypothesis that all the coefficients except the intercept are simultaneously equal to zero is rejected (Chi-square value of 183.153). The Cox and Snell and Nagelkerke R^2s are 0.246 and the 0.370. Eighty percent of the observations are correctly predicted by the model. The signs of the coefficient are generally as expected based on theory, previous literature, and *a priori* knowledge.

Table 5.5 Correlation Matrix of Explanatory Variables Used in the Analyses

Variable	Females	Non-whites	Employed	Retired	<25K	25.1-50K	50.1-75K	75.1-100K	Age	No Kids	Non Home-owners	Non-Environmentalists	Non-Recycler	No Support	Bid Price
Females	1	-.012	.020	.030	.075	.082	.042	.003	-.069	.020	.037	-.102	.012	-.032	.055
Non-whites		1	-.051	-.031	-.093	-.065	.007	.005	.037	-.031	-.079	.040	-.077	.021	-.028
Employed			1	.079	.010	-.046	-.033	-.038	-.071	.154	.100	-.064	.008	-.064	.005
Retired				1	-.025	-.066	-.053	-.095	-.098	-.068	.133	-.035	-.040	-.071	.017
<25K					1	.497	.567	.517	.077	.025	-.287	-.010	-.171	.063	-.011
25.1-50K						1	.549	.504	.018	.028	-.269	-.017	-.041	.038	.012
50.1-75K							1	.633	.096	.007	-.180	.024	-.068	.003	-.004
75.1-100K								1	.090	-.001	-.060	-.013	-.075	.031	-.011
Age									1	-.014	.403	.196	-.040	-.021	.070
No Kids										1	-.047	.008	-.019	-.008	.021
Non-homeowners											1	.030	-.050	-.094	.045
Non-Environmentalists												1	-.333	.034	.018
Non-Recycler													1	.092	.049
No Support														1	-.062
Bid Price															1

N=618

Table 5.6 Logit Results of Recycling Behavior with Mail Data

Variable	Coefficient	Marginal Effects	Standard Error	p-value
Female	.146	0.732	.255	.120
Non-whites	-.396	-0.613	.392	.408
Employed	.325	0.765	.413	.704
Retired	-.157	0.668	.451	.000
<25K	-1.575	-0.328	.492	.436
25.1-50K	-.383	-0.616	.406	.078
50.1-75K	-.714	-0.536	.424	.018
75.1-100K	-1.002	-0.464	.007	.003
Age	-.022	-0.697	.271	.907
No Kids	.032	0.709	.285	.068
Non-Homeowner	-.521	-0.583	.243	.000
Non-Environmentalist	-1.899	-0.261	.614	.000
Mail	-3.085	0.097	.945	.000
Intercept	6.857		.225	.517
N	620			
Cox & Snell R^2	0.246			
Nagelkerke R^2	0.370			
Model $?^2$	183.153			
% Correct Predications	80.60			

Four coefficients, non-whites, employed, first income category (<$25,000), and age, are not significantly different from zero at an a-level of 0.15. Coefficient signs on the insignificant coefficients indicate that non-whites, respondents with incomes less than $25,000, and older respondents are less likely to recycle than their respective reference categories. Employed respondents are more likely to recycle than students.

Signs on the significant coefficients indicate the following. Females are more likely to recycle than males. Retired respondents are less likely to recycle than students. Compared to respondents with incomes greater than $100,001, respondents in the second, third, and fourth incomes categories are less likely to recycle. Respondents without children are more likely to recycle when compared to respondents with children. Non-homeowners and non-environmentalists are less likely to recycle than homeowners and environmentalists.

Mail respondents are also less likely to recycle than handout respondents. Among the coefficients that are significant, female, followed by respondents without children and those in the second income category have the highest marginal effect, most likely to recycle, on recycling behavior. Mail respondents, followed by non-environmentalists and respondents in the fourth income category are the least likely to recycle.

Pooled Data

Results using the pooled data are presented in table 5.7. Excluding three variables and including additional observations did not change the R^2s. A test of the model that all coefficients except the intercept are simultaneously equal to zero is rejected (Chi-square value of 223.917). The signs of the coefficients using the pooled data are similar to those from using the mail data except in the case of females, which is now negative. The coefficient associated with non-whites and the first income category are significantly different from zero, but were insignificant in the mail data set model. While females and non-homeowners were significant in the mail data set model, they are now insignificant. Mail respondents and handout respondents are less likely to recycle than face-to-face respondents, but both coefficients are insignificant. The marginal effect indicates that non-whites are the most unlikely to recycle and non-environmentalist are most likely to recycle among the coefficients that are significant.

Table 5.7 Logit Results of Recycling Behavior with Pooled Data

Variable	Coefficient	Marginal Effects	Standard Error	p-value
Female	-.025	-0.682	.205	.904
Non-whites	-.499	-0.571	.233	.032
<25K	-1.307	-0.373	.404	.001
25.1-50K	-.271	-0.626	.455	.551
50.1-75K	-.633	-0.538	.358	.077
75.1-100K	-.817	-0.492	.378	.031
Non-Homeowner	-.061	-0.674	.232	.794
Non-Environmentalist	-1.688	-0.289	.210	.000
Mail	-2.199	-0.196	.391	.996
Handout	-1.507	-0.327	.139	.997
Intercept	2.786		.301	.996
N	797			
Cox & Snell R^2	0.245			
Nagelkerke R^2	0.376			
Model $?^2$	223.917			
% Correct Predications	80.20			

Policy I – Additional Drop-off Recycling Center

Respondents were asked to indicate whether they would support the Bryan's effort to establish an additional drop-off center by diverting SWM revenues or by obtaining grant funds. This question was framed in the form a referendum on an additional drop-off center. The null hypothesis that all coefficients, except the intercept, are simultaneously equal to zero is rejected in both the mail and pooled data set models (tables 5.8 and 5.9).

Mail Data

The R^2's for the model estimated using mail data are low; Cox and Snell R^2 is 0.054 and the Nagelkerke R^2 is 0.096 (table 5.8). Eighty-six percent of the observations are correctly classified by the model. The signs of the coefficients are generally as expected.

Coefficients associated with, female, non-whites, third and fourth income categories, age, no kids, non-environmentalists, and mail respondents, are not significantly different from zero at an a-level of 0.15. Signs on the insignificant coefficients indicate that females and respondents who do not have children are less likely to support Policy I than males and respondents with children. Non-whites, respondents in third and fourth income categories, older respondents, non-environmentalists, and mail respondents are more likely to support the additional drop-off center than their corresponding reference categories.

Table 5.8 Logit Results of Support of a Drop-off Center with Mail Data

Variable	Coefficient	Marginal Effects	Standard Error	p-value
Female	-.169	-0.105	.249	.498
Non-whites	.191	0.143	.289	.509
Employed	-.862	-0.055	.393	.028
Retired	-.825	-0.057	.422	.051
<25K	1.054	0.284	.481	.028
25.1-50K	.727	0.223	.498	.145
50.1-75K	.382	0.169	.420	.363
75.1-100K	.377	0.168	.445	.397
Age	.008	0.122	.008	.300
No Kids	-.386	-0.086	.289	.181
Non-Homeowner	-.833	-0.057	.350	.017
Non-Environmentalist	.210	0.146	.268	.435
Non-Recycler	.645	0.209	.290	.026
Mail	.340	0.163	.341	.318
Intercept	-1.978		.728	.007
N	620			
Cox & Snell R^2	0.054			
Nagelkerke R^2	0.096			
Model $?^2$	34.134			
% Correct Predications	86.1			

Affects of the significant coefficients are as follows. Employed and retired respondents are less likely to support the drop-off center than students. People earning less than $50,000 are more likely to support the establishment of the additional recycling center

than those earning over $100,001. Non-homeowners are less likely to support the establishment of a drop-off center. In the case of the coefficients that are significant, respondents who do not recycle followed by respondents in the first income category and in the second income category are most likely to support a drop-off center. Respondents who are employed, followed by non-homeowners and the retired are least likely to support a drop-off center.

Table 5.9 Logit Results for Support of a Drop-off Center with Pooled Data

Variable	Coefficient	Marginal Effects	Standard Error	p-value
Female	-.170	-0.094	.217	.433
Non-whites	.186	0.129	.263	.480
<25K	.994	0.249	.404	.014
25.1-50K	.421	0.157	.438	.337
50.1-75K	.263	0.137	.354	.456
75.1-100K	.140	0.123	.378	.712
Non-Homeowner	-.934	-0.046	.286	.001
Non-Environmentalist	.262	0.137	.236	.268
Non-Recycler	.562	0.177	.262	.032
Mail	.022	0.111	.418	.959
Handout	-.421	-0.074	.482	.382
Intercept	-2.100		.506	.000
N	759			
Cox & Snell R^2	0.044			
Nagelkerke R^2	0.078			
Model $?^2$	34.014			
% Correct Predications	85.4			

Pooled Data

Results using the pooled data are presented in table 5.9. The R^2s for the pooled data are marginally lower than the mail data model. Cox and Snell R^2 is 0.044 and the Nagelkerke R^2 is 0.078. Signs of the coefficient are the same between the two data sets. Significant coefficients are first income category, non-homeowner, and non-recyclers. Compared to

face-to-face respondents, mail respondents are more likely to support a new drop-off center, whereas, handout respondents are less likely to support the center, but these variables are not significant.

Policies II and III – Willingness-to-Pay

Two questions regarding policy changes are related to willingness-to-pay (WTP) for a curbside recycling program (Policy II) and a combination of curbside recycling and a drop-off center (Policy III). In both questions, information relating to the policy was provided followed by the WTP question. For all estimated models, the Chi-squared test indicated the null hypothesis that all coefficients except the intercept are jointly equal to zero is rejected at an a-level of 0.00.

Policy II - Curbside Recycling Program

Mail-Unconsolidated. Results using the mail-unconsolidated data for Policy II are presented in table 5.10. Both the Cox and Snell and Nagelkerke R^2s are low (0.161 and 0.232). Seventy-five percent of the observed responses are correctly predicted by the model. Generally, the signs of the coefficients are as expected.

Estimated coefficients for female, non-whites, employed, retired, fourth income category, no kids, non-homeowner, non-recycler, and mail are not significantly different from zero at an a-level of 0.15. Signs on the insignificant coefficients indicate that females, non-whites, retired, respondents in the fourth income category, and mail respondents are less likely to pay the bid price than their respective reference category. Continuing with the

insignificant coefficients, respondents that are employed, have no children, non-homeowners, and non-recycler more likely to pay the bid price than their corresponding reference category.

Table 5.10 Logit Results for Policy II with Mail-Unconsolidated Data

Variable	Coefficient	Marginal Effects	Standard Error	p-value
Female	-.106	-0.734	.203	.601
Non-whites	-.297	-0.695	.261	.256
Employed	.097	0.772	.358	.787
Retired	-.177	-0.720	.383	.643
<25K	-.767	-0.587	.407	.060
25.1-50K	-.736	-0.595	.397	.064
50.1-75K	-.790	-0.582	.309	.010
75.1-100K	-.057	-0.743	.310	.854
Age	-.027	-0.749	.007	.000
No Kids	.297	0.805	.251	.236
Non-homeowners	.220	0.792	.269	.413
Non-Environmentalists	-.497	-0.651	.221	.024
Non-Recycler	.209	0.791	.266	.433
No Support	.906	0.883	.342	.008
Mail	-.013	-0.725	.253	.958
BidII	-.153	-0.752	.023	.000
Intercept	1.120		.704	.112
N	618			
Cox & Snell R^2	0.161			
Nagelkerke R^2	0.232			
Model $?^2$	108.656			
% Correct Predications	75.6			

Affects of the significant coefficients are as follows. All respondents earning less than $75,001 are less likely to pay for Policy II than to those earning more than $100,001. Older respondents are less likely to pay for Policy II than younger respondents. Non-environmentalists are less likely to pay than environmentalists. Respondents who do not support Policy I are more likely to pay for Policy II. As the bid price increases, respondents are less likely to pay for the implementation of Policy II.

Mail-Consolidated. Results for Policy II using the mail-consolidated data are presented in table 5.11. The R^2s and percent correctly predicted are similar to the mail-unconsolidated model. In general, the signs of the coefficients are as expected. Most coefficients (female, non-white, employed, retired, first, second and fourth income categories, no kids, non-homeowners, non-recyclers, and mail) are not significantly different from zero at an a-level of 0.15. The signs on the insignificant coefficients indicate that females, non-whites, retired, first and second income categories, and non-homeowners are less likely to pay than their reference category. Respondents who are employed, in the fourth income category, have no children, are non-recyclers, and responded by mail are less likely to pay than their reference category.

Table 5.11 Logit Results for Policy II with Mail-Consolidated Data

Variable	Coefficient	Marginal Effects	Standard Error	Sig.
Female	-.233	-0.657	.194	.231
Non-whites	-.307	-0.641	.245	.211
Employed	.191	0.746	.349	.585
Retired	-.166	-0.672	.372	.656
<25K	-.371	-0.626	.385	.335
25.1-50K	-.511	-0.592	.375	.173
50.1-75K	-.700	-0.546	.296	.018
75.1-100K	.192	0.746	.302	.524
Age	-.021	-0.703	.007	.001
No Kids	.233	0.754	.237	.325
Non-homeowners	-.005	-0.707	.258	.983
Non-Environmentalists	-.624	-0.565	.212	.003
Non-Recycler	.363	0.777	.253	.151
No Support	1.184	0.888	.325	.000
Mail	.053	0.719	.242	.825
CbidII	-.157	-0.674	.021	.000
Intercept	.885		.667	.185
N	620			
Cox & Snell	0.180			
Nagelkerke	0.248			
Model $?^2$	122.766			
% Correct Predications	73.1			

For the significant coefficients, the following affects are noted. Respondents in the third income category are more likely to pay than those earning more than $100,001. Older respondents are less likely to pay for a Policy II than younger respondents. Non-environmentalists are less likely to pay than environmentalists. Respondents who do not support Policy I are more likely to pay for implementation of Policy II. As the bid price increases, respondents are less likely to pay for Policy II.

Pooled-Unconsolidated. Results of the pooled-unconsolidated data model are presented in table 5.12. The Cox and Snell R^2 is 0.151, whereas the Nagelkerke R^2 is 0.218. Seventy-six percent of the observed responses are correctly predicated. Five coefficients in the estimated model, female, and the first, second and fourth income categories, and non-recyclers are not significantly different from zero at an a-level of 0.15. Signs of these coefficients indicate that females and respondents in the first and second income categories are less likely to pay for a curbside recycling program than their reference category. Respondents in the fourth income category and non-recyclers are more likely to pay for a Policy II.

The affects of the significant coefficients are as follows. Non-whites are less likely to pay the bid price for Policy II than whites. Respondents in the third income category are less likely to pay than those earning more than $100,001. Non-homeowners are more likely and non-environmentalists are less likely to pay than their corresponding reference category. Respondents who do not support Policy I are more likely to pay for implementation of Policy II. Mail and handout respondents are less likely to pay for Policy II than face-to-face respondents. As the bid price increases, respondents are less likely to pay for Policy II.

Table 5.12 Logit Results for Policy II with Pooled-Unconsolidated Data

Variables	Coefficient	Marginal Effects	Standard Error	p-value
Female	-.122	-0.630	.180	.497
Non-whites	-.455	-0.550	.245	.064
<25K	-.417	-0.559	.357	.242
25.1-50K	-.415	-0.560	.349	.234
50.1-75K	-.528	-0.532	.279	.058
75.1-100K	.224	0.707	.280	.425
Non-Homeowner	.690	0.793	.221	.002
Non-Environmentalist	-.371	-0.571	.201	.066
Non-Recycler	.055	0.671	.249	.825
No Support	1.085	0.851	.310	.000
Mail	-1.026	-0.409	.356	.004
Handout	-1.208	-0.365	.391	.002
BidII	-.157	-0.622	.020	.000
Intercept	.656		.530	.215
N	757			
Cox & Snell	0.151			
Nagelkerke	0.218			
Model $?^2$	124.363			
% Correct Predications	76.0			

Pooled-Consolidated. The results of the pooled-consolidated model (table 5.13) are similar to pooled-unconsolidated model. The signs and significance of the coefficients are the same as with the pooled-unconsolidated model with one exception. The fourth income category becomes significant at an a-level of 0.15.

Model Comparisons. In general, the R^2s, the Chi-square values, and the percent correct predictions between the four models are similar (table 5.14). There is more of a difference within the two mail data models than between the two pooled data models. Signs of three coefficients differ between the two mail data models. Two coefficients which are significant in the mail-unconsolidated model are not significant in the mail-consolidated model. In contrast, results of the two pooled data models are very similar. For instance, all the signs in

the pooled data models are the same. Significance of only one coefficient varies between the pooled-consolidated and pooled-unconsolidated models.

Table 5.13 Logit Results for Policy II with Pooled-Consolidated Data

Variables	Coefficient	Marginal Effects	Standard Error	p-value
Female	-.235	-0.588	.173	.175
Non-whites	-.394	-0.549	.229	.085
<25K	-.115	-0.616	.340	.734
25.1-50K	-.278	-0.577	.336	.408
50.1-75K	-.456	-0.533	.268	.089
75.1-100K	.405	0.730	.273	.138
Non-Homeowner	.380	0.725	.213	.074
Non-Environmentalists	-.524	-0.516	.194	.007
Non-Recycler	.224	0.693	.237	.344
No Support	1.293	0.868	.292	.000
Mail	-.733	-0.464	.344	.033
Handout	-.946	-0.412	.377	.012
CbidII	-.165	-0.604	.019	.000
Intercept	.589		.505	.243
N	759			
Cox & Snell	0.174			
Nagelkerke	0.240			
Model $?^2$	144.648			
% Correct Predications	73.1			

Except for three coefficients, the signs of most of the estimated coefficients are the same across all four models. The fourth income category is negative in the mail-unconsolidated model, but is positive in the other three models. The mail-consolidated model has two coefficients, non-homeowners and mail, which have different signs than in other three models. More coefficients are significant in the pooled data models than in the mail data models. From an economic standpoint, maybe the most important variable is the bid price. The differing assumptions on the bid price calculation have little effect on the sign, magnitude, and significance of the coefficients associated with bid price.

Table 5.14 Comparison of Model Estimates and Their Significance

	Mail-Unconsolidated		Mail-Consolidated		Pooled-Unconsolidated		Pooled-Consolidated	
Variable	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.
Female	-		-		-		-	
Non-whites	-		-		-		-	
Employed	+		+		nd	nd	nd	nd
Retired	-		-		nd	nd	nd	nd
<25K	-		-		-		-	
25.1-50K	-		-		-		-	
50.1-75K	-	S	-	S	-	S	-	S
75.1-100K	-[a, b]		+		+		+	
Age	-	S	-	S	nd	nd	nd	nd
No Kids	+		+		nd	nd	nd	nd
Non-Homeowners	+		-[a, b]		+		+	
Non-Environmentalists	-	S	-	S	-	S	-	S
Non-Recyclers	+		+		+		+	
No Support	+	S	+	S	+	S	+	S
Mail	-		+[a, b]		-		-	
Handout	na	na	na	na	-	S	-	S
Bid Price	-	S	-	S	-	S	-	S
Intercept	+		+		+		+	
N	618		620		757		759	
Cox & Snell R^2	0.161		0.180		0.151		0.174	
Nagelkerke R^2	0.232		0.248		0.218		0.240	
Model $?^2$	108.656		122.766		124.363		144.648	
% Correct Predications	75.6		73.1		76.0		73.1	

S Significant at the 15 percent level.
na Not Applicable.
nd No Data, variable dropped.
a Differs within data a set, consolidated vs. unconsolidated.
b Differs across the data sets, mail vs. pooled.

Policy III - Combination of Curbside and Drop-off Center

Mail-Unconsolidated. Results for Policy III using the mail-unconsolidated data are presented in table 5.15. The Cox and Snell and the Nagelkerke R^2s are 0.140 and 0.232. The proportion of correct predictions is 83 percent. Nine coefficients, female, non-whites, employed, retired, first and fourth income categories, non-homeowners, non-recyclers, and mail are not significantly different from zero at an a-level of 0.15. Signs on the coefficients of the insignificant coefficients indicate that females, employed, non-homeowners, and non-recyclers are more likely to pay, whereas non-whites, retired, first and fourth income

categories, and mail respondents are less likely to pay for the implementing Policy III than their reference categories.

Affects of the significant coefficients are as follows. All respondents earning between $25,001 and $75,000 are less likely to pay for Policy III than those earning more than $100,001. Older respondents are less likely to pay for a Policy III than younger respondents. Respondents without children are more likely to pay than those without children. Non-environmentalists are less likely to pay than environmentalists. Respondents who do not support Policy I are more likely to pay for Policy III. As the bid price increases, respondents are less likely to pay for Policy III.

Mail-Consolidated. The Cox and Snell and the Nagelkerke R^2s are 0.147 and 0.223 for the mail-consolidated data (table 5.16). The proportion of correct predictions of the observed responses by the model is 78 percent. Twelve coefficients, female, non-whites, employed, retired, all four income categories, no kids, non-homeowners, non-recycler, and mail, are not significantly different from zero at an a-level of 0.15. The signs on the insignificant coefficients indicate that females, employed respondents, respondents in the fourth income category, those without children, non-homeowners, and non-recyclers are more likely to pay for Policy III than their reference categories. In contrast, non-whites, retirees, respondents in the first three income categories, and mail respondents are less likely to pay than their reference categories.

Signs of the significant coefficients indicate that older respondents are less likely to pay for Policy III than younger respondents. Non-environmentalists are less likely to pay than environmentalists. Respondents who do not support Policy I are more likely to pay for Policy III. As the bid price increases respondents are less willing to pay for Policy III.

Table 5.15 Logit Results for Policy III with Mail-Unconsolidated Data

Variables	Coefficient	Marginal Effects	Standard Error	p-value
Female	.185	0.565	.236	.433
Non-whites	-.349	-0.433	.313	.265
Employed	.394	0.616	.427	.356
Retired	-.166	-0.478	.459	.718
<25K	-.635	-0.364	.474	.180
25.1-50K	-.732	-0.342	.459	.110
50.1-75K	-.702	-0.349	.348	.044
75.1-100K	-.414	-0.417	.358	.246
Age	-.027	-0.513	.009	.002
No Kids	.590	0.661	.304	.052
Non-Homeowners	.271	0.586	.312	.386
Non-Environmentalists	-.991	-0.286	.269	.000
Non-Recyclers	.238	0.578	.324	.463
No Support	1.284	0.796	.495	.010
Mail	-.283	-0.449	.287	.325
BidII	-.150	-0.482	.027	.000
Intercept	.078		.877	.929
N	618			
Cox & Snell R^2	0.140			
Nagelkerke R^2	0.232			
Model $?^2$	73.96			
% Correct Predications	83.5			

Table 5.16 Logit Results for Policy III with Mail-Consolidated Data

Variables	Coefficient	Marginal Effects	Standard Error	Sig.
Female	.112	0.624	.214	.601
Non-whites	-.211	-0.545	.277	.447
Employed	.206	0.645	.388	.595
Retired	-.184	-0.552	.416	.658
<25K	-.474	-0.480	.439	.280
25.1-50K	-.459	-0.484	.420	.274
50.1-75K	-.431	-0.491	.325	.185
75.1-100K	.107	0.622	.329	.746
Age	-.024	-0.591	.008	.002
No Kids	.178	0.639	.263	.498
Non-Homeowners	.203	0.645	.284	.475
Non-Environmentalists	-1.000	-0.353	.242	.000
Non-Recyclers	.226	0.650	.292	.439
No Support	1.319	0.847	.428	.002
Mail	-.283	-0.527	.260	.277
CbidIII	-.140	-0.563	.024	.000
Intercept	.393		.777	.613
N	620			
Cox & Snell	0.147			
Nagelkerke	0.223			
Model $?^2$	98.672			
% Correct Predications	78.7			

Pooled-Unconsolidated. Results using the pooled-unconsolidated data are presented in table 5.17. Eighty-two percent of the observations are correctly predicted by the model. Five coefficients, female, first, second, and fourth income categories, and non-recyclers are not significantly different from zero at an a-level of 0.15. Signs of the insignificant coefficients indicate that females and non-recyclers are more likely to pay for the implementation of Policy III than their reference category. Respondents in the first, second and fourth income categories are less likely to pay for a Policy III than respondents earning more than $100,001.

Table 5.17 Logit Results for Policy III with Pooled-Unconsolidated Data

Variables	Coefficient	Marginal Effects	Standard Error	p-value
Female	.109	0.580	.205	.595
Non-whites	-.560	-0.414	.294	.057
<25K	-.301	-0.478	.403	.456
25.1-50K	-.332	-0.471	.388	.392
50.1-75K	-.526	-0.423	.312	.091
75.1-100K	-.190	-0.506	.318	.552
Non-Homeowners	.678	0.709	.252	.007
Non-Environmentalists	-.914	-0.332	.246	.000
Non-Recyclers	.150	0.590	.300	.616
No Support	1.343	0.826	.419	.001
Mail	-1.305	-0.251	.401	.001
Handout	-1.225	-0.267	.435	.005
BidIII	-.146	-0.517	.022	.000
Intercept	.214		.640	.737
N	757			
Cox & Snell	0.127			
Nagelkerke	0.206			
Model $?^2$	102.941			
% Correct Predications	82.6			

The signs of the significant coefficients indicate that non-whites are less likely to pay for Policy III than whites. Respondents in the third income category are less likely to pay

than those earning more than $100,001. Non-homeowners are more likely to pay, whereas non-environmentalists are less likely to pay. Respondents who do not support Policy I are more likely to pay for Policy III. Mail and handout respondents are less willing to pay than face-to-face respondents. Bid price and the likelihood that the respondents would agree to pay the stated bid amount are inversely related.

Pooled-Consolidated. Results for Policy III using the pooled-consolidated data are presented in table 5.18. The R^2s increase slightly over the pooled-unconsolidated model. However, the proportion of correct predictions decreases to 77.

Table 5.18 Logit Results for Policy III with Pooled-Consolidated Data

Variables	Coefficient	Marginal Effects	Standard Error	p-value
Female	.016	0.575	.188	.933
Non-whites	-.356	-0.483	.260	.170
<25K	-.317	-0.493	.378	.401
25.1-50K	-.276	-0.503	.365	.450
50.1-75K	-.323	-0.491	.291	.266
75.1-100K	.199	-0.619	.295	.500
Non-Homeowners	.570	0.702	.232	.014
Non-Environmentalists	-.874	-0.358	.222	.000
Non-Recyclers	.182	0.615	.272	.503
No Support	1.490	0.855	.379	.000
Mail	-1.351	-0.257	.364	.000
Handout	-1.219	-0.283	.396	.002
CbidIII	-.147	-0.535	.020	.000
Intercept	.288		.580	.619
N	759			
Cox & Snell	0.151			
Nagelkerke	0.226			
Model $?^2$	124.062			
% Correct Predications	77.1			

Seven coefficients in the estimated model, female, non-whites, all four income categories, and non-recyclers are not significantly different from zero at an a-level of 0.15.

Signs on the insignificant coefficients indicate that females, respondents in the fourth income category, and non-recyclers are more likely to pay for Policy III than their reference category. Non-whites and all respondents earning less than $75,001 are less likely to pay for Policy III than their reference categories.

Affects of the significant coefficients are as follows. Non-homeowners are more willing to pay for Policy III than homeowners. Non-environmentalists are less likely to pay than non-environmentalists, whereas respondents who do not support Policy I are more likely to pay for Policy III. Compared to face-to-face respondents, mail and handout respondents are less likely to pay. As the bid price increases respondents are less willing to pay for Policy III.

Model Comparisons. There are some differences and similarities between the results for Policy III (table 5.19). The results of the two mail data models are similar in terms of coefficients' signs, except in the case of the fourth income category ($75,001 to 100,000). A similar difference in sign is seen for the same coefficients between the two pooled data models. Additionally, there are three (two) coefficients that are significant in the mail- (pooled-) unconsolidated model that are not in the mail- (pooled-) consolidated model.

The model Chi-square values vary between the mail and pooled models, with the latter being larger. In the mail- and pooled-unconsolidated models, the percent correct predictions are about five percentage points higher than in the mail- and pooled-consolidated models. Only the sign of the fourth income category, $75,001-$100,000, is inconsistent across all the models. More coefficients are significant in the pooled models than in the mail models.

Table 5.19 Comparison of Model Estimates and Their Significance

	Mail-Unconsolidated		Mail-Consolidated		Pooled-Unconsolidated		Pooled-Consolidated	
Variable	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.
Female	+		+		+		+	
Non-whites	-		-		-		-	
Employed	+		+		nd	nd	nd	nd
Retired	-		-		nd	nd	nd	nd
<25K	-		-		-		-	
25.1-50K	-		-		-		-	
50.1-75K	-		-		-		-	
75.1-100K	-		+ [a, b]		-		+ [a, b]	
Age	-	S	-	S	nd	nd	nd	nd
No Kids	+		+		nd	nd	nd	nd
Non-Homeowners	+		+		+		+	
Non-Environmentalists	-	S	-	S	-	S	-	S
Non-Recyclers	+		+		+		+	
No Support	+	S	+	S	+	S	+	S
Mail	-		-		-		-	
Handout	na	na	na	na	-	S	-	S
Bid Price	-	S	-	S	-	S	-	S
Intercept	+		+		+		+	
N	618		620		757		759	
Cox & Snell R^2	0.140		0.147		0.127		0.151	
Nagelkerke R^2	0.232		0.223		0.206		0.226	
Model $?^2$	73.96		98.672		102.941		124.062	
% Correct Predications	83.5		78.7		82.6		77.1	

S Significant at the 15 percent level.
na Not Applicable.
nd No Data, variable dropped.
a Differs within data a set, consolidated vs. unconsolidated.
b Differs across the data sets, mail vs. pooled.
c Differs within and across the data sets, mail vs. pooled and unconsolidated v. consolidated.

Willingness-to-Pay

Mean monthly WTP and the standard error for WTP are calculated using the delta method for the estimated coefficients for Policies II and III are presented in table 5.20 (Greene). Mean WTPs associated with the models estimated using the pooled data sets are higher than the corresponding WTPs from models estimated using the mail data sets. Within each set of models, models estimated using the consolidated bid price provide higher mean WTP than models estimated using the unconsolidated bid price. Given the data sets design, higher WTPs using the consolidated bid price are not unexpected. For a given data set

design, the mean WTPs for Policy II are higher than the WTPs for Policy III. The standard deviations are low in all eight cases, ranging between a high of $0.42 in the case of Policy II for the mail-consolidated model and a low of $0.004 for Policy III for the pooled-unconsolidated model. also, standard deviations of WTP are higher for Policy II than for Policy III. Using the consolidated bid prices results in a higher standard deviation of WTP than unconsolidated bid prices.

Table 5.20 Mean WTP for Different Regression Models at Means of All Categories

	Policy II	Policy III
Mail-Unconsolidated Model	$2.43	$0.90
	(0.193)	(0.082)
Mail-Consolidated Model	2.78	1.50
	(0.490)	(0.320)
Pooled-Unconsolidated Model	2.93	1.48
	(0.034)	(0.004)
Pooled-Consolidated Model	3.21	1.77
	(0.095)	(0.019)

Note: WTP calculated at sample means for continuous variables, except for income, and included factor for categorical variables.
Standard errors are in parenthesis.

The effect on WTP is examined for three factors, transitory population, income, and data collection mode. Students, being a transitory population, may have an affect on the WTP for curbside recycling services. Second, previous studies have shown the importance of income in economic analysis. Finally, because the data was collected by three different methods, examining the influence of the data source on WTP is important. Using the mail-unconsolidated model, WTP by income categories and employment are presented in table 5.21a. WTPs for students across all five-income categories are higher than retired respondents, but lower than employed respondents for both Policy II and III. The

difference between employed and student respondents, however, is small. WTP differs by approximately 10 to 15 cents between employed respondents and students. For a given income category, WTPs for Policy II are higher than those for Policy III. As income increases, WTP increases.

Table 5.21a WTP for Proposed Recycling Policies Using Mail-Unconsolidated Data

	Inc1	Inc2	Inc3	Inc4	Inc5
			Policy II		
Employed	3.06	3.33	3.51	3.97	4.34
	(0.250)	(0.914)	(0.489)	(0.557)	(0.438)
Retired	2.84	3.05	3.22	3.65	4.01
	(0.548)	(0.497)	(0.457)	(0.191)	(0.931)
Student	2.96	3.22	3.40	3.84	4.20
	(0.199)	(0.455)	(0.581)	(0.178)	(0.619)
			Policy III		
Employed	1.09	1.26	1.36	1.50	1.61
	(0.005)	(0.233)	(0.278)	(0.396)	(0.411)
Retired	0.90	1.01	1.10	1.21	1.29
	(0.108)	(0.009)	(0.195)	(0.200)	(0.109)
Student	0.94	1.15	1.25	1.37	1.52
	(0.119)	(0.089)	(0.011)	(0.158)	(0.210)

Note: WTP calculated at sample means for continuous variables, except for income, and included factor for categorical variables.
Standard errors are in parenthesis.

In table 5.21b, the WTP using the mail-consolidated model are presented. Students' WTPs are lower than employed respondents, but higher than retired respondents are across all income categories for both Policy II and III. Differences between students' and employed WTPs are slightly higher than for the mail-unconsolidated models ranging up to 26 cents. WTP increases as income increases. Policy II's WTP are higher than the WTPs for Policy III.

Table 5.21b WTP for Proposed Recycling Policies Using Mail-Consolidated Data

	Inc1	Inc2	Inc3	Inc4	Inc5
			Policy II		
Employed	3.13	3.40	3.44	3.91	4.27
	(0.119)	(0.244)	(0.615)	(0.019)	(0.459)
Retired	2.87	3.03	3.07	3.50	3.83
	(0.245)	(0.401)	(0.237)	(0.293)	(0.009)
Student	3.03	3.19	3.23	3.67	4.01
	(0.181)	(0.489)	(0.419)	(0.398)	(0.671)
			Policy III		
Employed	1.48	1.73	1.82	1.98	2.76
	(0.009)	(0.223)	(0.331)	(0.511)	(0.417)
Retired	1.27	1.50	1.58	1.72	2.42
	(0.019)	(0.019)	(0.070)	(0.415)	(0.291)
Student	1.41	1.60	1.68	1.83	2.56
	(0.101)	(0.201)	(0.198)	(0.217)	(0.294)

Note: WTP calculated at sample means for continuous variables, except for income, and included factor for categorical variables.
Standard errors are in parenthesis.

WTP using the pooled-unconsolidated models by data source, mail, handout, and face-to-face, are presented in tables 5.22a and 5.22b. Face-to-face respondents have higher WTPs than mail and handout respondents, whereas mail respondents' WTPs are higher than handout respondents'. Respondents in higher income categories have higher WTPs than people in the lower income categories. WTPs for Policy II are higher than WTP Policy III for all three data sources. Consolidated bid price models' WTP are higher than for the unconsolidated models. The WTPs using the pooled-consolidated data set have the same pattern as the WTPs using the unconsolidated data set.

Table 5.22a WTP for Proposed Recycling Policies Using Pooled- Unconsolidated Data

	Inc1	Inc2	Inc3	Inc4	Inc5
		Policy II			
Mail	2.88	3.00	3.18	3.40	5.67
	(0.187)	(0.511)	(0.487)	(0.401)	(0.629)
Handout	2.44	2.54	2.75	2.94	5.03
	(0.172)	(0.353)	(0.413)	(0.514)	(0.579)
Face-to-face	3.51	3.66	3.98	4.25	6.83
	(0.255)	(0.388)	(0.357)	(0.398)	(0.917)
		Policy III			
Mail	1.52	1.74	1.74	2.01	2.41
	(0.019)	(0.189)	(0.164)	(0.004)	(0.111)
Handout	1.62	1.87	1.86	2.02	2.14
	(0.025)	(0.204)	(0.287)	(0.391)	(0.220)
Face-to-face	1.97	2.18	2.17	2.35	2.80
	(0.000)	(0.355)	(0.517)	(0.593)	(0.415)

Note: WTP calculated at sample means for continuous variables, except for income, and included factor for categorical variables.
Standard errors are in parenthesis.

Table 5.22b WTP for Proposed Recycling Policies Using Pooled-Consolidated Data

	Inc1	Inc2	Inc3	Inc4	Inc5
		Policy II			
Mail	3.05	3.40	3.39	3.75	5.91
	(0.305)	(0.453)	(0.511)	(0.445)	(0.641)
Handout	2.45	2.88	2.87	3.19	5.14
	(0.351)	(0.379)	(0.241)	(0354)	(0.401)
Face-to-face	3.08	3.42	3.40	3.77	5.93
	(0.090)	(0.219)	(0.088)	(0.331)	(0.558)
		Policy III			
Mail	1.79	1.94	1.97	2.13	2.55
	(0.217)	(0.239)	(0.262)	(0.567)	(0.419)
Handout	2.01	2.17	2.21	2.38	2.84
	(0.107)	(0.184)	(0.281)	(0.249)	(0.335)
Face-to-face	2.19	2.48	2.53	2.72	3.23
	(0.278)	(0.090)	(0.157)	(0.228)	(0.283)

Note: WTP calculated at sample means for continuous variables, except for income, and included factor for categorical variables.
Standard errors are in parenthesis.

Most Preferred Policy Change

Policies I through III were presented on the questionnaire as mutually exclusive alternatives. Obtaining a referendum on Policy I and WTPs for Policies II and III provides information on each individual policy, but does not indicate which policy is preferred. Respondents, therefore, were given an opportunity to state their most preferred policy by ranking their preferences among the four possible policy scenarios. Results of multinomial logit models comparing the preference of respondents for Policies I through III to the situation at the time of the survey (Current Situation) are presented in tables 5.23 and 5.24. As with all models presented here, the null hypotheses that all coefficients except the intercept are equal to zero are rejected for the two models (Chi-Square values of 100.783 and 104.162). The different R^2 measures between the two models are similar.

Using the mail data set, the coefficients associated with non-white, employed, retired, the fourth income category, and mail, are not significant for all three policies at an a-level of 0.15. Individually, only the coefficients associated with non-homeowners are significant at a-level of 0.15 for all three policies. Females are more likely than males to prefer Policy I and III to the Current Situation, but are less likely to support either Policy II to the Current Situation. Non-whites are also more likely to prefer Policy III and less likely to prefer either Policy I or II to the Current Situation.

Table 5.23 Multinomial Logit Results of the Most Preferred Change with Mail Data

Variables	Coefficients	Standard Error	p-value
	Policy I		
Female	0.055	0.239	0.816
Non-whites	-0.121	0.294	0.680
Employed	0.361	0.435	0.406
Retired	-0.141	0.457	0.758
<25K	-0.008	0.477	0.987
25.1-50K	-0.880	0.462	0.057
50.1-75K	-0.192	0.379	0.613
75.1-100K	-0.162	0.406	0.690
Age	-0.011	0.007	0.152
No Kids	0.518	0.285	0.069
Non-Homeowners	0.714	0.349	0.041
Non-Environmentalists	0.166	0.256	0.516
Non-Recyclers	-1.553	0.337	0.000
Mail	-0.206	0.287	0.473
Intercept	0.765	0.713	0.283
	Policy II		
Female	-0.396	0.247	0.109
Non-whites	-0.384	0.309	0.214
Employed	0.430	0.452	0.342
Retired	0.357	0.469	0.447
<25K	-1.460	0.498	0.003
25.1-50K	-1.740	0.486	0.000
50.1-75K	-0.843	0.378	0.026
75.1-100K	-0.399	0.396	0.313
Age	-0.016	0.008	0.036
No Kids	0.370	0.296	0.212
Non-Homeowners	0.936	0.351	0.008
Non-Environmentalists	-0.124	0.265	0.639
Non-Recyclers	-0.239	0.299	0.424
Mail	0.408	0.316	0.197
Intercept	0.978	0.736	0.184
	Policy III		
Female	0.313	0.270	0.246
Non-whites	0.155	0.318	0.626
Employed	0.429	0.499	0.391
Retired	0.004	0.525	0.993
<25K	-0.322	0.548	0.557
25.1-50K	-0.483	0.515	0.348
50.1-75K	-0.240	0.439	0.585
75.1-100K	-0.172	0.470	0.714
Age	-0.015	0.008	0.076
No Kids	0.210	0.317	0.509
Non-Homeowners	0.837	0.379	0.027
Non-Environmentalists	-0.523	0.298	0.079
Non-Recyclers	-0.168	0.343	0.623
Mail	-0.400	0.329	0.225
Intercept	0.487	0.804	0.545
N	616		
Cox and Snell R^2	0.140		
Nagelkerke R^2	0.150		
McFadden R^2	0.055		
Model $?^2$	100.783		

Table 5.24 Multinomial Logit Results of the Most Preferred Change with Pooled Data

Variables	Coefficients	Standard Error	p-value
	Policy I		
Female	-0.085	0.211	0.686
Non-whites	-0.169	0.270	0.533
<25K	-0.329	0.410	0.423
25.1-50K	-1.056	0.410	0.010
50.1-75K	-0.469	0.328	0.153
75.1-100K	-0.076	0.359	0.833
Non-Homeowners	0.836	0.284	0.003
Non-Environmentalists	0.246	0.231	0.285
Non-Recyclers	-1.636	0.312	0.000
Mail	-0.105	0.424	0.804
Handout	-0.088	0.461	0.848
Intercept	0.856	0.506	0.091
	Policy II		
Female	-0.387	0.217	0.074
Non-whites	-0.395	0.279	0.158
<25K	-1.186	0.432	0.006
25.1-50K	-1.420	0.430	0.001
50.1-75K	-0.725	0.335	0.031
75.1-100K	0.051	0.357	0.886
Non-Homeowners	1.091	0.286	0.000
Non-Environmentalists	-0.075	0.239	0.752
Non-Recyclers	-0.366	0.274	0.181
Mail	-0.232	0.446	0.603
Handout	-0.795	0.492	0.106
Intercept	1.235	0.522	0.018
	Policy III		
Female	0.244	0.235	0.299
Non-whites	0.079	0.289	0.785
<25K	-0.228	0.477	0.633
25.1-50K	-0.320	0.458	0.485
50.1-75K	-0.171	0.391	0.662
75.1-100K	0.200	0.421	0.636
Non-Homeowners	1.071	0.303	0.000
Non-Environmentalists	-0.504	0.269	0.061
Non-Recyclers	-0.173	0.311	0.578
Mail	-0.399	0.447	0.372
Handout	-0.105	0.487	0.829
Intercept	0.427	0.558	0.999
N	753		
Cox and Snell R^2	0.129		
Nagelkerke R^2	0.138		
McFadden R^2	0.050		
Model $?^2$	104.162		

Employed respondents are more likely than students are to prefer a policy change to the Current Situation. Compared to students, retirees are more likely to prefer Policy II and III to the Current Situation; however, retirees prefer the Current Situation to Policy I. Respondents in all income categories are less likely than those earning more than $100,001 to prefer a policy change to Current Situation. Older respondents are less likely to prefer any of the three proposed policy changes to the Current Situation. Respondents without children and non-homeowners are more likely to prefer a policy change to the Current Situation.

Non-environmentalists are more likely to prefer Policy I and less likely to prefer Policies II and III to the Current Situation. Non-recyclers are more likely to prefer the Current Situation than any of the proposed policy changes. Mail respondents are more likely to prefer Policy II and less likely to prefer Policies II and III to the Current Situation.

Results using the pooled data are presented in table 5.24. In the pooled data set, individually the coefficients associated with the coefficients, non-white, fourth income category and mail, are not significant for any of the policies, whereas the coefficients associated with non-homeowners are significant for all three policies. Signs of the coefficients are the same as for the mail model, except for four coefficients. The coefficient associated with females for Policy I using the pooled data is negative, but it is positive when using the mail data set. For Policies II and III using the pooled data the fourth income category, coefficients are positive, whereas they are negative when using the mail data. The coefficient associated with mail in Policy II is negative in the pooled model, but it is positive using the mail data set. In the pooled model, there are three categories to capture mode of

survey, mail, handout, and face-to-face. Both mail and handout respondents are less likely to prefer either of the policy changes to the Current Situation than face-to-face respondents.

Probabilities of Most Preferred Policy

Predicted probabilities for the most preferred policy computed using the sample means of the explanatory variables are presented in table 5.25. The probabilities are similar between models estimated using the two data sets. At the means, respondents tend to have slightly higher probability of preferring Policy II to the other two policies or the Current Situation. The probabilities are spread, however, between the two new Policies (II and III) and the Current Situation. The probability of preferring Policy I is the lowest.

Table 5.25 Probabilities for Most Preferred Policy for Mail and Pooled Model

	Mail Model	Pooled Model
Policy I	0.17	0.16
Policy II	**0.34**	**0.40**
Policy III	0.23	0.23
Current	0.26	0.21

Probabilities calculated at the sample means of the independent variables.

Probabilities of preferring a particular policy using the mail data set for income categories by employed, retired, and student are presented in tables 5.26a, 5.26b and 5.26c. For employed respondents, people in the first income category have a higher probability of preferring Policy I, while those in the second, fourth and fifth income categories are more likely to prefer Policy II (table 5.26a). Employed respondents in the third income category have a higher probability of preferring the Current Situation. Retired respondents in the

first two and last two income categories tend to prefer Policy II, whereas retirees in the third income category are equally likely to prefer Policy III and the Current Situation (table 5.26b). Students across all income categories, except the third, have a higher probability of preferring the Policy II (table 5.26c). Students in the third income category prefer the Current Situation.

Table 5.26a Probabilities for Most Preferred Policy for Employed Respondents Across Income Categories for Mail Model

	Inc1	Inc2	Inc3	Inc4	Inc5
Policy I	**0.33**	0.14	0.12	0.14	0.14
Policy II	0.28	**0.42**	0.26	**0.44**	**0.49**
Policy III	0.20	0.22	0.23	0.21	0.20
Current	0.19	0.22	**0.38**	0.20	0.17
Total	1.00	1.00	1.00	1.00	1.00

Probabilities calculated at the sample means of the independent variables except for variables varied.

Table 5.26b Probabilities for Most Preferred Policy for Retired Respondents Across Income Categories for Mail Model

	Inc1	Inc2	Inc3	Inc4	Inc5
Policy I	0.13	0.12	0.17	0.12	0.12
Policy II	**0.42**	**0.43**	0.21	**0.46**	**0.50**
Policy III	0.23	0.23	**0.31**	0.22	0.21
Current	0.22	0.22	**0.31**	0.21	0.18
Total	1.00	1.00	1.00	1.00	1.00

Probabilities calculated at the sample means of the independent variables except for variables varied.

Table 5.26c Probabilities for Most Preferred Policy for Student Respondents Across Income Categories for Mail Model

	Inc1	Inc2	Inc3	Inc4	Inc5
Policy I	0.17	0.15	0.20	0.14	0.15
Policy II	**0.42**	**0.41**	0.19	**0.42**	**0.50**
Policy III	0.23	0.22	0.28	0.20	0.20
Current	0.19	0.22	**0.32**	0.23	0.15
Total	1.00	1.00	1.00	1.00	1.00

Probabilities calculated at the sample means of the independent variables except for variables varied.

In tables 5.27a through 5.27c, the probabilities of preferring a particular policy for the pooled data set model by the three survey modes are presented. Mail respondents in the first three income categories have a higher probability of preferring the Current Situation, whereas mail respondents in the fourth and fifth categories prefer Policy II. While handout respondents in the first income category are equally likely to prefer Policy III and the Current Situation, those in second income category prefer only the Current Situation. Handout respondents in the third and fourth income categories have a higher probability of preferring Policy III, whereas respondents in the fifth income category prefer Policy II. Face-to-face respondents in the first two income categories are more likely to prefer Policy I, whereas respondents in the third prefer Policy III. Respondents in the fourth and fifth income categories have a higher probability of preferring Policy II.

Table 5.27a Probabilities for Most Preferred Policy for Mail Respondents Across Income Categories for Pooled Model

	Inc1	Inc2	Inc3	Inc4	Inc5
Policy I	0.22	0.07	0.15	0.14	0.18
Policy II	0.10	0.08	0.22	**0.45**	**0.50**
Policy III	0.29	0.32	0.29	0.26	0.17
Current	**0.40**	**0.53**	**0.35**	0.15	0.15
Total	1.00	1.00	1.00	1.00	1.00

Probabilities calculated at the sample means of the independent variables except for variables varied.

Table 5.27b Probabilities for Most Preferred Policy for Handout Respondents Across Income Categories for Pooled Model

	Inc1	Inc2	Inc3	Inc4	Inc5
Policy I	0.21	0.06	0.15	0.16	0.22
Policy II	0.05	0.04	0.12	0.29	**0.34**
Policy III	**0.37**	0.40	**0.38**	**0.39**	0.27
Current	**0.37**	**0.49**	0.35	0.17	0.17
Total	1.00	1.00	1.00	1.00	1.00

Probabilities calculated at the sample means of the independent variables except for variables varied.

Table 5.27c Probabilities for Most Preferred Policy for Face-to-Face Respondents Across Income Categories for Pooled Model

	Inc1	Inc2	Inc3	Inc4	Inc5
Policy I	**0.34**	**0.36**	0.27	0.14	0.17
Policy II	0.09	0.06	0.20	**0.45**	**0.52**
Policy III	0.32	0.30	**0.32**	0.31	0.21
Current	0.24	0.28	0.21	0.10	0.10
Total	1.00	1.00	1.00	1.00	1.00

Probabilities calculated at the sample means of the independent variables except for variables varied.

Discussion

Recycling behavior is examined against a more comprehensive list of explanatory variables than previous studies. While many of the explanatory variables included in the estimation

have been individually applied in different studies, they have not been considered in unison. However, two of the more common variables used in previous studies, social conformity and incentives (motivations to recycle), are not included in this study. Including explanatory variables for these factors in the models estimated here would non-trivially reduce the number of observations, therefore, the degrees of freedom. A large number of respondents did not respond to one or both of the questions addressing these factors. Of those responding to the social conformity question, only four percent of the respondents who recycled reported knowing somebody who also recycled. Likewise, monetary gains from recycling were stated to be a factor motivating recycling behavior by only seven percent of the respondents. Previous studies found recycling behavior is positively correlated with females, whites, employment, income, households with children, homeowners, and environmental awareness (for a discussion see Chapter II). Results from the models examining recycling behavior in Bryan are similar to the previous studies for these factors. Contrary to previous findings, recycling is negatively correlated with age in the Bryan sample.

As expected, respondents in lower income categories are less likely to recycle compared to those in the highest income category. Although the opportunity cost of time is higher for people with higher income, those with higher incomes also tend to be more educated and environmentally aware. Retirees are less likely to recycle than students possibly because of the effort—collection, cleaning, storing and transportation—involved in recycling and a lack of environmental awareness among retirees. Because of its beginnings in the 1970s, the influence of the environmental movement in general and environmental education in particular may be more pronounced on younger generations than on older

generations. Mail respondents are less likely to recycle than handout and face-to-face respondents. The most likely explanation is the sample population of each group. By design, respondents in the handout and face-to-face groups were recycling at the Bryan drop-off center. Mail respondents were randomly chosen from all households in Bryan.

A referendum on a new drop-off center (Policy I) is the second aspect of study. Because no previous study could be found concerning this issue, comparison of the results is not possible. The signs of the coefficients are generally as expected. Lack of support for Policy I among females is contrary to the finding associated with recycling behavior and expectation. Because results from previous literature regarding recycling behavior and those presented here show that females are more likely to recycle, it was expected the sign of the coefficient associated with female should be positive instead of negative. It is important to note that support for Policy I among respondents in the lowest income category and non-whites may be contrary to previous studies, which suggest these groups do not recycle at rates comparable to whites and people with higher incomes. However, results are consistent in light of the information contained in the referendum question. The questions explicitly state funds would be obtained from other sources such as grants, which imply no new monetary burden would be imposed in the form of a tax or fee to establish the new drop-off center. Retirees are less likely to support Policy I than students. One possible explanation is retirees are less likely to engage in recycling behavior. Face-to-face and handout respondents are less likely to support than mail respondents. The face-to-face and handout respondents are already using the existing drop-off center; they may feel there is no use to duplicate the efforts of the existing center. Given that a majority of those who recycle combine their trips to the drop-off center with other errands, the effort of transporting recyclables is probably

minimal. Interestingly, environmentalists and recyclers are less likely to support Policy I. Again, this may be because they are already recycling.

The estimated mail and pooled data set models used to calculate the WTPs for Policies II and III are also more comprehensive in terms of the explanatory variables than previous studies (for a discussion see Chapter II). Variables included in this study that are not used in previous studies are, ethnicity, employment, non-homeowner, and non-environmentalist. One of the most important variables from an economic standpoint is the bid price. Inferences concerning the affect, magnitude, and significance of the bid price coefficients do not change between the different data sets. In terms of signs on the other coefficients, the majority of them are the same across the different models.

The four models estimated for Policy II are very similar. Only three of the 52 estimated coefficients have different signs. In terms of significance, the pooled data set models have more coefficients that are significantly different from zero at a-level of 0.15 than the mail data set models. Two potential reasons for this difference in significance are postulated. First, by pooling the data sources, three variables could not be used in the estimation procedure. The effects of these three excluded variables may be captured by the remaining variables in the pooled models, causing a change in standard error and magnitudes, thus the significance levels. Second, by pooling the data from different sources there is a substantial increase in the number of observations and variability in the pooled model.

Females are less willing than males to pay for Policy II, although they are more likely to recycle. But, they are more willing to pay for Policy III than males. Also recall females are less likely to support Policy I. These results may indicate females want more recycling

services and are willing to pay for these services. It is postulated that females may have compared the three policy options, although respondents were specifically asked not to, and chose the policy that offered the most services. This probably is also an indication of the altruistic and egalitarian nature that females are stated to have (Andreoni and Vesterlund; Dietz, Kalof and Stern; Eckel and Grossman).

Non-whites may be less likely to pay for curbside recycling, previous studies indicate they tend to recycle less than whites, and as such they may not be willing to pay for a service they may not use. Differences between employed, retirees, and students indicate a slight transitory population affect may exist in Bryan. However, the impact of the large student population in Bryan may not lower the overall WTP for curbside recycling services since the standard deviations are very narrow. Interestingly, those who do not support Policy I are more willing to pay for Policy II, the curbside recycling service. It appears that the opportunity cost associated with transportation of recyclables to the drop-off center matters to the subgroup who do not support Policy I.

In the case of the four estimated models for Policy III, the results are generally the same. Even fewer differences in coefficient signs (two different out of 52) are noted. As is the case for Policy II, more variables are significant in the pooled model than the mail model. The reasons given for Policy II also hold here. Results for Policy III are very similar to the results for Policy II. Thus, the discussion associated with Policy II also holds for Policy III.

Monthly mean WTPs for Policy II are higher than for Policy III, even though Policy III offers more recycling services to the community, while imposing a negative externality on individual households in the forma of a subsidy to households not covered by curbside.

Proposed in Policy III was a curbside recycling service along with a new drop-off center to give households not covered by curbside an opportunity to recycle. Respondents may not feel both a new recycling center and curbside recycling service is necessary. As such, they are less WTP for combined services which they may are not necessary. Again, respondents appear to be comparing the mutually exclusive policy alternatives. A related factor leading to the higher WTPs for Policy II is the questionnaire design. The bid amount proposed for Policy II in each questionnaire was consistently lower than that for Policy III. Therefore, respondents may have focused on the higher cost rather than focus on the expanded services; they may not have answered each policy question separately. Accordingly, in the data sets, there are fewer respondents agreeing to pay the stated bid amount for Policy III than for Policy II.

Mean WTPs for students are higher than for retirees, but lower than for employed respondents. It is postulated that students are probably more environmentally aware than retirees and are more willing to pay since they can transfer the burden to their parents or to permanent residents by only expressing a WTP, but not actually pay. Also, students are on much lower income, a transitory population and hence less likely to pay more than employed residents who are also likely to be residents of Bryan. Face-to-face respondents have higher WTPs than mail and handout respondents. This may be indicative of the "yea saying" bias in CVM studies that are based on personal interviews; higher likelihood of respondents agreeing to a bid amount because of the interviewer's presence. Also, bias introduced by the interviewer could be influencing responses. Handout respondents are already engaged in recycling activities using the drop-off recycling center. Therefore, handout respondents' lower WTP than mail respondents maybe a function of the fact that

the former respondents are less willing to pay for new recycling services they feel are a duplication of current services.

Generally, the WTPs presented here are lower than the WTP presented in previous studies (approximately $12 ($4) for urban (rural) residents for a drop-off recycling center, and between $4 and $14 for curbside service, see discussion in Chapter II). Several possible reasons are postulated for the lower WTP. Geographic location may be a contributing factor. Waste disposal may not be as important of a problem as respondents felt it was in the previous studies. Landfill space may be comparatively less expensive because of the relative abundance of available land in Texas than in England, Williamson County, TN, Ogden, UT, Finland, and UT. Another geographically related factor is the potential preference of Bryan residents for decentralized recycling programs. While there is no direct evidence to support this statement regarding the public, public agencies in Texas have preferred voluntary compliance approaches to regulations (see Hall; and TNRCC 2000).[4] Third, the relatively smaller size and comparative non-urban nature of Bryan could be contributing to the lower WTP. Finally, the schedule of bid amounts assigned to the follow-up questions were too close to the initial bid amounts. The DCFQ did not capture the upper bound of respondents willing to pay. This is evidenced in the overwhelming majority of the respondents who agreed to pay the bid amount proposed on the initial WTP question also agreed to pay the bid amount proposed on follow-up question.

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[4] More recently, and specifically in connection with recycling, Objective 01 in The Strategic Plan for Fiscal Years 2003 – 2007 (Volume 1) is, "To decrease the amount of toxics released and disposed of in Texas by 30 percent by 2005 from the 1992 level through assessing the environment, permitting facilities, and promoting voluntary pollution prevention and recycling." (Document available at http://www.tnrcc.state.tx.us/admin/topd oc/sfr/035_02/vol1_part-iii.pdf).

The WTP calculated at the independent variables' sample means for Policy II are only slightly higher than Bryan's estimated cost of $2.50 per household to establish a curbside recycling program. Because Bryan will not be able to recover the cost of recyclable collection, households will have to be charged a fee to pay a private hauler. The closeness of the WTP to the estimated cost of the program may help explain why there is no determined effort in Bryan to establish a curbside service. Household WTP would not cover the cost of implementing Policy III.

The probabilities calculated for the most preferred policy indicate that most respondents prefer Policy II followed by Policy III. Disaggregating the probabilities by the different data sets, employment, and income, shows that the Policy II is preferred in a majority of the cases.

In terms of serving as a guide to policymaking in Bryan, the different models offer some general direction. Taken together the WTPs and probabilities associated with the most preferred policy show that respondents may prefer a curbside service. This tempered support is somewhat manifest in the summary statistics, a total of 66 percent of the respondents preferring some policy change. It is unclear, however, whether the tempered support for Policy II will result in sufficient participation rates to make the program successful.

CHAPTER VI

CONCLUSIONS

Municipal waste recycling rates in Bryan are lower than the target rate of 40 percent set by the City when it signed-up to become part of the Clean Cities Campaign. Bryan is considering alternative policies in an attempt to increase recycling rates. However, data and / or information required to choose among alternative policies is lacking. This study is designed to collect necessary data and provide Bryan decision makers with additional information concerning its citizens' opinions on solid waste management (SWM) issues, recycling behavior, and willingness-to-pay (WTP) for different SWM policies.

Specifically, the overall objective of this study is to analyze economic aspects of household recycling behavior and attitudes in Bryan to improve its SWM policies. To achieve this overall objective, a survey of households in Bryan was conducted. Using data from the survey, residents' attitudes towards SWM are analyzed, in general, and specifically the factors influencing recycling behavior are characterized. In addition, three SWM policies are examined, a new recycling drop-off center (Policy I), curbside recycling service (Policy II), and a combination of curbside recycling and drop-off center (Policy III).

Residents of Bryan were sampled in two overlapping populations. First, a systematic sampling technique was used to select a representative sample of Bryan households who were administered a mail survey. Second, recyclers using the city's drop-off recycling center were either interviewed or they were provided the questionnaire to be completed and returned by mail.

Results and Discussion

The combined response rate from the three modes of survey is approximately 40 to percent. Retirees, people with higher education, and higher income brackets are overrepresented, whereas non-whites and students are under-represented when compared to the 2000 census figures for Bryan. Because the sample is not completely representative of the population, care should be taken when interpreting results. Respondents generally ranked the five SWM alternatives, source reduction, recycling, composting, landfilling, and incineration, consistent with the SWM hierarchy (U.S. EPA 1989). Further, respondents reported that the focus of future SWM policies in Bryan should include recycling, source reduction, and composting (currently a major focus of Bryan's SWM policies). Most respondents who did not recycle reported either having no useful information about recycling or were unaware of the existence of the drop-off center. Only a fifth of the respondents reported using the drop-off recycling center Bryan currently operates. Most trips to the drop-off center were combined with other errands. The drive through nature and help unloading recyclables were identified as the most important features of the center. Approximately, 66 percent of the respondents were in favor of changes to Bryan's SWM policies.

Five aspects of SWM in Bryan are examined in detail. Residents that are female, white, employed, have higher incomes, have children, own a house, and are self-perceived environmentalists tend to recycle more. These results are similar to previous studies, indicating a set of factors that can be used, in general, to explain recycling behavior. Because respondents approached at the drop-off center are already recycling, these respondents are more likely than the mail survey respondents to recycle. This issue may indicate a bias in the mode of data collection.

The second aspect examined is the referendum on a new drop-off center (Policy I). The signs of the coefficients are generally as expected, except for females and retirees. The lack of support for Policy I among females is contrary to findings associated with recycling behavior. Retirees also do not support Policy I possibly because they are less likely to engage in recycling and do not perceive a need for recycling program(s). Respondents in the lowest income category and non-whites support Policy I. Face-to-face and handout respondents are less likely to support than mail respondents, because the former group already uses the existing drop-off center and may find no use to duplicate services. Possibly because they are already recycling, environmentalists and recyclers also do not support Policy I.

Given these set of results, future SWM policies promoting recycling programs in Bryan should focus on providing recycling related information, especially associated benefits, to citizens. Specifically, Bryan should inform their citizens regarding the cost-benefits of SWM programs in general and recycling programs in particular, and recycling services available in the City. Bryan may want to focus on households with older citizens who are more likely to voice their opposition to new recycling programs, because they are more likely to be on fixed income, least likely to recycle, and least likely to support a recycling program.

Because of the different data collection modes and assumptions on bid price, four logit models are estimated for Policies II and III. The estimated models are similar both within a Policy and between the Policies in terms of the affects of the variables, significance of coefficients, and consistency with previous studies combining the results of this study with previous studies indicates a set of factors that can be used to explain WTP for recycling services. Of particular importance are the coefficients associated with the bid price. These

coefficient are always negative and highly significant. Interestingly between the two policies, the bid price coefficients does not change much in magnitude. In terms of signs on other coefficients, approximately 95 percent are the same across the different models. As with recycling behavior, there may be a bias associated with the data collection mode.

Calculated monthly mean WTPs recycling services in Bryan appear to be lower than WTP from previous studies. It should be noted the services provided are not completely comparable between the studies. Five studies dealt with curbside while one dealt with drop-off recycling service. Among the possible reasons a lower WTP is calculated include the following aspects associate with Bryan, minimal problems with waste disposal, lack of landfill space shortage, geographic location, and non-urban setting.

WTP for Policy II are higher than for Policy III. Policy III contains more services, however, the policy requires that households with curbside service also pay for an additional drop-off recycling center. Currently there is a drop-off center and Policy III included a new drop-off center, in addition to the curbside service. Findings indicate that not only may Bryan citizens not be willing to pay for multiple programs or what they possibly perceive as duplicate programs, but they may also be unwilling to subsidize other households who want to recycle. Further, it appears students, the transitory population, have a lower mean WTP than employed residents. However, the standard deviations of the mean WTPs between the resident population (employed and retirees) and the transitory population (students) within each of the five different income groups are relatively small. The effect of a transitory population on recycling has not been analyzed before. The lower WTP among students may be a function of the knowledge that they will only temporarily be a part of the community, whereas, SWM is a long term issue. It is likely that a lower WTP among

transitory population places externalities on the rest of the population. Such a finding may indicate differential policies directed toward the student population and permanent residents of Bryan.

Bryan residents tend to slightly prefer Policy II over the Current Situation, Policy I, and Policy III. However, preference for Policy III was not that far behind Policy II. Disaggregating the probabilities of support for the three policies by the different data sets, employment, and income, shows a somewhat ambiguous preference for Policy II. Also, the calculated mean WTP would just cover the estimated costs of Policy II. Thus, there appears to be tempered support to implement a curbside recycling program. However, given previous experience with a pilot curbside program, it is unclear whether implementing Policy II will ensure sufficient recycling rates to make the program successful. It is important to note that the estimated cost of $2.50 per household is the fee charged by a private firm to collect recyclables for the city. The city is then responsible for the sale of the recyclables. Since the recycling rates usually do not cover the cost of collection, Bryan will have to charge for the curbside service. However, at some point in the future, if the recycling rates are sufficiently high to cover the cost of collection, or at least part of it, the City may be able subsidize some of the collection cost reducing the burden to households.

Advances to Existing Knowledge

Despite undertaking a study similar to previous ones, there are at least four contributions to existing knowledge in the area of SWM. First, an important aspect of this study is the estimation of WTPs for two alternative recycling policies. Respondents have a lower WTP for the policy with more services, maybe indicating a reluctance to pay for duplicate services.

Second, the explanatory variables included in the estimation procedures are more comprehensive than any previous application. Robustness and interpretation of the results both between the different models presented here and between the present study and previous studies adds substantially to existing knowledge on SWM issues. Third, this study is pioneering in obtaining information relating to the most preferred recycling program. No previous study has presented alternative policies on recycling and statistically estimated explanatory models and probabilities of the most preferred policy. Fourth, the impact of a transitory population (college students) may have on SWM are examined. Again, such populations have not been the focus in the SWM literature.

Study Limitations

One of the limitations of this study is the inability to use bivariate probit to analyze the dichotomous choice with follow-up question (DCFQ). Because the goal is to estimate a WTP as close as possible to respondents' true WTP, the correlation between the responses is exploited indirectly by consolidating the responses to the DCFQ. Although the results are consistent with theory and expectation, this procedure may not be statistically efficient, however. Second, the sample respondents may not be representative of the Bryan population. That is, although the mail survey design was randomly selected, respondents tend to be white, older, retired, highly educated and of higher incomes than the general population. Also, percentage-wise substantially less students responded than live in Bryan. This may be a function of sample selection procedure, low responses rates among students who are not vested in the community, and a high response rates among retirees who are on fixed incomes.

A third important limitation in terms of information needed for policymaking in Bryan is the low participation rates in the pilot curbside recycling program and at the drop-off center. Neither an expressed WTP for a recycling program nor a preference for a policy, because of the hypothetical nature of the survey questions, may be indicative of participation rates. A question relating to participation in the various programs should have been included, in conjunction to the most preferred question to obtain potential participation rates and to identify hypothetical bias in responses.

Future Research

In most cases, households may not track the amount of waste disposed in the face of a zero marginal cost of disposal. Therefore, households have no incentives to recycle. Thus, despite a WTP that covers the potential cost of recycling and a preference for a curbside policy, there is no guarantee that a given recycling program will succeed. In addition to examining participation rates, future research should focus on how recycling programs that offer households economic incentives, such as pay-as-you-throw programs, to minimize waste will work.

Alternative econometric specifications can be used to increase efficiency of estimation by using the correlation between the first and second responses to the DCFQ format of the WTP question. One potential candidate is the nested logit estimation procedure (Greene). Nested logit is a non-linear application of seemingly unrelated regression procedure for limited dependent variables. Responses to the first question can be used to estimate the WTP equation and the resulting parameters can be used in the estimation of the second equation containing responses to the follow-up WTP question.

Comparing coefficients and WTPs from nested logit to the logit models can not only be a fruitful academic exercise, but may also have policy implications.

In Bryan, like in many cities around the nation, there are neither well-developed nor properly working markets where households can sell recyclables. Examining how recycling behavior may change if there were recyclables markets is an important aspect that deserves attention. Future work should also ensure non-whites and lower income populations are representative in the sample, along with students. The issue of transitory population deserves further attention and theoretical development.

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APPENDIX A

MAIL SURVEY

Dear Citizen of Bryan:

Population growth, economic development, and environmental regulations are increasing the costs associated with solid waste management in the Brazos Valley and elsewhere in the United States. The cost of disposing a ton of waste in the Brazos Valley has increased from $9.20 per ton in 1991 to $23.00 per ton in 1998. Alternatives to landfilling, such as recycling, incineration, composting, and reduction of packaging of consumer goods (source reduction), are being used around the country.

As a member of the Clean Cities 2000 project, the City of Bryan has voluntarily committed to reduce municipal waste going to landfills by 50% [1990 levels] by the year 2000. Reduction of waste going to landfills will help keep your waste disposal costs down and extend the life of current and future landfills. To reach its goals, the City of Bryan is investigating the possibility of implementing a curbside recycling program and/or an opening additional drop-off recycling center.

Citizen involvement is crucial for the success of these programs. The enclosed questionnaire is designed to provide citizens' input into the solid waste management decision making process. There is no substitute for information coming from the citizens of Bryan. Please take the time to complete the questionnaire and return it in the enclosed postage paid envelope. Approximate time required to complete the survey is 15 minutes. The questionnaire contains information concerning solid waste management that we feel you will find interesting. Thank you for your valuable time and help in this important issue.

As a small token of our appreciation, enclosed are two stickers. The smaller one is obtained each time you recycle at the City of Bryan operated recycling center located at the Wal-Mart Supercenter on Briarcrest Avenue. Twelve such stickers can be used to cover one month's garbage fee.

Sincerely,

José Pastrana, P. E.
Division Manager
Department of Public Services
City of Bryan

James W. Mjelde, Ph.D.
Professor
Department of Agricultural Economics
Texas A&M University

P. O. BOX 1000 • BRYAN, TEXAS 77805 • (409) 821 5900

Examining Alternative Solid Waste Management Approaches

A Collaborative Effort of

The City of Bryan

and

Texas A&M University

Si usted desea un questionario en español, favor de llamarnos al 845-0966.
Muchas gracias por su cooperación.
If you would rather obtain a Spanish version of this questionnaire, please contact us at 845-0966.
Thank you very much for your cooperation

Waste: To Throw or Not to Throw?

Growing population, economic development, and stringent environmental standards have drawn attention to many new challenges regarding solid waste management. The Environmental Protection Agency and Texas Natural Resource Conservation Commission have encouraged cities to decrease landfilling waste by increasing source reduction, recycling, and composting.

The City of Bryan needs your opinions concerning non-hazardous waste disposal and recycling. Information generated from your responses to this survey will be used in the planning process to formulate, design, implement, and operate efficient and citizen-friendly waste management polices. Bryan recognizes citizen involvement in the decision making is crucial to ensure the success of policies and programs. There is no substitute for information coming from you, the citizens of Bryan.

Terms Used in The Survey

Recycling	Collecting and reprocessing of components of waste for introduction back into the production and/or consumption cycles.
Source reduction	Reducing the generation of waste at the source by encouraging better packaging, use of durable products, and repairing and reusing of products.
Composting	Recovery of waste that can be decomposed naturally to be used to produce organic fertilizer and mulch.
Landfilling	Burying of waste in approved disposal sites.
Incineration	Burning of waste to ashes that is subsequently landfilled.
Non-hazardous recyclables	Items of waste that can be recycled. N Glass [colored & clear bottles] N Metal cans [aluminum, steel & tin] N Paper [newspaper & print paper] N Plastic [clear (#1) & translucent (#2)]
Hazardous recyclables	Items of waste that must be recycled and are illegal to dispose with waste. N Automobile tires N Used motor oil N Household chemicals N Paints

Please Take the Time to Provide Your Opinions.

Please Do Not Write Your Name on the Survey.
Strict Confidentiality will be Maintained.

Please use the pre-paid envelope pro
vided to mail your completed survey.

This study is funded by a grant from the Texas Natural Resource Conservation Commission obtained through the Brazos Valley Council of Governments

1. In your opinion, how important are solid waste management issues compared with other environmental issues in the City of Bryan? [Please check only one.]

Very important	___	Less important	___
Equally important	___	Not important	___
Do not know	___		

2. In your opinion, which of the following approaches should the City of Bryan emphasize in it's future solid waste management plans? [Please check a level of importance for each management approach.]

	More emphasis	Equal emphasis	Less emphasis	Undecided
Source reduction	___	___	___	___
Recycling	___	___	___	___
Composting	___	___	___	___
Landfilling	___	___	___	___
Incineration	___	___	___	___

3. Your gender: Male ___ Female ___

4. Your racial or ethnic background:

White	___	Native American	___
Black	___	Multiracial	___
Hispanic	___	Other [Please Specify]_____	

5. Your highest level of education completed:

Elementary school	___	Some college	___
Junior high or middle school	___	Bachelor / Associate degree	___
High school or equivalent	___	Post Bachelor	___

6. Your present employment status:

Employed full-time	___	Unemployed	___
Employed part time	___	Retired	___
Full time homemaker	___	Student	___

7. Your household's before tax annual income:

Under $10,000	___	$50,001 - $75,000	___
$10,001 - $15,000	___	$75,001 - $100,000	___
$15,001 - $25,000	___	Over $100,001	___
$25,001 - $50,000	___		

8. Your age: ___ years

9. Including yourself, how many members of your household belong to each age group?

Under 18	___	41 - 65	___
19 - 25	___	Over 66	___
26 - 40	___		

10. Do you own or rent the residence where you live?

Own ___ Rent ___

11. Do you consider yourself an environmentalist?

Yes ___ No ___

12. Do you currently? [Please check yes or no for each of the options.]

	Yes	No
Use the City of Bryan drop-off recycling center at Wal Mart to recycle	___	___
Recycle at work	___	___
Recycle at buyback centers	___	___

If you do not recycle [answered No to all three options in question 12], please go to question 13.

If you do recycle [answered Yes to any of the three options in question 12], please go to question 14.

13. What factor(s) best describes why you do not recycle? [Please check all that apply.]

No information on recycling	___	Takes too much time & effort	___
No curbside recycling	___	Nobody I know recycles	___
No convenient drop-off center	___	Other	_____

If you answered question 13, please go to question 20.

14. What factor(s) best describe why you recycle? [Please check all that apply.]

Makes me feel good	___	Conserves resources	___
Earn money	___	Conserves energy	___
Good for the environment	___	Conserves landfill space	___
Benefits the general public	___	Benefits future generations	___
Most people I know recycle	___	Other	_____

15. Do you recycle at the drop-off recycling center located at Wal Mart? [Please check only one.]

Yes___ No___

If you do not recycle at the drop-off recycling center located at Wal Mart, please answer question 16.

If you recycle at the drop-off recycling center located at Wal Mart, please go to question 17.

16. Which factor(s) best describes why you do not recycle at the drop-off recycling center at Wal Mart? [Please check all that apply.]

No economic incentive for me	___	Didn't know there was a drop-off center	___
Not in a convenient location	___	Takes too much time and effort	___
Too much traffic in the area	___	Other [Please specify]	_____

If you answered question 16, please go to question 20.

17. Are your trips to the drop-off recycling center at Wal Mart coordinated with other activities?

Just to recycle ___ Combined with other errands ___

18. What features of the drop-off recycling center at Wal Mart do you like? [Please check for each feature.]

	Most like	Somewhat like	Dislike	Not an Issue
Credit toward garbage fee	___	___	___	___
Location convenience	___	___	___	___
Cleanliness	___	___	___	___
Easy to use(drive through)	___	___	___	___
Manned (help unloading)	___	___	___	___
Hours of operation	___	___	___	___

19. Identify the time period you are most likely to visit the drop-off recycling center at Wal Mart? [Please check only one.]

	7 - 9 a.m.	9 a.m.-12 noon	12 -3 p.m.	3 - 6 p.m.	6 - 9 p.m.
Monday - Thursday	___	___	___	___	___
Friday - Saturday	___	___	___	___	___
Sunday			___	___	___

Recycling Benefits and Costs

20. Benefits and costs of recycling do not always directly involve dollars saved or earned. In general, the benefits from recycling are realized by the general public, while the costs of recycling are borne by the people who recycle. Please identify the importance of these costs and benefits to you. [Please check a level of importance for each.]

Benefits and costs to the individual

a. How important to you are the time and effort spent collecting, sorting, and storing recyclables?

___ Very important ___Somewhat important ___ Not important ___ Undecided

b. How important to you are the costs of taking recyclables from your home to a recycling center?

___ Very important ___Somewhat important ___ Not important ___ Undecided

c. How important to you is the money earned from selling recyclables?

___ Very important ___Somewhat important ___ Not important ___ Undecided

Benefits and costs to the general public

d. How important to you are the benefits from extending the life of landfills and reducing other landfill related costs?

___ Very important ___Somewhat important ___ Not important ___ Undecided

e. How important to you are the benefits from resource and energy conservation that result from recycling?

___ Very important ___Somewhat important ___ Not important ___ Undecided

f. How important to you are the benefits of decreased pollution associated with less landfilling and mining of raw materials?

___ Very important ___Somewhat important ___ Not important ___ Undecided

g. How important to you are the costs of increased pollution resulting from collection, storing, transporting, and processing recyclables?

___ Very important ___Somewhat important ___ Not important ___ Undecided

Current Situation

The City of Bryan operates a drop-off recycling center for non-hazardous waste at the Wal Mart superstore center on Briarcrest drive. It also operates two used oil drop-off centers at the Municipal Service Center on Waco Street and at Twin City Mission on San Jacinto Drive. Residents recycling at the drop-off recycling center at Wal Mart are given a sticker for each visit. Twelve such stickers can be used to cover one month's garbage fee. A three-year pilot curbside recycling program [1991 -93], covering 800 households, was canceled because too few citizens participated.

The landfill on Rock Praire road is expected to be operational only for a few more years. However, every 15% increase in recycling rates extends the landfill life by about a year. Also, landfilling costs have increased in the region. Between 1991-98, the monthly garbage fee for one container increased from $7.50 to $12.75. Also, locating new landfills is an expensive political and economic process.

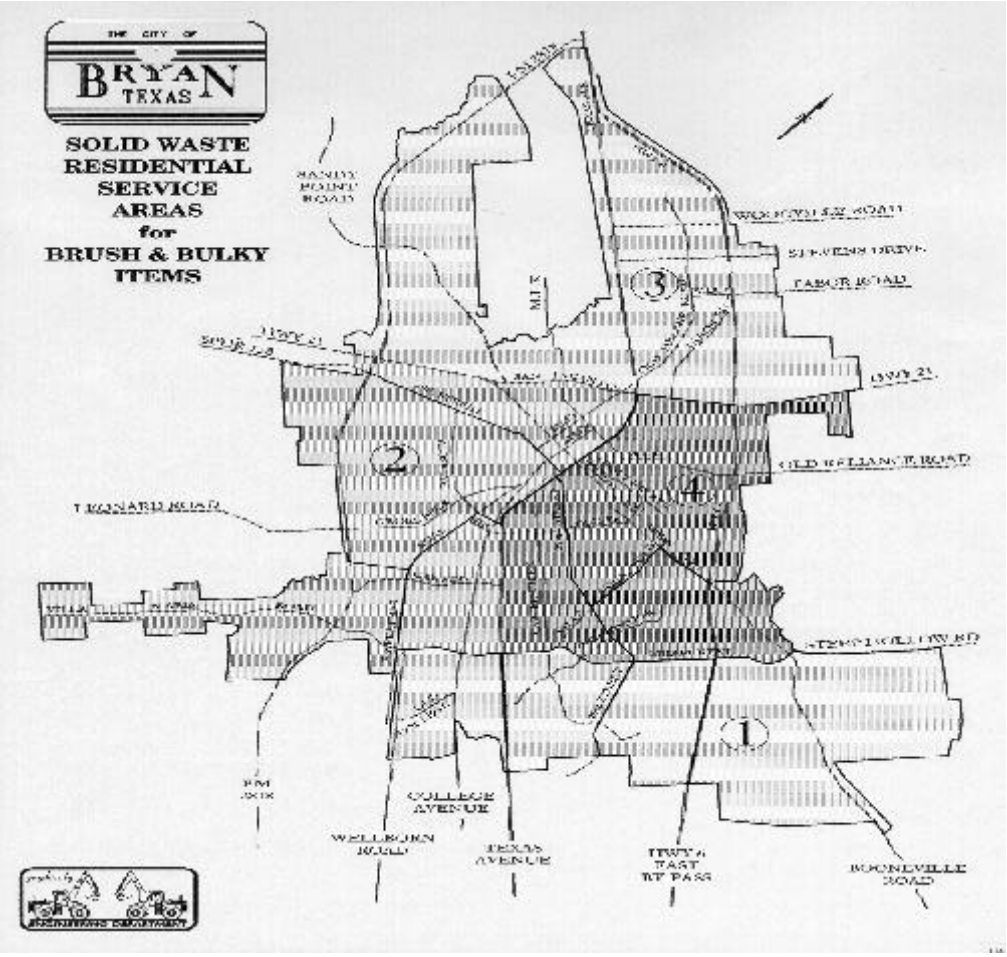
Further, the City of Bryan has voluntarily committed to recycle 50% [1990 levels] of its municipal solid waste and reduce waste going to landfills by the year 2000. It is currently composting and recycling about 15% of its municipal waste. In response, the City of Bryan is investigating three proposed changes to help meet its solid waste management goals.

PLEASE CONSIDER EACH OF THE THREE PROPOSED CHANGES SEPARATELY WHEN ANSWERING THE QUESTIONS.

Proposed Change I: An additional drop-off recycling center

21. The City of Bryan is investigating the possibility of starting an additional drop-off recycling center. Location and design aspects are being considered to ensure better citizen participation.
Indicate your preference for each of the following features? [Please check for each feature listed.]

	Most prefer	Somewhat Prefer	Not an issue
Credit toward garbage fee	___	___	___
Accept both non-hazardous recyclables & motor oil	___	___	___
Manned (help unloading)	___	___	___
Cleanliness	___	___	___
Easy to use(drive through)	___	___	___
Extended hours of operation	___	___	___
Close to shopping center	___	___	___
Close to major street	___	___	___



22. Using the above map of the City of Bryan, please assign a value of 1 [most preferred] through 4 [least preferred] for locating a new drop-off center. [Please rank all four areas.]

Area ① ____ Area ③ ___

Area ② ___ Area ④ ___

23. Assume the new drop-off recycling center has the features you prefer and is located in your preferred region.

Would you support Bryan's effort [City's personnel time and expenses] to obtain state grant monies and/or reallocation of solid waste management revenues to start and fund an additional drop-off center?

Yes ___ No ___

Proposed Change II: Curbside Recycling Service

24. The City of Bryan is investigating the possibility of starting a curbside recycling program to complement the current drop-off recycling centers. Changes in market conditions require the curbside recycling program be partially financed by public funds to ensure nonstop service. Curbside service provides you the opportunity to place your recyclables at your curb on a designated day of the week. Further, this reduces the time, effort, and expense of dropping your recyclables at a recycling center. Increased recycling rates extends the life of landfills and postpones landfill development costs.

    Would you pay a fee of $___ per month as an additional charge to your monthly utility bill for a curbside recycling program?

    a. Yes ___ [Please go to b.] No ___ [Please go to c.]

    ⇓ ⇓ ⇓ ⇓ ⇓ ⇓

    b. If you answered Yes to 24a., Would you pay $___ per month?

    Yes___ No ___

    c. If you answered No to 24a., Would you pay $___ per month?

    Yes ___ No ___

25. If you answered No to both questions 24a. and 24c., check the one reason that best describes why? [Please check only one.]

    ___ The proposed fee is too high for me.
    ___ I am not sure if I should be paying for the recycling programs.
    ___ The City should not be involved in providing recycling programs.

Proposed Change III: Curbside and an additional drop-off recycling center

26. A curbside recycling program servicing all Bryan households may not be possible because of cost and planning factors. Further, the current drop-off center is not convenient for all Bryan residents. The additional drop-off recycling center would provide residents without curbside recycling and those living in apartments, and households outside the City limits an opportunity to recycle. Therefore, a combination of curbside recycling program and a new drop-off recycling center to complement the current center at Wal Mart is being investigated.

    Would you pay $___ per month as an additional charge on your monthly utility bill to implement both Proposed Change I and II?

    a. Yes ___ [Please go to b.] No ___ [Please go to c.]

    ⇓ ⇓

    b. If you answered Yes to 26a., Would you pay $___ per month?

    Yes ___ No ___

    c. If you answered No to 26a., Would you pay $___ per month?

    Yes ___ No ___

27. If you answered No to both questions 26a. and 26c., check the one reason that best describes why? [Please check only one.]

    ___ The proposed fee is too high for me.
    ___ I am not sure if I should be paying for the recycling programs.
    ___ The City should not be involved in providing recycling programs.

The Change You Most Prefer

28. Given the three proposed changes, which change do you most prefer? Please consider the convenience, time, effort, benefits, and costs to your household and the City of Bryan when you answer. [Please check only one.]

    ___ **Proposed Change I**: An additional drop-off recycling center.
    ___ **Proposed Change II**: Implement curbside recycling service.
    ___ **Proposed Change III**: Combination of curbside and an additional drop-off recycling center.
    ___ **Current Situation**: No changes to Bryan's current recycling programs.

YOUR COMMENTS

We welcome your comments.
Please feel free to provide any additional comments in the space below.

Thank you

Please use the pre-paid envelope provided to mail your completed survey.

If you misplaced the envelope, our address is
City of Bryan
Public Works—Survey
P O Box 1000
Bryan, TX 77805

THANK YOU FOR YOUR VALUABLE TIME AND ASSISTANCE

This study is funded by a grant from the Texas Natural Resource Conservation Commission obtained through the Brazos Valley Council of Governments

The City of Bryan

and

Texas A&M University

Reminder Postcard

Dear Bryan Resident:

You recently received a survey titled "Examining Alternative Solid Waste Management Approaches" from the City of Bryan and Texas A&M University. If you have completed and returned the survey, thank you. If not, please complete the survey and return it in the postage-paid envelope. Your opinions regarding solid waste management issues are important to the City of Bryan.

If you did not receive the survey or have misplaced it, please contact Jay at 845-0695 to obtain a copy. Thank you for your valuable time and assistance.

Please mail your completed survey to:

City of Bryan
Public Works—Survey
P. O. Box 1000
Bryan, TX 77805

Survey Re-mail Cover Letter

February 1999

Dear Citizen of Bryan:

You recently received a survey titled "Examining Alternative Solid Waste Management Approaches." If you have already completed and mailed the survey, thank you and please disregard this letter.

If you have not completed the survey please take the time to complete the survey and return it in the postage-paid envelope. Approximate time required to complete it is 15 minutes. The survey has been designed to obtain your opinions regarding solid waste management practices. Information you provide will be held confidential.

Solid waste management costs have increased steadily across the United States, and Brazos Valley is no exception. The cost of disposing a ton of waste has increased from $9.20 in 1991 to $21.50 in 1998. Hence, several alternatives to landfilling are being used. As a member of the Clean Cities 2000 project, the City of Bryan has voluntarily committed to reduce waste going to landfills by 50% by the year 2000. Reduced landilling will lead to cost savings in the long term. The City is, therefore, investigating the possibilities of implementing a curbside recycling program and/or opening an additional drop-off recycling center.

Thank you for your valuable time and help in this important issue.

Sincerely,

José Pastrana, P. E.
Division Manager
Department of Public Services
City of Bryan

James W. Mjelde, Ph.D.
Professor
Department of Agricultural Economics
Texas A&M University

P. O. BOX 1000 • BRYAN, TEXAS 77805 • (409) 821 5900

Survey Re-Mail Flyer

PLEASE RESPOND TO THIS SURVEY

You Are Part of a Random Sample of Bryan Residents

YOUR INPUT WILL INCREASE THE ACCURACY OF THE STUDY RESULTS & RECOMMENDATIONS MADE TO THE CITY OF BRYAN

Strict Confidentiality Will Be Maintained

THANK YOU VERY MUCH FOR YOUR HELP

APPENDIX B

FACE-TO-FACE SURVEY

Excuse me, we are conducting a study for the City of Bryan. Did you recently receive a survey in the mail? It was titled "Examining Alternative Solid Waste Management Approaches."

◙ **YES, I did get the survey**: Did you answer the questionnaire and mail it back?

YES: Thank you very much for your cooperation. Have a good day.

NO: Would you please take the time to answer it & mail it back. In case you do not have the survey, I can provide you with one. Thank you for your valuable time and help in this important issue. [G*ive them a survey and return envelope if they want one*.]

◙ **NO, didn't get the survey**: Would you be willing to spare about 8-10 minutes of your time to answer a few questions regarding SWM & recycling?

[*If they hesitate*] Your answers today will be used along with other information to make appropriate recommendations regarding recycling programs for the City of Bryan.

♢ **No Time**: Would be willing to take a survey home, answer it, & mail it back to us? Your input is very important to us. Thank you for your valuable time & help in this important issue. [*Give them a survey & return envelope*.]

♢ **Yes, Have The Time**; [*continue*]: Thank you for your valuable time & help in this important issue.

[*If they ask for details of the study, the importance of their participation or something to that effect*]:

To reduce garbage disposal fees [*for details see Card I*] Bryan is planning to expand its recycling program [*for details see Card II*]. Due to the failure of a 3 year pilot curbside recycling program [*for details see Card II*], & the success of this drop-off center & College Station's recycling program, the City is getting mixed signals. Therefore, Bryan deems it necessary to get information regarding tastes & preferences of its residents. Your answers today will be used along with other information to make appropriate recommendations regarding recycling programs for the City of Bryan.

1. Please check respondents gender: Male ___ Female ___

2. Please check respondents racial or ethnic background:
[*Ask if unclear*] — Race is an important factor in studies like the one we are conducting. I hope I am not being intrusive by asking you to identify your race.

White	___	Native American	___
Black	___	Multiracial	___
Hispanic	___	Other [Please Specify]	_____

3. Please indicate the highest level of education level you have completed:

Elementary school	___	Some college	___
Junior high or middle school	___	Bachelor / Associate degree	___
High school or equivalent	___	Post Bachelor	___

4. Are your presently:

Employed full-time	___	Unemployed	___
Employed part time	___	Retired	___
Full time homemaker	___	Student	___

5. Income is an important factor of studies like the one we are conducting. I hope I am not being intrusive by asking which of the following income bracket your household belongs to.
Please identify your household's before tax annual income bracket:

Under $10,000	___	$50,001 - $75,000	___
$10,001 - $15,000	___	$75,001 - $100,000	___
$15,001 - $25,000	___	Over $100,001	___
$25,001 - $50,000	___		

6. Including yourself please indicate, how many members of your household belong to each age group?

Under 18	___	41 - 65	___
19 - 25	___	Over 66	___
26 - 40	___		

7. Do you own or rent the residence where you live? Own ___ Rent ___

8. Do you consider yourself an environmentalist? Yes ___ No ___

9. What factor(s) best describe why you recycle? Please say yes or no when I read out each factor.

Makes me feel good	___	Conserves resources	___
To earn money	___	Conserves energy	___
Good for the environment	___	Conserves landfill space	___
Benefits the general public	___	Benefits future generations	___
Most people I know recycle	___	Other	_____

10. Are there any other materials that you want to recycle and the recycling center does not accept?

_____ _____

11. Please identify the time period you are most likely to visit the drop-off recycling center at Wal Mart? [*Please show Card IV and check corresponding responses*.]

	7 - 9 a.m.	9 a.m.-12 noon	12 -3 p.m.	3 - 6 p.m.	6 - 9 p.m.
Monday to Thursday	___	___	___	___	___
Friday and Saturday	___	___	___	___	___
Sunday			___	___	___

12. Would you be inconvenienced if the drop-off recycling center were close on sundays?

Yes___ No___

Current Situation

The landfill on Rock Praire road is expected to be operational only for a few more years. However, every 15% increase in recycling rates extends the landfill life by about a year. In addition, landfilling costs have increased as reflected in your monthly garbage fee for one container; increasing from $7.50 to $12.75 between 1991-98. Moreover, locating new landfills is an expensive political and economic process.

Further, the City of Bryan has voluntarily committed to recycle 50% [1990 levels] of its municipal solid waste and reduce waste going to landfills by the year 2000. It is currently composting and recycling about 15% of its municipal waste. In response, the City of Bryan is investigating three proposed changes to help meet its solid waste management goals. I am going to read each one, please consider each proposed change separately when answering the following questions.

Proposed Change I: An additional drop-off recycling center

13. This recycling center is not conveniently located for all the residents of Bryan to recycle. Would you support Bryan's effort [using City's personnel time and expenses] to obtain state grant monies and/or reallocation of solid waste management revenues to start and fund an additional recycling center?

Yes ___ No ___

Proposed Change II: Curbside Recycling Service

14. The City of Bryan is investigating the possibility of starting a curbside recycling program to complement this recycling center. Curbside service provides you the opportunity to recycle at your curb thereby eliminating the time you spend coming here. Would you pay a fee of $ 0.50 per month as an additional charge to your monthly utility bill for a curbside recycling program?

a. Yes ___ [Please go to b.] No ___ [Please go to c.]

⇓ ⇓

b. If they answered Yes to 14a., Would you pay $0.75 per month?

Yes___ No ___

c. If they answered No to 14a., Would you pay $0.25 per month?

Yes ___ No ___

14d. [*If they answered No to both questions 14a. and 14c.*] Please identify which one reason best describes why you are not willing to pay. [Please check only one.]

___ The proposed fee is too high for me.
___ I am not sure if I should be paying for the recycling programs.
___ The City should not be involved in providing recycling programs.

Proposed Change III: Curbside and an additional drop-off recycling center

15. A curbside recycling program servicing all Bryan households may not be possible because of cost and planning factors. Further, this recycling center is not convenient for all Bryan residents. An additional recycling center would provide residents without curbside recycling and those living in apartments, and households outside the City limits an opportunity to recycle. Therefore, a combination of curbside recycling program and a new recycling center to complement this one is being investigated. Would you pay $.75 per month as an additional charge on your monthly utility bill to implement both Proposed Changes I and II?

a. Yes ___ [Please go to b.] ⇓ ⇓ ⇓

b. If they answered Yes to 15a., Would you pay $1.00 per month?

Yes ___ No ___

No ___ [Please go to c.] ⇓ ⇓ ⇓

c. If they answered No to 15a., Would you pay $0.50 per month?

Yes ___ No ___

15d. [*If they answered No to both questions 15a. and 15c.*] Please identify which one reason best describes why you are not willing to pay. [Please check only one.]

___ The proposed fee is too high for me.
___ I am not sure if I should be paying for the recycling programs.
___ The City should not be involved in providing recycling programs

The Change You Most Prefer

16. Given the three proposed changes, which one change do you most prefer? Please consider the convenience, time, effort, benefits, and costs to your household and the City of Bryan when you answer. [*Read out the proposed changes, solicit and check only one.*]

___ **Proposed Change I**: An additional drop-off recycling center.
___ **Proposed Change II**: Implement curbside recycling service.
___ **Proposed Change III**: Combination of curbside and an additional drop-off recycling center.
___ **Current Situation**: No changes to Bryan's current recycling programs.

APPENDIX C

RESPONSES BY MODE OF SURVEY

Responses to Mail Survey

Table C1. Gender of Mail Respondents

Category	Frequency	Percent
Female	287	47.05
Male	311	50.98
Total	598	98.03

Table C2. Racial Background of Mail Respondents

Category	Frequency	Percent
White	437	71.64
Black	66	10.82
Hispanic	43	7.05
Native American	5	.82
Multiracial	28	4.59
Asian	10	1.64
Other	7	1.15
Total	596	97.71

Table C3. Age and Household Size of Mail Respondents

Household size	Frequency	Percent
1	293	48.03
2	176	28.85
3	39	6.39
4	6	1.00
5	1	0.01
Mean Age	**Min. Age**	**Max. Age**
48.78 years	17	96

Table C4. Education Level of Mail Respondents

Category	Frequency	Percent
Elementary school	11	1.80
Junior high or middle school	16	2.62
High school or equivalent	127	20.82
Some college	151	24.75
Bachelor / Associate degree	146	23.93
Post Bachelor	148	24.26

Table C5. Employment Status of Mail Respondents

Category	Frequency	Percent
Employed full-time	312	51.15
Employed part time	34	5.57
Full time homemaker	31	5.08
Unemployed	10	1.64
Retired	156	25.57
Student	55	9.02

Table C6. Household Annual Income (before tax) of Mail Respondents

Category	Frequency	Percent
Under $10,000	71	11.64
$10,001 - $15,000	40	6.56
$15,001 - $25,000	69	11.31
$25,001 - $50,000	202	33.12
$50,001 - $75,000	113	18.53
$75,001 - $100,000	48	7.87
Over $100,000	26	4.26

Table C7. Residential Status and Environmentalism of Mail Respondents

Category	Frequency	Percent
Residential Status		
Own property	428	70.16
Rent property	169	27.71
Environmentalist		
Yes	300	49.18
No	270	44.26

Table C8. Importance of Solid Waste Management Issues Relative to Other Environmental Issues of Mail Respondents

Category	Frequency	Percent
More Important	217	35.57
Equally Important	295	48.36
Less Important	21	3.44
Not Important	4	0.66
Do Not Know	61	10.00
Total	598	98.02

Table C9. Emphasis on Solid Waste Management Alternatives of Mail Respondents

	Source Reduction		Recycling		Composting		Landfilling		Incineration	
Category	No.	%	No.	%	No.	%	No.	%	No.	%
More emphasis	246	40.33	377	61.80	237	38.85	119	19.51	125	13.77
Equal emphasis	204	33.44	137	22.46	231	37.87	235	38.53	188	30.82
Less emphasis	38	6.23	24	3.93	39	6.39	146	23.94	141	23.12
Undecided	46	7.54	12	1.97	22	3.61	35	5.74	72	11.80
Total	534	87.54	550	90.2	529	86.7	535	87.7	526	79.5

Table C10. Recycling Behavior of Mail Respondents

Category	Frequency
Recycles at Wal Mart	
Yes	212
No	221
Recycles at work	
Yes	238
No	264
Recycles at buyback center	
Yes	120
No	397

Table C11. Motivations Underlying Recycler's and Non-recycler's Behavior of Mail Respondents

Category	Frequency	Percent
Do Not Recycle		
No information on recycling	157	25.74
No curbside recycling	130	21.31
No convenient drop-off center	172	28.20
Takes too much time & effort		
Nobody I know recycles	231	37.87
Recycles		
Makes me feel good	202	33.12
Earn money		
Good for the environment	69	11.31
Benefits the general public	158	25.90
Most people I know recycle	360	59.02
Conserves resources	126	20.66
Conserves energy	189	30.98
Conserves landfill space	107	17.54
Benefits future generations	121	19.84

Table C12. Perceptions Regarding Recycling Costs and Benefits Among Mail Respondents

Category	Frequency 1[a]	2[b]	3[c]	4[d]
Importance of Benefits and Costs to Individual				
Cost of collecting, sorting and storing recyclables	169	253	122	49
Cost of Transporting recyclables	126	230	193	44
Benefit from earnings from sale of recyclables	55	137	352	44
Importance of Benefits and Costs to Public				
Benefits from avoided costs	361	181	20	34
Benefits from conserving resource and energy	345	190	30	30
Benefits from decreased pollution from recycling	389	143	38	26
Cost of increased pollution from recycling	237	237	61	52

[a] Very important; [b] Somewhat important; [c] Not important; [d] Undecided

Table C13. Preferences Regarding Additional Drop-off Center of Mail Respondents

Category	Frequency 1[a]	2[b]	3[c]
Features at drop-off center			
Credit toward garbage fee	311	139	107
Accept both non-hazardous recyclables & motor oil	293	148	113
Manned (help unloading)	261	158	131
Cleanliness	359	157	41
Easy to use (drive through)	394	110	54
Extended hours of operation	289	148	115
Close to shopping center	188	155	209
Close to major street	252	169	133

[a] Most prefer; [b] Somewhat prefer; [c] Not an issue

Table C14. Preferences Regarding Location of Additional Drop-off Center of Mail Respondents

Category	Frequency 1[a]	2[b]	3[c]	4[d]
Area for locating new drop-off center				
Area ①	156	92	81	143
Area ③	111	58	94	205
Area ②	176	116	129	65
Area ④	154	155	94	64
Support to divert revenues and grants				
Yes				463
No				100

[a] 1st rank; [b] 2nd rank; [c] 3rd rank; [d] 4th rank.

Table C15. Preferences Regarding Drop-off Center Timing Among Mail Respondents

Category		Frequency	Percent
Trips to drop-off center			
Only to recycle		42	6.89
Combined with errands		172	28.20
Both		10	1.64
Hours of operation			
Monday	7 - 9 a.m.	7	1.15
to	9 a.m.-12 noon	29	4.75
Thursday	12 -3 p.m.	15	2.46
	3 - 6 p.m.	11	1.80
	6 - 9 p.m.	8	1.31
Friday	7 - 9 a.m.	5	0.82
and	9 a.m.-12 noon	27	4.43
Saturday	12 -3 p.m.	16	2.62
	3 - 6 p.m.	10	1.64
	6 - 9 p.m.	5	0.82
Sunday	12 -3 p.m.	5	0.82
	3 - 6 p.m.	2	0.33
	6 - 9 p.m.	81	13.28

Table C16. Preferences Regarding Proposed Features of the Drop-off Center Among Mail Respondents

	Frequency				Percent			
Category	1[a]	2[b]	3[c]	4[d]	1[a]	2[b]	3[c]	4[d]
Features at drop-off center								
Credit toward garbage fee	84	28	6	70	13.77	4.59	0.98	11.48
Location convenience	133	53	17	9	21.80	8.69	2.79	1.48
Cleanliness	117	65	5	17	19.18	10.66	0.82	2.79
Easy to use (drive through)	174	25	9	8	28.53	4.10	1.48	1.31
Manned (help unloading)	138	53	4	15	22.62	8.69	0.66	2.46
Hours of operation	77	81	24	24	12.62	13.28	3.93	3.93

[a] Most like, [b] Somewhat like; [c] Dislike; [d] Undecided

Table C17. Preference of Most Preferred Program Among Mail Respondents

Category		Frequency	Percent
Proposed Change I:	An additional drop-off recycling center.	156	25.57
Proposed Change II:	Implement curbside recycling service.	160	26.23
Proposed Change III:	Combination of curbside and drop-off center.	89	14.59
Current Situation:	No changes to Bryan's current recycling programs.	153	25.08
Proposed Change III and Current Situation		1	.16
Proposed Change I and Current Situation		3	.49
Proposed Change II and III		2	.33
Proposed Change I and II		1	.16

Responses to Handout Survey

Table C18. Gender of Handout Respondents

Category	Frequency	Percent
Female	76	40.00
Male	114	60.00
Total	190	100

Table C19. Racial Background of Handout Respondents

Category	Frequency	Percent
White	169	88.94
Black	3	1.55
Hispanic	9	4.73
Native American	2	1.0
Multiracial	4	2.1
Asian	1	0.05
Other	1	0.05
Total	189	98.42

Table C20. Age and Household Size of Handout Respondents

Household size	Frequency	Percent
1	102	53.68
2	52	27.36
3	16	8.42
4	1	0.52
5	0	0.0
Total	171	89.98
Mean Age	**Min. Age**	**Max. Age**
54.43	20	85

Table C21. Education Level of Handout Respondents

Category	Frequency	Percent
Elementary school	0	0.0
Junior high or middle school	3	1.57
High school or equivalent	25	13.15
Some college	43	22.63
Bachelor / Associate degree	68	35.78
Post Bachelor	51	26.84
Total	190	99.97

Table C22. Employment Status of Handout Respondents

Category	Frequency	Percent
Employed full-time	55	28.94
Employed part time	20	10.52
Full time homemaker	29	15.26
Unemployed	2	1.05
Retired	76	40.00
Student	8	4.21
Total	190	99.98

Table C23. Household Annual Income (before tax) of Handout Respondents

Category	Frequency	Percent
Under $10,000	5	2.63
$10,001 - $15,000	9	4.73
$15,001 - $25,000	22	11.57
$25,001 - $50,000	58	30.52
$50,001 - $75,000	53	27.89
$75,001 - $100,000	14	7.36
Over $100,000	22	11.59
Total	178	93.66

Table C24. Residential Status and Environmentalism of Handout Respondents

Category	Frequency	Percent
Residential Status		
Own property	164	86.31
Rent property	24	12.63
Environmentalist		
Yes	141	74.21
No	48	25.26

Table C25. Importance of Solid Waste Management Issues Relative to Other Environmental Issues of Handout Respondents

Category	Frequency	Percent
More Important	106	55.78
Equally Important	73	38.42
Less Important	1	4.73
Not Important	1	0.05
Do Not Know	9	0.05
Total	190	99.03

Table C26. Emphasis on Solid Waste Management Alternatives of Handout Respondents

	Source Reduction		Recycling		Composting		Landfilling		Incineration	
Category	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent
More emphasis	87	45.78	136	71.57	88	46.31	41	21.57	39	20.52
Equal emphasis	71	37.36	44	23.15	81	42.63	74	38.94	69	36.31
Less emphasis	6	3.15	1	0.05	7	3.68	54	28.42	49	25.78
Undecided	16	8.42	2	0.10	4	2.10	10	0.52	21	11.05
Total	180	94.71	183	94.9	180	94.7	179	89.5	178	93.7

Table C27. Recycling Behavior of Handout Respondents

Category	Frequency
Recycles at Wal Mart	
Yes	172
No	14
Recycles at work	
Yes	61
No	63
Recycles at buyback center	
Yes	48
No	98

Table C28. Motivations Underlying Recycler's and Non-recycler's Behavior Handout Respondents

Category	Frequency	Percent[a]
Do Not Recycle		
No information on recycling	3	1.57
No curbside recycling	6	3.10
No convenient drop-off center	2	1.05
Takes too much time & effort	2	1.05
Nobody I know recycles	2	1.05
Recycles		
Makes me feel good	109	57.36
Earn money	37	19.47
Good for the environment	171	90.00
Benefits the general public	130	68.42
Most people I know recycle	13	6.84
Conserves resources	147	77.36
Conserves energy	113	59.47
Conserves landfill space	161	84.73
Benefits future generations	144	72.78

[a] Percent answering yes.

Table C29. Perceptions Regarding Recycling Costs and Benefits Handout Respondents

	Frequency			
Category	1[a]	2[b]	3[c]	4[d]
Importance of Benefits and Costs to Individual				
Cost of collecting, sorting and storing recyclables	71	67	45	6
Cost of Transporting recyclables	45	51	88	5
Benefit from earnings from sale of recyclables	14	41	129	2
Importance of Benefits and Costs to Public				
Benefits from avoided costs	160	25	0	3
Benefits from conserving resource and energy	148	38	1	1
Benefits from decreased pollution from recycling	160	23	4	1
Cost of increased pollution from recycling	73	65	28	16

[a] Very important; [b] Somewhat important; [c] Not important; [d] Undecided

Table C30. Preferences Regarding Additional Drop-off Center of Handout Respondents

Category	Frequency 1[a]	2[b]	3[c]
Features at drop-off center			
Credit toward garbage fee	88	41	52
Accept both non-hazardous recyclables & motor oil	89	49	44
Manned (help unloading)	123	43	20
Cleanliness	138	40	8
Easy to use (drive through)	157	24	4
Extended hours of operation	75	62	47
Close to shopping center	83	55	47
Close to major street	92	50	40

[a] Most prefer; [b] Somewhat prefer; [c] Not an issue

Table C31. Preferences Regarding Location of Additional Drop-off Center Handout Respondents

Category	Frequency 1[a]	2[b]	3[c]	4[d]
Area for locating new drop-off center				
Area ①	45	36	38	40
Area ③	59	33	42	30
Area ②	22	22	41	64
Area ④	53	51	28	26
Support to divert revenues and grants				
Yes				158
No				18

[a] 1st rank; [b] 2nd rank; [c] 3rd rank; [d] 4th rank.

Table C32. Preferences Regarding Timing of Drop-off Center Timing Among Handout Respondents

Category		Frequency	Percent
Trips to drop-off center			
Only to recycle		43	22.63
Combined with errands		112	59.94
Both		18	9.47
Hours of operation			
Monday	7 - 9 a.m.	6	3.15
to	9 a.m.-12 noon	55	28.94
Thursday	12 -3 p.m.	19	10.00
	3 - 6 p.m.	12	6.31
	6 - 9 p.m.	3	1.57
Friday	7 - 9 a.m.	0	0.00
and	9 a.m.-12 noon	8	4.21
Saturday	12 -3 p.m.	7	3.68
	3 - 6 p.m.	2	1.05
	6 - 9 p.m.	0	0.00
Sunday	12 -3 p.m.	1	0.05
	3 - 6 p.m.	0	0.00
	6 - 9 p.m.	0	0.00

Table C33. Preferences Regarding Proposed Features of Drop-off Center Handout Respondents

	Frequency				Percent			
Category	1[a]	2[b]	3[c]	4[d]	1[a]	2[b]	3[c]	4[d]
Features at drop-off center								
Credit toward garbage fee	74	31	1	51	38.94	16.31	0.50	26.84
Location convenience	139	21	6	5	73.15	11.05	3.15	2.63
Cleanliness	143	19	0	8	75.26	10.00	0.00	4.21
Easy to use (drive through)	154	14	0	3	81.05	7.36	0.00	1.57
Manned (help unloading)	146	17	0	7	76.84	8.94	0.00	3.68
Hours of operation	108	42	5	11	56.84	22.10	2.63	5.78

[a] Most like, [b] Somewhat like; [c] Dislike; [d] Undecided

Table C34. Preference of Most Preferred Program Handout Respondents

Category		Frequency	Percent
Proposed Change I:	An additional drop-off recycling center.	63	33.15
Proposed Change II:	Implement curbside recycling service.	35	18.42
Proposed Change III:	Combination of curbside and drop-off center.	34	17.89
Current Situation:	No changes to Bryan's current recycling programs.	41	21.57
Proposed Change III and Current Situation		0	0.00
Proposed Change I and Current Situation		1	0.52
Proposed Change II and III		2	1.05
Proposed Change I and II		1	0.52

Responses to Face-to-Face Survey

Table C35. Gender of Face-to-Face Respondents

Category	Frequency	Percent
Female	48	52.17
Male	44	47.82
Total	92	100.00

Table C36. Racial Background of Face-to-Face Respondents

Category	Frequency	Percent
White	85	92.39
Black	1	01.00
Hispanic	3	03.20
Native American	0	00.00
Multiracial	0	00.00
Asian	1	01.00
Other	0	00.00
Total	90	97.59

Table C37. Age and Household Size of Face-to-Face Respondents

Household size	Frequency	Percent
1	52	56.52
2	33	35.87
3	7	7.60
Total	92	99.99

Table C38. Education Level of Face-to-Face Respondents

Category	Frequency	Percent
Elementary school	0	0.00
Junior high or middle school	2	2.17
High school or equivalent	15	16.30
Some college	15	16.30
Bachelor / Associate degree	29	31.52
Post Bachelor	30	32.60
Total	91	98.89

Table C39. Employment Status of Face-to-Face Respondents

Category	Frequency	Percent
Employed full-time	39	51.15
Employed part time	7	5.57
Full time homemaker	11	5.08
Unemployed	4	1.64
Retired	19	25.57
Student	11	9.02
Total	91	98.03

Table C40. Household Annual Income (before tax) of Face-to-Face Respondents

Category	Frequency	Percent
Under $10,000	7	7.60
$10,001 - $15,000	9	9.78
$15,001 - $25,000	12	13.04
$25,001 - $50,000	25	27.17
$50,001 - $75,000	20	21.73
$75,001 - $100,000	6	6.52
Over $100,000	6	6.52
Total	85	92.36

Table C41. Residential Status and Environmentalism of Face-to-Face Respondents

Category	Frequency	Percent
Residential Status		
Own property	70	76.08
Rent property	21	22.82
Environmentalist		
Yes	80	86.95
No	10	10.87

Table C42. Motivations Underlying Recycler's and Non-recycler's Behavior of Face-to-Face Respondents

Category	Frequency	Percent
Recycles		
Makes me feel good	76	82.60
Earn money	6	6.52
Good for the environment	84	91.30
Benefits the general public	80	86.95
Most people I know recycle	15	16.30
Conserves resources	84	91.30
Conserves energy	77	83..69
Conserves landfill space	87	94.56
Benefits future generations	82	89.13

Table C43. Preferences Regarding Drop-off Center Timing Among Face-to-Face Respondents

Category		Frequency	Percent
Hours of operation			
Monday	7 - 9 a.m.	3	3.26
to	9 a.m.-12 noon	16	17.39
Thursday	12 -3 p.m.	3	3.26
	3 - 6 p.m.	7	7.60
	6 - 9 p.m.	2	2.17
Friday	7 - 9 a.m.	0	0.00
and	9 a.m.-12 noon	6	6.52
Saturday	12 -3 p.m.	2	2.17
	3 - 6 p.m.	6	6.52
	6 - 9 p.m.	0	0.00
Sunday	12 -3 p.m.	0	0.00
	3 - 6 p.m.	0	0.00
	6 - 9 p.m.	0	0.00
Multiple timing		43	46.73
Total		88	89.44

Table C44. Most Preferred Program of Face-to-Face Respondents

Category		Frequency	Percent
Proposed Change I:	An additional drop-off recycling center.	28	30.43
Proposed Change II:	Implement curbside recycling service.	22	23.91
Proposed Change III:	Combination of curbside and drop-off center.	19	20.62
Current Situation:	No changes to Bryan's current recycling programs.	19	20.62
Proposed Change III and Current Situation		0	0.00
Proposed Change I and Current Situation		3	3.26
Proposed Change II and III		0	0.00
Proposed Change I and II		0	0.00
Total		91	98.84

Table C45. Responses to Closure of Drop-off Center on Sundays

Category	Frequency
Not inconvenienced	74
Inconvenienced	11

Table C46. Additional Recyclables to be Added

Category	Frequency
Office paper	4
Plastics	22
Motor oil	4
Metals	3
Others (primarily phone books)	20
Plastics and Others	5
None	34
Total	92

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