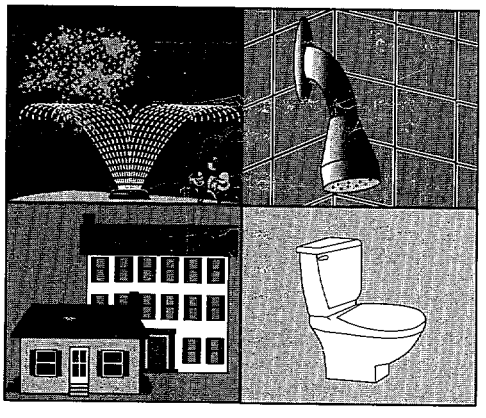
The Value of Water Supply Reliability:

Results of a Contingent Valuation Survey of Residential Customers



California Urban Water Agencies

Prepared by:
Barakat & Chamberlin, Inc.

August 1994

THE VALUE OF WATER SUPPLY RELIABILITY:
Results of a Contingent Valuation Survey of Residential Customers

CALIFORNIA URBAN WATER AGENCIES

Participating Agencies:

Alameda County Water District
Contra Costa Water District
Los Angeles Department of Water and Power
Metropolitan Water District of Southern California
Municipal Water District of Orange County
Orange County Water District
San Diego County Water Authority
San Diego Water Utilities Department
San Francisco Public Utilities Commission
Santa Clara Valley Water District

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August 1994

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FOREWORD

California Urban Water Agencies (CUWA) is an organization of the largest urban water providers in California. Its member agencies serve water to metropolitan areas comprising about two-thirds of the state's 32 million population. CUWA was formed to work on water supply issues of common concern to its members. Paramount among these concerns is the reliability of our urban water supplies. Statewide surveys show that California citizens rank water shortages close to crime, taxes, and traffic in listing their concerns about current problems in our society.

CUWA has an ongoing program to improve understanding of all aspects of urban water supply reliability. One important component of planning for supply reliability is being able to estimate the economic impact of water shortages so that an appropriate balance between costs and benefits of water management improvements can be found. CUWA and its member agencies sponsored earlier work on the cost of water shortages in California's manufacturing industries and the urban horticulture industry. However, the largest shortage cost component in some communities is in the residential sector, and this factor has proven difficult to quantify. CUWA and its consultant, Barakat & Chamberlin, Inc., determined that contingent valuation (CV) is the best available method for studying residential water shortage losses, and so undertook this survey—the most comprehensive and informative survey of its type conducted in the urban water supply industry.

This report detailed results of the CV surveys which shows that, on average, California residents are willing to pay $12 to $17 more per month per household on their water bills to avoid the kinds of water shortages which they or their regional neighbors have incurred in recent memory. The statewide magnitude of such additional consumer payments would be well over $1 billion per year. This customer value can be considered in planning for various demand- and supply-related options to meet reliability goals. While environmental and social impacts were not assessed in the CV survey, this report points out that they must be considered in water resource planning. CUWA is planning an additional phase of its Water Supply Reliability Program which will help water managers integrate all aspects of reliability planning.

California Urban Water Agencies

CONTENTS

CONTENTS (Continued)

EXECUTIVE SUMMARY

INTRODUCTION

California Urban Water Agencies (CUWA) is conducting ongoing research on issues of water supply reliability. The goal of the CUWA reliability project is to provide the framework and tools with which each water agency can better incorporate reliability issues into its overall resource planning. One of the key pieces of information needed to do this is the *value* that customers place on reliability.

To address this question, CUWA engaged the consulting firm of Barakat & Chamberlin, Inc., to design, conduct, and analyze the results of a *contingent valuation* survey to estimate the value to residential customers of water supply reliability. The survey was conducted within the service areas of ten CUWA member agencies. This report presents the combined results for the ten participating agencies. The individual results for each agency are included as appendices.

As will be discussed below, estimates and patterns of residential customers' willingness to pay for increased water supply reliability are remarkably consistent across participating agencies. This consistency supports the integrity of the results and general findings of the study. However, contingent valuation is not an exact science, and dollar figures should be used with caution.

THE CUWA CONTINGENT VALUATION SURVEY

The primary purpose of the CUWA contingent valuation (CV) survey is to estimate the value residential customers place on water supply reliability, specifically how much they are willing to pay to avoid water shortages of varying magnitude and frequency.

The CUWA CV survey asked participants whether they would vote "yes" or "no" in a hypothetical referendum. Participants were told that if a majority votes "yes," water bills would be increased by a designated amount, and there would be no future water shortages; if a majority votes "no," respondents were told that water bills would remain the same as they otherwise would have been, but water shortages of a specified magnitude and frequency would occur. Of course, individual customers differ in their willingness to pay to avoid different shortages.

The survey purposely did not tell customers where additional supply would come from, but rather indicated that it could come from any of a number of different sources. The intent was to avoid responses that were unduly influenced by preferences for or against particular resource types.

The CV questions are preceded by a series of questions that address a number of experiential and attitudinal issues, which help to place the CV questions in context and are also used in the analysis. The actual CV questions include a carefully worded description of the hypothetical "scenario" that will form the basis of a "yes" or "no" vote. The CV questions are followed by several "debriefing" questions that provide information on the reasons why respondents voted as they did. The survey concludes with a series of demographic questions.

Respondents are distributed randomly across a range of shortage scenarios. Shortage magnitudes range from 10% to 50%. Frequencies range from once every 3 years to once every 30 years. Bid amounts range from $1 to $50 increments to monthly water bills.

Because of the complexity of a survey of this type, it was decided to use a combination mail/telephone survey. A package of information was mailed to potential respondents. The mail package contained material that explained the purpose of the survey and helped customers understand the impacts of various shortage magnitudes. Interviewers called several days after the mail material was received.

The survey was conducted from August 1993 through February 1994. The total number of completions across all participating agencies was 3,769.

ANALYTICAL APPROACH

Many questions pertaining to sociodemographic, attitudinal, and perceptual variables were included in the survey. Responses to many of these questions were included as explanatory variables in the statistical model. By doing this, we can see how these factors affect willingness to pay.

Two statistical models were estimated. The so-called "detailed" model included all of the key explanatory variables obtained from the survey. A "simplified" model included only those variables that can be obtained from census or agency billing records. To the extent that this simplified model is statistically valid, it will enable agencies to reestimate willingness to pay in the future without resurveying customers.

ANALYTICAL RESULTS

Willingness to pay (WTP) can be interpreted as the losses that customers incur as a result of particular shortage scenarios. The amount that a customer is willing to pay to avoid an event is a measure of the losses that customer would incur if that event were to occur.

Tables ES-1 and ES-2 show the mean WTP for the detailed and the simplified model for each shortage magnitude and frequency. WTP for the detailed model varies from a low of $11.62/month to avoid a 20% shortage once every 30 years, to a high of $16.92/month to avoid a 50% shortage every 20 years. The results of the simplified model are almost identical to the results of the detailed model. While results for individual agencies do exhibit some differences, the range of WTP estimates is remarkably consistent across all participating agencies. Blank cells in the table reflect scenarios that were not part of the survey.

Table ES-1
MEAN MONTHLY WILLINGNESS TO PAY, DETAILED MODEL
(Additional $/Month)

Shortage (Percent Reduction from Full Service)	Frequency (Occurrences/Years)				
	1/30	1/20	1/10	1/5	1/3
10%			$11.63	$11.98	$12.12
20%	$11.62	$12.33	$13.06		
30%	$13.05	$13.80	$14.57		
40%	$14.56	$15.34	$16.13		
50%	$16.12	$16.92			

Table ES-2
MEAN MONTHLY WILLINGNESS TO PAY, SIMPLIFIED MODEL
(Additional $/Month)

Shortage (% Reduction from Full Service)	Frequency (Occurrences/Years)				
	1/30	1/20	1/10	1/5	1/3
10%			$11.67	$12.00	$12.14
20%	$11.71	$12.39	$13.08		
30%	$13.13	$13.84	$14.56		
40%	$14.61	$15.35	$16.10		
50%	$16.15	$16.92			

The "loss function" is shown graphically in Figure ES-1. In examining the tabular and graphical results, two major conclusions can be drawn:

- As expected, respondents are willing to pay more to avoid larger shortages and for shortages that occur with higher frequency. However, the impact of frequency variations is considerably smaller than the impact of shortage magnitude on consumers' responses.

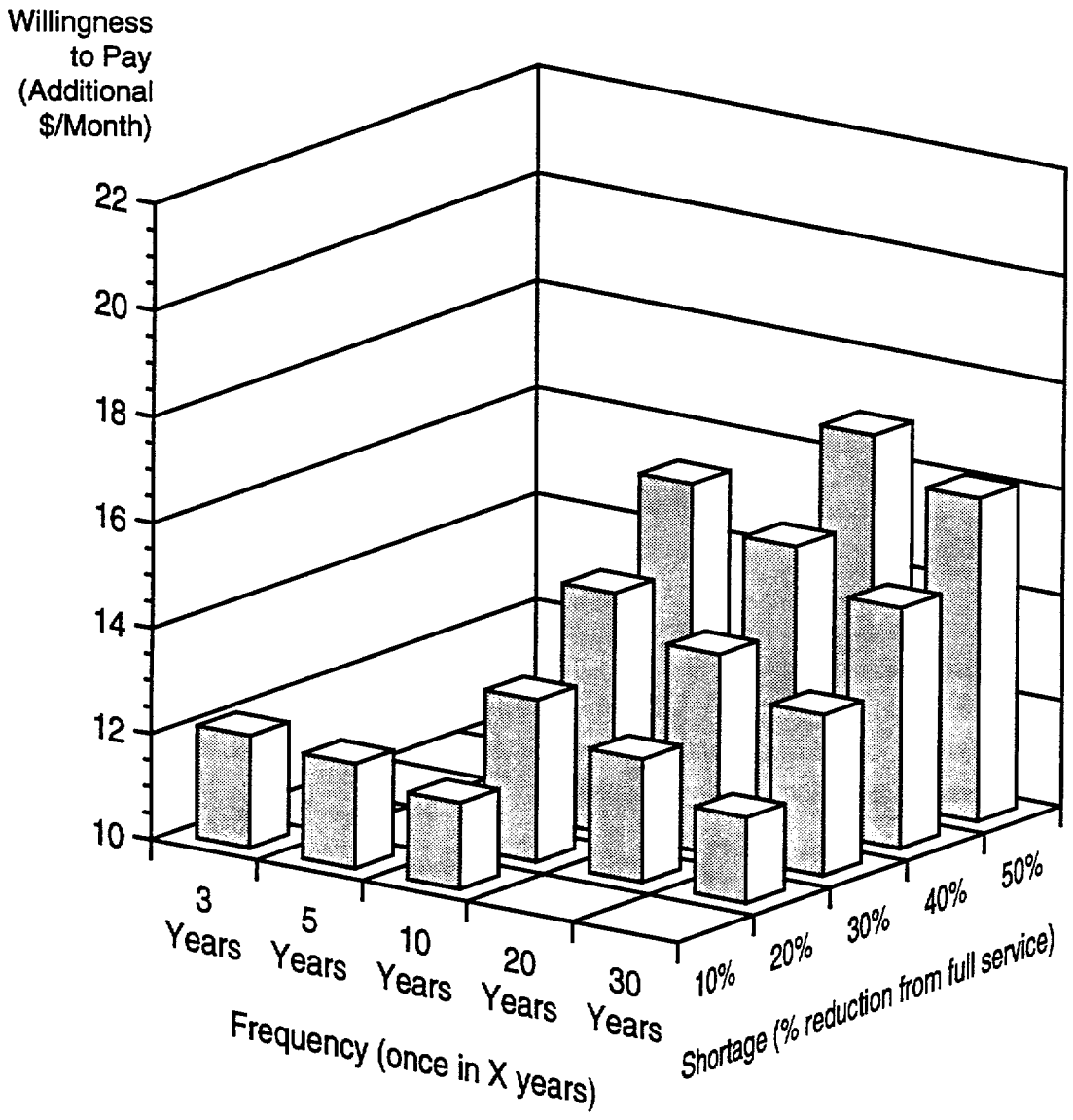
  Put another way, it appears that residential customers believe that infrequent large shortages impose higher losses than more frequent small shortages. This result is also consistent across all of the individual agencies. This type of conclusion may be important to agencies as they plan supply-side or demand-side resource additions and make system operations decisions.

- To avoid even apparently minor shortage scenarios (e.g., 10% once every 10 years), respondents are willing to pay substantial amounts. This type of "threshold" response is not uncommon in surveys of this type and may indicate that respondents regard even a mild shortage scenario as an inconvenience that they want to avoid. They may make a greater distinction between "shortage" and "no shortage" than between different magnitudes or frequencies of shortages.

  Again, this pattern of responses holds for all participating agencies.

Figure ES-1

Mean Monthly Willingness to Pay to Avoid Particular Shortage Frequencies and Magnitudes



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Impact of Key Explanatory Variables on Willingness to Pay

As described previously, the statistical model includes many variables that could potentially explain the variation in willingness to pay. The report selects several explanatory variables that are statistically significant and illustrates their impact on willingness to pay.

Additionally, an analysis was done to determine whether Northern California respondents had different willingness to pay than Southern California respondents. There did not appear to be any systematic differences in willingness to pay between the two regions.

Water Shortages as a Public Concern

In the survey, respondents were asked to rate the importance of various public problems, including water shortages, as "not at all important," "somewhat important," or "very important." There were three reasons for asking this question:

- To analyze the extent to which concern with any given set of issues (e.g., financial issues) affected willingness to pay.
- To test the perceived importance of water shortages relative to other public issues.
- To see how respondents categorized water shortages. With what other issues are water shortages associated?

Water shortages fall into the middle of the list of concerns. Respondents placed water shortages into the category that includes issues that can best be described as having public service components.

SUMMARY OF KEY CONCLUSIONS

The important conclusions that can be drawn from the analysis are as follows:

- Monthly willingness to pay higher residential water bills to avoid shortages ranged from $11.62 to $16.92. Individual agency results, while exhibiting some variation, are generally consistent with this range.

- As expected, respondents' willingness to pay increases with increasing magnitude and frequency of shortages.

- To avoid even apparently minor shortage scenarios (e.g. 10% once every 10 years), respondents are willing to pay substantial amounts. This type of "threshold" may indicate that respondents regard even a mild shortage scenario as an inconvenience that they want to avoid. They may make a greater distinction between "shortage" and "no shortage" than between different sizes or frequencies of shortages.

- Shortage frequency is not as important a determinant of willingness to pay as shortage magnitude. Residential customers appear to be more willing to tolerate frequent small shortages than infrequent large ones.

- There are no significant differences in willingness to pay between Northern California and Southern California respondents.

- The simplified model has virtually the same predictive power as the detailed model. Participating agencies who wish to replicate this type of analysis in the future can therefore use the simplified model rather than resurveying their customers to gather data on the remaining variables required for the detailed model.

THE VALUE OF WATER SUPPLY RELIABILITY: RESULTS OF A CONTINGENT VALUATION SURVEY

I. INTRODUCTION

California Urban Water Agencies (CUWA) is conducting ongoing research on issues of water supply reliability. This work has included the development of a framework within which to define, measure, and analyze water supply reliability[1] as well as the development of the Water Reliability Analysis and Planning (WRAP) model, which allows water agencies to model the reliability of their own supply.

The CUWA reliability project does not seek to set one standard of supply reliability for all of California. Rather, the goal is to provide the framework and tools with which each water agency can better incorporate reliability issues into its overall resource planning. One of the key pieces of information needed to do this is the *value* that customers place on reliability.

To address this question, CUWA engaged the consulting firm of Barakat & Chamberlin, Inc. to design, conduct, and analyze the results of a *contingent valuation* survey to estimate the value to residential customers of water supply reliability. The survey was conducted within the service areas of ten CUWA member agencies. This report presents the combined results for the ten participating agencies. The results for each agency are included as appendices to this report.

As will be discussed below, estimates and patterns of willingness to pay are remarkably consistent across participating agencies. This consistency supports the integrity of the results and general findings of the study. However, contingent valuation is not an exact science, and dollar figures should be used with caution.

A Brief Description of Contingent Valuation and the CUWA Survey

Contingent valuation (CV) is a well-developed technique that is used by market researchers and economists to place a value on goods or services for which no market-based pricing mechanism exists. For example, CV has been used to value

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[1]Barakat & Chamberlin, Inc., *Water Supply Reliability in California: How Much Do We Have? How Much Do We Need? Phase I, Setting the Stage: Defining, Measuring, and Setting Goals for Water Supply Reliability*. Prepared for California Urban Water Agencies, January 1992.

environmental amenities such as clean air or water, or health benefits, such as reduced cancer risks. It has also been used on many occasions to estimate the value that customers place on electric service reliability. In 1987, Carson & Mitchell conducted a contingent valuation survey of 2000 water customers in Southern California and the Bay Area.[2]

In a contingent valuation survey, respondents are asked in a very structured way how much they are willing to pay to avoid certain types of events. Alternatively, they are asked how much they would be willing to accept in exchange for tolerating various events.

In recent years, contingent valuation has become a predominant technique for valuing nonmarket goods. As with any methodology, contingent valuation has advantages and disadvantages. Critics argue that people are unable to state directly their willingness to pay for nonmarket goods because most people have never attempted to value such goods. These critics suggest that such valuation is difficult through direct inquiry and that the assessed values are hypothetical. They suggest that the valuation approach should be less direct (e.g., revealed preferences that rely on observable choices). However, there may not be data available to apply these indirect methods, and even if data exist it is often infeasible to isolate the behavioral choices that are associated with the good to be valued.

Studies have shown that contingent valuation estimates are reliable in that repeated tests obtain similar results. In the case of use values (i.e., values of people who intend to use the good in question) for familiar goods, CV estimates generally correspond to values obtained by other methods.[3]

The primary purpose of the CUWA contingent valuation survey is to estimate the value residential customers place on water supply reliability, specifically how much they are willing to pay to avoid water shortages of varying magnitude and frequency.

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[2]QED Research, Inc. *Economic Value of Reliable Water Supplies for Residential Water Users in the State Water Project Service Area*, Prepared for the Metropolitan Water District of Southern California, by Richard T. Carson and Robert C. Mitchell, 1987.

[3]R. Cummings, D. Brookshire, and W. Schulze, *Valuing Environmental Goods: Assessment of the Contingent Valuation Method*, (Roman and Allanheld, Totowa, NJ: 1986); Robert Mitchell and Richard Carson, *Using Surveys to Value Public Goods: The Contingent Valuation Method*, (Resources for the Future, Washington D.C.: 1989); William Schulze, "Use of Direct Methods for Valuing Natural Resource Damages," in *Valuing Natural Assets: The Economics of Natural Resource Damage Assessment*, Edited by Raymond J. Kopp and V. Kerry Smith, (Resources for the Future, Washington D.C.: 1993).

The CUWA CV survey asked participants whether they would vote "yes" or "no" in a hypothetical referendum. Participants were told that if a majority votes "yes," water bills would be increased by a designated amount, and there would be no future water shortages; if a majority votes "no," respondents were told that water bills would remain the same as they otherwise would have been, but water shortages of a specified magnitude and frequency would occur. Of course, individual customers differ in their willingness to pay to avoid different shortages.

The survey purposely did not tell participants where additional supply would come from, but rather indicated that it could come from any of a number of different sources. The intent was to avoid responses that were unduly influenced by preferences for or against particular resource types.

The survey did not attempt to estimate the value that water customers place on avoiding damage to the environment or other social impacts. Many types of water resources have environmental or social impacts associated with them. For many customers, the knowledge that reliability improvements might have associated adverse environmental or social impacts would reduce their willingness to pay. The CUWA Project Advisory Committee (PAC) and the consultants determined that, while these concerns are critical, they are best treated as a cost associated with particular resource additions. Thus, agencies that use the results of this survey to estimate the reliability benefits of particular supply-side or demand-side resource additions must also consider the environmental and social costs associated with those additions.

Organization of Report

The rest of this report discusses the survey methodology and results. Section II describes the development of the survey instrument, sampling procedures, survey administration, and response rates. Section III describes the methodology used to analyze the responses, including the model specification and the statistical approach. Section IV presents the results of the analysis. Appendices to the report contain a variety of supporting documentation, including: the mail materials and survey instrument, technical details of the statistical method, a description of the variables included in the model, results of the model runs, summary tables of participants' open-ended responses, and all agency-specific results and analysis.

II. THE CUWA CONTINGENT VALUATION SURVEY

Development of the Survey

Because of the complexity of a survey of this type, it was decided to use a combination mail/telephone survey. A package of information was mailed to potential respondents. The mail package contained material that explained the purpose of the survey and helped customers understand the impacts of various shortage magnitudes. Interviewers called several days after the mail material was received.

Both the mail material and the interview instrument are products of a lengthy development and review process overseen by the 30 person project advisory committee (PAC) and a smaller (6-person) survey design subcommittee.[4] The final mail materials are included as Appendix A of this report.

A key step in the refinement of the survey instrument was to conduct four focus groups, two in the Bay Area, and two in Southern California. This is a common technique used in the development of complex surveys to ensure that survey questions are understandable and elicit the type of information that the survey seeks to obtain. The focus groups tested different ways of posing the contingent valuation "scenarios." One of the key goals was to ensure that respondents could, in fact, separate their responses from resource preferences and environmental concerns.

Focus groups participants were asked to read and respond to the contingent valuation (CV) scenarios. The moderator questioned participants on their responses to the CV scenarios to determine the basis of their responses. One purpose of this exercise was to assure that the responses actually reflected the value that participants place on water supply reliability and were not a reaction to other cues that may have been present in the wording of the questions.

The survey was pilot tested in the service areas of East Bay Municipal Utility District (EBMUD) and the City of San Diego. The pilot test was an actual field test of the survey, and interviewers were encouraged to solicit feedback from respondents with respect to the survey questions and associated mailing materials. Based on the results of the pilot, the survey was further refined.

The survey asks each respondent two independent sets of "double bounded" contingent valuation questions. (See Section III for a discussion of the "double

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[4]Dr. Michael Hanemann of U.C. Berkeley, an expert in contingent valuation survey research, served as a technical advisor to the PAC.

bounded" technique.) Respondents are distributed randomly across a range of shortage magnitudes, frequencies, and dollar (bid) amounts. Shortage magnitudes range from 10% to 50%. Frequencies range from once every 3 years to once every 30 years. Bid amounts range from $1 to $50 increments to monthly water bills.[5]

Magnitudes and frequencies were combined to accomplish two objectives:

- To cover a wide range of shortage severity; and
- To present shortage scenarios that would be perceived by respondents as realistic possibilities and to avoid those that are too mild to elicit reliable willingness to pay (WTP) responses.

The CV questions are preceded by a series of questions that address a number of experiential and attitudinal issues. These questions help to place the CV questions in context and responses to these questions are also used in the analysis (see Section III). The actual CV questions include a carefully-worded description of the hypothetical "scenario" that will form the basis of a "yes" or "no" vote. The CV questions are followed by several "debriefing" questions that provide information on the reasons why respondents voted as they did. The survey concludes with a series of demographic questions. The complete survey instrument is included as Appendix B of this report.

Sampling Procedures

Each participating CUWA member agency was allocated 300 survey completions. Several agencies purchased additional completions to increase coverage of their service area, to increase statistical confidence in the results, or to evaluate differences in WTP among subpopulations in their service area.

The total number of completions across all participating agencies was 3,769. Approximately two-thirds of the survey sample was obtained from utility billing records—the remaining third was purchased from Survey Sampling, Inc. and Affordable Listed Samples, two independent sampling firms.

Utility billing record samples were divided among single family and multifamily records in proportion to the number of single family and multifamily households in

[5]Initial bid amounts ranged from $5 to $20. However, the follow-up portion of the double-bounded question accommodated values as low as $1 or as high as $50, if necessary.

each agency's service territory. Reverse directories (organized by address) were used to identify residents of multifamily households. This was necessary since residents of multifamily buildings do not typically pay water bills. The billing records therefore contain addresses and telephone numbers of property managers or landlords rather than building residents. Because the purchased sample is randomly selected, presumably it already contains the appropriate proportions of single-family and multifamily households.

Survey Administration

The survey was conducted from August 1993 through February 1994. The mail materials were mailed in batches to ensure that potential respondents would be contacted within a reasonable period of time after receiving the mailing; excessive lags were viewed as undesirable, since residential customers would tend to misplace the material and/or forget the contents. Telephone surveying generally began four to seven days after the mailing. For telephone numbers that were either inaccurate or not included in the billing record, the survey team contacted directory assistance to attempt to obtain the number. Interviewers attempted to call potential respondents up to 12 times, varying the day of the week and time of day that calls were made.

Analysis of Response Rates

The overall response rate for the survey was 41%. The largest number of nonrespondents (25%) simply were not reached during the course of the study. The refusal rate was approximately 16%. Another 18% were unable to participate due to language or other communication barriers, or because they had not read, not received, or thrown away the mail materials.

The final disposition of sample points is illustrated in Table 1.

III. ANALYTICAL METHOD

As described earlier, the contingent valuation (CV) survey uses the referendum approach. The referendum approach "bounds" the maximum willingness to pay (WTP) by asking the respondent whether he or she would be willing to pay a specified amount. A "yes" response indicates that the respondent would be willing to pay that amount or more, i.e, it gives a lower bound to the maximum WTP; a "no" response gives an upper bound. The mean WTP to avoid particular shortage scenario

Table 1
RESPONSE RATES

	Total
Initial sample	13,565
Unused sample[1]	1,284
Out of sample[2]	944
No telephone number available	2,202
Corrected sample size	**9,135**
Refusals	1,482
Not reached during study	2,268
Unable to participate[3]	1,616
Completed interviews	**3,769**
Response rate[4]	**41%**

[1]There was no attempt to contact these sample points.
[2]These include businesses, landlords, vacancies, duplicate sample points, and sample points no longer residing in the study area.
[3]Includes language and other communication barriers, or mailing not received, not read, or thrown away.
[4]Calculated as a percent of the corrected sample size.

can be estimated statistically from responses of different residential customers to different shortage descriptions.

An extension of this approach, and one which is more statistically reliable, is the "double-bounded" technique. The CUWA contingent valuation survey asked respondents whether they would pay an additional monthly amount (or bid) to avoid a particular percentage shortage occurring with a specified frequency. A second choice question, whose bid depended on the answer to the first question, was then asked. If the response to the first question was "yes," then the second bid was an amount greater than the first bid, and if it was "no," the second bid was an amount smaller. The technical description of the statistical approach is included as Appendix C of this report.

The superior statistical efficiency of the "double-bounded" approach makes intuitive sense given that the "double-bounded" approach yields more information than the

"single-bounded" approach about each respondent's preferences. The solution to the double-bounded model used maximum likelihood techniques, applying a program that was written in GAUSS, a statistical software package widely used by economists and statisticians.

Specification of the Statistical Model

As described above, many questions pertaining to sociodemographic, attitudinal, and perceptual variables were included in the survey. Responses to many of these questions were included as explanatory variables in the statistical model. By doing this, we can see how these factors affect WTP. Explanatory variables included in the model are discussed in detail below. More specifics on each variable are included in Appendix D of this report. Figure 1 describes the key explanatory variables.

Two statistical models were estimated. The so-called "detailed" model included all of the key explanatory variables discussed above. A "simplified" model included only those variables that can be obtained from census or agency billing records. These include:

- Age
- Household income
- Education level
- Dwelling type
- Household size

To the extent that this simplified model is statistically valid, it will enable agencies to reestimate willingness to pay in the future without resurveying residential customers.

The approach results in the following expression for the mean WTP for each shortage frequency (FREQ) and magnitude (REDUCE) combination:

$$WTP(REDUCE,FREQ) = \frac{\log(1+\exp(\alpha+\beta_1(REDUCE)+\beta_2(FREQ)+\sum \gamma_n X_{mean_n}+\sum \delta_t Z_{prop_t}))}{-\beta_3}$$

where:

X_{mean} = the mean of those explanatory variables that are not binary (i.e., either zero or one)

Z_{prop} = the proportion of customers for which each of the binary explanatory variables takes on a value of one.

Figure 1
KEY EXPLANATORY VARIABLES

- **Number of years living in area**
- **Household size**†
- **Age**†
- **Income**†
- **Education**†
- **Housing type**†
- **Concern for other public issues**
- **Perception of drought severity**
- **Perception of water shortages as a long-term problem**
- **Awareness of agency mandates to cut back on water use**
- **Home ownership/rental status and water bill responsibility**
- **Amount and type (private or shared) of external landscaping**
- **Population growth preferences**
- **Average residential water rate for respondent's water agency**
- **Northern California or Southern California agency**

†Included in simplified model.

The coefficients in this equation are derived from the model estimation procedure described in Appendix C.

This expression enables us to derive *customer loss functions* that express average customer willingness to pay as a function of shortage magnitude and frequency. Such functions can be a key tool for agency resource planners.

IV. ANALYTICAL RESULTS

Comparison of the Sample with the Population

Before discussing the customer loss functions, we first must determine the extent to which the survey sample differs from the underlying population. To do this, census results were compared to sample characteristics with respect to age, income, education, household size, and type of dwelling (i.e., single family versus multifamily). The census figures for each participating agency were weighted in proportion to each agency's share of the total underlying population. The results are presented in Table 2.

Table 2 indicates that the sample was more educated, wealthier, and middle-aged than the overall population, and also had a higher proportion of single-family residents. For many reasons, the demographics of a survey sample frequently differ from the demographics of the underlying population. For example, certain groups, such as people under age 35, may be home less often and therefore more difficult to reach by telephone. The standard analytical technique that is used to correct for such differences is to use population means rather than sample means to derive loss functions. The estimates of willingness to pay (WTP) then reflect the population rather than the sample demographics. That is the approach that was used in this case.

For example, if residential customers with annual household income greater than $50,000 have higher willingness to pay, then using unweighted results would yield a higher estimate of mean WTP. By substituting the population mean, we weight the response of lower income respondents in proportion to their occurrence in the underlying population. This provides a more accurate estimate of WTP.

Willingness to Pay

WTP can be interpreted as the losses that residential customers incur as a result of particular shortage scenarios. The amount that a customer is willing to pay to avoid an event is a measure of the losses that customer would incur if that event were to occur. Therefore, we refer to these willingness to pay results as a "loss function."

Tables 3A and 3B present the mean WTP for the detailed model and the simplified model for each magnitude and frequency of shortage. WTP figures represent increments to monthly water bills.

Table 2
COMPARISON OF SAMPLE WITH POPULATION

	Sample	Population
Age		
18 to 34	14%	32%
34 to 54	42%	26%
55+	44%	42%
Household Income		
Under $50,000	54%	65%
$50,000+	46%	35%
Education		
Not college grad	53%	74%
College graduate	47%	26%
Dwelling Type		
Single-family	67%	58%
Multifamily	33%	42%
Household Size	2.6	2.7

WTP for the detailed model varies from a low of $11.62/month to avoid a 20% shortage once every 30 years, to a high of $16.92/month to avoid a 50% shortage every 20 years. Blank cells in the table reflect scenarios which were not part of the survey.

The results of the simplified model are almost identical to the detailed model. The remainder of this report cites results based on the detailed model.

While results for individual agencies do exhibit some differences, the range of WTP estimates are remarkably consistent across all participating agencies, as illustrated in Table 4.

The loss function is shown graphically in Figure 2. In examining the tabular and graphical results, two major conclusions can be drawn:

- As expected, respondents are willing to pay more to avoid larger shortages and for shortages that occur with higher frequency. However, the impact of frequency variations is considerably smaller than the impact of shortage

Table 3A
MEAN MONTHLY WILLINGNESS TO PAY, DETAILED MODEL
(Additional $/Month)

Shortage (% Reduction from Full Service)	Frequency (Occurrences/Years)				
	1/30	1/20	1/10	1/5	1/3
10%			$11.63	$11.98	$12.12
20%	$11.62	$12.33	$13.06		
30%	$13.05	$13.80	$14.57		
40%	$14.56	$15.34	$16.13		
50%	$16.12	$16.92			

Table 3B
MEAN MONTHLY WILLINGNESS TO PAY, SIMPLIFIED MODEL
(Additional $/Month)

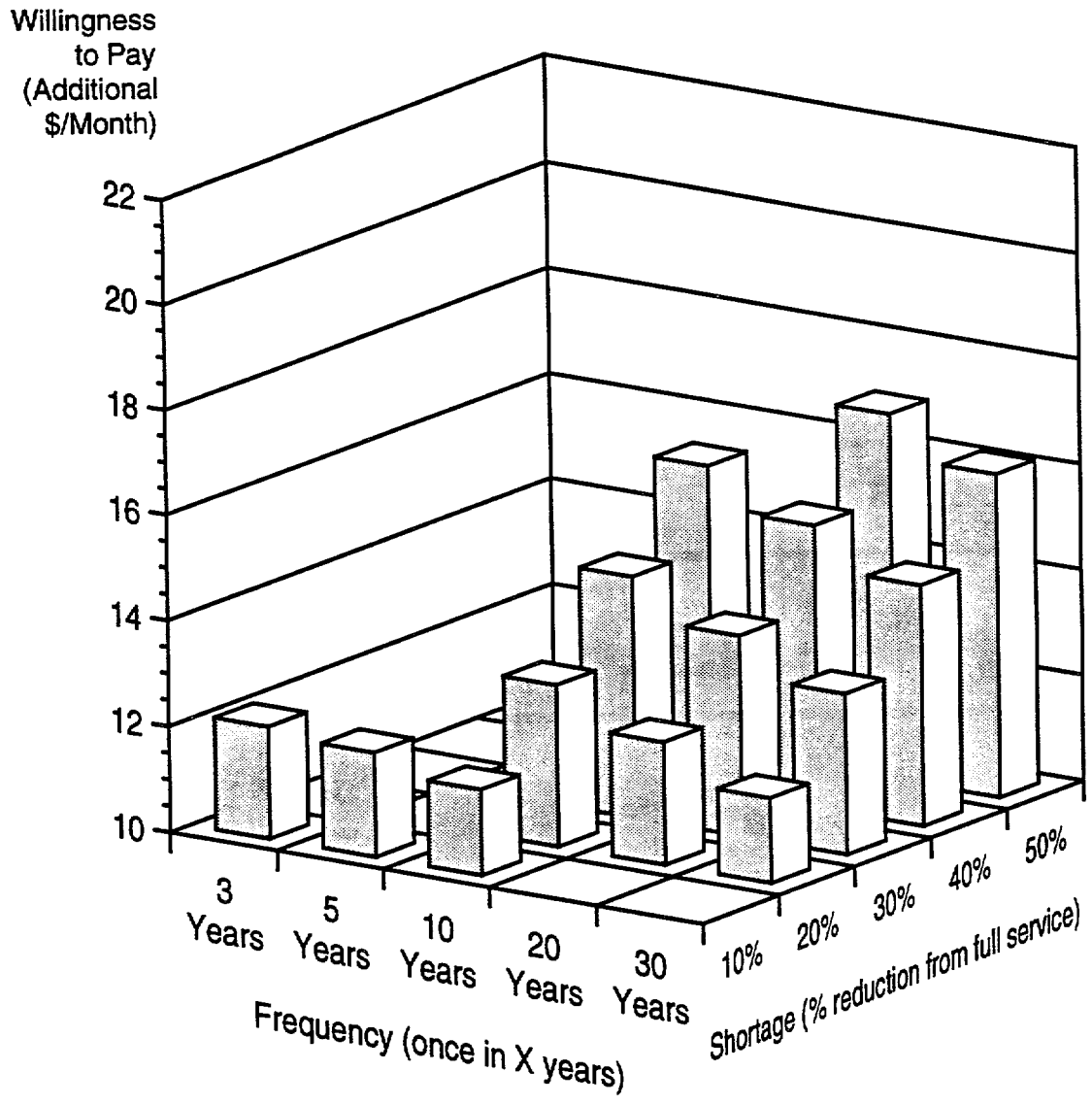
Shortage (% Reduction from Full Service)	Frequency (Occurrences/Years)				
	1/30	1/20	1/10	1/5	1/3
10%			$11.67	$12.00	$12.14
20%	$11.71	$12.39	$13.08		
30%	$13.13	$13.84	$14.56		
40%	$14.61	$15.35	$16.10		
50%	$16.15	$16.92			

Table 4
MEAN MONTHLY WILLINGNESS TO PAY

Shortage	Frequency (one occurance in X years)	ACWD	CCWD	LADWP	MWDOC/ OCWD	MWD	SDCWA	City of San Diego	SFWD	SCVWD
10%	10	$12.46	$12.67	$10.95	$11.26	$11.32	$10.23	$11.71	$11.77	$13.15
10%	5	$12.69	$12.97	$10.74	$11.76	$12.12	$10.54	$11.47	$12.08	$14.21
10%	3	$12.78	$13.10	$10.65	$11.96	$12.45	$10.67	$11.38	$12.20	$14.64
20%	30	$11.98	$12.38	$13.38	$10.89	$9.83	$10.94	$13.48	$12.12	$11.43
20%	20	$12.42	$12.99	$12.92	$11.87	$11.36	$11.58	$12.99	$12.75	$13.45
20%	10	$12.87	$13.62	$12.46	$12.89	$12.99	$12.24	$12.51	$13.38	$15.61
30%	30	$12.38	$13.32	$15.02	$12.50	$11.41	$13.00	$14.32	$13.76	$13.75
30%	20	$12.82	$13.95	$14.53	$13.54	$13.04	$13.69	$13.82	$14.41	$15.92
30%	10	$13.28	$14.59	$14.04	$14.61	$14.74	$14.40	$13.33	$15.08	$18.20
40%	30	$12.78	$14.29	$16.71	$14.19	$13.08	$15.20	$15.18	$15.47	$16.24
40%	20	$13.23	$14.93	$16.21	$15.28	$14.79	$15.93	$14.67	$16.16	$18.53
40%	10	$13.69	$15.59	$15.70	$16.40	$16.56	$16.67	$14.16	$16.85	$20.91
50%	30	$13.19	$15.28	$18.47	$15.96	$14.84	$17.51	$16.05	$17.26	$18.87
50%	20	$13.65	$15.94	$17.94	$17.09	$16.61	$18.27	$15.53	$17.97	$21.25

Figure 2

Mean Monthly Willingness to Pay to Avoid Particular Shortage Frequencies and Magnitudes



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magnitude on consumers' responses. This is confirmed by referring to the model estimation results, which are shown in Appendix E.

Put another way, it appears that residential customers believe that infrequent large shortages impose higher losses than more frequent small shortages. This result is remarkably consistent across all of the individual agencies. This type of conclusion may be important to agencies as they plan supply-side or demand-side resource additions and make system operations decisions.

- To avoid even apparently minor shortage scenarios (e.g., 10% once every 10 years), respondents are willing to pay substantial amounts. This type of "threshold" response is not uncommon in surveys of this type and may indicate that respondents regard even a mild shortage scenario as an inconvenience that they want to avoid. They may make a greater distinction between "shortage" and "no shortage" than between different sizes or frequencies of shortages.

  Again, this pattern of responses holds for all participating agencies.

While there are few previous comparable studies to which these results can be compared, they do appear to be consistent with a contingent valuation survey in Southern California and the Bay Area that was reported in 1987 by Carson and Mitchell.[6] While the results are not directly comparable because of differing survey and analytical approaches and different shortage scenario definitions, they are quite similar. The Carson-Mitchell results are presented in Table 5.

Confidence Intervals

Consistent with the approach typically used in the literature to calculate confidence intervals for CV results, we have estimated a range around the WTP associated with the mean shortage frequency and magnitude. Using this approach, the 95% confidence interval is $\pm$\$0.43. In other words, we can state with 95% certainty that the WTP to avoid this average shortage lies within a $\pm$\$0.43 range of the estimated WTP. This range most likely underestimates the size of the confidence interval for low and high level shortages, where there are fewer observations. However, it does provide a good relative indicator of the precision of the WTP results.

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[6]QED Research, Inc., "Economic Value of Reliable Water Supplies for Residential Water Users in the State Water Project Service Area." June 9, 1987.

Table 5
CARSON & MITCHELL 1987 WTP RESULTS

Shortage Scenario	Annual WTP (1987 $)	Monthly WTP (1987 $)	Monthly WTP (1993 $)
30%–35% once every 5 years	$114	$9.50	$12.02
10–15% once every 5 years	$83	$6.92	$8.75
30–35% once every 5 years and 10–15% once every 5 years	$258	$21.50	$27.20
10–15% twice every 5 years	$152	$12.67	$16.03

The confidence interval represents only the likely margin of error due to sampling. There are also other sources of uncertainty in the WTP estimates, including nonresponse and response errors. Nonresponse errors arise if the sample points who were not reached or who refused to participate differ systematically from respondents. Response errors arise if survey participants provide incorrect or dishonest answers.

Impact of Key Explanatory Variables on WTP

As described previously, the statistical model includes many variables that could potentially explain the variation in WTP. For example, the variable "RATE" was included to determine if the average residential rate charged by the respondent's water agency affected WTP. This variable was not reliably distinguishable from zero. The model results in Appendix E include all of the estimated model coefficients and their statistical significance. The following discussion selects three explanatory variables that are statistically significant and illustrates their impact on WTP. Figures 3-5 show the variation of WTP at various shortage magnitudes when all other variables, other than the one in question, are held constant.

Landscape Area

Not unexpectedly, the quantity and type of outdoor landscaping has a statistically significant influence on respondents' willingness to pay to avoid future shortages. Figure 3 illustrates this by using the variables in the model that capture variations in landscaped area. The results show that respondents who have private lots with

landscapes larger than 3000 square feet have higher WTP than families with other types of landscaping.

Growth Preferences

Another interesting relationship is demonstrated in Figure 4, which shows the relationship between participant feelings about community growth and their willingness to pay to avoid water shortages. Individuals who indicate a desire for their communities to grow in size have a higher WTP than do people who want their communities to stay the same size or to get smaller. Many in the latter group may perceive a relationship between water resource development and growth and are therefore more likely to prefer enduring more severe and/or frequent water shortages rather than adding to the resource base.

Perception of Water Shortages as a Long-Term Problem

Survey respondents were asked to what extent they considered water shortages to be a long-term problem in their area. Those who considered the water shortages to be a long-term problem have higher WTP than those who do not. WTP for these two groups is illustrated in Figure 5.

Regional Comparisons

An analysis was done to determine whether Northern California respondents had different WTP than Southern California respondents. To isolate the variation that is due to regional differences, a variable NORTH was included in the model. The variable was set equal to 1 if the respondent was in the service area of:

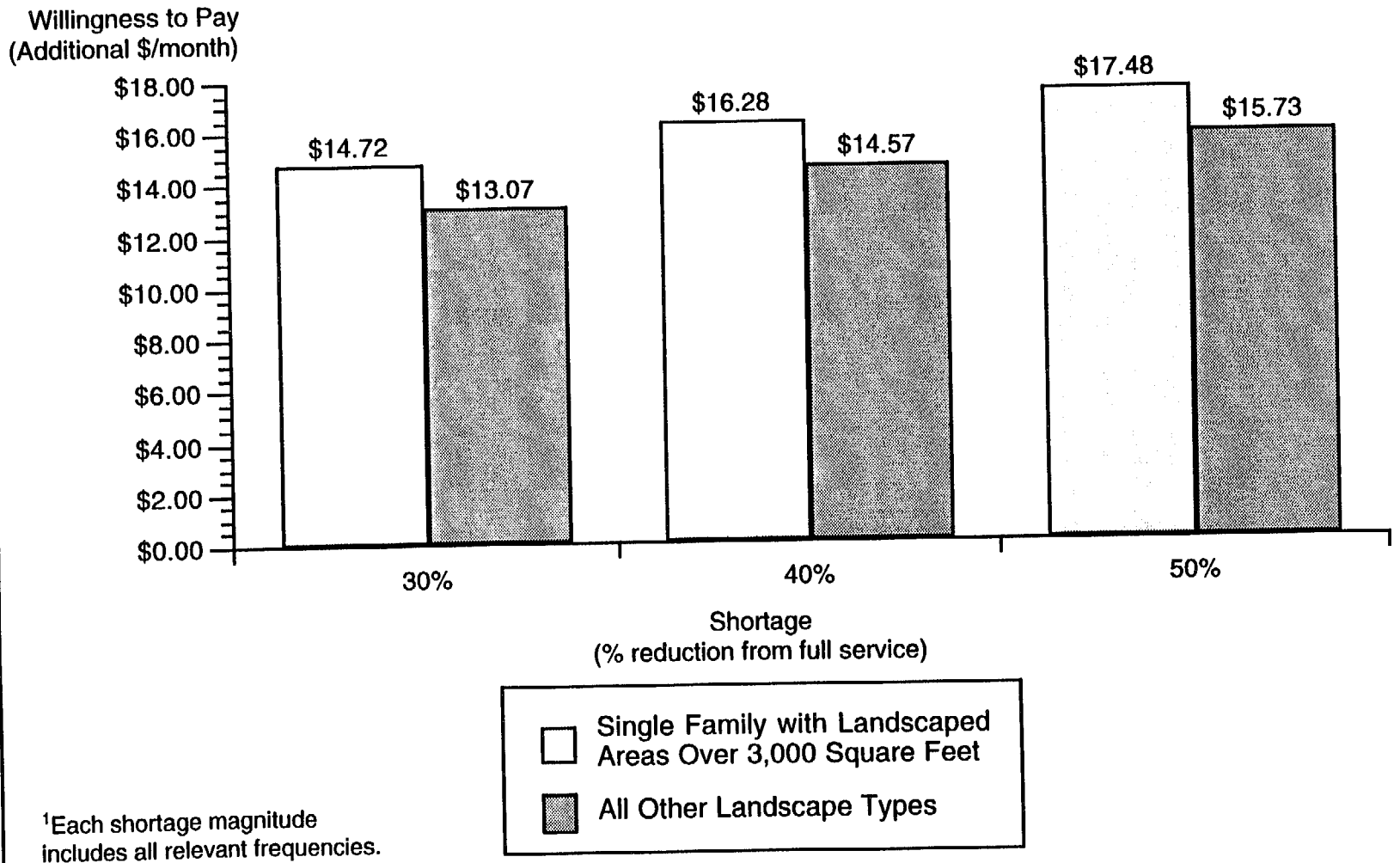
- Alameda County Water District
- Contra Costa Water District
- San Francisco Public Utilities Commission
- Santa Clara Valley Water District

The variable was set to 0 if the respondent was in the service area of:

- Los Angeles Department of Water and Power
- Metropolitan Water District of Southern California
- Municipal Water District of Orange County

Figure 3

Effect of Landscape Characteristics on Willingness to Pay[1]



[1]Each shortage magnitude includes all relevant frequencies.

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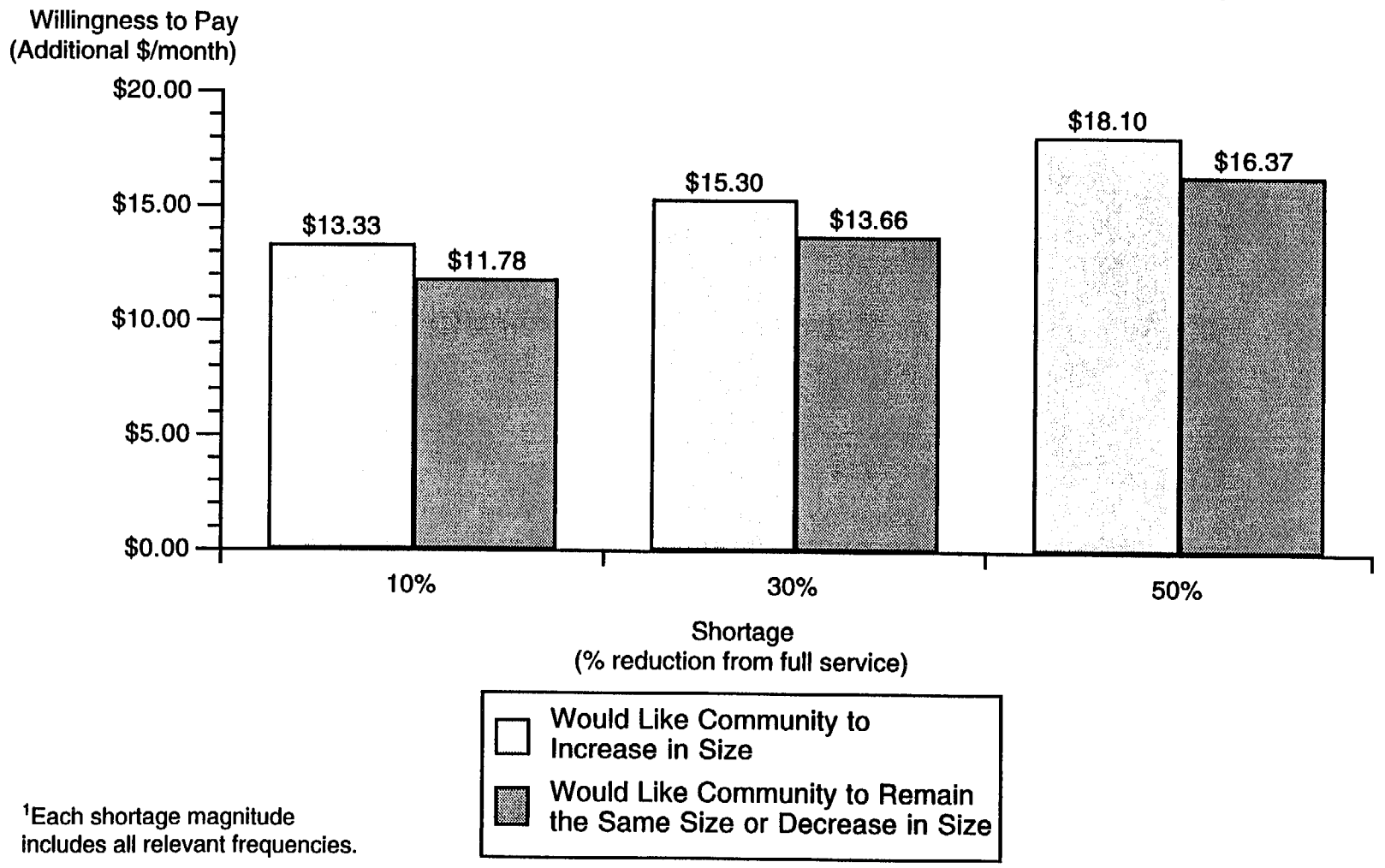
Figure 4

Effect of Population Growth Preferences on Willingness to Pay[1]



[1]Each shortage magnitude includes all relevant frequencies.

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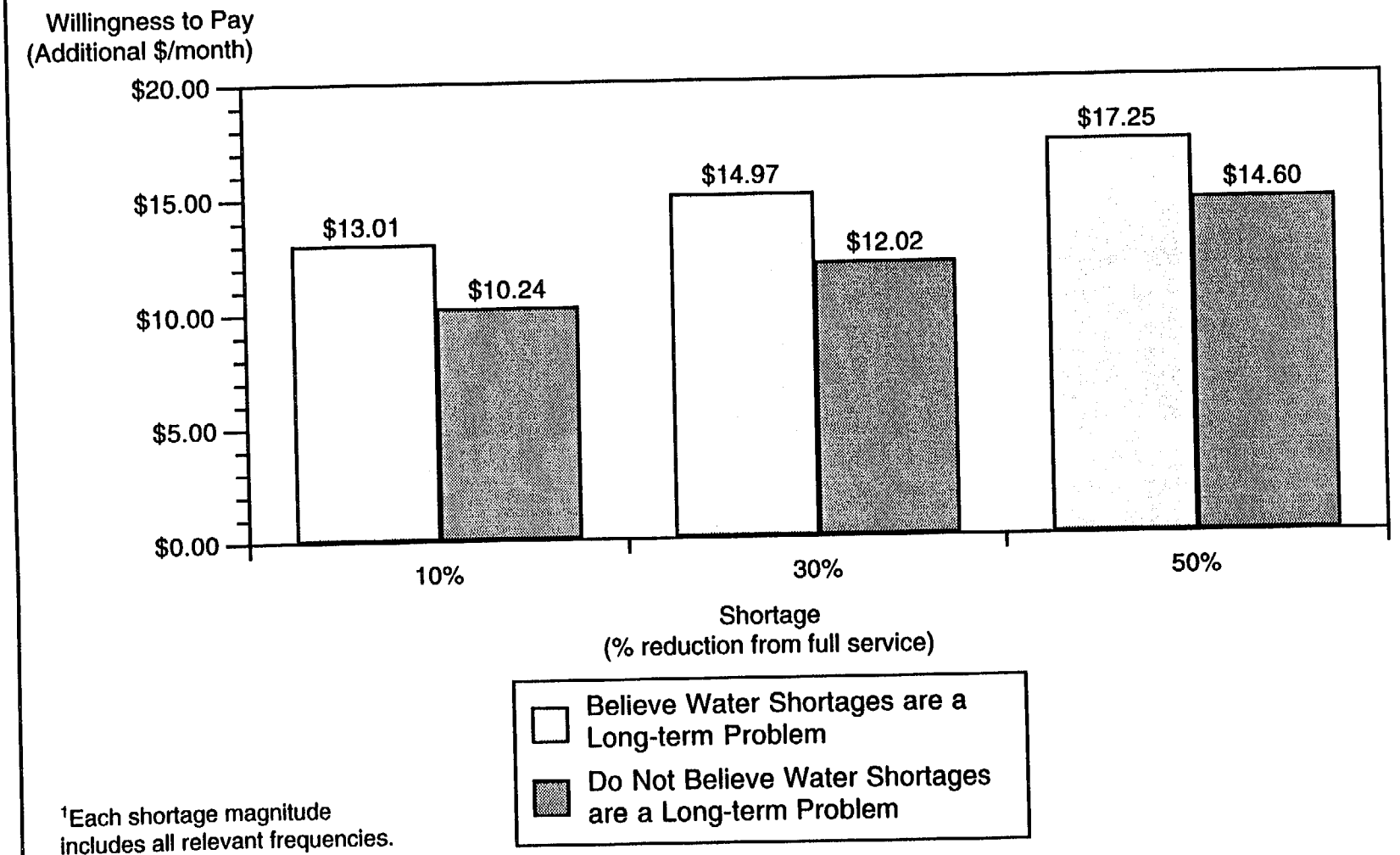
Figure 5

Effect of Perception of Water Shortages as a Long-term Problem on Willingness to Pay



[1]Each shortage magnitude includes all relevant frequencies.

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- Orange County Water District
- San Diego County Water Authority
- City of San Diego

Although all Southern California mean values are slightly lower than the corresponding Northern California mean values, the variable "North" was not reliably different from zero.

Separate models were then run for the Northern California and Southern California agencies to determine whether, apart from a difference that could be attributed to living in Northern or Southern California, there were demographic and attitudinal differences that were captured in other model variables and that resulted in different estimates of WTP for the two populations. The results, illustrated in Table 6, indicate no significant differences in WTP.

The confidence interval for the Southern California model is +/- $0.51; the confidence interval for the Northern California model is +/-$0.63. Except at the 10% shortage magnitude, the differences all fall within the overlapping confidence intervals. Given that the confidence interval is underestimated at that level because there are fewer observations, it is likely that the actual confidence intervals overlap at the 10% shortage as well and that there is therefore no statistically significant difference in WTP between Northern and Southern California respondents.
As discussed previously, the confidence interval represents only sampling error. There are other sources of error as well.

Explanatory Power of Models

Statistical goodness-of-fit tests were applied to test the explanatory power of the detailed and simplified models. Traditionally, regression models use R^2 as a measure of "goodness of fit." Discrete choice models use other statistics to measure the explanatory power of the models. Such measure are similar to the traditional R^2. These include McFadden's R^2 and pseudo R^2. Both of these measures compare the amount of information gained by constructing the model to the amount of information available without the model (the null case). In a single bounded logit model, the null case is simply allocating respondents randomly to the TWO (yes/no) groups (50/50). Hence, in a single bounded logit model, R^2 measures the model's predictive power improvement from this random null case.

In a double bounded scenario, the structure is more complex. No easy approach is available for allocating respondents to the FOUR (yy, yn, ny, and nn) groups without

Table 6
MEAN MONTHLY WILLINGNESS TO PAY, BY REGION
(Additional $/Month)

Shortage (% Reduction from Full Service)	Frequency (One Occurrence in X Years)	Northern California	Southern California
10%	10	$12.32	$11.13
10%	5	$12.70	$11.50
10%	3	$12.85	$11.64
20%	30	$12.10	$11.19
20%	20	$12.85	$11.93
20%	10	$13.63	$12.68
30%	30	$13.40	$12.75
30%	20	$14.19	$13.52
30%	10	$14.99	$14.32
40%	30	$14.75	$14.38
40%	20	$15.57	$15.20
40%	10	$16.40	$16.02
50%	30	$16.15	$16.09
50%	20	$16.99	$16.93

the model (i.e., randomly). The reason for this difficulty is that the second response is a function of the first, so we cannot allocate observations based on a "joint" response.

Another widely used approach for discrete choice models is to consider the *proportion* of correct predictions. We applied this approach to our double bounded model. We estimated the probabilities of belonging to one of two groups (yes/no) for the first bid. For observations that were allocated accurately, we estimated the probability of belonging to one of two groups for the second bid. In order for an observation to be described as "correctly classified," the model had to predict its group membership correctly for both bids.[7] Although, it is a useful measure of the models' predictive and explanatory power, this measure is inherently conservative. In order for the model to receive credit for a correct prediction, an observation must be classified correctly on the first response *and* on the second response. This is considerably more demanding than a single bounded logit model. For example, while a single bounded

[7]That is, the estimated probability associated with *both* actual responses had to exceed 50%.

logit may yield 60% accurate prediction, an equivalent double bounded logit would yield only 36% (0.6 * 0.6).

The results of our calculations are presented in Table 7.

In this case, the detailed model has only slightly more explanatory power than the simplified model. This result was also true for each individual agency. This, coupled with the similarity of the WTP results for the two models, indicate that agencies can apply the simplified model to estimate WTP, rather than going to the trouble of estimating the detailed model.

Water Shortages as a Public Concern

In survey question 4, respondents were asked to rate the importance of various public problems, including water shortages, as "not at all important," "somewhat important," or "very important." Based on these responses, a factor analysis was performed to attempt to cluster these variables into a small number of groups.

There were three reasons for conducting this analysis.

- To analyze the extent to which concern with any given set of issues (e.g financial issues) affected WTP.
- To test the perceived importance of water shortages relative to other public issues.
- To see how respondents categorized water shortages. With what other issues are water shortages associated?

Overall, the mean response for each issue is illustrated in Table 8.

Water shortages fall in the middle of the list of concerns.[8]

The factor analysis showed that respondents grouped issues as illustrated in Table 9. Water shortages fall into the category that includes issues that can best be described as having public service components. The factors are ranked within each category according to the strength of their rating in the factor analysis.

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[8]It is possible that had this survey been conducted a year earlier, when the state was still in the grip of a serious drought, water shortages would have been viewed as much more of a concern.

Table 7
GOODNESS OF FIT COMPARISON

	Percent Predicted Correctly
Detailed model	33%
Simplified model	32%
In a single bounded logit model, these numbers are equivalent to 58% and 57% (square root of 0.33 and 0.32 respectively.	

Each of the four factors was included in the model as a binary variable to test its explanatory impact on WTP.[9] Each of these variables was assigned the value of 1 if the mean value of all of a respondent's ratings for the issues included in that factor exceeded the value assigned to the water shortage issue, and zero otherwise. For the combined CUWA results, the social concerns, quality of life, and financial factors are statistically significant in explaining WTP. Respondents who placed any of those concerns above their concern for water shortages had lower WTP.

Open-Ended Responses

Respondents were asked several open-ended questions regarding what actions they thought they would have to take under specified shortage scenarios, and what issues they considered when deciding whether to vote yes or no. These questions were asked to better understand the reasoning of participants. Of particular importance is determining whether respondents who voted "no" were in fact indicating their unwillingness to pay or rather indicating unwillingness to fully participate in the survey. The primary reasons respondents gave for voting "no" were that they prefer to reduce their water usage (36%), or they are tired of paying for others who don't conserve (29%).

Some respondents who voted no may, in fact, be "non-players." In other words, these respondents may have been basing their responses on something other than willingness to pay for water supply reliability. This could include respondents who said that they were not confident in the water agency, respondents who said that they did not think that water shortages could be avoided, or respondents who were concerned that additional water supply encourages population growth.

[9]The "public services/environmental" factor included in the model excluded the water shortages variable.

Table 8
ISSUE RANKING AND MEAN RESPONSE

Issue	Mean Rating	Standard Error
Economy	2.66	.0095
Drug abuse	2.38	.0126
Education	2.35	.0136
Housing costs	2.32	.0122
Taxes	2.31	.0123
Traffic	2.29	.0122
Crime	2.26	.0122
Drinking water quality	2.18	.0138
Water shortages	**2.17**	**.0129**
Air pollution	2.08	.0124
Homelessness	1.98	.0130
Overcrowding	1.92	.0129
Trash disposal	1.88	.0138
Racial issues	1.73	.0126

Table 9
FACTOR ANALYSIS OF PUBLIC ISSUES

Public Services Concerns	Social Concerns	Quality of Life Concerns	Financial Concerns
Trash disposal	Crime	Overcrowding	Taxes
Education	Racial issues	Traffic	Economy
Water shortages	Drug abuse	Air pollution	
Homelessness			
Drinking water quality			

It is difficult to determine the appropriate disposition for these respondents. Eliminating those respondents from the analysis would raise the mean WTP. In the current study, all respondents were included in the analysis. All "no" votes were accepted. This is a conservative approach; it is also consistent with that used by Carson and Mitchell.

Participants' answers to these questions are summarized in Appendix F.

Summary of Key Conclusions

The important conclusions that can be drawn from this analysis are as follows:

- Results were remarkably consistent across participating agencies.
- Monthly WTP to avoid shortages across all participating CUWA agencies ranged from $11.62 to $16.92 monthly. Individual agency results, while exhibiting some variation, are generally consistent with this range.
- Results of the current study are generally consistent with the Carson-Mitchell results when those results are adjusted for inflation.
- As expected, respondents' WTP increases with increasing magnitude and frequency of shortages.
- To avoid even apparently minor shortage scenarios (e.g. 10% once every 10 years), respondents are willing to pay substantial amounts. This type of "threshold" may indicate that respondents regard even a mild shortage scenario as an inconvenience that they want to avoid. They may make a greater distinction between "shortage" and "no shortage" than between different sizes or frequencies of shortages.
- Response to shortage frequency is not as strong as response to shortage magnitude. Residential customers appear to be more willing to tolerate frequent small shortages than infrequent large ones.
- There are no significant differences in WTP between Northern California and Southern California respondents.
- The simplified model has virtually the same predictive power of the detailed model. Participating agencies who wish to replicate this type of

analysis in the future can therefore use the simplified model rather than resurveying their residential customers to gather data on the remaining variables required for the detailed model.

Use of Survey Results

The survey results are intended to assist water agency planners and decision makers, as they formulate water resource plans, in considering the value that their residential customers place on reliability. In any such plan, one of the key tradeoffs that must be made is between increased costs and increased reliability. This tradeoff is illustrated conceptually in Figure 6, which is taken from the initial report of the CUWA Water Supply Reliability project.[10] In concept, an agency's reliability goal should be that level of reliability that minimizes the sum of the costs of reliability and the customer losses that are incurred as a result of shortages. This survey was intended to provide information on these customer losses.

Moving from this concept to the real world of resource planning is, of course, difficult. The implementation of the goal-setting concept illustrated in Figure 6 has not yet been attempted. Moreover, water agencies must consider many issues, some of which are very local in nature, as they make this type of inherently difficult tradeoff. Many of these factors cannot be captured in the conceptual design illustrated in Figure 6.

A logical final phase of the CUWA Water Supply Reliability project would:

- Develop a detailed analytical framework which would use the contingent valuation results to develop reliability goals; and

- Illustrate the application of that framework to one or more CUWA member agencies.

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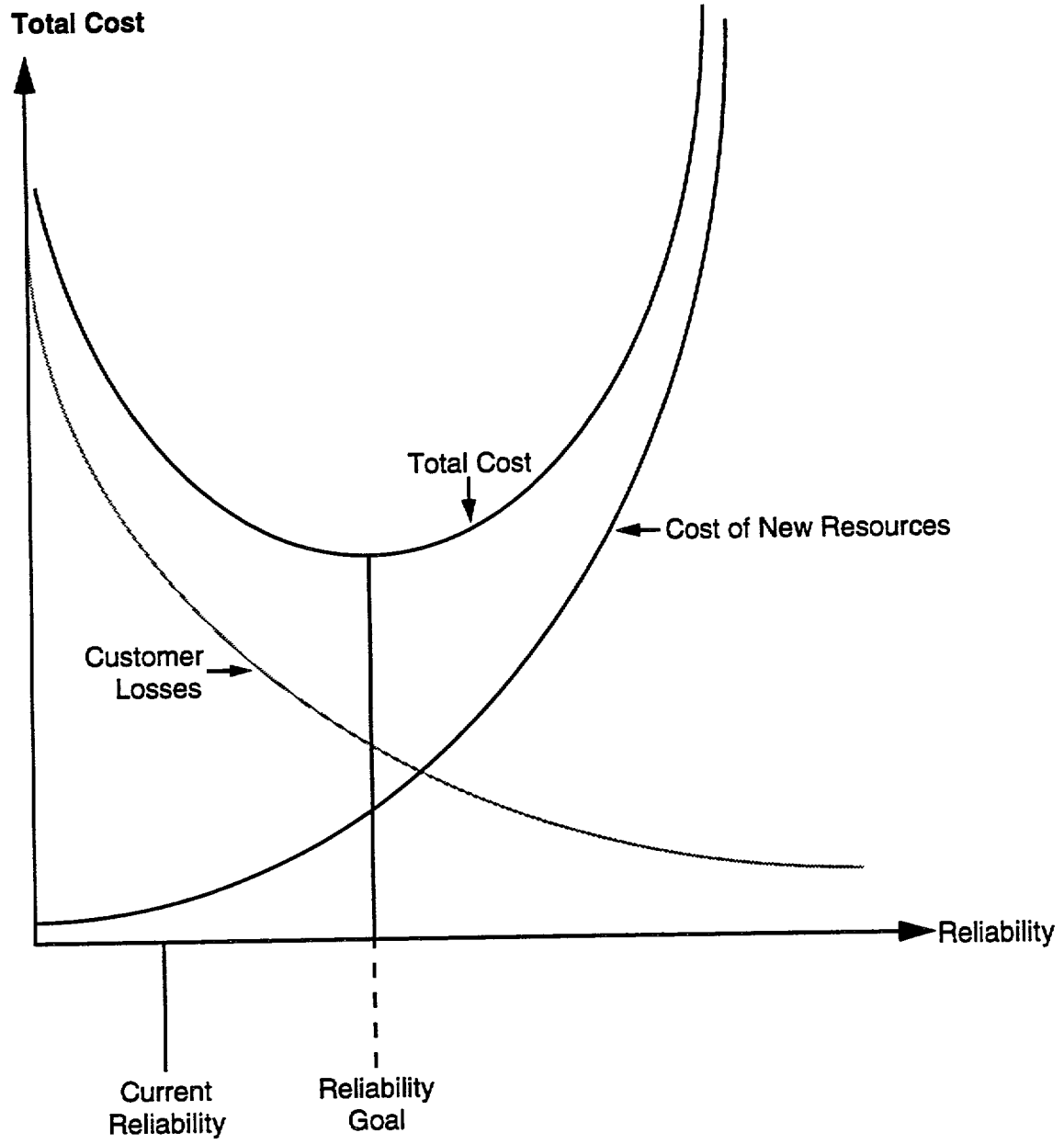
[10]Barakat & Chamberlin, Inc., *Water Supply Reliability in California: How Much Do We Have? How Much Do We Need? Phase I, Setting the Stage: Defining, Measuring, and Setting Goals for Water Supply Reliability*. Prepared for California Urban Water Agencies, January 1992.

Figure 6

Determining the Water Supply Reliability Goal



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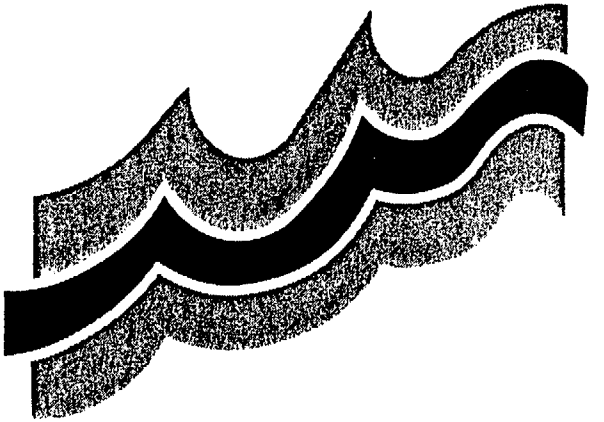
Agency-Specific Results

Complete agency-specific results, including survey administration details, response rates, loss functions, model results, factor analyses, and open-ended responses are presented in Appendices G through O.

Appendix A
MAIL MATERIALS

INFORMATION ABOUT YOUR WATER SUPPLY



BACKGROUND INFORMATION ON THE RELIABILITY OF YOUR WATER SUPPLY

The past several years of drought and related water shortages have caused concern about the long-term reliability of the water supplies in California. Water providers in California are considering taking steps to improve water supply reliability to help avoid shortages in the future. These steps might include: reclaiming or recycling water, making more effective use of groundwater, adding more storage reservoirs, developing desalination projects, expanding water conservation programs, transporting water from other areas of the state, and adding more capability to the existing water transport system. If any of these steps are taken, future shortages–and the associated reductions in your water use–could be reduced or avoided. However, all of the steps described above would cost money, and your water bills would increase to pay for the improved reliability.

The state's water suppliers want to know how you, as a citizen of California, view this tradeoff between increasing the reliability of your water supply and having to pay higher water bills. In the telephone interview, which will take place within the next few days, you will be asked to evaluate several possible future water shortage situations. These situations will be described according to how often shortages would be expected to occur and how large they would be.

WATER SHORTAGES: How Often?

No one knows for sure when water shortages will occur. So, for our purposes, you will be asked to assume that without additional water resources you can occasionally expect to experience a shortage. For example, we might ask you to assume that a water shortage is expected to occur, on average, once in 10 years. (Of course, these shortages are likely to occur at irregular intervals. For example, there could be several years of shortages in a row, followed by a period of no shortages.)

WATER USE REDUCTIONS: How Much?

Just as we don't know when shortages will occur, we also are unsure how large they will be when they do occur. But, we will ask you to assume that when these shortages occur, you would have to reduce your water consumption by a certain percentage. The water shortages we will describe could range from as little as a 10 percent shortage to as much as a 50 percent shortage. This would represent a reduction from your normal level of water use during non-shortage situations. The percent reductions are not in addition to reductions you may have already made in response to the past several years of drought-related shortages you may have experienced.

After the situation is described to you, you will be asked to imagine that you could vote in an election on whether additional water resources should be developed. In each case, we want you to assume that if a majority voted "YES," additional water resources would be developed so that you would avoid future water shortages; however, your water bill would go up by a specified amount. If a majority voted "NO," your water bill would not be affected, but you would periodically have to reduce your water consumption in the manner that the interviewer will describe to you.

HOW COULD I REDUCE MY HOUSEHOLD'S WATER USE?

To help you determine how different water shortages might affect your household, we have provided descriptions that discuss some of the different actions that households could take to reduce their water use. The descriptions are intended to provide information for people who are not sure how their household could reduce their water use by various amounts.

We realize that there are many different actions that households can take to reduce their water use. The descriptions in this booklet are based upon a "typical" household and may or may not be the same actions that your household would take. You should use your best judgement in determining what your household would do in the event of water shortages of various sizes.

The descriptions most appropriate for your household depend upon your current housing situation. Please answer the 4 questions on the following page to determine which description is most appropriate for your household. Based upon your answers to these questions, you will be instructed to read the blue, yellow, or pink card that is attached to the back of this booklet. Please keep this booklet and the colored card that pertains to your household handy, so that you can refer to it again when the interviewer calls.

1. In what type of residence do you currently live? *(CIRCLE ONE NUMBER)*

   1 Single family home—>Skip to Question 4
   2 Mobile home with a private lot—>Skip to Question 4
   3 Mobile home with no private lot
   4 Townhouse or condominium
   5 Duplex, triplex or fourplex
   6 Larger apartment building (five or more units)

2. Is there an outdoor common area shared by other residents? *(CIRCLE ONE NUMBER)*

   1 No——>Please read yellow card
   2 Yes

3. About how large is the common outdoor area shared by other residents? *(CIRCLE ONE NUMBER)*

   1 Small (less than 5,000 sq. ft.)—>Please read yellow card
   2 Large (5,000 sq. ft. or larger)—>Please read pink card

4. About how large is your lot size? *(CIRCLE ONE NUMBER)*

   1 Small (less than 3,000 sq. ft.)—>Please read yellow card
   2 Large (3,000 sq. ft. or larger)—>Please read blue card

MORE INFORMATION ABOUT THE SURVEY

Q. How was my name selected for this study?

A. Names of California residents were randomly selected from records of water agencies.

Q. How many people are being called for the telephone survey?

A. Statewide, about 4,000 residents have been sampled for the study. Since this is a small percentage of California's population, everyone's answers are very important.

Q. Will my name be used or get added to any mailing list?

A. **Absolutely not.** Our survey records are confidential. We can assure you that no information about you will be revealed.

Q. Do I have to answer every question in the telephone interview?

A. We would like you to please try to answer every question. It is important that we get an accurate picture of how residential water customers feel about long-term water supplies so that possible solutions to future water shortages can be evaluated.

Q. What if I rent and don't pay a household water bill?

A. We are still very interested in your opinions about additional water supplies. There will be an opportunity in the telephone survey for you to tell us if you rent or own your residence.

Q. What if I need more information?

A. If you need more information about the survey, you may call Bob Baumgartner or Marty Phillips collect at HBRS, Inc. Their number is (608) 232-2800. You may also call the San Francisco Water Department. The number is (415) 923-2467.

TOWNHOMES, APARTMENTS, AND CONDOMINIUMS WITH LARGE COMMON AREAS

10% - 15% WATER SHORTAGE

To reduce water use by 10 - 15%, some indoor or outdoor conservation, but probably not both, would be necessary. Indoor conservation might include shorter showers, flushing the toilet less often, repair of leaks, or using full loads in the clothes washer and dishwasher. Outdoor conservation might include some reduction in watering your lawn or patio and washing your car.

20% - 30% WATER SHORTAGE

To reduce water use by 20 - 30%, such indoor conservation actions as shorter showers, flushing the toilet only when necessary, repair of leaks, and using full loads in the clothes washer and dishwasher would be necessary. Installation of low-flow showerheads and toilet displacement devices might also be necessary. The conservation would most likely be mandatory with possible penalties for not complying. Your landlord or homeowners association might also curtail such outdoor water uses as car washing and reduce its own watering of common landscape areas, which may result in stressed lawns, with possible damage to trees and shrubs.

40% - 50% WATER SHORTAGE

To reduce water use by 40 - 50%, extensive indoor and outdoor conservation actions would be necessary. The conservation would be mandatory and penalties would be assessed for not complying. Indoor conservation would include installing low-flow showerheads and taking shorter showers, minimum flushing of toilets, repair of leaks, and using full loads in the clothes washer and dishwasher. Your toilets might also have to be replaced with models that use less water. In addition, you might have to collect "grey water" from your shower or clothes washer to flush the toilet or water your indoor and outdoor plants. Your landlord or homeowners association would completely ban such outdoor uses as car washing, and would cut back significantly on its own watering of common areas. Many lawns would die and other vegetation, such as trees or shrubs, could be seriously stressed or die. The filling of swimming pools would also be limited in some fashion.

SINGLE FAMILY RESIDENCES OR MOBILE HOMES WITH LARGE LOTS

10% - 15% WATER SHORTAGE

To reduce water use by 10 - 15%, some indoor or outdoor conservation, but probably not both, would be necessary. Indoor conservation might include shorter showers, flushing the toilet less often, repair of leaks, or using full loads in the clothes washer and dishwasher. Outdoor conservation might include some reduction in watering your lawn or patio and washing your car.

20% - 30% WATER SHORTAGE

To reduce water use by 20 - 30%, both indoor and outdoor conservation would be necessary. The conservation would most likely be mandatory with possible penalties for not complying. Indoor conservation would include shorter showers, flushing the toilet only when necessary, repair of leaks, and using full loads in the clothes washer and dishwasher. Outdoor conservation would include a moderate reduction in car washing and lawn watering, which may result in stressed lawns, with possible damage to trees and shrubs.

40% - 50% WATER SHORTAGE

To reduce water use by 40 - 50%, extensive indoor and outdoor conservation actions would be necessary. The conservation would be mandatory and penalties would be necessary. The conservation would be mandatory and penalties would be assessed for not complying. Indoor conservation would include installing low-flow showerheads and taking shorter showers, minimum flushing of toilets, repair of leaks, and using full loads in the clothes washer and dishwasher. It is very likely that there would be a complete ban on such outdoor uses as car washing and lawn watering. Other outdoor watering might have to be done by using "grey water" that you have collected from your shower or clothes washer. Many lawns would die and other vegetation, such as trees or shrubs, could be seriously stressed or die. The filling of swimming pools would also be limited in some fashion.

SINGLE-FAMILY HOMES, MOBILE HOMES, TOWNHOMES, APARTMENTS, AND CONDOMINIUMS WITH SMALL LOTS OR COMMON AREAS

10% - 15% WATER SHORTAGE

To reduce water use by 10 - 15%, some indoor or outdoor conservation, but probably not both, would be necessary. Indoor conservation might include shorter showers, flushing the toilet less often, repair of leaks, or using full loads in the clothes washer and dishwasher. Outdoor conservation might include some reduction in watering your lawn or patio and washing your car.

20% - 30% WATER SHORTAGE

To reduce water use by 20 - 30%, such indoor conservation actions as shorter showers, flushing the toilet only when necessary, repair of leaks, and using full loads in the clothes washer and dishwasher would be necessary. Installation of low-flow showerheads and toilet displacement devices might also be necessary. The conservation would most likely be mandatory with possible penalties for not complying.

40% - 50% WATER SHORTAGE

To reduce water by 40 - 50%, extensive indoor and outdoor conservation actions would be necessary. The conservation would be mandatory and penalties would be assessed for not complying. Indoor conservation would include installing low-flow showerheads and taking shorter showers, minimum flushing of toilets, repair of leaks, and using full loads in the clothes washer and dishwasher. Your toilets might also have to be replaced with models that use less water. In addition, you might have to collect "grey water" from your shower or clothes washer to flush the toilet or water your indoor and outdoor plants. It is very likely that there would be a complete ban on such outdoor uses as car washing and lawn watering. Many lawns would die and other vegetation, such as trees or shrubs, could be seriously stressed or die. The filling of swimming pools would also be limited in some fashion.

Appendix B
SURVEY INSTRUMENT

ID Number: _ _ _ _ _

Hello, my name is _____. I'm calling on behalf of the **(insert Agency name from label)**. I need to speak with _____.

1 **Correct person is currently on line**----------> *(SKIP TO NEXT BOX)*

2 **Correct person is being called to phone**-----> *(REPEAT ABOVE)*

3 **Correct person is unavailable**----------> *(READ NEXT BOX)*

4 **All people refuse**----------> *(TERMINATE)*

Your home was selected randomly from a list of residential customers in your area. Recently, we mailed you a pamphlet describing this study on the reliability of your water supply.

[INTERVIEWER RESPONSE TO QUESTION OF WHAT THIS STUDY IS ABOUT]

The purpose of this study is to collect information about people's water usage and the values they place on the reliability of their water supply.

1.1. Did you receive a package of materials about this survey in the mail? *(CIRCLE ONE NUMBER)*

1 No----------> *(CONFIRM ADDRESS. IF CORRECT THEN:)* Perhaps the information is still in the mail. I'll try again within the next few days. Thank you for your time.----------> *(TERMINATE)*

(IF INCORRECT ADDRESS, THEN GET CORRECTIONS:) Thank you. We'll mail that information out to you and call you back.----------> *(TERMINATE)*

2 Yes----------> Did you read the letter from the water utility? *(CIRCLE ONE NUMBER)*

1 No----------> *(SKIP TO QUESTION 1.4)*

2 Yes----------> *(SKIP TO QUESTION 1.4)*

8 Don't know-----> Is there another adult in the household who would know if you received the mailing? *(CIRCLE ONE NUMBER)*

1 No----------> *(CONFIRM ADDRESS. IF CORRECT THEN:)* Perhaps the information is still in the mail. I'll try again within the next few days. Thank you for your time.
----> *(TERMINATE)*

(IF INCORRECT ADDRESS, THEN GET CORRECTIONS:) Thank you. We'll mail that information out to you and call you back. Thank you for your time.
-----> *(TERMINATE)*

2 Yes

1.2. Who would that be? *(RECORD NAME ON CONTACT SHEET)*

1.3. May I speak with him/her please? *(CIRCLE ONE NUMBER)*

1 Correct person is being called to the phone----------> *(REPEAT FIRST INTRODUCTION BOX)*

2 Person is available----------> When would be a good time to call him/her? *(RECORD INFORMATION ON THE CONTACT SHEET; TERMINATE)*

1.4. Did you read the booklet that provided background information about the study? *(CIRCLE ONE NUMBER)*

1 No----------> This booklet contains some background information that will be very helpful in answering some of the questions. I'd like to give you a chance to read the booklet before we do the survey. I'll try calling you back in a few days. When would be the best time to call back? *(RECORD INFORMATION ON CONTACT SHEET; TERMINATE)*

(IF RESPONDENT IS NOT INTERESTED IN PARTICIPATING; GO TO QUESTION 1.5)

2 Yes----------> *(SKIP TO QUESTION 2)*

1.5. Is there another adult in the household who may have read the booklet and can participate in the study? *(CIRCLE ONE NUMBER)*

1 No----------> Thank you for your time----------> *(TERMINATE INTERVIEW)*

2 Yes

1.6. Who would that be? *(RECORD NAME ON CONTACT SHEET)*

1.7. May I speak with him/her please? *(CIRCLE ONE NUMBER)*

1 Correct person is being called to the phone----------> *(REPEAT FIRST INTRODUCTION BOX)*

2 Person is unavailable----------> When would be a good time to call him/her? *(RECORD INFORMATION ON THE CONTACT SHEET; TERMINATE)*

Today we would like to learn how your household uses water. I am not selling anything. This survey should take about 15 minutes to complete, and your responses will be kept confidential.

Starting Time: __ __ : __ __ **ID Number:** __ __ __ __ __

(DO NOT USE MILITARY TIME)

2. First, I'd like to know how many years have you lived in California? *(FILL IN BLANK)*

_____ **Years lived in California**

3. Approximately how many years have you lived in the **(insert name of city of residence from label)** area? *(FILL IN BLANK)*

_____ **Years lived in area**

4. I am going to read you a list of issues which may or may not be a problem in your area. For each issue, please tell me whether you feel it is not at all important, somewhat important or a very important problem in your area. *(BEGINNING WITH THE LETTER SHOWN ON CONTACT SHEET LABEL; READ LIST AND REPEAT RESPONSE CATEGORIES IF NECESSARY; CIRCLE ONE NUMBER FOR EACH CATEGORY)*

		Not at all Important Problem	Somewhat Important Problem	Very Important Problem
a.	Overcrowding	1	2	3
b.	Traffic	1	2	3
c.	Racial issues	1	2	3
d.	Crime	1	2	3
e.	Air pollution	1	2	3
f.	Cost of housing	1	2	3
g.	Water shortages	1	2	3
h.	Homeless people	1	2	3
i.	Education	1	2	3
j.	Trash disposal	1	2	3
k.	High taxes	1	2	3
l.	State of the economy	1	2	3
m.	Drinking water quality	1	2	3
n.	Drugs	1	2	3

Now I am going to ask you a few questions about the recent drought and your opinion of water shortages.

5. First, I would like you to think about the past several years of drought. On a scale of 1 to 5, where 1 means your area has not experienced a drought-related shortage over that time period and 5 means your area has experienced a severe drought-related shortage, how would you rate the severity of the drought impacts in your area? *(REPEAT RESPONSE SCALE IF NECESSARY; CIRCLE ONE NUMBER)*

1	2	3	4	5
No Shortage				Severe Shortage

6. How much did the drought affect your household? On a scale of 1 to 5 where 1 means it did not affect your household at all and 5 means you were affected a great deal, how would you rate how the drought affected your household? *(OFFER TO REPEAT RESPONSE SCALE; CIRCLE ONE NUMBER)*

1	2	3	4	5
Not at all Affected				Affected a Great Deal

7. Beyond the recent drought, do you think water shortages are a long-term problem in your area? On a scale of 1 to 5 where 1 means water shortages are not a long-term problem and 5 means water shortages are a long-term problem, how would you rate the water situation in your area? *(OFFER TO REPEAT RESPONSE SCALE; CIRCLE ONE NUMBER)*

1	2	3	4	5
Not a Long-Term Problem				Long-Term Problem

8. How long have you lived in your current residence? *(READ LIST; CIRCLE ONE NUMBER)*

1 **Less than 1 year**----------> *(SKIP TO QUESTION 10)*
2 **1 to 5 years**
3 **6 to 10 years**
4 **11 to 20 years**
5 **21 to 30 years**
6 **31 to 40 years**
7 **More than 40 years**
8 **DON'T KNOW** *(DON'T READ)*

9. During the past several years of drought, did your household cut back on the use of water? *(CIRCLE ONE NUMBER)*

1 **No**

2 Yes----------> How much did your household cut back on the use of water during the most severe year of the recent drought, compared with what you used before the drought? *(FILL IN BLANK)*

_____

_____

_____

_____

_____

[INTERVIEWER NOTE: IF RESPONDENT SAID "YES" ABOVE AND GAVE A PERCENTAGE, THEN SKIP TO QUESTION 10. IF THEY DIDN'T GIVE A PERCENTAGE, THEN ASK:]

Do you know the most severe percentage cutback in water use that was made by your household? *(CIRCLE ONE NUMBER)*

1 No

2 Yes----------> How much? *(FILL IN BLANK)*

___ ___ ___ **Percent**

☐ *[INTERVIEWER NOTE: PLEASE CHECK HERE IF RESPONDENT MENTIONED WATER AGENCY REQUESTS OR MANDATES WHEN ANSWERING QUESTION 9]*

INTERVIEWER NOTE: IF RESPONDENT ELABORATES HERE AND INDICATES ACTIONS TAKEN TO REDUCE WATER USE, RECORD THAT INFORMATION IN QUESTIONS 11 AND 12

10. Did your local water agency suggest or mandate that your household cut back on the use of water at any time during the past several years of drought? *(CIRCLE ONE NUMBER)*

1 No

2 Yes----------> How much did the agency ask your household to cut back on your water use? *(FILL IN BLANK)*

_____

_____

_____

_____

_____

[INTERVIEWER NOTE: IF RESPONDENT SAID "YES" ABOVE AND MENTIONED A PERCENTAGE CUTBACK, THEN MOVE ON TO QUESTION 11, IF RESPONDENT DOES NOT MENTION A PERCENTAGE, ASK:]

Did the agency ask your household to cut back your water usage by any particular percentage? *(CIRCLE ONE NUMBER)*

1 No

2 Yes----------> What was the most severe percentage? *(FILL IN BLANK)*

___ ___ ___ **Percent**

998 DON'T REMEMBER

INTERVIEWER NOTE: IF RESPONDENT ELABORATES HERE AND INDICATES ACTIONS TAKEN TO REDUCE WATER USE, RECORD THAT INFORMATION IN QUESTIONS 11 AND 12

[INTERVIEWER NOTE: IF RESPONDENT SAYS "NO" TO QUESTION 9, DO A DOUBLE CHECK WITH QUESTIONS 11 AND 12: "SO YOUR HOUSEHOLD HAS NOT TAKEN ANY ACTIONS TO REDUCE WATER USE EITHER INDOORS OR OUTDOORS."

IF RESPONDENT SAYS HE OR SHE DID CUT BACK, THEN COMPLETE QUESTIONS 11 AND 12. IF RESPONDENT STILL DID NOT CUT BACK WATER USE, CONTINUE WITH QUESTION 13. OTHERWISE, BEGIN READING WITH THE BOX BELOW:]

The next two questions ask about methods you used to decrease your household's water usage as a result of the past several years of drought. First, I will ask about water reduction methods you used indoors, and then I will ask about methods you may have used to reduce water use outside.

11. Did your household take any actions to reduce your indoor water use that have specifically resulted from the past several years of drought? *(CIRCLE ONE NUMBER)*

1 No

2 Yes----------> What indoor water conservation actions did you take? *(RECORD UP TO FOUR RESPONSES; DO NOT READ LIST. FOR EACH RESPONSE, ASK:)* Did your water agency ask or suggest that you take this action? *(CIRCLE ONE NUMBER. AFTER COMPLETING EACH RESPONSE, ASK:)* Is there anything else?

Code	Written Response	*Did your water agency ask or suggest that you take this action?* No	Yes	Don't Remember
__ __	[first response] _____	1	2	8
__ __	[second response] _____	1	2	8
__ __	[third response] _____	1	2	8
__ __	[fourth response] _____	1	2	8

[INTERVIEWER: PLEASE USE CODES LISTED BELOW; IF OTHER, THEN PLEASE WRITE OUT RESPONSE]

01 Installed low-flow showerheads
02 Installed displacement devices in toilet tanks
03 Replaced toilets with low-flow toilets
04 Purchased water-efficient appliances (dish/clothes washers)
05 Put aerators on faucets
06 Take shorter showers
07 Use fewer flushes
08 Use grey water for flushing, plant watering, etc.
09 Repaired leaks
10 Use full loads in clothes and dish washers
11 Turn off water while shaving or brushing teeth
12 Collect rain water for inside uses (i.e., plant watering)
13 Turn of shower while soaping
14 Buy bottled water
15 Take laundry to laundromat
16 Stop using dishwasher--wash dishes by hand
17 Boil water instead of waiting for faucet to run hot

12. Did your household take any actions to reduce your outdoor water use that have specifically resulted from the past several years of drought? *(CIRCLE ONE NUMBER)*

1 No

2 Yes----------> What outdoor water conservation actions did you take? *(RECORD UP TO FOUR RESPONSES; DO NOT READ LIST. FOR EACH RESPONSE, ASK:)* Did your water agency ask or suggest that you take this action? *(CIRCLE ONE NUMBER. AFTER COMPLETING EACH RESPONSE, ASK:)* Is there anything else?

Code	Written Response	*Did your water agency ask or suggest that you take this action?* No	Yes	Don't Remember
__ __	[first response] _____	1	2	8
__ __	[second response] _____	1	2	8
__ __	[third response] _____	1	2	8
__ __	[fourth response] _____	1	2	8

[INTERVIEWER: PLEASE USE CODES LISTED BELOW; IF OTHER, THEN PLEASE WRITE OUT RESPONSE]

01 Changed sprinkler/irrigation system
02 Replaced lawn/changed landscaping
03 Covered swimming pool
04 Don't fill swimming pool
05 Changed outside plant watering habits
06 Don't wash the car as often/stopped
07 Use grey water to water plants
08 Take car to car wash
09 Use rain water for outside uses

13. Do you own or rent your residence? *(CIRCLE ONE NUMBER)*

1 **Own**----------> Do you personally pay the water bills for your household, does another household member do this, or are the water bills paid by a homeowners' association? *(CIRCLE ONE NUMBER)*

1 **I personally pay the water bill**

2 **Another household member pays the water bill**

3 **Water bills are paid by a homeowners' association**

2 **Rent**----------> Is your household responsible for its own water bills, or is the water included in your rent? *(CIRCLE ONE NUMBER)*

1 **My household is responsible for its water bills**-----> Do you personally pay the water bills for your household or does another household member do this? *(CIRCLE ONE NUMBER)*

1 **Yes, I personally pay the water bill**

2 **No, another household member pays the water bill**

2 **Included in rent**

14. In what type of residence do you currently live? *(READ LIST; CIRCLE ONE NUMBER)*

1 **Townhouse or condominium**

2 **Duplex, triplex or fourplex**

3 **Larger apartment building (five or more units)**

4 **Mobile home**----------> Do you have a private lot? *(CIRCLE ONE NUMBER)*

1 **No**

2 **Yes**----------> *(SKIP TO QUESTION 16)*

5 **Single-family house**----------> *(SKIP TO QUESTION 16)*

15. Is there an outdoor common area shared by other residents? *(CIRCLE ONE NUMBER)*

1 No----------> *(SKIP TO QUESTION 17, **YELLOW**)*

2 Yes----------> About how large is the common area shared by other residents? *(CIRCLE ONE NUMBER)*

1 Small (less than 5,000 sq. ft.)----------> *(SKIP TO Q17, **YELLOW**)*

2 Large (5,000 sq. ft. or larger)----------> *(SKIP TO Q17, **PINK**)*

8 DON'T KNOW *(DON'T READ)*----------> *(SKIP TO Q17, **PINK**)*

16. Do you have any outdoor landscaped areas or lawn? *(CIRCLE ONE NUMBER)*

1 No *(YELLOW)*

2 Yes----------> How large would you say the landscaped area is around your residence? *(CIRCLE ONE NUMBER)*

1 Small (less than 3,000 sq. ft.)-------> *(YELLOW)*

2 Large (3,000 sq. ft. or larger)-------> *(BLUE)*

8 DON'T KNOW----------> *(BLUE)*

For Interviewer Use Only		
1/8 acre	>	5,000 sq. ft.
1/15 acre	~	3,000 sq. ft.
10' x 10'	=	100 sq. ft.
25' x 25'	=	625 sq. ft.
50' x 50'	=	2,500 sq. ft.
100' x 100'	=	10,000 sq. ft.

Now I am going to describe a possible water shortage situation to you, and then I will ask you to respond to a question about that situation.

17. No one knows for sure when water shortages will occur or how severe they will be, but for this exercise we would like you to assume that a (an) ____ percent shortage is expected to occur, on average, once every ____ years. These shortages could occur at irregular intervals. For example, there could be several years of shortages in a row, followed by a period of no shortages. However, assume that, on average, in one out of every ____ years you would be required to reduce your household's use of water by ____ percent below your normal non-drought water use.

Water providers in California are considering steps to develop additional water resources to help avoid these types of shortages in the future. These steps could include reclamation or water recycling projects, making more effective use of ground water, additional water storage reservoirs, desalination projects, additional water conservation programs, water transfers from other areas of the state, or additional water transport capabilities. If these steps are taken, you and other households would avoid the shortages I just described; however, your water bill or your rent would have to increase to pay for these additional water resources.

Some people may prefer to pay a higher water bill to avoid future water shortages. Others may choose to reduce their water usage rather than pay a higher bill. They may not be able to afford a higher bill or they may feel that the cost of the new water resources is more than the additional water is worth.

Suppose you were given the opportunity to vote on this issue. If a majority of the community voted "yes" to develop the additional water resources, you would have to pay an additional $____ per month--a total of $____ per year--from now on, but you would not have to reduce your future water use. If a majority of your community voted "no"--not to develop the additional water resources, your water bills would remain the same, but you would have to reduce your household water use by ____ percent, on average, for one out of every ____ years.

Would you vote "yes" to develop the additional water resources or "no" not to develop them? *(CIRCLE ONE NUMBER)*

1 No----------> Suppose, instead of $____ per month, the cost of developing additional water resources would increase your water bill by $____ per month--that is $____ per year--from now on. Would you vote for it then? *(CIRCLE ONE NUMBER)*

1 No
2 Yes

2 Yes----------> Suppose, instead of $____ per month, the cost of developing additional water resources would increase your water bill by $____ per month--that is $____ per year--from now on. Would you vote for it then? *(CIRCLE ONE NUMBER)*

1 No
2 Yes

INTERVIEWER NOTE: APPLICABLE RESPONDENT COMMENTS CAN BE RECORDED IN QUESTIONS 19, 20, AND 21

18. This next question is similar to the one that we just completed. However, now I'd like you to assume that a ____ percent shortage is expected to occur, on average, once in every ____ years.

Again, suppose you were given the opportunity to vote on this issue of whether or not to develop new water resources to avoid these shortages. If a majority of your community voted "yes" to develop the additional water resources, you would have to pay an additional $____ per month--a total of $____ per year--from now on, but you would not have to reduce your future water use. If the community voted not to develop the additional resources, your water bills would remain the same, but you would have to reduce your household water use by ____ percent, on average, in one out of every ____ years.

Would you vote "yes" to develop the additional water resources or "no" not to develop them? *(CIRCLE ONE NUMBER)*

1 No----------> Suppose, instead of $____ per month, the cost of developing additional water resources would increase your water bill by $____ per month--that is $____ per year--from now on. Would you vote for it then? *(CIRCLE ONE NUMBER)*

1 No

2 Yes

2 Yes----------> Suppose, instead of $____ per month, the cost of developing additional water resources would increase your water bill by $____ per month--that is $____ per year--from now on. Would you vote for it then? *(CIRCLE ONE NUMBER)*

1 No

2 Yes

INTERVIEWER NOTE: APPLICABLE RESPONDENT COMMENTS CAN BE RECORDED IN QUESTIONS 19, 20, AND 22

(Note: This page was not part of the actual survey instrument.)

The blanks in questions 17 and 18 were filled in by the interviewer as follows. Participants were randomly assigned one of the following shortage scenarios:

SHORTAGE SCENARIOS

Shortage (% reduction from full service)	Frequency (one occurrence in X years)
10%	3
10%	5
10%	10
20%	10
20%	20
20%	30
30%	10
30%	20
30%	30
40%	10
40%	20
40%	30
50%	20
50%	30

Participants were randomly assigned a starting bid of $5, $10, $15 or $20. The second bid was based on the respondent's answer to the first bid. Initial and follow-up bids were structured as follows.

INITIAL AND FOLLOW-UP BIDS

Initial Bid (additional $/month)	Second bid if respondent said yes to initial bid (additional $/month)	Second bid if respondent said no to initial bid (additional $/month)
$5	$15	$1
$10	$20	$3
$15	$30	$5
$20	$50	$10

[INTERVIEWER NOTE: IF RESPONDENT VOTES "NO" TO BOTH CV QUESTIONS 17 AND 18, OR IF RESPONDENT REFUSES TO VOTE, ASK QUESTION 19; OTHERWISE ASK QUESTION 20]

19. What are the primary reasons you would choose not to pay the additional money on your water bill to avoid the future shortages I described? (*PROBE:* Are there any other reasons?) *(DO NOT READ LIST; CIRCLE ALL THAT APPLY)*

1 **Additional water supplies only encourages population growth**

2 **Prefer to reduce my water usage and feel others should do the same**

3 **Too much money for what the additional water would do for me (not willing to pay more)**

4 **Cannot afford to pay the amount stated**

5 **Cannot afford to pay a higher water bill at all**

6 **Don't believe water shortages can be avoided even if additional storage facilities were built**

7 **Don't trust the water agency to develop new water storage facilities**

8 **Tired of paying for others who don't conserve when I (we) do**

9 **Support mandatory reduction methods**

10 **Other** (please describe: _____)

[INTERVIEWER NOTE: IF RESPONDENT WAS ASKED QUESTION 19, THEN SKIP TO QUESTION 21]

20. What factors or issues did you consider when you were deciding to vote yes or no? *(FILL IN BLANK)*

Response #1:_____

In what way were you thinking about this issue?

_____

Response #2:_____

In what way were you thinking about this issue?

_____

Response #3:_____

In what way were you thinking about this issue?

_____

Response #4:_____

In what way were you thinking about this issue?

_____

21. When you were answering the first question about what it would be worth to you to avoid the ____ percent water shortage once every ____ years, what did you assume your household would have to do to cut back your water use? *(FILL IN BLANK; PROBE IF NECESSARY)*

_____

_____

_____

22. When you were answering the second question about the ____ percent water shortage once every ____ years, what did you assume your household would have to do to cut back your water use? *(FILL IN BLANK; PROBE IF NECESSARY)*

_____

_____

_____

23. When you were answering the two questions about how much it would be worth to you to be able to avoid the future water shortages, did you assume that, if these shortage prevention measures were taken, it would really be possible to avoid those water shortages? *(CIRCLE ONE NUMBER)*

1 No----------> Did this influence how you voted? *(CIRCLE ONE NUMBER)*

1 No

2 Yes----------> How? *(FILL IN BLANK)*

_____

_____

_____

_____

2 Yes

24. Has your water provider recently added new charges on your water bill for the purpose of improving future water supply reliability? *(CIRCLE ONE NUMBER)*

1 No

2 Yes----------> Did this influence how you voted? *(CIRCLE ONE NUMBER)*

1 No

2 Yes----------> How? *(FILL IN BLANK)*

_____

_____

_____

_____

8 DON'T KNOW *(DON'T READ)*

25. When you think about population growth in your community, which of the following statements comes closest to your own opinion? *(READ LIST; CIRCLE ONE NUMBER)*

1 I want my community to increase in size

2 I want my community to remain the same size

3 I want my community to decrease in size

Finally, I have a few general questions about you and your household.

26. Which of the following groups includes your age? Are you between . . . *(READ LIST; CIRCLE ONE NUMBER)*

0 Under 18

1 18 to 24

2 25 to 34

3 35 to 44

4 45 to 54

5 55 to 64

6 65 to 74

7 75 or older

8 CONFIDENTIAL *(DON'T READ)*

27. What is the last grade of formal education you have completed? *(ONLY READ LIST IF NECESSARY; CIRCLE ONE NUMBER)*

1 Less than high school
2 High school graduate
3 Some college
4 Bachelor's degree
5 Graduate degree
6 CONFIDENTIAL *(DON'T READ)*

28. Including yourself, how many people are there in your household? *(DO NOT READ; CIRCLE ONE NUMBER)*

1 One/self only
2 Two
3 Three
4 Four
5 Five
6 Six
7 Seven
8 Eight or more
9 CONFIDENTIAL *(DON'T READ)*

29. Which of the following groups includes your total 1992 household income before taxes? Was it . . *(READ LIST; CIRCLE ONE NUMBER)*

01 Under $10,000
02 $10,000 to $19,999
03 $20,000 to $29,999
04 $30,000 to $39,999
05 $40,000 to $49,999
06 $50,000 to $74,999
07 $75,000 to $99,999
08 $100,000 to $149,999
09 $150,000 or more
10 CONFIDENTIAL *(DON'T READ)*

Those are all the questions I have for you. Thank you for your participation in this study.

Ending Time: ___ ___ : ___ ___
(DO NOT USE MILITARY TIME)

INTERVIEWER OBSERVATIONS [To be recorded after completion of each interview]

1. Sex of Respondent

   1 Male
   2 Female

2. Did the respondent have difficulty hearing the questions?

   1 No, no difficulty at all
   2 Yes, some difficulty
   3 Yes, a great deal of difficulty

3. Did the respondent have difficulty understanding the non-CV questions?

   1 No, no difficulty at all
   2 Yes, some difficulty
   3 Yes, a great deal of difficulty

4. Did the respondent have difficulty understanding the CV question(s)?

   1 No, no difficulty at all
   2 Yes, some difficulty
   3 Yes, a great deal of difficulty

5. How confident do you feel about the validity of the respondent's answers to the CV question(s)?

   1 Very confident
   2 Somewhat confident
   3 Some doubts
   4 Serious doubts

Other Comments _____

_____

_____

Appendix C
STATISTICAL METHOD

CUWA Contingent Valuation Survey
Statistical Method

Willingness to pay will was estimated using the *contingent valuation method*, an approach used to solicit information about individuals' values for non-market, public goods. Traditionally, the approach used in contingent valuation has been to directly ask survey respondents to state their exact maximum willingness to pay for the particular non-market good. Because of the difficulty of responding reliably to these types of questions, however, the direct approach has fallen out of favor and is no longer used in high quality applications of the contingent valuation method. Instead, researchers use discrete response techniques where survey respondents are asked to provide "yes/no" responses to questions that ask whether or not the respondent is willing to pay a stated price, known as the *bid amount*. This approach resembles market decision-making and is thought to be easier for the respondent to answer reliably. The discrete response approach has been strongly endorsed by the panel on contingent valuation (a panel composed of leading economists, including two Nobel prize winners, who were assigned the task of evaluating the reliability of the contingent valuation method for use by public agencies, especially for litigation purposes).

The traditional model is estimated by specifying the functional form associated with the responses obtained (likelihood function). This function is then estimated using "maximum likelihood." The likelihood function requires expressions for the probabilities associated with the two possible responses, yes/no, expressed as follows:

$$Prob(yes) = f(BID, X)$$

$$Prob(no) = 1 - Prob(yes)$$

where f(Bid,X) is specified as some particular function of the bid value and the respondents characteristics, X. When the functional form is assumed to be logistic, a logit model of the following form is estimated:

$$f(BID, X) = \frac{1}{1 + e^{(\alpha + \beta BID + \gamma X)}}$$

In this project, a new model has been developed to improve the statistical efficiency (decrease the standard error of the estimated coefficients) of the discrete choice approach. The model, known as the *double-bounded model,* is a simple extension of the standard discrete choice model, now known by way of contrast, as the *single-bounded model.*

In a double bounded approach, the respondents are engaged in two rounds of questions. For example, in determining willingness to pay (WTP), if the first answer is "yes," the bid is raised, otherwise the bid is lowered. As a result, four sets of answers are possible; "YY," "YN," "NY," and "NN."

In a double bounded model, the level of the second bid is contingent upon the first. In cases where respondents fall in the "YN," and "NY" categories, researchers are able to place the true WTP between the two bids. In the cases where respondent fall in the "YY," and "NN" categories, the second bid sharpens the single choice interval (raising the lower bound or lowering the upper bound).

The mathematics of the double bounded logit technique are a straight forward extension of the traditional logit model. When each participant is presented with two bids and the level of the second bid is conditional on the first the probability of Y/Y can be presented is:

$$P_i^{YY} = Prob(FIRST\text{-}BID \leq WTP, SECOND\text{-}BID \leq WTP)$$

In other words, the probability of YY is the probability that the first bid AND the second bid are smaller than the respondents true WTP. This probability has a shorter left tail than the one estimated in a regular "single bounded" approach. Similarly, the P_i^{nn} will have shorter right tail, and the P_i^{yn} and P_i^{ny} will have shorter both left and right hand side tails (i.e., will be double bounded).

The exact probabilities are estimated in a logit framework, as follows:

$$P_i^{YY} = 1 - \frac{1}{1 + e^{(\alpha + \beta_b HIGHBID + \beta_r REDUCE + \beta_f FREQ + \sum \gamma_i X_i)}}$$

$$P_i^{NN} = \frac{1}{1+e^{(\alpha+\beta_b LOWBID+\beta_r REDUCE+\beta_f FREQ+\sum \gamma_t X_i)}}$$

$$P_i^{YN} = \frac{1}{1+e^{(\alpha+\beta_b HIGHBID+\beta_r REDUCE+\beta_f FREQ+\sum \gamma_t X_i)}} - \frac{1}{1+e^{(\alpha+\beta_b 1stBID+\beta_r REDUCE+\beta_f FREQ+\sum \gamma_t X_i)}}$$

$$P_i^{NY} = \frac{1}{1+e^{(\alpha+\beta_b 1stBID+\beta_r REDUCE+\beta_f FREQ+\sum \gamma_t X_i)}} - \frac{1}{1+e^{(\alpha+\beta_b LOWBID+\beta_r REDUCE+\beta_f FREQ+\sum \gamma_t X_i)}}$$

Where:

REDUCE	=	the proposed percent reduction in water usage (i.e., 10%, 20%, 30%, 40%, 50%)
FREQ	=	the proposed frequency of water shortages (i.e., once in 3 years, 5 years, 10 years, 20 years, 30 years)
X	=	a vector representing consumption level and some sociodemographic variables (these variables are included in the model as continuous). It also represents perceptual, attitudinal, and the remaining sociodemographic variables (these variables are included in the model as binary)
BID_1	=	the initial additional monthly payment (i.e., \$5, \$10, \$15, or \$20)
BID_L	=	the second lower additional monthly payment (i.e., \$1, \$3, \$5, or \$10)
BID_U	=	the second higher additional monthly payment (i.e., \$15, \$20, \$30, or \$50)

Once the double bounded logit model has been estimated, the mean WTP may be derived directly from the double bounded logit estimated coefficients as follows:

$$WTP(REDUCE,FREQ) =$$

$$\frac{\log(1+\exp(\alpha+\beta_1(REDUCE)+\beta_2(FREQ)+\sum \gamma_n X_{mean_n}+\sum \delta_t Z_{prop_t}))}{-\beta_3}$$

WTP was estimated for each scenario combination of REDUCE and FREQ. "Mean values" of the continuous explanatory variables and the "proportion of customers" for binary (0 or 1) explanatory variables were inserted for the X vector of customer characteristics.

The double-bounded approach maintains the simple nature of the discrete choice format, thus preserving the reliability of the information collected, and also obtains a substantially greater amount of information about willingness to pay from each survey respondent. This increased information improves the statistical efficiency of the WTP estimator and therefore reduces the size of the associated confidence interval.

Finally, in estimating the WTP, researchers have either used a linear or a logarithmic functional form. This refers to how the logit model is estimated. In a linear logit model, the explanatory variables enter the equation in their "raw" original form, while in a logarithmic logit model, explanatory variables are first transformed to their logs and then enter the equation.

The linear logit is commonly used in the literature (Haneman, 1984). The linear model assumes symmetry in the distribution of people's WTP, while the log model assumes the distribution to be more asymmetrical (one long tail). Finally, the linear model corrections for the truncation of the data (no negative WTP values allowed), is very straightforward compared to the log model.

The primary advantage of using the linear model is that it is a more stable form and is not as sensitive to the shape of the tail of the curve, which in this case is an area outside the range of the cv scenarios. The estimated mean in log models is very sensitive to the estimated model and to what happens in the tails of the distribution. The linear form offers much reduced sensitivity of the mean to shape of the distribution, presence of outliers, etc.

A second advantage of using the linear model is that it reduces the importance of deciding whether to use the mean or the median as the measure of WTP. In a log

model these two measures differ significantly, because the mean is more influenced by the shape of the tail. In a linear model the mean and median are very close, as follows:

$$Median = \frac{\alpha}{-\beta}$$

$$Mean = \frac{\log(1+e^{\alpha})}{-\beta}$$

The difference between the two estimates is due to the need to correct the mean for the truncation of the negative WTPs.

In the case of this study, the linear functional form is used because "fit" the data better[1]. The log model produced some unacceptable differences between the mean and the median.

[1] We attempted to compute some reasonable range of values for the true WTP by taking the high bid plus a random amount between $1 and $10 for the yy responses, the average of the high and the initial bid for the yn responses, the average of the low and initial bid for the ny responses, and the low bid minus a random value between $1 and $10 with negative values set to zero. This resulted in an average of the "true WTP" that was considerably closer to the estimates obtained with the linear model than with the log model.

Appendix D
SURVEY VARIABLES

CUWA Contingent Valuation Survey
Explanatory Variables

Various sociodemographic, attitudinal, and perceptual variables obtained from the survey instrument are included in the model. Many factors affecting willingness to pay can be discerned, including length of residence, perception of drought severity, and population growth preferences. By explicitly recognizing these factors in the loss function, more of the sample variation is explained, and thus more confidence can be placed in the findings.

Explanatory variables included in the model (variable mnemonics and survey question number, if appropriate, in parentheses) are discussed in detail below:

- **Number of years living in California** (CALYRS, Question 2); **number of years living in area** (AREAYRS, Question 3); **number of years living in current residence** (RESYRS, Question 8)

  There is likely to be a high correlation between CALYRS and AREAYRS. Thus only the variable with the superior summary statistics was included.

- **Concern for other public issues.** (Question 4) Respondents were asked to rate the importance of various public problems, including: overcrowding, racial issues, cost of housing, air pollution, state of the economy, homelessness, water shortages, etc., by using 1 for "not at all important," 2 for "somewhat important," and 3 for "very important." Based on these responses, a factor analysis was performed to reduce the number of issues to three or four primary groups.

  For example, overcrowding and traffic may be grouped as quality of life issues (QUALLIFE), racial issues and crime grouped as social issues (SOCIAL), cost of housing and state of the economy as financial issues (FINANCE), and air pollution and drinking water quality as environmental issues (ENVIRON). Other groupings are possible as well.

  We calculate a mean rating for each grouping and create a binary variable for each of the defined groups. The binary variable equals zero if the respondent's group mean is lower than his or her water shortage rating and one if it is higher. This provides a sense as to how water shortages are perceived in relation to other important problems.

In addition, as part of the factor analysis, we determine whether water shortages fall into any clearly defined group of issues, which indicates how respondents think about water shortages (e.g., as an environmental issue, quality of life issue, financial issue). If water shortages are found to fall within an issue group, then concern for those issues would correspond to perceived importance of water shortages and a correspondingly higher WTP.

- **Perception of drought severity.** (Question 5) Respondents were asked to rate the severity of the recent drought on a scale of 1 to 5 by answering 1 for "no drought" and 5 for "severe drought." A binary variable (SEVERE) was set to zero if the respondent indicates the drought is mild (rating of 3 or less) and set to one if the drought has been more serious (a rating of 4 or 5).

- **Impact of drought on household.** (Question 6) The survey asked respondents to indicate how much the drought has affected his or her household on a scale of 1 to 5 by answering 1 for "not at all affected" and 5 for "affected a great deal." A binary variable (AFFECTED) indicating whether the respondent has been noticeably affected (rating of 4 or 5) or slightly affected (rating of 3 or less) was constructed.

  Tests were performed to determine whether the variables SEVERE and AFFECTED are highly correlated. If, as is likely, a high degree of correlation is found, only the variable with the higher predictive power was used. Including only one of two highly correlated variables has the affect of reducing multicollinearity[1] among the regressors.

- **Perception of water shortages as long-term.** (Question 7) The survey asked respondents to indicate, on a scale of 1 to 5, whether water shortages are a long-term problem, using 1 for "not a long-term problem" and 5 for "long-term problem." A binary variable (LONGTERM) was included in the model to capture the affect of respondents' perception in this area on their willingness to pay. The variable equals one for ratings of 4 or 5, and zero for ratings of 3 or less.

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[1]Multicollinearity may exist if the explanatory variables in the defined equations are interrelated in some way. When an independent variable is a linear combination of other independent variables in the model, the affected coefficient estimates may have large sampling errors and be unstable. For instance, if SEVERE is related to AFFECTED, the resulting variation in WTP cannot be accurately assigned to a specific source.

- **Perceived cutbacks in water use.** (Question 9) Customers were asked for their estimates of the highest percent by which they cut usage during the drought. The variable PCTEST was set equal to that percentage estimate.

- **Mandates to cut back on water use.** (Question 10) Customers were asked whether their local water agency suggested or mandated that their household cut back on water consumption during the drought and, if so, the extent of that request or mandate. Since all agencies included in the survey either mandated or suggested such reductions, the responses to this question will indicate awareness.

  Two variables were created. The binary variable MANDATE equals one if the respondent answers yes and zero if he or she answers no. A second variable (PCTMAN) also equals zero if the respondent answers no OR if he or she answers yes but does not offer an estimate of requested percentage reduction. PCTMAN was set to equal the estimated reduction request for those respondents who do offer such an estimate.

  We will select the variable with the most predictive power to be included in the model.

- **Own or rent residence; pay or not pay water bill.** (Question 13) There is a likely interdependence between willingness to pay and responsibility for the water bill. The survey asked respondents a series of questions to determine this level of responsibility. First the survey asks the respondent whether she owns or rents her residence. If the respondent owns, then the survey asked whether (1) she personally pays the water bill, (2) whether another household member pays it, or (3) whether the bill is paid by a homeowners' association. If the respondent rents, the survey asked (1) whether her household is responsible for its water bills or (2) whether the bill is included in the rent. Four binary variables were created to capture this variation in responsibility, the values of which are summarized in the table below:

Variable Name	Own Home; Self Pays Water Bill	Own Home; Other Household Member Pays Water Bill	Own Home; Association Pays Water Bill	Rent; Pay Water Bill	Rent; Water Bill Included in Rent
OWNPAY	1	0	0	0	0
OWNELSE	0	1	0	0	0
OWNASSOC	0	0	1	0	0
RENTPAY	0	0	0	1	0

- **External landscaping.** (Questions 15 and 16) The survey categorizes respondents by the type of residence in which they live and whether or not their residences have large landscaped areas. We use binary variables to divide respondents into three categories, corresponding to the color coded descriptions that respondents will have received in the mail. Broadly speaking, respondents who live in multi-family buildings or single family homes without large outdoor landscaped areas are classified as YELLOW. If they live in a multi-family building with a large outdoor common area, they are classified as PINK. If they live in a single family home with a large outdoor area, they are classified as BLUE. The table below summarizes the values of these binary variables:

Variable Name	Single-Family or Multifamily Home; Small Outdoor or Landscaped Area	Multifamily Home; Large Outdoor Area	Single-Family Home; Large Landscaped Area
YELLOW	1	0	0
PINK	0	1	0

- **Population growth preferences.** (Question 24) Respondents were asked whether they would like their community to increase in size, remain the same size, or decrease in size. A binary variable (NOGROWTH) equals one if the respondent chooses either of the latter two options.

- **Various demographic descriptors.** (Questions 25 through 28) Demographic characteristics of the respondent were included in the model. Binary variables indicating age ranges (AGE1834, AGE3554, AGEGT54), education (COLGRAD), and income level (INCGT50K) illustrate how variations in demographics account for variations in respondents' willingness to pay.

- **Regional differences.** For the model runs that combined results of all participating agencies, a binary variable (NORTH) was created to determine the impact of regional differences on WTP. The variable equals one if the respondent is a customer of a Northern California water agency and zero if the respondent is a customer of a Southern California water agency.

- **Water rate.** For the model runs that combined the results of all participating agencies, the average residential rate for the respondent's water agency is included as a continuous variable (RATE).

Appendix E
MODEL RESULTS

Results for the detailed and simplified models follow this page. The results present each variable included in the model along with the following information:

- **Coefficient** indicates the magnitude of the variable's impact on WTP
- **Standard error** reflects the distribution of the coefficient
- **T-statistic** is a commonly used measure of statistical significance
- **P-value** is the observed significance level (for example, if p = .05, the coefficient is statistically significant at the 95% level)

The following key of variable pneumonics used in the model will facilitate interpretation of these results.

Key of Survey Variables

SUPPLY:	Percentage reduction from full service demand specified in the cv scenario.
FREQ:	Frequency of drought specified in the CV scenario.
AREAYRS:	Number of years respondent has lived in the area.
HHSIZE:	Number of persons in the household, including respondent.
AGE1834:	Respondent's age is in the range of 18 to 34 years old.
AGE3554:	Respondent's age is in the range of 35 to 54 years old.
COLGRAD:	Respondent is a college graduate.
INCGT%50:	1992 household income is greater than $50,000.
SNGL_FAM:	Respondent lives in a single family residence.
QUALLIFE:	Concern for "quality of life issues" (as defined by a factor analysis) relative to concern for water shortages.
SOCIAL:	Concern for "social issues" (as defined by a factor analysis) relative to concern for water shortages.
FINANCE:	Concern for "finance issues" (as defined by a factor analysis) relative to concern for water shortages.
ENVIRON:	Concern for "public services and/or environmental issues" (as defined by a factor analysis) relative to concern for water shortages.
SEVERE:	Perception of the severity of the recent drought
SHORTAGE:	Water shortages considered a somewhat or very important problem.
LONGTERM:	Perception of water shortages as a long-term problem in the area.
MANDATE:	Respondent believes that their water agency suggested or mandated cutbacks during the recent drought.
OWNPAY:	Respondent owns home and is personally responsible for paying the water bill.

OWNELSE:	Respondent owns home and someone else in the household is responsible for paying the water bill.
OWNASSOC:	Respondent owns home and a homeowners association is responsible for paying the water bill.
RENTPAY:	Respondent rents home, water bill is not included in the rent.
YELLOW:	Homes with private landscaped areas less than 3,000 square feet or shared landscaped areas less than 5,000 square feet.
PINK:	Homes with shared landscaped areas greater than 5,000 square ft.
NOGROWTH:	Respondent wants community to remain the same size/decrease in size.
RATE:	Average residential rate for respondent's water agency
NORTH:	Northern California water agency
BID:	Amount that respondents bill would increase per month if the majority of the community voted yes to the referendum.

All CUWA simplified model

Date: 4/25/1994
Observations: 6511 D.F. : 6500

Var	Coef	Std. Error	t-Stat	P-Value
CONSTANT	3.238165	0.196496	16.48	4.131e-60
SUPPLY	-2.188419	0.202279	-10.82	2.379e-27
FREQ	-0.01057832	0.0028981	-3.65	0.0001321
AREAYRS	0.002592463	0.00181725	1.427	0.07687
HHSIZE	-0.02688377	0.0185887	-1.446	0.07408
AGE1834	-0.176535	0.0766515	-2.303	0.01065
AGE3554	-0.01833189	0.0571875	-0.3206	0.3743
COLGRAD	0.1095631	0.0486062	2.254	0.01211
INCGT50K	0.1370765	0.051653	2.654	0.003989
SNGL_FAM	-0.1014833	0.0534325	-1.899	0.02879
BID	-0.119326	0.00190541	-62.62	0

All CUWA detailed model

Date: 4/30/1994
Observations: 6280 D.F. : 6252

Var	Coef	Std. Error	t-Stat	P-Value
CONSTANT	3.820373	0.244011	15.66	1.572e-54
NORTH	-0.03321355	0.0534619	-0.6213	0.2672
RATE	-0.01920611	0.0371351	-0.5172	0.3025
SUPPLY	-2.255448	0.207461	-10.87	1.375e-27
FREQ	-0.01134932	0.00297393	-3.816	6.839e-05
AREAYRS	0.003169382	0.00191059	1.659	0.0486
HHSIZE	-0.01603749	0.0191803	-0.8361	0.2016
AGE1834	-0.1813797	0.0817332	-2.219	0.01326
AGE3554	-0.02022873	0.0595875	-0.3395	0.3671
COLGRAD	0.08224596	0.0499938	1.645	0.05
INCGT50K	0.125282	0.0543326	2.306	0.01058
SNGL_FAM	-0.1708845	0.0805592	-2.121	0.01697
PUBLIC	0.005745942	0.0715927	0.08026	0.468
SOCIAL	-0.2167907	0.0725061	-2.99	0.0014
QUALLIFE	0.09621679	0.0698895	1.377	0.08433
FINANCE	-0.1716622	0.0673602	-2.548	0.005422
SEVERE	-0.08008228	0.0512011	-1.564	0.05893
SHORTAGE	-0.08746105	0.0700891	-1.248	0.1061
LONGTERM	0.4475739	0.0510281	8.771	1.124e-18
MANDATE	-0.01663764	0.0648504	-0.2566	0.3988
OWNPAY	-0.1520571	0.095405	-1.594	0.05551
OWNELSE	0.009164299	0.115934	0.07905	0.4685
OWNASSOC	-0.1285465	0.105504	-1.218	0.1116
RENTPAY	0.1436558	0.12134	1.184	0.1182
YELLOW	-0.2050176	0.0511395	-4.009	3.084e-05
PINK	-0.2902122	0.087258	-3.326	0.0004432
NOGROWTH	-0.2417884	0.0802034	-3.015	0.001291
BID	-0.1222788	0.0019869	-61.54	0

Northern California

Date: 4/30/1994
Observations: 2471 D.F. : 2444

Var	Coef	Std. Error	t-Stat	P-Value
CONSTANT	4.296121	0.407862	10.53	1.04e-25
RATE	-0.0813596	0.042044	-1.935	0.02655
SUPPLY	-1.975235	0.329236	-5.999	1.135e-09
FREQ	-0.01156508	0.00477056	-2.424	0.007705
AREAYRS	-0.0003102167	0.00302516	-0.1025	0.4592
HHSIZE	-0.04374635	0.0302063	-1.448	0.07384
AGE1834	-0.2708379	0.132879	-2.038	0.02082
AGE3554	-0.20967	0.0980698	-2.138	0.01631
COLGRAD	0.01352822	0.0798856	0.1693	0.4328
INCGT50K	0.1325837	0.0855262	1.55	0.06061
SNGL_FAM	-0.2384976	0.131362	-1.816	0.03478
PUBLIC	0.08304341	0.116654	0.7119	0.2383
SOCIAL	-0.3726826	0.119911	-3.108	0.0009525
QUALLIFE	-0.1045689	0.113651	-0.9201	0.1788
FINANCE	-0.07762493	0.108547	-0.7151	0.2373
SEVERE	0.008091691	0.080035	0.1011	0.4597
SHORTAGE	-0.2339705	0.119166	-1.963	0.02486
LONGTERM	0.3756075	0.0840182	4.471	4.077e-06
MANDATE	0.2095662	0.10339	2.027	0.02139
OWNPAY	-0.2738597	0.159593	-1.716	0.04315
OWNELSE	0.3527009	0.191628	1.841	0.0329
OWNASSOC	0.08709058	0.163553	0.5325	0.2972
RENTPAY	0.2264691	0.201988	1.121	0.1312
YELLOW	-0.4068647	0.0866313	-4.697	1.396e-06
PINK	-0.439666	0.14812	-2.968	0.001512
NOGROWTH	-0.4494673	0.133926	-3.356	0.0004013
BID	-0.1183811	0.00311221	-38.04	6.34e-250

Southern California

Date: 5/03/1994
Observations: 3809 D.F. : 3782

Var	Coef	Std. Error	t-Stat	P-Value
CONSTANT	3.68546	0.327755	11.24	3.495e-29
RATE	0.09545748	0.0930766	1.026	0.1526
SUPPLY	-2.528792	0.268921	-9.403	4.425e-21
FREQ	-0.01216651	0.00382806	-3.178	0.0007468
AREAYRS	0.00514206	0.00255637	2.011	0.02217
HHSIZE	0.001244916	0.0250908	0.04962	0.4802
AGE1834	-0.1928603	0.105512	-1.828	0.03383
AGE3554	0.06446997	0.0761565	0.8465	0.1987
COLGRAD	0.1503157	0.0651801	2.306	0.01058
INCGT50K	0.1046283	0.0713883	1.466	0.07142
SNGL_FAM	-0.1692615	0.104687	-1.617	0.053
PUBLIC	-0.05756428	0.0915015	-0.6291	0.2647
SOCIAL	-0.1415302	0.0921851	-1.535	0.0624
QUALLIFE	0.2242347	0.0898753	2.495	0.00632
FINANCE	-0.2192984	0.086922	-2.523	0.005839
SEVERE	-0.1390766	0.068147	-2.041	0.02067
SHORTAGE	-0.02746329	0.087681	-0.3132	0.3771
LONGTERM	0.5160715	0.0648974	7.952	1.198e-15
MANDATE	-0.1591584	0.0843984	-1.886	0.0297
OWNPAY	-0.08725933	0.122048	-0.715	0.2373
OWNELSE	-0.1870358	0.149193	-1.254	0.105
OWNASSOC	-0.3035761	0.140673	-2.158	0.01549
RENTPAY	0.1096019	0.154217	0.7107	0.2387
YELLOW	-0.1088372	0.0643518	-1.691	0.04543
PINK	-0.2668627	0.111343	-2.397	0.008294
NOGROWTH	-0.1476364	0.101371	-1.456	0.07268
BID	-0.126659	0.00261992	-48.34	0

Appendix F
OPEN-ENDED RESPONSES

SURVEY QUESTION 19

WHAT ARE THE PRIMARY REASONS YOU WOULD CHOSE NOT TO PAY THE ADDITIONAL MONEY ON YOUR WATER BILL TO AVOID FUTURE SHORTAGES?

(Asked Only of the 585 Respondents Who Voted No to the First and Second Bids for Both Scenarios)

CALIFORNIA URBAN WATER AGENCIES

Reason	Percent of Respondents
Prefer to reduce my water usage	36%
Tired of paying for others/everyone should conserve	29%
Low confidence in the water agency	19%
Cannot afford a higher water bill	17%
Not willing to pay more	17%
Additional water supplies encourage population growth	10%
Do not believe water shortages can be avoided	7%

The table indicates the percent of respondents who listed the specified reason. The sum of the column is greater than 100% because respondents could list more than one reason. Responses given by fewer than 2% of the respondents are not listed.

SURVEY QUESTION 20

WHAT FACTORS OR ISSUES DID YOU CONSIDER WHEN DECIDING TO VOTE YES OR NO?

(Asked Only of Respondents Who Voted Yes to at Least One Bid)

CALIFORNIA URBAN WATER AGENCIES

Factors Considered	Percent of Respondents
Cannot afford more on bill	35%
We can conserve	21%
Water is a necessity	15%
New resources should be developed	11%
No confidence in the water agency	9%
Not willing to pay more	9%
Not willing to pay for others use	7%
Future generations and their needs	6%
Depends upon the resource project	6%
Magnitude of shortage	5%
Too many people/restrict new development	5%
Frequency of shortage	4%
Frequency and magnitude of shortage	3%
Impacts of shortage on greenery/aesthetics	2%
Impacts of new resources on environment	2%

The table indicates the percent of respondents who listed the specified issue or factor. The sum of the column is greater than 100% because respondents could list more than one issue or factor. Responses given by fewer than 2% of the respondents are not listed.

SURVEY QUESTIONS 21 AND 22

WHEN YOU WERE ANSWERING THE QUESTIONS ABOUT WHAT IT WOULD BE WORTH TO YOU TO AVOID THE ___% WATER SHORTAGE ONCE EVERY ___ YEARS, WHAT DID YOU ASSUME YOUR HOUSEHOLD WOULD HAVE TO DO TO CUT BACK YOUR WATER USE?

CALIFORNIA URBAN WATER AGENCIES

Actions to Reduce Water Use	Water Shortage				
	10%	20%	30%	40%	50%
Can't conserve anymore, would do nothing more	16.2%	13.8%	13.8%	15.0%	12.9%
Install low-flow showerheads	6.1	7.6	5.9	6.7	5.8
Install displacement devices in toilet	3.3	4.7	3.4	3.7	3.3
Replace toilets with low-flush toilets	3.3	4.3	4.9	5.0	4.2
Take fewer/shorter showers	30.9	31.7	30.7	32.1	34.7
User fewer flushes	14.3	17.3	16.3	15.4	16.9
Use grey water/recycle water	5.6	8.2	8.8	9.8	12.2
Use dishwasher less/not at all	12.2	12.3	11.3	12.4	13.0
Do laundry less/take to a laundromat	12.7	14.0	14.6	15.2	16.4
Change outside plant watering habits	6.2	8.5	8.8	8.8	6.9
Wash car less/not at all/take to carwash	8.7	10.4	10.6	9.3	10.3
Water lawn less/let lawn die	20.7	21.7	25.4	19.5	25.2

The table indicates the percentage of respondents who listed the specified action. The sum of each column is greater than 100% because respondents could list more than one action.

Appendix G
ALAMEDA COUNTY WATER DISTRICT
RESULTS

THE VALUE OF WATER SUPPLY RELIABILITY: RESULTS OF A CONTINGENT VALUATION SURVEY

ALAMEDA COUNTY WATER DISTRICT (ACWD)

This appendix discusses the contingent valuation (CV) survey results for the Alameda County Water District. Section I discusses survey administration, including sampling, survey procedures, and response rates. Section II presents analytic results. Exhibits G-1 and G-2 contain the model results, and summary tables of participants' open-ended responses.

I. SURVEY ADMINISTRATION

The total number of completions for ACWD was 308. Barakat & Chamberlin worked closely with ACWD to draw a sample of 1158 customer billing records. The survey of ACWD customers began in mid-August 1993 and continued through mid-October.

The ACWD sample had a higher than expected percentage of inaccurate or unavailable telephone numbers that the survey team was not able to obtain through use of directory assistance. This significantly decreased the size of the usable sample. Also, a high percentage of sample points could not be reached by telephone after 12 attempts. The final disposition of sample points is illustrated in Table G-1.

II. ANALYTIC RESULTS

Comparison of the Sample with the Population

Before discussing the customer loss functions for ACWD, we first must determine the extent to which the survey sample differs from the overall District population. To do this, census results were compared to sample characteristics with respect to age, income, education, household size, and type of dwelling (i.e., single-family vs. multifamily). The results are presented in Table G-2.

Table G-2 indicates that the sample was more educated, wealthier, middle-aged, and had a higher proportion of multifamily residents than the overall population. The standard analytical technique that is used to correct for such differences is to use population means rather than sample means to derive loss functions. The estimates of willingness to pay then reflect the population rather than the sample demographics.

Table G-1
ACWD RESPONSE RATES

	Single Family	Multifamily	Total
Initial sample	654	504	1,158
Unused sample[a]	4	97	101
Out of sample[b]	47	25	72
No telephone number available	260	43	303
Corrected sample size	**343**	**339**	**682**
Refusals	59	57	116
Not reached during study	58	106	164
Unable to participate[c]	43	51	94
Completed interviews	**183**	**125**	**308**
Response rate[d]	**53%**	**37%**	**45%**

[a]There was no attempt to contact these sample points.
[b]These include businesses, landlords, vacancies, duplicate sample points, and sample points no longer residing in the study area.
[c]Includes language and other communication barriers, or mailing not received, not read, or thrown away.
[d]Calculated as a percent of the corrected sample size.

That approach was used in this case.

Willingness to Pay (WTP)

WTP can be interpreted as the losses that customers incur as a result of particular shortage scenarios. The amount that a customer is willing to pay to avoid an event is a measure of the losses that customer would incur if that event were to occur. Therefore, we refer to these willingness to pay results as a "loss function."

Table G-2
COMPARISON OF SAMPLE WITH DISTRICT POPULATION

	Sample	Population
Age		
18 to 34	19%	31%
34 to 54	54%	29%
55+	27%	40%
Household income		
Under $50,000	42%	49%
$50,000+	58%	51%
Education		
Not college grad	52%	73%
College graduate	48%	27%
Dwelling type		
Single-family	59%	66%
Multifamily	41%	34%
Household size	3.0	2.6

Tables G-3A and G-3B present the mean WTP for the detailed model and the simplified model for each magnitude and frequency of shortage. WTP figures represent increments to monthly water bills. The results show little overall variation in willingness to pay as a function of either shortage magnitude or frequency. In addition, respondents appear willing to pay comparatively high amounts to avoid relatively minor shortages.

The results of the simplified model are almost identical to the detailed model. The remainder of this report cites results based on the detailed model only.

The loss function is shown graphically in Figure G-1. In examining the tabular and graphical results, two major observations can be made:

- To avoid even apparently minor shortage scenarios (e.g., 10% once every 10 years), respondents are willing to pay substantial amounts. This type of "threshold" response is not uncommon in surveys of this type and may indicate that respondents regard even a mild shortage scenario as an

Table G-3A
MEAN MONTHLY WILLINGNESS TO PAY, DETAILED MODEL
(Additional $/Month)

Shortage (% Reduction from Full Service)	Frequency (Occurrences/Years)				
	1/30	1/20	1/10	1/5	1/3
10%			$12.46	$12.69	$12.78
20%	$11.98	$12.42	$12.87		
30%	$12.38	$12.82	$13.28		
40%	$12.78	$13.23	$13.69		
50%	$13.19	$13.65			

Table G-3B:
MEAN MONTHLY WILLINGNESS TO PAY, SIMPLIFIED MODEL
(Additional $/Month)

Shortage (% Reduction from Full Service)	Frequency (Occurrences/Years)				
	1/30	1/20	1/10	1/5	1/3
10%			$12.77	$12.84	$12.86
20%	$12.83	$12.97	$13.10		
30%	$13.17	$13.30	$13.44		
40%	$13.50	$13.64	$13.78		
50%	$13.84	$13.98			

inconvenience that they want to avoid. They may make a greater distinction between "shortage" and "no shortage" than between different sizes or frequencies of shortages.

- The flat shape of Figure G-1, along both the frequency and magnitude dimensions is unexpected. One would expect customers to be willing to pay more to avoid increasingly severe future shortage scenarios.

Confidence Intervals

Consistent with the approach typically used in the literature to calculate confidence intervals for CV results, we have estimated a range around the WTP associated with the mean shortage frequency and magnitude. Using this approach, the 95% confidence interval for ACWD is ±$1.21. In other words, there is a 95% probability that the WTP to avoid this average shortage lies within a ±$1.21 range of the estimated WTP. This range most likely underestimates the size of the confidence interval for low and high level shortages, where there are fewer observations. However, it does provide a good relative indicator of the precision of the WTP results. The confidence interval represents only the likely margin of uncertainty due to sampling error. There are also other sources of uncertainty in the WTP estimates, including nonresponse and response errors.

Impact of Key Explanatory Variables on WTP

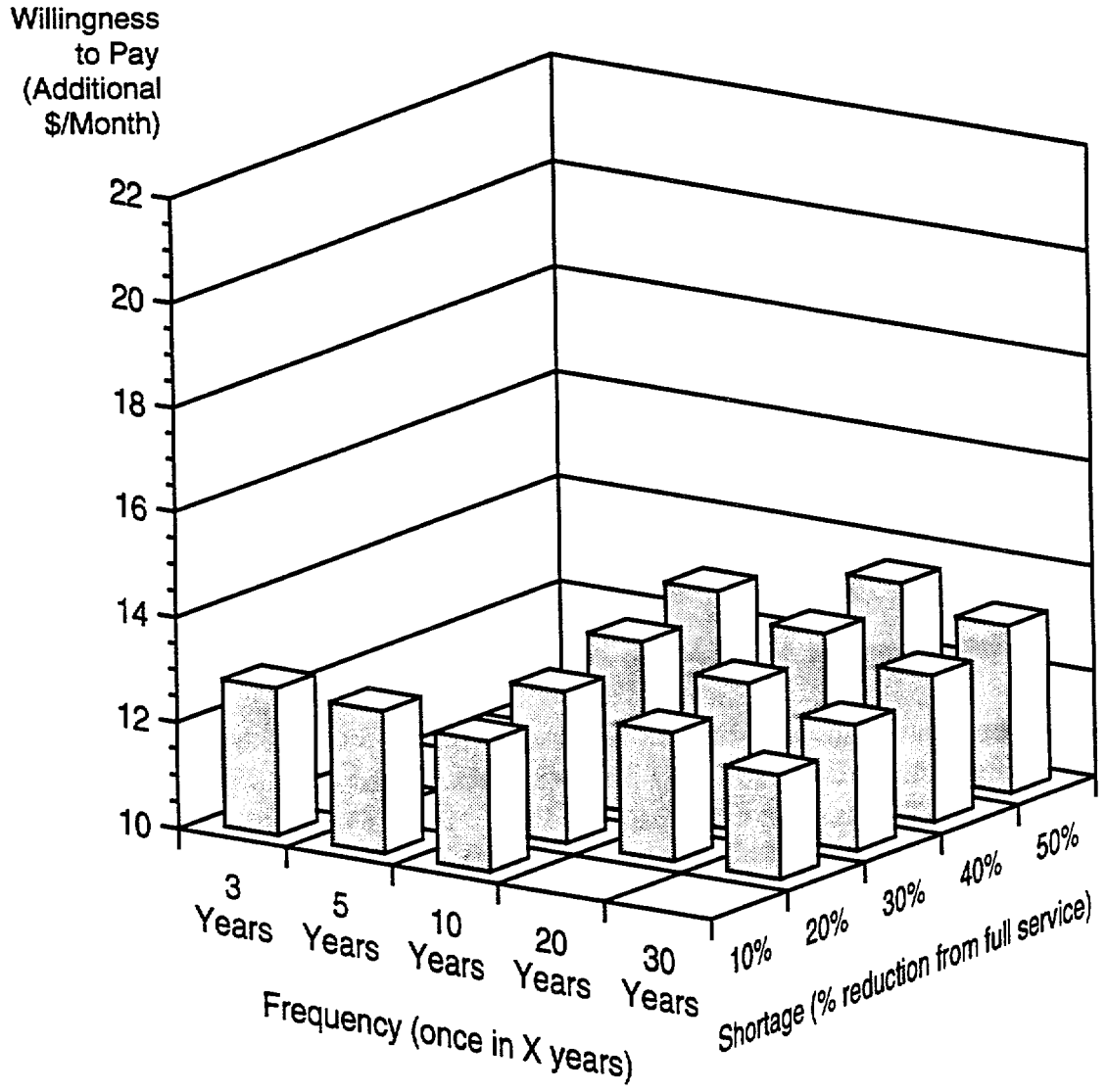
As described previously, the statistical model includes many variables that could potentially explain the variation in WTP. The model results in Exhibit G-1 include the estimated model coefficients and their statistical significance. The following discussion selects three explanatory variables that are statistically significant and illustrates their impact on WTP. Figures G-2 through G-4 show the variation of WTP at various shortage magnitudes when all other variables, other than the one in question, are held constant.

Age. Figure G-2 illustrates the variation of WTP by age for several representative shortage scenarios. Older respondents are willing to pay more to avoid shortages than younger respondents.

Growth Preferences. Another interesting relationship is demonstrated in Figure G-3, which shows the relationship between participant feelings about community growth and their willingness to pay to avoid water shortages. Individuals who indicate a

Figure G-1

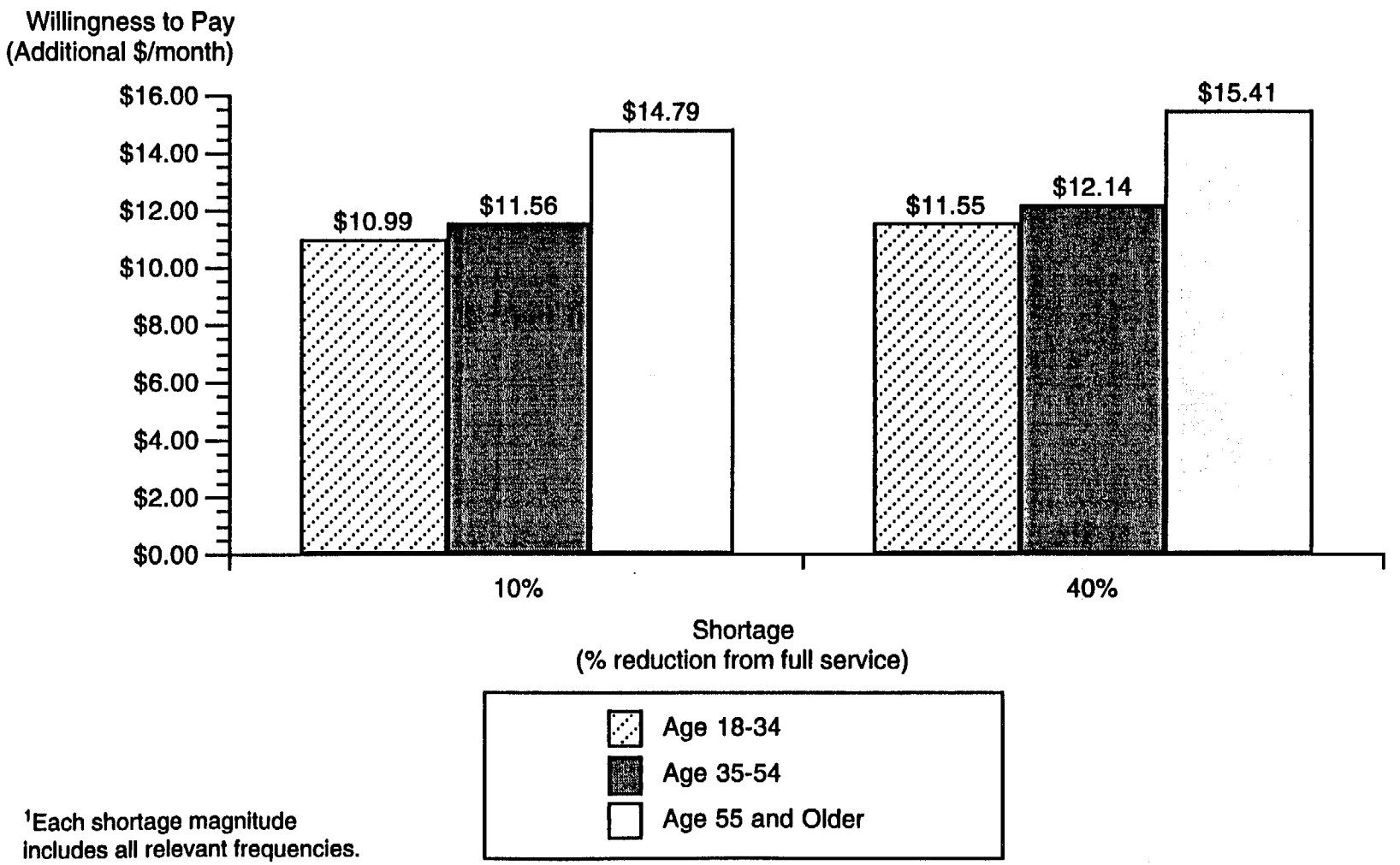
Mean Monthly Willingness to Pay to Avoid Particular Shortage Frequencies and Magnitudes



Alameda County Water District

Figure G-2

Effect of Age on Willingness to Pay[1]



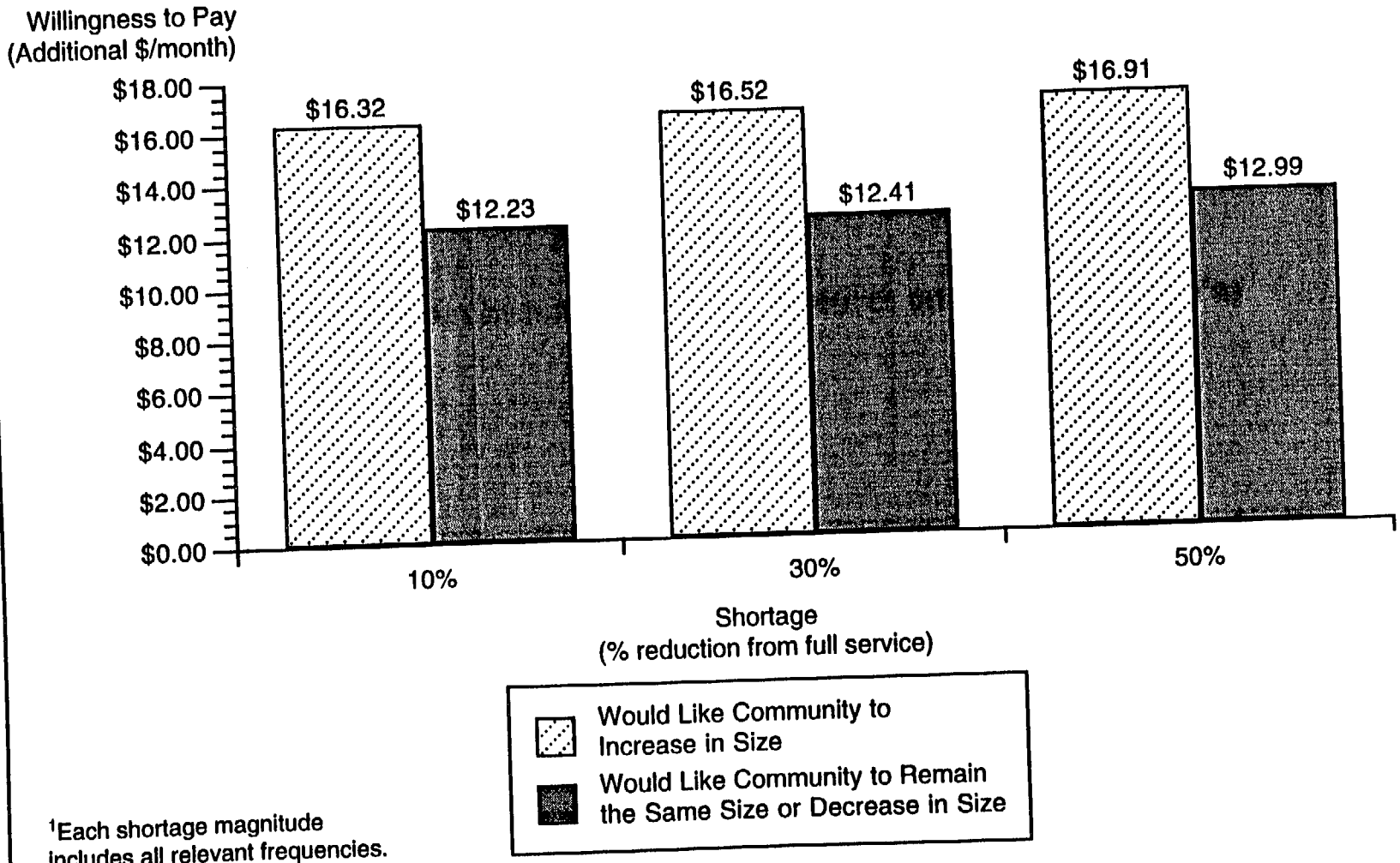
[1]Each shortage magnitude includes all relevant frequencies.

94-141100.32.final.6/94.ap

Alameda County Water District

Figure G-3

Effect of Population Growth Preferences on Willingness to Pay[1]



[1]Each shortage magnitude includes all relevant frequencies.

94-141100.32.final.6/94.ap

desire for their communities to grow in size have a higher WTP than do people who want their communities to stay the same size or to get smaller. Many in the latter group may perceive a relationship between water resource development and growth and are therefore more likely to prefer enduring more severe and/or frequent water shortages rather than adding to the resource base.

Landscape Area. The quantity and type of outdoor landscaping has a statistically significant influence on respondents' willingness to pay to avoid future shortages. Figure G-4 illustrates this by using the variables in the model that capture variations in landscaped area. Again, WTP is shown for several levels of shortage severity. The results show that single family homes with landscapes larger than 3000 square feet have higher WTP than families with other types of landscaping.

Explanatory Power of Models

Statistical goodness-of-fit tests were applied to test the explanatory power of the detailed and simplified models. The results of our calculations are presented in Table G-4.

TABLE G-4: GOODNESS OF FIT COMPARISON

	% Predicted Correctly[1]
Detailed model	37%
Simplified model	34%

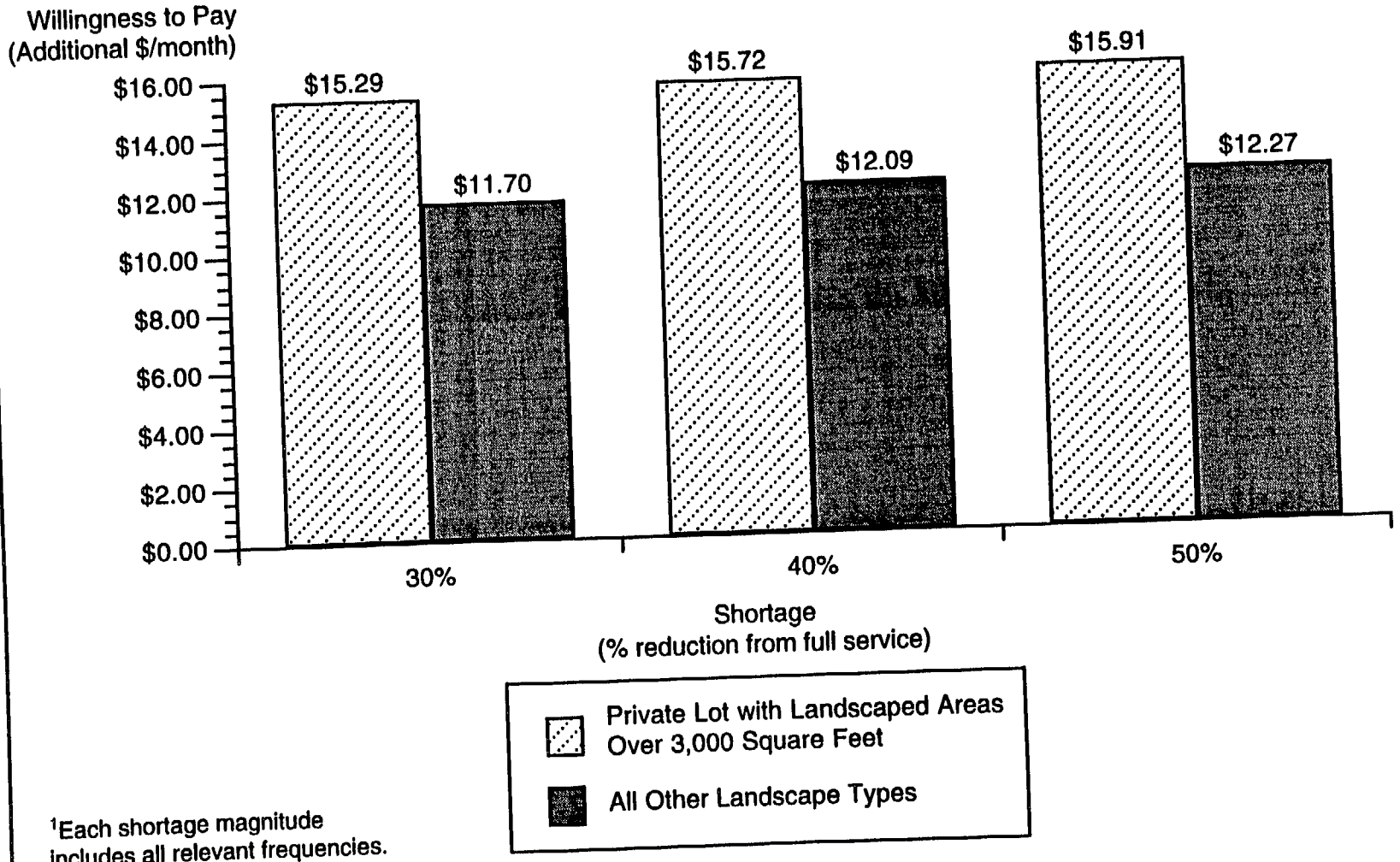
In this case, the detailed model has only slightly more explanatory power than the simplified model. This, coupled with the similarity of the WTP results for the two models, indicate that ACWD can apply the simplified model to estimate WTP, rather than resurveying customers to gather data on the remaining variables required for the detailed model.

[1]In a single bounded logit model, these numbers are equivalent to 61% and 58% (square root of 0.37 and 0.34 respectively).

Alameda County Water District

Figure G-4

Effect of Landscape Characteristics on Willingness to Pay[1]



[1]Each shortage magnitude includes all relevant frequencies.

94-141100.32.final.6/94.ap

Water Shortages as a Public Concern

In survey question 4, respondents were asked to rate the importance of various public problems, including water shortages, as "not at all important," "somewhat important," or "very important." Based on these responses, a factor analysis was performed to attempt to cluster these variables into a small number of groups.

Overall, the mean response for each issue is illustrated in Table G-5.

TABLE G-5: ISSUE RANKING AND MEAN RESPONSE[2]

Issue	Mean Rating	Standard Error
Economy	2.71	.0226
Housing costs	2.52	.0287
Education	2.45	.0332
Drug abuse	2.42	.0318
Taxes	2.36	.0310
Traffic	2.33	.0302
Drinking water quality	2.26	.0342
Crime	2.24	.0317
Water shortages	**2.17**	**.0333**
Air pollution	2.15	.0308
Overcrowding	2.01	.0322
Homelessness	1.94	.0325
Trash disposal	1.94	.0362
Racial issues	1.78	.0325

Water shortages fall in the middle of the list of concerns.[3]

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[2]Note that allowable responses ranged from 1 ("not at all important") to 3 ("very important").

[3]It is possible that had this survey been conducted a year earlier, when the state was still in the grip of a serious drought, water shortages would have been viewed as much more of a concern.

The factor analysis showed that ACWD respondents grouped issues as illustrated in Table G-6. Water shortages fall into the category that includes several issues that can best be described as having public service and/or environmental components. The factors are ranked within each category according to the strength of their rating in the factor analysis.

TABLE G-6: FACTOR ANALYSIS OF PUBLIC ISSUES

Public Services/ Environmental Concerns	Social Concerns	Quality of Life Concerns	Financial Concerns
Trash disposal	Crime	Overcrowding	Taxes
Homelessness	Drug abuse	Traffic	Economy
Education	Racial issues		
Water shortages			
Drinking water quality			
Air pollution			

Each of the four factors was included in the model as a binary variable to test its explanatory impact on WTP.[4] Each of these variables was assigned the value of 1 if the mean value of all of a respondent's ratings for the issues included in that factor exceeded the value assigned to the water shortage issue, and zero otherwise. For ACWD, only the finance factor is statistically significant in explaining WTP. Not unexpectedly, respondents with high levels of concern for financial issues relative to their concern for water shortages have lower WTP.

Open-Ended Responses

Following the referendum questions, respondents were asked several open-ended questions regarding what actions they thought they would have to take under specified shortage scenarios, and what issues they considered when deciding whether to vote yes or no. These questions were asked to better understand the reasoning of participants. Responses to these questions are summarized in Exhibit G-2.

[4]The "public services/environmental" factor included in the model excluded the water shortages variable.

Exhibit G-1
MODEL RESULTS

Results for the detailed and simplified models follow this page. The results present each variable included in the model along with the following information:

- **Coefficient** indicates the magnitude of the variable's impact on WTP
- **Standard error** reflects the distribution of the coefficient
- **T-statistic** is a commonly used measure of statistical significance
- **P-value** is the observed significance level (for example, if p = .05, the coefficient is statistically significant at the 95% level)

The following key of variable pneumonics used in the model will facilitate interpretation of these results.

Key of Survey Variables

SUPPLY:	Percentage reduction from full service demand specified in the cv scenario.
FREQ:	Frequency of drought specified in the CV scenario.
AREAYRS:	Number of years respondent has lived in the area.
HHSIZE:	Number of persons in the household, including respondent.
AGE1834:	Respondent's age is in the range of 18 to 34 years old.
AGE3554:	Respondent's age is in the range of 35 to 54 years old.
COLGRAD:	Respondent is a college graduate.
INCGT%50:	1992 household income is greater than $50,000.
SNGL_FAM:	Respondent lives in a single family residence.
QUALLIFE:	Concern for "quality of life issues" (as defined by a factor analysis) relative to concern for water shortages.
SOCIAL:	Concern for "social issues" (as defined by a factor analysis) relative to concern for water shortages.
FINANCE:	Concern for "finance issues" (as defined by a factor analysis) relative to concern for water shortages.
ENVIRON:	Concern for "public services and/or environmental issues" (as defined by a factor analysis) relative to concern for water shortages.
SEVERE:	Perception of the severity of the recent drought
SHORTAGE:	Water shortages considered a somewhat or very important problem.
LONGTERM:	Perception of water shortages as a long-term problem in the area.
MANDATE:	Respondent believes that their water agency suggested or mandated cutbacks during the recent drought.
OWNPAY:	Respondent owns home and is personally responsible for paying the water bill.

OWNELSE:	Respondent owns home and someone else in the household is responsible for paying the water bill.
OWNASSOC:	Respondent owns home and a homeowners association is responsible for paying the water bill.
RENTPAY:	Respondent rents home, water bill is not included in the rent.
YELLOW:	Homes with private landscaped areas less than 3,000 square feet or shared landscaped areas less than 5,000 square feet.
PINK:	Homes with shared landscaped areas greater than 5,000 square ft.
NOGROWTH:	Respondent wants community to remain the same size/decrease in size.
RATE:	Average residential rate for respondent's water agency
NORTH:	Northern California water agency
BID:	Amount that respondents bill would increase per month if the majority of the community voted yes to the referendum.

Alameda Simplified Model

Date: 2/14/1994
Observations: 569 D.F. : 558

Var	Coef	Std. Error	t-Stat	P-Value
CONSTANT	3.048299	0.682735	4.465	4.833e-06
SUPPLY	-0.5313021	0.682688	-0.7783	0.2184
FREQ	-0.002145917	0.00984987	-0.2179	0.4138
AREAYRS	-0.02383598	0.00742572	-3.21	0.0007013
HHSIZE	-0.1155748	0.0555182	-2.082	0.01891
AGE1834	-0.823251	0.266718	-3.087	0.001062
AGE3554	-0.5873944	0.214558	-2.738	0.00319
COLGRAD	-0.009992675	0.1665	-0.06002	0.4761
INCGT50K	0.1194175	0.169492	0.7046	0.2407
SNGL_FAM	-0.1264976	0.170058	-0.7438	0.2286
BID	-0.1301607	0.00697312	-18.67	2.575e-61

Alameda Detailed Model

Date: 2/14/1994
Observations: 541 D.F. : 515

Var	Coef	Std. Error	t-Stat	P-Value
CONSTANT	4.491391	0.852366	5.269	9.904e-08
SUPPLY	-0.6788461	0.72197	-0.9403	0.1737
FREQ	-0.007514644	0.0103592	-0.7254	0.2343
AREAYRS	-0.01629524	0.00818313	-1.991	0.02347
HHSIZE	-0.1068396	0.0593506	-1.8	0.0362
AGE1834	-0.6343245	0.298203	-2.127	0.01693
AGE3554	-0.5334971	0.231368	-2.306	0.01075
COLGRAD	0.09028904	0.183762	0.4913	0.3117
INCGT50K	0.1382523	0.184742	0.7484	0.2273
SNGL_FAM	-0.3414689	0.243052	-1.405	0.08031
QUALLIFE	-0.1095249	0.249656	-0.4387	0.3305
SOCIAL	-0.3005359	0.247843	-1.213	0.1129
FINANCE	-0.4196452	0.263234	-1.594	0.05574
ENVIRON	0.09430826	0.27978	0.3371	0.3681
SEVERE	-0.05607447	0.183602	-0.3054	0.3801
SHORTAGE	-0.5196331	0.26375	-1.97	0.02466
LONGTERM	0.1564052	0.174344	0.8971	0.185
MANDATE	0.1556682	0.219807	0.7082	0.2396
OWNPAY	0.1060695	0.344631	0.3078	0.3792
OWNELSE	0.6594527	0.429188	1.537	0.0625
OWNASSOC	0.2911715	0.328939	0.8852	0.1882
RENTPAY	1.288351	0.464382	2.774	0.002861
YELLOW	-0.5893346	0.199523	-2.954	0.001638
PINK	-0.5893227	0.286232	-2.059	0.01999
NOGROWTH	-0.6597875	0.263827	-2.501	0.006342
BID	-0.1385007	0.00763735	-18.13	4.489e-58

Appendix G-2
OPEN-ENDED RESPONSES

SURVEY QUESTION 19

WHAT ARE THE PRIMARY REASONS YOU WOULD CHOSE NOT TO PAY THE ADDITIONAL MONEY ON YOUR WATER BILL TO AVOID FUTURE SHORTAGES?

(Asked Only of the 49 Respondents Who Voted No to the First and Second Bids for Both Scenarios)

ALAMEDA COUNTY WATER DISTRICT

Reason	Percent of Respondents
Tired of paying for others/everyone should conserve	41%
Prefer to reduce my water usage	37%
Cannot afford a higher water bill	18%
Not willing to pay more	14%
Low confidence in the water agency	10%
Do not believe water shortages can be avoided	8%
Additional water supplies encourage population growth	4%

The table indicates the percent of respondents who listed the specified reason. The sum of the column is greater than 100% because respondents could list more than one reason. Responses given by fewer than 2% of the respondents are not listed.

SURVEY QUESTION 20

WHAT FACTORS OR ISSUES DID YOU CONSIDER WHEN DECIDING TO VOTE YES OR NO?

(Asked Only of Respondents Who Voted Yes to at Least One Bid)

ALAMEDA COUNTY WATER DISTRICT

Factors Considered	Percent of Respondents
Cannot afford more on bill	41%
We can conserve	26%
New resources should be developed	18%
No confidence in the water agency	9%
Water is a necessity	8%
Not willing to pay for others use	7%
Not willing to pay more	6%
Magnitude of shortage	6%
Frequency of shortage	6%
Too many people/restrict new development	6%
Depends upon the resource project	4%
Impacts of new resources on environment	3%
Frequency and magnitude of shortage	2%
Future generations and their needs	2%
Impacts of shortage on greenery/aesthetics	1%

The table indicates the percent of respondents who listed the specified issue or factor. The sum of the column is greater than 100% because respondents could list more than one issue or factor. Responses given by fewer than 2% of the respondents are not listed.

SURVEY QUESTIONS 21 AND 22

WHEN YOU WERE ANSWERING THE QUESTIONS ABOUT WHAT IT WOULD BE WORTH TO YOU TO AVOID THE ____% WATER SHORTAGE ONCE EVERY ____ YEARS, WHAT DID YOU ASSUME YOUR HOUSEHOLD WOULD HAVE TO DO TO CUT BACK YOUR WATER USE?

ALAMEDA WATER DISTRICT

Actions to Reduce Water Use	Water Shortage				
	10%	20%	30%	40%	50%
Can't conserve anymore, would do nothing more	27.1%	19.4%	15.6%	10.3%	14.3%
Install low-flow showerheads	6.2	7.8	10.7	4.0	8.3
Install displacement devices in toilet	1.6	5.4	5.7	1.6	7.1
Replace toilets with low-flush toilets	0	4.7	5.7	4.0	6.0
Take fewer/shorter showers	24.0	25.6	27.9	45.2	35.7
User fewer flushes	14.0	9.3	18.0	14.3	19.0
Use grey water/recycle water	6.2	7.0	12.3	11.9	15.5
Use dishwasher less/not at all	12.4	8.5	13.9	12.7	7.1
Do laundry less/take to a laundromat	14.7	12.4	18.0	15.1	17.9
Change outside plant watering habits	5.4	11.6	9.0	11.1	11.9
Wash car less/not at all/take to carwash	10.9	14.7	18.0	13.5	14.3
Water lawn less/let lawn die	17.8	28.7	22.1	31.7	34.5

The table indicates the percentage of respondents who listed the specified action. The sum of each column is greater than 100% because respondents could list more than one action.

Appendix H
CONTRA COSTA WATER DISTRICT RESULTS

THE VALUE OF WATER SUPPLY RELIABILITY: RESULTS OF A CONTINGENT VALUATION SURVEY

CONTRA COSTA WATER DISTRICT (CCWD)

This appendix discusses the contingent valuation (CV) survey results for the Contra Costa Water District (CCWD). Section I discusses survey administration, including sampling, survey procedures, and response rates. Section II presents analytic results. Exhibits H-1 and H-2 contain the model results, and summary tables of participants' open-ended responses.

I. SURVEY ADMINISTRATION

The total number of completions for CCWD was 283. Barakat & Chamberlin worked closely with CCWD to draw a sample of 1151 customer billing records. The survey of CCWD customers began in September 1993 and continued through mid-November. The CCWD sample had a higher than expected percentage of inaccurate or unavailable telephone numbers that the survey team were not able to obtain through use of directory assistance. This significantly decreased the size of the usable sample. The final disposition of sample points is illustrated in Table H-1.

TABLE H-1: CCWD RESPONSE RATES

	Single-Family	Multifamily	Total
Initial sample	627	524	1,151
Unused sample[a]	2	109	111
Out of sample[b]	35	26	61
No telephone number available	245	42	287
Corrected sample size	**345**	**347**	**692**
Refusals	79	58	137
Not reached during study	85	133	218
Unable to participate[c]	15	39	54
Completed interviews	**166**	**117**	**283**
Response rate[d]	**48%**	**33%**	**41%**

[a]There was no attempt to contact these sample points.
[b]These include businesses, landlords, vacancies, duplicate sample points, and sample points no longer residing in the study area.
[c]Includes language or other communication barriers, or mailing not received, not read, or thrown away.
[d]Calculated as a percent of the corrected sample size.

II. ANALYTIC RESULTS

Comparison of the Sample with the Population

Before discussing the customer loss functions for CCWD, we first must determine the extent to which the survey sample differs from the overall District population. To do this, census results were compared to sample characteristics with respect to age, income, education, household size, and type of dwelling (i.e. single-family vs. multifamily). The results are presented in Table H-2.

TABLE H-2: COMPARISON OF SAMPLE WITH DISTRICT POPULATION

	Sample	Population
Age		
18 to 34	22%	27%
34 to 54	45%	29%
55+	33%	44%
Household Income		
under $50,000	60%	56%
$50,000+	40%	44%
Education		
not college grad	53%	68%
college graduate	47%	32%
Dwelling Type		
single-family	57%	63%
multifamily	43%	37%
Household Size	2.7	2.6

Table H-2 indicates that the sample was more educated, middle-aged, and had a higher proportion of multifamily residents than the overall population. The standard analytical technique that is used to correct for such differences is to use population means rather than sample means to derive loss functions. The estimates of willingness to pay then reflect the population rather than the sample demographics. That approach was used in this case.

Willingness to Pay (WTP)

WTP can be interpreted as the losses that customers incur as a result of particular shortage scenarios. The amount that a customer is willing to pay to avoid an event is a measure of the losses that customer would incur if that event were to occur. Therefore, we refer to these willingness to pay results as a "loss function."

Tables H-3A and H-3B present the mean WTP for the detailed model and the simplified model for each magnitude and frequency of shortage. WTP figures represent increments to monthly water bills. WTP for the full model varies from a low of $12.38/month to avoid a 20% shortage once every 30 years, to a high of $15.94/month to avoid a 50% shortage every 20 years.

The results of the simplified model are almost identical to the detailed model. The remainder of this report cites results based on the detailed model only.

TABLE H-3A: MEAN MONTHLY WILLINGNESS TO PAY, DETAILED MODEL (Additional $/month)

Shortage (% Reduction from Full Service)	Frequency (Occurrences/Years)				
	1/30	1/20	1/10	1/5	1/3
10%			$12.67	$12.97	$13.10
20%	$12.38	$12.99	$13.62		
30%	$13.32	$13.95	$14.59		
40%	$14.29	$14.93	$15.59		
50%	$15.28	$15.94			

TABLE H-3B: MEAN MONTHLY WILLINGNESS TO PAY, SIMPLIFIED MODEL (Additional $/month)

Shortage (% Reduction from Full Service)	Frequency (Occurrences/Years)				
	1/30	1/20	1/10	1/5	1/3
10%			$12.32	$12.53	$12.62
20%	$12.45	$12.87	$13.31		
30%	$13.44	$13.88	$14.32		
40%	$14.45	$14.91	$15.37		
50%	$15.50	$15.97			

The loss function is shown graphically in Figure H-1. In examining the tabular and graphical results, two major conclusions can be drawn:

- As expected, respondents are willing to pay more for larger shortages and for shortages that occur with higher frequency. However, the response to frequency variations is considerably smaller than the impact of magnitude. This is confirmed by referring to the model estimation results, which are shown in Exhibit H-1.

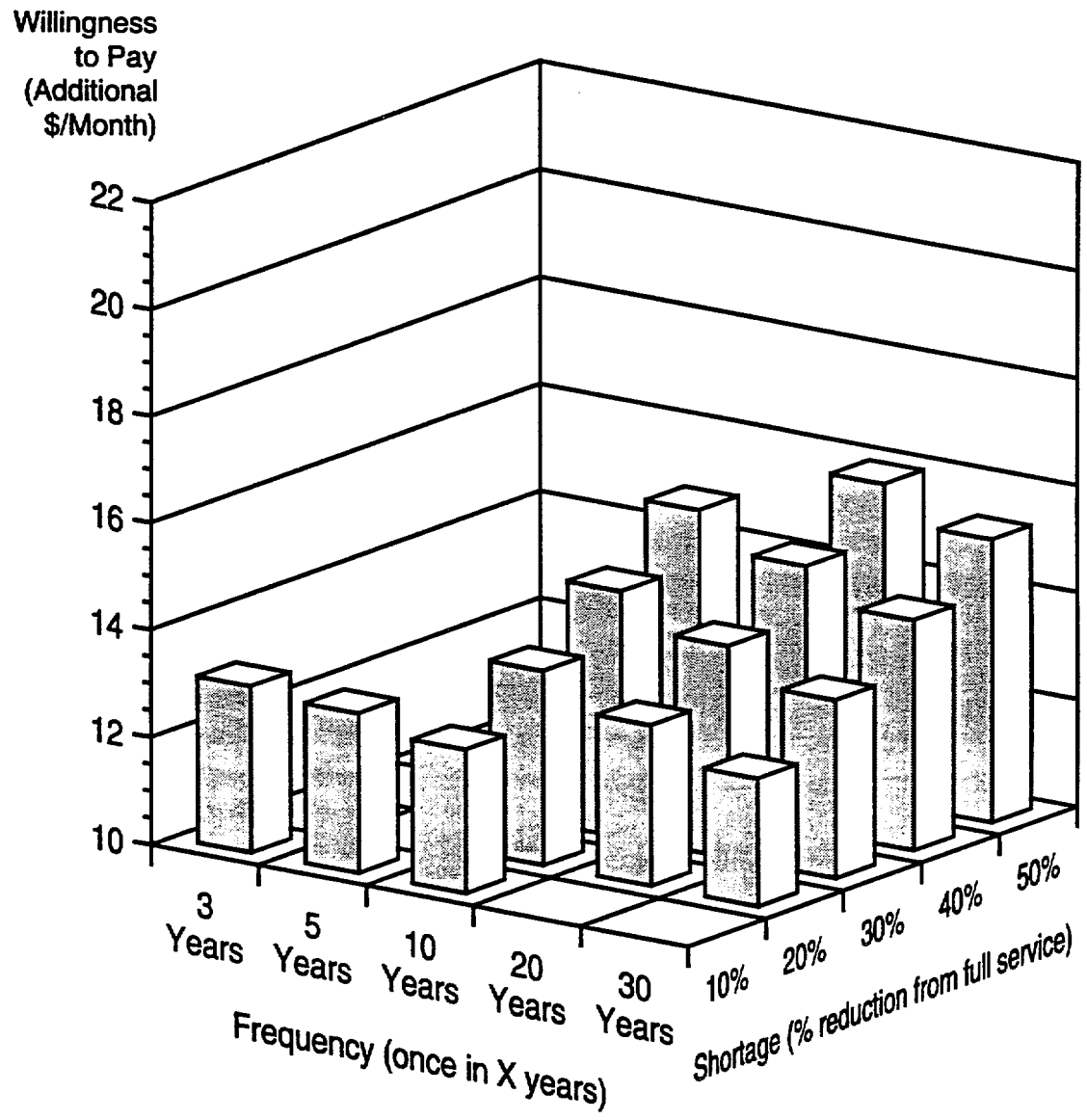
  Put another way, it appears that residential customers believe that infrequent large shortages impose higher losses than more frequent small shortages.

- To avoid even apparently minor shortage scenarios (e.g. 10% once every 10 years), respondents are willing to pay substantial amounts. This type of "threshold" response is not uncommon in surveys of this type and may indicate that respondents regard even a mild shortage scenario as an inconvenience that they want to avoid. They may make a greater distinction between "shortage" and "no shortage" than between different sizes or frequencies of shortages.

Contra Costa Water District

Figure H-1

Mean Monthly Willingness to Pay to Avoid Particular Shortage Frequencies and Magnitudes



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Confidence Intervals

Consistent with the approach typically used in the literature to calculate confidence intervals for CV results, we have estimated a range around the WTP associated with the mean shortage frequency and magnitude. Using this approach, the 95% confidence interval for CCWD is ±$1.40. In other words, there is a 95% probability that the WTP to avoid this average shortage lies within a ±$1.40 range. This range most likely underestimates the size of the confidence interval for low and high level shortages, where there are fewer observations. However, it does provide a good relative indicator of the precision of the WTP results. The confidence interval represents only the likely margin of uncertainty due to sampling error. There are also other sources of uncertainty in the WTP estimates, including nonresponse and response errors.

Impact of Key Explanatory Variables on WTP

As described previously, the statistical model includes many variables that could potentially explain the variation in WTP. The model results in Exhibit H-1 include the estimated model coefficients and their statistical significance. The following discussion selects three explanatory variables that are statistically significant and illustrates their impact on WTP. Figures H-2 through H-4 show the variation of WTP at various shortage magnitudes when all other variables, other than the one in question, are held constant.

Education. Figure H-2 illustrates the variation of WTP by education level for several representative shortage scenarios. College-educated respondents have lower willingness to pay to avoid water shortages than do less educated respondents.

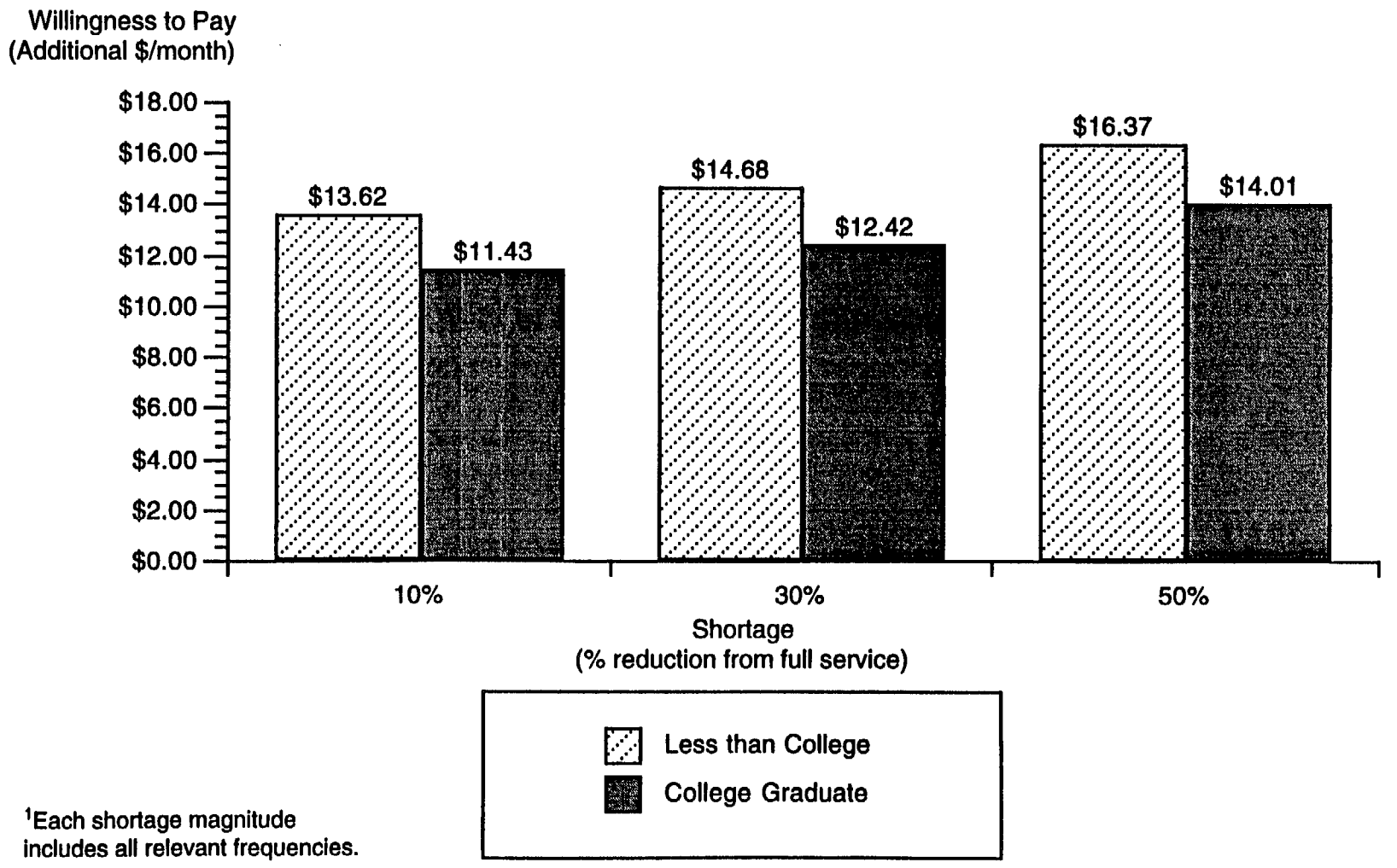
Income. Figure H-3 illustrates the variation of WTP by income level for several representative shortage scenarios. Respondents with higher annual income have higher willingness to pay then do respondents with lower household income.

Housing type. Figure H-4 illustrates the variation of WTP by housing type. The results show that multifamily residents have higher willingness to pay then single family residents. This may be because multifamily residents do not control outdoor water use and thus have less flexibility in reducing their water use.

Contra Costa Water District

Figure H-2

Effect of Education on Willingness to Pay[1]



[1]Each shortage magnitude includes all relevant frequencies.

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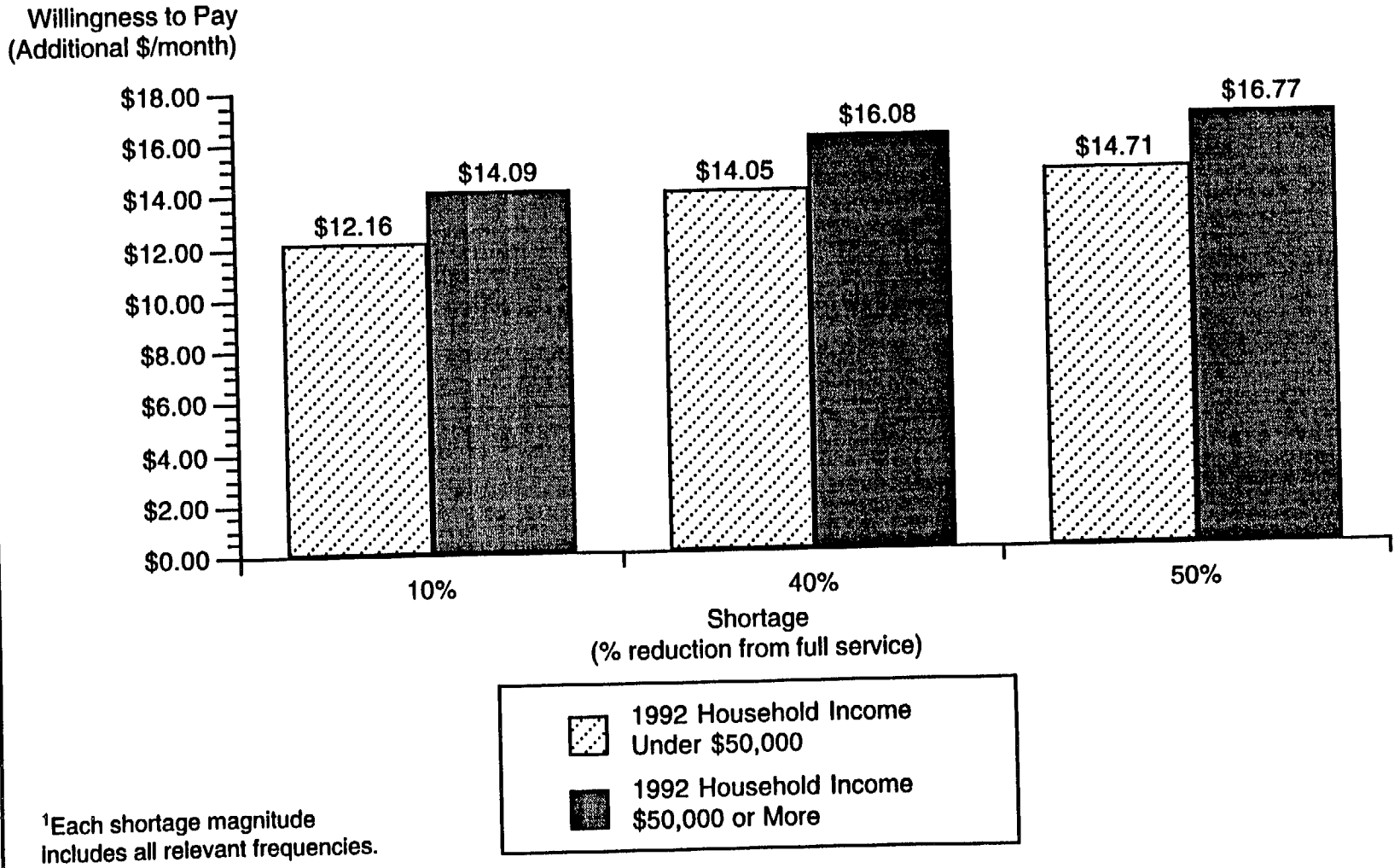
Contra Costa Water District

Figure H-3

Effect of Income on Willingness to Pay[1]



[1]Each shortage magnitude includes all relevant frequencies.

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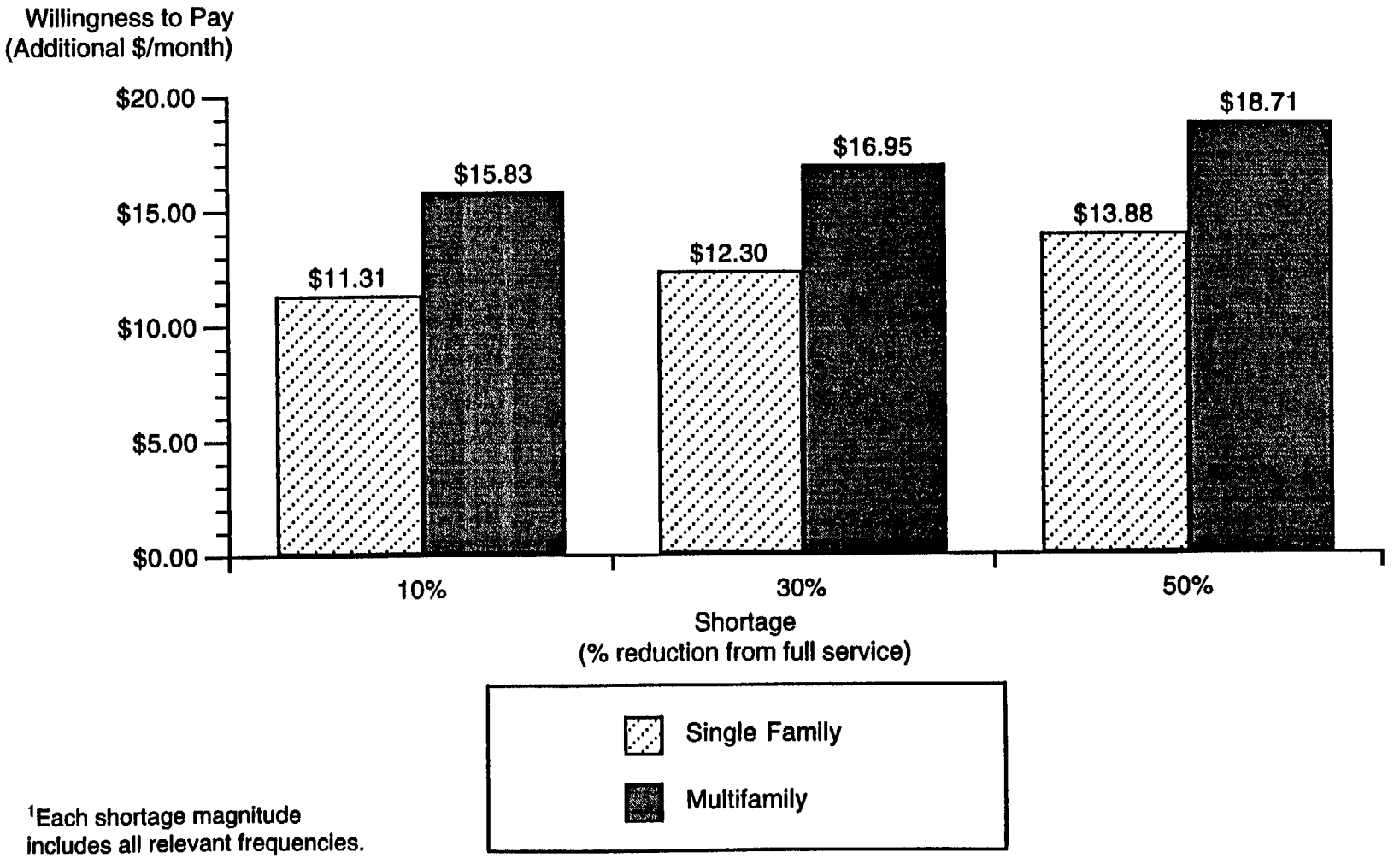
Contra Costa Water District

Figure H-4

Effect of Housing Type on Willingness to Pay[1]



[1]Each shortage magnitude includes all relevant frequencies.

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Explanatory Power of Models

Statistical goodness-of-fit tests were applied to test the explanatory power of the detailed and simplified models. The results of our calculations are presented in Table H-4.

TABLE H-4: GOODNESS OF FIT COMPARISON

	% Predicted Correctly[1]
Detailed model	37%
Simplified model	34%

In this case, the detailed model has only slightly more explanatory power than the simplified model. This, coupled with the similarity of the WTP results for the two models, indicate that CCWD can apply the simplified model to estimate WTP, rather than resurveying customers to gather data on the remaining variables required for the detailed model.

Water Shortages as a Public Concern

In survey question 4, respondents were asked to rate the importance of various public problems, including water shortages, as "not at all important," "somewhat important," or "very important." Based on these responses, a factor analysis was performed to attempt to cluster these variables into a small number of groups.

Overall, the mean response for each issue is illustrated in Table H-5.

[1]In a single bounded logit model, these numbers are equivalent to 61% and 58% (square root of 0.37 and 0.34 respectively).

TABLE H-5: ISSUE RANKING AND MEAN RESPONSE[2]

Issue	Mean Rating	Standard Error
Economy	2.65	.0349
Traffic	2.48	.0401
Education	2.47	.0472
Drug abuse	2.40	.0468
Taxes	2.38	.0433
Drinking water quality	2.38	.0459
Housing costs	2.37	.0422
Crime	2.35	.0410
Water shortages	**2.34**	**.0444**
Homelessness	2.15	.0443
Air pollution	2.15	.0453
Trash disposal	2.05	.0494
Overcrowding	2.02	.0480
Racial issues	1.83	.0430

Water shortages fall in the middle of the list of concerns.[3]

The factor analysis showed that CCWD respondents grouped issues as illustrated in Table H-6. Water shortages fall into the category that includes issues that can best be described as relating to public services. The factors are ranked within each category according to the strength of their rating in the factor analysis.

[2]Note that allowable responses ranged from 1 ("not at all important") to 3 ("very important").

[3]It is possible that had this survey been conducted a year earlier, when the state was still in the grip of a serious drought, water shortages would have been viewed as much more of a concern.

TABLE H-6: FACTOR ANALYSIS OF PUBLIC ISSUES

Public Services Concerns	Social Concerns	Quality of Life Concerns	Financial Concerns
Trash disposal	Crime	Overcrowding	Housing costs
Drinking water quality	Drug abuse	Traffic	Taxes
Water shortages	Racial issues	Air pollution	
Education	Homelessness		
	Economy		

Each of the four factors was included in the model as a binary variable to test its explanatory impact on WTP.[4] Each of these variables was assigned the value of 1 if the mean value of all of a respondent's ratings for the issues included in that factor exceeded the value assigned to the water shortage issue, and zero otherwise. For CCWD, both the public services factor and the social concerns factor are statistically significant in explaining WTP.

Open-Ended Responses

Following the referendum questions, respondents were asked several open-ended questions regarding what actions they thought they would have to take under specified shortage scenarios, and what issues they considered when deciding whether to vote yes or no. These questions were asked to better understand the reasoning of participants. Participants' answers to these questions are summarized in Exhibit H-2.

[4]The "public services/environmental" factor included in the model excluded the water shortages variable.

Exhibit H-1
MODEL RESULTS

Results for the detailed and simplified models follow this page. The results present each variable included in the model along with the following information:

- **Coefficient** indicates the magnitude of the variable's impact on WTP
- **Standard error** reflects the distribution of the coefficient
- **T-statistic** is a commonly used measure of statistical significance
- **P-value** is the observed significance level (for example, if p = .05, the coefficient is statistically significant at the 95% level)

The following key of variable pneumonics used in the model will facilitate interpretation of these results.

Key of Survey Variables

SUPPLY:	Percentage reduction from full service demand specified in the cv scenario.
FREQ:	Frequency of drought specified in the CV scenario.
AREAYRS:	Number of years respondent has lived in the area.
HHSIZE:	Number of persons in the household, including respondent.
AGE1834:	Respondent's age is in the range of 18 to 34 years old.
AGE3554:	Respondent's age is in the range of 35 to 54 years old.
COLGRAD:	Respondent is a college graduate.
INCGT%50:	1992 household income is greater than $50,000.
SNGL_FAM:	Respondent lives in a single family residence.
QUALLIFE:	Concern for "quality of life issues" (as defined by a factor analysis) relative to concern for water shortages.
SOCIAL:	Concern for "social issues" (as defined by a factor analysis) relative to concern for water shortages.
FINANCE:	Concern for "finance issues" (as defined by a factor analysis) relative to concern for water shortages.
ENVIRON:	Concern for "public services and/or environmental issues" (as defined by a factor analysis) relative to concern for water shortages.
SEVERE:	Perception of the severity of the recent drought
SHORTAGE:	Water shortages considered a somewhat or very important problem.
LONGTERM:	Perception of water shortages as a long-term problem in the area.
MANDATE:	Respondent believes that their water agency suggested or mandated cutbacks during the recent drought.
OWNPAY:	Respondent owns home and is personally responsible for paying the water bill.

OWNELSE:	Respondent owns home and someone else in the household is responsible for paying the water bill.
OWNASSOC:	Respondent owns home and a homeowners association is responsible for paying the water bill.
RENTPAY:	Respondent rents home, water bill is not included in the rent.
YELLOW:	Homes with private landscaped areas less than 3,000 square feet or shared landscaped areas less than 5,000 square feet.
PINK:	Homes with shared landscaped areas greater than 5,000 square ft.
NOGROWTH:	Respondent wants community to remain the same size/decrease in size.
RATE:	Average residential rate for respondent's water agency
NORTH:	Northern California water agency
BID:	Amount that respondents bill would increase per month if the majority of the community voted yes to the referendum.

Simplified model for CCWD

Date: 2/22/1994
Observations: 508 D.F. : 497

Var	Coef	Std. Error	t-Stat	P-Value
CONSTANT	2.798475	0.697657	4.011	3.474e-05
SUPPLY	-1.464372	0.709958	-2.063	0.01983
FREQ	-0.006381222	0.0102715	-0.6213	0.2674
AREAYRS	0.001753337	0.00736957	0.2379	0.406
HHSIZE	-0.02782055	0.067613	-0.4115	0.3405
AGE1834	0.01070027	0.26027	0.04111	0.4836
AGE3554	0.07044225	0.22478	0.3134	0.3771
COLGRAD	-0.1982849	0.171615	-1.155	0.1242
INCGT50K	0.2624848	0.191599	1.37	0.08565
SNGL_FAM	-0.4993276	0.189456	-2.636	0.004328
BID	-0.1145882	0.00668822	-17.13	1.437e-52

Detailed model for CCWD

Date: 2/22/1994
Observations: 489 D.F. : 464

Var	Coef	Std. Error	t-Stat	P-Value
CONSTANT	3.410983	0.881399	3.87	6.18e-05
SUPPLY	-1.430289	0.742087	-1.927	0.02726
FREQ	-0.009339811	0.0107445	-0.8693	0.1926
AREAYRS	0.001186538	0.00817342	0.1452	0.4423
HHSIZE	-0.02429286	0.0715144	-0.3397	0.3671
AGE1834	-0.2163051	0.273513	-0.7908	0.2147
AGE3554	-0.08950969	0.239754	-0.3733	0.3545
COLGRAD	-0.338179	0.183549	-1.842	0.03301
INCGT50K	0.2920016	0.213898	1.365	0.08642
SNGL_FAM	-0.6767415	0.358297	-1.889	0.02976
QUALLIFE	-0.1030494	0.293478	-0.3511	0.3628
SOCIAL	0.4248098	0.301723	1.408	0.07989
ENVIRON	-0.5328846	0.279924	-1.904	0.02877
SEVERE	0.2533616	0.186411	1.359	0.08736
SHORTAGE	0.1568271	0.289305	0.5421	0.294
LONGTERM	0.345697	0.200093	1.728	0.04234
MANDATE	-0.4036971	0.285008	-1.416	0.07864
OWNPAY	-0.08501198	0.430286	-0.1976	0.4217
OWNELSE	0.6682642	0.472012	1.416	0.07874
OWNASSOC	-0.0302338	0.314024	-0.09628	0.4617
RENTPAY	0.1708216	0.507894	0.3363	0.3684
YELLOW	-0.2572018	0.213068	-1.207	0.114
PINK	-0.3314017	0.294208	-1.126	0.1303
NOGROWTH	-0.2433281	0.278961	-0.8723	0.1917
BID	-0.1198101	0.00714036	-16.78	1.538e-50

Exhibit H-2
OPEN-ENDED RESPONSES

SURVEY QUESTION 19

WHAT ARE THE PRIMARY REASONS YOU WOULD CHOSE NOT TO PAY THE ADDITIONAL MONEY ON YOUR WATER BILL TO AVOID FUTURE SHORTAGES?

(Asked Only of the 48 Respondents Who Voted No to the First and Second Bids for Both Scenarios)

CONTRA COSTA WATER DISTRICT

Reason	Percent of Respondents
Prefer to reduce my water usage	35%
Low confidence in the water agency	27%
Tired of paying for others/everyone should conserve	23%
Cannot afford to pay a higher water bill	19%
Additional water supplies encourage population growth	17%
Not willing to pay more	10%
Do not believe water shortages can be avoided	10%

The table indicates the percent of respondents who listed the specified reason. The sum of the column is greater than 100% because respondents could list more than one reason. Responses given by fewer than 2% of the respondents are not listed.

SURVEY QUESTION 20

WHAT FACTORS OR ISSUES DID YOU CONSIDER WHEN DECIDING TO VOTE YES OR NO?

(Asked Only of Respondents Who Voted Yes to at Least One Bid)

CONTRA COSTA WATER DISTRICT

Factors Considered	Percent of Respondents
Cannot afford more on bill	44%
We can conserve	25%
New resources should be developed	20%
No confidence in the water agency	14%
Water is a necessity	13%
Depends upon the resource project	8%
Magnitude of shortage	8%
Not willing to pay for others use	8%
Too many people/restrict new development	5%
Future generations and their needs	4%
Not willing to pay more	4%
Frequency of shortage	4%
Frequency and magnitude of shortage	3%
Impacts of shortage on greenery/aesthetics	1%
Impacts of new resources on environment	0%

The table indicates the percent of respondents who listed the specified issue or factor. The sum of the column is greater than 100% because respondents could list more than one issue or factor. Responses given by fewer than 2% of the respondents are not listed.

SURVEY QUESTIONS 21 AND 22

WHEN YOU WERE ANSWERING THE QUESTIONS ABOUT WHAT IT WOULD BE WORTH TO YOU TO AVOID THE ___% WATER SHORTAGE ONCE EVERY ___ YEARS, WHAT DID YOU ASSUME YOUR HOUSEHOLD WOULD HAVE TO DO TO CUT BACK YOUR WATER USE?

CONTRA COSTA WATER DISTRICT

Actions to Reduce Water Use	Water Shortage				
	10%	20%	30%	40%	50%
Can't conserve anymore, would do nothing more	16.1%	5.3%	9.0%	9.8%	11.3%
Install low-flow showerheads	8.5	7.9	5.7	4.5	6.3
Install displacement devices in toilet	4.2	6.1	7.4	6.3	7.5
Replace toilets with low-flush toilets	3.4	2.6	4.1	3.6	3.8
Take fewer/shorter showers	34.7	40.4	41.0	28.6	37.5
User fewer flushes	16.1	14.9	17.2	12.5	23.8
Use grey water/recycle water	3.4	9.6	8.2	5.4	13.8
Use dishwasher less/not at all	16.1	16.7	16.4	16.1	18.8
Do laundry less/take to a laundromat	12.7	10.5	18.0	17.0	18.8
Change outside plant watering habits	6.8	7.9	6.6	11.6	5.0
Wash car less/not at all/take to carwash	13.6	11.4	14.8	13.4	12.5
Water lawn less/let lawn die	9.3	16.7	23.0	19.6	28.8

The table indicates the percentage of respondents who listed the specified action. The sum of each column is greater than 100% because respondents could list more than one action.

Appendix I
LOS ANGELES DEPARTMENT OF WATER AND POWER RESULTS

THE VALUE OF WATER SUPPLY RELIABILITY: RESULTS OF A CONTINGENT VALUATION SURVEY

LOS ANGELES DEPARTMENT OF WATER AND POWER (LADWP)

This appendix discusses the contingent valuation (CV) survey results for the Los Angeles Department of Water and Power (LADWP). Section I discusses survey administration, including sampling, survey procedures, and response rates. Section II presents analytic results. Exhibits I-1 and I-2 contain the model results, and summary tables of participants' open-ended responses.

I. SURVEY ADMINISTRATION

The total number of completions for LADWP was 277. Barakat & Chamberlin worked closely with LADWP to draw an initial sample of 1,000 customer billing records. Due to difficulty in obtaining sufficient survey completions from the initial sample, an additional sample of 300 names, addresses and telephone numbers from the same areas as the initial sample was later purchased from Affordable Listed Samples, an independent sampling firm. The survey of LADWP customers was conducted from mid-August through early November, 1993, and mid-January through mid-February, 1994.

The LADWP sample had a higher than expected percentage of inaccurate or unavailable telephone numbers that the survey team were not able to obtain through use of directory assistance. This significantly decreased the size of the usable sample. Also, a high percentage of sample points could not participate due to language barriers. The final disposition of sample points is illustrated in Table I-1.

II. ANALYTIC RESULTS

Comparison of the Sample with the Population

Before discussing the customer loss functions for LADWP, we first must determine the extent to which the survey sample differs from the underlying population. To do this, census results were compared to sample characteristics with respect to age, income, education, household size, and type of dwelling (i.e., single-family vs. multifamily). The results are presented in Table I-2.

Table I-1
LADWP RESPONSE RATES

	Total
Initial sample	1,300
Unused sample[a]	0
Out of sample[b]	137
No telephone number available	224
Corrected sample size	**939**
Refusals	118
Not reached during study	205
Unable to participate[c]	339
Completed interviews	**277**
Response rate[d]	**30%**

[a]There was no attempt to contact these sample points.
[b]These include businesses, landlords, vacancies, duplicate sample points, and sample points no longer residing in the study area.
[c]Includes language/communication barriers, or mailing not received, not read, or thrown away.
[d]Calculated as a percent of the corrected sample size.

Table I-2
COMPARISON OF SAMPLE WITH POPULATION

	Sample	Population
Age		
18 to 34	18%	34%
34 to 54	35%	25%
55+	47%	41%
Household income		
Under $50,000	74%	71%
$50,000+	26%	29%
Education		
Not college grad	58%	77%
College graduate	42%	23%
Dwelling type		
Single-family	53%	46%
Multifamily	47%	54%
Household size	2.4	2.4

Table I-2 indicates that the sample was more educated, older, and had a higher proportion of single-family residents than the overall population. The standard analytical technique that is used to correct for such differences is to use population means rather than sample means to derive loss functions. The estimates of willingness to pay then reflect the population rather than the sample demographics. That approach was used in this case.

Willingness to Pay (WTP)

WTP can be interpreted as the losses that customers incur as a result of particular shortage scenarios. The amount that a customer is willing to pay to avoid an event is a measure of the losses that customer would incur if that event were to occur. Therefore, we refer to these willingness to pay results as a "loss function."

Tables I-3A and I-3B present the mean WTP for the detailed model and the simplified model for each magnitude and frequency of shortage. WTP figures represent increments to monthly water bills. WTP for the full model varies from a low of $10.65/month to avoid a 10% shortage once every 10 years, to a high of $18.47/month to avoid a 50% shortage every 30 years.

The results of the simplified model are almost identical to the detailed model. The remainder of this report cites results based on the detailed model only.

Table I-3A
MEAN MONTHLY WILLINGNESS TO PAY, DETAILED MODEL
(Additional $/Month)

Shortage (% Reduction from Full Service)	Frequency (Occurrences/Years)				
	1/30	1/20	1/10	1/5	1/3
10%			$10.95	$10.74	$10.65
20%	$13.38	$12.92	$12.46		
30%	$15.02	$14.53	$14.04		
40%	$16.71	$16.21	$15.70		
50%	$18.47	$17.94			

Table I-3B
MEAN MONTHLY WILLINGNESS TO PAY, SIMPLIFIED MODEL
(Additional $/Month)

Shortage (% Reduction from Full Service)	Frequency (Occurrences/Years)				
	1/30	1/20	1/10	1/5	1/3
10%			$10.62	$10.57	$10.55
20%	$12.44	$12.32	$12.20		
30%	$14.13	$14.00	$13.88		
40%	$15.91	$15.78	$15.64		
50%	$17.77	$17.63			

The loss function is shown graphically in Figure I-1. In examining the tabular and graphical results, two major conclusions can be drawn:

- As expected, respondents are willing to pay more for larger shortages and for shortages that occur with higher frequency. However, the response to frequency variations is considerably smaller than the impact of magnitude. This is confirmed by referring to the model estimation results, which are shown in Exhibit I-1.

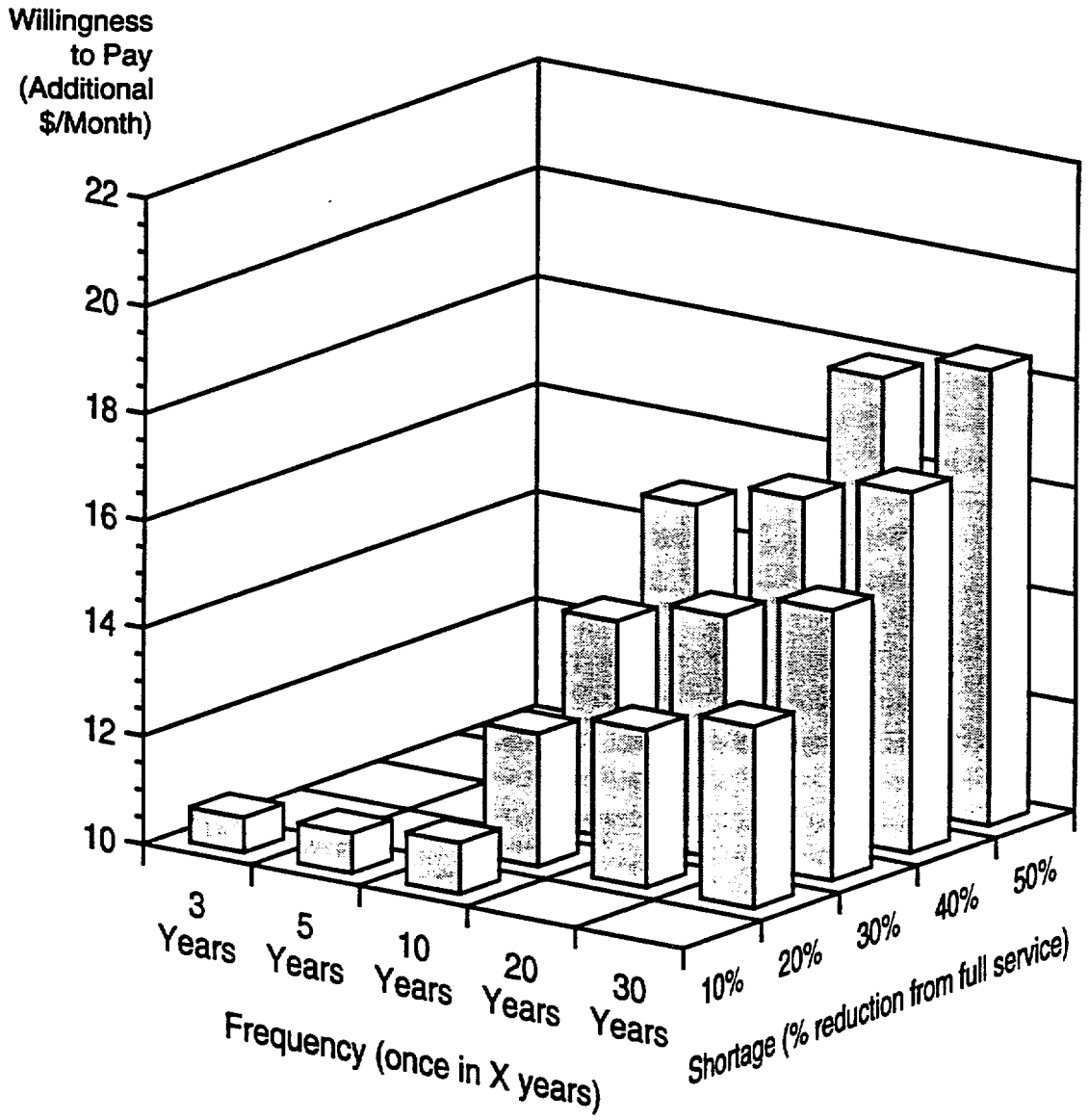
  Put another way, it appears that residential customers believe that infrequent large shortages impose higher losses than more frequent small shortages.

- To avoid even apparently minor shortage scenarios (e.g., 10% once every 10 years), respondents are willing to pay substantial amounts. This type of "threshold" response is not uncommon in surveys of this type and may indicate that respondents regard even a mild shortage scenario as an inconvenience that they want to avoid. They may make a greater distinction between "shortage" and "no shortage" than between different sizes or frequencies of shortages.

LADWP

Figure I-1

Mean Monthly Willingness to Pay to Avoid Particular Shortage Frequencies and Magnitudes



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Confidence Intervals

Consistent with the approach typically used in the literature to calculate confidence intervals for CV results, we have estimated a range around the WTP associated with the mean shortage frequency and magnitude. Using this approach, the 95% confidence interval for LADWP is ±$1.73. In other words, there is a 95% probability that the WTP to avoid this average shortage lies within a ±$1.73 range. This range most likely underestimates the size of the confidence interval for low and high level shortages, where there are fewer observations. However, it does provide a good relative indicator of the precision of the WTP results. The confidence interval represents only the likely margin of uncertainty due to sampling error. There are also other sources of uncertainty in the WTP estimates, including nonresponse and response errors.

Impact of Key Explanatory Variables on WTP

As described previously, the statistical model includes many variables that could potentially explain the variation in WTP. The model results in Exhibit I-1 include the estimated model coefficients and their statistical significance. The following discussion selects three explanatory variables that are statistically significant and illustrates their impact on WTP. Figures I-2 through I-4 show the variation of WTP at various shortage magnitudes when all other variables, other than the one in question, are held constant.

Housing type. Figure I-2 illustrates the variation of WTP by housing type. The results show that multifamily residents have higher willingness to pay then single-family residents. This may be because multifamily residents do not control outdoor water use and thus have less flexibility in reducing their water use.

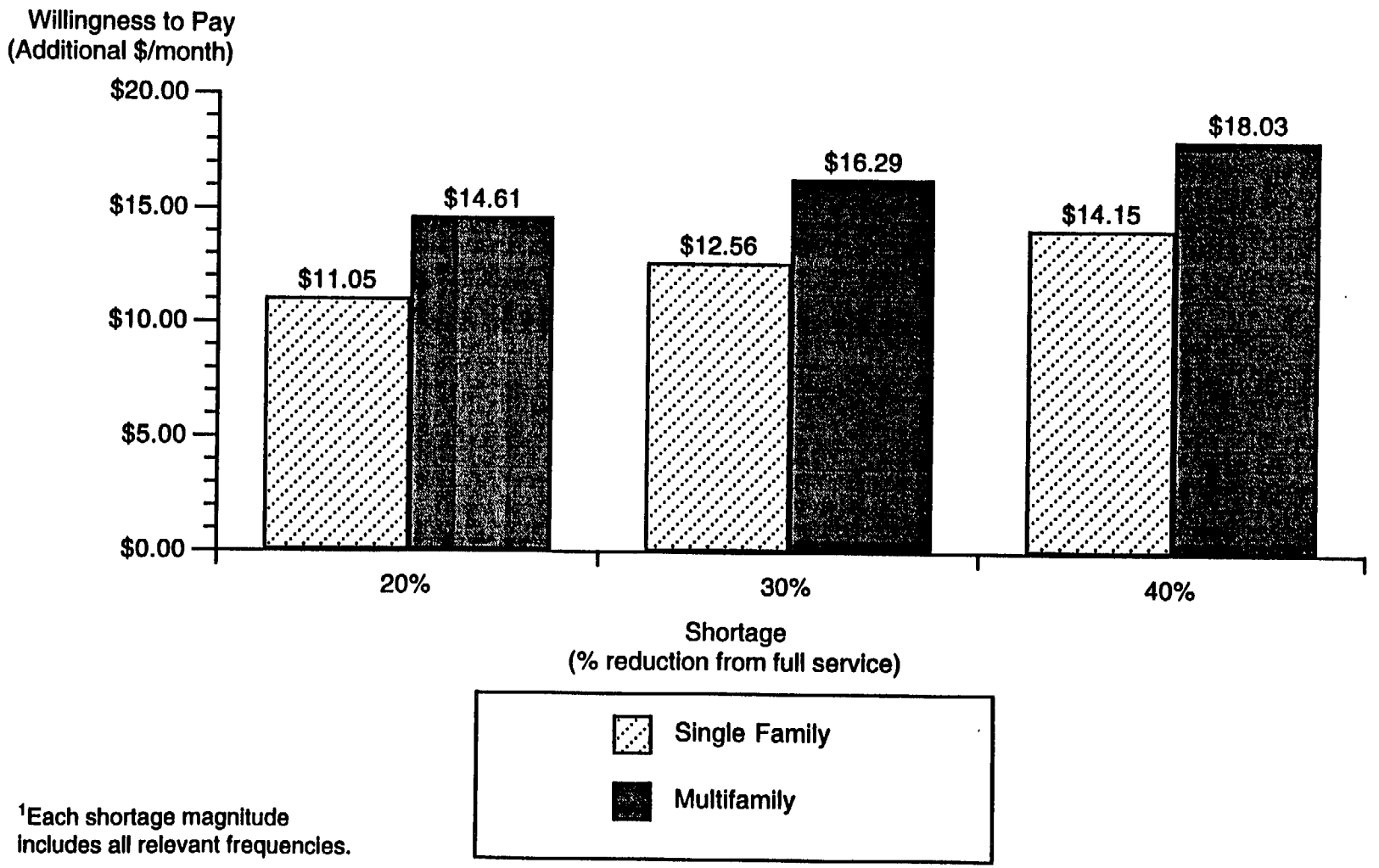
Growth Preferences. Another interesting relationship is demonstrated in Figure I-3, which shows the relationship between participant feelings about community growth and their willingness to pay to avoid water shortages. Individuals who indicate a desire for their communities to grow in size have a higher WTP than do people who want their communities to stay the same size or to get smaller. Many in the latter group may perceive a relationship between water resource development and growth and are therefore more likely to prefer enduring more severe and/or frequent water shortages rather than adding to the resource base.

Landscape Area. The quantity and type of outdoor landscaping has a statistically significant influence on respondents' willingness to pay to avoid future shortages.

LADWP

Figure I-2

Effect of Housing Type on Willingness to Pay[1]



[1]Each shortage magnitude includes all relevant frequencies.

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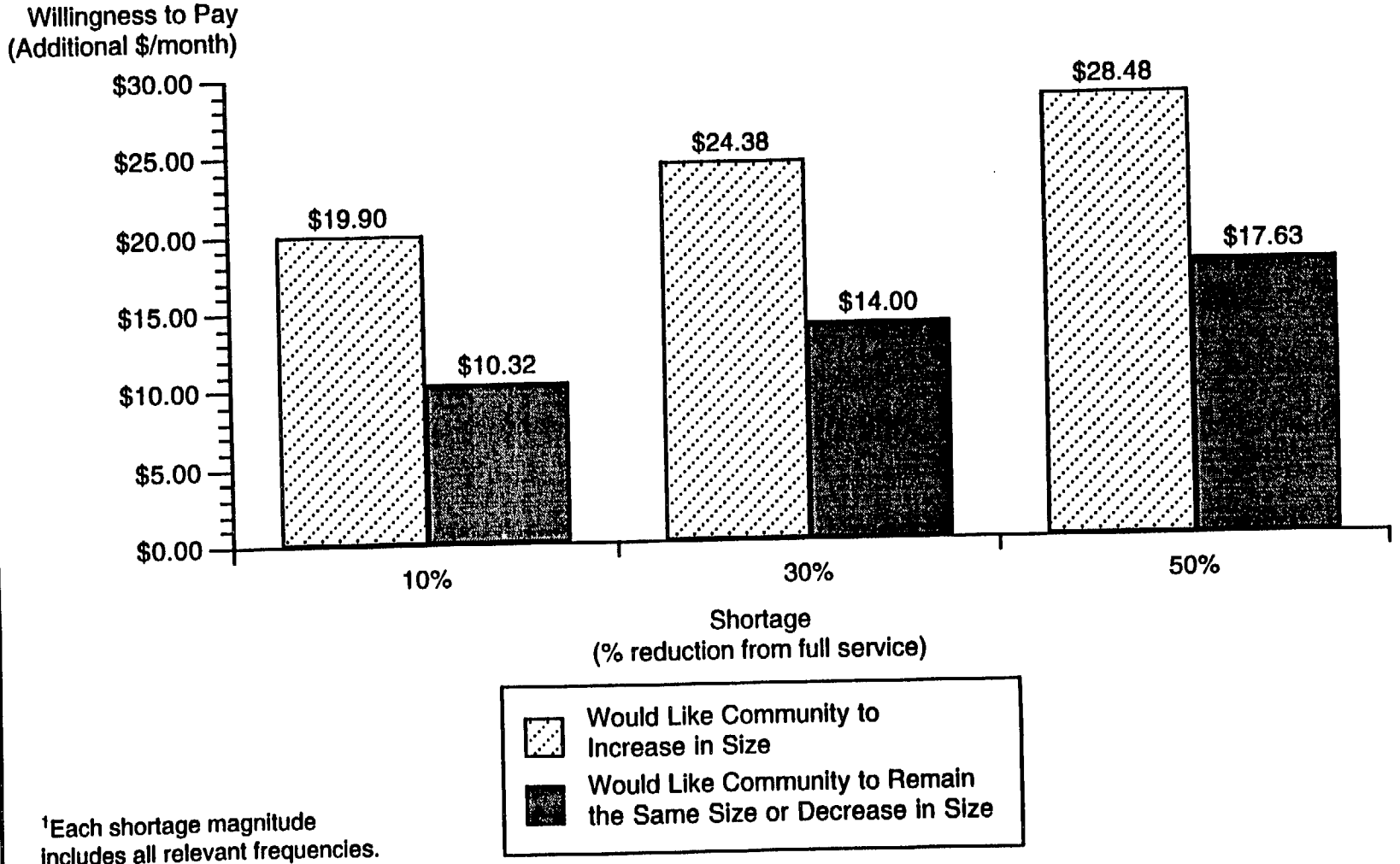
LADWP

Figure I-3

Effect of Population Growth Preferences on Willingness to Pay[1]



[1]Each shortage magnitude includes all relevant frequencies.

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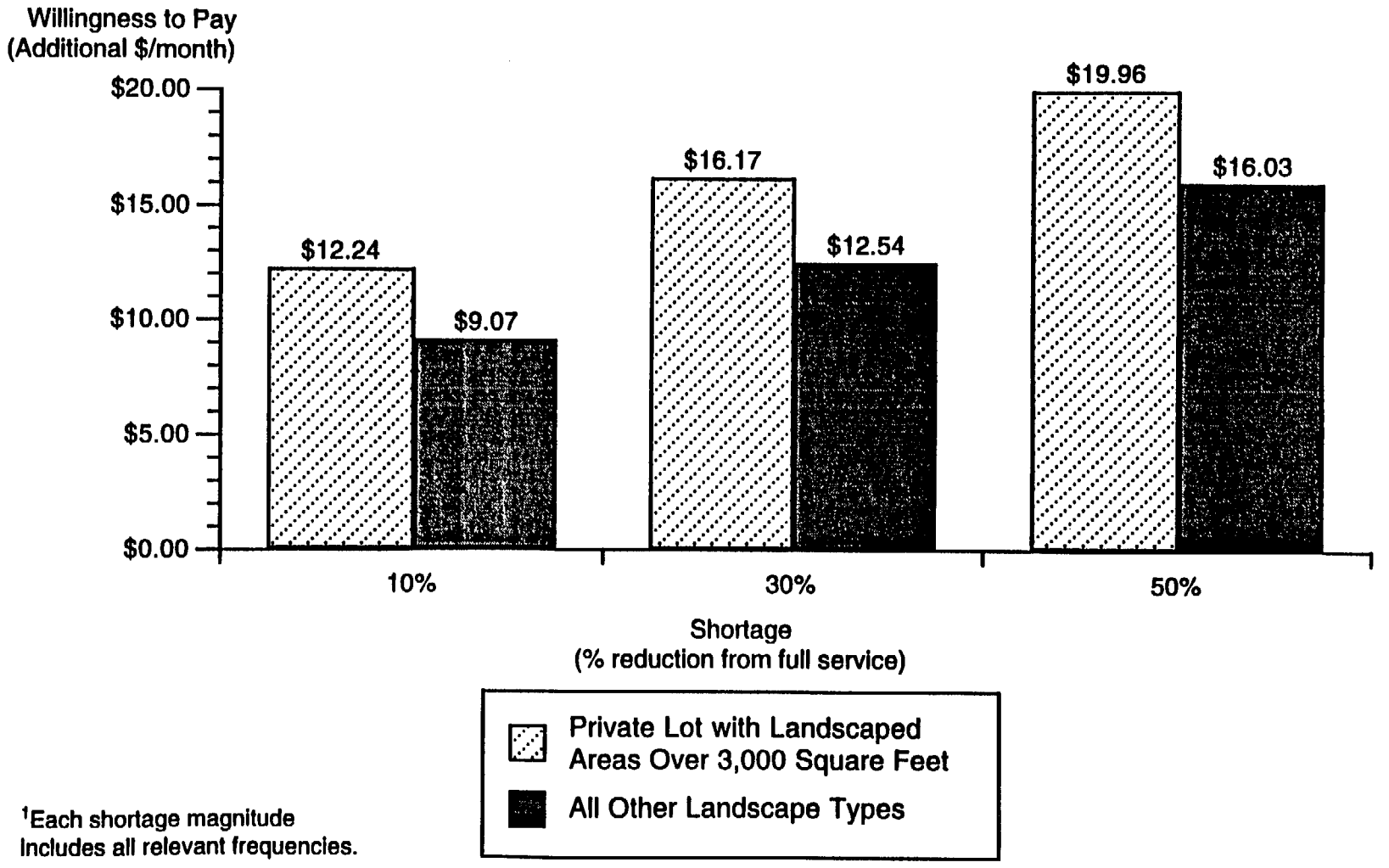
LADWP

Figure I-4

Effect of Landscape Characteristics on Willingness to Pay[1]



[1]Each shortage magnitude includes all relevant frequencies.

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Figure I-4 illustrates this by using the variables in the model that capture variations in landscaped area. Again, WTP is shown for several levels of shortage severity. The results show that respondents who have private lots with landscapes larger than 3000 square feet have higher WTP than families with other types of landscaping.

Explanatory Power of Models

Statistical goodness-of-fit tests were applied to test the explanatory power of the detailed and simplified models. The results of our calculations are presented in Table I-4.

In this case, the detailed model has only slightly more explanatory power than the simplified model. This, coupled with the similarity of the WTP results for the two models, indicate that LADWP can apply the simplified model to estimate WTP, rather than resurveying customers to gather data on the remaining variables required for the detailed model.

Table I-4
GOODNESS OF FIT COMPARISON

	% Predicted Correctly[1]
Detailed model	37%
Simplified model	34%

Water Shortages as a Public Concern

In survey question 4, respondents were asked to rate the importance of various public problems, including water shortages, as "not at all important," "somewhat important," or "very important." Based on these responses, a factor analysis was performed to attempt to cluster these variables into a small number of groups.

Overall, the mean response for each issue is illustrated in Table I-5.

[1]In a single bounded logit model, these numbers are equivalent to 61% and 58% (square root of 0.37 and 0.34 respectively).

Table I-5
ISSUE RANKING AND MEAN RESPONSE[2]

Issue	Mean Rating	Standard Error
Economy	2.74	.0388
Education	2.60	.0565
Drug abuse	2.57	.0574
Crime	2.53	.0529
Housing costs	2.41	.0576
Traffic	2.38	.0463
Taxes	2.34	.0528
Drinking water quality	2.34	.0500
Air pollution	2.33	.0448
Homelessness	2.23	.0548
Overcrowding	2.12	.0655
Water shortages	**2.11**	**.0526**
Trash disposal	2.04	.0534
Racial issues	1.85	.0561

Many issues are viewed as significantly more important than water shortages.[3]

The factor analysis showed that LADWP respondents grouped issues as illustrated in Table I-6. Water shortages fall into the category that includes issues that can best be described as having public service or environmental components. The factors are ranked within each category according to the strength of their rating in the factor analysis.

Each of the factors was included in the model as a binary variable to test its explanatory impact on WTP.[4] Each of these variables was assigned the value of 1 if the mean value of all of a respondent's ratings for the issues included in that factor

---

[2]Note that allowable responses ranged from 1 ("not at all important") to 3 ("very important").

[3]It is possible that had this survey been conducted a year earlier, when the state was still in the grip of a serious drought, water shortages would have been viewed as much more of a concern.

[4]The "public services/environmental" factor included in the model excluded the water shortages variable.

Table I-6
FACTOR ANALYSIS OF PUBLIC ISSUES

Public Services/ Environmental Issues	Urban Problems	Financial Concerns
Trash disposal	Crime	Taxes
Education	Overcrowding	Economy
Homelessness	Racial issues	Drug abuse
Water shortages	Traffic	Housing costs
Drinking water quality		
Air pollution		

exceeded the value assigned to the water shortage issue, and zero otherwise. For LADWP, only the finance factor is statistically significant in explaining WTP. Not unexpectedly, respondents with high levels of concern for financial issues relative to their concern for water shortages have lower WTP.

Open-Ended Responses

Following the referendum questions, respondents were asked several open-ended questions regarding what actions they thought they would have to take under specified shortage scenarios, and what issues they considered when deciding whether to vote yes or no. These questions were asked to better understand the reasoning of participants. Participants' answers to these questions are summarized in Exhibit I-2.

Exhibit I-1
MODEL RESULTS

Results for the detailed and simplified models follow this page. The results present each variable included in the model along with the following information:

- **Coefficient** indicates the magnitude of the variable's impact on WTP
- **Standard error** reflects the distribution of the coefficient
- **T-statistic** is a commonly used measure of statistical significance
- **P-value** is the observed significance level (for example, if p = .05, the coefficient is statistically significant at the 95% level)

The following key of variable pneumonics used in the model will facilitate interpretation of these results.

Key of Survey Variables

SUPPLY:	Percentage reduction from full service demand specified in the cv scenario.
FREQ:	Frequency of drought specified in the CV scenario.
AREAYRS:	Number of years respondent has lived in the area.
HHSIZE:	Number of persons in the household, including respondent.
AGE1834:	Respondent's age is in the range of 18 to 34 years old.
AGE3554:	Respondent's age is in the range of 35 to 54 years old.
COLGRAD:	Respondent is a college graduate.
INCGT%50:	1992 household income is greater than $50,000.
SNGL_FAM:	Respondent lives in a single family residence.
QUALLIFE:	Concern for "quality of life issues" (as defined by a factor analysis) relative to concern for water shortages.
SOCIAL:	Concern for "social issues" (as defined by a factor analysis) relative to concern for water shortages.
FINANCE:	Concern for "finance issues" (as defined by a factor analysis) relative to concern for water shortages.
ENVIRON:	Concern for "public services and/or environmental issues" (as defined by a factor analysis) relative to concern for water shortages.
SEVERE:	Perception of the severity of the recent drought
SHORTAGE:	Water shortages considered a somewhat or very important problem.
LONGTERM:	Perception of water shortages as a long-term problem in the area.
MANDATE:	Respondent believes that their water agency suggested or mandated cutbacks during the recent drought.
OWNPAY:	Respondent owns home and is personally responsible for paying the water bill.

OWNELSE:	Respondent owns home and someone else in the household is responsible for paying the water bill.
OWNASSOC:	Respondent owns home and a homeowners association is responsible for paying the water bill.
RENTPAY:	Respondent rents home, water bill is not included in the rent.
YELLOW:	Homes with private landscaped areas less than 3,000 square feet or shared landscaped areas less than 5,000 square feet.
PINK:	Homes with shared landscaped areas greater than 5,000 square ft.
NOGROWTH:	Respondent wants community to remain the same size/decrease in size.
RATE:	Average residential rate for respondent's water agency
NORTH:	Northern California water agency
BID:	Amount that respondents bill would increase per month if the majority of the community voted yes to the referendum.

LADWP simplified model

Date: 3/04/1994
Observations: 446 D.F. : 435

Var	Coef	Std. Error	t-Stat	P-Value
CONSTANT	2.926205	0.785445	3.726	0.00011
SUPPLY	-2.419107	0.798731	-3.029	0.001299
FREQ	0.001792914	0.0113349	0.1582	0.4372
AREAYRS	-0.0009450066	0.00673455	-0.1403	0.4442
HHSIZE	-0.0183238	0.073018	-0.2509	0.401
AGE1834	-0.4288792	0.289835	-1.48	0.06982
AGE3554	0.1346213	0.23419	0.5748	0.2828
COLGRAD	0.534277	0.202998	2.632	0.004392
INCGT50K	0.2106182	0.22428	0.9391	0.1741
SNGL_FAM	0.03818347	0.197121	0.1937	0.4232
BID	-0.1095484	0.00690499	-15.87	1.442e-45

LADWP detailed model

Date: 3/30/1994
Observations: 424 D.F. : 399

Var	Coef	Std. Error	t-Stat	P-Value
CONSTANT	5.332488	0.984072	5.419	5.042e-08
SUPPLY	-2.427279	0.831041	-2.921	0.001839
FREQ	0.007231034	0.0119966	0.6028	0.2735
AREAYRS	-0.001808686	0.00729551	-0.2479	0.4022
HHSIZE	-0.003956578	0.078601	-0.05034	0.4799
AGE1834	-0.362497	0.316044	-1.147	0.126
AGE3554	0.1403548	0.247902	0.5662	0.2858
COLGRAD	0.3976337	0.215067	1.849	0.03259
INCGT50K	0.205407	0.248196	0.8276	0.2042
SNGL_FAM	-0.6024938	0.310652	-1.939	0.02655
QUALLIFE	-0.4846822	0.312126	-1.553	0.0606
SOCIAL	0.350003	0.354344	0.9877	0.1619
ENVIRON	-0.5160193	0.372112	-1.387	0.08313
SEVERE	-0.17193	0.205087	-0.8383	0.2012
SHORTAGE	-0.3685266	0.266886	-1.381	0.08403
LONGTERM	0.04546015	0.200567	0.2267	0.4104
MANDATE	-0.2222354	0.234134	-0.9492	0.1715
OWNPAY	0.7946633	0.34478	2.305	0.01083
OWNELSE	0.2435749	0.483669	0.5036	0.3074
OWNASSOC	-0.002143188	0.554889	-0.003862	0.4985
RENTPAY	-0.03686236	0.332017	-0.111	0.4558
YELLOW	-0.2921527	0.201055	-1.453	0.07347
PINK	-0.7655834	0.362135	-2.114	0.01755
NOGROWTH	-1.45128	0.436584	-3.324	0.0004819
BID	-0.1205251	0.00766055	-15.73	1.462e-44

Exhibit I-2
OPEN-ENDED RESPONSES

SURVEY QUESTION 19

WHAT ARE THE PRIMARY REASONS YOU WOULD CHOSE NOT TO PAY THE ADDITIONAL MONEY ON YOUR WATER BILL TO AVOID FUTURE SHORTAGES?

(Asked Only of the 48 Respondents Who Voted No to the First and Second Bids for Both Scenarios)

LOS ANGELES DEPARTMENT OF WATER AND POWER

Reason	Percent of Respondents
Cannot afford a higher water bill	38%
Prefer to reduce my water usage	35%
Tired of paying for others/everyone should conserve	19%
Not willing to pay more	19%
Low confidence in the water agency	6%
Additional water supplies encourage population growth	2%
The table indicates the percent of respondents who listed the specified reason. The sum of the column is greater than 100% because respondents could list more than one reason. Responses given by fewer than 2% of the respondents are not listed.	

SURVEY QUESTION 20

WHAT FACTORS OR ISSUES DID YOU CONSIDER WHEN DECIDING TO VOTE YES OR NO?

(Asked Only of Respondents Who Voted Yes to at Least One Bid)

LOS ANGELES DEPARTMENT OF WATER AND POWER

Factors considered	Percent of Respondents
Cannot afford more on bill	36%
We can conserve	18%
Water is a necessity	17%
Not willing to pay for others use	10%
Not willing to pay more	8%
No confidence in the water agency	8%
Magnitude of shortage	7%
New resources should be developed	5%
Future generations and their needs	4%
Depends upon the resource project	4%
Too many people/restrict new development	4%
Impacts of shortage on greenery/aesthetics	0%
Impacts of new resources on environment	0%
Frequency of shortage	0%

The table indicates the percent of respondents who listed the specified issue or factor. The sum of the column is greater than 100% because respondents could list more than one issue or factor. Responses given by fewer than 2% of the respondents are not listed.

SURVEY QUESTIONS 21 AND 22

WHEN YOU WERE ANSWERING THE QUESTIONS ABOUT WHAT IT WOULD BE WORTH TO YOU TO AVOID THE ___% WATER SHORTAGE ONCE EVERY ___ YEARS, WHAT DID YOU ASSUME YOUR HOUSEHOLD WOULD HAVE TO DO TO CUT BACK YOUR WATER USE?

LOS ANGELES DEPARTMENT OF WATER AND POWER

Actions to Reduce Water Use	Water Shortage				
	10%	20%	30%	40%	50%
Can't conserve anymore, would do nothing more	17.1%	24.6%	15.7%	20.7%	18.6%
Install low-flow showerheads	5.4	.9	4.9	2.6	1.7
Install displacement devices in toilet	2.7	.9	2.9	2.6	1.7
Replace toilets with low-flush toilets	1.8	3.6	4.9	1.7	1.7
Take fewer/shorter showers	41.4	31.8	32.4	39.7	37.3
User fewer flushes	18.0	17.3	19.6	16.4	11.9
Use grey water/recycle water	2.7	8.2	3.9	10.3	10.2
Use dishwasher less/not at all	14.4	9.1	12.7	11.8	6.8
Do laundry less/take to a laundromat	15.3	17.3	13.7	16.4	15.3
Change outside plant watering habits	4.5	3.6	5.9	2.6	3.4
Wash car less/not at all/take to carwash	5.4	4.5	6.9	3.4	8.5
Water lawn less/let lawn die	27.9	20.0	26.5	21.6	23.8
The table indicates the percentage of respondents who listed the specified action. The sum of each column is greater than 100% because respondents could list more than one action.					

Appendix J
MUNICIPAL WATER DISTRICT OF ORANGE COUNTY/ ORANGE COUNTY WATER DISTRICT RESULTS

THE VALUE OF WATER SUPPLY RELIABILITY: RESULTS OF A CONTINGENT VALUATION SURVEY

MUNICIPAL WATER DISTRICT OF ORANGE COUNTY (MWDOC)/ ORANGE COUNTY WATER DISTRICT (OCWD)

This appendix discusses the combined contingent valuation (CV) survey results for the Municipal Water District of Orange County and the Orange County Water District (MWDOC/OCWD). Section I discusses survey administration, including sampling, survey procedures, and response rates. Section II presents analytic results. Exhibits J-1 and J-2 contain model results, and summary tables of participants' open-ended responses.

I. SURVEY ADMINISTRATION

The total number of completions for the combined MWDOC/OCWD sample was 623. A random sample of 1,800 names, addresses, and telephone numbers of residents in Capistrano Valley, Huntington Beach, and Yorba Linda was purchased from Survey Sampling, Inc., a private sampling firm. The survey of MWDOC/OCWD customers began in mid-August 1993 and continued through mid-October.

A high percentage of sample points could not be reached after twelve attempts: either there was no answer, a busy signal, or an answering machine picked up. Also, interviewers encountered a higher rate of refusals than expected. The final disposition of sample points is illustrated in Table J-1.

II. ANALYTIC RESULTS

Comparison of the Sample with the Population

Before discussing the customer loss functions for MWDOC/OCWD, we first must determine the extent to which the survey sample differs from the underlying population. To do this, census results were compared to sample characteristics with respect to age, income, education, household size, and type of dwelling (i.e., single-family vs. multifamily). The results are presented in Table J-2.

Table J-1
MWDOC/OCWD RESPONSE RATES

	Capistrano Valley	Huntington Beach	Yorba Linda	Total
Initial sample	600	600	600	1800
Unused sample[a]	54	46	146	246
Out of sample[b]	27	26	14	67
No telephone number available	57	75	37	169
Corrected sample size	**462**	**453**	**403**	**1318**
Refusals	109	126	83	318
Not reached during study	109	79	93	281
Unable to participate[c]	37	40	19	96
Completed interviews	**207**	**208**	**208**	**623**
Response rate[d]	**45%**	**46%**	**52%**	**47%**

[a]There was no attempt to contact these sample points.
[b]These include businesses, landlords, vacancies, duplicate sample points, and sample points no longer residing in the study area.
[c]Includes language and other communication barriers, or mailing not received, not read, or thrown away.
[d]Calculated as a percent of the corrected sample size.

Table J-2
COMPARISON OF SAMPLE WITH POPULATION

	Sample	Population
Age		
18 to 34	7%	33%
34 to 54	42%	27%
55+	51%	40%
Household income		
Under $50,000	42%	55%
$50,000+	58%	45%
Education		
Less than college	46%	72%
College graduate	54%	28%
Dwelling type		
Single-family	70%	61%
Multifamily	30%	39%
Household size	2.7	2.8

Table J-2 indicates that the sample was more educated, older, wealthier, and had a higher proportion of single-family residents than the overall population. The standard analytical technique that is used to correct for such differences is to use population means rather than sample means to derive loss functions. The estimates of willingness to pay then reflect the population rather than the sample demographics. That approach was used in this case.

Willingness to Pay (WTP)

WTP can be interpreted as the losses that customers incur as a result of particular shortage scenarios. The amount that a customer is willing to pay to avoid an event is a measure of the losses that customer would incur if that event were to occur. Therefore, we refer to these willingness to pay results as a "loss function."

Tables J-3A and J-3B present the mean WTP for the detailed model and the simplified model for each magnitude and frequency of shortage. WTP figures represent increments to monthly water bills. WTP for the full model varies from a low of $10.89/month to avoid a 20% shortage once every 30 years, to a high of $17.09/month to avoid a 50% shortage every 20 years.

The results of the simplified model are almost identical to the detailed model. The remainder of this report cites results based on the detailed model only.

Table J-3A
MEAN MONTHLY WILLINGNESS TO PAY, DETAILED MODEL
(Additional $/Month)

Shortage (% Reduction from Full Service)	Frequency (Occurrences/Years)				
	1/30	1/20	1/10	1/5	1/3
10%			$11.26	$11.76	$11.96
20%	$10.89	$11.87	$12.89		
30%	$12.50	$13.54	$14.61		
40%	$14.19	$15.28	$16.40		
50%	$15.96	$17.09			

Table J-3B
MEAN WILLINGNESS TO PAY, SIMPLIFIED MODEL
(Additional $/Month)

Shortage (% Reduction from Full Service)	Frequency (Occurrences/Years)				
	1/30	1/20	1/10	1/5	1/3
10%			$11.56	$12.06	$12.26
20%	$11.16	$12.15	$13.17		
30%	$12.75	$13.79	$14.87		
40%	$14.42	$15.51	$16.63		
50%	$16.17	$17.30			

The loss function is shown graphically in Figure J-1. In examining the tabular and graphical results, two major conclusions can be drawn:

- As expected, respondents are willing to pay more for larger shortages and for shortages that occur with higher frequency. However, the response to frequency variations is considerably smaller than the impact of magnitude. This is confirmed by referring to the model estimation results, which are shown in Exhibit J-1.

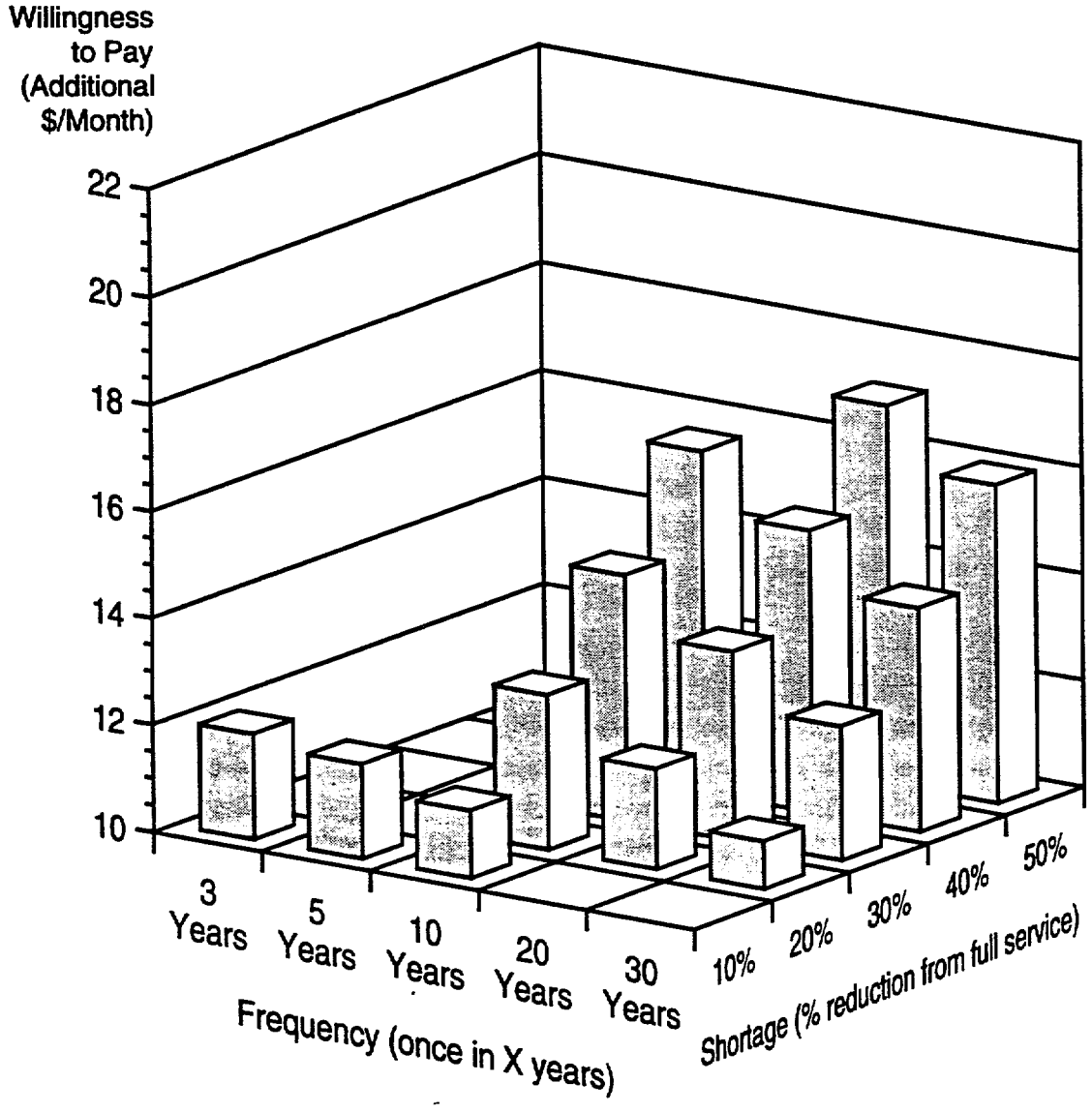
  Put another way, it appears that residential customers believe that infrequent large shortages impose higher losses than more frequent small shortages.

- To avoid even apparently minor shortage scenarios (e.g., 10% once every 10 years), respondents are willing to pay substantial amounts. This type of "threshold" response is not uncommon in surveys of this type and may indicate that respondents regard even a mild shortage scenario as an inconvenience that they want to avoid. They may make a greater distinction between "shortage" and "no shortage" than between different sizes or frequencies of shortages.

MWDOC/OCWD

Figure J-1

Mean Monthly Willingness to Pay to Avoid Particular Shortage Frequencies and Magnitudes



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Confidence Intervals

Consistent with the approach typically used in the literature to calculate confidence intervals for CV results, we have estimated a range around the WTP associated with the mean shortage frequency and magnitude. Using this approach, the 95% confidence interval for MWDOC/OCWD is ±$1.12. In other words, there is a 95% probability that the WTP to avoid this average shortage lies within a ±$1.12 range. This range most likely underestimates the size of the confidence interval for low and high level shortages, where there are fewer observations. However, it does provide a good relative indicator of the precision of the WTP results. The confidence interval represents only the likely margin of uncertainty due to sampling error. There are also other sources of uncertainty in the WTP estimates, including nonresponse and response errors.

Impact of Key Explanatory Variables on WTP

As described previously, the statistical model includes many variables that could potentially explain the variation in WTP. The model results in Exhibit J-1 include the estimated model coefficients and their statistical significance. The following discussion selects three explanatory variables that are statistically significant and illustrates their impact on WTP. Figures J-2 through J-4 show the variation of WTP at various shortage magnitudes when all other variables, other than the one in question, are held constant.

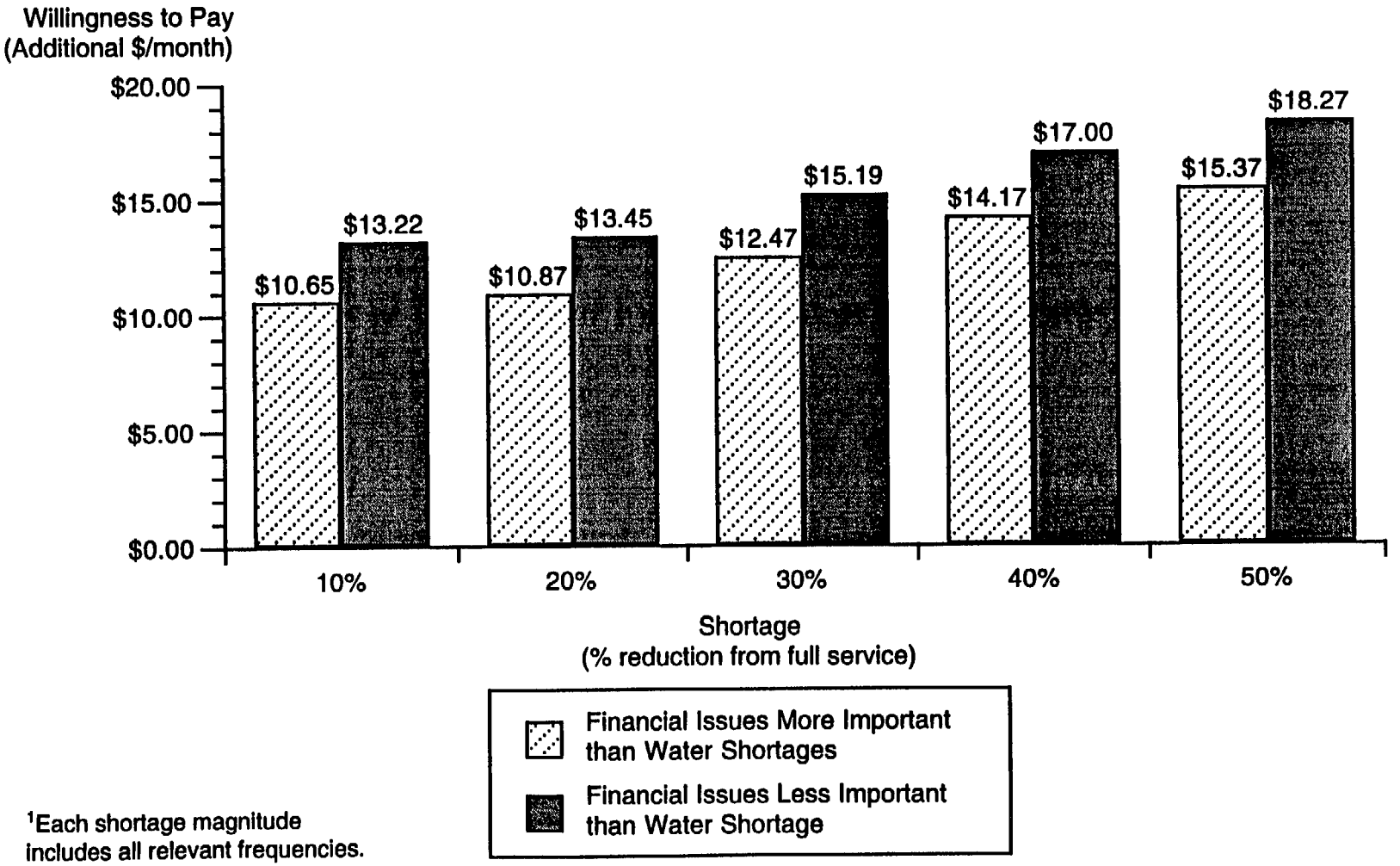
Concern for Financial Issues. Survey respondents were asked to rate various public issues as very important, somewhat important, or not at all important in their area. Figure J-2 illustrates WTP for people with different levels of concern for financial issues, which include taxes, the economy, and housing costs. Individuals who are more concerned about financial issues than they are about water shortages exhibit lower WTP.

Perception of Drought Severity. Unexpectedly, those who considered the recent drought to be severe have a lower WTP than those who considered the drought mild. One possible explanation for this trend is that respondents who considered this drought severe may feel that "it wasn't so bad" and are not willing to pay a lot to avoid a comparable situation. Respondents who considered this drought mild may be afraid of the possibility of more severe droughts. WTP for these two groups is illustrated in Figure J-3.

MWDOC/OCWD

Figure J-2

Effect of Concern for Financial Issues on Willingness to Pay[1]



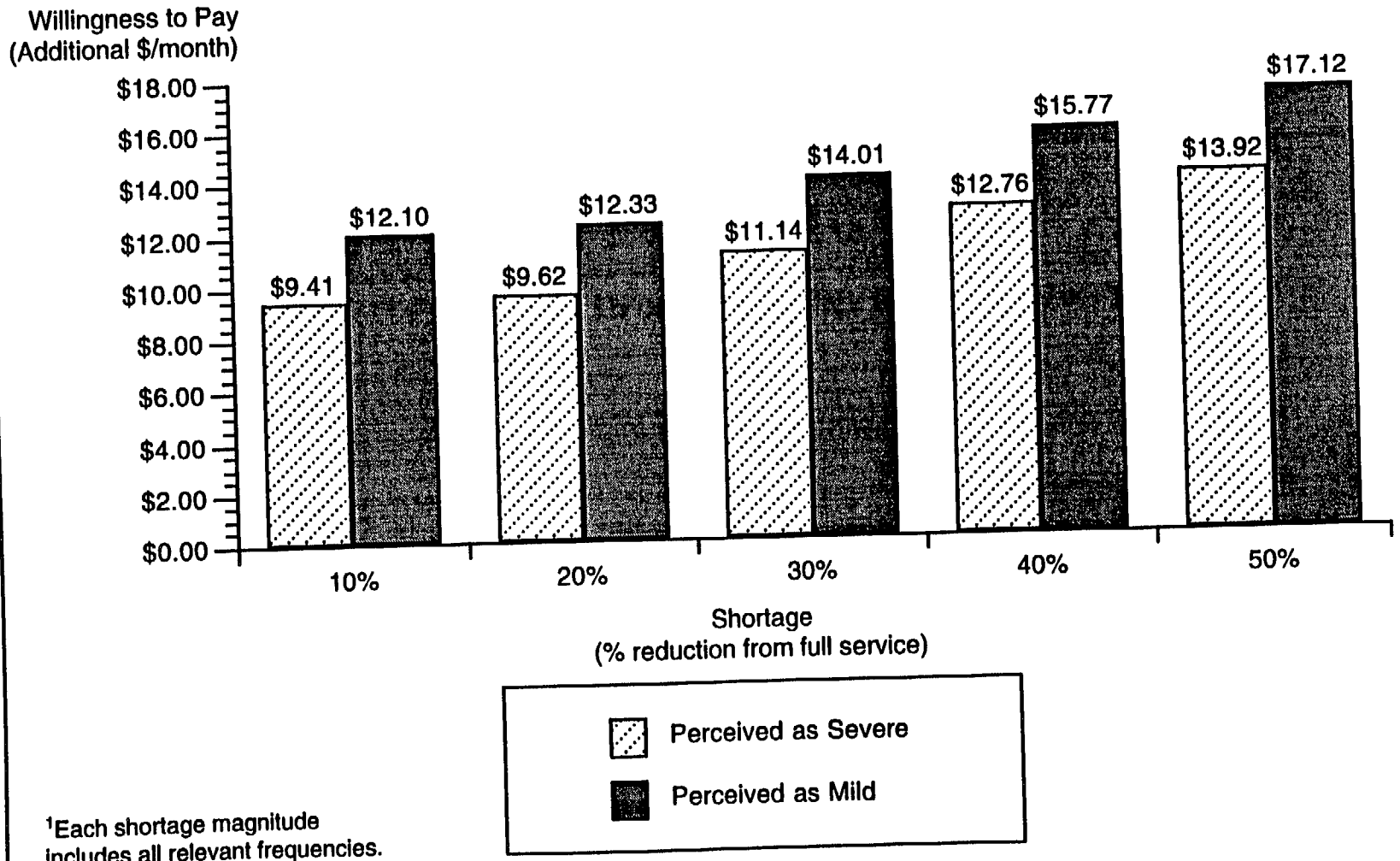
[1]Each shortage magnitude includes all relevant frequencies.

94-141100.32.final.6/94.ap

MWDOC/OCWD

Figure J-3

Effect of Perceived Drought Severity on Willingness to Pay[1]



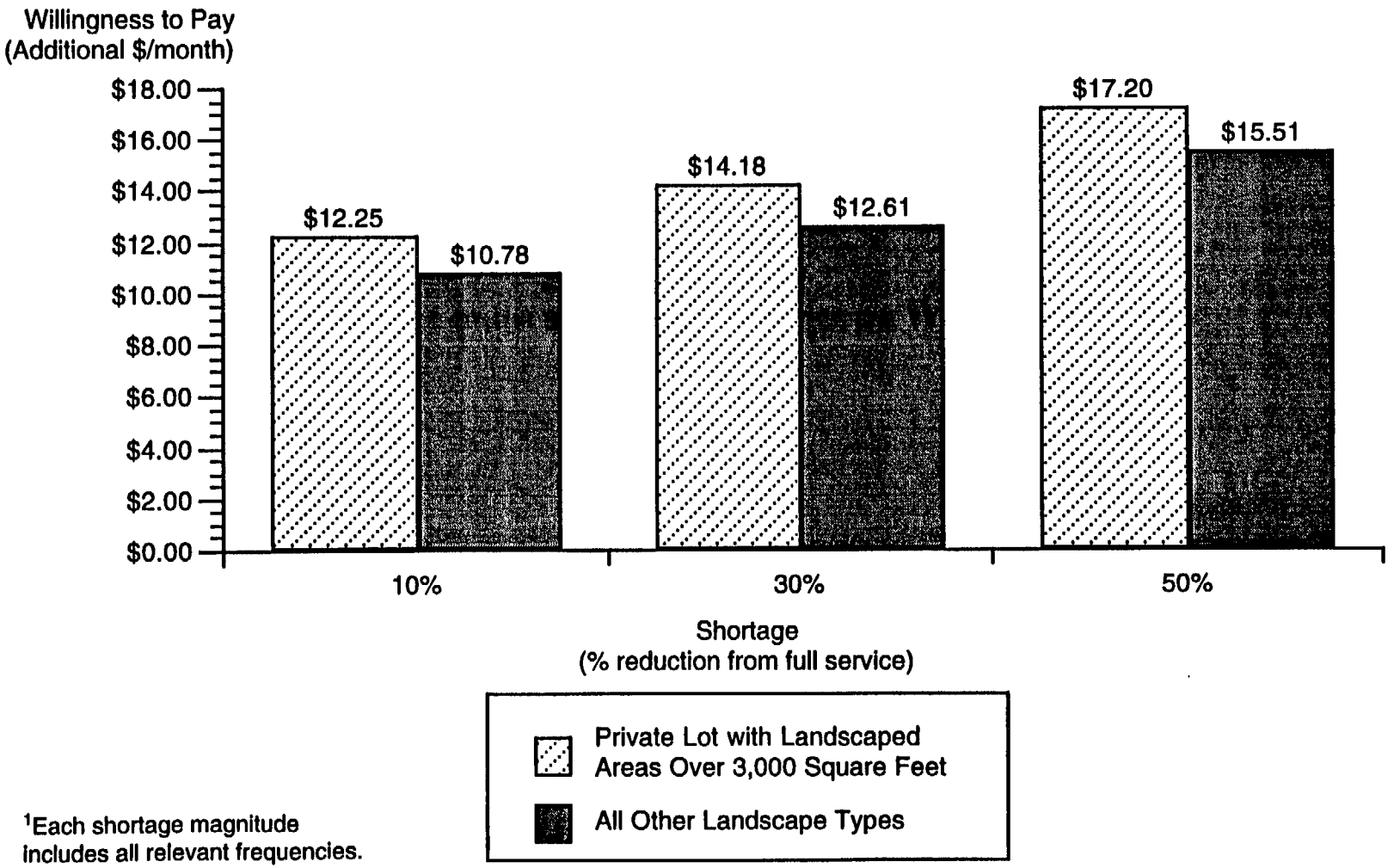
[1]Each shortage magnitude includes all relevant frequencies.

94-141100.32.final.6/94.ap

MWDOC/OCWD

Figure J-4

Effect of Landscape Characteristics on Willingness to Pay[1]



[1]Each shortage magnitude includes all relevant frequencies.

94-141100.32.final.6/94.ap

Landscape Area. The quantity and type of outdoor landscaping has a statistically significant influence on respondents' willingness to pay to avoid future shortages. Figure J-4 illustrates this by using the variables in the model that capture variations in landscaped area. Again, WTP is shown for several levels of shortage severity. The results show that respondents who have private lots with landscapes larger than 3000 square feet have higher WTP than respondents with other types of landscaping.

Explanatory Power of Models

Statistical goodness-of-fit tests were applied to test the explanatory power of the detailed and simplified models. The results of our calculations are presented in Table J-4.

Table J-4
GOODNESS-OF-FIT COMPARISON

	% Predicted Correctly[1]
Detailed model	35%
Simplified model	33%

In this case, the detailed model has only slightly more explanatory power than the simplified model. This, coupled with the similarity of the WTP results for the two models, indicate that MWDOC/OCWD can apply the simplified model to estimate WTP, rather than going to the trouble of estimating the detailed model.

Water Shortages as a Public Concern

In survey question 4, respondents were asked to rate the importance of various public problems, including water shortages, as "not at all important," "somewhat important," or "very important." Based on these responses, a factor analysis was performed to attempt to cluster these variables into a small number of groups.

[1]In a single bounded logit model, these numbers are equivalent to 59% and 57% (square root of 0.35 and 0.33 respectively).

Overall, the mean response for each issue is illustrated in Table J-5.

Table J-5
ISSUE RANKING AND MEAN RESPONSE[2]

Issue	Mean Rating	Standard Error
Economy	2.69	.0174
Traffic	2.40	.0216
Taxes	2.34	.0227
Drug abuse	2.30	.0234
Housing costs	2.24	.0231
Education	2.22	.0271
Crime	2.18	.0223
Drinking water quality	2.02	.0255
Air pollution	1.99	.0231
Water shortages	**1.97**	**.0239**
Overcrowding	1.97	.0242
Homelessness	1.80	.0232
Trash disposal	1.75	.0249
Racial issues	1.73	.0234

Water shortages fall in the middle of the list of concerns.[3]

The factor analysis showed that MWDOC/OCWD respondents grouped issues as illustrated in Table J-6. Water shortages fall into the category that includes issues that can best be described as relating to public services. The factors are ranked within each category according to the strength of their rating in the factor analysis.

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[2]Note that allowable responses ranged from 1 ("not at all important") to 3 ("very important").

[3]It is possible that had this survey been conducted a year earlier, when the state was still in the grip of a serious drought, water shortages would have been viewed as much more of a concern.

Table J-6
FACTOR ANALYSIS OF PUBLIC ISSUES

Public Service Concerns	Quality of Life Concerns	Financial Concerns
Trash disposal	Crime	Taxes
Education	Overcrowding	Economy
Homelessness	Racial issues	
Water shortages	Drug abuse	
Drinking water quality	Air pollution	
	Traffic	

Each of the three factors was included in the model as a binary variable to test its explanatory impact on WTP.[4] Each of these variables was assigned the value of 1 if the mean value of all of a respondent's ratings for the issues included in that factor exceeded the value assigned to the water shortage issue, and zero otherwise. For MWDOC/OCWD, only the finance factor is statistically significant in explaining WTP. Not unexpectedly, respondents with high levels of concern for financial issues (relative to their concern for water shortages) have lower WTP.

Open-Ended Responses

Following the referendum questions, respondents were asked several open-ended questions regarding what actions they thought they would have to take under specified shortage scenarios, and what issues they considered when deciding whether to vote yes or no. These questions were asked to better understand the reasoning of participants. Responses to these questions are summarized in Exhibit J-2.

[4]The "public services" factor included in the model excluded the water shortages variable.

Exhibit J-1
MODEL RESULTS

Results for the detailed and simplified models follow this page. The results present each variable included in the model along with the following information:

- **Coefficient** indicates the magnitude of the variable's impact on WTP
- **Standard error** reflects the distribution of the coefficient
- **T-statistic** is a commonly used measure of statistical significance
- **P-value** is the observed significance level (for example, if p = .05, the coefficient is statistically significant at the 95% level)

The following key of variable pneumonics used in the model will facilitate interpretation of these results.

Key of Survey Variables

SUPPLY:	Percentage reduction from full service demand specified in the cv scenario.
FREQ:	Frequency of drought specified in the CV scenario.
AREAYRS:	Number of years respondent has lived in the area.
HHSIZE:	Number of persons in the household, including respondent.
AGE1834:	Respondent's age is in the range of 18 to 34 years old.
AGE3554:	Respondent's age is in the range of 35 to 54 years old.
COLGRAD:	Respondent is a college graduate.
INCGT%50:	1992 household income is greater than $50,000.
SNGL_FAM:	Respondent lives in a single family residence.
QUALLIFE:	Concern for "quality of life issues" (as defined by a factor analysis) relative to concern for water shortages.
SOCIAL:	Concern for "social issues" (as defined by a factor analysis) relative to concern for water shortages.
FINANCE:	Concern for "finance issues" (as defined by a factor analysis) relative to concern for water shortages.
ENVIRON:	Concern for "public services and/or environmental issues" (as defined by a factor analysis) relative to concern for water shortages.
SEVERE:	Perception of the severity of the recent drought
SHORTAGE:	Water shortages considered a somewhat or very important problem.
LONGTERM:	Perception of water shortages as a long-term problem in the area.
MANDATE:	Respondent believes that their water agency suggested or mandated cutbacks during the recent drought.
OWNPAY:	Respondent owns home and is personally responsible for paying the water bill.

OWNELSE:	Respondent owns home and someone else in the household is responsible for paying the water bill.
OWNASSOC:	Respondent owns home and a homeowners association is responsible for paying the water bill.
RENTPAY:	Respondent rents home, water bill is not included in the rent.
YELLOW:	Homes with private landscaped areas less than 3,000 square feet or shared landscaped areas less than 5,000 square feet.
PINK:	Homes with shared landscaped areas greater than 5,000 square ft.
NOGROWTH:	Respondent wants community to remain the same size/decrease in size.
RATE:	Average residential rate for respondent's water agency
NORTH:	Northern California water agency
BID:	Amount that respondents bill would increase per month if the majority of the community voted yes to the referendum.

Orange County simplified model

Date: 2/09/1994
Observations: 1093 D.F. : 1082

Var	Coef	Std. Error	t-Stat	P-Value
CONSTANT	3.22366	0.480162	6.714	1.522e-11
FREQ	-0.01598004	0.00707515	-2.259	0.01205
SUPPLY	-2.535155	0.493581	-5.136	1.658e-07
AREAYRS	0.008386437	0.00587857	1.427	0.07699
HHSIZE	0.01741209	0.0493559	0.3528	0.3622
AGE1834	0.159222	0.233328	0.6824	0.2476
AGE3554	-0.3028125	0.142566	-2.124	0.01695
COLGRAD	0.09815988	0.119187	0.8236	0.2052
INCGT50K	0.4866607	0.133058	3.657	0.0001334
SNGL_FAM	-0.06755735	0.139107	-0.4857	0.3137
BID	-0.1229451	0.00477818	-25.73	7.814e-115

Orange County detailed model

Date: 2/09/1994
Observations: 1063 D.F. : 1038

Var	Coef	Std. Error	t-Stat	P-Value
CONSTANT	3.362721	0.598911	5.615	1.256e-08
FREQ	-0.01642392	0.00731873	-2.244	0.01252
SUPPLY	-2.651593	0.508984	-5.21	1.136e-07
AREAYRS	0.009380359	0.00614458	1.527	0.06358
HHSIZE	0.004838076	0.0505407	0.09573	0.4619
AGE1834	0.05652318	0.248582	0.2274	0.4101
AGE3554	-0.2816733	0.14932	-1.886	0.02976
COLGRAD	0.1008703	0.126064	0.8002	0.2119
INCGT50K	0.5336271	0.140779	3.791	7.939e-05
SNGL_FAM	-0.2665158	0.214011	-1.245	0.1066
QUALLIFE	0.140374	0.173093	0.811	0.2088
FINANCE	-0.4200215	0.16078	-2.612	0.004559
ENVIRON	0.06089448	0.166598	0.3655	0.3574
SHORTAGE	0.2186657	0.16082	1.36	0.08711
SEVERE	-0.4606734	0.161396	-2.854	0.002198
LONGTERM	0.510139	0.120697	4.227	1.288e-05
MANDATE	-0.04693176	0.153246	-0.3063	0.3797
OWNPAY	0.001023755	0.255452	0.004008	0.4984
OWNELSE	-0.3255264	0.294981	-1.104	0.135
OWNASSOC	0.08493504	0.314707	0.2699	0.3937
RENTPAY	0.4973543	0.354657	1.402	0.08055
YELLOW	-0.0519759	0.126372	-0.4113	0.3405
PINK	-0.4461252	0.227909	-1.957	0.02528
NOGROWTH	0.1148493	0.226938	0.5061	0.3065
BID	-0.1278105	0.00504377	-25.34	1.669e-111

Exhibit J-2
OPEN-ENDED RESPONSES

SURVEY QUESTION 19

WHAT ARE THE PRIMARY REASONS YOU WOULD CHOSE NOT TO PAY THE ADDITIONAL MONEY ON YOUR WATER BILL TO AVOID FUTURE SHORTAGES?

(Asked Only of the 99 Respondents Who Voted No to the First and Second Bids for Both Scenarios)

MUNICIPAL WATER DISTRICT OF ORANGE COUNTY

Reason	Percent of Respondents
Prefer to reduce my water usage	35%
Tired of paying for others/everyone should conserve	30%
Low confidence in the water agency	23%
Additional water supplies encourage population growth	13%
Not willing to pay more	12%
Cannot afford a higher water bill	9%
Do not believe water shortages can be avoided	4%

The table indicates the percent of respondents who listed the specified reason. The sum of the column is greater than 100% because respondents could list more than one reason. Responses given by fewer than 2% of the respondents are not listed.

SURVEY QUESTION 20

WHAT FACTORS OR ISSUES DID YOU CONSIDER WHEN DECIDING TO VOTE YES OR NO?

(Asked Only of Respondents Who Voted Yes to at Least One Bid)

MUNICIPAL WATER DISTRICT OF ORANGE COUNTY

Factors Considered	Percent of Respondents
Cannot afford more on bill	38%
We can conserve	22%
New resources should be developed	13%
Water is a necessity	12%
No confidence in the water agency	10%
Too many people/restrict new development	6%
Not willing to pay more	6%
Future generations and their needs	5%
Not willing to pay for others use	5%
Frequency of shortage	4%
Magnitude of shortage	4%
Depends upon the resource project	4%
Frequency and magnitude of shortage	3%
Impacts of shortage on greenery/aesthetics	2%
Impacts of new resources on environment	1%

The table indicates the percent of respondents who listed the specified issue or factor. The sum of the column is greater than 100% because respondents could list more than one issue or factor. Responses given by fewer than 2% of the respondents are not listed.

SURVEY QUESTIONS 21 AND 22

WHEN YOU WERE ANSWERING THE QUESTIONS ABOUT WHAT IT WOULD BE WORTH TO YOU TO AVOID THE ___% WATER SHORTAGE ONCE EVERY ___ YEARS, WHAT DID YOU ASSUME YOUR HOUSEHOLD WOULD HAVE TO DO TO CUT BACK YOUR WATER USE?

MUNICIPAL WATER DISTRICT OF ORANGE COUNTY

Actions to Reduce Water Use	Water Shortage				
	10%	20%	30%	40%	50%
Can't conserve anymore, would do nothing more	12.3%	9.1%	8.9%	14.6%	10.4%
Install low-flow showerheads	4.6	10.2	5.0	8.5	5.8
Install displacement devices in toilet	3.1	5.9	3.5	4.0	2.3
Replace toilets with low-flush toilets	3.1	3.1	6.6	2.4	4.0
Take fewer/shorter showers	30.8	29.1	33.2	27.9	36.4
User fewer flushes	15.0	16.9	15.4	16.6	17.9
Use grey water/recycle water	6.5	4.3	11.6	7.3	11.6
Use dishwasher less/not at all	15.4	15.0	13.1	12.6	12.7
Do laundry less/take to a laundromat	13.5	15.7	17.8	18.2	15.0
Change outside plant watering habits	5.0	7.5	9.3	7.7	5.2
Wash car less/not at all/take to carwash	10.4	11.0	12.4	11.7	12.1
Water lawn less/let lawn die	23.8	27.2	30.9	33.6	27.2

The table indicates the percentage of respondents who listed the specified action. The sum of each column is greater than 100% because respondents could list more than one action.

Appendix K
METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA RESULTS

THE VALUE OF WATER SUPPLY RELIABILITY: RESULTS OF A CONTINGENT VALUATION SURVEY

METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA (MWD)

This appendix discusses the contingent valuation (CV) survey results for the Metropolitan Water District of Southern California (MWD). Section I discusses survey administration, including sampling, survey procedures, and response rates. Section II presents analytic results. Exhibits K-1 and K-2 contain the model results, and summary tables of participants' open-ended responses.

I. SURVEY ADMINISTRATION

The total number of completions for MWD was 690. MWD obtained an initial sample of 1961 from three of its member agencies: Moreno Valley Water District, City of Thousand Oaks, and Las Virgenes Water District. Due to difficulty in obtaining sufficient survey completions from the initial sample, an additional sample of 700 names, addresses and telephone numbers from the same areas as the initial sample was later purchased from Affordable Listed Samples, an independent sampling firm.

The survey of MWD customers was conducted from September to November, 1993, and in February, 1994. The MWD sample had an extremely high incidence of unlisted telephone numbers that the survey team were not able to obtain through use of directory assistance. This significantly decreased the size of the usable sample. The final disposition of sample points is illustrated in Table K-1.

II. ANALYTIC RESULTS

Comparison of the Sample with the Population

Before discussing the customer loss functions for MWD, we first must determine the extent to which the survey sample differs from the overall District population. To do this, census results were compared to sample characteristics with respect to age, income, education, household size, and type of dwelling (i.e., single-family vs. multifamily). The results are presented in Table K-2.

Table K-1
MWD RESPONSE RATES

	Moreno Valley	Las Virgenes	Thousand Oaks	Total
Initial sample	1,003	843	815	2,661
Unused sample[a]	0	71	0	71
Out of sample[b]	73	65	56	194
No telephone number available	344	127	228	699
Corrected sample size	**586**	**580**	**531**	**1,697**
Refusals	90	124	83	297
Not reached during study	116	193	133	442
Unable to participate[c]	131	72	65	268
Completed interviews	**249**	**191**	**250**	**690**
Response rate[d]	**43%**	**33%**	**47%**	**41%**

[a]There was no attempt to contact these sample points.
[b]These include businesses, landlords, vacancies, duplicate sample points, and sample points no longer residing in the study area.
[c]Includes language and other communication barriers, or mailing not received, not read, or thrown away.
[d]Calculated as a percent of the corrected sample size.

Table K-2
COMPARISON OF SAMPLE WITH DISTRICT POPULATION

	Sample	Population
Age		
18 to 34	15%	28%
34 to 54	50%	35%
55+	35%	47%
Household income		
Under $50,000	49%	65%
$50,000+	51%	35%
Education		
Not college grad	54%	82%
College graduate	46%	18%
Dwelling type		
Single-family	81%	68%
Multifamily	19%	32%
Household Size	3	2.9

Table K-2 indicates that the sample was more educated, wealthier, middle-aged, and had a higher proportion of single-family residents than the overall population. The standard analytical technique that is used to correct for such differences is to use population means rather than sample means to derive loss functions. The estimates of willingness to pay then reflect the population rather than the sample demographics. That approach was used in this case.

Willingness to Pay (WTP)

WTP can be interpreted as the losses that customers incur as a result of particular shortage scenarios. The amount that a customer is willing to pay to avoid an event is a measure of the losses that customer would incur if that event were to occur. Therefore, we refer to these willingness to pay results as a "loss function."

Tables K-3A and K-3B present the mean WTP for the detailed model and the simplified model for each magnitude and frequency of shortage. WTP figures represent increments to monthly water bills. WTP for the full model varies from a low of $9.83/month to avoid a 20% shortage once every 30 years, to a high of $16.61/month to avoid a 50% shortage every 20 years.

The results of the simplified model are almost identical to the detailed model. The remainder of this report cites results based on the detailed model only.

Table K-3A
MEAN MONTHLY WILLINGNESS TO PAY, DETAILED MODEL
(Additional $/Month)

Shortage (% Reduction from Full Service)	Frequency (Occurrences/Years)				
	1/30	1/20	1/10	1/5	1/3
10%			$11.32	$12.12	$12.45
20%	$9.83	$11.36	$12.99		
30%	$11.41	$13.04	$14.74		
40%	$13.08	$14.79	$16.56		
50%	$14.84	$16.61			

Table K-3B
MEAN MONTHLY WILLINGNESS TO PAY, SIMPLIFIED MODEL
(Additional $/Month)

Shortage (% Reduction from Full Service)	Frequency (Occurrences/Years)				
	1/30	1/20	1/10	1/5	1/3
10%			$10.36	$10.60	$10.70
20%	$11.36	$11.86	$12.36		
30%	$13.43	$13.96	$14.50		
40%	$15.64	$16.19	$16.76		
50%	$17.94	$18.52			

The loss function is shown graphically in Figure K-1. In examining the tabular and graphical results, two major conclusions can be drawn:

- As expected, respondents are willing to pay more for larger shortages and for shortages that occur with higher frequency. However, the response to frequency variations is considerably smaller than the impact of magnitude. This is confirmed by referring to the model estimation results, which are shown in Exhibit K-1.

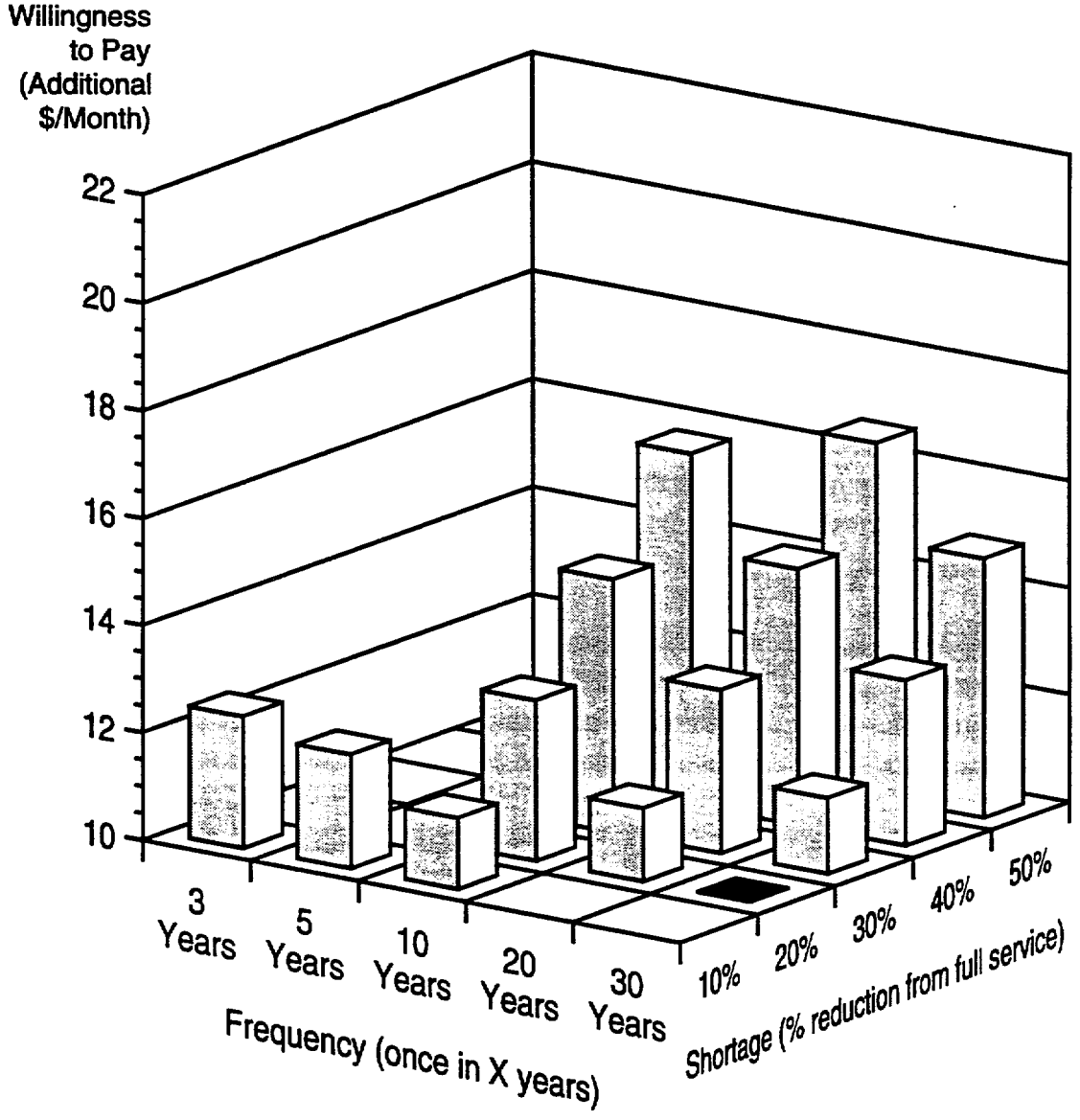
  Put another way, it appears that residential customers believe that infrequent large shortages impose higher losses than more frequent small shortages.

- To avoid even apparently minor shortage scenarios (e.g., 10% once every 10 years), respondents are willing to pay substantial amounts. This type of "threshold" response is not uncommon in surveys of this type and may indicate that respondents regard even a mild shortage scenario as an inconvenience that they want to avoid. They may make a greater distinction between "shortage" and "no shortage" than between different sizes or frequencies of shortages.

Metropolitan Water District of Southern California

Figure K-1

Mean Monthly Willingness to Pay to Avoid Particular Shortage Frequencies and Magnitudes



94-141100.32.final.6/94.ap

Confidence Intervals

Consistent with the approach typically used in the literature to calculate confidence intervals for CV results, we have estimated a range around the WTP associated with the mean shortage frequency and magnitude. Using this approach, the 95% confidence interval for MWD is ±$0.96. In other words, there is a 95% probability that the WTP to avoid this average shortage lies within a ±$0.96 range. This range most likely underestimates the size of the confidence interval for low and high level shortages, where there are fewer observations. However, it does provide a good relative indicator of the precision of the WTP results. The confidence interval represents only the likely margin of uncertainty due to sampling error. There are also other sources of uncertainty in the WTP estimates, including nonresponse and response errors.

Impact of Key Explanatory Variables on WTP

As described previously, the statistical model includes many variables that could potentially explain the variation in WTP. The model results in Exhibit K-1 include the estimated model coefficients and their statistical significance. The following discussion selects two explanatory variables that are statistically significant and illustrates their impact on WTP. Figures K-2 and K-3 show the variation of WTP at various shortage magnitudes when all other variables, other than the one in question, are held constant.

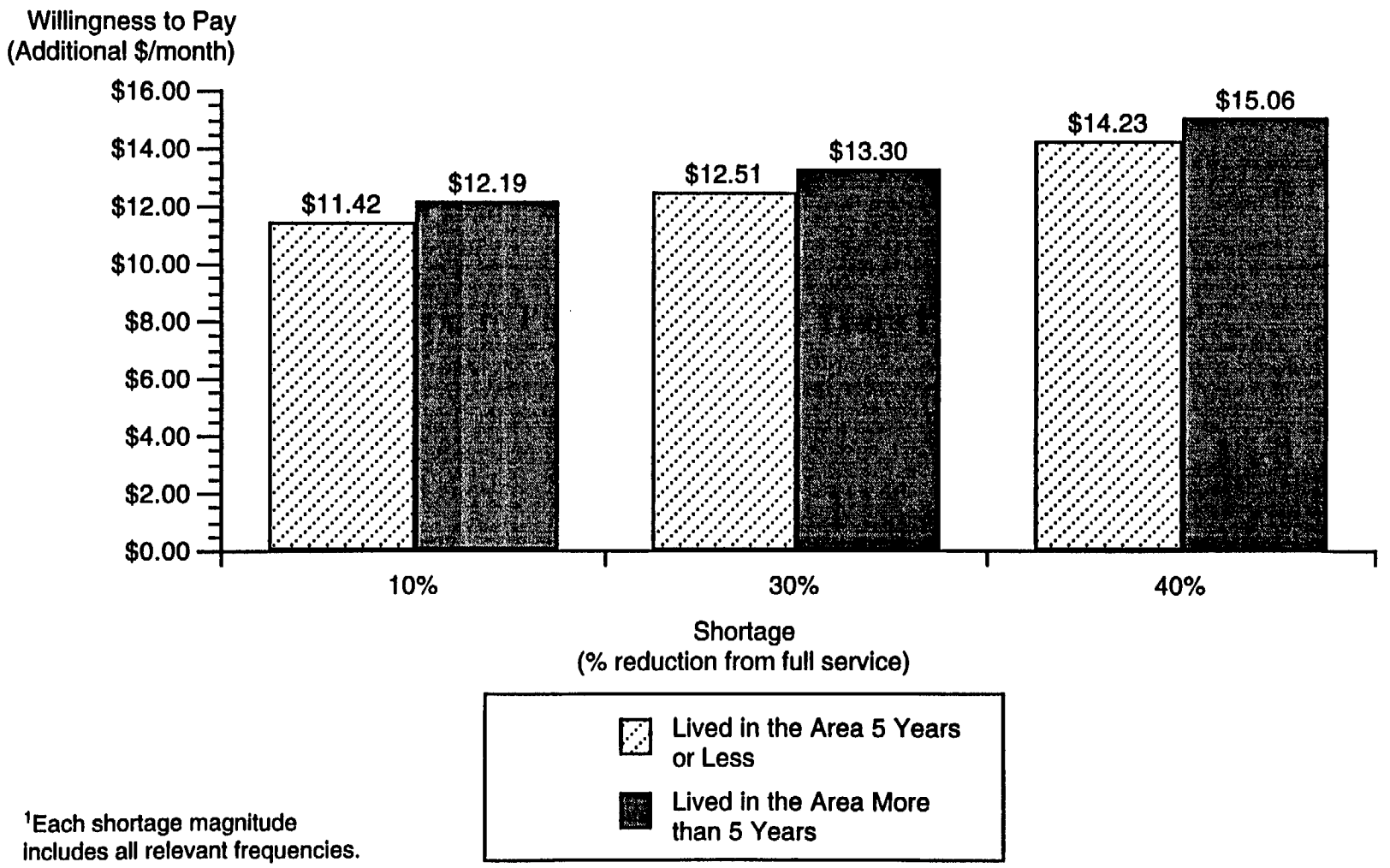
Years Lived in the Area. Survey respondents were asked how many years they have lived in the area. Figure K-2 illustrates WTP for people who have lived in the area more than five years, compared to those who have lived in the area for less than five years. The results indicate that respondents who have lived in the area longer have higher WTP.

Perception of Water Shortages as a Long-Term Problem. Survey respondents were asked to what extent they considered water shortages to be a long-term problem in their area. Not unexpectedly, those who considered the water shortages to be a long-term problem have higher WTP than those who do not. WTP for these two groups is illustrated in Figure K-3.

Metropolitan Water District of Southern California

Figure K-2

Willingness to Pay by Number of Years Lived in the Area[1]



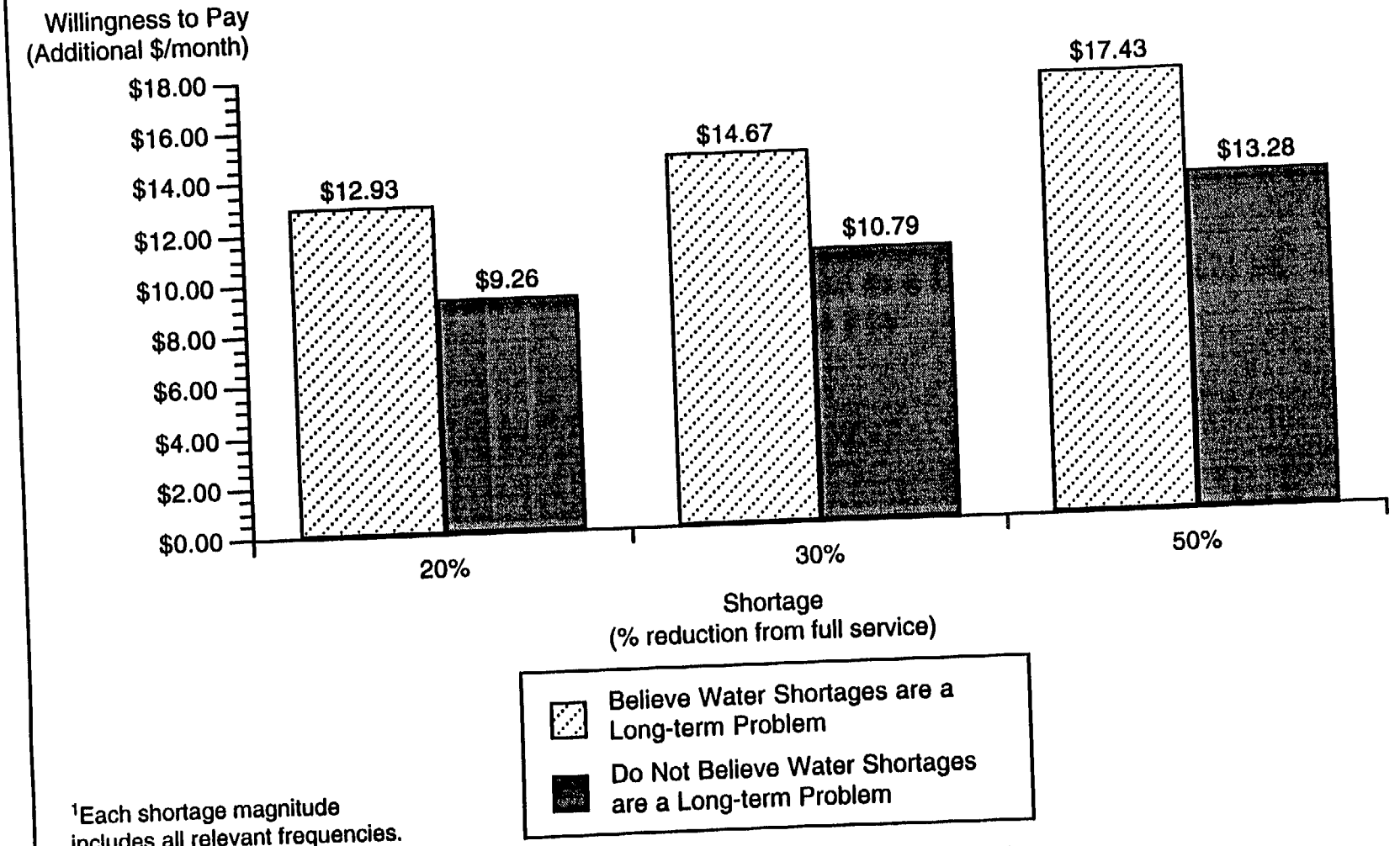
[1]Each shortage magnitude includes all relevant frequencies.

94-141100.32.final.6/94.ap

Metropolitan Water District of Southern California

Figure K-3

Effect of Perception of Water Shortages as a Long-term Problem on Willingness to Pay[1]



[1]Each shortage magnitude includes all relevant frequencies.

94-141100.32.final.6/94.ap

Explanatory Power of Models

Statistical goodness-of-fit tests were applied to test the explanatory power of the detailed and simplified models. The results of our calculations are presented in Table K-4.

Table K-4
GOODNESS OF FIT COMPARISON

	% Predicted Correctly[1]
Detailed model	36%
Simplified model	34%

In this case, the detailed model has only slightly more explanatory power than the simplified model. This, coupled with the similarity of the WTP results for the two models, indicate that MWD can apply the simplified model to estimate WTP, rather than resurveying customers to gather data on the remaining variables required for the detailed model.

Water Shortages as a Public Concern

In survey question 4, respondents were asked to rate the importance of various public problems, including water shortages, as "not at all important," "somewhat important," or "very important." Based on these responses, a factor analysis was performed to attempt to cluster these variables into a small number of groups.

Overall, the mean response for each issue is illustrated in Table K-5.

[1]In a single bounded logit model, these numbers are equivalent to 60% and 58% (square root of 0.36 and 0.34 respectively).

Table K-5
ISSUE RANKING AND MEAN RESPONSE[2]

Issue	Mean Rating	Standard Error
Economy	2.72	.0250
Drug abuse	2.44	.0318
Taxes	2.37	.0311
Education	2.31	.0383
Crime	2.28	.0322
Housing costs	2.23	.0344
Water shortages	**2.22**	**.0357**
Drinking water quality	2.17	0.0370
Traffic	2.13	.0313
Air pollution	2.11	.0325
Homelessness	1.95	.0382
Overcrowding	1.82	.0333
Trash disposal	1.78	.0301
Racial issues	1.77	.0357

Water shortages fall in the middle of the list of concerns.[3]

The factor analysis showed that MWD respondents grouped issues as illustrated in Table K-6. Water shortages fall into the category that includes issues that can best be described as relating to public services. The factors are ranked within each category according to the strength of their rating in the factor analysis.

---

[2]Note that allowable responses ranged from 1 ("not at all important") to 3 ("very important").

[3]It is possible that had this survey been conducted a year earlier, when the state was still in the grip of a serious drought, water shortages would have been viewed as much more of a concern.

Table K-6
FACTOR ANALYSIS OF PUBLIC ISSUES

Public Services Concerns	Social Concerns	Quality of Life Concerns	Financial Concerns
Trash disposal	Crime	Overcrowding	Taxes
Education	Drug abuse	Traffic	Economy
Water shortages	Racial issues		
Drinking water quality	Air pollution		
Homelessness			

Each of the four factors was included in the model as a binary variable to test its explanatory impact on WTP.[4] Each of these variables was assigned the value of 1 if the mean value of all of a respondent's ratings for the issues included in that factor exceeded the value assigned to the water shortage issue, and zero otherwise. For MWD, both the public services and the quality of life factors are statistically significant in explaining WTP.

Open-Ended Responses

Following the referendum questions, respondents were asked several open-ended questions regarding what actions they thought they would have to take under specified shortage scenarios, and what issues they considered when deciding whether to vote yes or no. These questions were asked to better understand the reasoning of participants. Participants' answers to these questions are summarized in Exhibit K-2.

[4]The "public services/environmental" factor included in the model excluded the water shortages variable.

Exhibit K-1
MODEL RESULTS

Results for the detailed and simplified models follow this page. The results present each variable included in the model along with the following information:

- **Coefficient** indicates the magnitude of the variable's impact on WTP
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- **T-statistic** is a commonly used measure of statistical significance
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The following key of variable pneumonics used in the model will facilitate interpretation of these results.

Key of Survey Variables

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HHSIZE:	Number of persons in the household, including respondent.
AGE1834:	Respondent's age is in the range of 18 to 34 years old.
AGE3554:	Respondent's age is in the range of 35 to 54 years old.
COLGRAD:	Respondent is a college graduate.
INCGT%50:	1992 household income is greater than $50,000.
SNGL_FAM:	Respondent lives in a single family residence.
QUALLIFE:	Concern for "quality of life issues" (as defined by a factor analysis) relative to concern for water shortages.
SOCIAL:	Concern for "social issues" (as defined by a factor analysis) relative to concern for water shortages.
FINANCE:	Concern for "finance issues" (as defined by a factor analysis) relative to concern for water shortages.
ENVIRON:	Concern for "public services and/or environmental issues" (as defined by a factor analysis) relative to concern for water shortages.
SEVERE:	Perception of the severity of the recent drought
SHORTAGE:	Water shortages considered a somewhat or very important problem.
LONGTERM:	Perception of water shortages as a long-term problem in the area.
MANDATE:	Respondent believes that their water agency suggested or mandated cutbacks during the recent drought.
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OWNELSE:	Respondent owns home and someone else in the household is responsible for paying the water bill.
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YELLOW:	Homes with private landscaped areas less than 3,000 square feet or shared landscaped areas less than 5,000 square feet.
PINK:	Homes with shared landscaped areas greater than 5,000 square ft.
NOGROWTH:	Respondent wants community to remain the same size/decrease in size.
RATE:	Average residential rate for respondent's water agency
NORTH:	Northern California water agency
BID:	Amount that respondents bill would increase per month if the majority of the community voted yes to the referendum.

Simplified model for all MWDSC Observations

Date: 3/21/1994
Observations: 1187 D.F. : 1176

Var	Coef	Std. Error	t-Stat	P-Value
CONSTANT	4.180697	0.484266	8.633	9.464e-18
SUPPLY	-2.777051	0.491743	-5.647	1.019e-08
FREQ	-0.02644878	0.00696839	-3.796	7.738e-05
AREAYRS	0.01117522	0.00595009	1.878	0.0303
HHSIZE	-0.002557537	0.0423666	-0.06037	0.4759
AGE1834	0.00105005	0.179954	0.005835	0.4977
AGE3554	0.3515139	0.140647	2.499	0.00629
COLGRAD	0.05845617	0.114508	0.5105	0.3049
INCGT50K	-0.1037943	0.120202	-0.8635	0.194
SNGL_FAM	-0.4917003	0.150399	-3.269	0.0005545
BID	-0.1327711	0.0048479	-27.39	1.085e-128

Detailed model for all MWDSC observations

Date: 3/30/1994
Observations: 1151 D.F. : 1125

Var	Coef	Std. Error	t-Stat	P-Value
CONSTANT	4.564831	0.598467	7.628	2.497e-14
SUPPLY	-2.781827	0.502585	-5.535	1.926e-08
FREQ	-0.02752087	0.00715028	-3.849	6.258e-05
AREAYRS	0.01198516	0.00621548	1.928	0.02703
HHSIZE	0.01467547	0.0440977	0.3328	0.3697
AGE1834	-0.04874769	0.196161	-0.2485	0.4019
AGE3554	0.2765892	0.147762	1.872	0.03074
COLGRAD	-0.01772886	0.118245	-0.1499	0.4404
INCGT50K	-0.08013061	0.125609	-0.6379	0.2618
SNGL_FAM	-0.2197013	0.259722	-0.8459	0.1989
QUALLIFE	0.2810065	0.162131	1.733	0.04166
FINANCE	-0.008346316	0.151422	-0.05512	0.478
SOCIAL	0.07410155	0.164438	0.4506	0.3262
ENVIRON	-0.4458381	0.162504	-2.744	0.003086
SEVERE	0.02954805	0.119256	0.2478	0.4022
SHORTAGE	0.01158428	0.17071	0.06786	0.473
LONGTERM	0.6298555	0.122146	5.157	1.48e-07
MANDATE	-0.3392536	0.173454	-1.956	0.02536
OWNPAY	-0.614232	0.289413	-2.122	0.01701
OWNELSE	-0.51983	0.319513	-1.627	0.05201
OWNASSOC	-0.7049685	0.355096	-1.985	0.02367
RENTPAY	-0.5247622	0.329016	-1.595	0.0555
YELLOW	-0.1701837	0.118487	-1.436	0.07559
PINK	0.1380349	0.277651	0.4972	0.3096
NOGROWTH	0.03231123	0.175221	0.1844	0.4269
BID	-0.1370058	0.0050903	-26.92	1.805e-124

Exhibit K-2
OPEN-ENDED RESPONSES

SURVEY QUESTION 19

WHAT ARE THE PRIMARY REASONS YOU WOULD CHOSE NOT TO PAY THE ADDITIONAL MONEY ON YOUR WATER BILL TO AVOID FUTURE SHORTAGES?

(Asked Only of the 115 Respondents Who Voted No to the First and Second Bids for Both Scenarios)

METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

Reason	Percent of Respondents
Prefer to reduce my water usage	38%
Tired of paying for others/everyone should conserve	27%
Low confidence in the water agency	24%
Not willing to pay more	19%
Cannot afford a higher water bill	19%
Do not believe water shortages can be avoided	9%
Additional water supplies encourage population growth	7%

The table indicates the percent of respondents who listed the specified reason. The sum of the column is greater than 100% because respondents could list more than one reason. Responses given by fewer than 2% of the respondents are not listed.

SURVEY QUESTION 20

WHAT FACTORS OR ISSUES DID YOU CONSIDER WHEN DECIDING TO VOTE YES OR NO?

(Asked Only of Respondents Who Voted Yes to at Least One Bid)

METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

Factors Considered	Percent of Respondents
Cannot afford more on bill	40%
We can conserve	17%
Water is a necessity	12%
No confidence in the water agency	12%
New resources should be developed	10%
Not willing to pay more	8%
Depends upon the resource project	8%
Magnitude of shortage	7%
Future generations and their needs	7%
Not willing to pay for others use	7%
Too many people/restrict new development	6%
Frequency of shortage	5%
Impacts of shortage on greenery/aesthetics	3%
Frequency and magnitude of shortage	2%
Impacts of new resources on environment	1%

The table indicates the percent of respondents who listed the specified issue or factor. The sum of the column is greater than 100% because respondents could list more than one issue or factor. Responses given by fewer than 2% of the respondents are not listed.

SURVEY QUESTIONS 21 AND 22

WHEN YOU WERE ANSWERING THE QUESTIONS ABOUT WHAT IT WOULD BE WORTH TO YOU TO AVOID THE ___% WATER SHORTAGE ONCE EVERY ___ YEARS, WHAT DID YOU ASSUME YOUR HOUSEHOLD WOULD HAVE TO DO TO CUT BACK YOUR WATER USE?

METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

	Water Shortage				
Actions to Reduce Water Use	**10%**	**20%**	**30%**	**40%**	**50%**
Can't conserve anymore, would do nothing more	16.8%	12.4%	18.4%	15.7%	12.4%
Install low-flow showerheads	3.4	5.7	3.2	4.1	4.0
Install displacement devices in toilet	3.4	3.9	2.8	2.7	1.1
Replace toilets with low-flush toilets	4.0	4.2	3.5	6.5	2.8
Take fewer/shorter showers	31.3	30.4	28.9	33.8	31.6
User fewer flushes	11.5	14.5	12.7	10.2	18.1
Use grey water/recycle water	5.7	8.8	6.7	8.2	14.7
Use dishwasher less/not at all	8.8	10.2	8.8	8.9	13.0
Do laundry less/take to a laundromat	14.5	17.3	13.1	12.3	17.5
Change outside plant watering habits	7.4	11.3	8.5	10.6	9.0
Wash car less/not at all/take to carwash	8.1	10.2	7.1	9.2	9.6
Water lawn less/let lawn die	24.6	25.4	31.5	26.6	33.3

The table indicates the percentage of respondents who listed the specified action. The sum of each column is greater than 100% because respondents could list more than one action.

Appendix L
SAN DIEGO COUNTY WATER AUTHORITY
RESULTS

THE VALUE OF WATER SUPPLY RELIABILITY: RESULTS OF A CONTINGENT VALUATION SURVEY

SAN DIEGO COUNTY WATER AUTHORITY (SDCWA)

This appendix discusses the contingent valuation (CV) survey results for the San Diego County Water Authority (SDCWA). Section I discusses survey administration, including sampling, survey procedures, and response rates. Section II presents analytic results. Exhibits L-1 and L-2 contain the model results, and summary tables of participants' open-ended responses.

I. SURVEY ADMINISTRATION

The total number of completions for SDCWA was 407. SDCWA selected two of its member agencies, Helix Water District and Vallecitos Water District, from which to obtain customer records. Helix and Vallecitos provided a total sample of 1,812 customer billing records. The sample was divided among single-family and multifamily records in proportion to the number of single-family and multifamily households in San Diego County, exclusive of the City of San Diego, which was surveyed separately.

The survey of SDCWA customers began in September 1993 and continued through mid-November. The SDCWA sample performed comparable to expectations. The final disposition of sample points is illustrated in Table L-1.

II. ANALYTIC RESULTS

Comparison of the Sample with the Population

Before discussing the customer loss functions for SDCWA, we first must determine the extent to which the survey sample differs from the underlying population. To do this, census results were compared to sample characteristics with respect to age, income, education, household size, and type of dwelling (i.e., single-family vs. multifamily). The results are presented in Table L-2.

Table L-1
SDCWA RESPONSE RATES

	Helix	Vallecitos	Total
Initial sample	867	945	1812
Unused sample[a]	369	312	681
Out of sample[b]	28	37	65
No telephone number available	50	124	174
Corrected sample size	**420**	**472**	**892**
Refusals	65	75	140
Not reached during study	137	147	284
Unable to participate[c]	13	48	61
Completed interviews	**205**	**202**	**407**
Response rate[d]	**49%**	**43%**	**47%**

[a]There was no attempt to contact these sample points.
[b]These include businesses, landlords, vacancies, duplicate sample points, and sample points no longer residing in study area.
[c]Includes language and other communication barriers, or mailing not received, not read, or thrown away.
[d]Calculated as a percent of the corrected sample size.

Table L-2
COMPARISON OF SAMPLE WITH POPULATION

	Sample	Population
Age		
18 to 34	10%	33%
34 to 54	30%	24%
55+	60%	43%
Household income		
Under $50,000	71%	69%
$50,000+	29%	31%
Education		
Not college grad	69%	75%
College graduate	31%	25%
Dwelling type		
Single-family	59%	63%
Multifamily	41%	37%
Household size	2.4	2.7

Table L-2 indicates that the sample was more educated and older, and had a smaller number of persons per household than the overall population. The standard analytical technique that is used to correct for such differences is to use population means rather than sample means to derive loss functions. The estimates of willingness to pay then reflect the population rather than the sample demographics. That approach was used in this case.

Willingness to Pay (WTP)

WTP can be interpreted as the losses that customers incur as a result of particular shortage scenarios. The amount that a customer is willing to pay to avoid an event is a measure of the losses that customer would incur if that event were to occur. Therefore, we refer to these willingness to pay results as a "loss function."

Tables L-3A and L-3B present the mean WTP for the detailed model and the simplified model for each magnitude and frequency of shortage. WTP figures represent increments to monthly water bills. WTP for the full model varies from a low of $10.23/month to avoid a 10% shortage once every 10 years, to a high of $18.27/month to avoid a 50% shortage every 20 years.

The results of the simplified model are almost identical to the detailed model. The remainder of this report cites results based on the detailed model only.

Table L-3A
MEAN MONTHLY WILLINGNESS TO PAY, DETAILED MODEL
(Additional $/Month)

Shortage (% Reduction from Full Service)	Frequency (Occurrences/Years)				
	1/30	1/20	1/10	1/5	1/3
10%			$10.23	$10.54	$10.67
20%	$10.94	$11.58	$12.24		
30%	$13.00	$13.69	$14.40		
40%	$15.20	$15.93	$16.67		
50%	$17.51	$18.27			

Table L-3B
MEAN MONTHLY WILLINGNESS TO PAY, SIMPLIFIED MODEL
(Additional $/Month)

Shortage (% Reduction from Full Service)	Frequency (Occurrences/Years)				
	1/30	1/20	1/10	1/5	1/3
10%			$10.36	$10.60	$10.70
20%	$11.36	$11.86	$12.36		
30%	$13.43	$13.96	$14.50		
40%	$15.64	$16.19	$16.76		
50%	$17.94	$18.52			

The loss function is shown graphically in Figure L-1. In examining the tabular and graphical results, two major conclusions can be drawn:

- As expected, respondents are willing to pay more for larger shortages and for shortages that occur with higher frequency. However, the response to frequency variations is considerably smaller than the impact of magnitude. This is confirmed by referring to the model estimation results, which are shown in Exhibit L-1.

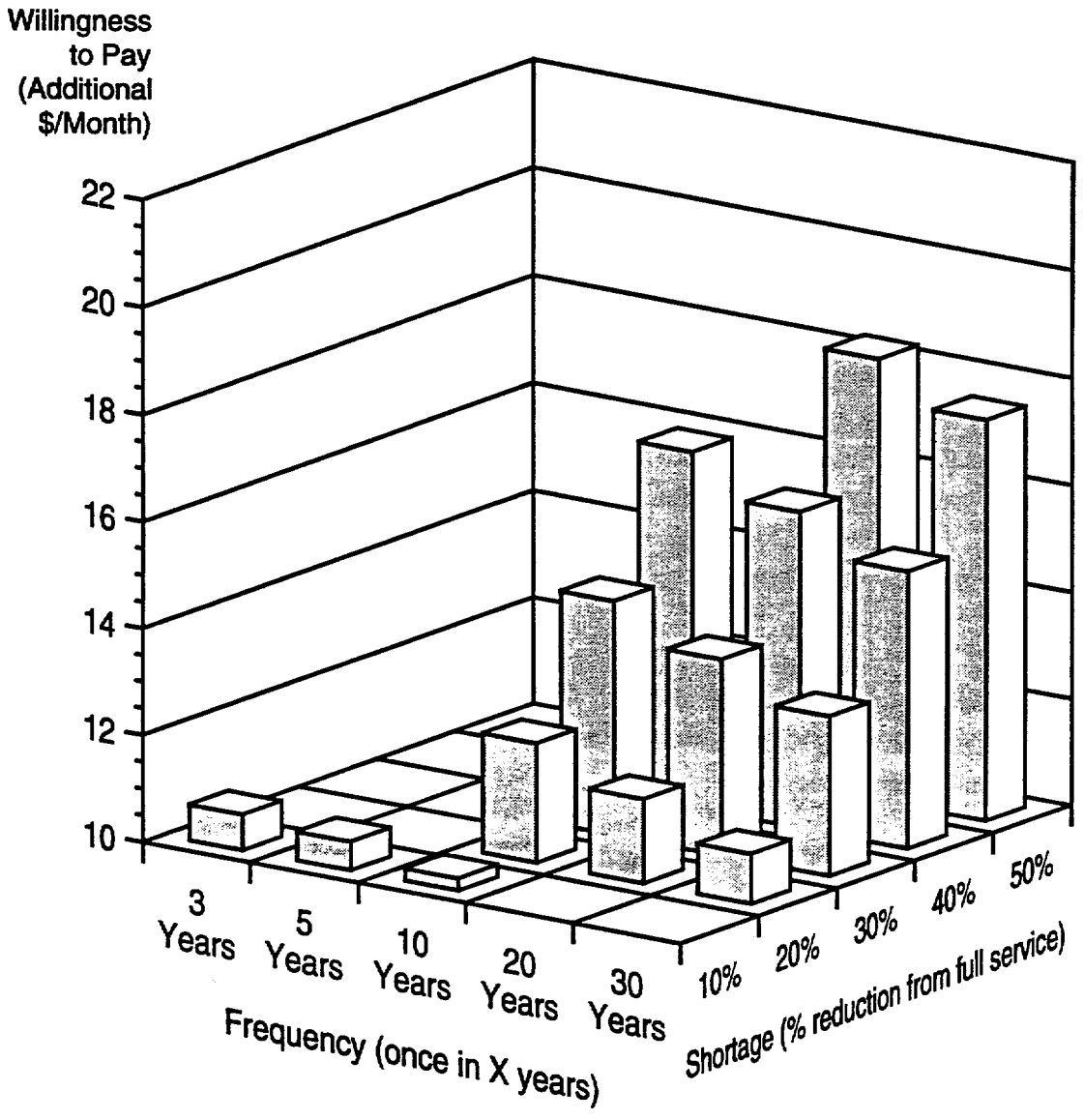
  Put another way, it appears that residential customers believe that infrequent large shortages impose higher losses than more frequent small shortages.

- To avoid even apparently minor shortage scenarios (e.g., 10% once every 10 years), respondents are willing to pay substantial amounts. This type of "threshold" response is not uncommon in surveys of this type and may indicate that respondents regard even a mild shortage scenario as an inconvenience that they want to avoid. They may make a greater distinction between "shortage" and "no shortage" than between different sizes or frequencies of shortages.

San Diego County Water Authority

Figure L-1

Mean Monthly Willingness to Pay to Avoid Particular Shortage Frequencies and Magnitudes



94-141100.32.final.6/94.ap

Confidence Intervals

Consistent with the approach typically used in the literature to calculate confidence intervals for CV results, we have estimated a range around the WTP associated with the mean shortage frequency and magnitude. Using this approach, the 95% confidence interval for SDCWA is ±$1.18. In other words, there is a 95% probability that the WTP to avoid this average shortage lies within a ±$1.18 range. This range most likely underestimates the size of the confidence interval for low and high level shortages, where there are fewer observations. However, it does provide a good relative indicator of the precision of the WTP results. The confidence interval represents only the likely margin of uncertainty due to sampling error. There are also other sources of uncertainty in the WTP estimates, including nonresponse and response errors.

Impact of Key Explanatory Variables on WTP

As described previously, the statistical model includes many variables that could potentially explain the variation in WTP. The model results in Exhibit L-1 include the estimated model coefficients and their statistical significance. The following discussion selects three explanatory variables that are statistically significant and illustrates their impact on WTP. Figures L-2 through L-4 show the variation of WTP at various shortage magnitudes when all other variables, other than the one in question, are held constant.

Age. Figure L-2 illustrates the variation of WTP by age for several representative shortage scenarios. Older respondents are willing to pay more to avoid shortages than younger respondents.

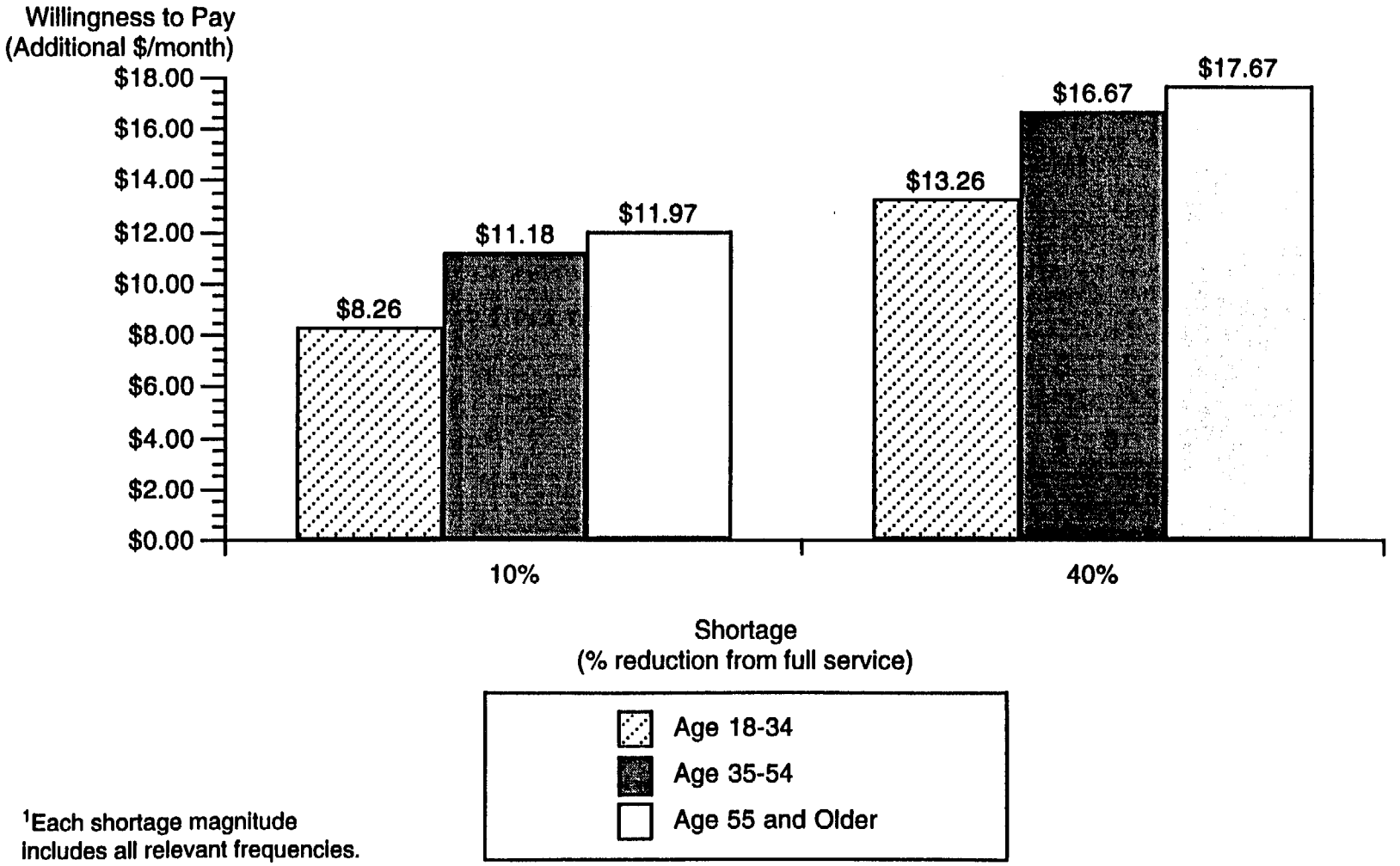
Education. Figure L-3 illustrates the variation of WTP by education level for several representative shortage scenarios. College-educated respondents have higher willingness to pay to avoid water shortages than do less educated respondents.

Income. Figure L-4 illustrates the variation of WTP by income level for several representative shortage scenarios. Respondents with higher annual income have higher willingness to pay then do respondents with lower household income.

San Diego County Water Authority

Figure L-2

Effect of Age on Willingness to Pay[1]



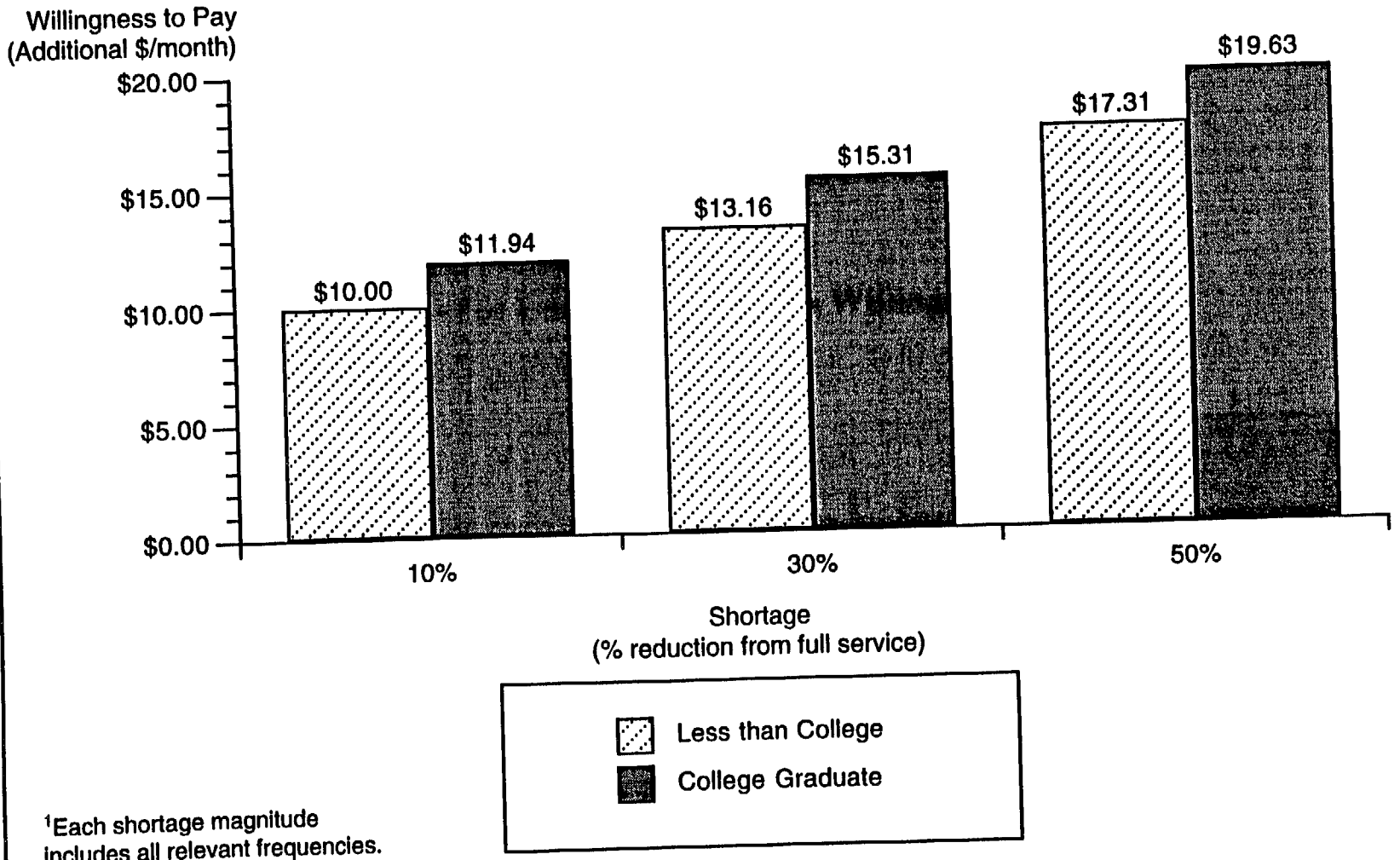
[1]Each shortage magnitude includes all relevant frequencies.

94-141100.32.final.6/94.ap

San Diego County Water Authority

Figure L-3

Effect of Education Level on Willingness to Pay[1]



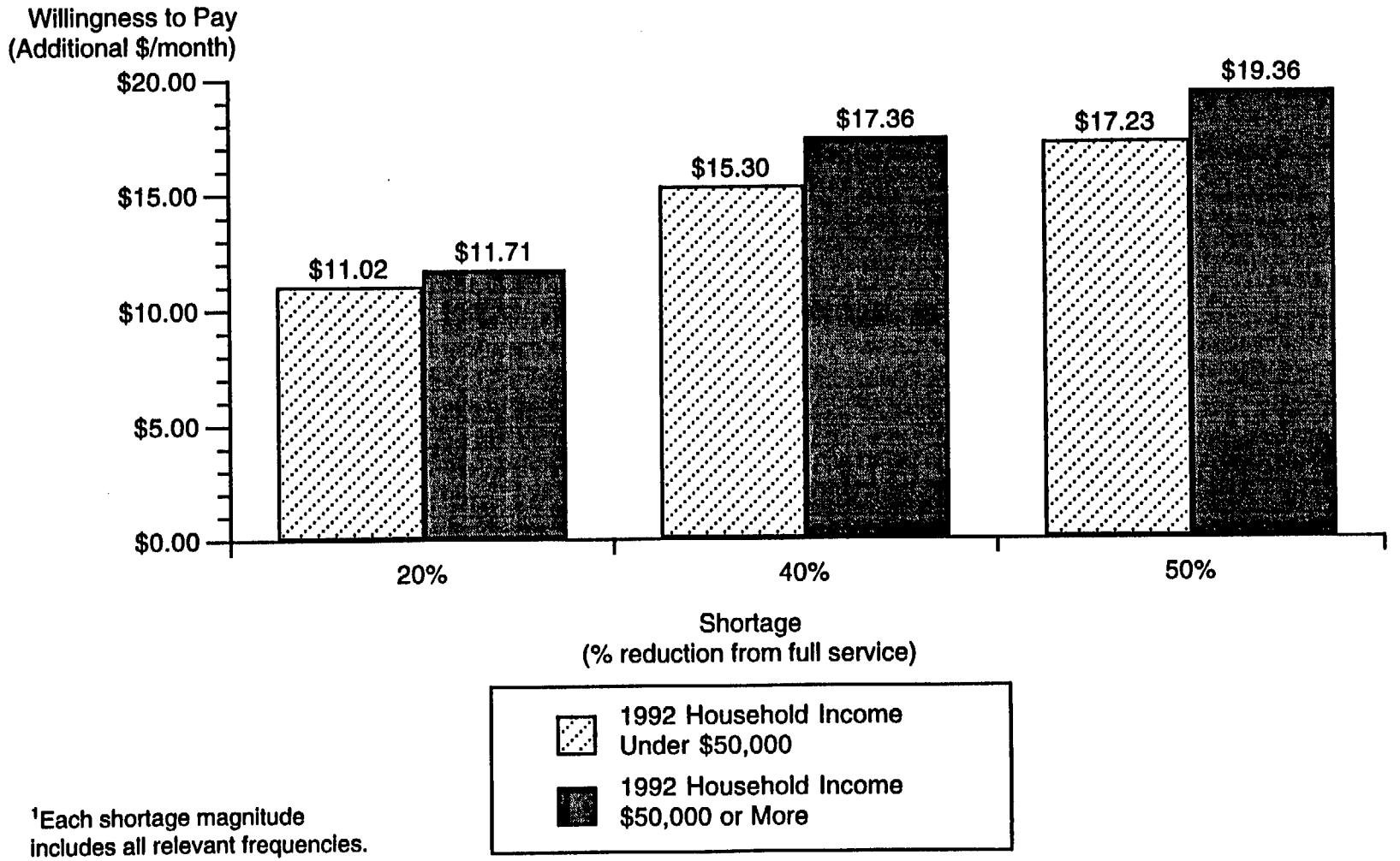
[1]Each shortage magnitude includes all relevant frequencies.

94-141100.32.final.6/94.ap

San Diego County Water Authority

Figure L-4

Effect of Income on Willingness to Pay[1]



[1]Each shortage magnitude includes all relevant frequencies.

94-141100.32.final.6/94.ap

Comparison of Subpopulations

An analysis was done to determine whether Helix Water District customers have different WTP than Vallecitos Water District customers. Table L-4 presents WTP for the two groups. There does not appear to be any systematic difference between the two groups.

Table L-4
MEAN MONTHLY WILLINGNESS TO PAY, BY WATER DISTRICT

Shortage (% Reduction from Full Service)	Frequency (One Occurrence in X Years)	Helix	Vallecitos
10%	3	$12.85	$10.98
10%	5	$12.54	$11.03
10%	10	$11.79	$11.15
20%	10	$14.01	$12.93
20%	20	$12.45	$13.19
20%	30	$10.96	$13.46
30%	10	$16.35	$14.81
30%	20	$14.72	$15.09
30%	30	$13.13	$15.36
40%	10	$18.79	$16.77
40%	20	$17.09	$17.06
40%	30	$15.44	$17.35
50%	20	$19.55	$19.10
50%	30	$17.84	$19.39

An additional analysis was done by including in the model a binary variable to capture the impacts of "water district" on WTP. The variable was set equal to 1 if the respondent is served by Helix, and set to 0 if the respondent is served by Vallecitos. The analysis indicates that this variable was not statistically significant.

Explanatory Power of Models

Statistical goodness-of-fit tests were applied to test the explanatory power of the detailed and simplified models. The results of our calculations are presented in Table L-5.

Table L-5
GOODNESS OF FIT COMPARISON

	% Predicted Correctly[1]
Detailed model	38%
Simplified model	35%

In this case, the detailed model has only slightly more explanatory power than the simplified model. This, coupled with the similarity of the WTP results for the two models, indicate that SDCWA can apply the simplified model to estimate WTP, rather than resurveying customer to gather data on the remaining variables required for the detailed model.

Water Shortages as a Public Concern

In survey question 4, respondents were asked to rate the importance of various public problems, including water shortages, as "not at all important," "somewhat important," or "very important." Based on these responses, a factor analysis was performed to attempt to cluster these variables into a small number of groups.

Overall, the mean response for each issue is illustrated in Table L-6.

Water shortages fall in the middle of the list of concerns.[2]

The factor analysis showed that SDCWA respondents grouped issues as illustrated in Table L-7. Water shortages fall into the category that includes issues that can best be described as having public service and/or environmental components. The factors are ranked within each category according to the strength of their rating in the factor analysis.

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[1]In a single bounded logit model, these numbers are equivalent to 62% and 59% (square root of 0.38 and 0.35 respectively).

[2]It is possible that had this survey been conducted a year earlier, when the state was still in the grip of a serious drought, water shortages would have been viewed as much more of a concern.

Table L-6
ISSUE RANKING AND MEAN RESPONSE[3]

Issue	Mean Rating	Standard Error
Economy	2.66	.0296
Drug abuse	2.37	.0398
Crime	2.36	.0355
Taxes	2.28	.0391
Education	2.26	.0426
Housing costs	2.24	.0389
Traffic	2.22	.0370
Water shortages	**2.19**	**.0406**
Drinking water quality	2.16	.0422
Homelessness	1.99	.0409
Trash disposal	1.95	.0434
Overcrowding	1.95	.0388
Air pollution	1.94	.0376
Racial issues	1.76	.0385

Table L-7
FACTOR ANALYSIS OF PUBLIC ISSUES

Public Services/Environmental Concerns	Social Concerns	Quality of Life Concerns	Financial Concerns
Trash disposal	Crime	Overcrowding	Taxes
Education	Drug abuse	Traffic	Housing costs
Water shortages		Racial issues	Economy
Homelessness		Air pollution	
Drinking water quality			

[3]Note that allowable responses ranged from 1 ("not at all important") to 3 ("very important").

Each of the four factors was included in the model as a binary variable to test its explanatory impact on WTP.[3] Each of these variables was assigned the value of 1 if the mean value of all of a respondent's ratings for the issues included in that factor exceeded the value assigned to the water shortage issue, and zero otherwise. For SDCWA, only the social concerns factor is statistically significant in explaining WTP. Respondents who are more concerned with social issues than with water shortages have lower WTP.

Open-Ended Responses

Following the referendum questions, respondents were asked several open-ended questions regarding what actions they thought they would have to take under specified shortage scenarios, and what issues they considered when deciding whether to vote yes or no. These questions were asked to better understand the reasoning of participants. Responses to these questions are summarized in Exhibit L-2.

[3]The "public services/environmental" factor included in the model excluded the water shortages variable.

Exhibit L-1
MODEL RESULTS

Results for the detailed and simplified models follow this page. The results present each variable included in the model along with the following information:

- **Coefficient** indicates the magnitude of the variable's impact on WTP
- **Standard error** reflects the distribution of the coefficient
- **T-statistic** is a commonly used measure of statistical significance
- **P-value** is the observed significance level (for example, if p = .05, the coefficient is statistically significant at the 95% level)

The following key of variable pneumonics used in the model will facilitate interpretation of these results.

Key of Survey Variables

SUPPLY:	Percentage reduction from full service demand specified in the cv scenario.
FREQ:	Frequency of drought specified in the CV scenario.
AREAYRS:	Number of years respondent has lived in the area.
HHSIZE:	Number of persons in the household, including respondent.
AGE1834:	Respondent's age is in the range of 18 to 34 years old.
AGE3554:	Respondent's age is in the range of 35 to 54 years old.
COLGRAD:	Respondent is a college graduate.
INCGT%50:	1992 household income is greater than $50,000.
SNGL_FAM:	Respondent lives in a single family residence.
QUALLIFE:	Concern for "quality of life issues" (as defined by a factor analysis) relative to concern for water shortages.
SOCIAL:	Concern for "social issues" (as defined by a factor analysis) relative to concern for water shortages.
FINANCE:	Concern for "finance issues" (as defined by a factor analysis) relative to concern for water shortages.
ENVIRON:	Concern for "public services and/or environmental issues" (as defined by a factor analysis) relative to concern for water shortages.
SEVERE:	Perception of the severity of the recent drought
SHORTAGE:	Water shortages considered a somewhat or very important problem.
LONGTERM:	Perception of water shortages as a long-term problem in the area.
MANDATE:	Respondent believes that their water agency suggested or mandated cutbacks during the recent drought.
OWNPAY:	Respondent owns home and is personally responsible for paying the water bill.

OWNELSE:	Respondent owns home and someone else in the household is responsible for paying the water bill.
OWNASSOC:	Respondent owns home and a homeowners association is responsible for paying the water bill.
RENTPAY:	Respondent rents home, water bill is not included in the rent.
YELLOW:	Homes with private landscaped areas less than 3,000 square feet or shared landscaped areas less than 5,000 square feet.
PINK:	Homes with shared landscaped areas greater than 5,000 square ft.
NOGROWTH:	Respondent wants community to remain the same size/decrease in size.
RATE:	Average residential rate for respondent's water agency
NORTH:	Northern California water agency
BID:	Amount that respondents bill would increase per month if the majority of the community voted yes to the referendum.

Simplified Model for San Diego County Water Authority

Date: 2/14/1994
Observations: 685 D.F. : 674

Var	Coef	Std. Error	t-Stat	P-Value
CONSTANT	3.920294	0.597698	6.559	5.339e-11
SUPPLY	-3.319971	0.634422	-5.233	1.11e-07
FREQ	-0.008145055	0.00900743	-0.9043	0.1831
AREAYRS	0.007897536	0.00548785	1.439	0.07529
HHSIZE	-0.03591069	0.0618245	-0.5808	0.2808
AGE1834	-0.597869	0.247375	-2.417	0.007958
AGE3554	-0.1138274	0.174469	-0.6524	0.2572
COLGRAD	0.2988739	0.163548	1.827	0.03403
INCGT50K	0.3525352	0.178249	1.978	0.02418
SNGL_FAM	0.2505196	0.162895	1.538	0.06227
BID	-0.1266837	0.00617776	-20.51	1.567e-73

Detailed Model for San Diego County Water Authority

Date: 2/14/1994
Observations: 669 D.F. : 644

Var	Coef	Std. Error	t-Stat	P-Value
CONSTANT	4.532465	0.738559	6.137	7.206e-10
SUPPLY	-3.410911	0.653709	-5.218	1.209e-07
FREQ	-0.01091077	0.00925254	-1.179	0.1194
AREAYRS	0.01130304	0.00588058	1.922	0.02751
HHSIZE	-0.03910145	0.0652141	-0.5996	0.2745
AGE1834	-0.6642148	0.270654	-2.454	0.007189
AGE3554	-0.1324389	0.183195	-0.7229	0.235
COLGRAD	0.3322359	0.171923	1.932	0.02686
INCGT50K	0.3049872	0.190649	1.6	0.05507
SNGL_FAM	0.07341999	0.215798	0.3402	0.3669
QUALLIFE	0.08395184	0.238224	0.3524	0.3623
SOCIAL	-0.3443323	0.241927	-1.423	0.07756
FINANCE	0.01585801	0.230844	0.0687	0.4726
SEVERE	0.1119559	0.154136	0.7263	0.2339
SHORTAGE	-0.3070773	0.218148	-1.408	0.07985
LONGTERM	0.4582586	0.172798	2.652	0.004096
MANDATE	0.1674399	0.248706	0.6732	0.2505
OWNPAY	-0.4640187	0.294214	-1.577	0.05762
OWNELSE	0.1370081	0.396882	0.3452	0.365
OWNASSOC	-0.9028557	0.308738	-2.924	0.001784
RENTPAY	0.2356769	0.458593	0.5139	0.3037
YELLOW	0.09306459	0.159981	0.5817	0.2805
PINK	-0.215839	0.269487	-0.8009	0.2117
NOGROWTH	-0.2299716	0.208884	-1.101	0.1357
BID	-0.1300847	0.00643606	-20.21	1.434e-71

San Diego County Water Authority with binary variable for Helix/Vallecitos

Date: 3/22/1994
Observations: 685 D.F. : 673

Var	Coef	Std. Error	t-Stat	P-Value
CONSTANT	3.919043	0.597871	6.555	5.475e-11
HELIX	0.009027506	0.15423	0.05853	0.4767
SUPPLY	-3.319867	0.634426	-5.233	1.111e-07
FREQ	-0.008134768	0.00900806	-0.9031	0.1834
AREAYRS	0.007775189	0.00591357	1.315	0.09451
HHSIZE	-0.03654857	0.0625622	-0.5842	0.2796
AGE1834	-0.5999535	0.249486	-2.405	0.008224
AGE3554	-0.1144279	0.175002	-0.6539	0.2567
COLGRAD	0.2991346	0.163552	1.829	0.03392
INCGT50K	0.3526096	0.178255	1.978	0.02416
SNGL_FAM	0.2507235	0.162893	1.539	0.06211
BID	-0.1266874	0.00617806	-20.51	1.575e-73

San Diego detailed model for Helix only

Date: 3/31/1994
Observations: 352 D.F. : 327

Var	Coef	Std. Error	t-Stat	P-Value
CONSTANT	5.186263	1.0622	4.883	7.958e-07
SUPPLY	-3.740499	0.923345	-4.051	3.139e-05
FREQ	-0.02593172	0.0130378	-1.989	0.02374
AREAYRS	0.009824365	0.00774386	1.269	0.1027
HHSIZE	-0.1101845	0.0865653	-1.273	0.102
AGE1834	-0.6709822	0.384557	-1.745	0.04094
AGE3554	0.2005744	0.251034	0.799	0.2124
COLGRAD	0.7109944	0.24377	2.917	0.001882
INCGT50K	0.4588017	0.279935	1.639	0.05106
SNGL_FAM	0.1779852	0.351828	0.5059	0.3066
QUALLIFE	-0.01566676	0.328728	-0.04766	0.481
SOCIAL	-0.3371037	0.315204	-1.069	0.1428
FINANCE	0.1373744	0.325397	0.4222	0.3366
SEVERE	0.4417032	0.217091	2.035	0.02132
SHORTAGE	-0.5777114	0.30019	-1.924	0.02755
LONGTERM	0.4977644	0.232827	2.138	0.01661
MANDATE	-0.1352841	0.352074	-0.3842	0.3505
OWNPAY	-0.6008764	0.438765	-1.369	0.08586
OWNELSE	-0.3471488	0.573846	-0.605	0.2728
OWNASSOC	-0.1404246	0.47371	-0.2964	0.3835
RENTPAY	0.7300874	0.715622	1.02	0.1542
YELLOW	0.03050567	0.231872	0.1316	0.4477
PINK	-0.4709949	0.410024	-1.149	0.1257
NOGROWTH	0.0425167	0.352164	0.1207	0.452
BID	-0.1405573	0.00950725	-14.78	4.115e-39

San Diego detailed model for Vallecitos only

Date: 3/31/1994
Observations: 317 D.F. : 292

Var	Coef	Std. Error	t-Stat	P-Value
CONSTANT	3.770375	1.15485	3.265	0.0006075
SUPPLY	-2.908759	0.959655	-3.031	0.001319
FREQ	0.004177262	0.0137981	0.3027	0.3811
AREAYRS	0.003426175	0.0125789	0.2724	0.3928
HHSIZE	0.1455652	0.118509	1.228	0.1101
AGE1834	-1.239889	0.431446	-2.874	0.002165
AGE3554	-0.8964172	0.308791	-2.903	0.001978
COLGRAD	-0.06023171	0.269124	-0.2238	0.4115
INCGT50K	0.4069894	0.285727	1.424	0.07766
SNGL_FAM	0.2139968	0.300018	0.7133	0.2381
QUALLIFE	0.1337491	0.389858	0.3431	0.3659
SOCIAL	-0.3535556	0.41023	-0.8618	0.1947
FINANCE	-0.2087194	0.353504	-0.5904	0.2777
SEVERE	-0.253493	0.241652	-1.049	0.1475
SHORTAGE	-0.2003278	0.345889	-0.5792	0.2814
LONGTERM	0.3346005	0.29298	1.142	0.1271
MANDATE	0.7805085	0.400824	1.947	0.02619
OWNPAY	-0.455148	0.535798	-0.8495	0.1981
OWNELSE	0.4505412	0.667909	0.6746	0.2502
OWNASSOC	-1.282786	0.560728	-2.288	0.01141
RENTPAY	-0.001111142	0.708202	-0.001569	0.4994
YELLOW	0.2011608	0.243923	0.8247	0.2051
PINK	-0.1543043	0.414687	-0.3721	0.355
NOGROWTH	-0.4593273	0.277452	-1.656	0.0494
BID	-0.1287725	0.00941841	-13.67	4.514e-34

Exhibit L-2
OPEN-ENDED RESPONSES

SURVEY QUESTION 19

WHAT ARE THE PRIMARY REASONS YOU WOULD CHOSE NOT TO PAY THE ADDITIONAL MONEY ON YOUR WATER BILL TO AVOID FUTURE SHORTAGES?

(Asked Only of the 58 Respondents Who Voted No to the First and Second Bids for Both Scenarios)

SAN DIEGO COUNTY WATER AUTHORITY

Reason	Percent of Respondents
Prefer to reduce my water usage	36%
Tired of paying for others/everyone should conserve	28%
Not willing to pay more	19%
Cannot afford to pay a higher water bill	19%
Low confidence in the water agency	17%
Additional water supplies encourage population growth	12%
Do not believe water shortages can be avoided	10%
Other	33%

The table indicates the percent of respondents who listed the specified reason. The sum of the column is greater than 100% because respondents could list more than one reason. Responses given by fewer than 2% of the respondents are not listed.

SURVEY QUESTION 20

WHAT FACTORS OR ISSUES DID YOU CONSIDER WHEN DECIDING TO VOTE YES OR NO?

(Asked Only of Respondents Who Voted Yes to at Least One Bid)

SAN DIEGO COUNTY WATER AUTHORITY

Factors Considered	Percent of Respondents
Cannot afford more on bill	41%
We can conserve	27%
No confidence in the water agency	14%
Water is a necessity	14%
New resources should be developed	10%
Too many people/restrict new development	8%
Not willing to pay more	6%
Not willing to pay for others use	6%
Depends upon the resource project	5%
Future generations and their needs	4%
Impacts of shortage on greenery/aesthetics	3%
Magnitude of shortage	3%
Frequency of shortage	3%
Impacts of new resources on environment	0%

The table indicates the percent of respondents who listed the specified issue or factor. The sum of the column is greater than 100% because respondents could list more than one issue or factor. Responses given by fewer than 2% of the respondents are not listed.

SURVEY QUESTIONS 21 AND 22

WHEN YOU WERE ANSWERING THE QUESTIONS ABOUT WHAT IT WOULD BE WORTH TO YOU TO AVOID THE ___% WATER SHORTAGE ONCE EVERY ___ YEARS, WHAT DID YOU ASSUME YOUR HOUSEHOLD WOULD HAVE TO DO TO CUT BACK YOUR WATER USE?

SAN DIEGO COUNTY WATER AUTHORITY

Actions to Reduce Water Use	Water Shortage				
	10%	20%	30%	40%	50%
Can't conserve anymore, would do nothing more	19.4%	14.5%	15.3%	14.7%	11.5%
Install low-flow showerheads	7.1	11.5	7.4	10.4	7.7
Install displacement devices in toilet	3.5	6.1	3.1	6.1	2.9
Replace toilets with low-flush toilets	4.1	5.5	6.1	5.5	3.8
Take fewer/shorter showers	28.2	36.4	26.4	25.8	35.6
User fewer flushes	12.9	18.8	15.3	17.8	15.4
Use grey water/recycle water	4.1	11.5	8.6	10.4	15.4
Use dishwasher less/not at all	14.1	20.6	14.7	19.6	18.3
Do laundry less/take to a laundromat	14.1	20.0	11.0	19.0	17.3
Change outside plant watering habits	5.3	6.1	9.8	10.4	10.6
Wash car less/not at all/take to carwash	10.0	9.7	8.0	9.8	10.6
Water lawn less/let lawn die	18.8	17.6	20.9	20.9	19.2

The table indicates the percentage of respondents who listed the specified action. The sum of each column is greater than 100% because respondents could list more than one action.

Appendix M
CITY OF SAN DIEGO RESULTS

THE VALUE OF WATER SUPPLY RELIABILITY: RESULTS OF A CONTINGENT VALUATION SURVEY

CITY OF SAN DIEGO

This appendix discusses the contingent valuation (CV) survey results for the City of San Diego. Section I discusses survey administration, including sampling, survey procedures, and response rates. Section II presents analytic results. Exhibits M-1 and M-2 contain the model results, and summary tables of participants' open-ended responses.

I. SURVEY ADMINISTRATION

The total number of completions for City of San Diego was 302. Barakat & Chamberlin worked closely with City of San Diego to draw a sample of approximately 1,000 customer billing records. The survey of City of San Diego customers began in September 1993 and was completed by early November. The City of San Diego sample performed comparable to expectations. The final disposition of sample points is illustrated in Table M-1.

II. ANALYTIC RESULTS

Comparison of the Sample with the Population

Before discussing the customer loss functions for the City of San Diego, we first must determine the extent to which the survey sample differs from the overall District population. To do this, census results were compared to sample characteristics with respect to age, income, education, household size, and type of dwelling (i.e., single-family vs. multifamily). The results are presented in Table M-2.

Table M-2 indicates that the sample was more educated, wealthier, and older than the overall population. The standard analytical technique that is used to correct for such differences is to use population means rather than sample means to derive loss functions. The estimates of willingness to pay then reflect the population rather than the sample demographics. That approach was used in this case.

Table M-1
CITY OF SAN DIEGO RESPONSE RATES

	Single-Family	Multifamily	Total
Initial sample	546	377	923
Unused sample[a]	74	0	74
Out of sample[b]	28	35	63
No telephone number available	119	23	142
Corrected sample size	**325**	**319**	**644**
Refusals	54	71	125
Not reached during study	82	55	137
Unable to participate[c]	22	58	80
Completed interviews	**167**	**135**	**302**
Response rate[d]	**51%**	**42%**	**47%**

[a]There was no attempt to contact these sample points.
[b]These include businesses, landlords, vacancies, duplicate sample points, and sample points no longer residing in the study area.
[c]Includes language and other communication barriers, or mailing not received, not read, or thrown away.
[d]Calculated as a percent of the corrected sample size.

Table M-2
COMPARISON OF SAMPLE WITH CITY POPULATION

	Sample	Population
Age		
18 to 34	22%	36%
34 to 54	31%	24%
55+	47%	40%
Household income		
Under $50,000	66%	77%
$50,000+	34%	23%
Education		
Not college grad	51%	80%
College graduate	49%	20%
Dwelling type		
Single-family	55%	55%
Multifamily	45%	45%
Household size	2.3	2.6

Willingness to Pay (WTP)

WTP can be interpreted as the losses that customers incur as a result of particular shortage scenarios. The amount that a customer is willing to pay to avoid an event is a measure of the losses that customer would incur if that event were to occur. Therefore, we refer to these willingness to pay results as a "loss function."

Tables M-3A and M-3B present the mean WTP for the detailed model and the simplified model for each magnitude and frequency of shortage. WTP figures represent increments to monthly water bills. WTP for the full model varies from a low of $11.38/month to avoid a 10% shortage once every 3 years, to a high of $16.05/month to avoid a 50% shortage every 30 years.

The results of the simplified model are almost identical to the detailed model. The remainder of this report cites results based on the detailed model only.

Table M-3A
MEAN MONTHLY WILLINGNESS TO PAY, DETAILED MODEL
(Additional $/Month)

Shortage (% Reduction from Full Service)	Frequency (Occurrences/Years)				
	1/30	1/20	1/10	1/5	1/3
10%			$11.71	$11.47	$11.38
20%	$13.48	$12.99	$12.51		
30%	$14.32	$13.82	$13.33		
40%	$15.18	$14.67	$14.16		
50%	$16.05	$15.53			

Table M-3B
MEAN MONTHLY WILLINGNESS TO PAY, SIMPLIFIED MODEL
(Additional $/Month)

Shortage (% Reduction from Full Service)	Frequency (Occurrences/Years)				
	1/30	1/20	1/10	1/5	1/3
10%			$11.67	$11.42	$11.33
20%	$13.43	$12.92	$12.41		
30%	$14.21	$13.68	$13.16		
40%	$15.01	$14.47	$13.94		
50%	$15.82	$15.27			

The loss function is shown graphically in Figure M-1. In examining the tabular and graphical results, two major conclusions can be drawn:

- As expected, respondents are willing to pay more for larger shortages and for shortages that occur with higher frequency. However, the response to frequency variations is considerably smaller than the impact of magnitude. This is confirmed by referring to the model estimation results, which are shown in Exhibit M-1.

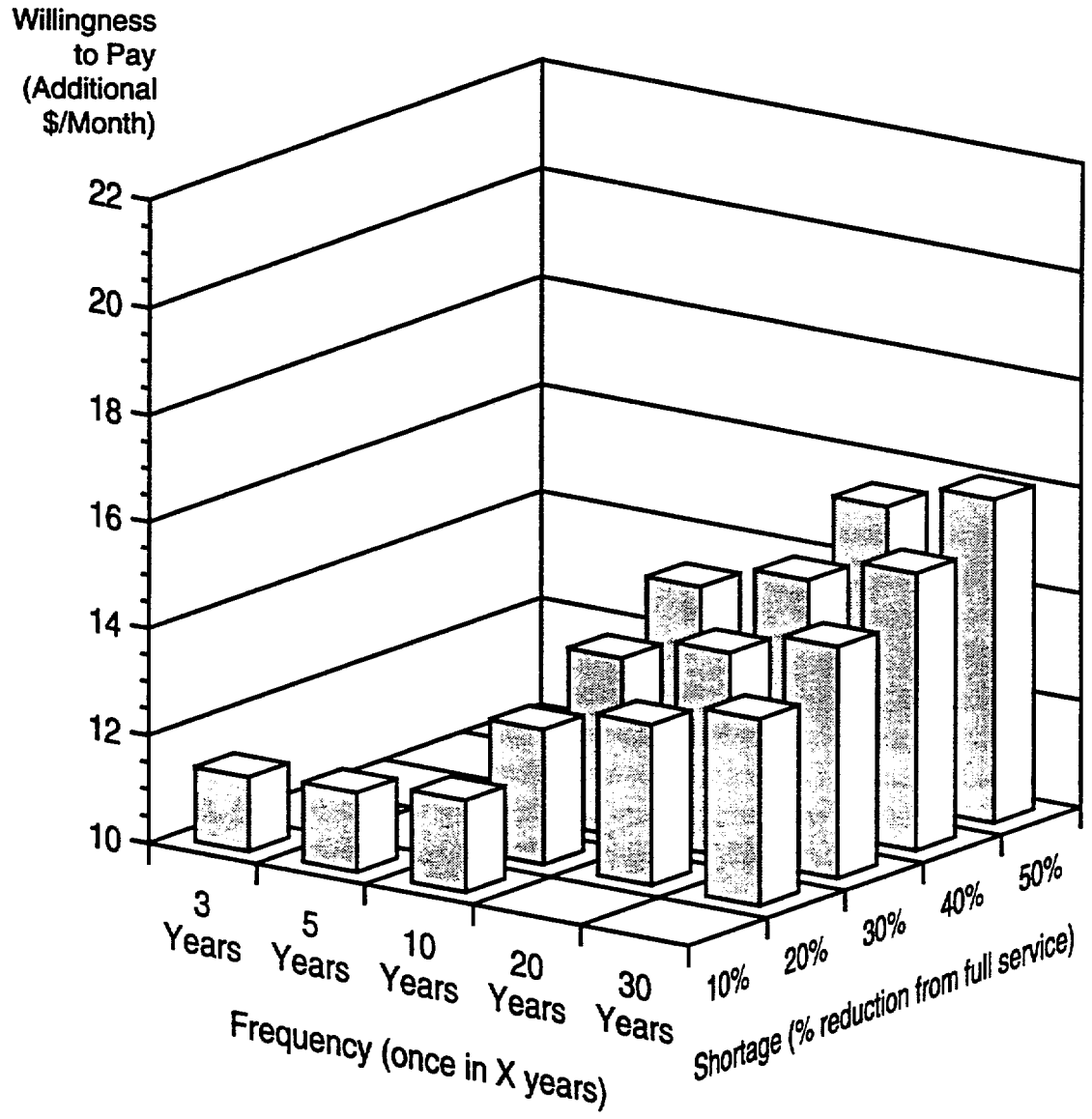
  Put another way, it appears that residential customers believe that infrequent large shortages impose higher losses than more frequent small shortages.

- To avoid even apparently minor shortage scenarios (e.g., 10% once every 10 years), respondents are willing to pay substantial amounts. This type of "threshold" response is not uncommon in surveys of this type and may indicate that respondents regard even a mild shortage scenario as an inconvenience that they want to avoid. They may make a greater distinction between "shortage" and "no shortage" than between different sizes or frequencies of shortages.

City of San Diego

Figure M-1

Mean Monthly Willingness to Pay to Avoid Particular Shortage Frequencies and Magnitudes



94-141100.32.final.6/94.ap

Confidence Intervals

Consistent with the approach typically used in the literature to calculate confidence intervals for CV results, we have estimated a range around the WTP associated with the mean shortage frequency and magnitude. Using this approach, the 95% confidence interval for the City of San Diego is ±$1.33. In other words, there is a 95% probability that the WTP to avoid this average shortage lies within a ±$1.33 range. This range most likely underestimates the size of the confidence interval for low and high level shortages, where there are fewer observations. However, it does provide a good relative indicator of the precision of the WTP results. The confidence interval represents only the likely margin of uncertainty due to sampling error. There are also other sources of uncertainty in the WTP estimates, including nonresponse and response errors.

Impact of Key Explanatory Variables on WTP

As described previously, the statistical model includes many variables that could potentially explain the variation in WTP. The model results in Exhibit M-1 include the estimated model coefficients and their statistical significance. The following discussion selects three explanatory variables that are statistically significant and illustrates their impact on WTP. Figures M-2 through M-4 show the variation of WTP at various shortage magnitudes when all other variables, other than the one in question, are held constant.

Concern for Financial Issues. Survey respondents were asked to rate various public issues as very important, somewhat important, or not at all important in their area. Figure M-2 illustrates WTP for people with different levels of concern for financial issues, (which include taxes, the economy, and housing costs) relative to their concern for water shortages. As expected, individuals who are more concerned about financial issues than about water shortages exhibit lower WTP.

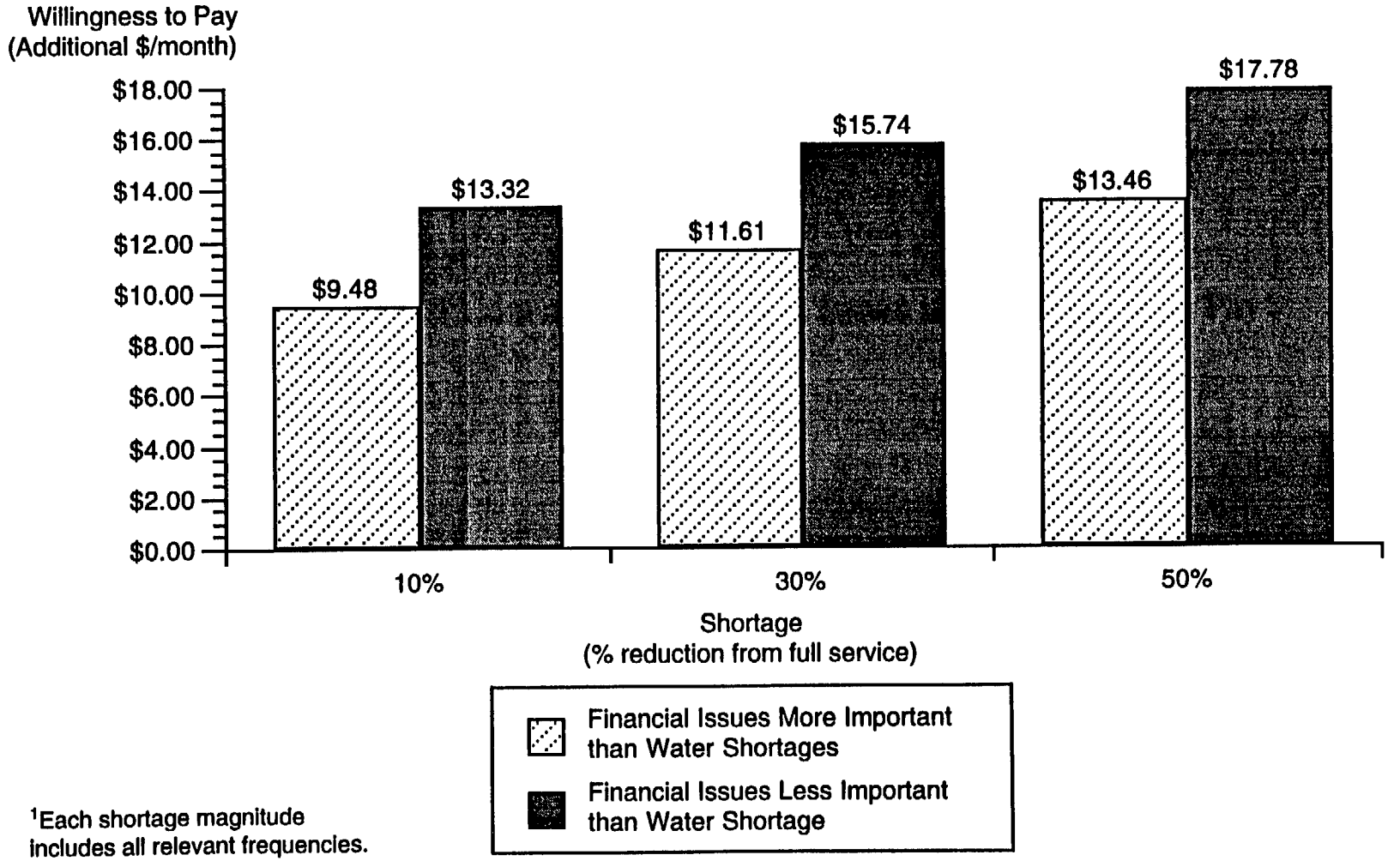
Perception of Water Shortages as a Long-Term Problem. Survey respondents were asked to what extent they considered water shortages to be a long-term problem in their area. Those who considered the water shortages to be a long-term problem have higher WTP than those who do not. WTP for these two groups is illustrated in Figure M-3.

Landscape Area. Results indicate that the quantity and type of outdoor landscaping has a statistically significant influence on respondents' willingness to pay to avoid future shortages. Figure M-4 illustrates this by using the variables in the model that

City of San Diego

Figure M-2

Importance of Concern for Financial Issues on Willingness to Pay[1]



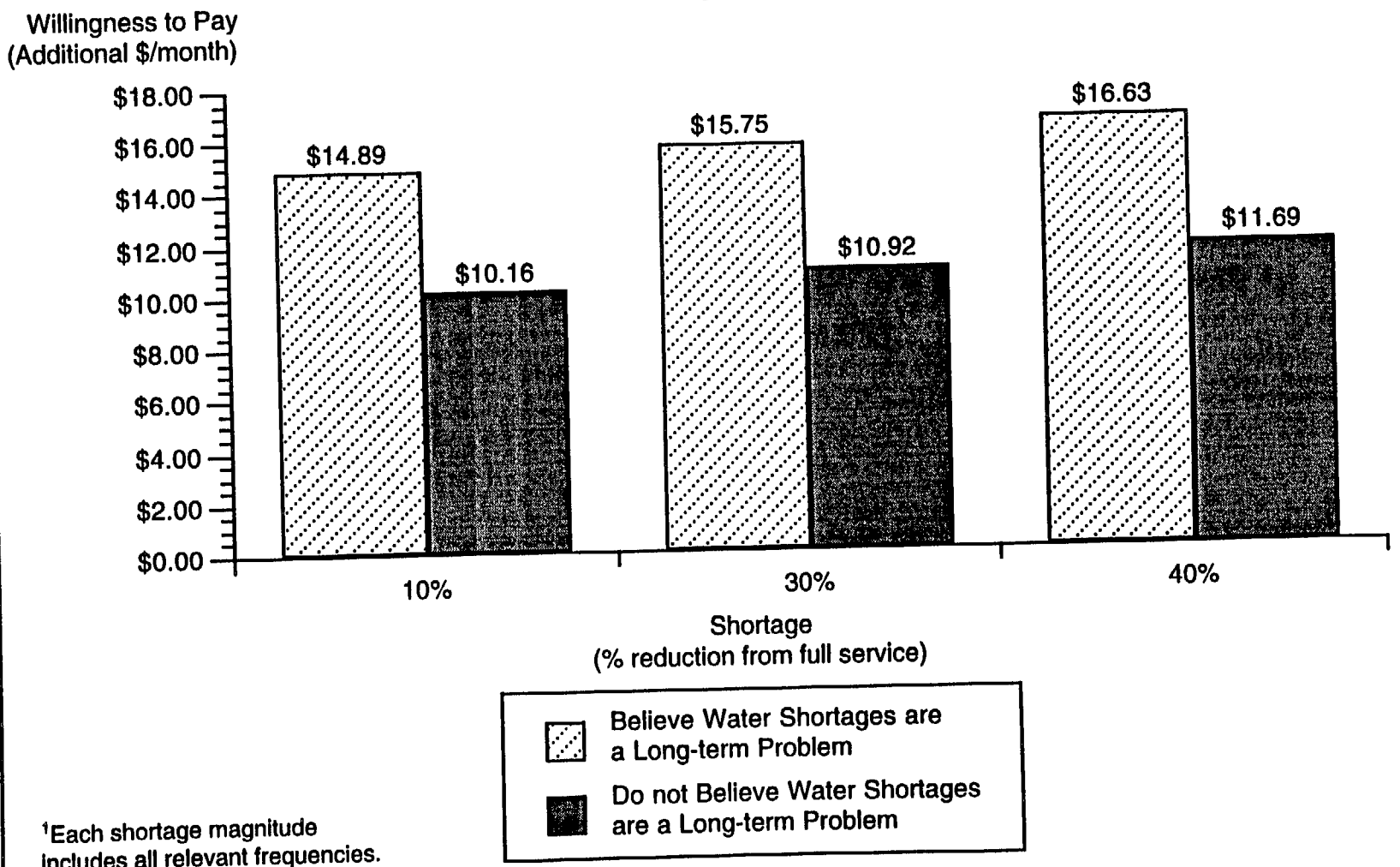
[1]Each shortage magnitude includes all relevant frequencies.

94-141100.32.final.6/94.ap

City of San Diego

Figure M-3

Effects of Perception of Water Shortages as a Long-term Problem on Willingness to Pay[1]



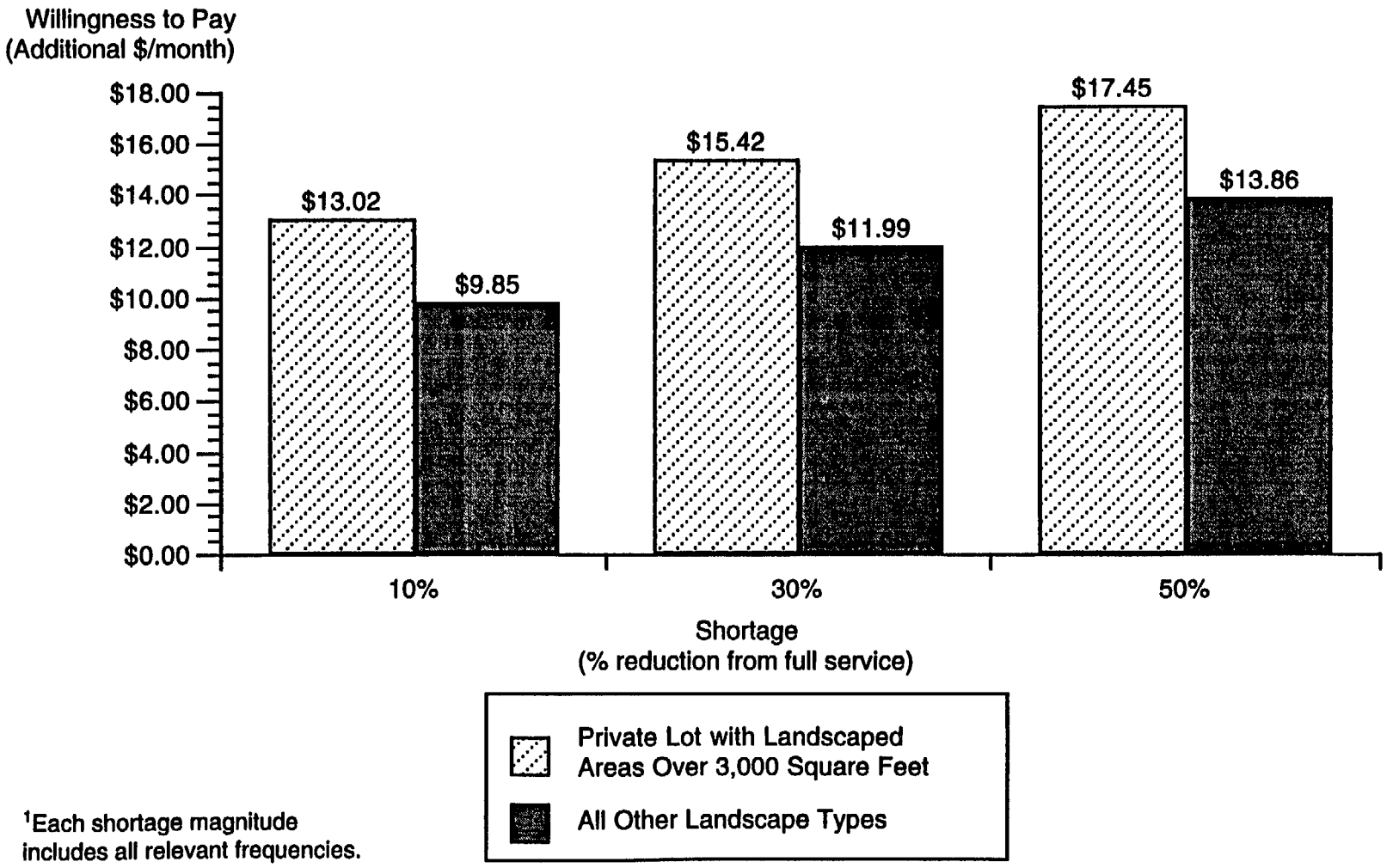
[1]Each shortage magnitude includes all relevant frequencies.

94-141100.32.final.6/94.ap

City of San Diego

Figure M-4

Effect of Landscape Characteristics on Willingness to Pay[1]



[1]Each shortage magnitude includes all relevant frequencies.

94-141100.32.final.6/94.ap

capture variations in landscaped area. Again, WTP is shown for several levels of shortage severity. The results show that respondents who have private lots with landscapes larger than 3,000 square feet have higher WTP than families with other types of landscaping.

Explanatory Power of Models

Statistical goodness-of-fit tests were applied to test the explanatory power of the detailed and simplified models. The results of our calculations are presented in Table M-4.

Table M-4
GOODNESS OF FIT COMPARISON

	% Predicted Correctly[1]
Detailed model	38%
Simplified model	33%

In this case, the detailed model has only slightly more explanatory power than the simplified model. This, coupled with the similarity of the WTP results for the two models, indicate that the City of San Diego can apply the simplified model to estimate WTP, rather than resurveying customers to gather data on the remaining variables required for the detailed model.

Water Shortages as a Public Concern

In survey question 4, respondents were asked to rate the importance of various public problems, including water shortages, as "not at all important," "somewhat important," or "very important." Based on these responses, a factor analysis was performed to attempt to cluster these variables into a small number of groups.

Overall, the mean response for each issue is illustrated in Table M-5.

[1]In a single bounded logit model, these numbers are equivalent to 62% and 57% (square root of 0.38 and 0.33 respectively).

Table M-5
ISSUE RANKING AND MEAN RESPONSE[2]

Issue	Mean Rating	Standard Error
Economy	2.67	.0335
Crime	2.47	.0402
Drug abuse	2.39	.0463
Education	2.34	.0490
Drinking water quality	2.30	.0458
Housing costs	2.30	.0443
Taxes	2.27	.0425
Water shortages	**2.21**	**.0470**
Homelessness	2.20	.0472
Air pollution	2.08	.0423
Traffic	2.03	.0436
Overcrowding	2.02	.0475
Trash disposal	1.98	.0505
Racial issues	1.95	.0453

Water shortages fall in the middle of the list of concerns.[3]

The factor analysis showed that City of San Diego respondents grouped issues as illustrated in Table M-6. Water shortages fall into the category that includes issues that can best be described as relating to public services. The factors are ranked within each category according to the strength of their rating in the factor analysis.

[2]Note that allowable responses ranged from 1 ("not at all important") to 3 ("very important").

[3]It is possible that had this survey been conducted a year earlier, when the state was still in the grip of a serious drought, water shortages would have been viewed as much more of a concern.

Table M-6
FACTOR ANALYSIS OF PUBLIC ISSUES

Public Services Concerns	Social/Quality of Life Concerns	Financial Concerns
Education	Overcrowding	Housing costs
Trash disposal	Crime	Taxes
Water shortages	Racial issues	Economy
Homelessness	Air pollution	
	Traffic	
	Drug abuse	

Each of the factors was included in the model as a binary variable to test its explanatory impact on WTP.[4] Each of these variables was assigned the value of 1 if the mean value of all of a respondent's ratings for the issues included in that factor exceeded the value assigned to the water shortage issue, and zero otherwise. For City of San Diego, both the finance factor and the public services factor are statistically significant in explaining WTP.

Open-Ended Responses

Following the referendum questions, respondents were asked several open-ended questions regarding what actions they thought they would have to take under specified shortage scenarios, and what issues they considered when deciding whether to vote yes or no. These questions were asked to better understand the reasoning of participants. Participants' answers to these questions are summarized in Exhibit M-2.

[4]The "public services/environmental" factor included in the model excluded the water shortages variable.

Exhibit M-1
MODEL RESULTS

Results for the detailed and simplified models follow this page. The results present each variable included in the model along with the following information:

- **Coefficient** indicates the magnitude of the variable's impact on WTP
- **Standard error** reflects the distribution of the coefficient
- **T-statistic** is a commonly used measure of statistical significance
- **P-value** is the observed significance level (for example, if p = .05, the coefficient is statistically significant at the 95% level)

The following key of variable pneumonics used in the model will facilitate interpretation of these results.

Key of Survey Variables

SUPPLY:	Percentage reduction from full service demand specified in the cv scenario.
FREQ:	Frequency of drought specified in the CV scenario.
AREAYRS:	Number of years respondent has lived in the area.
HHSIZE:	Number of persons in the household, including respondent.
AGE1834:	Respondent's age is in the range of 18 to 34 years old.
AGE3554:	Respondent's age is in the range of 35 to 54 years old.
COLGRAD:	Respondent is a college graduate.
INCGT%50:	1992 household income is greater than $50,000.
SNGL_FAM:	Respondent lives in a single family residence.
QUALLIFE:	Concern for "quality of life issues" (as defined by a factor analysis) relative to concern for water shortages.
SOCIAL:	Concern for "social issues" (as defined by a factor analysis) relative to concern for water shortages.
FINANCE:	Concern for "finance issues" (as defined by a factor analysis) relative to concern for water shortages.
ENVIRON:	Concern for "public services and/or environmental issues" (as defined by a factor analysis) relative to concern for water shortages.
SEVERE:	Perception of the severity of the recent drought
SHORTAGE:	Water shortages considered a somewhat or very important problem.
LONGTERM:	Perception of water shortages as a long-term problem in the area.
MANDATE:	Respondent believes that their water agency suggested or mandated cutbacks during the recent drought.
OWNPAY:	Respondent owns home and is personally responsible for paying the water bill.

OWNELSE:	Respondent owns home and someone else in the household is responsible for paying the water bill.
OWNASSOC:	Respondent owns home and a homeowners association is responsible for paying the water bill.
RENTPAY:	Respondent rents home, water bill is not included in the rent.
YELLOW:	Homes with private landscaped areas less than 3,000 square feet or shared landscaped areas less than 5,000 square feet.
PINK:	Homes with shared landscaped areas greater than 5,000 square ft.
NOGROWTH:	Respondent wants community to remain the same size/decrease in size.
RATE:	Average residential rate for respondent's water agency
NORTH:	Northern California water agency
BID:	Amount that respondents bill would increase per month if the majority of the community voted yes to the referendum.

Simplified model for City of San Diego

Date: 2/22/1994
Observations: 518 D.F. : 507

Var	Coef	Std. Error	t-Stat	P-Value
CONSTANT	2.272191	0.688119	3.302	0.0005131
SUPPLY	-1.195991	0.716861	-1.668	0.04792
FREQ	0.008072613	0.0102564	0.7871	0.2158
AREAYRS	-0.004345922	0.00580978	-0.748	0.2274
HHSIZE	-0.00599841	0.0740587	-0.081	0.4677
AGE1834	-0.04145761	0.239999	-0.1727	0.4315
AGE3554	0.5680887	0.205025	2.771	0.002896
COLGRAD	0.1525424	0.182932	0.8339	0.2024
INCGT50K	-0.5001148	0.201117	-2.487	0.006604
SNGL_FAM	0.02560756	0.193096	0.1326	0.4473
BID	-0.1268521	0.00708474	-17.9	1.833e-56

Detailed model for City of San Diego

Date: 2/22/1994
Observations: 502 D.F. : 476

Var	Coef	Std. Error	t-Stat	P-Value
CONSTANT	3.404611	0.861849	3.95	4.46e-05
SUPPLY	-1.339869	0.742654	-1.804	0.0359
FREQ	0.007948067	0.0105975	0.75	0.2268
AREAYRS	-0.0004638296	0.00619589	-0.07486	0.4702
HHSIZE	-0.05339888	0.079729	-0.6698	0.2517
AGE1834	0.01201	0.25478	0.04714	0.4812
AGE3554	0.6428702	0.217613	2.954	0.001641
COLGRAD	-0.01614454	0.203068	-0.0795	0.4683
INCGT50K	-0.4249417	0.212382	-2.001	0.02297
SNGL_FAM	0.4665603	0.391612	1.191	0.117
QUALLIFE	0.009607491	0.286547	0.03353	0.4866
SOCIAL	-0.01052753	0.278187	-0.03784	0.4849
FINANCE	-0.6644894	0.261333	-2.543	0.00565
ENVIRON	0.3945587	0.264217	1.493	0.06799
SEVERE	-0.4381343	0.196199	-2.233	0.01299
SHORTAGE	-0.3652836	0.27527	-1.327	0.09256
LONGTERM	0.7864187	0.194304	4.047	2.999e-05
MANDATE	-0.2975842	0.221577	-1.343	0.08994
OWNPAY	-0.3459822	0.411093	-0.8416	0.2002
OWNELSE	-0.7311579	0.537467	-1.36	0.08716
OWNASSOC	0.3508599	0.29856	1.175	0.1202
RENTPAY	-0.05676196	0.453761	-0.1251	0.4503
YELLOW	-0.2704206	0.197926	-1.366	0.08623
PINK	-0.8474579	0.28181	-3.007	0.001384
NOGROWTH	-0.3740396	0.325613	-1.149	0.1256
BID	-0.1349617	0.00764904	-17.64	7.219e-55

Exhibit M-2
OPEN-ENDED RESPONSES

SURVEY QUESTION 19

WHAT ARE THE PRIMARY REASONS YOU WOULD CHOSE NOT TO PAY THE ADDITIONAL MONEY ON YOUR WATER BILL TO AVOID FUTURE SHORTAGES?

(Asked Only of the 39 Respondents Who Voted No to the First and Second Bids for Both Scenarios)

CITY OF SAN DIEGO

Reason	Percent of Respondents
Prefer to reduce my water usage	44%
Tired of paying for others/everyone should conserve	36%
Cannot afford a higher water bill	36%
Low confidence in the water agency	26%
Not willing to pay more	23%
Additional water supplies encourage population growth	15%
Do not believe water shortages can be avoided	13%

The table indicates the percent of respondents who listed the specified reason. The sum of the column is greater than 100% because respondents could list more than one reason. Responses given by fewer than 2% of the respondents are not listed.

SURVEY QUESTION 20

WHAT FACTORS OR ISSUES DID YOU CONSIDER WHEN DECIDING TO VOTE YES OR NO?

(Asked Only of Respondents Who Voted Yes to at Least One Bid)

CITY OF SAN DIEGO

Factors Considered	Percent of Respondents
Cannot afford more on bill	46%
We can conserve	18%
Water is a necessity	14%
New resources should be developed	11%
No confidence in the water agency	11%
Depends upon the resource project	8%
Not willing to pay more	7%
Magnitude of shortage	6%
Future generations and their needs	6%
Not willing to pay for others use	6%
Frequency of shortage	5%
Impacts of shortage on greenery/aesthetics	4%
Too many people/restrict new development	3%
Impacts of new resources on environment	2%
Frequency and magnitude of shortage	0%

The table indicates the percent of respondents who listed the specified issue or factor. The sum of the column is greater than 100% because respondents could list more than one issue or factor. Responses given by fewer than 2% of the respondents are not listed.

SURVEY QUESTIONS 21 AND 22

WHEN YOU WERE ANSWERING THE QUESTIONS ABOUT WHAT IT WOULD BE WORTH TO YOU TO AVOID THE ____% WATER SHORTAGE ONCE EVERY ____ YEARS, WHAT DID YOU ASSUME YOUR HOUSEHOLD WOULD HAVE TO DO TO CUT BACK YOUR WATER USE?

CITY OF SAN DIEGO

Actions to Reduce Water Use	Water Shortage				
	10%	20%	30%	40%	50%
Can't conserve anymore, would do nothing more	22.7%	20.3%	11.5%	19.5%	8.2%
Install low-flow showerheads	8.6	4.7	2.5	5.5	1.2
Install displacement devices in toilet	2.3	3.1	.8	3.1	2.4
Replace toilets with low-flush toilets	4.7	7.0	2.5	5.5	3.5
Take fewer/shorter showers	36.7	37.5	32.0	26.6	34.1
User fewer flushes	13.3	16.4	19.7	12.5	12.9
Use grey water/recycle water	3.9	6.3	5.7	9.4	3.5
Use dishwasher less/not at all	14.1	13.3	13.9	12.5	14.1
Do laundry less/take to a laundromat	10.2	11.7	17.2	16.4	9.4
Change outside plant watering habits	3.1	3.1	5.7	7.0	4.7
Wash car less/not at all/take to carwash	7.0	11.7	17.2	7.0	14.1
Water lawn less/let lawn die	14.8	16.4	23.8	23.4	22.4

The table indicates the percentage of respondents who listed the specified action. The sum of each column is greater than 100% because respondents could list more than one action.

Appendix N
SAN FRANCISCO WATER DEPARTMENT
RESULTS

THE VALUE OF WATER SUPPLY RELIABILITY: RESULTS OF A CONTINGENT VALUATION SURVEY

SAN FRANCISCO WATER DEPARTMENT (SFWD)

This appendix discusses the contingent valuation (CV) survey results for the San Francisco Water Department (SFWD). Section I discusses survey administration, including sampling, survey procedures, and response rates. Section II presents analytic results. Exhibits N-1 and N-2 contain model results, and summary tables of participants' open-ended responses.

I. SURVEY ADMINISTRATION

SFWD opted to purchase additional survey completions beyond its initial allocation of 300 in order to increase overage and to look at potential differences in willingness to pay among difficult subpopulations in its service area. The total number of completions for SFWD was 580. A random sample of 1,800 names, addresses, and telephone numbers of residents in the City of San Francisco, Hayward, Burlingame, Milpitas, and Sunnyvale[1] was purchased from Survey Sampling, Inc., a private sampling firm.

The survey of SFWD customers was conducted in January and February, 1994. A high percentage of sample points could not be reached by telephone during the study, or were unable to participate because they did not speak English, were ill or hard of hearing, or had thrown out the mail materials and were uninterested in receiving a second set. The final disposition of sample points is illustrated in Table N-1.

II. ANALYTIC RESULTS

Comparison of the Sample with the Population

Before discussing the customer loss functions for SFWD, we first must determine the extent to which the survey sample differs from the underlying population. To do this, census results were compared to sample characteristics with respect to age, income,

[1]Portions of Milpitas and Sunnyvale are served by Santa Clara Valley Water District (SCVWD).

Table N-1
SFWD RESPONSE RATES

	San Francisco	Burlingame	Hayward	Milpitas	Sunnyvale	Total
Initial sample	600	300	300	300	300	1,800
Unused sample[a]	0	0	0	0	0	0
Out of sample[b]	52	37	30	24	27	170
No telephone number available	45	21	25	26	17	136
Corrected sample size	**503**	**242**	**245**	**250**	**256**	**1,494**
Refusals	56	46	22	13	38	175
Not reached during study	107	45	32	58	49	291
Unable to participate[c]	157	52	95	83	64	451
Completed interviews	**183**	**99**	**96**	**96**	**106**	**580**
Response rate[d]	**36%**	**41%**	**39%**	**38%**	**41%**	**38%**

[a]There was no attempt to contact these sample points.
[b]These include businesses, landlords, vacancies, duplicate sample points, and sample points no longer residing in study area.
[c]Includes language and other communication barriers, or mailing not received, not read, or thrown away.
[d]Calculated as a percent of the corrected sample size.

education, household size, and type of dwelling (i.e., single-family vs. multifamily). The results are presented in Table N-2.

Table N-2 indicates that the sample was more educated, higher income, older, and had a higher proportion of single-family residents than the overall population. The standard analytical technique that is used to correct for such differences is to use population means rather than sample means to derive loss functions. The estimates of willingness to pay then reflect the population rather than the sample demographics. That approach was used in this case.

Willingness to Pay (WPT)

WTP can be interpreted as the losses that customers incur as a result of particular shortage scenarios. The amount that a customer is willing to pay to avoid an event is a measure of the losses that customer would incur if that event were to occur. Therefore, we refer to these willingness to pay results as a "loss function."

Table N-2
COMPARISON OF SAMPLE WITH POPULATION

	Sample	Population
Age		
18 to 34	10%	32%
34 to 54	41%	28%
55+	49%	40%
Household income		
Under $50,000	54%	67%
$50,000+	46%	33%
Education		
Not college grad	50%	67%
College graduate	50%	33%
Dwelling type		
Single-family	67%	43%
Multifamily	33%	57%
Household size	2.5	2.6

Tables N-3A and N-3B present the mean WTP for the detailed model and the simplified model for each magnitude and frequency of shortage. WTP figures represent increments to monthly water bills. WTP for the full model varies from a low of $11.77/month to avoid a 10% shortage once every 10 years, to a high of $17.97/month to avoid a 50% shortage every 20 years.

The results of the simplified model are almost identical to the detailed model. The remainder of this report cites results based on the detailed model only.

The loss function is shown graphically in Figure N-1. In examining the tabular and graphical results, two major conclusions can be drawn:

- As expected, respondents are willing to pay more for larger shortages and for shortages that occur with higher frequency. However, the response to frequency variations is considerably smaller than the impact of magnitude. This is confirmed by referring to the model estimation results, which are shown in Exhibit N-1.

  Put another way, it appears that residential customers believe that infrequent large shortages impose higher losses than more frequent small shortages.

Table N-3A
MEAN MONTHLY WILLINGNESS TO PAY, DETAILED MODEL
(Additional $/Month)

Shortage (% Reduction from Full Service)	Frequency (Occurrences/Years)				
	1/30	1/20	1/10	1/5	1/3
10%			$11.77	$12.08	$12.20
20%	$12.12	$12.75	$13.38		
30%	$13.76	$14.41	$15.08		
40%	$15.47	$16.16	$16.85		
50%	$17.26	$17.97			

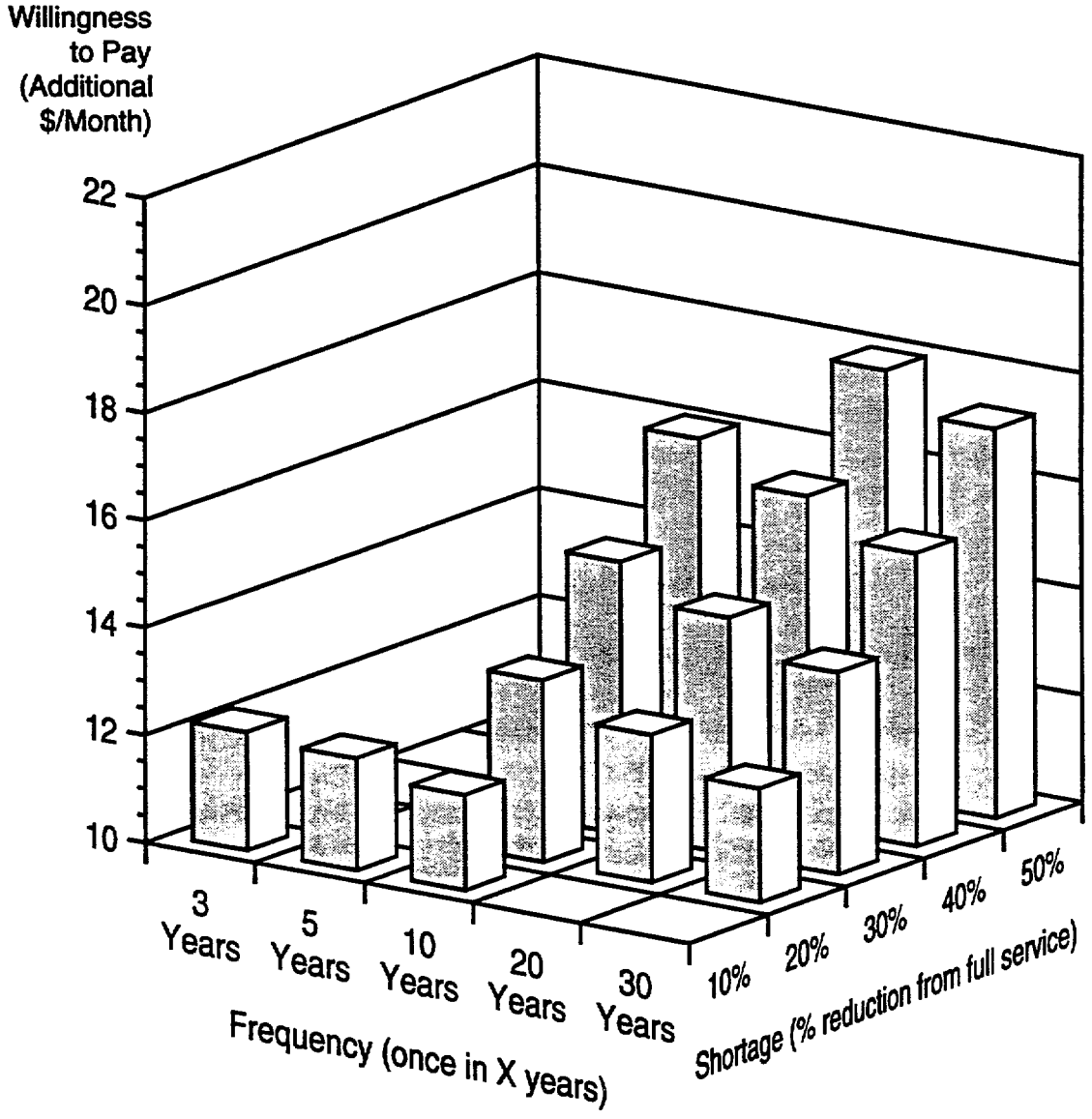
Table N-3B
MEAN MONTHLY WILLINGNESS TO PAY, SIMPLIFIED MODEL
(Additional $/Month)

Shortage (% Reduction from Full Service)	Frequency (Occurrences/Years)				
	1/30	1/20	1/10	1/5	1/3
10%			$12.03	$12.26	$12.36
20%	$12.61	$13.08	$13.56		
30%	$14.17	$14.67	$15.18		
40%	$15.81	$16.33	$16.86		
50%	$17.51	$18.05			

San Francisco Water Department

Figure N-1

Mean Monthly Willingness to Pay to Avoid Particular Shortage Frequencies and Magnitudes



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- To avoid even apparently minor shortage scenarios (e.g., 10% once every 10 years), respondents are willing to pay substantial amounts. This type of "threshold" response is not uncommon in surveys of this type and may indicate that respondents regard even a mild shortage scenario as an inconvenience that they want to avoid. They may make a greater distinction between "shortage" and "no shortage" than between different sizes or frequencies of shortages.

Confidence Intervals

Consistent with the approach typically used in the literature to calculate confidence intervals for CV results, we have estimated a range around the WTP associated with the mean shortage frequency and magnitude. Using this approach, the 95% confidence interval for SFWD is ±$1.41. In other words, there is a 95% probability that the WTP to avoid this average shortage lies within a ±$1.41 range. This range most likely underestimates the size of the confidence interval for low and high level shortages, where there are fewer observations. However, it does provide a good relative indicator of the precision of the WTP results. The confidence interval represents only the likely margin of uncertainty due to sampling error. There are also other sources of uncertainty in the WTP estimates, including nonresponse and response errors.

Impact of Key Explanatory Variables on WTP

As described previously, the statistical model includes many variables that could potentially explain the variation in WTP. The model results in Exhibit N-1 include the estimated model coefficients and their statistical significance. The following discussion selects three explanatory variables that are statistically significant and illustrates their impact on WTP. Figures N-2 through N-4 show the variation of WTP at various shortage magnitudes when all other variables, other than the one in question, are held constant.

Age. Figure N-2 illustrates the variation of WTP by age for several representative shortage scenarios. Older respondents are willing to pay more to avoid shortages than younger respondents.

Landscape Area. The quantity and type of outdoor landscaping has a statistically significant influence on respondents' willingness to pay to avoid future shortages. Figure N-3 illustrates this by using the variables in the model that capture variations

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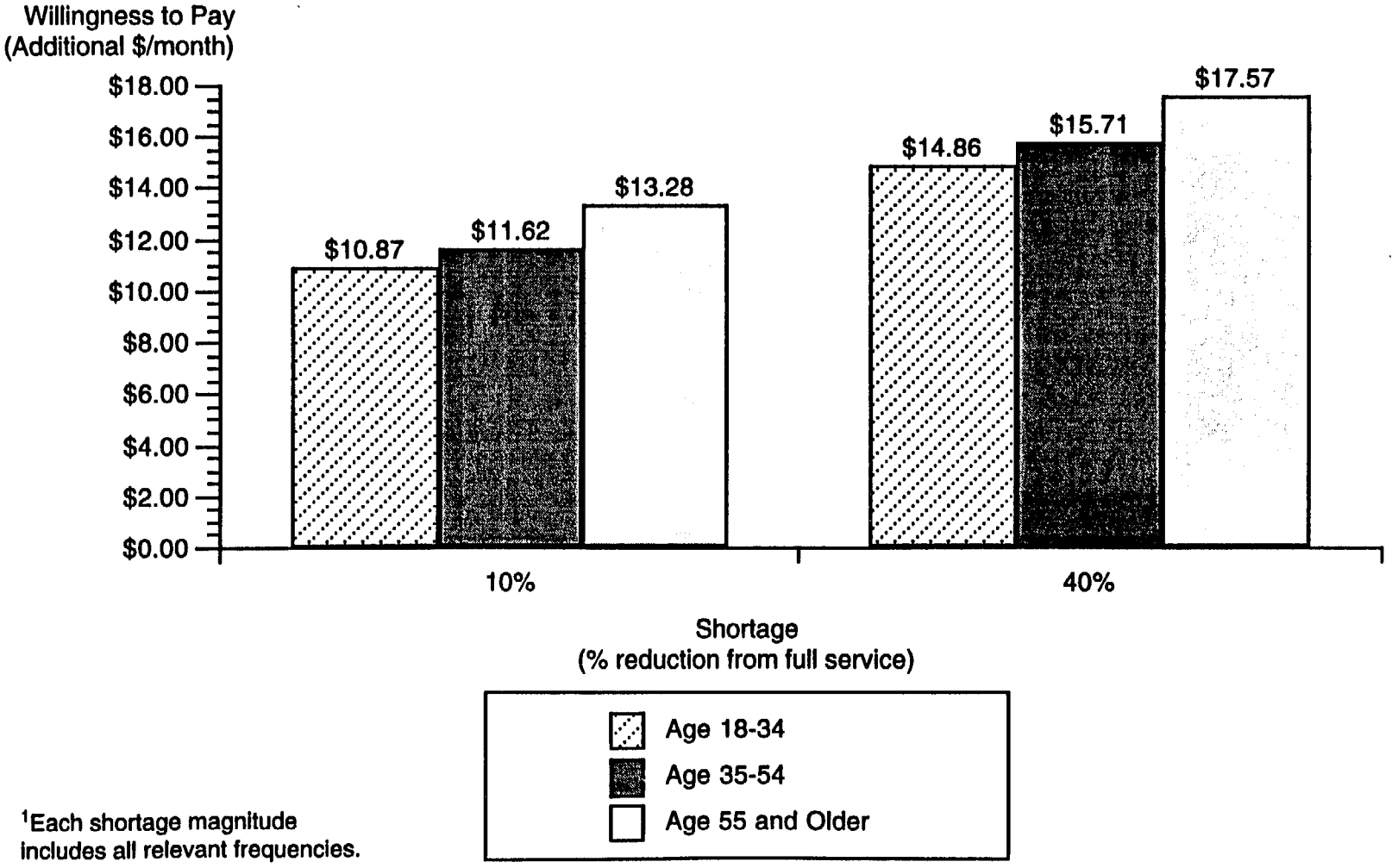
Figure N-2

Effect of Age on Willingness to Pay[1]



[1]Each shortage magnitude includes all relevant frequencies.

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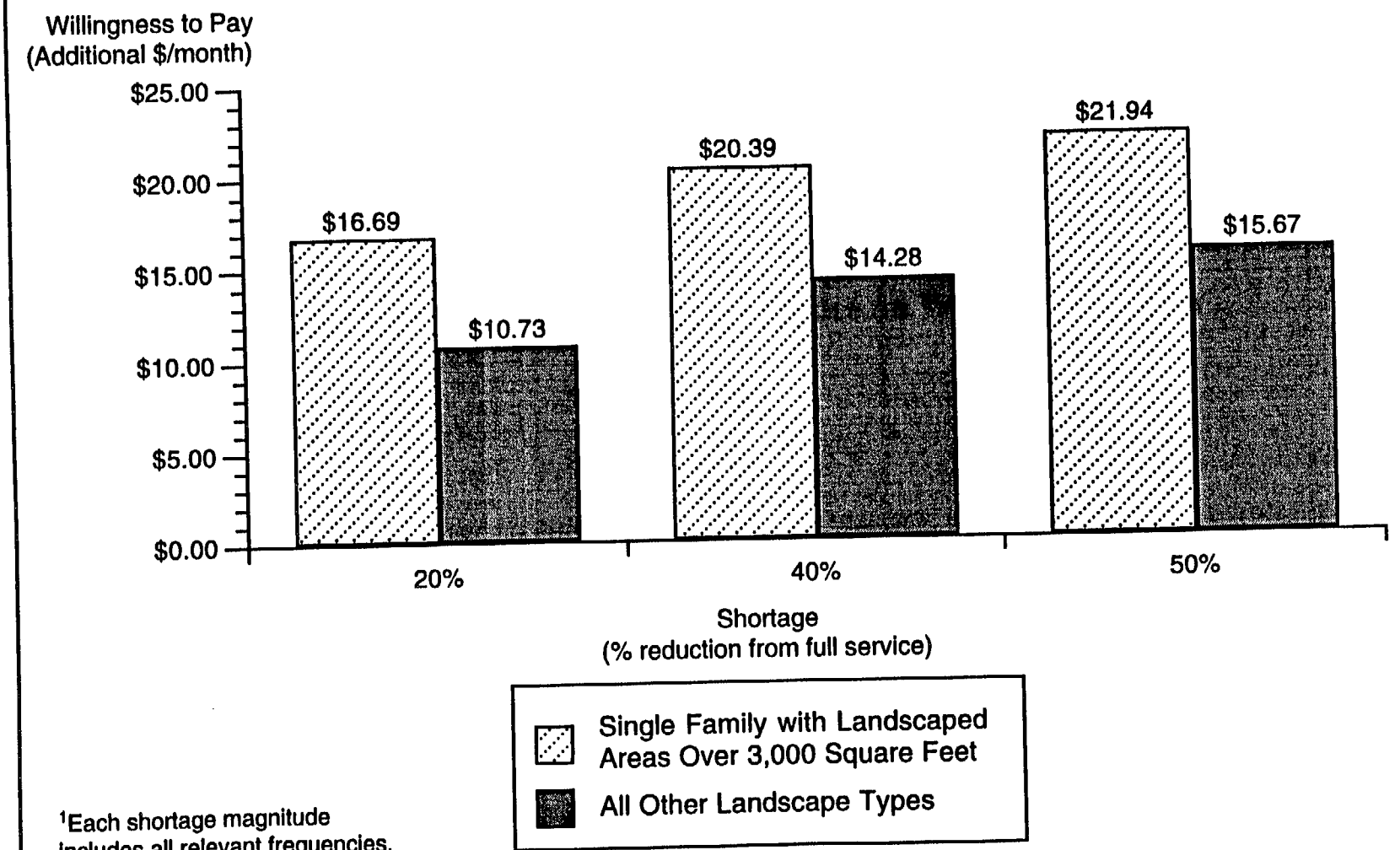
Figure N-3

Effect of Landscape Characteristics on Willingness to Pay[1]



[1]Each shortage magnitude includes all relevant frequencies.

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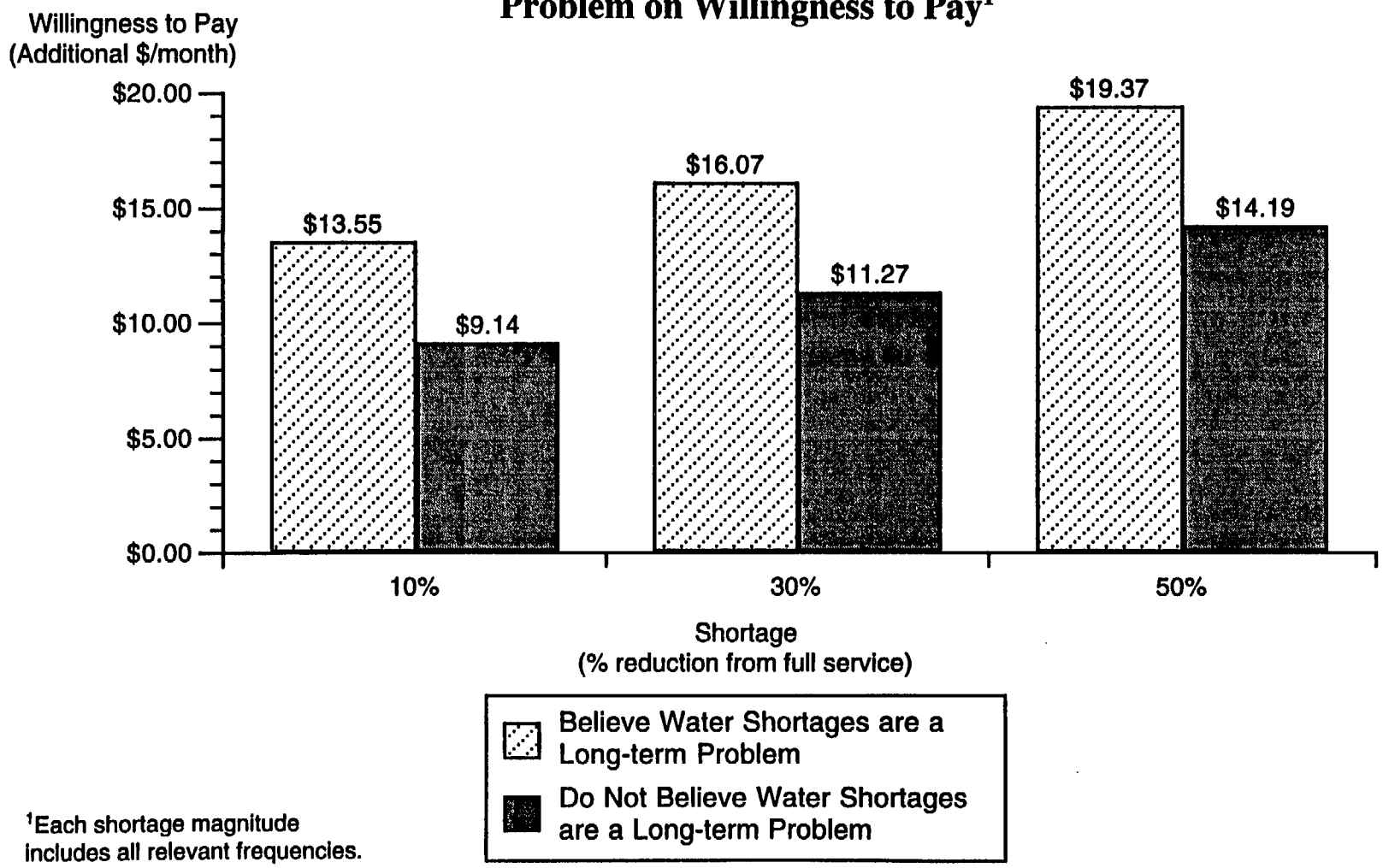
Figure N-4

Effect of Perception of Water Shortages as a Long-term Problem on Willingness to Pay[1]



[1]Each shortage magnitude includes all relevant frequencies.

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in landscaped area. Again, WTP is shown for several levels of shortage severity. The results show that single family homes with landscapes larger than 3000 square feet have higher WTP than families with other types of landscaping.

Perception of Water Shortages as a Long-Term Problem. Survey respondents were asked to what extent they considered water shortages to be a long-term problem in their area. Not unexpectedly, those who considered the water shortages to be a long-term problem have higher WTP than those who do not. WTP for these two groups is illustrated in Figure N-4.

Analysis of Subpopulations

SFWD was interested in exploring whether variations in climate and in stage of development across its service area had an impact on WTP. To facilitate an analysis of these differences the sample was selected from a mixture of hotter and colder areas, and a mixture of built out and developing areas.[2] Table N-4 illustrates differences in WTP between the hotter and colder parts of the SFWD service territory and between the developing and the built out areas of the SFWD service territory.

As Table N-4 indicates, there appear to be differences between hotter and cooler parts of the SFWD service territory, as well as between built out and developing areas of the SFWD service territory. To isolate the variation that is due to the characteristic in question, two additional variables were included in the model. The variable HOT was set equal to 1 if the respondent lived in Hayward, Milpitas, Burlingame, or Sunnyvale, and set to 0 if the respondent lived in the City of San Francisco. Similarly, the variable BUILTOUT was set equal to 1 if the respondent lived in San Francisco, Sunnyvale, or Burlingame, and set to 0 otherwise.

The results indicate that both of these variables are statistically significant in explaining WTP. Figures N-5 and N-6 illustrate the impact of these variables on WTP, holding all variables constant except the one in question. Respondents who live in warmer areas of the SFWD service territory have higher WTP than respondents who live in colder areas. Respondents who live in built out areas have higher WTP than respondents who live in developing areas.

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[2]For the purposes of this analysis, the City of San Francisco is considered to be colder and built out; Hayward and Milpitas are considered to be warmer and growing; Burlingame and Sunnyvale are considered to be warmer and built out.

Table N-4
MEAN MONTHLY WILLINGNESS TO PAY,
BY CLIMATE AND BY STAGE OF DEVELOPMENT

Shortage	Frequency	Hotter Areas	Colder Areas	Built Out Areas	Developing Areas
10%	3	$13.34	$9.93	$12.52	$11.88
10%	5	$13.12	$9.92	$12.40	$11.77
10%	10	$12.59	$9.89	$12.10	$11.51
20%	10	$14.19	$11.78	$14.19	$12.43
20%	20	$13.09	$11.72	$13.56	$11.90
20%	30	$12.03	$11.65	$12.94	$11.38
30%	10	$15.86	$13.83	$16.42	$13.37
30%	20	$14.72	$13.76	$15.75	$12.83
30%	30	$13.61	$13.69	$15.09	$12.30
40%	10	$17.59	$16.01	$18.75	$14.34
40%	20	$16.41	$15.94	$18.06	$13.78
40%	30	$15.25	$15.86	$17.37	$13.24
50%	20	$18.16	$18.22	$20.46	$14.76
50%	30	$16.97	$18.14	$19.74	$14.20

Explanatory Power of Models

Statistical goodness-of-fit tests were applied to test the explanatory power of the detailed and simplified models. The results of our calculations are presented in Table N-5.

In this case, the detailed model has only slightly more explanatory power than the simplified model. This, coupled with the similarity of the WTP results for the two models, indicate that SFWD can apply the simplified model to estimate WTP, rather than resurveying customers to gather data on the remaining variables required for the detailed model.

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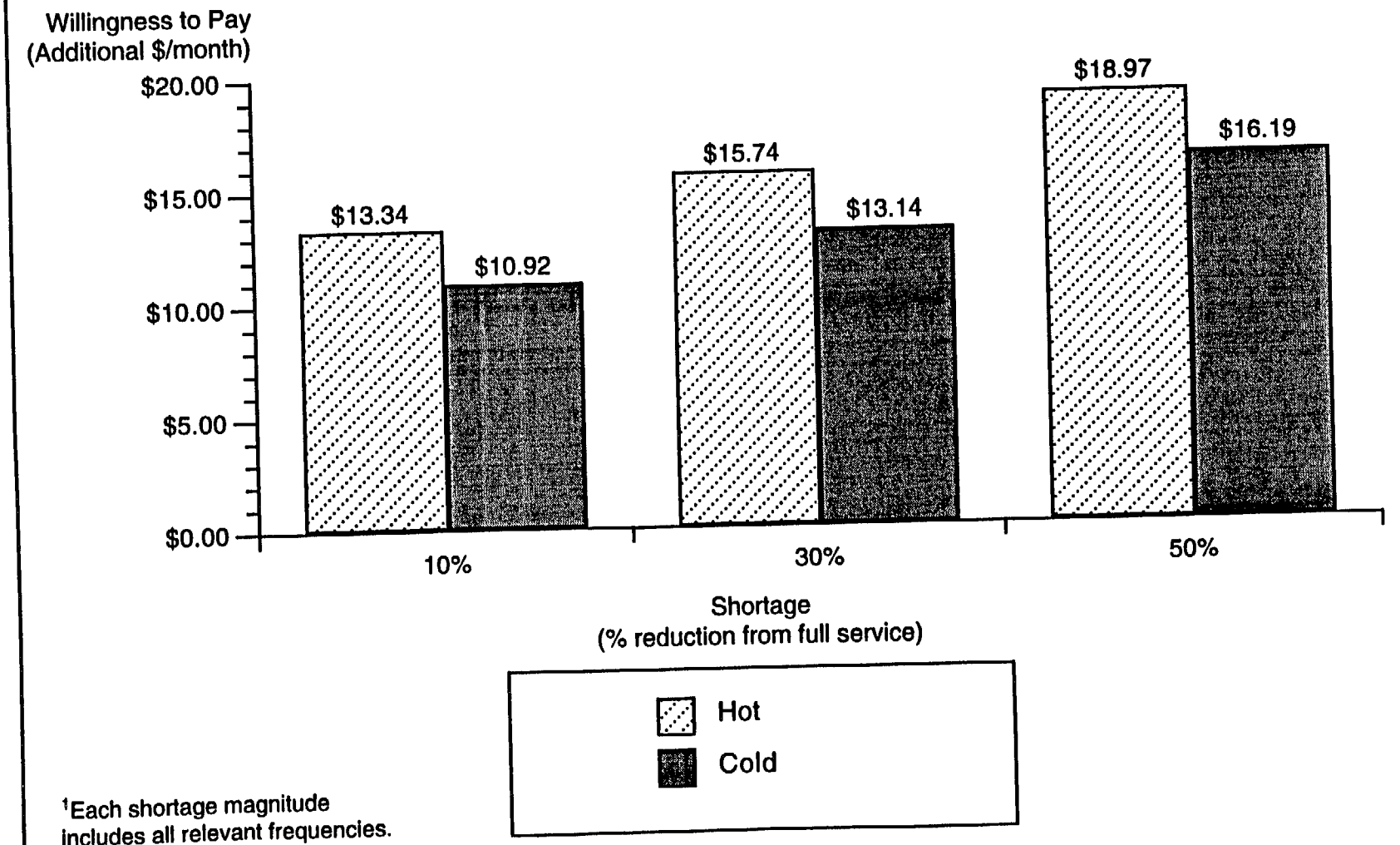
Figure N-5

Effect of Climate on Willingness to Pay[1]



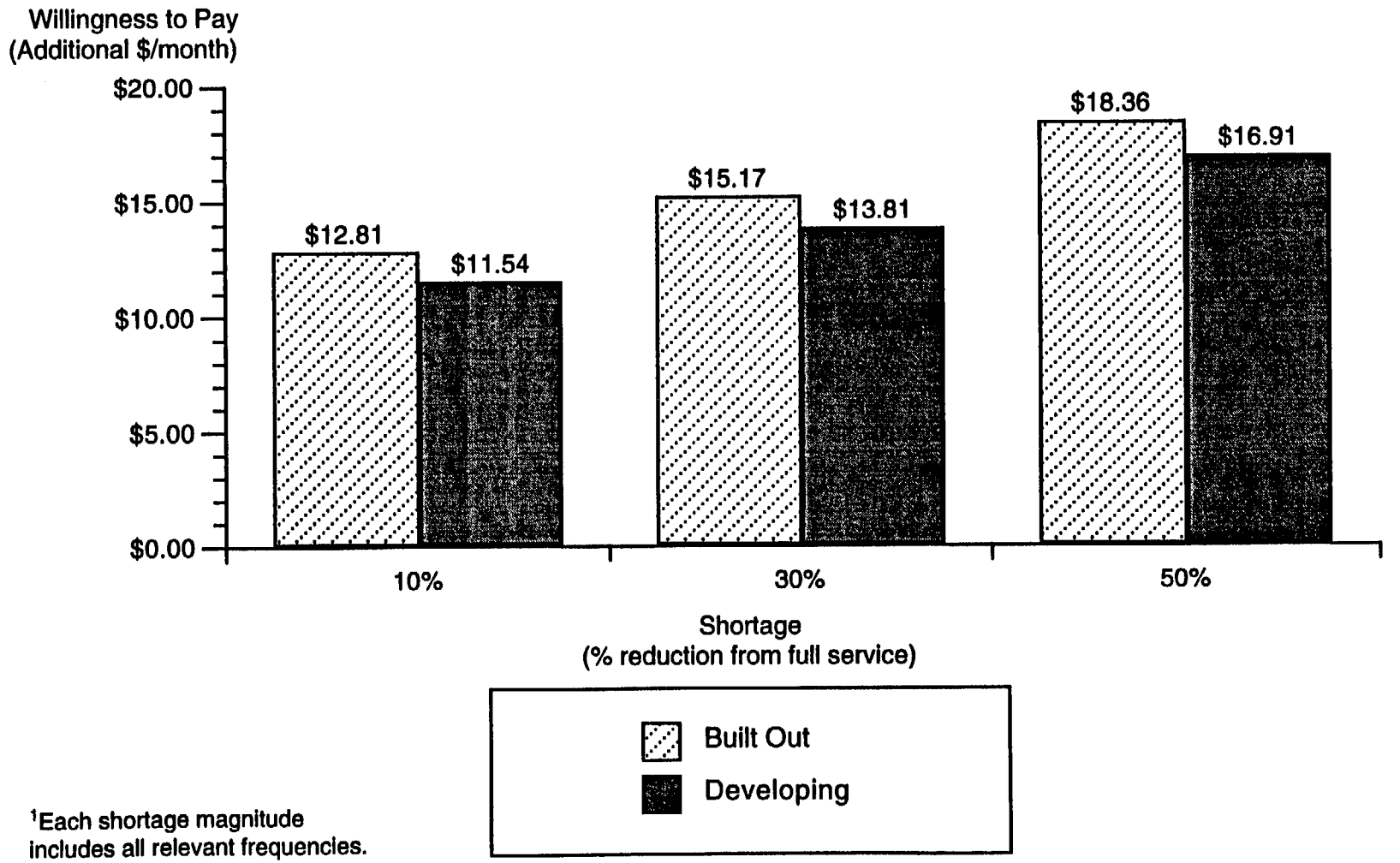
[1]Each shortage magnitude includes all relevant frequencies.

94-141100.32.final.6/94.ap

San Francisco Water Department

Figure N-6

Effect of Development on Willingness to Pay[1]



[1]Each shortage magnitude includes all relevant frequencies.

94-141100.32.final.6/94.ap

Table N-5
GOODNESS OF FIT COMPARISON

	% Predicted Correctly
Detailed model	35%
Simplified model	32%

Water Shortages as a Public Concern

In survey question 4, respondents were asked to rate the importance of various public problems, including water shortages, as "not at all important," "somewhat important," or "very important." Based on these responses, a factor analysis was performed to attempt to cluster these variables into a small number of groups.

Overall, the mean response for each issue is illustrated in Table N-6.

Water shortages fall in the middle of the list of concerns.[3]

The factor analysis showed that SFWD respondents grouped issues as illustrated in Table N-7. Water shortages fall into the category that includes issues that can best be described as relating to public services. The factors are ranked within each category according to the strength of their rating in the factor analysis.

Each of the three factors was included in the model as a binary variable to test its explanatory impact on WTP.[4] Each of these variables was assigned the value of 1 if the mean value of all of a respondent's ratings for the issues included in that factor exceeded the value assigned to the water shortage issue, and zero otherwise. For SFWD, both the financial/public services and the quality of life factors are statistically significant in explaining WTP. As expected, respondents who are more

[3]It is possible that had this survey been conducted a year earlier, when the state was still in the grip of a serious drought, water shortages would have been viewed as much more of a concern.

[4]The "public services/environmental" factor included in the model excluded the water shortages variable.

Table N-6
ISSUE RANKING AND MEAN RESPONSE[5]

Issue	Mean Rating	Standard Error
Economy	2.57	.0260
Housing costs	2.45	.0299
Education	2.40	.0334
Drug abuse	2.37	.0324
Traffic	2.33	.0309
Taxes	2.24	.0332
Water shortages	**2.22**	**.0322**
Crime	2.14	.0319
Drinking water quality	2.08	.0367
Homelessness	2.04	.0335
Air pollution	2.00	.0324
Overcrowding	1.82	.0312
Trash disposal	1.78	.0342
Racial issues	1.58	.0312

Table N-7
FACTOR ANALYSIS OF PUBLIC ISSUES

Social Concerns	Financial/Public Services Concerns	Quality of Life Concerns
Crime	Drinking water quality	Traffic
Drug abuse	Trash disposal	Overcrowding
Education	Taxes	Air pollution
Homelessness	Economy	
Racial issues		
Water shortages		

[5]Note that allowable responses ranged from 1 ("not at all important") to 3 ("very important").

concerned about quality-of-life issues (such as traffic and overcrowding) than they are about water shortages have lower WTP. Similarly, respondents who are more concerned with financial/public service issues than they are with water shortages have lower WTP.

Open-Ended Responses

Following the referendum questions, respondents were asked a series of questions to illuminate factors that influenced their responses. In particular, respondents were asked what factors they took into consideration when deciding whether to vote yes or no, and what actions they assumed they would have to take to cope with the specified shortage. Participants' answers to these questions are summarized in Exhibit N-2.

Exhibit N-1
MODEL RESULTS

Results for the detailed and simplified models follow this page. The results present each variable included in the model along with the following information:

- **Coefficient** indicates the magnitude of the variable's impact on WTP
- **Standard error** reflects the distribution of the coefficient
- **T-statistic** is a commonly used measure of statistical significance
- **P-value** is the observed significance level (for example, if p = .05, the coefficient is statistically significant at the 95% level)

The following key of variable pneumonics used in the model will facilitate interpretation of these results.

Key of Survey Variables

SUPPLY:	Percentage reduction from full service demand specified in the cv scenario.
FREQ:	Frequency of drought specified in the CV scenario.
AREAYRS:	Number of years respondent has lived in the area.
HHSIZE:	Number of persons in the household, including respondent.
AGE1834:	Respondent's age is in the range of 18 to 34 years old.
AGE3554:	Respondent's age is in the range of 35 to 54 years old.
COLGRAD:	Respondent is a college graduate.
INCGT%50:	1992 household income is greater than $50,000.
SNGL_FAM:	Respondent lives in a single family residence.
QUALLIFE:	Concern for "quality of life issues" (as defined by a factor analysis) relative to concern for water shortages.
SOCIAL:	Concern for "social issues" (as defined by a factor analysis) relative to concern for water shortages.
FINANCE:	Concern for "finance issues" (as defined by a factor analysis) relative to concern for water shortages.
ENVIRON:	Concern for "public services and/or environmental issues" (as defined by a factor analysis) relative to concern for water shortages.
SEVERE:	Perception of the severity of the recent drought
SHORTAGE:	Water shortages considered a somewhat or very important problem.
LONGTERM:	Perception of water shortages as a long-term problem in the area.
MANDATE:	Respondent believes that their water agency suggested or mandated cutbacks during the recent drought.
OWNPAY:	Respondent owns home and is personally responsible for paying the water bill.

OWNELSE:	Respondent owns home and someone else in the household is responsible for paying the water bill.
OWNASSOC:	Respondent owns home and a homeowners association is responsible for paying the water bill.
RENTPAY:	Respondent rents home, water bill is not included in the rent.
YELLOW:	Homes with private landscaped areas less than 3,000 square feet or shared landscaped areas less than 5,000 square feet.
PINK:	Homes with shared landscaped areas greater than 5,000 square ft.
NOGROWTH:	Respondent wants community to remain the same size/decrease in size.
RATE:	Average residential rate for respondent's water agency
NORTH:	Northern California water agency
BID:	Amount that respondents bill would increase per month if the majority of the community voted yes to the referendum.

San Francisco simplified model

Date: 3/14/1994
Observations: 985 D.F. : 974

Var	Coef	Std. Error	t-Stat	P-Value
CONSTANT	3.115378	0.500507	6.224	3.57e-10
SUPPLY	-2.233299	0.51002	-4.379	6.603e-06
FREQ	-0.006903591	0.00749132	-0.9215	0.1785
AREAYRS	0.002714526	0.00431906	0.6285	0.2649
HHSIZE	-0.01107638	0.0482481	-0.2296	0.4092
AGE1834	-0.2277483	0.223514	-1.019	0.1542
AGE3554	-0.1540579	0.146528	-1.051	0.1467
COLGRAD	0.0715081	0.124882	0.5726	0.2835
INCGT50K	0.2426935	0.130733	1.856	0.03185
SNGL_FAM	-0.09816115	0.138372	-0.7094	0.2391
BID	-0.1100911	0.00461429	-23.86	5.839e-100

San Francisco detailed model

Date: 3/24/1994
Observations: 945 D.F. : 920

Var	Coef	Std. Error	t-Stat	P-Value
CONSTANT	4.719287	0.673927	7.003	2.381e-12
SUPPLY	-2.450356	0.53101	-4.615	2.242e-06
FREQ	-0.009511335	0.0078494	-1.212	0.113
AREAYRS	0.0008641425	0.00463695	0.1864	0.4261
HHSIZE	0.03111497	0.0540224	0.576	0.2824
AGE1834	-0.3739805	0.241624	-1.548	0.06101
AGE3554	-0.2536972	0.158005	-1.606	0.05434
COLGRAD	0.08984595	0.132239	0.6794	0.2485
INCGT50K	0.1880282	0.140739	1.336	0.09093
SNGL_FAM	-0.1676212	0.24278	-0.6904	0.245
QUALLIFE	-0.3684873	0.178628	-2.063	0.0197
SOCIAL	-0.08976911	0.189675	-0.4733	0.3181
FINANCE	-0.24884	0.187864	-1.325	0.09282
SEVERE	-0.1338936	0.13253	-1.01	0.1563
SHORTAGE	-0.5722874	0.192334	-2.975	0.0015
LONGTERM	0.7067521	0.142182	4.971	3.958e-07
MANDATE	0.4539014	0.162907	2.786	0.002719
OWNPAY	-0.7252611	0.273572	-2.651	0.004079
OWNELSE	0.05666691	0.324457	0.1747	0.4307
OWNASSOC	-0.1856221	0.295092	-0.629	0.2647
RENTPAY	-0.3697211	0.308424	-1.199	0.1155
YELLOW	-0.7000928	0.166822	-4.197	1.482e-05
PINK	-0.957208	0.30795	-3.108	0.0009689
NOGROWTH	-0.3478964	0.256483	-1.356	0.08765
BID	-0.1169425	0.00500945	-23.34	7.894e-96

San Francisco Model with Binary Variables for Climate and Stage of Development

Date: 3/24/1994
Observations: 945 D.F. : 918

Var	Coef	Std. Error	t-Stat	P-Value
CONSTANT	4.281929	0.708011	6.048	1.056e-09
HOT	0.3732601	0.177518	2.103	0.01788
BUILTOUT	0.1953587	0.154887	1.261	0.1038
SUPPLY	-2.428707	0.531647	-4.568	2.784e-06
FREQ	-0.01014076	0.00786983	-1.289	0.09893
AREAYRS	0.003113041	0.00489444	0.636	0.2625
HHSIZE	0.03826273	0.0541581	0.7065	0.24
AGE1834	-0.280153	0.246617	-1.136	0.1281
AGE3554	-0.2140105	0.159829	-1.339	0.09045
COLGRAD	0.09998148	0.133954	0.7464	0.2278
INCGT50K	0.1823915	0.141162	1.292	0.09832
SNGL_FAM	-0.2339251	0.247183	-0.9464	0.1721
QUALLIFE	-0.4150261	0.182687	-2.272	0.01166
SOCIAL	-0.01686132	0.192935	-0.08739	0.4652
FINANCE	-0.2842157	0.18996	-1.496	0.06747
SEVERE	-0.1275664	0.132696	-0.9613	0.1683
SHORTAGE	-0.595535	0.193819	-3.073	0.001091
LONGTERM	0.7041477	0.142959	4.926	4.965e-07
MANDATE	0.4518244	0.16365	2.761	0.002938
OWNPAY	-0.762656	0.277255	-2.751	0.00303
OWNELSE	0.0475963	0.325218	0.1464	0.4418
OWNASSOC	-0.2574849	0.301517	-0.854	0.1967
RENTPAY	-0.3674359	0.309161	-1.188	0.1175
YELLOW	-0.6452424	0.170134	-3.793	7.929e-05
PINK	-0.9750553	0.308911	-3.156	0.0008239
NOGROWTH	-0.3398019	0.25716	-1.321	0.09335
BID	-0.1172579	0.0050281	-23.32	1.124e-95

San Francisco Detailed Model for Hot Areas Only

Date: 3/31/1994
Observations: 667 D.F. : 642

Var	Coef	Std. Error	t-Stat	P-Value
CONSTANT	5.189763	0.815424	6.364	1.822e-10
SUPPLY	-2.418374	0.63656	-3.799	7.924e-05
FREQ	-0.01641961	0.00949675	-1.729	0.04214
AREAYRS	0.0069481	0.00628842	1.105	0.1348
HHSIZE	0.04342275	0.065312	0.6649	0.2532
AGE1834	-0.2440965	0.339969	-0.718	0.2365
AGE3554	-0.255398	0.190241	-1.343	0.08995
COLGRAD	0.1049017	0.159464	0.6578	0.2554
INCGT50K	0.261079	0.172094	1.517	0.06486
SNGL_FAM	-0.3253263	0.343488	-0.9471	0.172
QUALLIFE	-0.5465517	0.226354	-2.415	0.008011
SOCIAL	-0.002555789	0.230438	-0.01109	0.4956
FINANCE	-0.2646462	0.222698	-1.188	0.1176
SEVERE	-0.1886088	0.158113	-1.193	0.1167
SHORTAGE	-0.747046	0.236748	-3.155	0.0008373
LONGTERM	0.8031459	0.171906	4.672	1.805e-06
MANDATE	0.3906933	0.215424	1.814	0.03509
OWNPAY	-0.8431796	0.395494	-2.132	0.01669
OWNELSE	0.1059783	0.46131	0.2297	0.4092
OWNASSOC	-0.3143916	0.368059	-0.8542	0.1967
RENTPAY	-1.271597	0.488276	-2.604	0.004706
YELLOW	-0.6353764	0.184791	-3.438	0.0003108
PINK	-1.173918	0.373525	-3.143	0.0008738
NOGROWTH	-0.3895241	0.296097	-1.316	0.09439
BID	-0.1211642	0.00614466	-19.72	7.633e-69

San Francisco Detailed Model for Cold Areas Only

Date: 3/31/1994
Observations: 278 D.F. : 253

*** LOGI

Var	Coef	Std. Error	t-Stat	P-Value
CONSTANT	5.826933	1.50766	3.865	6.92e-05
SUPPLY	-3.074324	1.00526	-3.058	0.001222
FREQ	-0.001038107	0.0146754	-0.07074	0.4718
AREAYRS	0.003645696	0.00882974	0.4129	0.34
HHSIZE	-0.07214158	0.1069	-0.6748	0.2502
AGE1834	-0.4073443	0.411962	-0.9888	0.1618
AGE3554	-0.06902802	0.327346	-0.2109	0.4166
COLGRAD	0.03248146	0.268049	0.1212	0.4518
INCGT50K	-0.1275968	0.269166	-0.474	0.3179
SNGL_FAM	0.120451	0.395349	0.3047	0.3804
QUALLIFE	-0.407743	0.345814	-1.179	0.1197
SOCIAL	-0.4345795	0.407173	-1.067	0.1434
FINANCE	0.1412822	0.410881	0.3439	0.3656
SEVERE	-0.07557555	0.271582	-0.2783	0.3905
SHORTAGE	-0.4565326	0.378101	-1.207	0.1141
LONGTERM	0.3273541	0.2903	1.128	0.1302
MANDATE	0.5399649	0.273243	1.976	0.02456
OWNPAY	-1.155695	0.472405	-2.446	0.007524
OWNELSE	-0.3095265	0.529678	-0.5844	0.2797
OWNASSOC	0.3954644	0.780839	0.5065	0.3065
RENTPAY	0.9076055	0.447537	2.028	0.02176
YELLOW	-1.502957	0.602877	-2.493	0.006625
PINK	-1.770786	0.787798	-2.248	0.01269
NOGROWTH	-0.2308787	0.561447	-0.4112	0.3406
BID	-0.1160578	0.00931357	-12.46	6.456e-29

San Francisco Detailed Model for Builtout Areas Only

Date: 3/31/1994
Observations: 618 D.F. : 593

Var	Coef	Std. Error	t-Stat	P-Value
CONSTANT	5.171618	0.855943	6.042	1.315e-09
SUPPLY	-3.048942	0.644865	-4.728	1.405e-06
FREQ	-0.008964166	0.00983298	-0.9116	0.1812
AREAYRS	0.004861138	0.00565894	0.859	0.1953
HHSIZE	0.124947	0.070743	1.766	0.03893
AGE1834	-0.3386705	0.300775	-1.126	0.1303
AGE3554	-0.3165898	0.202406	-1.564	0.05915
COLGRAD	0.05501005	0.171896	0.32	0.3745
INCGT50K	0.257202	0.181895	1.414	0.07893
SNGL_FAM	-0.3386735	0.290612	-1.165	0.1222
QUALLIFE	-0.3048576	0.235767	-1.293	0.09824
SOCIAL	-0.1571023	0.246185	-0.6381	0.2618
FINANCE	-0.1836941	0.242767	-0.7567	0.2248
SEVERE	-0.05509284	0.171204	-0.3218	0.3739
SHORTAGE	-0.4337062	0.241147	-1.799	0.03629
LONGTERM	0.7441297	0.184486	4.034	3.091e-05
MANDATE	0.3596605	0.192924	1.864	0.03138
OWNPAY	-0.6534516	0.321463	-2.033	0.02125
OWNELSE	0.04372522	0.389616	0.1122	0.4553
OWNASSOC	-0.1433538	0.371653	-0.3857	0.3499
RENTPAY	-0.1620319	0.35307	-0.4589	0.3232
YELLOW	-1.259971	0.220578	-5.712	8.675e-09
PINK	-1.241552	0.376402	-3.298	0.000514
NOGROWTH	-0.3758957	0.364803	-1.03	0.1516
BID	-0.1122708	0.00602477	-18.63	3.86e-62

San Francisco Detailed Model for Developing Areas

Date: 3/31/1994
Observations: 327 D.F. : 302

Var	Coef	Std. Error	t-Stat	P-Value
CONSTANT	5.959686	1.32311	4.504	4.64e-06
SUPPLY	-1.573222	0.993303	-1.584	0.0571
FREQ	-0.008990338	0.0140268	-0.6409	0.261
AREAYRS	-0.007749533	0.00952072	-0.814	0.2081
HHSIZE	-0.1146299	0.0901031	-1.272	0.1021
AGE1834	-0.4305541	0.45738	-0.9413	0.1736
AGE3554	-0.01730411	0.274114	-0.06313	0.4749
COLGRAD	0.172564	0.236738	0.7289	0.2333
INCGT50K	0.04470854	0.248733	0.1797	0.4287
SNGL_FAM	0.1316054	0.516415	0.2548	0.3995
QUALLIFE	-0.4558271	0.310114	-1.47	0.07128
SOCIAL	0.2534219	0.327789	0.7731	0.22
FINANCE	-0.4593811	0.320351	-1.434	0.07626
SEVERE	-0.3293413	0.23182	-1.421	0.07818
SHORTAGE	-0.6891598	0.367745	-1.874	0.03091
LONGTERM	0.8388839	0.247538	3.389	0.0003938
MANDATE	0.2577133	0.351094	0.734	0.2317
OWNPAY	-2.193338	0.777332	-2.822	0.002535
OWNELSE	-1.36684	0.851433	-1.605	0.05469
OWNASSOC	-1.317198	0.748998	-1.759	0.03979
RENTPAY	-2.061071	0.864811	-2.383	0.008865
YELLOW	0.1922233	0.288069	0.6673	0.2525
PINK	-0.9827157	0.613566	-1.602	0.0551
NOGROWTH	-0.7295572	0.384744	-1.896	0.02941
BID	-0.1390192	0.00985818	-14.1	6.578e-36

Exhibit N-2
OPEN-ENDED RESPONSES

SURVEY QUESTION 19

WHAT ARE THE PRIMARY REASONS YOU WOULD CHOSE NOT TO PAY THE ADDITIONAL MONEY ON YOUR WATER BILL TO AVOID FUTURE SHORTAGES?

(Asked Only of the 82 Respondents Who Voted No to the First and Second Bids for Both Scenarios)

SAN FRANCISCO WATER DEPARTMENT

Reason	Percent of Respondents
Tired of paying for others/everyone should conserve	33%
Prefer to reduce my water usage	26%
Not willing to pay more	17%
Low confidence in the water agency	17%
Additional water supplies encourage population growth	12%
Cannot afford a higher water bill	7%
Do not believe water shortages can be avoided	4%

The table indicates the percent of respondents who listed the specified reason. The sum of the column is greater than 100% because respondents could list more than one reason. Responses given by fewer than 2% of the respondents are not listed.

SURVEY QUESTION 20

WHAT FACTORS OR ISSUES DID YOU CONSIDER WHEN DECIDING TO VOTE YES OR NO?

(Asked Only of Respondents Who Voted Yes to at Least One Bid)

SAN FRANCISCO WATER DEPARTMENT

Factors Considered	Percent of Respondents
Water is a necessity	24%
Cannot afford more on bill	20%
We can conserve	18%
Not willing to pay more	15%
Future generations and their needs	11%
Not willing to pay for others use	9%
Frequency and magnitude of shortage	6%
Depends upon the resource project	6%
New resources should be developed	5%
Too many people/restrict new development	4%
Magnitude of shortage	4%
Frequency of shortage	4%
Impacts of new resources on environment	4%
Impacts of shortage on greenery/aesthetics	2%
No confidence in the water agency	2%

The table indicates the percent of respondents who listed the specified issue or factor. The sum of the column is greater than 100% because respondents could list more than one issue or factor. Responses given by fewer than 2% of the respondents are not listed.

SURVEY QUESTIONS 21 AND 22

WHEN YOU WERE ANSWERING THE QUESTIONS ABOUT WHAT IT WOULD BE WORTH TO YOU TO AVOID THE ___% WATER SHORTAGE ONCE EVERY ___ YEARS, WHAT DID YOU ASSUME YOUR HOUSEHOLD WOULD HAVE TO DO TO CUT BACK YOUR WATER USE?

SAN FRANCISCO WATER DEPARTMENT

Actions to Reduce Water Use	Water Shortage				
	10%	20%	30%	40%	50%
Can't conserve anymore, would do nothing more	11.2%	14.2%	17.5%	14.3%	15.3%
Install low-flow showerheads	5.6	7.3	6.1	10.4	6.5
Install displacement devices in toilet	3.9	3.4	2.2	3.9	2.4
Replace toilets with low-flush toilets	2.6	3.9	6.1	7.8	6.5
Take fewer/shorter showers	28.9	33.2	28.1	33.3	35.3
User fewer flushes	17.2	22.8	16.2	20.8	18.2
Use grey water/recycle water	6.5	8.2	10.1	13.0	10.6
Use dishwasher less/not at all	7.3	8.2	6.6	10.0	14.7
Do laundry less/take to a laundromat	12.5	8.6	13.2	11.7	20.6
Change outside plant watering habits	9.9	10.8	8.8	8.7	7.6
Wash car less/not at all/take to carwash	5.3	8.6	7.5	7.8	7.6
Water lawn less/let lawn die	19.0	15.1	18.9	18.6	19.4

The table indicates the percentage of respondents who listed the specified action. The sum of each column is greater than 100% because respondents could list more than one action.

Appendix O
SANTA CLARA VALLEY WATER DISTRICT
RESULTS

THE VALUE OF WATER SUPPLY RELIABILITY: RESULTS OF A CONTINGENT VALUATION SURVEY

SANTA CLARA VALLEY WATER DISTRICT (SCVWD)

This appendix discusses the contingent valuation (CV) survey results for the Santa Clara Valley Water District (SCVWD). Section I discusses survey administration, including sampling, survey procedures, and response rates. Section II presents analytic results. Exhibits O-1 and O-2 contain model results, and summary tables of participants' open-ended responses.

I. SURVEY ADMINISTRATION

The total number of completions for SCVWD was 300. A random sample of 960 names, addresses, and telephone numbers of residents in Santa Clara County, excluding the City of Palo Alto, was purchased from Survey Sampling, Inc., a private sampling firm.

The survey of SCVWD customers was conducted from mid-January to early February 1994. A relatively high number of sample points could not be reached by telephone or were unable to participate due to language barriers or because they had thrown out the mail materials. The final disposition of sample points is illustrated in Table O-1.

II. ANALYTIC RESULTS

Comparison of the Sample with the Population

Before discussing the customer loss functions for SCVWD, we first must determine the extent to which the survey sample differs from the overall District population. To do this, census results were compared to sample characteristics with respect to age, income, education, household size, and type of dwelling (i.e., single-family vs. multifamily). The results are presented in Table O-2.

Table O-2 indicates that the sample was more educated, older, wealthier, and had a higher proportion of single-family residents than the overall population. The standard analytical technique that is used to correct for such differences is to use population means rather than sample means to derive loss functions. The estimates of willingness

Table O-1
SCVWD RESPONSE RATES

	Total
Initial sample	960
Unused sample[a]	0
Out of sample[b]	115
No telephone number available	70
Corrected sample size	**775**
Refusals	56
Not reached during study	246
Unable to participate[c]	173
Completed interviews	**300**
Response rate[d]	**39%**

[a]There was no attempt to contact these sample points.
[b]These include businesses, landlords, vacancies, duplicate sample points, and sample points no longer residing in study area.
[c]Includes language/other communication barriers, or mailing not received, not read, or thrown away.
[d]Calculated as a percent of the corrected sample size.

Table O-2
COMPARISON OF SAMPLE WITH DISTRICT POPULATION

	Sample	Population
Age		
18 to 34	11%	33%
34 to 54	40%	28%
55+	49%	39%
Household income		
Under $50,000	45%	52%
$50,000+	55%	48%
Education		
Not college grad	44%	67%
College graduate	56%	33%
Dwelling type		
Single-family	80%	65%
Multifamily	20%	35%
Household size	2.7	2.8

to pay then reflect the population rather than the sample demographics. That approach was used in this case.

Willingness to Pay (WTP)

WTP can be interpreted as the losses that customers incur as a result of particular shortage scenarios. The amount that a customer is willing to pay to avoid an event is a measure of the losses that customer would incur if that event were to occur. Therefore, we refer to these willingness to pay results as a "loss function."

Tables O-3A and O-3B present the mean WTP for the detailed model and the simplified model for each magnitude and frequency of shortage. WTP figures represent increments to monthly water bills. WTP for the full model varies from a low of $11.43/month to avoid a 20% shortage once every 30 years, to a high of $21.25/month to avoid a 50% shortage once every 20 years.

The results of the simplified model are almost identical to the detailed model. The remainder of this report cites results based on the detailed model only.

Table O-3A
MEAN MONTHLY WILLINGNESS TO PAY, DETAILED MODEL
(Additional $/Month)

Shortage (% Reduction from Full Service)	Frequency (Occurrences/Years)				
	1/30	1/20	1/10	1/5	1/3
10%			$13.15	$14.21	$14.64
20%	$11.43	$13.45	$15.61		
30%	$13.75	$15.92	$18.20		
40%	$16.24	$18.53	$20.91		
50%	$18.87	$21.25			

Table O-3B
MEAN MONTHLY WILLINGNESS TO PAY, SIMPLIFIED MODEL
(Additional $/Month)

Shortage (% Reduction from Full Service)	Frequency (Occurrences/Years)				
	1/30	1/20	1/10	1/5	1/3
10%			$13.21	$14.14	$14.32
20%	$11.57	$13.35	$15.23		
30%	$13.49	$15.38	$17.36		
40%	$15.53	$17.52	$19.58		
50%	$17.67	$19.74			

The loss function is shown graphically in Figure O-1. In examining the tabular and graphical results, two major conclusions can be drawn:

- As expected, respondents are willing to pay more for larger shortages and for shortages that occur with higher frequency. However, the response to frequency variations is considerably smaller than the impact of magnitude. This is confirmed by referring to the model estimation results, which are shown in Exhibit O-1.

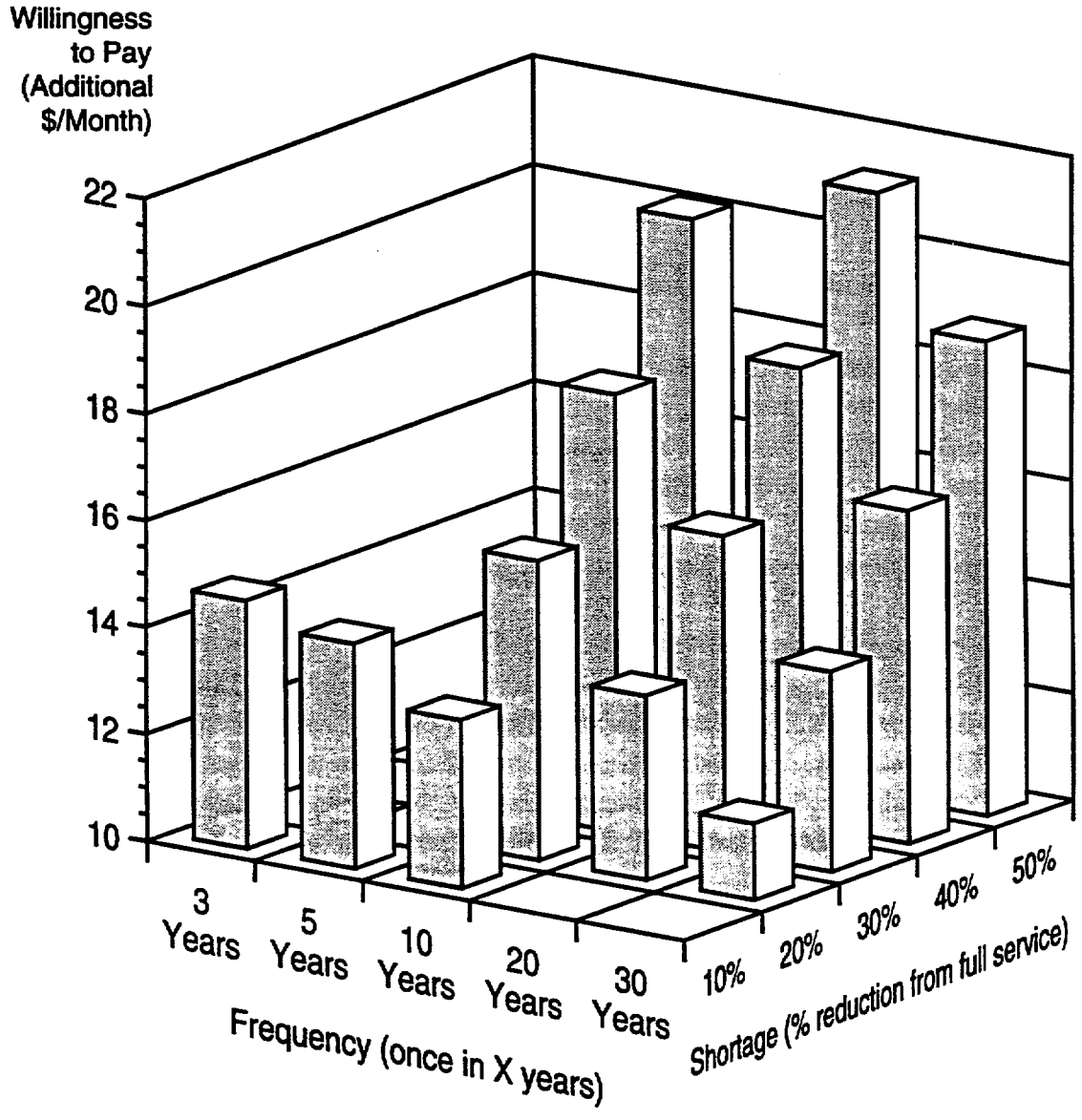
  Put another way, it appears that residential customers believe that infrequent large shortages impose higher losses than more frequent small shortages.

- To avoid even apparently minor shortage scenarios (e.g., 10% once every 10 years), respondents are willing to pay substantial amounts. This type of "threshold" response is not uncommon in surveys of this type and may indicate that respondents regard even a mild shortage scenario as an inconvenience that they want to avoid. They may make a greater distinction between "shortage" and "no shortage" than between different sizes or frequencies of shortages.

Santa Clara Valley Water District

Figure O-1

Mean Monthly Willingness to Pay to Avoid Particular Shortage Frequencies and Magnitudes



Confidence Intervals

Consistent with the approach typically used in the literature to calculate confidence intervals for CV results, we have estimated a range around the WTP associated with the mean shortage frequency and magnitude. Using this approach, the 95% confidence interval for SCVWD is ±$1.91. In other words, there is a 95% probability that the WTP to avoid this average shortage lies within a ±$1.91 range. This range most likely underestimates the size of the confidence interval for low and high level shortages, where there are fewer observations. However, it does provide a good relative indicator of the precision of the WTP results. The confidence interval represents only the likely margin of uncertainty due to sampling error. There are also other sources of uncertainty in the WTP estimates, including nonresponse and response errors.

Impact of Key Explanatory Variables on WTP

As described previously, the statistical model includes many variables that could potentially explain the variation in WTP. The model results in Exhibit O-1 include the estimated model coefficients and their statistical significance. The following discussion selects three explanatory variables that are statistically significant and illustrates their impact on WTP. Figures O-2 and O-3 show the variation of WTP at various shortage magnitudes when all other variables, other than the one in question, are held constant.

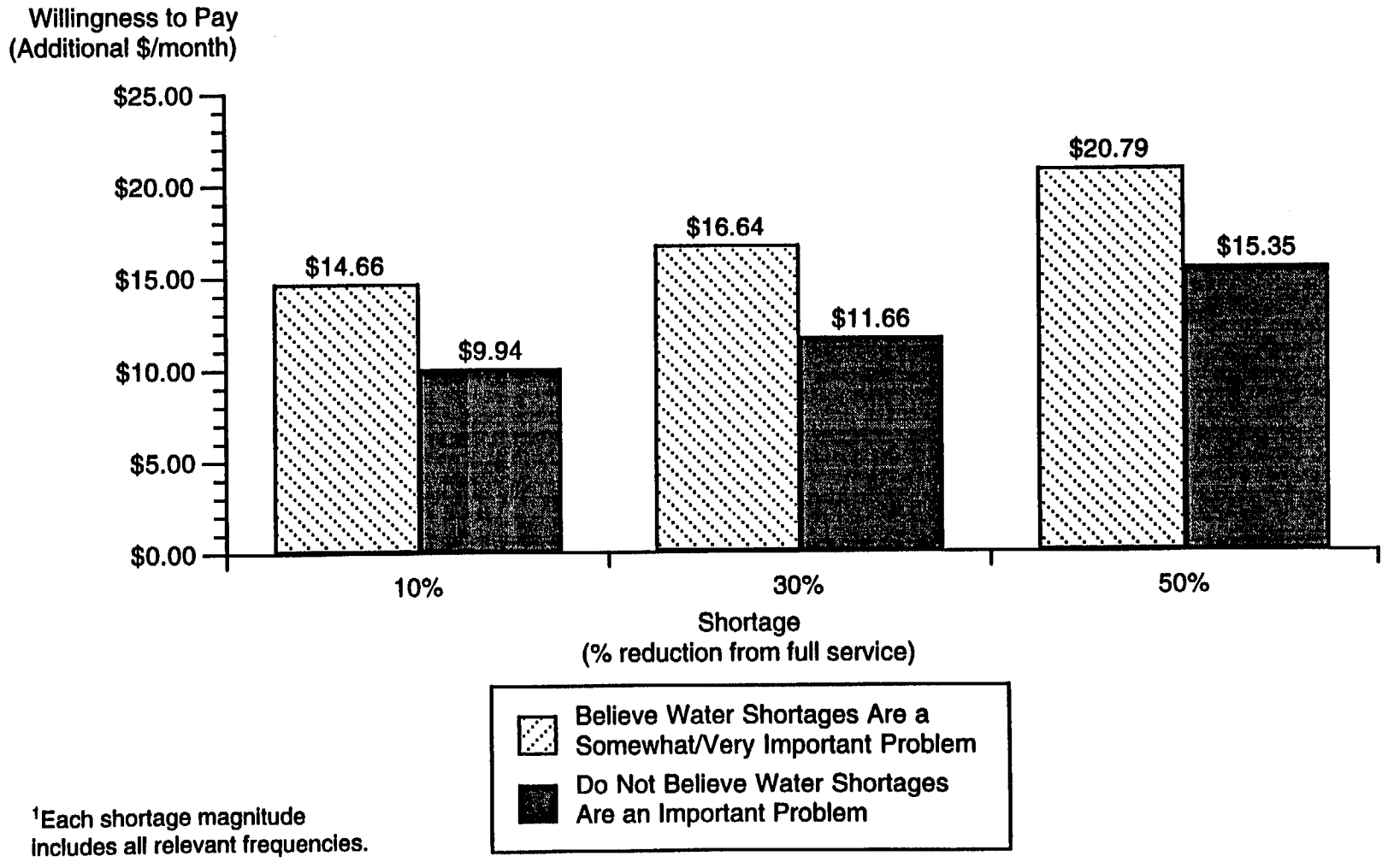
Concern for Water Shortages. Survey respondents were asked to rate various public issues as very important, somewhat important, or not at all important in their area. Figure O-2 illustrates WTP for people with different levels of concern for water shortages. WTP is shown for various shortage magnitudes. As expected, the results indicate that individuals who consider water shortages to be a somewhat or very important problem exhibit higher WTP than individuals who consider water shortages not at all a problem.

Growth Preferences. An interesting relationship is demonstrated in Figure O-3, which shows the relationship between participant feelings about community growth and their willingness to pay to avoid water shortages. Individuals who indicate a desire for their communities to grow in size have a higher WTP than do people who want their communities to stay the same size or to get smaller. Many in the latter group may perceive a relationship between water resource development and growth and are therefore more likely to prefer enduring more severe and/or frequent water shortages rather than adding to the resource base.

Santa Clara Valley Water District

Figure O-3

Effect of Concern for Water Shortages on Willingness to Pay[1]



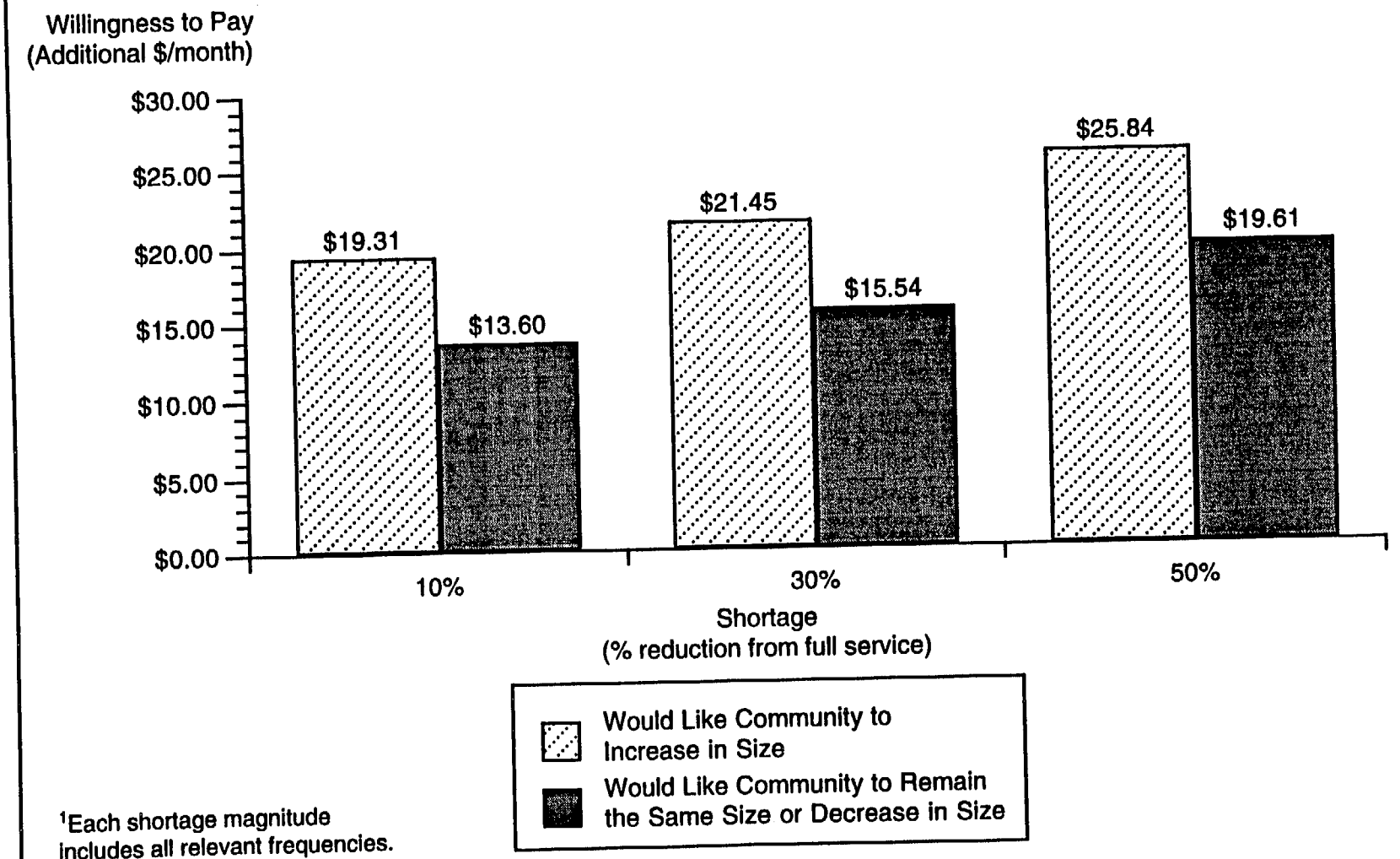
[1]Each shortage magnitude includes all relevant frequencies.

94-141100.32.final.6/94.ap

Santa Clara Valley Water District

Figure O-4

Effect of Population Growth Preferences on Willingness to Pay[1]



[1]Each shortage magnitude includes all relevant frequencies.

94-141100.32.final.6/94.ap

Explanatory Power of Models

Statistical goodness-of-fit tests were applied to test the explanatory power of the detailed and simplified models. The results of our calculations are presented in Table O-4.

TABLE O-4: GOODNESS OF FIT COMPARISON

	% Predicted Correctly[1]
Detailed model	35%
Simplified model	33%

In this case, the detailed model has only slightly more explanatory power than the simplified model. This, coupled with the similarity of the WTP results for the two models, indicate that SCVWD can apply the simplified model to estimate WTP, rather than resurveying customers to gather data on the remaining variables required for the detailed model.

Water Shortages as a Public Concern

In survey question 4, respondents were asked to rate the importance of various public problems, including water shortages, as "not at all important," "somewhat important," or "very important." Based on these responses, a factor analysis was performed to attempt to cluster these variables into a small number of groups.

Overall, the mean response for each issue is illustrated in Table O-5.

Water shortages fall in the middle of the list of concerns.[2]

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[1]In a single bounded logit model, these numbers are equivalent to 59% and 58% (square root of 0.35 and 0.33 respectively).

[2]It is possible that had this survey been conducted a year earlier, when the state was still in the grip of a serious drought, water shortages would have been viewed as much more of a concern.

Table O-5
ISSUE RANKING AND MEAN RESPONSE[3]

Issue	Mean Rating	Standard Error
Economy	2.66	.0464
Education	2.64	.0662
Drug abuse	2.64	.0805
Housing costs	2.62	.0696
Taxes	2.42	.0737
Water shortages	**2.38**	**.0444**
Drinking water quality	2.38	.0563
Traffic	2.35	.0489
Air pollution	2.30	.0568
Trash disposal	2.15	.0573
Homelessness	2.15	.0708
Crime	2.13	.0556
Overcrowding	1.92	.0506
Racial issues	1.64	.0617

Table O-6
FACTOR ANALYSIS OF PUBLIC ISSUES

Public Services/ Environmental Issues	Social Concerns	Quality of Life Concerns	Financial/Governmental Concerns
Water shortages	Crime	Traffic	Homelessness
Air pollution	Drug abuse	Overcrowding	Education
Drinking water quality	Racial issues		Economy
Trash disposal			Taxes

[3]Note that allowable responses ranged from 1 ("not at all important") to 3 ("very important").

The factor analysis showed that SCVWD respondents grouped issues as illustrated in Table O-6. Water shortages fall into the category that includes issues that can best be described as having public service and/or environmental components. The factors are ranked within each category according to the strength of their rating in the factor analysis.

Each of the four factors was included in the model as a binary variable to test its explanatory impact on WTP.[4] Each of these variables was assigned the value of 1 if the mean value of all of a respondent's ratings for the issues included in that factor exceeded the value assigned to the water shortage issue, and zero otherwise. For SCVWD, both the public services/environmental factor and the quality of life factor are statistically significant in explaining WTP.

Open-Ended Responses

Following the referendum questions, respondents were asked several open-ended questions regarding what actions they thought they would have to take under specified shortage scenarios, and what issues they considered when deciding whether to vote yes or no. These questions were asked to better understand the reasoning of participants. Responses to these questions are summarized in Exhibit O-2.

[4]The "public services/environmental" factor included in the model excluded the water shortages variable.

Exhibit O-1
MODEL RESULTS

Results for the detailed and simplified models follow this page. The results present each variable included in the model along with the following information:

- **Coefficient** indicates the magnitude of the variable's impact on WTP
- **Standard error** reflects the distribution of the coefficient
- **T-statistic** is a commonly used measure of statistical significance
- **P-value** is the observed significance level (for example, if p = .05, the coefficient is statistically significant at the 95% level)

The following key of variable pneumonics used in the model will facilitate interpretation of these results.

Key of Survey Variables

SUPPLY:	Percentage reduction from full service demand specified in the cv scenario.
FREQ:	Frequency of drought specified in the CV scenario.
AREAYRS:	Number of years respondent has lived in the area.
HHSIZE:	Number of persons in the household, including respondent.
AGE1834:	Respondent's age is in the range of 18 to 34 years old.
AGE3554:	Respondent's age is in the range of 35 to 54 years old.
COLGRAD:	Respondent is a college graduate.
INCGT%50:	1992 household income is greater than $50,000.
SNGL_FAM:	Respondent lives in a single family residence.
QUALLIFE:	Concern for "quality of life issues" (as defined by a factor analysis) relative to concern for water shortages.
SOCIAL:	Concern for "social issues" (as defined by a factor analysis) relative to concern for water shortages.
FINANCE:	Concern for "finance issues" (as defined by a factor analysis) relative to concern for water shortages.
ENVIRON:	Concern for "public services and/or environmental issues" (as defined by a factor analysis) relative to concern for water shortages.
SEVERE:	Perception of the severity of the recent drought
SHORTAGE:	Water shortages considered a somewhat or very important problem.
LONGTERM:	Perception of water shortages as a long-term problem in the area.
MANDATE:	Respondent believes that their water agency suggested or mandated cutbacks during the recent drought.
OWNPAY:	Respondent owns home and is personally responsible for paying the water bill.

OWNELSE:	Respondent owns home and someone else in the household is responsible for paying the water bill.
OWNASSOC:	Respondent owns home and a homeowners association is responsible for paying the water bill.
RENTPAY:	Respondent rents home, water bill is not included in the rent.
YELLOW:	Homes with private landscaped areas less than 3,000 square feet or shared landscaped areas less than 5,000 square feet.
PINK:	Homes with shared landscaped areas greater than 5,000 square ft.
NOGROWTH:	Respondent wants community to remain the same size/decrease in size.
RATE:	Average residential rate for respondent's water agency
NORTH:	Northern California water agency
BID:	Amount that respondents bill would increase per month if the majority of the community voted yes to the referendum.

Santa Clara simplified model

Date: 3/03/1994
Observations: 520 D.F. : 509

Var	Coef	Std. Error	t-Stat	P-Value
CONSTANT	4.18907	0.753662	5.558	2.179e-08
SUPPLY	-2.849189	0.736086	-3.871	6.116e-05
FREQ	-0.026501	0.0104718	-2.531	0.005839
AREAYRS	0.006336521	0.00612673	1.034	0.1508
HHSIZE	-0.0511856	0.0676593	-0.7565	0.2248
AGE1834	-0.04222821	0.303355	-0.1392	0.4447
AGE3554	-0.1959568	0.210517	-0.9308	0.1762
COLGRAD	0.01289975	0.17604	0.07328	0.4708
INCGT50K	0.1865691	0.179607	1.039	0.1497
SNGL_FAM	-0.2536172	0.219304	-1.156	0.124
BID	-0.1122446	0.00639659	-17.55	8.718e-55

Santa Clara detailed model

Date: 3/30/1994
Observations: 496 D.F. : 470

Var	Coef	Std. Error	t-Stat	P-Value
CONSTANT	4.280256	0.993123	4.31	9.853e-06
SUPPLY	-3.289895	0.780027	-4.218	1.467e-05
FREQ	-0.02904178	0.0110695	-2.624	0.004484
AREAYRS	0.003098932	0.00655795	0.4725	0.3184
HHSIZE	-0.06699315	0.0728071	-0.9201	0.179
AGE1834	-0.1246284	0.329085	-0.3787	0.3525
AGE3554	-0.07446273	0.226292	-0.3291	0.3711
COLGRAD	-0.08091926	0.190093	-0.4257	0.3353
INCGT50K	0.09408366	0.19003	0.4951	0.3104
SNGL_FAM	-0.2008005	0.404354	-0.4966	0.3098
QUALLIFE	-0.270937	0.294988	-0.9185	0.1794
SOCIAL	0.1511409	0.291236	0.519	0.302
FINANCE	-0.1883187	0.255514	-0.737	0.2307
ENVIRON	0.4667472	0.282707	1.651	0.04969
SEVERE	0.06897941	0.17957	0.3841	0.3505
SHORTAGE	0.5669411	0.304433	1.862	0.03158
LONGTERM	0.0931395	0.203447	0.4578	0.3236
MANDATE	0.1512895	0.241145	0.6274	0.2653
OWNPAY	0.5329261	0.390433	1.365	0.08644
OWNELSE	1.304809	0.485813	2.686	0.003739
OWNASSOC	1.274594	0.555335	2.295	0.01107
RENTPAY	1.375136	0.57951	2.373	0.009014
YELLOW	-0.2839846	0.194531	-1.46	0.07248
PINK	0.3045941	0.499131	0.6102	0.271
NOGROWTH	-0.8100445	0.350382	-2.312	0.0106
BID	-0.1165349	0.0068478	-17.02	8.642e-52

Exhibit O-2
OPEN-ENDED RESPONSES

SURVEY QUESTION 19

WHAT ARE THE PRIMARY REASONS YOU WOULD CHOSE NOT TO PAY THE ADDITIONAL MONEY ON YOUR WATER BILL TO AVOID FUTURE SHORTAGES?

(Asked Only of the 47 Respondents Who Voted No to the First and Second Bids for Both Scenarios)

SANTA CLARA VALLEY WATER DISTRICT

Reason	Percent of Respondents
Prefer to reduce my water usage	43%
Tired of paying for others/everyone should conserve	26%
Not willing to pay more	21%
Low confidence in the water agency	13%
Additional water supplies encourage population growth	11%
Cannot afford a higher water bill	6%
Do not believe water shortages can be avoided	6%

The table indicates the percent of respondents who listed the specified reason. The sum of the column is greater than 100% because respondents could list more than one reason. Responses given by fewer than 2% of the respondents are not listed.

SURVEY QUESTION 20

WHAT FACTORS OR ISSUES DID YOU CONSIDER WHEN DECIDING TO VOTE YES OR NO?

(Asked Only of Respondents Who Voted Yes to at Least One Bid)

SANTA CLARA VALLEY WATER DISTRICT

Factors Considered	Percent of Respondents
We can conserve	20%
Cannot afford more on bill	19%
Not willing to pay more	18%
Water is a necessity	17%
Future generations and their needs	11%
Not willing to pay for others use	10%
Depends upon the resource project	8%
Frequency and magnitude of shortage	7%
New resources should be developed	6%
Too many people/restrict new development	6%
Magnitude of shortage	5%
Frequency of shortage	4%
Impacts of new resources on environment	3%
No confidence in the water agency	3%
Impacts of shortage on greenery/aesthetics	2%

The table indicates the percent of respondents who listed the specified issue or factor. The sum of the column is greater than 100% because respondents could list more than one issue or factor. Responses given by fewer than 2% of the respondents are not listed.

SURVEY QUESTIONS 21 AND 22

WHEN YOU WERE ANSWERING THE QUESTIONS ABOUT WHAT IT WOULD BE WORTH TO YOU TO AVOID THE ___% WATER SHORTAGE ONCE EVERY ___ YEARS, WHAT DID YOU ASSUME YOUR HOUSEHOLD WOULD HAVE TO DO TO CUT BACK YOUR WATER USE?

SANTA CLARA VALLEY WATER DISTRICT

Actions to Reduce Water Use	Water Shortage				
	10%	20%	30%	40%	50%
Can't conserve anymore, would do nothing more	10.2%	11.8%	11.5%	17.9%	19.5%
Install low-flow showerheads	11.8	10.9	12.2	8.9	11.5
Install displacement devices in toilet	5.5	7.6	5.0	4.5	6.9
Replace toilets with low-flush toilets	5.5	5.9	4.3	6.3	5.7
Take fewer/shorter showers	29.1	26.9	35.3	36.6	37.9
User fewer flushes	14.2	25.2	21.6	21.4	13.8
Use grey water/recycle water	9.4	13.4	10.8	16.1	16.1
Use dishwasher less/not at all	13.4	11.8	7.9	15.2	10.3
Do laundry less/take to a laundromat	9.4	10.9	12.9	17.0	14.9
Change outside plant watering habits	5.5	11.8	15.1	9.8	3.4
Wash car less/not at all/take to carwash	10.2	13.4	12.2	8.9	6.9
Water lawn less/let lawn die	25.2	26.9	28.8	24.1	20.7

The table indicates the percentage of respondents who listed the specified action. The sum of each column is greater than 100% because respondents could list more than one action.