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Impacts of Compressed Work Week on Vehicle Trips and Miles Traveled

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

AIR RESOURCES BOARD
Research Division

Impacts of Compressed Work Week on Vehicle Trips and Miles Traveled

Final Report

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ABSTRACT

The purpose of this project was to evaluate the effectiveness of compressed work week schedules (CWW) as transportation control measures. Compressed work week schedules allow a full-time regular shift (forty hours per week) to be worked over fewer than five days, thus reducing the number of work trips per week compared to a regular five day schedule. The most common types of CWW are the "4/40" schedule (four days of work per week, ten hours of work per day), and the "9/80" schedule (nine days of work per two week period, 8.5 to 9 hours of work per day). Both types of CWW schedules are included in the analysis.

The potential of CWW to reduce travel and improve air quality depends on how daily travel patterns are affected when more hours each day and fewer days each week are worked. Since most employees on CWW schedules have Friday or Monday as the extra day off, less weekday work travel may be at least partially offset by more weekend nonwork travel. Trips also may be combined in different ways or distributed differently through the day.

We conducted our analysis by comparing travel patterns of workers on CWW schedules with those of workers on regular schedules. Our data were obtained by conducting employee surveys at eleven work locations within Los Angeles and Orange Counties. Survey participants were asked to complete a seven day travel diary, describing each trip taken over the seven day period. Several different aspects of travel were examined, such as total weekly travel, travel by private vehicle, number of trips, etc. We accounted for individual socioeconomic and demographic factors that are known to both to affect travel and affect the likelihood of working a CWW schedule in our analysis in order to quantify the effects of the work schedule as accurately as possible.

Our analysis revealed that there is a great deal of variability in weekly travel patterns, making it difficult to make precise estimates of the impact of CWW on travel patterns. Individual characteristics (gender, age, etc.) have a more powerful effect on travel than the work schedule. We found that CWW is associated with significantly less work travel and no measurable increase in nonwork travel. CWW is also associated with

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S.1 INTRODUCTION

Commitment to attaining air quality standards in California and the U.S. has led to a variety of recent legislative and regulatory actions. The Clean Air Act of 1990, together with the ISTEA of 1991 (Intermodal Surface Transportation Efficiency Act) strengthens this commitment by linking transportation and air quality policy.

Remarkable progress has been made in improving air quality, mainly by regulating industries and improving emissions controls on vehicles. However, air standards have still not been achieved in many metropolitan areas. Given current forecasts of population and employment growth, anticipated technological improvements are not expected to be sufficient to achieve air quality standards within the targeted time limits. Private vehicle use, especially solo driving, will increase more than emissions rates can be reduced.

Private vehicle use and solo driving have continued to increase in recent decades. National data shows that about 90 percent of all person travel is by private vehicle, and solo driving trips account for about 85 percent of all private vehicle trips. More emphasis is consequently being placed on the possibility of limiting increases in vehicle use by policies that influence travel decisions. Termed Transportation Demand Management (TDM), these policies seek to reduce the amount of solo driving by diverting travelers to other modes, diverting trips to off-peak periods, or eliminating trips.

Compressed work week schedules (CWW) are aimed at eliminating work trips and thus reducing private vehicle travel. CWW schedules allow employees to work a regular full-time shift (forty hours per week equivalent) over fewer than five days. The most common forms of CWW are the "4/40" and "9/80" schedules. The 4/40 is four work days of ten hours per day per week. The 9/80 schedule is nine work days of eight to nine hours, totaling 80 hours over a two week period. The 4/40 thus requires 4 round work trips per week, and the 9/80 schedule requires an average of 4.5 work trips per week.

The California Air Resources Board is interested in compressed work week schedules as a Transportation Control Measure (TCM), a travel reduction policy measure that can be used as part of transportation and air quality attainment plans. If indeed vehicle travel is reduced as a result of CWW, air quality will be improved. This report presents an analysis of the travel impacts of CWW.

S.2 STUDY PURPOSE

In order to understand how compressed work week schedules can affect air quality, it is useful to summarize the basic relationships between vehicle use and vehicle emissions. Emissions depend on two major factors, cold starts and running speed. High emissions result from a cold engine right after it starts, because the catalytic converter must warm up before it can perform properly and because a richer fuel mix is used when the engine is cold. Cold starts occur whenever the vehicle engine is cold, or whenever an engine has been turned off for more than one hour. Once the engine is warm, the emissions rate depends on speed, and this relationship varies by pollutant. For speeds up to about 30 mph, the emissions rate decreases as speed increases. For speeds between 30 and 45 mph, emissions are relatively constant. For speeds above 45 mph, the emissions rate increases as speed decreases.[1] Emissions are also affected by driving patterns. Rapid acceleration as well as frequent starts and stops generate more emissions than steady speed driving.

Travel patterns can have a significant effect on vehicle emissions. Emissions are directly related to vehicle miles traveled (VMT). Travel on congested streets and highways will generate higher emissions than travel in uncongested conditions; thus travel during peak periods affects air quality more than off-peak travel. A series of short trips made throughout the day, each one involving a cold start, will generate more emissions

[1] The relationship between emissions and speed is currently under study by CARB and EPA. Statements here are based on most recent information available.

than the same set of trips made in sequence. For example, running an errand at lunch generates an extra cold start, compared to running the same errand on the way home from work. CWW can help improve air quality by reducing cold starts, reducing travel under heavily congested condition, and reducing VMT.

The purpose of this study is to determine whether CWW is an effective TCM, as measured by changes in travel.[2] How might different work schedules affect travel, and what impacts might such effects have on vehicle emissions? First, CWW reduces the number of work trips per week, compared to a regular five day schedule. Total work travel should therefore be lower for CWW workers. Emissions should be reduced as a result of fewer work trips and fewer miles of work travel. Second, CWW requires longer work days than the regular five day schedule, and therefore may shift some work trips out of the peak travel periods when congestion is most severe. Less travel in congested conditions will also reduce emissions. Longer work days will also suppress nonwork travel before and after work (because less time is available for nonwork activities) leading to generally less weekday travel for CWW workers.

Can we assume that these expected work travel reductions will lead to less travel overall? The impact on total travel depends on how CWW workers use their time off, and how they arrange their trips throughout the day and week. Most CWW schedules provide Friday or Monday as the extra day off, so CWW workers have longer weekends and may use them to travel more. On the extra day off, other household members may use the now available vehicle, thus generating more miles of travel. CWW workers may use the extra day off to run most of their errands, thus reducing cold starts. Errands may also be performed closer to home, resulting in less nonwork VMT. On the other hand, if activities that would normally be performed on the way to or from work are shifted to another day, cold starts may be increased. Finally, CWW may in the long run lead to more travel, as fewer weekly work trips may be an incentive for commuting longer distances.

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[2] Estimation of air quality impacts of CWW is beyond the scope of this study. Air quality impacts are discussed only in general terms.

S.3 RESEARCH APPROACH

In order to measure the travel impacts of CWW, we must account for all the other factors that may affect individual travel patterns. We must be particularly careful to consider individual characteristics that are related both to the likelihood of choosing a CWW schedule as well as to travel patterns. Prior research has shown that CWW workers are more likely to be male, to have higher household incomes, and to not have younger children. These characteristics are also associated with travel. For example, males travel further to work than females; higher income households have longer work trips; and in households with young children, mothers make more household-related trips that fathers. We must therefore separate the effects of individual characteristics and household roles from the effect of different work schedules.

A key methodological issue is whether to use individual employees or households as the basis of our study. Using households would allow us to examine directly any shifts in travel among household members as a result of CWW, but would vastly increase the cost and complexity of the study. Our preliminary research suggested that intrahousehold shifts leading to more travel were unlikely. Considering the trade-off between obtaining a sufficiently large sample of workers for statistical analysis and the possibility of underestimating travel savings in some cases, we chose to obtain an adequate sample.[3]

We conducted an analysis of employees on different work schedules to determine the effects of CWW. Travel patterns of employees on CWW schedules were compared with those of employees on regular workweek schedules. Since both work and nonwork travel, as well as travel patterns on both weekends and weekday may be affected by CWW, we must examine travel over a seven day period. Using as our sample universe the 2.2 million employees working at sites subject to the South Coast Air Quality Management District's Regulation XV, we recruited volunteer participants to complete a seven day travel diary. We identified potential diary participants by using the Regulation

[3] For further explanation, see Chapter 3, section 3.1.2.

XV data base[4] to identify sites using CWW, and requesting the employer's participation in the survey. All sites listed as having 50 percent or more of their employees on some form of CWW schedule were contacted. We recruited participating sites by contacting the sites's Employee Transportation Coordinator (ETC). Eleven participant sites were recruited; they are located in Los Angeles and Orange Counties. Nine sites are public agencies, and two are private firms. Employees at each of these sites were requested to participate in the travel diary survey. Knowing that recruitment of diary participants would be difficult and that volunteers would be a self-selected group, we conducted a short preliminary survey that elicited basic demographic and socio-economic information as part of our diary participation solicitation. We used the preliminary survey data to weight the diary sample, so as to generate a more representative data sample. While the preliminary survey employee sample is not necessarily representative of the general population of workers, it does represent a much broader array of individual characteristics than the diary respondents. The weighting procedure thus increases the policy relevance of our results. Survey distribution and return information is given in Table S-1.

TABLE S-1
SURVEY DISTRIBUTIONS AND RETURNS

SURVEY	# DELIVERED	DELIVERY DATES	# RETURNED	% RETURNED[a]
Preliminary	7279	2/23/93 to 4/28/93	2609	39%
Diary	939	3/16/93 to 5/17/93	536	57%

[a] Returned as percent of delivered

[4] Regulation XV, issued in 1987 by the South Coast Air Quality Management District, requires all employment sites with 100 or more employees to develop and implement a plan for increasing the level of ridesharing (measured in terms of "Average Vehicle Ridership") at the site. The plans contain information on site characteristics, including work schedules.

S.4 RESEARCH HYPOTHESES

Our analysis is aimed at testing the following set of hypotheses. For ease of presentation, we use statements of expected relationships, rather than the traditional null hypothesis.

1. WORK TRAVEL: CWW should be associated with less work travel, both in terms of number of work trips and amount of private vehicle work travel, because of the reduced number of work trips required by CWW schedules.

2. NONWORK TRAVEL: CWW should be associated with more nonwork travel, since CWW workers have more days off. We expect more nonwork trips and more total nonwork travel distance.

3. TOTAL WEEKLY TRAVEL: We expect less total weekly travel for CWW workers. That is, although nonwork travel may be higher for CWW workers, the difference will be of a smaller magnitude than that for work travel. Thus we expect less travel overall for CWW workers.

4. TRAVEL BY WEEKDAY VS WEEKEND: We expect less travel on weekdays and more travel on weekends for CWW workers compared to regular workers. Longer workdays should reduce travel opportunities on weekdays, and thus generate more travel on weekends. In addition, CWW workers may have more opportunities for longer recreational trips, again suggesting more weekend travel.

5. TRAVEL BY TIME OF DAY: We expect fewer trips during peak periods for CWW workers, because longer work days imply earlier start work and later end work times. Thus CWW work trips will occur before and after the traditional peak periods. In addition, we expect fewer weekday nonwork trips to be made as part of the trip to or from work for CWW workers, as described in hypothesis 4 above. We also expect more midday travel by CWW workers due to the extra day off.

6. MODE CHOICE: We have no prior expectations on work trip choice of mode (solo drive, drive with passenger, travel as passenger, etc.). On the one hand, the longer work day might make ridesharing more difficult. On the other hand, the longer work day might make solo driving more tiring and therefore less attractive for the work trip. For nonwork trips we do not expect any difference between CWW and regular schedule workers.

7. AVERAGE TRIP LENGTH: Theories of travel behavior predict that reducing the cost of travel will lead to an increase in travel. Reducing the number of work trips per week effectively reduces the cost of commuting, which provides an incentive for more travel, and specifically for more commuting (e.g. longer commute trips). We therefore expect CWW workers to have longer commute trips than workers on regular schedules. For all travel, we expect the average trip length to be affected by the distribution of trips for various purposes.

8. TRIP PURPOSE: For CWW workers, we expect more social and recreational travel. We expect CWW workers to run fewer errands and to make fewer trips to pick up or drop off other passengers due to their longer daily work schedules.

9. TYPE OF CWW SCHEDULE: In all cases, we expect travel characteristic differences between CWW and regular workers to be greater for the 4/40 schedule than for the 9/80 schedule, simply because the 4/40 schedule is a more radical departure from the regular work schedule.

Our analysis was conducted using the weighted travel diary data. Our diary sample consists of 503 cases with seven consecutive days of travel information. Socio-demographic data were drawn from the preliminary survey and merged with the diary data. Missing data on the type of work schedule reduced the sample to 487 cases. The work schedule sample distribution is 238 on regular schedule, 77 on the 4/40 schedule, 151 on the 9/80 schedule, and 13 on a long work schedule (working more than 10 days per 2-week period). We conducted two sets of comparisons: all CWW vs regular schedule workers, and 4/40 CWW vs regular schedule workers.

Our results are based on a variety of statistical tests. For travel distance and total trips, we estimated regression models that express the dependent variable (distance or trips) as a function of individual characteristics (age, gender, etc.) and type of work schedule. Value and statistical significance level of the work schedule variable coefficients were the basis of our study analysis. For trips by purpose or other category, we conducted statistical tests for differences in average group values between CWW and regular workers.

S.5 SUMMARY OF RESULTS

Our analysis of travel characteristics revealed a high degree of variability in weekly travel patterns. The statistical models explained only a small portion of the sample variation in weekly travel distance, driving distance and trip making. Significant explanatory factors include auto availability, gender, household composition and income -- results that are entirely consistent with prior travel behavior research. Once we control for these factors, we find that the differences between CWW and regular workers are difficult to estimate with any precision. The variability in weekly travel patterns suggests that the use of full 7-day diaries was certainly warranted, and that 14-day diaries would likely have produced better results.

Key results are summarized in Table S-2. Many different statistical tests were conducted. For example, travel distance was measured in terms of total distance by all modes, distance by private vehicle modes, which includes driving or riding as passenger, and driving distance, which includes both drive alone and drive with passenger. We give numerical estimates in cases where results were statistically significant.[5] We give a range of estimates when results differ by the particular type of measure used. In cases where results are not statistically significant but are consistent, we give the direction of the relationship, and in some cases numerical values.

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[5] We use the conventional standard of statistical significance: The effect of CWW is greater than zero with a probability of at least 95 percent.

Work Travel: Significantly less work travel is observed for CWW workers, particularly when measured in terms of work tours that account for stops along the way.[6] Work travel is measured by counting all trips for which work is listed as the destination. Trips from work are therefore not counted as part of work travel. For all CWW workers, the estimated mean difference between CWW and regular workers is about 13 miles/week, and for CWW 4/40 workers the difference ranges from 15 to 20 miles/week, depending on the particular variable used in the analysis. Given our sample average one-way work trip of about 17 miles, these estimates are quite reasonable. Our estimates of work trip differences are also reasonable: about 0.5 work trips less for CWW and about 0.8 trips less for CWW 4/40. The CWW group includes workers on 9/80 as well as 4/40. Differences are smaller for the CWW group compared to regular schedule workers, since some of the 9/80 workers worked a 5-day week during the survey period.

Nonwork Travel: The average number of nonwork trips per week is no different across work schedules categories, nor is nonwork driving distance. This finding supports the idea that compressed work schedules may cause travel to be distributed across days and times differently, but does not necessarily lead to more travel.

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[6] Diary respondents were asked to list each stop made. Thus if a stop were made on the way to work, for example to pick up or drop off a passenger, only the portion of the trip from that stop to work would be listed as a work trip. A work tour includes all travel from home to the work destination, provided that intermediate stops are no longer than 15 minutes.

TABLE S-2
SUMMARY OF RESULTS

HYPOTHESIS	CWW vs REGULAR	CWW 4/40 vs REGULAR
1. WORK TRAVEL Work Travel Distance Work Trips	 CWW approx. 13 mi/week less CWW approx. .5 trips/wk less	 CWW 4/40 15 to 20 mi/wk less CWW 4/40 approx .8 trips/wk less
2. NONWORK TRAVEL Nonwork Travel Distance Nonwork Trips	 No significant difference[a] No significant difference	 No significant difference No significant difference
3. TOTAL WEEKLY TRAVEL Weekly Travel Distance Weekly Trips	 CWW approx 11 mi/wk less, but not significant No significant difference	 CWW 4/40 approx 10 mi/wk less, but not significant No significant difference
4. WEEKDAY vs WEEKEND TRAVEL Weekday Distance Weekend Distance Weekday Trips Weekend Trips	 CWW approx. 25 mi/wk less CWW 6 to 12 mi/wk more No significant difference No significant difference	 CWW 4/40 29 to 44 mi/wk less CWW 4/40 approx 7 mi/wk more No significant difference No significant difference
5. TIME OF DAY AM Peak Distance Midday Distance PM Peak Distance Other Times Distance AM Peak Trips Midday Trips PM Peak Trips Other Times Trips	 CWW 5 to 16 mi/wk less No difference[b] CWW less, but not significant CWW approx. 4 to 9 mi/wk less CWW 0.7 to 1.2 trips/wk less CWW 1.0 to 1.2 trips/wk more CWW 0.6 to 0.8 trips/wk less No significant difference	 CWW 4/40 7 to 23 mi/wk less No difference CWW 4/40 less, but not significant No difference CWW 4/40 1.5 to 2.2 trips/wk less CWW 4/40 1.4 to 1.5 trips/wk more CWW 4/40 0.9 to 1.3 trips/wk less No significant difference
6. MODE CHOICE	Slightly more trips as passenger for CWW	No difference
7. AVERAGE TRIP LENGTH All Trips All Drive Trips Work Trips	 No difference CWW approx. 1.6 mi. shorter No difference	 No difference CWW 4/40 shorter, but not significant No difference
8 TRIP PURPOSE To Work Pick up/ Drop off Social/ Recreational All Other	 CWW approx. 0.3 trips/wk less CWW approx. 0.7 trips/wk less CWW approx. 0.5 trips/wk more No difference	 CWW 4/40 approx. 1.0 trips/wk less No difference CWW 4/40 approx 0.7 trips/wk more No difference

[a] Difference not statistically significant at a 95% confidence level, but direction of effect (positive or negative) is as expected.
[b] Difference not statistically significant at a 95% confidence level, and direction of effect cannot be determined.

Total Weekly Travel: Our analysis of total weekly travel distance showed that miles traveled per week was lower for the CWW and CWW 4/40 groups, with the best estimate being 10 to 11 miles less per week. Because of the great variation within our sample, these differences are not statistically significant. Another way of expressing these results is to say that total weekly travel distance is less for CWW, but we cannot state how much less. Our best estimate for total weekly trips is 0.5 trips per week less for the CWW groups; this difference is also not statistically significant. Nevertheless, considering all our results for total travel, work travel and nonwork travel, we conclude that *weekly travel is indeed lower* for CWW workers, but the sample variation has precluded precise measurement of the difference.

Weekday vs Weekend Travel: More weekend travel distance is associated with CWW, but mean estimates of the increases are not as large as the weekday travel decreases. Again, these results support the general hypothesis that CWW schedules lead to overall travel reductions. On the other hand, there is no difference in the number of trips made on weekdays and weekends by CWW compared to regular workers.

Time of Day: As expected, CWW is associated with fewer trips and less travel distance during the AM peak period. CWW is also associated with more trips in the midday, but not necessarily more travel distance, suggesting that CWW workers are able to economize on travel by combining trips on the day off. CWW is associated with fewer trips during the PM peak, but not necessarily less travel distance. For travel between 6 PM and 6 AM, results are mixed: possibly less travel for CWW workers, but more travel for CWW 4/40 workers, likely because many start work very early in the morning.

Mode Share: CWW does not have much effect on mode share. CWW workers on the 9/80 schedule make slightly more trips as passenger; we attribute this difference to the larger number of women on the 9/80 schedule.[7] We observed that regular schedule workers make slightly more walk trips, but we attribute this difference to the characteristics of our sample.

[7] When men and women drive together, the man is more likely to drive.

Average Trip Length: There is no evidence that CWW is associated with longer work trips. Thus there is little concern that over the long term the travel savings of CWW will be eroded by longer commute trips. For all trips, average trip length for weekend trips is longer for CWW workers, while weekday average trip length is shorter. These differences are supported by results on trip purpose as described below. CWW workers have slightly shorter driving trips; again this may reflect gender differences within the CWW sample.

Trip Purpose: As expected, CWW workers make fewer trips with the reported purpose of going to work, and the difference is greater for CWW 4/40 workers. CWW workers make fewer pick-up or drop-off passenger trips, probably because longer work days preclude some types of trips. Also as expected, CWW is associated with more social and recreational travel.

S.6 CONCLUSIONS

In the most general terms, our results show that CWW schedules are associated with less travel, measured both in terms of trips and VMT, compared to regular work schedules. Fewer work trips per week reduce trips and VMT; the extra day off per week redistributes nonwork trips and allows for more weekend travel, but not enough to totally offset the work trip reduction. It is important to note that while we are not able to assign specific values to trip and VMT reductions, our results very consistently indicate some travel savings due to CWW. That is, we cannot predict with confidence how much travel would be reduced by more widespread implementation of CWW, but we can say with confidence that some reduction would occur.

These results clearly suggest air quality benefits. First, fewer AM peak trips means fewer morning cold starts. Since air pollution tends to build through the day, reductions in early morning emissions are particularly beneficial to improved air quality. Second, less peak travel implies less travel under congested conditions. Slow speeds and repeated acceleration and braking are characteristic of driving in congestion, and these driving patterns increase vehicle emissions. Less travel under congested conditions means smoother traffic flow and consequently lower rates of running emissions. Finally, less total VMT means less total running emissions.

Research on other TCMs shows that their effects are marginal. For example, studies of HOV lanes, transit subsidies, and rideshare incentives show that these efforts typically increase ridesharing by a few percentage points despite their often significant cost (Giuliano, 1992; Wachs and Giuliano 1992). These studies illustrate the difficulties of influencing travel behavior with policy instruments that can feasibly be implemented. Given these results, transportation policy has increasingly relied on the incremental approach: implement many different policies, each of which has a small effect, but which together may generate significant change. CWW is one more TCM that can contribute positively to trip reduction, and it has the added advantage of being essentially cost-free.

S.6.1 CAN CWW BE WIDELY IMPLEMENTED?

CWW can be an effective TCM only if it can be more widely implemented. Compressed work schedules have been advocated for more than two decades as energy saving and congestion mitigation strategies, and as measures to enhance employee recruitment and job satisfaction. Use of CWW has never become widespread, however. National estimates of the share of the employed labor force on CWW peaked in 1976 and has declined ever since.

Our results, as well as those of numerous other studies, show that there are significant differences between employees working on different schedules. We find that CWW workers are more likely to be male, be in the age groups of 25 to 54, have higher household income, be employed in a professional or managerial occupation, and are somewhat more likely to be members of single worker households. Prior research identifies constraints associated with nonwork responsibilities that make it difficult or impossible for some individuals to work the longer days of CWW (Cambridge Systematics, Inc., 1980).

There also appear to be constraints on the employer side. Use of CWW is concentrated by industrial sector: the 4/40 schedule is most widely used by manufacturing firms (the historic focus of 4/40 programs), and the 9/80 schedule is most widely used by public agencies. We surmise that public agencies have more flexibility in establishing operating hours than private firms and therefore are more willing to offer alternative schedules to their employees. Furthermore, alternative work schedules are often limited to specific occupational categories or tasks. The small number of employees on CWW suggests that barriers to widespread implementation exist and need to be examined.

S.6.2 IMPORTANCE OF THE PRIVATE VEHICLE

Effective transportation control measures must focus on the private vehicle. About 90 percent of all reported travel in this survey was by private vehicle. The 1990 NPTS data shows the same percentage. Any strategy that reduces private vehicle travel even by a small percentage will therefore have a significant beneficial effect. CWW is one of many possible strategies that can contribute to reduce vehicle emissions by reducing total private vehicle travel.

S.7 RECOMMENDATIONS

We recommend that CWW be pursued as part of the overall effort to reduce private vehicle travel. Prior research shows that many employees prefer these schedules. Thus, if offered on a voluntary basis, CWW can improve employee job satisfaction as well as generate transportation and air quality benefits. Further research is required on two issues in order to better quantify the potential transportation and air quality benefits of CWW.

First, research is needed to **more precisely quantify the expected impacts of CWW.** The richness of our travel diary data makes several extensions of the research possible:

- *Analysis of the relationship between employee characteristics and the likelihood of working on a given schedule.* This would provide information on the potential market for CWW within the workforce.

- *Analysis of causal relationships between employee characteristics, work schedule and travel patterns.* This would provide more precise information regarding the expected impacts of CWW across various types of employees by more effectively isolating individual characteristics that influence travel patterns from the effect of different work schedules.

- *Analysis of day-off travel across categories of workers.* Comparing day-off travel patterns will provide more information on the ways in which travel is redistributed as a consequence of CWW schedules.

- *Analysis of nonwork and work to home travel tours.* We have constructed travel tours in this analysis only for the travel associated with the trip to work. A more extensive analysis of travel tours would enable us to more clearly identify all work related travel, and to distinguish trips associated with cold starts.

- *Analysis of daily activity sequences across categories of workers.* This would also provide more information on how travel is redistributed as a result of CWW.

Second, research is needed to **determine the extent to which CWW could be employed.** As noted above, CWW schedules continue to be limited to few workplaces and to selected groups of employees within workplaces. Reasons for the limited use of CWW must be examined, and strategies for promoting CWW must be identified. This research would require a more detailed analysis of the types of firms that use CWW and of the types of jobs that are most amenable to a CWW schedule. In addition, employers should be surveyed to elicit information on the perceived problems associated with CWW and the reasons why CWW is not more extensively utilized.

CHAPTER ONE
INTRODUCTION

A renewed commitment to attaining air quality standards established by the Clean Air Act of 1970 has led to a variety of legislative and regulatory initiatives in the past few years. The Clean Air Act of 1990, together with the ISTEA of 1991 (Intermodal Surface Transportation Efficiency Act), strengthens this commitment by linking transportation and air quality policy. California has been at the forefront of these efforts, both in terms of establishing standards and developing policies for implementing them.

The regulatory efforts of the past twenty years have had remarkable success. Smog controls on automobiles have dramatically reduced vehicle emissions rates, and stationary source regulation has greatly reduced emissions from these sources. Although much progress has been made, air quality standards, particularly in the state's major metropolitan areas, have not been achieved. And given current expectations of population and employment growth, anticipated emissions reduction technologies will not be sufficient to achieve these standards within the targeted time limits.

Recognition that technology alone cannot bring the necessary mobile source emissions to acceptable levels has led to policy efforts to influence travel behavior. Termed Transportation Demand Management, or TDM, these policies seek to reduce the amount of solo driving by diverting travelers to other modes (such as transit or carpools), diverting trips to off-peak periods, or reducing trips. Commuting travel has been the primary focus of TDM, both because of the regularity of work travel and because work travel typically takes place during the peak periods.

One of the TDM measures that has received much attention is alternative work hours. Alternative work hours programs include flexible or staggered work schedules, in which work start and end times are shifted out of the peak period, and compressed work week schedules, in which the regular 40 hours per week is compressed into fewer work days. Flexible hours programs typically allow the employee to choose his/her start and end work times, subject to being at work during a specified "core time." Staggered hours programs spread start and end work times over a given time interval (generally in 15 minute intervals), but each employee's schedule is fixed. Compressed work week schedules (CWW) reduce the number of work trips, and thus should reduce vehicle travel.

The California Air Resources Board is interested in compressed work schedules as a Transportation Control Measure (TCM) that can be used as part of transportation and air quality attainment plans. If indeed vehicle travel is reduced as a result of CWW, the reduction in Vehicle Miles Traveled (VMT) and vehicle starts and stops will contribute to air quality improvement by reducing cold starts and running emissions. This Report presents an analysis of the travel impacts of CWW.

1.1 TCMS AND AIR QUALITY

In order to understand how compressed work week schedules can affect air quality, it is useful to summarize the basic relationships between vehicle use and vehicle emissions, and between vehicle emissions and air quality.

Photochemical smog is the most important urban air pollution problem. Smog is generated from chemical reactions between hydrocarbons (HC) and oxides of nitrogen (No_x) in the presence of sunlight. The products of this chemical reaction include ozone (O_3) and carbon monoxide (CO), both of which are known to negatively affect human health (Calvert et al, 1993). Vehicle emissions account for a significant portion of each of these pollutants. The transportation sector generates about 80 percent of US carbon monoxide emissions, 45 percent of NO_x emissions and 36 percent of volatile organic compounds (hydrocarbons) (EPA, 1993a).

Vehicle emissions are commonly described in three categories:

- Cold start: Cold starts occur whenever the engine is cold, or whenever an engine has been turned off for more than one hour. A cold engine produces high emissions right after it starts, because the catalytic converter must warm up before it can perform properly, and because a richer fuel mix is used when the engine is cold.

- Running emissions: These are the emissions generated while the vehicle is in operation. Running emissions depend on speed and on speed variability (starts and stops, acceleration and braking). The relationship between speed and emissions varies by pollutant. For CO and HC, emissions decrease as speed increases up to about 30 mph. Between 30 and 45 mph, speed does not significantly affect emissions. For speeds greater than 45 mph emissions increase. The relationship between speed and NO_x is less clear. NO_x may or may not decrease with speeds up to 50 mph, but significantly increases with speed in excess of 50 mph (EPA, 1993b).

- Hot soak: Once the engine is turned off, additional emissions are produced from the residual heat of the engine, and from the evaporation of fuel as the vehicle remains idle.

The relative importance of each emission category depends on the time and length of the trip. For short trips, the cold start is most important; for long trips (especially high speed trips), running emissions are most important.

CWW can contribute to emissions reductions by reducing cold starts, reducing travel under congested conditions, and reducing total travel. If CWW results in fewer work trips, there will be fewer early morning cold starts and possibly fewer total daily cold starts. If CWW reduces peak travel by reducing the number of work trips and by shifting some work trips out of the peak, there will be fewer miles traveled under congested conditions, and therefore fewer miles at very slow speeds with frequent stops and starts. If CWW has the effect of reducing the total amount of travel, additional emissions reductions will result from lower VMT.

1.2 COMPRESSED WORK WEEK SCHEDULES

Compressed work week schedules allow employees to work a regular full-time shift (forty hours per week equivalent) over a fewer number of days. The most common forms of CWW are the "4/40" and "9/80" schedules. The 4/40 schedule is four work days of ten hours per seven day week. The 9/80 schedule is nine work days of eight to nine hours totaling eighty hours over a two week period. The 4/40 schedule thus requires 4 work round trips per week, and the 9/80 schedule requires an average of 4.5 work round trips per week.

Alternative work schedules were heavily promoted in the 1970's in response to the energy crisis. Several experiments were undertaken, mostly with the 4/40 schedule. These schedules were never widely adopted, however, and only a small percentage of the work force is working on these schedules today.[8] For example, we estimate that no more than five percent of employees in the South Coast Air Basin work some form of CWW. If compressed work schedules do result in VMT reductions, and if CWW can be widely implemented, the potential for this TCM is significant.

Most of the prior research on alternative work schedules was conducted on flexible work schedules. Several studies document the peak spreading effects of flexible and staggered work schedules (e.g. Jones and Sullivan, 1978; Giuliano, 1988). Flexible hours are more common than CWW, mainly because they require less adjustment within the workplace itself.

Prior research on CWW is limited. Only two case studies have been conducted, one of federal employees in Denver in 1979-1980, and one of Los Angeles Department of Public Works employees in 1990 (Cambridge Systematics, 1980; Commuter Transportation Services, Inc., 1992). These case studies suggest that VMT is reduced, and trips are shifted across time periods and days of the week as a result of CWW. Both case studies were before/after studies, and thus focussed on how employees changed travel patterns after changing their work schedules. Unfortunately, the Denver study

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[8] We were unable to locate any national data on work schedules, and therefore cannot estimate the extent of CWW use outside of our sample population.

took place at the height of the 1979 oil crisis, and the effects of fuel price increases and supply interruptions confounded study results. The Los Angeles study used only one employment site and had a small number of comparable observations. Thus, although these studies provide support for CWW as an effective TCM, more detailed analysis is required.

1.3 STUDY PURPOSE

The purpose of this research is to determine whether CWW is an effective TCM. As measures of effectiveness, we examine total vehicle miles of travel (VMT), trips, and trip scheduling. Reduced VMT, fewer trips or fewer peak period trips should positively affect air quality. Although CWW reduces the required number of work trips per week, these work trip reductions may not result in overall travel reductions. Since most CWW schedules provide Friday or Monday as the extra day off, CWW workers have longer weekends and may use them to travel more. On the extra day off, other household members may use the now available vehicle, thus generating more VMT. Finally, fewer work trips may be an incentive for commuting longer distances; fewer work trips reduces the cost of making it possible to take advantage of cheaper housing costs located further from employment centers.

Longer work days should have the effect of shifting some work trips out of the peak period, thus reducing congestion. In addition, longer work days should suppress nonwork travel before and after work. Thus weekday travel in general should be lower for CWW workers. Longer work days may also have some effect on mode choice. It could be more difficult to rideshare (because the extra time required for ridesharing compared to driving alone is more critical with a nine or ten hour work day), but on the other hand, ridesharing could be more attractive to those who find the driving commute tiring.

Trip frequency and scheduling could change in many ways, having a significant effect on vehicle emissions. If travel is more concentrated (e.g. lots of activities performed on the day off), cold starts may be reduced. On the other hand, if activities normally performed on the way to or from work are shifted to another day, cold starts may be increased. If fewer trips are taken during the peak, there should be less travel in congested conditions, and therefore less pollution impact.

1.4 RESEARCH APPROACH

We conducted a cross-section analysis of South Coast Air Basin employees to determine the effects of CWW. Using as our sample universe the estimated 2.2 million employees working at sites subject to the South Coast Air Quality Management District's Regulation XV[9], we recruited volunteer participants to complete a seven day travel diary. Seven day travel characteristics are used to determine CWW impacts.

We used the Regulation XV data base to identify sites using CWW; we recruited potential participating sites by contacting the site's Employee Transportation Coordinator (ETC). Eleven participant sites were recruited; they are located within Los Angeles and Orange Counties. Employees at each of these sites were requested to participate in the travel diary survey. Knowing that recruitment of diary participants would be difficult, we conducted a short preliminary survey that elicited basic demographic and socio-economic information, as well as soliciting diary participation. The preliminary survey data were used to weight the diary sample.

We compare weekly travel characteristics across four different categories of work schedule: regular, 4/40, 9/80 and "long" (individuals who work more than ten days in a two week period). The travel diaries provide information on trips by time, purpose, mode, and distance. After controlling for individual characteristics that affect travel behavior, we analyze differences in travel characteristics across these work schedule categories.

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[9] Regulation XV, issued in 1987 by the South Coast Air Quality Management District, requires all employment sites with 100 or more employees to develop and implement a plan for increasing the level of ridesharing (measured in terms of "Average Vehicle Ridership") at the site. The plans contain information on site characteristics, including work schedules.

1.5 ORGANIZATION OF REPORT

The following chapters present the research results. Chapter Two provides a review of the literature. After presenting a description of travel characteristics, Chapter Two reviews activity-based concepts of travel, and discusses empirical findings of activity-based studies. Prior studies of CWW are then summarized. Chapter Three describes the research methodology, including the survey design, sampling plan, site and participant recruitment, and the survey distribution and collection.

Chapter Four presents a description of the data. Data from the two different survey instruments are summarized, and construction of the data files is described. Tests of sample bias are also discussed, and descriptive statistics for both survey data sets are presented. Chapter Five presents research results. Travel characteristics, including travel distance, trip frequency, trip scheduling, trip purpose and mode are examined. Chapter Six presents conclusions regarding the overall effectiveness of CWW as a transportation control measure and makes recommendations for further study.

This report also contains four appendices. The first two contain copies of the survey instruments. The last two contain frequencies for all categorical variables in each of the survey files.

CHAPTER TWO
LITERATURE REVIEW

This chapter reviews and summarizes the existing literature on alternative work schedules and related topics. First, we present a brief review of travel behavior characteristics. Second, we discuss travel patterns and the activity-based approach to travel behavior. The third part of the chapter reviews prior findings on alternative work schedules and related strategies.

2.1 TRAVEL BEHAVIOR CHARACTERISTICS

The effectiveness of compressed work weeks and other travel demand management policies depend on how travel patterns are affected by them. These changes are in turn a function of travel behavior. It is therefore appropriate to briefly summarize the basic characteristics of travel behavior. Although trips are taken for many purposes, the work trip has historically been the focus of transportation policy. Empirical studies show that commuting to and from work is only a part, and sometimes not a very large part, of urban travel. The long-term trend, measured from the earliest National Personal Transportation Survey (NPTS) in 1969, is one of work travel becoming a diminishing part of all travel. According to the NPTS data, work trips accounted for just 20.1 percent of all person trips in 1990 (Hu and Young, 1992).
Because work trips appear to have increased in length faster than other trips, the share of person miles of travel attributable to work trips increased from 20.1 percent to 22.7 percent over the same period (Pisarsky, 1992). The trend, measured in vehicle trips, was very similar: a decrease in the share of vehicle trips, but an increase in the share of vehicle miles of travel. The relatively minor changes in share of trips and travel for work are not the result of lack of growth. All segments of work travel have increased, in some cases substantially. Rather, the growth in trips for other purposes has been greater. For example, trips for personal businesses have shown dramatic increases (Hu and Young, 1992).

Although work trips account for a small share of all travel, their characteristics make them important to transportation policy. Work trips generate peaks in travel demand in the early morning (AM peak) and evening (PM peak), thus having a more significant impact on transit and highway system capacities than trips that are more evenly distributed across the day. Work travel demand is also very inelastic: the number and timing of work trips are determined by one's job schedule. Work travel is consequently difficult to manage via policy initiatives.

National data also illustrate the extent to which private vehicle travel, and particularly driving alone, has come to overwhelm all other modes for work travel. Somewhat surprisingly, however, only a small increase in mean travel time to work has been observed despite these trends. According to U.S. Census data, mean travel time to work increased from 21.7 minutes in 1980 to 22.4 minutes in 1990. With a 35 percent increase in persons driving alone over the same period, this is a great comment on the flexibility and capacity of the nation's highway system. These national averages, however, obscure localized congestion problems that have become a major concern, particularly in metropolitan areas that have experienced rapid population and employment growth.

2.2 ACTIVITY-BASED APPROACH TO TRAVEL BEHAVIOR

Research over the past decade has shown that trip making is dependent upon the activities associated with it (Hensher and Stopher, 1979; Jones, Koppelman and Orfeuil, 1990). Trip choices are made as part of a generalized decision process of sequencing activities over the course of a day (Miller and O'Kelly, 1984). Travel outcomes are the result of the individual's resources (time, money, car access) and constraints (work schedule, household responsibilities, etc.). Daily travel patterns also depend both on individual and household characteristics, and some evidence suggests that travel decisions are made jointly among household members (Koppelman, 1987). These interdependencies have been termed "complex travel patterns," and research methods that explicitly incorporate these interdependencies are termed "activity-based" approaches. Activity-based approaches have evolved considerably since they were first recognized as a new development in the study of travel behavior. The growing interest in these approaches has been reflected in an increase both in the number of studies conducted and in the range of approaches used. A wide range of issues have now been addressed from an activity-based perspective. Activity-based approaches share a common philosophical perspective. The conventional approach to the study of travel behavior based on single trips (the 'trip-based paradigm') is replaced by a richer, more holistic, framework in which travel is analyzed as daily or multi-day patterns of behavior, related to and derived from differences in life styles and activity participation among the population (Jones, Koppelman and Orfeuil, 1990). Features of the activity approach to travel behavior include:

- Explicit treatment of travel as a derived demand (while recognizing that, on occasion, travel may be a primary activity in its own right).
- Focus on sequences or patterns of behavior rather than an analysis of discrete trips.
- Emphasis on decision-making in a household context, taking explicit account of linkages and interactions among household members (Koppelman, 1987).
- Emphasis on the detailed timing as well as the duration of activity and travel, rather than using the simple categorization of 'peak' and 'off peak' events (Pas, 1988).
- Explicit consideration of spatial, temporal and inter-personal constraints on travel and location choices (Kitamura, 1987).
- Recognition of the interdependencies among events that occur at different times, involve different people, and occur in different places.
- Use of household and person classification schemes (e.g. stage in family life cycle), based on differences in activity needs, commitments and constraints.

This shift to a broader, and theoretically more complete, perspective on travel behavior parallels a shift in intellectual orientation in the general scientific community (Jones, 1990). In this new scientific environment, the dominant thinking has evolved from simple physical and economic frameworks to incorporate broader concepts derived from a variety of physical and social sciences, e.g. recognition of complexity, emphasis on interactions, and search for underlying casual structures (see, for example, Capra, 1982).

The motivation for the development of activity-based approaches has derived largely from dissatisfaction with the established analytical procedures on both theoretical and operational grounds. In many instances forecasts of trip-based models have been inaccurate, and this seems to be the result of mis-specification - an inappropriate representation of travel behavior relationships - which is itself the result of a failure to recognize the existence of linkages among trips, and between trips and activity participation (Jones, 1990).

Activity-based analysis approaches seek a deeper understanding of travel behavior, both of travel itself and the characteristics of households and their activities which relate to it directly or indirectly. Activity-based research has provided a more complete representation and understanding of travel, but has also resulted in a more complex treatment of travel. While many important insights have been obtained, much of the work has been carried out in an academic rather than practitioner-oriented environment, and activity-based studies have yet to make a significant breakthrough into transport planning practice (Koppelman and Orfeuil, 1989).

Two issues revealed by activity-based research are particularly relevant to this research. First, the existence of complex travel patterns calls into question the analysis of trips as discrete events, and therefore generates the question of the appropriate unit of analysis. There are a variety of ways in which travel can be measured, including the number of stops in a tour or a chain, the duration or activities, or the sequence of events. Koppelman and Pas (1984) have developed analytic relationships between trips and tours, with a tour defined as any sequence of trips that begins and ends at home. The tour concept can be extended to all-day or multi-day travel patterns. Pas (1988) has developed an alternative structure which relates daily travel patterns combinations to multi-day travel patterns using classification schemes for the daily and multi-day patterns.

A recent survey conducted by Seattle Metro illustrates the results of analyzing sequences of trips. Researchers found that a large proportion of commute travel (20 percent) includes stops along the way, and it appears that the frequency of these multiple stop journeys have increased over time (Willis and Hodge, 1990). If work travel is considered to include all travel associated with the journey to or from work, Willis and Hodge estimate that 45 percent of all trips are commute trips.

A second issue in the analysis of travel has been the recognition that travel varies from day-to-day, even in an equilibrium situation. It has long been acknowledged that travel patterns differ between population groups as a function of the severity of constraints on their behavior (Pas and Koppelman, 1986). More recently, studies have examined the variation in travel behavior of the same individuals on a day-to-day basis. Day-to-day variability is attributed to differences in daily activity patterns, since many activities are not carried out on a daily basis (Hirsch, 1986). The existence of variability has a crucial bearing on the measurement of changes in behavior and the assessment of the impacts of transport policy measures. Without an adequate understanding of travel pattern variability, observed differences in before and after studies may be erroneously attributed to the transport changes (Jones and Koppelman, 1986).

Empirical evidence of day to day variability is mixed. James Huff and Susan Hanson (1986), using data drawn from the Uppsala Household Travel Survey collected in 1971, examined day-to-day variability in travel behavior. Their analysis is based on a representative sample of 149 persons, each of whom kept a detailed travel activity diary for 35 consecutive days. Analysis revealed that habit is not the simple repetition of the same suite of behaviors. It was found that, although each person has a few highly repetitious behaviors (for example, going to work by car), these tend to be repeated as parts of different daily patterns. The study also showed that each person has more than one typical daily travel pattern, and, perhaps more surprising, more than one typical weekday travel pattern. Furthermore, these archetypical daily patterns tend to be quite different from each other in terms of the number and types of stops comprising the pattern. Huff and Hanson concluded that little of the day-to-day variability present in the individual's travel-activity pattern could be said to be systematic.

In contrast, Kitamura and van der Hoorn (1987) found significant stability in travel patterns. Their analysis is based on two waves of Dutch panel data, each wave consisting of a fourteen day travel diary. The study found that 69.8 percent of the male workers and 58.6 percent of the female workers had identical daily patterns of shopping participation or non-participation on five or more of the days of each of the two weeks (six months apart) in the study. For example, if the respondent shopped on a Tuesday and not on a Wednesday in week one of the first panel, this pattern was repeated in week one six months later.

A more recent study of commuting behavior based on data from one to two week travel diaries documents extensive trip chaining and daily variability (Mahmassani, Joseph and Jou, 1992). Approximately 25 percent of all morning commutes and 34 percent of all evening commutes contain at least one intermediate stop. The study also found that the journey to work, long considered one of the more stable elements of urban travel, is itself quite variable from day to day. Commuters' departure time decisions both from home and from work are subject to significant daily variation: approximately 31 percent of morning trips and 49 percent of evening trips vary more than 10 minutes from the commuter's median departure time.

The research findings of activity-based travel studies suggest that in order to accurately measure the effect of different work schedules, the linkages between travel and activities, as well as between the scheduling and sequencing of activities must be taken into account. In addition, the travel data must cover a period of time sufficient to capture day to day variability. Our research methodology thus incorporates a seven day travel diary, as described in Chapter 3.

Pas (1985) and Pas and Koppelman (1987) have illustrated the importance of daily variation of travel choices. They advocate the use of multi-day surveys on both substantive and statistical grounds. Given the existence of variability, collection of multi-day data becomes important, both as means improving the statistical significance of travel relationships (Pas, 1985), and because the variability may itself be of interest (e.g. are the cars which contribute to congestion the same or different each day). The identification of variability crucially depends on the measure of behavior used, i.e. the more detailed the measure, the greater will be the extent of day-to-day variability (Huff and Hanson, 1988).

2.3 PRIOR RESEARCH ON ALTERNATIVE WORK HOURS

Work schedule changes may either affect the location at which work is performed or the times when an individual must be at work. These strategies are believed to have a positive impact on peak congestion by moving work trips out of the peak period, reducing the length of the trip, or by eliminating trips. Air quality benefits are realized from reduced congestion and VMT. Although we concentrate on 4/40 and 9/80 compressed work week schedules, a brief discussion of other forms of work schedules is presented.

2.3.1 COMPRESSED WORK WEEKS

Compressed work week schedules (CWW) are advocated as effective transportation control measures because they reduce the number of daily work trips. With compressed work weeks, employees work more hours per day and fewer days per week as compared to a normal work schedule. The most common types of compressed work week schedules are the four-day, ten-hour day work week (commonly referred to as 4/40) and the 9/80 plan. In the 9/80 plan, the employee works 80 hours in nine days, and all of the employees work the same hours. A third and far less common type of compressed schedule is the 3/36 schedule, or three twelve hour work days per week.

Alternative work schedules were heavily promoted in the 1970s in response to the energy crisis, and several experiments with the 4/40 schedule were undertaken. These schedules were never widely adopted, and only a small percentage of the work force is working on these schedules today. However, air quality requirements, as well as the congestion management programs mandated by Proposition 111 in California, have promoted more aggressive implementation of transportation control strategies. Thus it is anticipated that more employers will shift to CWW programs as part of their efforts to achieve trip reduction targets. Only two major studies of the transportation and air quality impacts of CWW have been conducted. Both of these are discussed below.

2.3.1.1 Denver Federal Employee Compressed Work Week Experiment

Denver participated in a federal employee compressed work week experiment that lasted for three years, beginning in 1978. The experiment was viewed as a way to demonstrate that a compressed work week program would reduce the total weekly trips and/or weekly distances, thus reducing congestion and air pollution. The Denver experiment involved 35 agencies. Within the participating agencies, about 7,000 employees participated, with the selected type of compressed work week about evenly split between a four-day work week and the 9/80 plan.

The evaluation study had two objectives: to determine impacts on transportation and air quality; and to examine factors that influence an employee's choice of work schedule. The study was conducted during 1979 and 1980 (Cambridge Systematics, Inc., 1980). The analysis approach developed to evaluate the transportation impacts of such a program involved the measurement of a number of travel related impacts prior to implementation of CWW and again during the experiment. Also involved in the experiment was the use of a control group to isolate those impacts attributed to the CWW from other changes occurring during the experimental period. Surveys were administered to approximately 2,500 federal employees in 29 agencies in June 1979 and again in June 1980. This effort involved two types of survey forms: a relatively straightforward questionnaire requesting the employee's work schedule, work trip mode choice, and various socio-economic data, and a series of vehicle logs designed to record household travel patterns over a period of a week. Supplementing these survey data were a series of traffic counts and bus ridership counts.

Comparison of the samples for which vehicle log data were available suggests that the compressed work week resulted in a reduction in total weekly household VMT of approximately 49 miles, or 16 percent. Prior to a compressed work week schedule, total weekly VMT for employees in participating and non-participating agencies were the same. One year later, though, average weekly VMT for employees in participating agencies had decreased and VMT for employees in the control group of non-participating agencies had increased[10] (Table 2-1). Since not all employees at participating agencies actually worked on a compressed schedule, these numbers suggest a very large decrease in travel for at least some employees.

A more direct comparison is with the employees who participated in both survey waves and who switched to a compressed work schedule. Results are shown in Table 2-2. The study authors conclude that both work and non-work travel is significantly reduced, and some weekday work travel is offset by shifts of non-work travel to the weekday off.

Although these results suggest rather large changes as a result of CWW, it bears noting that these are comparisons of different cross-sections of vehicle logs with highly variable amounts of missing information, and may thus have limited reliability. In particular, the worktrip mileage reductions appear to be excessive. For example, a reduction of 60 miles in weekday work travel (Table 2-2) is about one-third of the base work VMT. Since the participant employees were working both 4/40 and 9/80, the reduction should not exceed 20 percent of the base figure, all else equal.[11] The results of this study suggest VMT reductions from CWW, but the magnitudes are somewhat uncertain. In addition to the reduction in VMT, the study reported that work arrival times were spread over a longer period, and that there was no significant effect on mode share.

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[10] The authors attribute these increases to the increased availability gasoline in 1980, as the before survey was taken at the height of the 1979 oil crisis.

[11] Work travel is defined in the study as all sequences of trips in which work is a destination.

TABLE 2-1
DENVER EXPERIMENT: CHANGES IN WEEKLY HOUSEHOLD VMT

	EMPLOYEES IN NON-PARTICIPATING AGENCIES		EMPLOYEES IN PARTICIPATING AGENCIES		DIFFERENCE
	VMT[a]	N[b]	VMT	N	
Before CWW					
Total	285	154	286	594	+1
Weekend	75	129	79	490	+4
Weekday	210	129	202	490	-8
Weekday Work	133	111	145	432	+12
After CWW					
Total	315	138	266	395	-49*
Weekend	86	110	75	320	-11
Weekday	204	110	185	320	-19
Weekday Work	156	91	124	286	-32**

* Difference between group means significant at $p < .10$
** Difference between group means significant at $p < .05$
[a] Vehicle Miles Traveled by household vehicles per week
[b] Number of employee observations

Source: Atherton, Scheuernstuhl and Hawkins, 1982

TABLE 2-2
DENVER EXPERIMENT: CHANGES IN WEEKLY HOUSEHOLD VMT FOR EMPLOYEES CHOOSING COMPRESSED WORK SCHEDULES

TYPE OF VMT	BASE VMT	CHANGE ONE YEAR LATER (MILES)	N
Total	336	-59*	140
Weekend	98	-28*	72
Weekday	240	-33*	87
Weekday Work	182	-60*	65
Average Monday - Friday	52	-6*	85

* Difference between group means significant at p <.025

Source: Atherton, Scheuernstuhl & Hawkins, 1982

The air quality impact of compressed work weeks greatly depends upon the magnitude of the transportation impacts. If the number of work-related trips that are eliminated, taking into account changes in mode share, are greater than the number of non-work trips that are generated, then there will be an air quality benefit due to the reduced number of cold starts. In addition, the non-work trips are probably shorter in length than the work trips; therefore there will be an emissions benefit due to the reduced VMT. Finally, if a sufficiently large number of commuters are shifted out of the peak period, speeds will be increased and emissions will be further decreased. The evaluation of the air quality impacts of the Denver experiment did not examine the effect of cold starts, because no data were collected on the number of trips. It can be assumed, however, that there was a reduction in the number of cold starts due to the reduced number of work-related trips and, because the non-work VMT did decrease, there was probably also a reduction in cold starts for non-work related trips.

The Denver study also examined factors that influence the employee's choice of work schedule. It was found that participation in compressed work schedules is highest among married employees with unemployed spouses and older children (74.4 percent), and lowest among single employees with younger children (50.9 percent). That is, participation is most likely when household tasks would be least affected. Marital status and childcare responsibilities have a greater impact on the choice of work schedule of female employees relative to that of male employees. Among households in which both spouses are employed, participation rates of female employees (45 percent) is much lower than for male employees (69 percent).

2.3.1.2 The Los Angeles County Department of Public Works Study

This case study, conducted in 1991 by Commuter Transportation Services, Inc., was designed to determine whether the compressed work week program reduces total weekly trips and/or weekly distances, thus reducing congestion and pollution (Commuter Transportation Services, Inc., 1992). It examines the effects of 4/40 CWW by analyzing seven-day travel logs completed by employees at the Los Angeles County Department of Public Works (LACDPW), before and after the implementation of a 4/40 work schedule. LACDPW is closed for business on Friday of each week, and all employees were required to shift to the new schedule. A representative sample of 300 was randomly selected from LACDPW's 1600 employees to participate in the survey. The before survey was conducted two weeks prior to implementation of the program, and the after survey was conducted six months after implementation. The surveys were distributed to the same sample group, yielding 158 responses before and 139 responses after. Each survey included a one week travel log designed to record details of employee trips each day of the week (Monday through Sunday). The survey examined employee's day off trips, number of trips, length (distance/time) of trip, and mode split.

The study results indicate that respondents are making more trips on their day off (Friday) than any other day of the week, but these extra trips are more than compensated by a reduction in the number of trips on the remaining days of the week. Thus, on average, fewer trips are being made per week after the implementation of the new schedule. The trips that are being made are, on average, shorter than those made before the 4/40 was implemented and thus, the average total distance traveled per respondent for the week decreased by 46 miles.

The study also conclude that respondents are making fewer trips before and after work, and instead tend to run errands during the workday or on their day off. Employees use their new day-off, Friday, as a day to run short errands, to go shopping, to visit a friend; activities that were previously conducted on Saturday. After the implementation of the new schedule, there was a sharp reduction in the number of trips on Sunday, in terms of both distance and time. Apparently, the extra day off is used for relaxation. On the day off most of the trips are made in the afternoon, suggesting that trips have shifted from the peak period to the off-peak periods, thus reducing the number of non-commute trips made at peak traffic volume times. Although the average distance traveled for the week decreased by 46 miles per respondent, the average time spent travelling decreased only slightly. This would indicate that in terms of reducing congestion and pollution, the savings may not be as great as it would initially seem, since the time vehicles are actually on the road did not decrease significantly, despite the reduction in distance traveled.

2.3.2 FLEXTIME

Flextime refers to a wide range of flexible scheduling procedures that allow employees to set their own start times. The specific way in which flextime is implemented is subject to company policy. The employees may or may not be allowed to vary their start times from day to day, the length of the lunch period may or may not be allowed to vary, and the number of hours worked may be set by day or by week. Flextime allows the employee to coordinate his work, commute, and home activities and thus minimize any conflicts. In addition to a number of personnel-related benefits, transportation and air quality benefits could be realized, as flextime allows employees to avoid the peak commute periods and to better coordinate with transit schedules and rideshare arrangements. Flextime has been most successful in those areas dominated by office-related employment that can accommodate this level of flexibility (Jones and

Harrison, 1983). For manufacturing or production activities, flextime is not a feasible option, because employees need to be at work at the same time.

The first documented flexible work hours program was established in 1967 at the Messerschmidt Headquarters in Ottobrunn, West Germany. Since then, a number of individual companies have allowed their employees some flexibility in their work hours. However, there are far fewer projects that have been documented and evaluated. The San Francisco Flex-Time Demonstration Project provides the most comprehensive evaluation of flexible work hours (Jones and Harrison, 1983). The purpose of the project was to determine whether sufficient participation would occur to affect the performance of the transportation system. In San Francisco, travel to the Central Business District (CBD) was heavily concentrated between 7:30 am and 8:00 am, resulting in very crowded conditions on the roadways and on the public transportation system. The flexible hours program was aimed at spreading out the morning peak.

Approximately 6,000 employees participated in the demonstration program, representing 2.3 percent of the workforce in downtown San Francisco. Most of the employees chose to arrive at work earlier than had been the previous norm. They were able to avoid the peak congestion or more conveniently meet transit schedules, thus realizing a significant savings in travel time. On average, transit users saved six minutes per trip and commuters traveling by car save nine minutes per trip.

Impacts on transportation system performance were less clear. In the East Bay corridor, (crossing the Bay Bridge into San Francisco), there was no significant impact on the number of vehicles during the peak period. In the North Bay corridor (crossing the Golden Gate Bridge into San Francisco), the public transit system experienced an increase in patronage while spreading out peak service, yielding a significant increase in operating efficiency.

2.3.3 IMPACTS OF ALTERNATIVE SCHEDULES ON WORKERS

Much of the early research on compressed work hours deals with issues of employee productivity, absenteeism and job satisfaction (Maklan, 1977; Nollen, 1982). This research is important for evaluating the feasibility of implementing alternative work schedules on a broad scale.

Emphasis on the quality of work life has led to a number of variations on the traditional nine to five work day. Attempts are being made to accommodate workers because of a changed labor force, changing attitudes about work itself, and the problem of declining job satisfaction among US workers. The systems being adopted include: 1) flextime; 2) job-sharing, whereby two or more persons share the same job; 3) permanent part-time work; 4) the compressed work week; and 5) work during nights or on weekends only (Burdetsky and Kaplan, 1981).

Studies of alternative work schedules on productivity have yielded generally positive results. Increased work continuity and extended hours of service were reported as a result of implementing a 4/40 schedule among engineering service salaried employees (Economides, Reck and Allen, 1989). A survey of computer operations employees found very positive attitudes toward the compressed work week, especially among those who had participated in the implementation decision. Also positive were employees who perceived the scheduling change to enrich their jobs. No evidence of fatigue due to longer working days was found, and absenteeism due to sick time and personal time was substantially reduced (Latack and Foster, 1985). Other studies also document favorable employee responses (Ronen and Primps, 1981; Newstrom and Pierce, 1979). Impacts on firms have been positive as a result of reduced absenteeism, and no negative effects on marketing or customer satisfaction have been documented (Burdetsky and Kaplan, 1981).

Although alternative work hours have been widely promoted, their use continues to be limited. It was estimated that in 1971 about 600 firms in the US offered some form of CWW, and about 75,000 employees worked on a 4/40 schedule (Hedges, 1971). It was anticipated that the use of compressed work schedules would increase rapidly, yet even today only a small share of all employees work these schedules. In the Southern

California region, we estimate that about 5 percent of the workforce works some form of compressed schedule (See Chapter 3).

In view of the positive impacts reported from studies of alternative work schedules, it is important to examine what barriers may exist to their implementation. Hedges (1971) cites potential adverse effects on the health and safety of workers, and fear of a long run decrease in productivity due to employee fatigue and intra-organization constraints. Other possible explanations include household constraints that make long work days difficult and long-term adverse effects on business activities due to demand side constraints (e.g. customer preferences for business hours and service availability).

2.4 CONCLUSIONS

The literature review shows that the work schedule is associated with travel patterns in many different ways. Impacts associated with different schedules must therefore be examined in the context of total travel, both work and non-work and weekday and weekend. In addition, trip linkages and day to day variability must be considered.

Prior studies of CWW document less total travel. The reduced number of work trips is not entirely offset by increased non-work travel. Prior studies also document differences in trip scheduling (mainly taking advantage of the extra day off), but no significant differences in mode share. These studies provide limited information on the impact of CWW on trips, trip distances, and individual travel patterns.

CHAPTER THREE
RESEARCH METHODOLOGY

The purpose of this research is to determine how compressed work schedules affect travel behavior. Key issues include 1) whether the reduced number of work trips are replaced by other types of trips; 2) whether total travel by private vehicle is reduced; 3) whether trip timing is affected; 4) whether patterns of trips are affected. Since all travel must be considered, travel data for an entire week must be collected.

3.1 RESEARCH DESIGN

There are two possibilities for measuring the effects of compressed work schedule, before/after or cross-section. A before/after analysis requires identifying sufficient numbers of respondents before and after a compressed work schedule is implemented, as in the Denver study (Cambridge Systematics, 1980). The benefit of such an analysis is the ability to hold as much constant as possible. Ideally, the same sample of respondents would be surveyed before and after the new schedule is implemented. Any observed differences in travel behavior could then be attributed to the new work schedule.

A cross-sectional analysis requires identifying a sample of respondents working on different schedules and comparing their travel patterns. This approach requires that other differences that could affect travel behavior among the respondents are taken into account. We have chosen the cross-section alternative because it was the most feasible way to obtain a sufficiently large survey sample.

3.1.1 COLLECTING SEVEN DAYS OF TRAVEL DATA

Few multi-day travel surveys have been conducted in the U.S. because of the high cost and difficulty of obtaining a suitable sample. The difficulty comes from the high level of effort required on the part of the respondent. Prior survey efforts show that it is difficult to recruit survey participants, and that participants may be unwilling to complete the survey for seven days (Golob and Meurs, 1986). Extensive recruitment efforts and regular personal contacts with respondents contribute to the high cost of diary survey efforts.

One way to reduce respondent fatigue is to collect fewer days of data from each respondent. For example, each respondent could be asked to complete a three day diary, and respondents could be surveyed on a rolling basis to obtain a sufficient sample of weekdays and weekends. Weekly travel patterns would be constructed from the total pool of reported days. While this approach might encourage a higher response rate, it would also generate reliability problems associated with combining travel days from different individuals.

Given that the sample would be a cross-section, and thus would require comparison of different individuals to determine impacts of compressed work schedules, we concluded that a seven day diary would be most appropriate. Response rate problems could be evaluated in the pre-test phase, and, if necessary, the data could be adjusted by weighting the final sample.

3.1.2 HOUSEHOLD VS. INDIVIDUAL SURVEYS

Prior research suggests that compressed work schedules could lead to different allocations of trip tasks and travel resources within the household (e.g. Pas and Koppelman, 1986). For example, the vehicle left home on a day off may be used by another household member. In this case, the CWW employee's reduced travel would not be a true indication of the effect of compressed work week schedules. Possibilities for intra-household activity and travel shifts raises the question of who should be surveyed, the employee or the household. Using households would allow us to examine directly any shifts in travel among household members as a result of CWW, but would vastly increase the cost and complexity of the study. We chose to use individual employees as the basis of our study for the following reasons:

1. Detailed multi-day travel information is very difficult (and therefore very costly) to obtain.

2. Data on auto ownership in Southern California shows that the vast majority of households with at least one worker have cars available for each household driver, suggesting that additional driving of the CWW worker's vehicle on the day off would be an unlikely occurrence.
3. Interviews conducted early in the study provided support for point 2 above. The interviews are described below.
4. Given funds available, using individuals would provide the best opportunity for obtaining a sufficiently large sample for analysis. The reduction in sample size that would result from using households would more than offset the benefits of directly measuring vehicle use by other household members.

As part of our deliberations on this issue, we conducted telephone interviews with eight employees on some form of compressed work week schedule. Respondents were found by placing an advertisement at a city Civic Center in Orange County requesting volunteers from employees who worked the compressed work week. The advertisement also specified that we were particularly interested in employees with children living at home. Three of the employees interviewed work a 4/40 (4 days/week, 10 hours/day) schedule, and five work a 36/44 schedule (4 days one week, 5 days one week). Six respondents have Friday off; the remainder have Monday off. Three had children with driver's licenses living at home, and two had a parent with driver's license at home. Children ranged in ages from 2 to 22 years old. Six respondents were women and two were men.

All of those interviewed said no one else had use of the car on the day that they were at home. Indeed, responses took on a strong tone of ownership and responsibility for the vehicles' use. Several were very concerned to keep gas use and mileage as low as possible. Only one couple swapped cars; they had a Mercedes and a Toyota truck, and stated that their activities determined which vehicle they used. We concluded from both these interviews and the level of auto ownership among households with workers that household based interviews would add very little to our investigation of the impact of compressed work weeks on family dynamics of car use.

3.1.3 SURVEY TYPE

The three alternatives for conducting such a survey are personal interview, telephone, or questionnaire. A personal interview would require recruiting participants, establishing the survey period, and conducting either seven consecutive daily interviews or one interview at the end of the seven day period. Consecutive interviews would provide the best information, but are prohibitively costly. A single interview at the end of the seven days would rely too heavily on retrospective information that would likely result in significant under-reporting of trips, particularly short trips or non-vehicle trips.

Telephone interview techniques have developed rapidly in recent years and are now very efficient. Trained interviewers enter response data directly into a data base file, making the data file construction simultaneous with the interview. However, the need for seven days of data also made the telephone method impractical and too costly. We therefore chose the third alternative and developed a questionnaire survey that would be distributed at the worksite and returned by mail to the research site. A written survey can be completed on a daily basis, and thus has a higher probability of accuracy than any form of retrospective survey.

3.1.4 THE TWO PART SURVEY

Given the substantial commitment of time and effort required on the part of the respondent, it is obvious that a true random sample of respondents cannot be obtained. Respondents must be recruited, and personal contact is necessary to provide instructions, guidance, and encouragement to complete the survey. The survey instrument was designed for personal distribution, and the survey process included personal contacts with all respondents.

We developed a two part survey design that would serve to both recruit travel diary participants and provide a means for measuring diary sample bias. The first part of the survey elicits basic demographic and employment information, and requests the respondent to participate in the travel diary. We refer to this part as Survey A. The second part of the survey is the travel diary, referred to as Survey B. The diary is a comprehensive accounting of all separate journeys. It requires the respondent to 1) list each trip taken each day by time began and time ended, purpose, mode and distance; 2) provide information on type of travel day and car use, and 3) list year, make and model of each household vehicle. Copies of the surveys are included in Appendices A and B.

3.2 SAMPLING PLAN

Our sample universe is the workforce at sites located within the South Coast Air Basin (SCAB) and subject to SCAQMD's Regulation XV. Any employment site, public or private, having at least 100 workers is subject to the Regulation. As of December 1993, there were approximately 6,200 sites that had filed Regulation XV plans. The plans provide data on worksite characteristics. These sites employ about 2.2 million workers, which we estimate to comprise about 40 percent of the entire regional workforce. The sites are distributed throughout the South Coast Air Basin and represent a wide range of worksite characteristics.

3.2.1 USE OF CWW AT REGULATION XV SITES

Examination of the Regulation XV data showed that there are three basic types of CWW: 4/40, 9/80 and 3/36. The 4/40 schedule is most widely offered; 1367 sites have at least one worker on this schedule. The 3/36 is the least popular, and it is offered at just 377 sites. More than one type of CWW is offered at many sites. Types of CWW offered, both alone and in combination, are summarized in Table 3-1.

TABLE 3-1
TYPES AND COMBINATIONS OF CWW SCHEDULES
AT REGULATION XV SITES

TYPE OF SCHEDULE OFFERED	NUMBER OF SITES	PERCENT
No CWW	4,492	72.0%
4/40 CWW Only	687	11.0%
9/80 CWW Only	233	4.0%
3/36 CWW Only	100	2.0%
4/40 and 9/80 CWW	416	7.0%
4/40 and 3/36 CWW	110	2.0%
9/80 and 3/36 CWW	10	0.2%
4/40, 9/80 and 3/36 CWW	152	2.5%
All Sites	6,200	100.0%*

* Percentages do not add exactly to 100 due to rounding.

The Regulation XV plans give the number of employees working on CWW schedules, and thus can be used to compute the total number of workers on CWW. We find that compressed work schedules are quite uncommon. Although 28 percent of all sites offer a compressed work week schedule to at least one employee, the share of total employees on CWW schedules is much smaller. We estimate that there are 45,515 workers (2.1% of total workforce) on the 4/40 schedule, 44,928 workers (2.0% of total workforce) on the 9/80 schedule, and just 10,501 workers (0.5% of total workforce) on the 3/36 schedule (Table 3-2). Thus, less than 5 percent of all employees represented in the Regulation XV data base work on some form of compressed schedule.

TABLE 3-2
NUMBER OF EMPLOYEES ON CWW AS A PERCENTAGE OF TOTAL EMPLOYMENT

TYPE	NUMBER OF EMPLOYEES [a]	PERCENT OF TOTAL EMPLOYMENT
4/40 CWW	45,515	2.07%
9/80 CWW	44,928	2.04%
3/36 CWW	10,501	0.48%
No CWW	2,099,056	95.41%
Universe	2,200,000	100.00%

[a] Estimate based on number of total employees as reported in Regulation XV plan.

In addition, most CWW employees are concentrated at a few sites. Although many sites have at least one worker on a CWW schedule, there are relatively few where the majority of workers have a CWW schedule. Table 3-3 gives the distribution of sites by the share of employees working on each type of CWW schedule. These percentages—show that there are relatively few potential CWW survey sites. Table 3-3 also shows that there are just two sites where 50 percent or more of the employees work a 3/36 schedule. Further investigation revealed that these sites are using the 3/36 CWW schedule not as a result of Regulation XV, but as a standard operating schedule. One site is an oil refinery; the other is a plastics manufacturer. Both operate 24 hours a day, five days a week. In addition, most of the other sites offering the 3/36 CWW schedule to certain employees are in the health service industries. The 3/36 schedule is a standard operating schedule for many health professionals. We conclude that the 3/36 schedule is not representative of either compressed work week policies or most employment contexts, and therefore do not include it in our analysis.

TABLE 3-3
SHARE OF EMPLOYEES ON CWW BY TYPE OF CWW

PERCENT OF EMPLOYEES AT SITE ON CWW	4/40		9/80		3/36	
	# OF SITES	PERCENT [a]	# OF SITES	PERCENT	# OF SITES	PERCENT
50% or More	64	4.7%	58	7.2%	2	0.1%
10 to 49%	268	19.6%	170	21.0%	53	14.0%
Less Than 10%	1035	75.7%	583	71.2%	317	86.0%

[a] Sites in category as percent of all sites offering the given CWW type

There are several variations within the two basic types of CWW schedules. For 4/40 schedules, some sites have a fixed day off (usually Friday) for all employees, and the site is closed on the day off . Others use a rolling schedule, in which about 20 percent of the workforce is off on any given weekday. Although the sites of the first type close the sites once a week, minimal staffing is usually maintained for public assistance and security matters. For 9/80 schedules, a fixed day off occurs once every two weeks (usually Friday or Monday), and the site is closed on the day off. Other 9/80 schedules utilize a rolling day off, and the site remains open for business during the conventional work week. Restriction of both 4/40 and 9/80 to certain departments or functions also occurs. Sites that close on the day off on either 4/40 or 9/80 are most frequently public agencies, while the other variations are found in all industry groups.

3.2.2 CHARACTERISTICS OF CWW SITES

Tables 3-4 through 3-6 summarize some basic characteristics of the CWW sites and compare them with those of the total population of Regulation XV sites that do not offer any type of compressed work schedule. The tables are based on the CWW sites that have at least half of the workforce on a CWW schedule: 64 sites on the 4/40 schedule and 58 sites on the 9/80 schedule. The total population comparison is based on a 1-

in-4 random sample of the 4,492 sites that have no workers on any type of CWW schedule.

Table 3-4 shows the distribution of these three categories of sites by location. About two thirds of all sites are located within Los Angeles County, one fifth in Orange County, and the remainder in the outlying counties of the region. A relatively larger share of 9/80 sites are located in Orange County; the distribution of 4/40 sites is nearly identical to the total sample. The greater share of 9/80 sites in Orange County may reflect differing strategies to achieve the Regulation XV Average Vehicle Ridership (AVR) objectives.

TABLE 3-4
LOCATION DISTRIBUTION OF CWW AND NON-CWW SITES

COUNTY	NO CWW	4/40	9/80
Los Angeles	66%	66%	48%
Orange	20%	20%	36%
San Bernardino	6%	6%	10%
Riverside	8%	8%	5%

Table 3-5 suggests that the use of CWW is strongly related to industrial sector. Manufacturing sites account for 64 percent of the 4/40 schedules, but for only 29 percent of all sites. In contrast, manufacturing sites account for just 12 percent of the 9/80 schedules. Apparently, manufacturing sites can more easily adapt to a 4/40 schedule. Public agencies have adopted CWW schedules more extensively than any other sector. While public agencies account for just 6 percent of all sites, they account for 19 percent of the 4/40 sites and 45 percent of the 9/80 sites. Public agencies apparently have more flexibility in determining operating hours and staff availability than other sectors.

TABLE 3-5
DISTRIBUTION OF CWW AND NON-CWW SITES BY INDUSTRY

INDUSTRY	NO CWW	4/40	9/80
Service/Public	6%	19%	45%
Service/Private	55%	11%	33%
Manufacturing	29%	64%	12%
Other	11%	6%	10%

Table 3-6 gives the distribution of work schedules by the number of total employees working at the site. It suggests that the use of CWW is not related to size of the workforce. Taken together, the information presented in these tables suggests that the use of CWW is heavily dependent on industrial sector, and probably not dependent on geographic location or size of the workforce.

TABLE 3-6
DISTRIBUTION OF CWW AND NON-CWW SITES
BY NUMBER OF EMPLOYEES

NUMBER OF EMPLOYEES	NO CWW	4/40	9/80
100-199	55%	59%	50%
200-499	30%	31%	34%
500-999	8%	6%	10%
1000+	6%	6%	5%

3.2.3 SAMPLING ALTERNATIVES

The intended method was to select a group of work sites that would give a wide representation of employer types, geographic location, size and type of work schedule. In order to assure the possibility of collecting a reasonable number of observations at each site, only sites with 50% or more of the total workforce participating in a 4/40 or 9/80 CWW were considered. Each CWW site was to be matched with a comparable control site.

Sites were chosen to achieve representativeness across the following criteria: 1) type of CWW, 2) industry group, and 3) geographic location. Because of the small number of potential survey sites, site selection was not randomized. Rather, <u>all</u> potential sites were considered in the selection process. Each potential 4/40 or 9/80 site was then matched with a site not offering any CWW according to the following criteria: the matched site must be in the same county, within the same AVR target, in the same industrial group, and with a similar distribution of jobs across occupational categories. This process led to the identification of 28 potential sites.

<u>3.2.3.1 Site Recruitment</u>

The only efficient means of obtaining a sample of employees who work compressed work weeks is to go through their employers and ask for permission to contact them. Each of the employment sites has a trained Employee Transportation Coordinator (ETC). The ETC was the initial point of contact. Help required from the ETC was expected to be minimal, involving only making arrangements for the distribution and collection of surveys. If the ETC expressed great reluctance about the project, refused to cooperate or indicated management approval would not be forthcoming, they were thanked for their time and telephone contact was terminated. If the ETC responded positively and indicated that his or her management would be supportive then letters and supporting materials requesting permission to survey their employees was sent out to the CEO or responsible management decision maker and to the ETC. Follow on to this mailing began one week later by telephone.

The process proved to be extremely slow. Of the original 28 sites, only five agreed to participate and just two actually participated. The study team then called every company listed as offering compressed work weeks to more than 50% of their employees. They also resorted to using personal and local political contacts in order to locate participant sites. The site recruitment effort took five months and resulted in eleven participant sites, including the pilot site.

The reasons given for refusing to cooperate with the study illustrate the difficulties of sampling through employers, especially in the depressed Southern California economic climate. Reasons for refusal to cooperate were as follows:

- ETC overworked too busy
- About to undertake Regulation XV survey and do not want response rate lowered
- Management refusal based on lack of time, interest, economic circumstances, staff are overworked already, busy with budget priorities no time, company being reorganized
- Employees have problem with English (typically are Spanish or Vietnamese)
- ETC unreachable on any number
- ETC under notice to quit
- Companies have moved out of state (Arizona, Utah)
- Refusal to return calls
- Company allows only surveys required by government regulations

3.2.3.2 Participant Sites

The participant sites are listed in Table 3-7. Types of schedules are those obtained from the employee surveys, and do not necessarily reflect the schedules reported in the Regulation XV data. Sites are not listed by name to protect the anonymity of survey respondents.

As can be seen from the descriptions of the sample sites, the agencies that showed interest and support for the survey were predominantly in the public sector. Geographically the sites are distributed throughout Los Angeles and Orange counties. All three types of work schedules are effectively represented through the work site sample. The lack of variety in the types of **employers** is fortunately not an indication of lack of variety in the **employees** sampled, as will be discussed in Chapter 4.

TABLE 3-7
PARTICIPANT SITES

ID#	COMPANY TYPE AND LOCATION	TYPES OF SCHEDULES
1	City in Orange County	4/40,9/80,5/40
2	City west of Los Angeles	4/40,9/80,5/40
3	Utility Company, northern LA County	4/40, 9/80, 5/40
4	Utility Company, east of LA	4/40, 9/80, 5/40
5	Utility Company, east of LA	4/40, 9/80, 5/40
6	Federal Gov. Office, central Orange County	4/40, 9/80, 5/40
7	Federal Gov. Office, west central Orange County	9/80, 5/40
8	Federal Gov. Office, south Orange County	4/40, 9/80, 5/40
9	A University in Los Angeles	5/40
10	An aerospace manufacturer Orange County	4/40, 5/40
11	A Utility Company, northeast of LA	4/40, 9/80, 5/40

3.3 SURVEY DISTRIBUTION AND COLLECTION

Once the site was recruited, arrangements were made with the ETC or designated contact person for the distribution of Survey A. Survey A distribution began at the pilot site on February 23, 1993 and ended at the last site on April 28, 1993. Survey B distribution began at the pilot site on March 16, 1993; the last site received Survey B on May 17, 1993.

CHAPTER FOUR
DATA DESCRIPTION

This chapter describes the data sets obtained from Surveys A and B, discusses sample bias and weighting, and presents descriptive statistics of the final travel diary sample.

4.1 DESCRIPTION OF SURVEY A

As described in the previous chapter, Survey A elicited basic occupational and demographic information of the respondent, and requested that the respondent participate in the travel diary. Survey A was distributed at each participating site by the ETC or other designated employee. The surveys were hand delivered to each site by project personnel at a pre-arranged time and date. The number of surveys to be delivered was confirmed with the ETC or designated employee. They were asked to distribute the surveys immediately, and in most cases the distribution was through inter-office mail.

Table 4-1 lists the number of Survey A instruments that were delivered and the dates on which each set was delivered. Because the on-site distribution of surveys was performed by the designated employee, we do not have any information on the actual number delivered to employees. We therefore list the number of surveys delivered to the site. In two cases (sites 2 and 4) a large number of surveys were returned to us unused. At site 2 surveys were actually delivered to only one of two buildings; at site 4 we could not obtain an explanation for the unused surveys. The delivery dates show that most of the surveys were delivered in April as a result of the difficulties encountered in recruiting sites.

Respondents were asked to complete and return the survey within one week. ETCs were asked to issue a reminder after one week to encourage employees to return the surveys. With the exception of site 11, respondents returned the surveys to the ETC or designated employee, and project staff picked them up at the site. Survey pick-up dates and times were also pre-arranged; surveys were generally picked up in two batches. At site 11, surveys were returned directly to the project team.

Using the number of surveys returned as a percent of those distributed to approximate a response rate, Table 4-1 also shows that site response rates are quite varied. We attribute this variation to a) different ways that surveys were distributed, b) different levels of management endorsement and enthusiasm for the project, and c) different levels of employee morale at the various sites.

TABLE 4-1
SURVEY A DISTRIBUTION

SITE ID	# DELIVERED TO SITE	DATE	# RETURNED NOT USED	# RETURNED	RETURNED AS % OF NUMBER DELIVERED [a]
1	460	2/23	0	233	50.7%
2	800	3/18	445	196	55.2%
4	400	4/14	54	200	57.8%
5	420	4/20	0	135	32.1%
6	140	4/22	7	89	67.0%
7	276	4/22	0	128	46.4%
8	142	4/22	0	54	38.0%
9	1000	4/22	0	345	34.5%
11	3114	4/23	0	944	30.3%
12	397	4/28	0	236	59.5%
13	130	4/27	0	49	37.7%
TOTAL	7279		509	2609	38.5%

[a] For sites 2 and 4, returned as percent of (# Delivered - # Returned not used).

4.1.1 SURVEY A DATA

Of the 2,609 surveys returned, 2,528 had sufficient and consistent data. Survey data were entered into spreadsheet files for each site; the site data files were then merged to form the Survey A file. Data were checked for validity and internal consistency,[12] yielding the final sample. This section presents an overview of sample characteristics. A complete listing of frequencies for all variables is presented in Appendix C.

4.1.1.1 Work Characteristics

Respondents were asked about their regular work schedule. Because of the prevalence of 9/80 schedules, the question was asked on the basis of a two-week period (see Appendix A). This proved to be quite confusing, and the unfortunate result is a large number of missing responses. Table 4-2 gives the distribution of work schedules across four categories. "Regular" means working ten days each two weeks, "CWW4/40" means a compressed work week of four ten hour days per week. "Other CWW" indicates other types of compressed work week, such as nine days each two weeks, and "Long>10 days" designates those who work more than ten days in two weeks. These respondents may work extra hours at the participant site or may have a second job. Note that for the valid responses, the regular work schedule subsample is not much larger than that of the two compressed work schedules. Note also that this distribution represents the respondent's reported regular schedule, and not necessarily the actual number of days worked that week.

[12] Survey responses were checked to confirm that the respondent was employed at the site and that responses were internally consistent (for example, that presence of children is reported if child care services are used). These checks revealed that some questions were confusing to respondents, as is further described below.

TABLE 4-2

WORK SCHEDULE DISTRIBUTION, SURVEY A

SCHEDULE	FREQUENCY	PERCENT
Regular	1102	43.6%
CWW 4/40	382	15.1%
Other CWW	630	24.9%
Long Days > 10	66	2.6%
(Missing)	348	13.8%
Total	2528	100.0%

Respondents were asked to describe their occupation in terms of the categories used in the US Census. Table 4-3 gives the results. It may be noted that only three people listed sales. This is likely due to the types of sites that participated in the survey. The relatively small number of labor/operative responses is not surprising, since low and unskilled workers are less likely to respond to surveys of any kind. The majority of survey respondents are management or professional, suggesting relatively high educational and income status. The large share of clerical is again due to the makeup of the participant sites. In the data analysis, we combine the sales category with service, skilled crafts with labor/operative, and "not sure" with "other".

TABLE 4-3
OCCUPATION DISTRIBUTION, SURVEY A

OCCUPATION	FREQUENCY	PERCENT
Manager / Admin.	529	20.9%
Professional	809	32.0%
Sales	3	.1%
Admin. Sup / Clerical	597	23.6%
Service	133	5.3%
Skilled Crafts	130	5.1%
Labor / Operative	74	2.9%
Other	174	6.9%
Not Sure	19	.8%
(Missing)	60	2.4%
Total	2528	100.0%

The vast majority of respondents (98 percent) listed the site as their regular place of work. The purpose of this question was to make sure that Survey A respondents were potential diary candidates.

Respondents were asked about schedule flexibility, specifically whether their schedule is fixed by the employer or whether they are able to choose their own schedule. This question is relevant to whether employees have a choice between CWW and a regular schedule. Table 4-4 shows that only about one third of the sample respondents are able to choose their own work schedule.

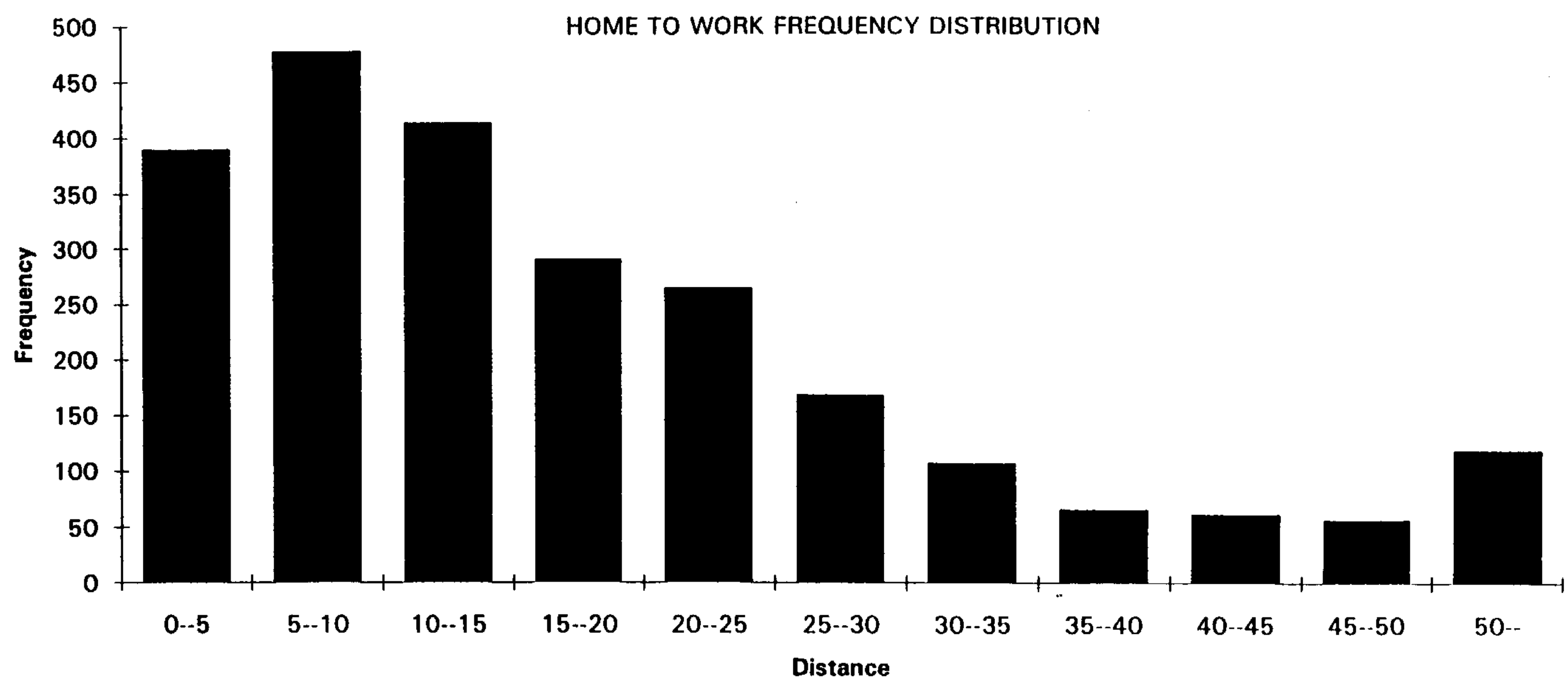
TABLE 4-4
ABLE TO CHOOSE WORK SCHEDULE OR NOT, SURVEY A

SCHEDULE	FREQUENCY	PERCENT
Able to choose	846	33.5%
Scheduled fixed	1601	63.3%
(Missing)	81	3.2%
Total	2528	100.0%

<u>4.1.1.2</u> <u>Work Trip Characteristics</u>

Average one-way work trip length for the entire sample is 17.3 miles, with a median of 13 miles. These figures are somewhat greater than those from other Los Angeles area studies. For example, the Commuter Transportation Services, Inc. 1993 State of the Commute Survey shows a mean of 15 miles and a median of 10 miles (Commuter Transportation Services, Inc., 1993). The sample range is from 0 to 129 miles. Figure 4-1 gives the work trip distance distribution in intervals of five miles. The mode (the interval with the highest frequency) is between five and ten miles. About 25 percent are longer than 25 miles -- a large proportion of long commute trips.

FIGURE 4-1
WORK TRIP DISTANCE DISTRIBUTION



Daily work schedules are clustered around a start work time of between 6 and 7 AM and an end work time of between 4 and 5 PM. About 85 percent of the respondents start work between 6 and 9 AM, and about 90 percent end work between 3 and 6 PM. Thus the vast majority of work trips in this sample take place during the AM and PM peak periods.

4.1.1.3 Demographic information

The age range of the sample is given in Table 4-5. Ages from 25 to 54 account for 85 percent of the sample. As expected in a sample of employees, there are relatively few respondents age 65 or older. The sample is evenly distributed by gender, with 50 percent male and 50 percent female.

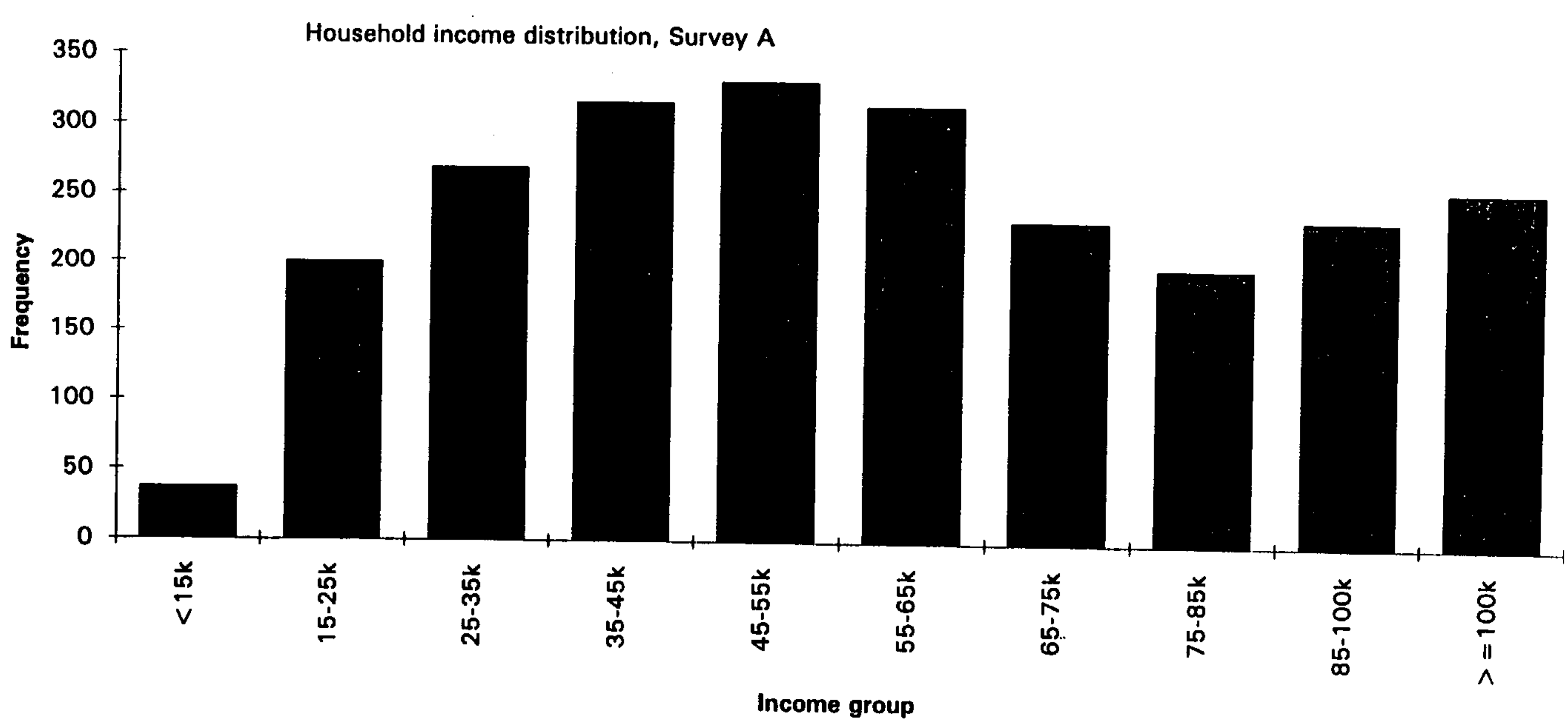
TABLE 4-5
AGE DISTRIBUTION, SURVEY A

AGE	FREQUENCY	PERCENT
16-24	117	4.8
25-34	637	25.9
35-44	802	32.6
45-54	650	26.4
55-64	219	8.9
65 or Older	34	1.4

More than half of those surveyed are from two worker households. Single worker households account for one third of the sample, with the remainder (14 percent) in households with three or more workers. About 40 percent of the sample report at least one child under age 18 in the household. Of those reporting at least one child in the household, 45 percent report one child, 35 percent report two children, and the remainder report three or more children.

The relative affluence of the sample is demonstrated by the reported household income distribution shown in Figure 4-2. The median income interval is $55,000 to $65,000, and over ten percent report incomes of $100,000 or more. Incomes of $25,000 or less also account for ten percent of the sample. Given the number of two worker households in the sample, these numbers are not surprising.

FIGURE 4-2
REPORTED HOUSEHOLD INCOME DISTRIBUTION



Sample respondents also have a high level of vehicle access: 24 percent report one vehicle, 46 percent report two vehicles, and the remainder report 3 or more. Vehicle access of course depends on both vehicles and drivers in the household. We calculated the ratio of vehicles to adults per household, and found that 85 percent of the respondents are in households with at least one vehicle per adult. Thus most respondents have full access to at least one vehicle.

4.1.2 COMPARISON OF CWW AND NON-CWW WORKERS

We conducted statistical tests to determine whether there were significant differences between employees working some form of compressed schedule and those working a regular schedule. Of particular interest are characteristics related to travel behavior. We eliminated respondents working more than 10 days per two-week period because of their small number, and because of potentially large differences between these workers and all others. These tests are thus based on a sample of 2,180 cases, with 50.5 percent on a regular schedule and 49.5 percent on some type of CWW.

We find that the two groups of workers differ by both age and gender. As shown in previous studies, CWW workers are more likely to be male. CWW workers also are more numerous in the ages groups of 25 to 54, and less numerous in the older and younger age groups. We found no significant difference between groups with respect to the number of children in the household. The difference with respect to the number of workers in the household was marginally significant, with CWW workers more likely to be members of single worker households. Results are based on cross tabulations of the distribution of sample observations across values of the given independent variable and work schedule type. Statistical significance of differences between groups was determined via the Chi-square test. Statistical significance is determined by the magnitude of Chi-square. Results are summarized in Table 4-6, which gives the Chi-square value and significance level for each variable.

Prevalence of CWW is significantly different with respect to occupation and household income. Professional occupations are more likely to have CWW schedules, while all others are more likely to have regular schedules. This is consistent with results on household income: CWW tends to be concentrated in the higher income categories. These results are explained by the high proportion of public agencies (that have large numbers of professionals) in the sample sites. These cross tabulation results are also summarized in Table 4-6.

TABLE 4-6
CWW VS NON-CWW COMPARISONS, SURVEY A

VARIABLE	CHI-SQUARE	SIG[a]
GENDER	9.10	.003
AGE	20.14	.000
KIDS / HOUSEHOLD	0.71	.400
WORKERS / HH	5.53	.062
OCCUPATION	26.05	.000
INCOME	62.72	.000

[a] level of probability at which null hypothesis can be rejected

Finally, we examine journey to work differences. Work trip distance is particularly important, because theoretical expectations are that CWW workers should have longer work trips. Fewer days of commuting reduces the cost of commuting; all else equal, lower commuting costs lead to more commuting (e.g. longer trips). Mean distances to work are 17.0 miles for CWW workers and 18.0 miles for regular schedule workers. Difference between the group means is not statistically significant at the 90 percent level.[13] Note that the somewhat shorter mean for CWW workers is surprising in

[13] T-test for equality of means: $t=1.52$, $df=2{,}053$, sig.=.129.

view of the higher household incomes of CWW workers, since commute distance is positively related to income.

There are also significant differences between workers on different types of CWW schedules. Comparing workers on CWW by gender, we find that males are more likely to work the 4/40 schedule, while females are more likely to work the 9/80 schedule. These findings are consistent with prior studies. Gender differences are likely also related to occupation. Results of a cross tabulation show that the regular work schedule is most prevalent in the management/administrative category, the 4/40 schedule is most prevalent in the service and labor/operative categories, and the 9/80 schedule is most prevalent in the professional and supervisor/clerical category.[14] The 4/40 schedule has traditionally been associated with manufacturing activities, and the sample site with the largest number of 4/40 workers is a manufacturing firm. The prevalence of the 9/80 schedule among professional workers again reflects the more common use of this schedule in public agencies.

We also compared journey to work distances across the three categories of work schedules. Mean journey to work trip distance is 18.0 miles for regular workers, 19.1 miles for 4/40 workers, and 15.6 miles for 9/80 workers. Since women typically have shorter commutes than men (mean distance in this sample is 15.6 miles for women and 19.5 miles for men), we test whether gender is related to work trip length by conducting an analysis of variance test.

Analysis of Variance (ANOVA) is a statistical test of differences in the mean value of a dependent variable within different categories of one or more independent variables. ANOVA tests group differences by comparing the variation in the dependent variable within groups (for example the variation in commute distance among all women) to the variation between groups (for example between groups of women on different work schedules). In this case, the dependent variable is mean commute distance. Independent variables are work schedule (regular, 4/40, 9/80) and gender.

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[14] $Chi^2 = 110.69$, df = 10, sig. = .000.

Results are given in Table 4-7. Main effects describe the relationship of each of the two independent variables to the dependent variable. Two way interaction effects describe the joint relationship of both independent variables to the dependent variables. The F value is used as the basis for significance tests. Magnitude of the F value is determined by the ratio of variation between groups to variation within groups. Table 4-7 shows that gender has a more powerful effect on commute distance than work schedule, and that all effects are significant at 90 percent. We conclude that work trip distance is jointly determined by gender and work schedule.

TABLE 4-7
ANALYSIS OF VARIANCE, WORK TRIP DISTANCE, SURVEY A

SOURCE OF VARIATION	MEAN SQUARE	F	SIG OF F
Main Effects	3498.927	14.991	.000
Work Schedule	1369.831	5.869	.003
Gender	7164.438	30.696	.000
2-Way Interactions			
Work Schedule	612.368	2.624	.073
Gender	612.368	2.624	.073
Explained	2344.303	10.044	.000
Residual	233.396		
Total	238.560		

4.2 COMPARISON OF SURVEY A AND SURVEY B RESPONDENTS

The purpose of conducting Survey A was to generate a basis for evaluating the representativeness of travel diary respondents. As anticipated, only a small share of the sample population actually completed and returned a travel diary. Assuming that the 6,773 Survey A instruments that were not returned to us unused were actually delivered to employees, 939 (13.8 percent) employees volunteered to participate in the diary. Of these, 536 diaries (7.9 percent of the original sample) were actually completed and returned.

As with Survey A, Survey B response rates differed by site. Table 4-8 gives the number of Survey B diaries distributed and returned by site. Response rates range from 33 percent to 75 percent. We attribute these differences both to site situational differences and the ability of the project staff to maintain personal contact with diary participants. Dairy participants at the pilot site, for example, were contacted by telephone at least twice over the course of the diary week. In contrast, participants at site 4 were often in the field and therefore could not be contacted.

TABLE 4-8
RESPONSES BY SITE, SURVEY B

SITE	# DELIVERED	DISTRIBUTION BEGIN DATE	RETURN END DATE	# RETURNED	PERCENT
1	91	3/16	4/18	68	74.7%
2	73	4/16	6/8	42	57.5%
4	69	5/7	6/9	23	33.3%
5	59	5/14	6/20	32	54.2%
6	27	5/11	5/30	17	63.2%
7	47	5/10	6/15	22	46.8%
8	22	5/10	5/19	11	50.0%
9	122	5/10	6/27	68	55.7%
11	290	5/11	7/28	160	55.2%
12	131	5/17	6/22	90	68.7%
13	8	5/11	5/23	3	37.5%
TOTAL	939			536	57.1%

total sample of 2,540 and a diary sample of 504. Results show that probability of diary completion is not related to the work schedule or to travel characteristics. We then estimate a logit model made up of the significant independent variables. This model estimates the probability of completing a diary as a function of respondent characteristics. Model results are given in Table 4-9.

TABLE 4-9
BINOMIAL LOGIT MODEL OF SUCCESSFUL COMPLETION OF TRAVEL DIARY

EXPLANATORY VARIABLE	CO-EFFICIENT	T-STATISTIC[a]
Age Less Than 25	-.799	-2.23
Age 45 - 54	.302	2.69
Income Less Than $25,000	-.648	-2.68
Occupation: Managerial / Admin. / Profess.	.569	5.23
Gender: Male	-.262	-2.54
5 or More Vehicles in Household	-.645	-2.24
No Child Care Used	.576	4.72
Constant	-2.010	15.34

[a] T-statistics for all coefficients show significance at $p < .05$

Model Chi^2 = 108.34 with 7 degrees of freedom
-2 log likelihood $_{initial}$ = 2530.91
-2 log likelihood $_{model}$ = 2422.58

The estimated model can then be used to calculate probabilities for each diary observation. For example, respondents under age 25 are less likely to complete a diary (all else equal), and thus would be assigned a low probability of being in the final sample. Conversely, managerial or professional workers are more likely to complete a diary (again all else equal), and thus would be assigned a high probability of being in the final sample. We use as sample weights the inverse of the probabilities, $(1/P_i)$, standardized such that the mean of the probabilities is equal to 1 (Small, 1992). The weighted diary sample is representative with respect to the Survey A sample respondents. As noted earlier, the Survey A sample is more representative of our sample of workers, but not representative of the population of all workers. All of our analysis is performed with the weighted sample.

4.3 DESCRIPTIVE STATISTICS OF THE DIARY SAMPLE

The original diary sample includes 545 diaries, 9 of which are pre-test diaries not used in the analysis. Pilot diaries are included in the analysis sample, as no significant changes were made to the survey instruments or to distribution/collection procedures as a result of the pilot survey. The diary files were created as four record types. File description, unit of observation and number of observations in each file type is shown in Table 4-10. The Type 0 file includes the start and end dates of the diary. The Type 1 file lists all household vehicles by make, model, year, and type of fuel. The Type 2 file includes information on the day of week, type of day (work or other), whether trips were made, and whether cars were driven. The trip file (Type 3) includes start and end time, purpose, mode and distance for each trip. All files have the person ID number as a variable, and this variable was used as the basis for merging the files. See Appendix D for the complete list of variables and their frequencies.

TABLE 4-10
DIARY RECORD TYPE FILES

RECORD TYPE	DESCRIPTION	OBSERVATION UNIT	N OF OBSERVATIONS
Type 0	person & diary ID	person	545
Type 1	vehicle inventory	person	536
Type 2	day description	diary day	3784
Type 3	trip description	trip	16640

4.3.1 BASIC DIARY SAMPLE CHARACTERISTICS

Because we had no assurance as to when each participant would actually receive the diary questionnaire, we could not request a specific start date. We therefore requested participants to start "tomorrow," anticipating that there would be enough variation in start days to generate a broad distribution across days of the week. The actual start day distribution was clustered around the latter part of the work week. Start days by frequency are: Wednesday (23 percent), Friday (22 percent), Thursday (19 percent), Monday (16 percent), Tuesday (14 percent), Saturday (4 percent) and Sunday (2 percent). Month of the diary was determined by when participant sites were recruited. The pilot diaries took place in March, while most of the other diaries were completed in May (56 percent) and June (19 percent).

Prior travel diary research indicates a potential problem with respondent fatigue. As described in Chapter Three, there was some concern about asking respondents to complete a trip diary for seven days. In this case, however, the pattern seemed to be that respondents would complete the diary for seven days or not return it at all. Thus there are 543 first days and 535 seventh days in the day file, and there is no clear pattern of decline from first to seventh day. In addition, if respondents left the region, they were asked to skip those days and complete the diary upon their return. There are consequently 22 eighth or later days as well. Since respondents generally completed seven days, days of the week are rather evenly distributed (ranging from 527 on Saturday to 546 on Wednesday) despite the clustering of start days. There is some decline, however, in the number of trips reported by day of the diary. Table 4-11 shows the ratio of trips to days for each diary day from one through seven. The ratio declines about 14 percent, from 4.78 on day one to 4.12 on day seven. This decline in trip reporting should not affect our analysis since the later diary days are rather evenly spread across days of the week, and we have no prior expectation that this type of respondent fatigue is related to work schedule.

TABLE 4-11
TRIPS BY DIARY DAY, TOTAL SAMPLE

DIARY DAY	TRIPS	DAYS	TRIP/DAY
1	2596	543	4.78
2	2503	541	4.63
3	2358	542	4.35
4	2324	538	4.32
5	2317	534	4.34
6	2266	529	4.28
7	2206	535	4.12

4.3.1.1 Vehicle Inventory

Diary respondents were asked to list all vehicles available to them to drive by make, model, year, and type of fuel. Only two diary respondents reported having no vehicles available. Forty-three percent reported one vehicle, 40 percent reported 2 vehicles, 13 percent reported 3 vehicles, and 3 percent reported 4 or more vehicles. These percentages imply lower vehicle ownership levels than revealed in Survey A, and may be the result of differences in the way the question was asked, as well as less complete responses by diary respondents.

4.3.1.2 Daily Trips and Car Use

The diary day file showed that respondents made at least one trip on 93 percent of the diary days. Ninety-seven percent of the first trips of the day started from home, and a car was driven by the respondent on 90 percent of the diary days.

Vehicle trips were usually made using the vehicle listed as number 1 (85 percent of all trips). Most trips were made by private vehicle, as shown in Table 4-12. The "as passenger" category includes car and van, but visual review of the diaries suggests that very few were actually vanpool trips. Assuming that most passenger trips are also private vehicle trips, about 90 percent of all trips reported were by private vehicle. After passenger trips, the next most frequent mode is walk, and less than 2 percent are by any form of public transit. These figures are quite consistent with national data (Hu and Young, 1992).

TABLE 4-12
TRIP FREQUENCY BY MODE, DIARY SAMPLE

MODE	FREQUENCY (%)
Drive Alone	53.6%
Drive with Passenger	26.1%
As Passenger	11.3%
Motorcycle	0.2%
Rail or Bus	1.7%
Bicycle	.9%
Walk or Jog	5.7%
Airplane	0.0%
Other	0.3%
N	16,313

The distribution of trips by purpose is shown in Table 4-13. As expected, the large categories are to home, to work, social, errands, shopping, and picking up or dropping off passengers. Journeys to work account for just 18.4 percent of all trips. This is not surprising, given that respondents were asked to list the purpose of every stop (and therefore trips from work are not counted as worktrips), and that weekend travel is included.

TABLE 4-13
TRIP FREQUENCY BY PURPOSE, DIARY SAMPLE

TRIP PURPOSE	FREQUENCY (%)
To Work	18.4%
Work Related	2.9%
Shopping	6.7%
Errands	10.8%
School	.8%
Medical / Dental	1.3%
Social / Recreation	15.9%
Pick Up / Drop Off	7.5%
Transfer to Another Mode	3.2%
To Home	30.4%
Other	1.9%
N	16,595

4.3.2 CONCLUSIONS ON DATA

This chapter has described the Survey A and Survey B samples. Data from both surveys are merged to create the travel diary analysis data set. Information presented in this chapter is from the respective record type files prior to merging and weighting. Of the 536 completed diaries, 503 with seven consecutive days of travel data are used in the diary analysis presented in the following chapter.

4.4 QUALITY ASSURANCE

Data from both Survey A and Survey B were extensively checked for consistency and reliability. Survey A data were entered into spreadsheet files by student assistants. Once entered, variables were subject to logical checks to assure consistency across observations. Inconsistent data were recorded as missing. Responses were also checked to confirm that the respondent was employed at the site.

Each Survey A instrument was assigned a unique ID number. The first two digits identified the site, and the following four digits identified the individual. Respondents were tracked through these ID numbers. Survey A respondents who agreed to participate in the diary had the same ID number assigned to the diary. The ID number was the mechanism used to link Survey A and B data, as well as to merge the various Survey B files.

Survey B was more complicated and extensive than Survey A, and thus required more extensive tracking and checking. The project team attempted to contact each diary respondent at least once during the travel diary survey period. Respondents were asked if they had any questions about filling out the diary and were encouraged to finish the diary. In addition, diaries were logged in as they arrived, and reminder calls were made if diaries were not returned within two weeks.

Each diary was hand checked by project team members. Checking included items such as the following:

- Correspondence of diary dates and days of week listed on cover page with dates and days of week on diary pages
- Correspondence of destination of last trip of the day with start location of first trip of the following day
- Correspondence of stated vehicle use and mode of trips
- Correspondence of stated trips made and trips listed in diary
- Checking for consistency in start and end times of all trips, and checking for missing trips

- Checking for consistency in mode, particularly for drive with passenger trips
- Checking for consistency in vehicle used across sequences of trips

Respondents had been asked to provide telephone numbers, and in some instances respondents were called back to verify diary information. Of particular concern for the analysis was information on the work schedule. As noted previously, the question on work schedule proved to be very confusing to respondents, resulting in many missing observations on this variable. For the diary sample of 503 valid cases, 65 had missing data on the work schedule. We attempted to contact each of these respondents to verify the work schedule, and we successfully reached 49 of the 65 respondents.

The Survey B diary data were entered by a data entry firm, and all cases were double entered. Extensive data cleaning was performed before conducting the analysis. The same types of checks were performed on the data as were done in the hand checking. In addition, travel times and travel speeds were compared, and inconsistent data were coded as missing.

CHAPTER FIVE
DATA ANALYSIS AND RESULTS

This chapter presents results of our analysis of the impacts of CWW on travel behavior. Major issues to be investigated include a) total amount of travel, particularly VMT, b) number of trips, particularly by private vehicle, and c) scheduling of trips, by day of week and time of day. We are primarily interested in vehicle trips for two reasons. First, the vast majority of trips taken are by private vehicle. Second, the ultimate purpose of this research is to determine the effectiveness of CWW as a transportation control measure to reduce congestion and air pollution. The chapter begins with a discussion of estimation models and expected impacts. Analysis results are then presented.

5.1 MEASURING CWW IMPACTS

Chapter Two discussed the relationship between activity patterns and travel behavior. Travel demand was described as a derived demand resulting from demand for specific activities such as work, social visits, etc. Travel decisions result from the utility maximizing decisions of individuals made in the context of personal and household resources and constraints. We may express travel demand in the most general terms as follows:

$$D = f(X,Y,Z), \tag{5-1}$$

where,

D = travel demand

X = vector of individual characteristics

Y = vector of household characteristics

Z = vector of household travel resources.

In order to measure the impact of CWW on travel, we must control for the other factors that affect travel behavior, e.g. individual and household characteristics. We therefore use the following model:

$$D = f(X,Y,Z,W), \qquad (5\text{-}2)$$

where W = type of work schedule, and all other terms are the same as in eq. 5-1. Various characteristics of travel demand, such as weekly VMT or trips, are used as dependent variables.

5.2 TRAVEL DIARY ANALYSIS DATA FILE

We constructed the diary analysis data by merging Survey A and Survey B data. The diary analysis file is a person file, with total distance and number of trips aggregated by various criteria (e.g. purpose, day of week, mode). The data are weighted as described in Chapter Four. We thus have socioeconomic and demographic characteristics for each respondent, as well as travel characteristics over the seven day period.

Of the 503 valid cases, 65 had missing data on the work schedule, leaving 438 cases for the CWW analysis. In order to enlarge the sample, we attempted to contact the 65 diary respondents for whom this item was missing to determine their work schedule. This effort enabled us to correct the missing data in 49 cases, yielding 487 cases (before weighting) for CWW analysis. The work schedule sample distribution is 238 on regular schedule, 77 on the 4/40 schedule, 151 on 9/80 or other CWW, and 13 on long work schedule. All results presented in this chapter are based on the 503 weighted cases.

5.3 IMPACTS ON TRAVEL DISTANCE

Compressed work schedules reduce weekly work travel, but do not necessarily reduce the total amount of travel. The reduced work travel could be offset by additional nonwork travel, leading to no change in total travel. We first test the (null) hypothesis that CWW has no effect on weekly travel. What is the appropriate dependent variable in this case? If we are most interested in VMT, the appropriate variable is weekly driving distance. Since most reported diary travel is by private vehicle, either alone or with passengers, weekly driving distance also accounts for most of the weekly travel. Descriptive statistics for weekly travel distance by all modes is given in Table 5-1. Driving distance, including solo driving and driving with passenger(s), accounts for 80 percent of the average total travel distance. Note also the very large standard deviations for most modes. These indicate a high degree of variability of weekly travel among the sample observations.

TABLE 5-1
DESCRIPTIVE STATISTICS ON INDIVIDUAL WEEKLY TRAVEL DISTANCE BY MODE, IN MILES

MODE	MEAN	STD DEV	MINIMUM	MAXIMUM
Drive Alone	165.3	136.0	0	976
Drive with Passenger	79.1	104.1	0	885
As Passenger	43.0	84.0	0	598
Motorcycle	.5	6.6	0	115
Rail/Bus	6.9	39.0	0	485
Bicycle	1.5	7.8	0	69
Walk	1.9	10.9	0	221
Airplane	.5	11.2	0	250
Other	1.1	14.9	0	320
Drive Alone + with Passenger	244.9	169.2	0	1034
Alone + Passenger + As Passenger	293.4	187.6	0	1102
All Modes	308.3	190.8	0	1102

For the analysis of travel distance, we estimate a series of least squares regressions with various distance measures as dependent variables. Least squares regression estimates the relationship between one or more independent variables and the dependent variable:

$$Y = \alpha + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_n x_n + \epsilon \qquad (5\text{-}3)$$

where Y = dependent variable

x_i = independent variable

β_i = parameter to be estimated

α = constant

ϵ = error term.

Regression analysis provides two types of information: the magnitude and direction of the relationship between each independent variable and the dependent variable (by the value and sign of the estimated coefficients), and the extent to which the set of independent variables account for or "explain" the variation in the dependent variable (by the measure of variation explained, R^2). The regressions reported here were estimated using a stepwise procedure, with the CWW variable a required entry. The stepwise procedure adds variables to the regression on the basis of their explanatory power. That is, the first variable entered is the one that explains the most variation in the dependent variable compared to all others; the second variable entered is the one that adds the most explanation of variation compared to all others not yet in the equation, etc. In this case, variables were entered as long as the coefficient was statistically significant at the 90 percent probability level or better (two tailed test). The CWW variable was named a required entry, meaning that it was included in the regression equation whether or not its coefficient was statistically significant.

We also conduct two comparisons: all CWW compared to regular schedule workers, and CWW 4/40 compared to regular workers. The independent variables are dummy variables generated from the categorical data in Survey A. Table 5-2 lists the independent variable names and definitions.

Using the step-wise regression procedure described above, we estimate regressions for both CWW and 4/40 CWW only, using total driving distance (which includes driving alone or with passengers) as the dependent variable. For the 4/40 CWW comparison, other CWW (e.g. 9/80) are eliminated from the sample. Results are given in Table 5-3. Results show that, taken together, the independent variables explain little of the variation in driving distance. These results are comparable to those of prior studies that document substantial day to day variability in travel behavior (Chapter Two). Since we are not interested in predicting driving distance, the R^2 value is not important. Rather, our interest is in testing for the effect of CWW. In this case, both CWW coefficients have the correct sign (CWW is associated with less total travel), but are not statistically significant due to large standard errors. Signs of all the other independent variables are as expected. Males travel more than females, as do workers in management positions or workers in very high income households. The negative sign on three drivers in the household may suggest that when there are more drivers, household-related travel may be more evenly distributed across the available drivers. For example, if the third driver is a teen-aged child, parents are not required to make as many pick-up and drop-off trips. Finally, having no car available dramatically reduces (but does not necessarily eliminate) weekly driving distance.

TABLE 5-2
INDEPENDENT VARIABLES USED IN STEP-WISE REGRESSIONS

VARIABLE NAME	DEFINITION
inclow	household income <$25,000
inc3	household income $25,000 - $35,000
inc4	household income $35,000 - $45,000
inc5	household income $45,000 - $55,000
inc6	household income $55,000 - $65,000
inc7	household income $65,000 - $75,000
inc8	household income $75,000 - $85,000
inc9	household income $85,000 - $100,000
inc10	household income >$100,000
occd1	manager
occd2	professional
occd3	admin/supv/clerical
occd4	service
occd5	labor/skilled crafts
kids06	kids home under 6 years of age
kids618	kids home between 6 and 18 years
kids_hh	kids <= 18 years in household
childc1	use childcare
adults1	one adult in household
pers1964	no. persons in household 19 to 64 years
adults	no. of adults in household
male	gender (male=1)
hometpd1	single family detached
hometpd2	townhome or duplex
hometpd3	apartment
age1	age 16 - 24
age2	age 25 - 34
age3	age 35 - 44
age4	age 45 - 54
age5	age 55 - 64
age6	age 65 or more
cars0	no cars in household
cars1	one car in household
cars2	two cars in household
cars3	three cars in household
cars4	four cars in household
cars5	five or more cars in household
drivers1	one driver in household
drivers2	two drivers in household
drivers3	three drivers in household
drivers4	four or more drivers in household
cww	on CWW =1, else = 0
cww410	on 4/40 = 1, else = 0

TABLE 5-3
REGRESSION RESULTS, TOTAL DRIVING DISTANCE

	CWW VS REGULAR		CWW 4/40 VS REGULAR	
VARIABLE	COEFF	T-VALUE	COEFF	T-VALUE
INC10			95.10	2.74
OCCD1	36.10	1.95		
MALE	66.99	4.23	50.67	2.46
CARS0	-187.20	3.68	-175.17	2.70
DRIVERS3	-39.54	1.66	-57.27	1.86
CWW	-11.55	.72		
CWW 4/40			-10.28	.42
CONSTANT	216.44	14.95	217.07	12.96
R^2 (adj)	0.11		0.10	
N	434		271	

5.3.1 WORK VS. NONWORK TRAVEL DISTANCE

We then split total driving distance into work and nonwork components and estimate similar regressions, including demographic, occupation and car ownership control variables. If in fact CWW has no effect on total travel, we would expect that if work travel is reduced with CWW, non-work travel should correspondingly be higher with CWW. Work travel in this case is defined as the total driving distance traveled on trips for which the purpose is listed as "to work." Note that by classifying trips according to destination purpose, trips from work are not included as part of work travel. Nonwork travel is defined as all driving travel for other purposes. Table 5-4 gives results for the CWW coefficients in each case, listing value, standard error, significance level, and the 95 percent (2-tailed) confidence interval. The confidence interval gives the range of values which contains the actual value of the CWW coefficient with a probability of 95 percent. The confidence intervals show how large the range of probable values is for the given coefficient. The work driving distance coefficient is of the expected sign and significant at about 88% for CWW and 70% for CWW 4/40. In both cases, the confidence interval is mostly negative: for example, confidence interval ranges from -19.47 miles to +2.22 miles for CWW compared to a regular schedule. Because there is a great deal of variation around the coefficient estimate, the true value cannot be estimated with precision. Thus, it is very probable that CWW is associated with less work driving, but we cannot say with precision by how much.

TABLE 5-4
REGRESSION RESULTS, WORK AND NONWORK DRIVING DISTANCE

DEPENDENT VARIABLE	COEFF	S.E.[a]	SIG.[b]	C.I. @ 95%[c]
Work Drive Dist.				
CWW	-8.63	5.53	.120	-19.47 - 2.22
CWW 4/40	-8.52	8.15	.297	-24.49 - 7.46
Nonwk Drive Dist.				
CWW	-3.70	6.92	.593	-17.26 - 9.86
CWW 4/40	-2.46	10.47	.814	-22.98 - 18.06

[a] Standard error
[b] Significance level
[c] Confidence Interval

Results for nonwork driving travel show both CWW coefficients not significantly different from zero, suggesting that there is no difference in the amount of nonwork driving travel by workers on different work schedules. It is important to note, however, that trips *from work* are included in the nonwork category, and thus should have the effect of reducing this category of travel for CWW workers. That is, if trips from work are part of the nonwork category, nonwork travel should be proportionately lower for CWW workers, all else equal.

Turning to the value of the work driving coefficients, note that the average commute distance in the sample is about 17 miles, while the coefficients suggest a reduction of 8.5 or 8.6 miles, half of the average one-way distance. Work driving as defined here includes only the journey to work; therefore the value of 8.6 seems reasonable for CWW, which reflects a mix of 4 day and 5 day work weeks. We would expect the reduction to range between one-half and one trip per week, depending on the mix of CWW schedules. We would expect, however, a larger value for CWW 4/40 -- a value closer to one average work trip.

5.3.2 WORK TOUR DISTANCE

It is also possible that these regressions underestimate work related travel reductions, because we have not accounted for work trips that have stops along the way. For example, if an individual drops a child off at school on the way to work, only the portion from the drop-off point to work is counted as the work trip. We test this idea by constructing journey to work tours, which we define as any series of trips starting from home and ending at work, with no stops longer than 15 minutes between any trip segment. We construct three types of tours: work driving (drive alone or with passenger), work private vehicle (driving and as passenger), and work all modes (all modes and all combinations of modes). Regression results are given in Table 5-5.

TABLE 5-5
REGRESSION RESULTS, WORK TOUR DISTANCE

DEPENDENT VARIABLE	COEFF	S.E.	SIG.	C.I. @ 95%
Work Drive Tours				
CWW	-13.51	5.43	.013	-24.16 - -2.86
CWW 4/40	-13.21	8.28	.112	-29.43 - 3.02
Work Veh Tours				
CWW	-12.21	5.57	.029	-23.12 - -1.29
CWW 4/40	-15.35	8.48	.071	-31.97 - 1.27

All Work Tours CWW CWW 4/40	-14.27 -20.63	6.50 10.11	.029 .042	-27.01 - -1.52 -40.44 - -0.82

The coefficient estimates are, with one exception, statistically significant at 90 percent or higher. The 95 % confidence intervals are, with two exceptions, negative throughout. As expected, the magnitude of the coefficients is larger and closer to the equivalent of one work trip. The CWW 4/40 estimate is larger than the CWW estimate for vehicle tours and all mode tours, also as expected. These results provide strong evidence for significant work travel reductions from CWW.

5.3.3 WEEKDAY VS. WEEKEND TRAVEL DISTANCE

Another question is whether there are differences in travel by day of week. This is an indirect way of testing for nonwork trip impacts, since most work trips occur on weekdays. We estimate regressions using total distance and driving distance for weekdays and weekends as dependent variables. Results are given in Table 5-6.

TABLE 5-6

WEEKDAY AND WEEKEND TRAVEL DISTANCE

DEP VAR	COEFF	S.E.	SIG.	C.I. @ 95%
Weekday				
Distance				
(all modes)				
CWW	-25.37	14.19	.075	-53.19 - 2.44
CWW 4/40	-44.44	21.60	.041	-86.78 - 2.10
Weekday				
Distance				
(driving)				
CWW	-23.30	12.97	.073	-48.73 - 2.13
CWW 4/40	-29.18	19.96	.145	-68.31 - 9.94
Weekend				
Distance				
(all modes)				
CWW	12.27	7.35	.096	- 2.14 - 26.68
CWW 4/40	6.85	10.29	.506	-13.32 - 27.02
Weekend				
Distance				
(driving)	6.08	6.43	.345	- 6.52 - 18.69
CWW	7.65	9.11	.402	-10.21 - 25.51
CWW 4/40				

The results for weekday travel imply a reduction in both work and nonwork travel, since the coefficient values are larger than those for work travel only. These are expected results, in that longer work days should suppress travel before and after work.

Confidence intervals are mostly negative, and large standard errors again reflect a high degree of variation about coefficient estimates. The results for weekend travel show very insignificant coefficients in three of the four cases. Signs on all coefficients are positive, but large standard errors preclude concluding that there is more weekend travel among CWW workers. Comparing the values of the estimated coefficients suggests that CWW is associated with more weekend travel compared to regular schedule workers, but not enough to offset the decrease in weekday travel.

5.3.4 DISTANCE BY TIME OF DAY

We are also interested in determining whether travel patterns differ by time of day as a result of CWW. We expect that the amount of weekday peak travel should be lower for CWW, because of both fewer work trips and longer work days, which would shift some work trips out of the peak periods. We constructed a series of travel distance variables for the following time periods: AM peak, from 6:00 AM to 8:59 AM; Midday, from 9:00 AM to 2:59 PM; PM peak, from 3:00 PM to 5:59 PM; and Other, from 6 PM to 5:59 AM. We used these time periods for weekday travel only, since the traditional AM and PM peak periods have no real meaning for weekend travel. We also constructed the travel distance variables for the following four categories: (1) Total travel distance, all modes; (2) driving travel distance (including drive alone or with passenger); (3) solo driving travel distance; and (4) driving with passenger travel distance. We estimated step-wise regressions for each travel category and each time period, for CWW and CWW 4/40, or 32 separate regressions. For both midday and PM peak periods, there were no significant differences in travel between CWW and regular workers, or between CWW 4/40 and regular workers. For PM peak travel, coefficient signs were negative and insignificant in every case. For midday travel, signs were positive and insignificant in all cases except driving with passenger, which was negative and insignificant.

Table 5-7 gives regression results for the AM peak and Other time periods. As expected, AM peak travel distance in all categories is significantly negative for both CWW and CWW 4/40. Coefficient magnitudes are quite reasonable: a difference of about 13 miles (somewhat less than one average work trip) for CWW, and a difference of about 17 miles (approximately one average work trip) for CWW 4/40. Note also that the difference in total driving distance is rather evenly split between solo driving and driving with passenger. Since more trips are solo drive than drive with passenger, these results suggest that the CWW reductions are coming disproportionately from drive with passenger trips. These drive with passenger trips could be carpool work trips or pick-up/drop-off trips. If the drive with passenger trips reflect the latter, it is quite possible that the reductions reflect constraints generated by very early work trips. That is, the timing of incidental tasks such as dropping off children at school or childcare are determined by the schedule of those activities.

Results from the Other time period (6 PM to 5:59 AM) are interesting because of the differences in the CWW comparisons. In the case of CWW, travel distance coefficients for all categories are negative, and confidence intervals are largely negative. In contrast, coefficients for CWW 4/40 are positive for total distance, zero for driving distance, positive for solo driving distance, and negative for drive with passenger distance. We would expect more work trips of CWW 4/40 workers to occur during this time period; a positive coefficient suggests that travel for other purposes during this time period does not decrease as much as work travel increases. Finally, the only clear decrease in travel is in the drive with passenger category, again suggesting that very long work days imply a different distribution of travel across household members.

Since our analysis is based on a cross-section, we cannot interpret differences between the various groups of workers as changes. That is, these differences do not necessarily imply that travel savings of the CWW worker are offset by more travel on the part of other members of the household. Our analysis of the characteristics of CWW workers (as well as results of prior studies) suggests that household constraints apply to the work schedule. Only workers who *do not have* binding schedule constraints are able to work the longer days of CWW. Thus the travel differences we observe are more likely related to household structure and roles than to different distributions of activity tasks within the household generated by CWW.

TABLE 5-7
TRAVEL DISTANCE BY TIME PERIOD

DEP VAR	COEFF.	S.E.	SIG.	C.I. @ 95%
AM PEAK				
Total Distance				
CWW	-16.23	4.98	.001	-26.00 to -6.47
CWW 4/40	-22.78	7.51	.003	-37.50 to -8.06
Driving Distance				
CWW	-12.82	4.56	.005	-21.76 to -3.88
CWW 4/40	-17.13	6.84	.013	-30.54 to -3.72
Solo Driving Dist				
CWW	-5.06	4.31	.241	-13.51 to 3.36
CWW 4/40	-7.97	6.24	.202	-20.19 to 4.25
Drive & Pass Dist				
CWW	-6.16	2.43	.012	-10.93 to -1.40
CWW 4/40	-7.60	3.98	.057	-15.39 to 0.20
OTHER				
Total Distance				
CWW	-5.93	7.03	.340	-19.71 to 7.86
CWW 4/40	4.35	10.57	.681	-16.36 to 25.06
Driving Distance				
CWW	-8.89	6.15	.149	-20.95 to 3.17
CWW 4/40	-1.35	9.24	.884	-19.47 to 16.76
Solo Driving Dist				
CWW	-5.17	5.68	.363	-16.30 to 5.96
CWW 4/40	5.77	8.59	.516	-11.06 to 22.60
Drive & Pass Dist				
CWW	-4.27	2.57	.098	- 9.32 to 0.77
CWW 4/40	-6.77	3.77	.074	-14.17 to 0.62

5.4 IMPACTS ON TRIPS

We are also interested in whether CWW affects the number of trips taken over the course of the week. Vehicle trips are particularly important, since they represent vehicle starts and stops. Our expectations regarding total trips is the same as that for total travel distance: if work trip savings are not offset by other types of trips, we should observe fewer trips for CWW workers. Table 5-8 gives step-wise regression results for total trips, total weekday trips, and total weekend trips. In terms of number of trips, there is no difference between CWW and regular workers. Comparing these results with those based on distance suggests that weekday trips are shorter for CWW workers.

TABLE 5-8
TOTAL TRIPS BY TIME OF WEEK

DEP VAR	COEFF	S.E.	SIG.	C.I. @ 95%
<u>All Trips</u>				
CWW	-0.458	1.643	.279	-3.68 - 2.76
CWW 4/40	-0.676	1.120	.547	-2.87 - 1.52
<u>All Weekday Trips</u>				
CWW	-0.921	0.844	.276	-2.58 - 0.73
CWW 4/40	-0.810	1.244	.516	-3.25 - 1.63
<u>All Weekend Trips</u>				
CWW	0.449	0.461	.331	-0.46 - 0.90
CWW 4/40	0.293	0.659	.656	-1.00 - 1.58

We further examine trip rates by comparing mean weekly trip rates across categories of workers. To do so we conduct one-way analysis of variance (ANOVA) tests. Table 5-9 gives results for driving trips, again our best indicator of vehicle starts and stops. Group means, F-statistic, and significance level are presented. Dividing these trips into work and nonwork categories, defined as before, we get results similar to those based on travel distances. Work trip rates are significantly lower for CWW and CWW

4/40, with the difference larger for CWW 4/40. Total weekly driving trips and total non-work driving trips are not significantly different across work schedule categories. These results are contradictory: if work trips are lower and non-work trips are the same, how can total trips also be the same? Looking at the group means, we find that they are slightly lower for CWW and CWW 4/40 in both cases. It would appear that the sample variation is overwhelming these small differences.

TABLE 5-9
MEAN NUMBER OF DRIVING TRIPS/WEEK BY TYPE

	CWW				CWW 4/40			
	CWW	REG	F	Sig.	CWW	REG	F	Sig.
Weekly Drive	23.69	24.50	0.47	.492	24.45	24.64	0.01	.914
Work Drive	3.95	4.41	4.13	.043	3.58	4.42	6.65	.010
Nonwork Drive	10.43	10.84	0.28	.600	10.88	10.98	0.01	.934

5.4.1 TRIPS BY TIME OF DAY

Differences in trip rates between categories of workers are clearer when segmented by time period. Table 5-10 gives one-way ANOVA results for trips by time period, using the same definitions as given previously. Group means and statistics are given for driving trips and for trips by all modes. Trip rates for the AM Peak period are lower for CWW and CWW 4/40 compared to regular schedule workers, and differences between the group means are of the expected magnitude in each case. From an air quality standpoint, the AM peak trip reductions are particularly beneficial. Compared to our findings on total driving distance, we also note the same pattern for the PM Peak period, but the differences are significant. It is important to note, however, that these group means comparisons are less precise tests than the regressions, because we have not controlled for other factors. Midday trip rates are higher for CWW and CWW 4/40, also consistent with the analysis based on distance. These results support prior research findings that CWW workers make more trips of shorter distance during the midday, especially on the day off. Trip rate results during the Other time period are similar to the distance results. CWW 4/40 workers make more trips than regular workers during this time period, but the reverse is true for CWW workers in general.

TABLE 5-10
MEAN NUMBER OF TRIPS/WEEK BY TIME INTERVAL

	CWW				CWW 4/40			
	CWW	REG	F	SIG	CWW	REG	F	SIG
<u>AM PEAK</u>								
All Modes	4.60	5.77	15.50	.000	3.74	5.92	24.34	.000
Driving	3.84	4.59	6.89	.001	3.17	4.71	13.55	.000
<u>PM PEAK</u>								
All Modes	5.64	6.40	6.56	.011	5.29	6.58	8.54	.004
Driving	4.49	5.14	4.95	.027	4.40	5.31	4.33	.038
<u>MIDDAY</u>								
All Modes	5.10	3.88	10.51	.001	5.05	3.56	8.80	.003
Driving	3.86	2.89	8.53	.004	3.99	2.60	10.24	.002
<u>OTHER</u>								
All Modes	6.21	6.65	1.07	.302	7.18	6.62	0.87	.352
Driving	4.81	5.47	2.74	.098	5.80	5.43	0.43	.515
<u>WEEKDAY</u>								
All Modes	22.00	23.18	1.96	.162	21.73	23.14	1.33	.249
<u>WEEKEND</u>								
All Modes	8.29	8.25	0.01	.910	8.06	8.36	0.21	.646

5.4.2 TRIPS BY PURPOSE

If indeed CWW workers use the extra days off to make more nonwork trips, we should observe differences in trip rates by trip purpose across different categories of workers. Table 5-11 gives ANOVA results for the eleven trip purposes listed in the travel diaries. There are only two group mean differences that are significant at 90 percent or better: trips to work for CWW 4/40 workers, and pick-up/drop-off trips for all CWW workers. Mean differences for trip rates to work for all CWW workers, as well as social/recreational trip rates for both CWW and CWW 4/40 are close to the 90 percent level. As discussed previously, lower trip rates for pick-up/drop-off are as expected. More social/recreational trips suggest that CWW workers do use the time off for more social and recreational activities. It bears noting again that these differences may be a function of the self-selection process of whether individuals are able to work a CWW schedule, given their household constraints and responsibilities. That is, the causal factor here may not be the work schedule, but rather the characteristics of individuals working on those schedules.

TABLE 5-11
MEAN NUMBER OF TRIPS/WEEK BY PURPOSE

	CWW				CWW 4/40			
	CWW	REG	F	SIG	CWW	REG	F	SIG
To Work	5.39	5.69	2.33	.128	4.71	5.68	12.69	.000
Work-related	0.86	0.88	0.14	.907	0.82	0.87	0.03	.862
Shop	2.20	1.97	1.24	.267	1.95	2.03	0.09	.766
Errands	3.31	3.38	0.05	.822	3.35	3.34	0.00	.980
School	0.22	0.03	0.88	.348	0.25	0.32	0.25	.618
Med/Dental	0.39	0.39	0.01	.915	0.40	0.39	0.01	.913
Social/Rec	5.23	4.69	2.53	.112	5.28	4.55	2.49	.116
Pickup/Drop	2.03	2.71	2.98	.085	2.30	2.84	0.74	.390
Transfer mode	0.89	1.20	0.95	.329	0.97	1.32	0.49	.483
To home	9.45	9.46	0.00	.976	9.51	9.46	0.01	.920
Other	0.69	0.05	1.83	.177	0.73	0.49	1.54	.216

5.4.3 AVERAGE TRIP LENGTH

Differences in results for travel distances and trip rates may be explained by differences in average trip length. We compute average trip length for each individual by dividing the total distance traveled by the total number of trips for which distance was reported. Then, for each category of travel, we compute the group mean, which is the mean of the individual averages. One-way ANOVA test results are shown in Table 5-12 for travel by week, weekday and weekend. For all weekly drive trips, mean average trip length is longer for regular schedule workers. Separating travel into weekday and weekend components, we find the same pattern, but it is more pronounced for driving trips. For weekend travel, the pattern is reversed, but not significantly so. Apparently, CWW workers make more and shorter trips than regular workers during weekdays, and about the same number but longer trips on weekends.

TABLE 5-12
MEANS OF AVERAGE TRIP LENGTHS, IN MILES

	CWW				CWW 4/40			
	CWW	REG	F	SIG	CWW	REG	F	SIG
<u>Weekly</u> Drive Trips	11.00	12.61	2.45	.118	10.49	12.36	1.56	.213
<u>Weekday</u> All Trips Drive Trips	10.82 10.72	12.09 13.06	1.73 4.82	.189 .029	10.42 10.15	11.87 12.92	1.28 3.06	.260 .082
<u>Weekend</u> All Trips Drive Trips	13.09 12.50	11.09 11.22	2.25 0.77	.135 .381	12.65 12.14	10.19 10.01	2.13 1.57	.146 .211

5.5 MODE SHARES

A major issue related to CWW policies is the possible effect of different schedules on mode share. Do CWW schedules make it more or less difficult to rideshare or use other alternative modes? Unfortunately, there is so little use of modes other than the private auto in this sample that we are able to test the effect of CWW only for private vehicle and walk trips. Results are given in Table 5-13 for drive alone, drive with passenger, ride as passenger, and walk trips. First, the mean trip rates reflect the split between private vehicle modes observed throughout the analysis. Over half of all trips are drive alone trips, and at least 80 percent of all trips are drive alone or with passenger. Second, there are no differences in the mean shares of drive alone trips. Third, the drive with passenger rate is somewhat lower for CWW and CWW 4/40, while the ride as passenger rate is higher for CWW. In terms of private vehicle use patterns, these results suggest no major differences across categories of workers. Finally, the walk trip share is slightly higher for regular schedule workers. This may be the result of the characteristics of our sample, as a large number of the regular schedule workers are employed at a large central city university, where many services are available within easy walking distance.

TABLE 5-13
MEAN NUMBER OF TRIPS/WEEK BY SELECTED MODES

MODE	CWW				CWW 4/40			
	CWW	REG	F	SIG	CWW	REG	F	SIG
Drive Alone	15.88	15.92	0.00	n/a	16.50	15.65	0.57	.450
Drive with Pass	7.82	8.58	1.89	.346	7.94	8.98	0.65	.418
Ride as Pass	3.81	2.89	3.59	.059	3.12	2.96	0.05	.821
Walk	1.65	2.08	1.35	.245	1.24	2.05	2.37	.125

5.6 CONCLUSIONS

Our analysis shows that CWW work schedules are associated with less work travel compared to regular schedules. Comparing all CWW workers to workers on a regular schedule, the difference is equivalent to somewhat less than the one-way journey to work distance. Comparing CWW 4/40 workers to regular schedule workers, the difference is at least the equivalent of the one-way journey to work distance. Effects of CWW are more pronounced for CWW 4/40 workers; the ten hour workday has a greater effect on weekday travel, and the long weekends have a greater effect on weekend travel.

The substantial variability in travel characteristics precludes estimating differences across work schedule categories with any precision. This is particularly the case for nonwork travel and for total weekly travel. We find no significant differences between the groups, yet observed differences consistently suggest less overall travel. Our conclusion is that differences in work travel are not entirely offset by differences in nonwork travel. That is, CWW is most likely associated with less total travel, but we cannot estimate how much with any precision. Although we cannot predict with much certainty how much travel is reduced as a result of CWW, *all indications are positive*. There is no evidence here that suggests more travel as a result of CWW. This is true for both travel distance and trip frequency.

Our analysis also shows that socioeconomic and demographic factors play a more significant role in travel patterns than the work schedule. In addition, we note that the ability to work on a compressed schedule depends on personal responsibilities and constraints. Thus the differences we observe may be more a function of the characteristics of the individual working on each type of schedule, rather than the work schedule itself. More research is needed to gain a clearer understanding of the dynamics involved in work schedules, individual characteristics, and observed travel patterns.

CHAPTER SIX
CONCLUSIONS

The purpose of this research has been to determine whether compressed work schedules are potentially effective as transportation control measures. In order to be effective, these measures must contribute to a reduction in mobile source emissions, which implies a reduction in VMT, trips, congestion, or any combination thereof.

We examined the impact of compressed work schedules on travel patterns by surveying a cross section of employees located at eleven different worksites within the Los Angeles Metropolitan Area. The surveyed employees completed a seven day travel diary that listed all trips taken by purpose, mode, distance and time. Our survey sample included employees working on two types of compressed work schedules, the 4/40 and 9/80, as well as a control group of employees working a regular (5/40) schedule. The travel survey was conducted in the Spring of 1993.

This research differs in significant ways from prior studies of CWW travel impacts. First, the research was conducted on the basis of a cross-section of employees that had been on the compressed schedule for quite some time. Other prior surveys were before/after surveys. Second, prior studies focussed on a single workplace or a single type of employer (e.g. Federal offices). This research included different types of employers, industries, and geographical locations. Finally, most of our analysis controlled for other factors that affect travel behavior, while the results of prior studies are based on simple comparisons across work schedule groups. It is therefore not surprising that our results differ in some ways from these previous research efforts.

6.1 SUMMARY OF RESULTS

Our analysis of travel characteristics revealed a high degree of variability in weekly travel patterns. Estimated regression models explained only a small portion of the sample variation in weekly travel distance, driving distance, and trip making. Significant explanatory factors include auto availability, gender, household composition and income -- results that are entirely consistent with prior travel behavior research. Once we control for these factors, we find that differences between CWW and regular workers are difficult to estimate with any precision, because of the great day-to-day variability in travel behavior.

6.1.1 WEEKLY TRAVEL DISTANCE AND TRIPS

Our analysis of total weekly travel, both in terms of distance and trips, shows little difference across work schedule categories. Signs on CWW and CWW 4/40 coefficients are negative (indicating travel reductions) and of the expected magnitude (about .5 trips/week and about 11 miles/week respectively), but not statistically significant at 90 percent or better.

In contrast, our analysis of work travel, particularly when measured in terms of work tours that account for stops along the way, shows significantly less work travel for CWW workers. Again, coefficients are of the expected magnitude: for all CWW workers, the estimated mean difference is about 13 miles/week, and for CWW 4/40 workers, the estimated mean difference ranges from 15 to 20 miles/week, depending on the particular form of the dependent variable. Given our sample average work trip length of about 17 miles, these estimates are quite reasonable.

Our results on nonwork travel are more difficult to interpret. The average number of nonwork trips per week is no different across work schedule categories. For nonwork driving distance, coefficients are negative, but highly insignificant. We thus have no evidence that there is *more* total nonwork travel among CWW workers. Since we have strong evidence that work travel is lower for CWW, we conclude that total travel is indeed lower for CWW workers, but the sample variation has precluded precise measurement of the difference.

There are, however, distinct differences in the nonwork travel patterns across work schedule categories. More weekend travel distance is associated with CWW, but mean estimates are not as large as the weekday travel decreases. That is, the estimated mean difference for weekday travel ranges between 23 and 44 miles less for CWW workers, while the estimated mean difference for weekend travel ranges between 6 and 12 miles more for CWW workers. Furthermore, average trip length for weekend trips is longer for CWW workers, while weekday average trip length is shorter. These differences are supported by results on trip purpose. CWW is associated with more social and recreational travel (typically longer trips), but fewer pick-up or drop-off trips (which are typically short). Long weekends make recreational travel more convenient. Long weekdays make pick-up or drop-off trips less convenient, because the start and end times of activities associated with such trips (e.g. school or childcare) conflict with the long work schedule.

There are also differences in travel patterns by time of day. As expected, CWW is associated with fewer trips and less travel distance during the AM peak period. CWW is also associated with more trips during the midday, but not necessarily more travel distance, supporting the idea that CWW workers are able to economize on travel by combining trips on the day off. CWW is associated with fewer trips during the PM peak, but not necessarily less travel distance. For travel between 6 PM and 6 AM, results are mixed: possibly less travel for all CWW workers, but more travel for CWW 4/40 workers. It seems reasonable that the long workday of the 4/40 schedule would shift some worktrips to this time interval.

Finally, our regression results suggest that employee characteristics are both more consistently significant and of greater magnitude than the work schedule. In the case of weekday travel distance per week, for example, being male adds 63 miles; residing in a single family dwelling adds 40 miles; having 4 or more cars adds 50 miles; and being over 65 years old reduces travel by 39 miles. The compressed work schedule reduces travel by 25 miles.

6.1.2 OTHER TRAVEL IMPACTS

Our analysis also shows that CWW does not have much effect on mode shares. We observe that regular schedule workers make slightly more walking trips, but we attribute this difference to the characteristics of our sample. Most of the regular schedule workers are employed at the central Los Angeles site, where many services are available within easy walking distance. We also observe slightly more CWW workers making private vehicle trips as passengers. Closer examination reveals that this difference exists only for 9/80 workers. This difference is probably due to gender rather than to the 9/80 schedule: 9/80 workers are more likely to be female, and when males and females travel together, the male is more likely to drive.

Finally, there is no evidence that CWW is associated with longer work trips. The availability of CWW does not appear to promote greater separation between home and work. Thus there is little concern that over the long term the travel savings of CWW will be eroded by longer commute trips.

6.2 INTERPRETATION OF RESULTS

In the most general terms, our results show that CWW schedules are associated with less travel, measured both in terms of trips and VMT, compared to regular work schedules. Fewer work trips per week reduce trips and VMT; the extra day off per week redistributes nonwork trips and allows for more weekend travel, but not enough to totally offset the work trip reduction. It is important to note that while we are not able to assign specific values to trip and VMT reductions, *our results very consistently indicate some travel savings due to CWW.* That is, we cannot predict with confidence how much travel would be reduced by more widespread implementation of CWW, but we can say with confidence that some reduction would occur.

These results clearly suggest air quality benefits. First, fewer AM peak trips means fewer morning cold starts. Since air pollution tends to build through the day, reductions in early morning emissions are particularly beneficial to improved air quality. Second, less peak travel implies less travel under congested conditions. Slow speeds and repeated acceleration and braking are characteristic of driving in congestion, and these driving patterns increase vehicle emissions. Less travel under congested conditions means smoother traffic flow and consequently lower rates of running emissions. Finally, less total VMT means less total running emissions.

6.2.1 RELIABILITY OF ANALYSIS RESULTS

Although our results support these general statements of potential transportation and air quality benefits, we are unable to provide reliable estimates of these benefits due to the great variability in our sample. It is therefore important to discuss sample variability. As stated previously, our sample was drawn from eleven different worksites. Geographic characteristics range from a large university campus in central Los Angeles, to public agencies located in inner suburbs, to a large suburban manufacturing company that is located miles from other services and activities. These differences also imply comparable variability in the residential areas from which employees are drawn. Thus, in addition to the differences in occupation, household structure, etc. of survey participants, they also reside in areas with different levels of accessibility to activities and services. Our results suggest that the effects of compressed work schedules are mediated both by employee characteristics and urban spatial structure.

6.2.2 WORKERS VS. THE WORK SCHEDULE

Our results, as well as those of numerous other studies, show that there are significant differences between employees working on different schedules. We find that CWW workers are more likely to be male, be in the age groups of 25 to 54, have higher household income, be employed in a professional or managerial occupation, and are somewhat more likely to be members of single worker households. Given these findings, are the observed differences in travel across work schedule categories attributable to the compressed work schedule, or to the workers who are working on the compressed work schedule? Research on CWW as well as other forms of alternative work hours document constraints associated with nonwork responsibilities that make it difficult or impossible to work on an alternative schedule (e.g. Giuliano and Golob, 1990). Only workers who do not have binding schedule constraints are able to work the longer days of CWW, for example. Furthermore, alternative work schedules are often limited to specific occupational categories or tasks, which are in turn related to gender and income (Giuliano, 1994).

If there is a form of self selection in who works on the CWW schedule, we would expect to see more dramatic results from a before/after study than from a cross-sectional study. In the before period, average travel rates would reflect travel of all workers, including those who are unable to work a CWW schedule due to nonwork-related constraints. In the after period, the CWW group consists of workers who do not have these constraints, and consequently may have made fewer weekday nonwork trips before as well as after CWW. Comparing the CWW group to the non-CWW group in the after period would generate an artificially high estimate of the travel savings attributable to CWW. It is also important to note that the causality issues related to why CWW is associated with less travel does not affect the assessment of whether it is an effective TCM. That is, even if the CWW schedule is feasible only for people who have few weekday travel obligations, the benefits of reduced work travel will still be realized. Similarly, if we argue that long weekends promote more weekend travel, the counterargument can be made that people who enjoy weekend travel will prefer CWW. The CWW schedule itself therefore should not be considered as the "cause" of more weekend travel.

6.3 POLICY IMPLICATIONS

The basic policy question is whether CWW is an effective transportation control measure. Our analysis shows that work travel is reduced, and that possible increases in nonwork travel are not so large as to offset the work travel savings. Overall, potential travel reductions from CWW may be described as modest. Do modest travel reductions (and corresponding air quality benefits) make CWW an effective TCM?

Research on other TCMs shows that their effects are marginal. For example, studies of HOV lanes, transit subsidies, and rideshare incentives show that these efforts typically increase ridesharing by a few percentage points despite their often significant cost (Giuliano, 1992; Giuliano and Small, 1994). These studies illustrate the difficulties of influencing travel behavior with policy instruments that can feasibly be implemented. Given these results, transportation policy has increasingly relied on the incremental approach: implement many different policies, each of which has a small effect, but which together may generate significant benefits.. CWW is one more TCM that can contribute positively to trip reduction, and it has the added advantage of being essentially cost-free.

Moreover, many workers prefer CWW, and therefore consider it a valuable job-related benefit. We conclude that CWW is cost-effective, feasible, and generates modest travel savings benefits. As such, it merits policy support.

6.3.1 POSSIBILITIES FOR WIDESPREAD IMPLEMENTATION

Perhaps a more critical issue is whether CWW can be more widely implemented. As noted earlier in this report, compressed work schedules have been advocated for more than two decades as energy saving and congestion mitigation strategies. They have also been advocated as measures to enhance employee recruitment and job satisfaction. Use of CWW has never become widespread, however. National estimates of the share of the employed labor force on CWW peaked in 1976 and has declined ever since.

The Los Angeles Metropolitan area is an exception; the emphasis on transportation management strategies to cope with congestion and the implementation of Regulation XV have promoted more experimentation with alternative work schedules. It is important to note, however, that although many employers *offer* CWW as part of their transportation demand management plans, a surprisingly small number of employees actually *work* on the CWW schedule. CWW schedules are also concentrated by industrial sector: the 4/40 schedule is most widely used by manufacturing firms (the historic focus of 4/40 programs), and the 9/80 schedule is most widely used by public agencies. We surmise that public agencies have more flexibility in establishing operating hours than private firms and therefore are more willing to offer alternative schedules to their employees. The small number of employees on CWW suggests that barriers to widespread implementation exist and need to be examined.

6.3.2 IMPORTANCE OF THE PRIVATE VEHICLE

Our research also shows that effective transportation control measures must focus on the private vehicle. About 90 percent of all reported travel in this survey was by private vehicle. The 1990 NPTS data shows the same percentage. Any strategy that reduces private vehicle travel even by a small percentage will therefore have a significant beneficial effect. In contrast, for example, even a doubling of the public transit share (which in this survey is 1.7 percent) would have little discernible effect on private vehicle travel or congestion levels. CWW is one of many possible strategies that can contribute to reduced vehicle emissions by reducing total private vehicle travel.

6.4 LIMITATIONS OF THE STUDY

The research results reported here are not generalizable to other areas or populations, because the data sample is not random, and therefore is not necessarily representative of all employees.[16] Research was based on a volunteer sample of workers in Los Angeles and Orange Counties. The sample universe was restricted to employment sites with 100 or more employees with sufficient numbers of CWW workers, and whose management were willing to participate in the study. Because of the difficulties encountered in soliciting employer participation, the eleven participating sites do not reflect the full range of industrial sectors and geographic environments. The travel diary respondents are a self-selected subset of workers at the participant sites. We therefore weighted the diary data by the characteristics of the Survey A respondents. Thus the weighted data sample is representative of the employees at the participant sites who completed Survey A, but not representative of the universe of employees.

The study is also limited by the factors that affect all multi-day travel research. The likelihood of responding to any type of survey is a function of education, income and other socio-economic and demographic factors. Thus certain population segments simply do not appear in survey responses. This problem is intensified in areas with large immigrant populations. Since our survey was conducted in English, only English speakers could respond. Such limitations are simply the reality of this type of research.

The Los Angeles Region is often considered an outlier among metropolitan areas because of its vast size and reliance on the automobile. It therefore might be argued that the research results are not transferable to cities with more extensive transit service or with higher densities. In fact, travel characteristics in Los Angeles are quite consistent

[16] It bears noting, however, that it is not practically possible to obtain a representative sample of seven day travel diaries without changing the survey technology to make it much less burdensome for respondents.

with national averages. The participant sites reflect a wide variety of local environments, including central city, major employment center, inner suburb and outer suburb. We therefore conclude that the geographic location of the study is not a major limitation.

6.5 FURTHER RESEARCH

We conclude this report with some suggestions for further research. Further research is required on two issues in order to better quantify the potential transportation and air quality benefits of CWW.

First, research is needed to **more precisely quantify the expected impacts of CWW.** The richness of our travel diary data makes several extensions of the research possible:

- *Analysis of the relationship between employee characteristics and the likelihood of working on a given schedule.* This would provide information on the potential market for CWW within the workforce.

- *Analysis of causal relationships between employee characteristics, work schedule and travel patterns.* This would provide more precise information regarding the expected impacts of CWW across various types of employees by more effectively isolating individual characteristics that influence travel patterns from the effect of different work schedules.

- *Analysis of day-off travel across categories of workers.* Comparing day-off travel patterns will provide more information on the ways in which travel is redistributed as a consequence of CWW schedules.

- *Analysis of nonwork and work to home travel tours.* We have constructed travel tours in this analysis only for the travel associated with the trip to work. A more extensive analysis of travel tours would enable us to more clearly identify all work related travel, and to distinguish trips associated with cold starts.

- *Analysis of daily activity sequences across categories of workers.* This would also provide more information on how travel is redistributed as a result of CWW.

Second, research is needed to **determine the extent to which CWW could be employed.** As noted above, CWW schedules continue to be limited to few workplaces and to selected groups of employees within workplaces. Reasons for the limited use of CWW must be examined, and strategies for promoting CWW must be identified. This research would require a more detailed analysis of the types of firms that use CWW and of the types of jobs that are most amenable to a CWW schedule. In addition, employers should be surveyed to elicit information on the perceived problems associated with CWW and the reasons why CWW is not more extensively utilized.

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ABBREVIATIONS

ANOVA - Analysis of Variance

AVR - Average Vehicle Ridership

CBD - Central Business District

CTS - Commuter Transportation Services

CWW - Compressed Work Week

ETC - Employee Transportation Coordinator

FHWA - Federal Highway Administration

ISTEA - Intermodal Surface Transportation Efficiency Act

LACDPW - Los Angeles County Department of Public Works

NPTS - National Personal Transportation Survey

SCAB - South Coast Air Basin

SCAQMD - Southern California Air Quality Management District

TCM - Transportation Control Measure

TDM - Transportation Demand Management

VMT - Vehicle Miles Traveled

APPENDIX A

Survey A

THE PLANNING INSTITUTE
UNIVERSITY OF SOUTHERN CALIFORNIA
LOS ANGELES

Dear Employee:

Researchers at The Planning Institute, University of Southern California (USC) are conducting a study to help our understanding of how work schedules affect the way we travel. For the project we need information about the daily travel patterns of people employed full time.

Your company is supporting this study, and we would like to invite you to participate in our survey of daily travel. Participation will mean keeping a "travel diary" of all of your trips for a period of one week (7 days). Members of the research team will show you how to fill out the diary and will be available to help you and answer your questions. We hope very much that you will agree to take part and fill out a travel diary. The quality of our study depends on how many people take part.

You will find a short questionnaire on the following pages. It requests some basic information about you and your household. At the end of the questionnaire you can indicate whether or not you will be willing to fill out a travel diary. **Please fill out the questionnaire, even if you do not wish to fill out a travel diary later.** The information we collect will be kept entirely confidential, and will be used only for statistical purposes. Please return your completed questionnaire in the envelope provided. Sealing the envelope will assure confidentiality.

If you have any questions please call The Planning Institute at (213) 740-1466.

Thank you for your help with this important study.

Sincerely,

Genevieve Giuliano

Genevieve Giuliano, Ph.D.
Director, The Planning Institute

WORK HOURS AND TRAVEL STUDY THE PLANNING INSTITUTE USC

1. Is this your regular place of work?
   - ☐1 YES
   - ☐2 NO → Stop and please return this questionnaire in the envelope provided.

2. How long have you been working at this location?
   ☐1 less than 1 year ☐2 1 to 2 years ☐3 more than 2 years

3. Do you usually work the same number of workdays each TWO WEEK period?
   - ☐1 YES → How many workdays? _____ days in each two week period.
   - ☐2 NO

4. Are you able to choose your work schedule, or is it fixed?
   ☐1 I am able to choose my work schedule. ☐2 My work schedule is fixed.

5. What time are you SUPPOSED to:
   Start work? _____:_____ am or pm End work?_____:_____ am or pm
   (HR) (MIN) (please circle) (HR) (MIN) (please circle)

   ☐ I do not have regular work hours.

6. Do you have a valid driver's license?
   ☐1 YES ☐2 NO

7. Do you usually drive the same car?
   ☐1 YES ☐2 NO

8. How many miles is it one way from your home to your regular workplace? __ miles

9. Which of the following best describe your occupation? (CHECK ONE)
   - ☐1 Manager/administrator ☐2 Professional
   - ☐3 Sales ☐4 Administrative support/clerical
   - ☐5 Service ☐6 Skilled crafts
   - ☐7 Labor/operative ☐8 Other:____________________ (PLEASE SPECIFY)

10. Are you? ☐1 Male ☐2 Female

11. What is your age group?
☐1 16-24 ☐2 25-34 ☐3 35-44 ☐4 45-54 ☐5 55-64 ☐6 65 or older

12. INCLUDING yourself, how many people are there in your household by age group?
_____ persons under 6 years old _____ persons 19 to 64 years old
_____ persons 6 to 18 years old _____ persons 65 years old or older

13. What childcare services do you use regularly while you or other household members are at work? (Please check all that apply)
☐1 do not use childcare services
☐2 babysitter or other at your home
☐3 after-school care at school
☐4 childcare at another site
☐5 other ______________________________
(PLEASE SPECIFY)

14. How many children in your household attend school?
_____ number of children in grade school (grades K - 8)
_____ number in high school (grades 9 - 12)
_____ number in college
_____ no children in school
_____ no children in household

15. How many motorized vehicles (cars, trucks, vans, recreation vehicles, motorcycles) are available to your household, including company vehicles kept at home?
☐1 ☐2 ☐3 ☐4 ☐5 ☐6 or more

16. INCLUDING yourself, how many licensed drivers are there in your household?
☐1 ☐2 ☐3 ☐4 ☐5 or more

17. INCLUDING yourself, how many persons in your household are employed outside your home most of the year (including part-time)?
☐1 ☐2 ☐3 ☐4 or more

18. What type of housing unit do you live in?
    - ☐1 single family home
    - ☐2 townhouse or condominium
    - ☐3 apartment
    - ☐4 duplex
    - ☐5 mobile home
    - ☐6 other ______________________ (PLEASE SPECIFY)

19. For statistical purposes only, please give the best approximation of your gross family income (before taxes)?

☐1	Less than $15,000	☐6	$55,000 to $65,000
☐2	$15,000 to $25,000	☐7	$65,000 to $75,000
☐3	$25,000 to $35,000	☐8	$75,000 to $85,000
☐4	$35,000 to $45,000	☐9	$85,000 to $100,000
☐5	$45,000 to $55,000	☐10	$100,000 or more

THANK YOU FOR COMPLETING THIS QUESTIONNAIRE

We would like you to participate in our travel diary. Are you willing to take part?

☐1 YES ☐2 NO

If YES, please give us your name, work address and daytime telephone number.

NAME: ______________________

WORK ADDRESS: ______________________

____

PHONE: DAY ______________ EVENINGS ______________

PLACE THIS QUESTIONNAIRE IN ENVELOPE PROVIDED AND SEAL

PLEASE RETURN BY:

THANK YOU

APPENDIX B

Survey B

WORK HOURS AND TRAVEL STUDY
THE PLANNING INSTITUTE
UNIVERSITY OF SOUTHERN CALIFORNIA

PERSONAL TRAVEL DIARY

YOUR NAME ______________________________

PLEASE START YOUR TRAVEL DIARY TOMORROW

Fill in your start and end dates below.
If you are unable to start your diary tomorrow, fill in the first and seventh days for your actual diary completion.

YOUR TRAVEL SURVEY DAYS ARE:

DAY 1: Month ______ Date ___ Day of Week ________________

DAY 7: Month ______ Date ___ Day of Week ________________

WORK HOURS AND TRAVEL STUDY

Thank you for participating in our WORK HOURS AND TRAVEL STUDY. This is your travel diary booklet. Please keep it with you at all times. Remember that you will be completing a diary every day for seven days. Be sure to fill in your diary page and odometer readings by the end of each day. It is very important that you maintain the diary for all seven days.

INSTRUCTIONS :

You will complete one diary each survey day. The diary is a list of all the trips you make each day. Fill out the day of the week at the top of each page. Each day you will answer some general questions about your travel, and you will list every trip you made that day.

A TRIP is one-way travel from a starting place to a STOP for a particular purpose. Whenever you stop for a particular purpose, you have made a trip.

A TRIP is one-way travel by ANY MEANS (walking, driving, taking a bus, etc.). Whenever you change your means of travel, you have made a trip.

NEED HELP?

Members of the WORK HOURS AND TRAVEL STUDY project team will be available to answer any questions you might have. Call our HELPLINE anytime. If a team member is not available, you can leave a message and someone will call you back.

WORK HOURS AND TRAVEL STUDIES HELPLINE

(213) 743-1646

WORK HOURS AND TRAVEL STUDY

VEHICLE INVENTORY

Fill this page out first. Please complete this Vehicle Inventory for all the vehicles that are available for you to drive. Then for any driving trips you make during your survey week, use the vehicle number to indicate which vehicle you used. If you do not drive, ignore this question.

Vehicle #1 YEAR ___________ MAKE ___________ MODEL___________

Fuel Type (check one)
☐1 unleaded gas ☐2 diesel ☐3 natural gas ☐4 other ___________ (please specify)

Vehicle #2 YEAR ___________ MAKE ___________ MODEL___________

Fuel Type (check one)
☐1 unleaded gas ☐2 diesel ☐3 natural gas ☐4 other ___________ (please specify)

Vehicle #3 YEAR ___________ MAKE ___________ MODEL___________

Fuel Type (check one)
☐1 unleaded gas ☐2 diesel ☐3 natural gas ☐4 other ___________ (please specify)

Vehicle #4 YEAR ___________ MAKE ___________ MODEL___________

Fuel Type (check one)
☐1 unleaded gas ☐2 diesel ☐3 natural gas ☐4 other ___________ (please specify)

Vehicle #5 YEAR ___________ MAKE ___________ MODEL___________

Fuel Type (check one)
☐1 unleaded gas ☐2 diesel ☐3 natural gas ☐4 other ___________ (please specify)

Vehicle #6 YEAR ___________ MAKE ___________ MODEL___________

Fuel Type (check one)
☐1 unleaded gas ☐2 diesel ☐3 natural gas ☐4 other ___________ (please specify)

WORK HOURS AND TRAVEL STUDY

TIPS FOR FILLING OUT YOUR TRAVEL DIARY

If you travel as a passenger in someone else's vehicle

- Leave the vehicle number blank on your trip diary

If you travel as part of your job

- Don't list the trips you make as part of your job
- List all trips up to your arrival at work
- List all trips after you finish work

If you leave Southern California during your travel diary week

- List your trip out of Southern California and write "Leave Southern Cal" under trip purpose
- Don't list trips you make while out of Southern California
- Start your travel diary again when you return to Southern California

TRAVEL DIARY EXAMPLE

The travel diary may look complicated, but it is really very simple. The example will help you see how easy it is.

John Smith's travel day

- leave home 6:57 am, drive to park & ride lot, arrive 7:10
- join carpool 7:15, arrive at work 7:48
- walk to bank 12:30, arrive 12:36
- walk to McDonald's 12:50, arrive 12:55
- walk back to work 1:20, arrive 1:29
- leave work 4:55 pm, arrive park & ride lot 5:45
- drive to grocery market 5:47, arrive 6:05
- leave market 6:20, arrive home 6:32 pm
- leave home 7:40 pm, drive to movie theatre, arrive 7:55 pm
- leave movie theatre 11:12 pm, arrive home 11:20 pm

Here is the diary page filled out with John Smith's travel day

TRAVEL DIARY **JOHN SMITH'S TRAVEL DAY** TODAY IS WEDNESDAY
(DAY OF WEEK)

Trip #	Time Trip Began (please circle am or pm)	Time Trip Ended (please circle am or pm)	Purpose 1 = To work 2 = Work related 3 = Shopping 4 = Errands e.g. bank, dry cleaner 5 = School 6 = Medical/dental 7 = Social recreation, eat out, entertainment 8 = Drop-off/pick up another person 9 = Transfer to other transportation 10 = To home 11 = Other (please describe)	Means of Travel 1 = Drove alone 2 = Drive & passenger(s) (carpool driver) 3 = Passenger in car/van (car or vanpool passenger) 4 = Motorcycle 5 = Rail/Bus 6 = Bicycle 7 = Walk, jogged 8 = Airplane 9 = Other (please specify)	Miles Travelled and Vehicle Number
1	6 : 57 am/pm	7 : 10 am/pm	1 2 3 4 5 6 7 8 9 10 11	1 2 3 4 5 6 7 8 9	Miles 5 Vehicle # 1
2	7 : 15 am/pm	7 : 48 am/pm	1 2 3 4 5 6 7 8 9 10 11	1 2 3 4 5 6 7 8 9	Miles 20 Vehicle #
3	12 : 30 am/pm	12 : 36 am/pm	1 2 3 4 5 6 7 8 9 10 11	1 2 3 4 5 6 7 8 9	Miles ½ Vehicle #
4	12 : 50 am/pm	12 : 55 am/pm	1 2 3 4 5 6 7 8 9 10 11	1 2 3 4 5 6 7 8 9	Miles ¼ Vehicle #
5	1 : 20 am/pm	1 : 29 am/pm	1 2 3 6 11	1 2 3 4 5 6 7 8 9	Miles ½ Vehicle #
6	4 : 55 am/pm	5 : 45 am/pm	4 5 7 8 9 10 11	1 2 3 4 5 6 7 8 9	Miles 20 Vehicle #
7	5 : 47 am/pm	6 : 05 am/pm	1 2 3 4 5 6 7 8 9 10 11	1 2 3 4 5 6 7 8 9	Miles 3 Vehicle #
8	6 : 20 am/pm	6 : 32 am/pm	1 2 3 4 5 6 7 8 9 10 11	1 2 3 4 5 6 7 8 9	Miles 5 Vehicle #
9	7 : 40 am/pm	7 : 55 am/pm	1 2 3 4 5 6 7 8 9 10 11	1 2 3 4 5 6 7 8 9	Miles 10 Vehicle #
10	11 : 12 am/pm	11 : 20 am/pm	1 2 3 4 5 6 7 8 9 10 11	1 2 3 4 5 6 7 8 9	Miles 10 Vehicle #
11	: am/pm	: am/pm	1 2 3 4 5 6 7 8 9 10 11	1 2 3 4 5 6 7 8 9	Miles Vehicle #
12	: am/pm	: am/pm	1 2 3 4 5 6 7 8 9 10 11	1 2 3 4 5 6 7 8 9	Miles Vehicle #
13	: am/pm	: am/pm	1 2 3 4 5 6 7 8 9 10 11	1 2 3 4 5 6 7 8 9	Miles Vehicle #
14	: am/pm	: am/pm	1 2 3 4 5 6 7 8 9 10 11	1 2 3 4 5 6 7 8 9	Miles Vehicle #
15	: am/pm	: am/pm	1 2 3 4 5 6 7 8 9 10 11	1 2 3 4 5 6 7 8 9	Miles Vehicle #
16	: am/pm	: am/pm	1 2 3 4 5 6 7 8 9 10 11	1 2 3 4 5 6 7 8 9	Miles Vehicle #

TRAVEL DIARY **DAY 1** TODAY IS ______________
(DAY OF WEEK)

1. What type of day is this for you?
   - ☐1 Normal scheduled work day
   - ☐2 Sick leave
   - ☐3 Vacation day/Personal day-off
   - ☐4 Other type of work day e.g. attended off-site meetings/went out-of-town
   - ☐5 Not a scheduled workday

2. Did you make any trips today?
   ☐1 YES (continue) ☐2 NO → Go to question #4
   ↓

2a. Where did your first trip of this day begin?
   ☐1 Home ☐2 Other location: please give nearest major intersection ______________

3. Did you drive a car today?
   ☐1 YES (continue) ☐2 NO → Go to question #4
   ↓
   Please complete for <u>each</u> car you drove today

VEH#	Odometer reading beginning this day	Odometer reading end this day	Anyone else drive this car today?

4. If you did not drive today, did anyone else drive your car today?
   ☐1 YES (continue) ☐2 NO ☐3 I don't drive/don't have a car
   ↓
   Please complete for <u>your</u> car

VEH#	Odometer reading beginning this day	Odometer reading end this day

If you made trips today, please continue →

TRAVEL DIARY **DAY 1** TODAY IS ______________
(DAY OF WEEK)

Trip #	Time Trip Began (please circle am or pm)	Time Trip Ended (please circle am or pm)	Purpose 1 = To work 2 = Work related 3 = Shopping 4 = Errands e.g. bank, dry cleaner 5 = School 6 = Medical/dental 7 = Social recreation, eat out, entertainment 8 = Drop-off/pick up another person 9 = Transfer to other transportation 10 = To home 11 = Other (please describe)	Means of Travel 1 = Drove alone 2 = Drive & passenger(s) (carpool driver) 3 = Passenger in car/van (car or vanpool passenger) 4 = Motorcycle 5 = Rail/Bus 6 = Bicycle 7 = Walk, jogged 8 = Airplane 9 = Other (please specify)	Miles Travelled and Vehicle Number
1	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles ______ Vehicle # ____
2	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles ______ Vehicle # ____
3	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles ______ Vehicle # ____
4	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles ______ Vehicle # ____
5	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles ______ Vehicle # ____
6	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles ______ Vehicle # ____
7	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles ______ Vehicle # ____
8	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles ______ Vehicle # ____
9	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles ______ Vehicle # ____
10	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles ______ Vehicle # ____
11	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles ______ Vehicle # ____
12	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles ______ Vehicle # ____
13	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles ______ Vehicle # ____
14	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles ______ Vehicle # ____
15	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles ______ Vehicle # ____
16	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles ______ Vehicle # ____

TRAVEL DIARY **DAY 2** TODAY IS ______________
(DAY OF WEEK)

1. What type of day is this for you?
   - ☐1 Normal scheduled work day
   - ☐2 Sick leave
   - ☐3 Vacation day/Personal day-off
   - ☐4 Other type of work day e.g. attended off-site meetings/went out-of-town
   - ☐5 Not a scheduled workday

2. Did you make any trips today?
   ☐1 YES (continue) ☐2 NO → Go to question #4
   ↓

2a. Where did your first trip of this day begin?
   ☐1 Home ☐2 Other location: please give nearest major intersection ______________

3. Did you drive a car today?
   ☐1 YES (continue) ☐2 NO → Go to question #4
   ↓
   Please complete for each car you drove today

VEH#	Odometer reading beginning this day	Odometer reading end this day	Anyone else drive this car today?

4. If you did not drive today, did anyone else drive your car today?
   ☐1 YES (continue) ☐2 NO ☐3 I don't drive/don't have a car
   ↓
   Please complete for your car

VEH#	Odometer reading beginning this day	Odometer reading end this day

If you made trips today, please continue →

TRAVEL DIARY **DAY 2** TODAY IS ________________
(DAY OF WEEK)

Trip #	Time Trip Began please circle am or pm	Time Trip Ended please circle am or pm	Purpose 1 = To work 2 = Work related 3 = Shopping 4 = Errands e.g. bank, dry cleaner 5 = School 6 = Medical/dental 7 = Social recreation, eat out, entertainment 8 = Drop-off/pick up another person 9 = Transfer to other transportation 10 = To home 11 = Other (please describe)	Means of Travel 1 = Drove alone 2 = Drive & passenger(s) (carpool driver) 3 = Passenger in car/van (car or vanpool passenger) 4 = Motorcycle 5 = Rail/Bus 6 = Bicycle 7 = Walk, jogged 8 = Airplane 9 = Other (please specify)	Miles Travelled and Vehicle Number
1	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #____
2	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #____
3	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #____
4	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #____
5	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #____
6	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #____
7	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #____
8	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #____
9	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #____
10	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #____
11	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #____
12	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #____
13	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #____
14	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #____
15	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #____
16	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #____

TRAVEL DIARY **DAY 3** TODAY IS ______________
(DAY OF WEEK)

1. What type of day is this for you?
   - ☐1 Normal scheduled work day
   - ☐2 Sick leave
   - ☐3 Vacation day/Personal day-off
   - ☐4 Other type of work day e.g. attended off-site meetings/went out-of-town
   - ☐5 Not a scheduled workday

2. Did you make any trips today?
   ☐1 YES (continue) ☐2 NO → Go to question #4
   ↓

2a. Where did your first trip of this day begin?
   ☐1 Home ☐2 Other location: please give nearest major intersection ______________________

3. Did you drive a car today?
   ☐1 YES (continue) ☐2 NO → Go to question #4
   ↓
   Please complete for <u>each</u> car you drove today

VEH#	Odometer reading beginning this day	Odometer reading end this day	Anyone else drive this car today?

4. If you did not drive today, did anyone else drive your car today?
   ☐1 YES (continue) ☐2 NO ☐3 I don't drive/don't have a car
   ↓
   Please complete for <u>your</u> car

VEH#	Odometer reading beginning this day	Odometer reading end this day

If you made trips today, please continue →

TRAVEL DIARY **DAY 3** TODAY IS ________________
(DAY OF WEEK)

Trip #	Time Trip Began please circle am or pm	Time Trip Ended please circle am or pm	Purpose 1 = To work 2 = Work related 3 = Shopping 4 = Errands e.g. bank, dry cleaner 5 = School 6 = Medical/dental 7 = Social recreation, eat out, entertainment 8 = Drop-off/pick up another person 9 = Transfer to other transportation 10 = To home 11 = Other (please describe)	Means of Travel 1 = Drove alone 2 = Drive & passenger(s) (carpool driver) 3 = Passenger in car/van (car or vanpool passenger) 4 = Motorcycle 5 = Rail/Bus 6 = Bicycle 7 = Walk, jogged 8 = Airplane 9 = Other (please specify)	Miles Travelled and Vehicle Number
1	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11________	1 2 3 4 5 6 7 8 9________	Miles______ Vehicle #____
2	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11________	1 2 3 4 5 6 7 8 9________	Miles______ Vehicle #____
3	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11________	1 2 3 4 5 6 7 8 9________	Miles______ Vehicle #____
4	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11________	1 2 3 4 5 6 7 8 9________	Miles______ Vehicle #____
5	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11________	1 2 3 4 5 6 7 8 9________	Miles______ Vehicle #____
6	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11________	1 2 3 4 5 6 7 8 9________	Miles______ Vehicle #____
7	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11________	1 2 3 4 5 6 7 8 9________	Miles______ Vehicle #____
8	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11________	1 2 3 4 5 6 7 8 9________	Miles______ Vehicle #____
9	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11________	1 2 3 4 5 6 7 8 9________	Miles______ Vehicle #____
10	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11________	1 2 3 4 5 6 7 8 9________	Miles______ Vehicle #____
11	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11________	1 2 3 4 5 6 7 8 9________	Miles______ Vehicle #____
12	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11________	1 2 3 4 5 6 7 8 9________	Miles______ Vehicle #____
13	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11________	1 2 3 4 5 6 7 8 9________	Miles______ Vehicle #____
14	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11________	1 2 3 4 5 6 7 8 9________	Miles______ Vehicle #____
15	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11________	1 2 3 4 5 6 7 8 9________	Miles______ Vehicle #____
16	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11________	1 2 3 4 5 6 7 8 9________	Miles______ Vehicle #____

TRAVEL DIARY **DAY 4** TODAY IS ____________
(DAY OF WEEK)

1. What type of day is this for you?
   - ☐1 Normal scheduled work day
   - ☐2 Sick leave
   - ☐3 Vacation day/Personal day-off
   - ☐4 Other type of work day e.g. attended off-site meetings/went out-of-town
   - ☐5 Not a scheduled workday

2. Did you make any trips today?
   ☐1 YES (continue) ☐2 NO → Go to question #4
   ↓

2a. Where did your first trip of this day begin?
   ☐1 Home ☐2 Other location: please give nearest major intersection____________

3. Did you drive a car today?
   ☐1 YES (continue) ☐2 NO → Go to question #4
   ↓
   Please complete for each car you drove today

VEH#	Odometer reading beginning this day	Odometer reading end this day	Anyone else drive this car today?

4. If you did not drive today, did anyone else drive your car today?
   ☐1 YES (continue) ☐2 NO ☐3 I don't drive/don't have a car
   ↓
   Please complete for your car

VEH#	Odometer reading beginning this day	Odometer reading end this day

If you made trips today, please continue →

TRAVEL DIARY **DAY 4** TODAY IS ________________
(DAY OF WEEK)

Trip #	Time Trip Began please circle am or pm	Time Trip Ended please circle am or pm	Purpose 1 = To work 2 = Work related 3 = Shopping 4 = Errands e.g. bank, dry cleaner 5 = School 6 = Medical/dental 7 = Social recreation, eat out, entertainment 8 = Drop-off/pick up another person 9 = Transfer to other transportation 10 = To home 11 = Other (please describe)	Means of Travel 1 = Drove alone 2 = Drive & passenger(s) (carpool driver) 3 = Passenger in car/van (car or vanpool passenger) 4 = Motorcycle 5 = Rail/Bus 6 = Bicycle 7 = Walk, jogged 8 = Airplane 9 = Other (please specify)	Miles Travelled and Vehicle Number
1	_____ : _____ am/pm	_____ : _____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #______
2	_____ : _____ am/pm	_____ : _____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #______
3	_____ : _____ am/pm	_____ : _____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #______
4	_____ : _____ am/pm	_____ : _____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #______
5	_____ : _____ am/pm	_____ : _____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #______
6	_____ : _____ am/pm	_____ : _____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #______
7	_____ : _____ am/pm	_____ : _____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #______
8	_____ : _____ am/pm	_____ : _____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #______
9	_____ : _____ am/pm	_____ : _____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #______
10	_____ : _____ am/pm	_____ : _____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #______
11	_____ : _____ am/pm	_____ : _____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #______
12	_____ : _____ am/pm	_____ : _____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #______
13	_____ : _____ am/pm	_____ : _____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #______
14	_____ : _____ am/pm	_____ : _____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #______
15	_____ : _____ am/pm	_____ : _____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #______
16	_____ : _____ am/pm	_____ : _____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #______

TRAVEL DIARY **DAY 5** TODAY IS ______________
(DAY OF WEEK)

1. What type of day is this for you?
   - ☐1 Normal scheduled work day
   - ☐2 Sick leave
   - ☐3 Vacation day/Personal day-off
   - ☐4 Other type of work day e.g. attended off-site meetings/went out-of-town
   - ☐5 Not a scheduled workday

2. Did you make any trips today?

   ☐1 YES (continue) ☐2 NO → Go to question #4

   ↓

2a. Where did your first trip of this day begin?

   ☐1 Home ☐2 Other location: please give nearest major intersection ______________

3. Did you drive a car today?

   ☐1 YES (continue) ☐2 NO → Go to question #4

   ↓

   Please complete for each car you drove today

VEH#	Odometer reading beginning this day	Odometer reading end this day	Anyone else drive this car today?

4. If you did not drive today, did anyone else drive your car today?

   ☐1 YES (continue) ☐2 NO ☐3 I don't drive/don't have a car

   ↓

   Please complete for your car

VEH#	Odometer reading beginning this day	Odometer reading end this day

If you made trips today, please continue →

TRAVEL DIARY **DAY 5** TODAY IS ________________ (DAY OF WEEK)

Trip #	Time Trip Began please circle am or pm	Time Trip Ended please circle am or pm	Purpose 1 = To work 2 = Work related 3 = Shopping 4 = Errands e.g. bank, dry cleaner 5 = School 6 = Medical/dental 7 = Social recreation, eat out, entertainment 8 = Drop-off/pick up another person 9 = Transfer to other transportation 10 = To home 11 = Other (please describe)	Means of Travel 1 = Drove alone 2 = Drive & passenger(s) (carpool driver) 3 = Passenger in car/van (car or vanpool passenger) 4 = Motorcycle 5 = Rail/Bus 6 = Bicycle 7 = Walk, jogged 8 = Airplane 9 = Other (please specify)	Miles Travelled and Vehicle Number
1	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle # ____
2	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle # ____
3	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle # ____
4	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle # ____
5	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle # ____
6	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle # ____
7	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle # ____
8	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle # ____
9	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle # ____
10	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle # ____
11	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle # ____
12	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle # ____
13	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle # ____
14	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle # ____
15	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle # ____
16	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle # ____

TRAVEL DIARY **DAY 6** TODAY IS ______________
(DAY OF WEEK)

1. What type of day is this for you?
   - ☐1 Normal scheduled work day
   - ☐2 Sick leave
   - ☐3 Vacation day/Personal day-off
   - ☐4 Other type of work day e.g. attended off-site meetings/went out-of-town
   - ☐5 Not a scheduled workday

2. Did you make any trips today?
   ☐1 YES (continue) ☐2 NO → Go to question #4
   ↓

2a. Where did your first trip of this day begin?
   ☐1 Home ☐2 Other location: please give nearest major intersection______________

3. Did you drive a car today?
   ☐1 YES (continue) ☐2 NO → Go to question #4
   ↓
   Please complete for each car you drove today

VEH#	Odometer reading beginning this day	Odometer reading end this day	Anyone else drive this car today?

4. If you did not drive today, did anyone else drive your car today?
   ☐1 YES (continue) ☐2 NO ☐3 I don't drive/don't have a car
   ↓
   Please complete for your car

VEH#	Odometer reading beginning this day	Odometer reading end this day

If you made trips today, please continue →

TRAVEL DIARY **DAY 6** TODAY IS ____________
(DAY OF WEEK)

Trip #	Time Trip Began please circle am or pm	Time Trip Ended please circle am or pm	Purpose 1 = To work 2 = Work related 3 = Shopping 4 = Errands e.g. bank, dry cleaner 5 = School 6 = Medical/dental 7 = Social recreation, eat out, entertainment 8 = Drop-off/pick up another person 9 = Transfer to other transportation 10 = To home 11 = Other (please describe)	Means of Travel 1 = Drove alone 2 = Drive & passenger(s) (carpool driver) 3 = Passenger in car/van (car or vanpool passenger) 4 = Motorcycle 5 = Rail/Bus 6 = Bicycle 7 = Walk, jogged 8 = Airplane 9 = Other (please specify)	Miles Travelled and Vehicle Number
1	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles ______ Vehicle # ______
2	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles ______ Vehicle # ______
3	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles ______ Vehicle # ______
4	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles ______ Vehicle # ______
5	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles ______ Vehicle # ______
6	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles ______ Vehicle # ______
7	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles ______ Vehicle # ______
8	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles ______ Vehicle # ______
9	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles ______ Vehicle # ______
10	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles ______ Vehicle # ______
11	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles ______ Vehicle # ______
12	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles ______ Vehicle # ______
13	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles ______ Vehicle # ______
14	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles ______ Vehicle # ______
15	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles ______ Vehicle # ______
16	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles ______ Vehicle # ______

TRAVEL DIARY **DAY 7** TODAY IS ______________
(DAY OF WEEK)

1. What type of day is this for you?
   - ☐1 Normal scheduled work day
   - ☐2 Sick leave
   - ☐3 Vacation day/Personal day-off
   - ☐4 Other type of work day e.g. attended off-site meetings/went out-of-town
   - ☐5 Not a scheduled workday

2. Did you make any trips today?

   ☐1 YES (continue) ☐2 NO → Go to question #4

   ↓

2a. Where did your first trip of this day begin?

   ☐1 Home ☐2 Other location: please give nearest major intersection ______________

3. Did you drive a car today?

   ☐1 YES (continue) ☐2 NO → Go to question #4

   ↓

   Please complete for <u>each</u> car you drove today

VEH#	Odometer reading beginning this day	Odometer reading end this day	Anyone else drive this car today?

4. If you did not drive today, did anyone else drive your car today?

   ☐1 YES (continue) ☐2 NO ☐3 I don't drive/don't have a car

   ↓

   Please complete for <u>your</u> car

VEH#	Odometer reading beginning this day	Odometer reading end this day

If you made trips today, please continue →

TRAVEL DIARY **DAY 7** TODAY IS ________________
(DAY OF WEEK)

Trip #	Time Trip Began please circle am or pm	Time Trip Ended please circle am or pm	Purpose 1 = To work 2 = Work related 3 = Shopping 4 = Errands e.g. bank, dry cleaner 5 = School 6 = Medical/dental 7 = Social recreation, eat out, entertainment 8 = Drop-off/pick up another person 9 = Transfer to other transportation 10 = To home 11 = Other (please describe)	Means of Travel 1 = Drove alone 2 = Drive & passenger(s) (carpool driver) 3 = Passenger in car/van (car or vanpool passenger) 4 = Motorcycle 5 = Rail/Bus 6 = Bicycle 7 = Walk, jogged 8 = Airplane 9 = Other (please specify)	Miles Travelled and Vehicle Number
1	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #____
2	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #____
3	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #____
4	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #____
5	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #____
6	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #____
7	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #____
8	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #____
9	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #____
10	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #____
11	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #____
12	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #____
13	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #____
14	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #____
15	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #____
16	____ : ____ am/pm	____ : ____ am/pm	1 2 3 4 5 6 7 8 9 10 11 ________	1 2 3 4 5 6 7 8 9 ________	Miles______ Vehicle #____

THANK YOU FOR COMPLETING

YOUR TRAVEL DIARY

PLEASE GIVE US YOUR TELEPHONE NUMBER

JUST IN CASE WE HAVE QUESTIONS

ABOUT YOUR DIARY

TELEPHONE (   ) ____________________

BEST TIME OF DAY TO CALL __________

PLACE YOUR DIARY IN THE

ENVELOPE PROVIDED AND MAIL

NO POSTAGE IS REQUIRED

APPENDIX C

Frequencies for Survey A Variables

ADULTS Number of adults in HH.

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
None or missing	.00	157	6.2	6.2	6.2
One adult	1.00	586	23.2	23.2	29.4
Two adults	2.00	1278	50.6	50.6	79.9
	3.00	319	12.6	12.6	92.6
	4.00	124	4.9	4.9	97.5
	5.00	40	1.6	1.6	99.1
	6.00	17	.7	.7	99.7
	7.00	4	.2	.2	99.9
	8.00	3	.1	.1	100.0
	Total	2528	100.0	100.0	

Valid cases 2528 Missing cases 0

- -

AGE Age groups of participants

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
16 to 24	1.00	117	4.6	4.8	4.8
25 to 34	2.00	637	25.2	25.9	30.7
35 to 44	3.00	802	31.7	32.6	63.3
45 to 54	4.00	650	25.7	26.4	89.7
55 to 64	5.00	219	8.7	8.9	98.6
64 or older	6.00	34	1.3	1.4	100.0
	.	69	2.7	Missing	
	Total	2528	100.0	100.0	

Valid cases 2459 Missing cases 69

AMPM1 Starting work in AM or PM

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Starting in AM	1.00	2247	88.9	98.0	98.0
Starting in PM	2.00	45	1.8	2.0	100.0
	.	236	9.3	Missing	
	Total	2528	100.0	100.0	

Valid cases 2292 Missing cases 236

- -

AMPM2 Ending working in AM or PM

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Ending work in AM	1.00	31	1.2	1.4	1.4
Ending work in PM	2.00	2259	89.4	98.6	100.0
	.	238	9.4	Missing	
	Total	2528	100.0	100.0	

Valid cases 2290 Missing cases 238

CHLDCAR2 Type of childcare services used

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Do not use childcare	1.00	1745	69.0	76.1	76.1
babysitter or other	2.00	123	4.9	5.4	81.5
After-school care	3.00	82	3.2	3.6	85.0
Care at another site	4.00	181	7.2	7.9	92.9
Other	5.00	102	4.0	4.4	97.4
More than one type	6.00	60	2.4	2.6	100.0
	.	235	9.3	Missing	
	Total	2528	100.0	100.0	

Valid cases 2293 Missing cases 235

COLLEGE Number of children attending college

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
One child in college	1.00	211	8.3	74.3	74.3
Two children in college	2.00	61	2.4	21.5	95.8
Three children in college	3.00	7	.3	2.5	98.2
Four children in cololllege	4.00	5	.2	1.8	100.0
	.	2244	88.8	Missing	
	Total	2528	100.0	100.0	

Valid cases 284 Missing cases 2244

- -

DAYSWK2 Working days each two week period

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	8.00	382	15.1	17.5	17.5
	8.50	1	.0	.0	17.6
	9.00	628	24.8	28.8	46.4
	9.50	1	.0	.0	46.4
	10.00	1102	43.6	50.6	97.0
	11.00	12	.5	.6	97.5
	12.00	33	1.3	1.5	99.0
	13.00	8	.3	.4	99.4
	14.00	13	.5	.6	100.0
	.	348	13.8	Missing	
	Total	2528	100.0	100.0	

Valid cases 2180 Missing cases 348

DAYSWK3 Working days each 2 weeks

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Regular	1.00	1102	43.6	50.6	50.6
CWW410	2.00	382	15.1	17.5	68.1
Other CWW	3.00	630	24.9	28.9	97.0
Long>=10 days	4.00	66	2.6	3.0	100.0
	.	348	13.8	Missing	
	Total	2528	100.0	100.0	

Valid cases 2180 Missing cases 348

- -

DIARY Willingness to participate in diary

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Yes	1.00	948	37.5	39.0	39.0
No	2.00	1483	58.7	61.0	100.0
	.	97	3.8	Missing	
	Total	2528	100.0	100.0	

Valid cases 2431 Missing cases 97

- -

DIARY2 Willingness to participate in diary

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Yes	1.00	948	37.5	37.5	37.5
No	2.00	1580	62.5	62.5	100.0
	Total	2528	100.0	100.0	

Valid cases 2528 Missing cases 0

DRIVERS # of licensed drivers in household

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
One	1.00	521	20.6	21.2	21.2
Two	2.00	1408	55.7	57.2	78.4
Three	3.00	334	13.2	13.6	92.0
Four	4.00	148	5.9	6.0	98.0
Five or more	5.00	50	2.0	2.0	100.0
	.	67	2.7	Missing	
	Total	2528	100.0	100.0	

Valid cases 2461 Missing cases 67

- -

EMPLY # of workers in HH

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
One	1.00	807	31.9	32.8	32.8
Two	2.00	1299	51.4	52.8	85.6
Three	3.00	238	9.4	9.7	95.3
Four or more	4.00	115	4.5	4.7	100.0
	.	69	2.7	Missing	
	Total	2528	100.0	100.0	

Valid cases 2459 Missing cases 69

- -

EMPLY2 Workers in HH.

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
One worker in HH.	1.00	807	31.9	32.8	32.8
Two workers in HH.	2.00	1299	51.4	52.8	85.6
Three or more in HH.	3.00	353	14.0	14.4	100.0
	.	69	2.7	Missing	
	Total	2528	100.0	100.0	

Valid cases 2459 Missing cases 69

GENDER Gender of participants

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Male	1.00	1239	49.0	50.0	50.0
Female	2.00	1238	49.0	50.0	100.0
	.	51	2.0	Missing	
	Total	2528	100.0	100.0	

Valid cases 2477 Missing cases 51

- -

HOMETYPE Housing types of the participants

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Single family home	1.00	1491	59.0	60.0	60.0
Townhouse or condo	2.00	383	15.2	15.4	75.4
Apartment	3.00	471	18.6	19.0	94.4
Duplex	4.00	77	3.0	3.1	97.5
Mobile home	5.00	34	1.3	1.4	98.8
Other	6.00	29	1.1	1.2	100.0
	.	43	1.7	Missing	
	Total	2528	100.0	100.0	

Valid cases 2485 Missing cases 43

INCOME Family annual income

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Less than $15,000	1.00	37	1.5	1.6	1.6
$15,000 to $25,000	2.00	200	7.9	8.4	9.9
$25,000 to $35,000	3.00	269	10.6	11.3	21.2
$35,000 to $45,000	4.00	316	12.5	13.2	34.4
$45,000 to $55,000	5.00	331	13.1	13.9	48.3
$55,000 to $65,000	6.00	314	12.4	13.2	61.5
$65,000 to $75,000	7.00	232	9.2	9.7	71.2
$75,000 to $85,000	8.00	198	7.8	8.3	79.5
$85,000 to $100,000	9.00	234	9.3	9.8	89.3
$100,000 or more	10.00	256	10.1	10.7	100.0
	.	141	5.6	Missing	
	Total	2528	100.0	100.0	

Valid cases 2387 Missing cases 141

- -

KIDS06 KIDS HOME UNDER 6 YEARS OLD

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
One	1.00	327	12.9	70.3	70.3
Two	2.00	124	4.9	26.7	97.0
Three	3.00	13	.5	2.8	99.8
Six	6.00	1	.0	.2	100.0
	.	2063	81.6	Missing	
	Total	2528	100.0	100.0	

Valid cases 465 Missing cases 2063

KIDS618 Kids home 6-18 years old

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
One	1.00	377	14.9	53.4	53.4
Two	2.00	241	9.5	34.1	87.5
Three	3.00	63	2.5	8.9	96.5
Four	4.00	20	.8	2.8	99.3
Five	5.00	4	.2	.6	99.9
Six	6.00	1	.0	.1	100.0
	.	1822	72.1	Missing	
	Total	2528	100.0	100.0	

Valid cases 706 Missing cases 1822

- -

KIDS_HH Kids <= 18 years old in HH.

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
No kids <= 18 in HH	.00	1540	60.9	60.9	60.9
One kid in HH <= 18	1.00	452	17.9	17.9	78.8
Two kids or more <= 18	2.00	536	21.2	21.2	100.0
	Total	2528	100.0	100.0	

Valid cases 2528 Missing cases 0

- -

KIDS_HH1 Kids <= 18 years old in HH.

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
No kids or missing	.00	1540	60.9	60.9	60.9
Have kids in HH.	1.00	988	39.1	39.1	100.0
	Total	2528	100.0	100.0	

Valid cases 2528 Missing cases 0

- -

LICENSE Having a driver's license or not

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Yes	1.00	2429	96.1	97.6	97.6
No	2.00	59	2.3	2.4	100.0
	.	40	1.6	Missing	
	Total	2528	100.0	100.0	

Valid cases 2488 Missing cases 40

NOCHILD No children in household

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
No children	1.00	1058	41.9	100.0	100.0
	.	1470	58.1	Missing	
	Total	2528	100.0	100.0	

Valid cases 1058 Missing cases 1470

- -

NOREG_HR No regular work hours

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
True	1.00	195	7.7	100.0	100.0
	.	2333	92.3	Missing	
	Total	2528	100.0	100.0	

Valid cases 195 Missing cases 2333

OCCUP2 Occupation of the participants

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Manager/admin.	1.00	529	20.9	21.4	21.4
Professional	2.00	809	32.0	32.8	54.2
Sales	3.00	3	.1	.1	54.3
Admin_sup/clerical	4.00	597	23.6	24.2	78.5
Service	5.00	133	5.3	5.4	83.9
Skilled crafts	6.00	130	5.1	5.3	89.2
Labor/operative	7.00	74	2.9	3.0	92.2
Other	8.00	174	6.9	7.1	99.2
Not sure	9.00	19	.8	.8	100.0
	.	60	2.4	Missing	
	Total	2528	100.0	100.0	

Valid cases 2468 Missing cases 60

- -

OCCUP3 Occupation of the participants

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Manager/admin.	1.00	529	20.9	21.4	21.4
Professional	2.00	809	32.0	32.8	54.2
Admin_sup/clerical	4.00	597	23.6	24.2	78.4
Service	5.00	136	5.4	5.5	83.9
Labor/operative	7.00	204	8.1	8.3	92.2
Other	8.00	193	7.6	7.8	100.0
	.	60	2.4	Missing	
	Total	2528	100.0	100.0	

Valid cases 2468 Missing cases 60

- -

PERS1964 # of hh. persons from 19-64

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
One	1.00	619	24.5	26.5	26.5
Two	2.00	1270	50.2	54.3	80.8
Three	3.00	288	11.4	12.3	93.1
Four	4.00	111	4.4	4.7	97.9
Five	5.00	34	1.3	1.5	99.3
Six	6.00	10	.4	.4	99.7
Seven	7.00	3	.1	.1	99.9
Eight	8.00	3	.1	.1	100.0
	.	190	7.5	Missing	
	Total	2528	100.0	100.0	

Valid cases 2338 Missing cases 190

PERS65UP # of HH persons 65 years old or above

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
One	1.00	126	5.0	78.3	78.3
Two	2.00	31	1.2	19.3	97.5
Four	4.00	1	.0	.6	98.1
Five	5.00	3	.1	1.9	100.0
	.	2367	93.6	Missing	
		-------	-------	-------	
	Total	2528	100.0	100.0	

Valid cases 161 Missing cases 2367

- -

RATIO1 Ratio - # of cars and # of adults in HH

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	.14	1	.0	.0	.0
	.17	2	.1	.1	.1
	.20	1	.0	.0	.2
	.25	3	.1	.1	.3
	.33	19	.8	.8	1.1
	.40	5	.2	.2	1.3
	.50	168	6.6	7.2	8.5
	.57	1	.0	.0	8.5
	.60	9	.4	.4	8.9
	.67	78	3.1	3.3	12.2
	.75	24	.9	1.0	13.3
	.80	10	.4	.4	13.7
	.83	3	.1	.1	13.8
	.86	2	.1	.1	13.9
Ratio = 1	1.00	1367	54.1	58.3	72.3
	1.20	7	.3	.3	72.6
	1.25	15	.6	.6	73.2
	1.33	47	1.9	2.0	75.2
	1.50	239	9.5	10.2	85.4
	1.67	14	.6	.6	86.0
Ratio = 2	2.00	237	9.4	10.1	96.1
	2.50	23	.9	1.0	97.1
Ratio = 3	3.00	54	2.1	2.3	99.4
Ratio = 4	4.00	10	.4	.4	99.8
Ratio = 5	5.00	2	.1	.1	99.9
Ratio = 6	6.00	2	.1	.1	100.0
	.	185	7.3	Missing	
		-------	-------	-------	
	Total	2528	100.0	100.0	

Valid cases 2343 Missing cases 185

- -

RATIO2 Ratio - # of cars and # of adults in HH

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Ratio < 1	1.00	326	12.9	13.9	13.9
1<= Ration < 1.5	2.00	1436	56.8	61.3	75.2
1.5 <= Ratio < 2	3.00	253	10.0	10.8	86.0
2<= Ratio <3	4.00	260	10.3	11.1	97.1
Ratio >= 3	5.00	68	2.7	2.9	100.0
	.	185	7.3	Missing	
	Total	2528	100.0	100.0	

Valid cases 2343 Missing cases 185

- -

REGPLACE Regular place of work or Not

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Yes	1.00	2481	98.1	98.6	98.6
No	2.00	36	1.4	1.4	100.0
	.	11	.4	Missing	
	Total	2528	100.0	100.0	

Valid cases 2517 Missing cases 11

- -

SAMECAR Usually driving the same car

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Yes	1.00	2228	88.1	91.1	91.1
No	2.00	217	8.6	8.9	100.0
	.	83	3.3	Missing	
	Total	2528	100.0	100.0	

Valid cases 2445 Missing cases 83

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SAMEWORK Same # of workdays or not

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Yes	1.00	2368	93.7	96.0	96.0
No	2.00	99	3.9	4.0	100.0
	.	61	2.4	Missing	
	Total	2528	100.0	100.0	

Valid cases 2467 Missing cases 61

- -

SCHEDULE Able to choose work schedule or not

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Able to choose	1.00	846	33.5	34.6	34.6
Schedule fixed	2.00	1601	63.3	65.4	100.0
	.	81	3.2	Missing	
	Total	2528	100.0	100.0	

Valid cases 2447 Missing cases 81

- -

SCHOOL12 Number of children in high school

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
One	1.00	259	10.2	76.4	76.4
Two	2.00	74	2.9	21.8	98.2
Three	3.00	6	.2	1.8	100.0
	.	2189	86.6	Missing	
	Total	2528	100.0	100.0	

Valid cases 339 Missing cases 2189

SCHOOL8 Number of children in grade school

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
One	1.00	343	13.6	61.1	61.1
Two	2.00	173	6.8	30.8	92.0
Three	3.00	34	1.3	6.1	98.0
Four	4.00	10	.4	1.8	99.8
Five	5.00	1	.0	.2	100.0
	.	1967	77.8	Missing	
	Total	2528	100.0	100.0	

Valid cases 561 Missing cases 1967

SCHOOLNO No children in school

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
No children in school	1.00	372	14.7	100.0	100.0
	.	2156	85.3	Missing	
	Total	2528	100.0	100.0	

Valid cases 372 Missing cases 2156

VEHICLES Motorized vehicles available

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
One	1.00	573	22.7	23.4	23.4
Two	2.00	1115	44.1	45.5	68.9
Three	3.00	467	18.5	19.1	88.0
Four	4.00	181	7.2	7.4	95.4
Five	5.00	65	2.6	2.7	98.0
Six or more	6.00	48	1.9	2.0	100.0
	.	79	3.1	Missing	
	Total	2528	100.0	100.0	

Valid cases 2449 Missing cases 79

YEARSWRK Years working at the location

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Less than 1 year	1.00	225	8.9	9.1	9.1
1 to 2 years	2.00	277	11.0	11.2	20.2
More than 2 years	3.00	1980	78.3	79.8	100.0
	.	46	1.8	Missing	
	Total	2528	100.0	100.0	

Valid cases 2482 Missing cases 46

APPENDIX D

Frequencies for Survey B Variables

RECORD 3

MEANS Means

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Alone	1	8736	52.5	53.6	53.6
With Passenger	2	4261	25.6	26.1	79.7
As Passenger	3	1851	11.1	11.3	91.0
Motorcycle	4	26	.2	.2	91.2
Rail/Bus	5	275	1.7	1.7	92.9
Bicycle	6	151	.9	.9	93.8
Walk/Jog	7	934	5.6	5.7	99.5
Airplane	8	3	.0	.0	99.5
Other	9	54	.3	.3	99.9
	99	22	.1	.1	100.0
	.	327	2.0	Missing	
	Total	16640	100.0	100.0	

Valid cases 16313 Missing cases 327

PURPOSE Purpose

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
To Work	1	3051	18.3	18.4	18.4
Work Related	2	489	2.9	2.9	21.3
Shopping	3	1116	6.7	6.7	28.1
Errands	4	1800	10.8	10.8	38.9
School	5	130	.8	.8	39.7
Medical/Dental	6	212	1.3	1.3	41.0
Social	7	2644	15.9	15.9	56.9
Drop-off/Pick Up	8	1254	7.5	7.6	64.5
Transfer Transportat	9	539	3.2	3.2	67.7
To Home	10	5043	30.3	30.4	98.1
Other	11	316	1.9	1.9	100.0
	99	1	.0	.0	100.0
	.	45	.3	Missing	
	Total	16640	100.0	100.0	

Valid cases 16595 Missing cases 45

TODAYIS Today Is

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Sunday	1	1887	11.3	11.4	11.4
Monday	2	2349	14.1	14.2	25.7
Tuesday	3	2324	14.0	14.1	39.7
Wednesday	4	2407	14.5	14.6	54.3
Thursday	5	2387	14.3	14.5	68.8
Friday	6	2719	16.3	16.5	85.2
Saturday	7	2438	14.7	14.8	100.0
	.	129	.8	Missing	
	Total	16640	100.0	100.0	

Valid cases 16511 Missing cases 129

TRIP# Trip #

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1	3586	21.6	21.6	21.6
	2	3526	21.2	21.2	42.7
	3	2733	16.4	16.4	59.2
	4	2274	13.7	13.7	72.8
	5	1541	9.3	9.3	82.1
	6	1074	6.5	6.5	88.5
	7	690	4.1	4.1	92.7
	8	458	2.8	2.8	95.4
	9	285	1.7	1.7	97.2
	10	180	1.1	1.1	98.2
	11	119	.7	.7	99.0
	12	77	.5	.5	99.4
	13	44	.3	.3	99.7
	14	25	.2	.2	99.8
	15	13	.1	.1	99.9
	16	7	.0	.0	100.0
	17	3	.0	.0	100.0
	18	3	.0	.0	100.0
	19	1	.0	.0	100.0
	20	1	.0	.0	100.0
	Total	16640	100.0	100.0	

Valid cases 16640 Missing cases 0

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VEHICLE# Vehicle #

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Vehicle 1	1	10921	65.6	85.4	85.4
Vehicle 2	2	1489	8.9	11.6	97.0
Vehicle 3	3	335	2.0	2.6	99.6
Vehicle 4	4	39	.2	.3	99.9
Vehicle 5	5	7	.0	.1	100.0
	.	3849	23.1	Missing	
	Total	16640	100.0	100.0	

Valid cases 12791 Missing cases 3849

RECORD 2

ANY1ELA Veh A Anyone Else

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Yes	1	289	7.6	10.1	10.1
No	2	2583	68.3	89.9	100.0
	.	912	24.1	Missing	
	Total	3784	100.0	100.0	

Valid cases 2872 Missing cases 912

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ANY1ELB Veh B Anyone Else

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Yes	1	100	2.6	52.6	52.6
No	2	90	2.4	47.4	100.0
	.	3594	95.0	Missing	
	Total	3784	100.0	100.0	

Valid cases 190 Missing cases 3594

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ANY1ELC Veh C Anyone Else

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Yes	1	3	.1	42.9	42.9
No	2	4	.1	57.1	100.0
	.	3777	99.8	Missing	
	Total	3784	100.0	100.0	

Valid cases 7 Missing cases 3777

QUEST1 q1 Type of Day

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Normal	1	2366	62.5	62.8	62.8
Sick	2	37	1.0	1.0	63.8
Vacation/Personal	3	112	3.0	3.0	66.8
Other	4	103	2.7	2.7	69.5
No Work	5	1149	30.4	30.5	100.0
	.	17	.4	Missing	
	Total	3784	100.0	100.0	

Valid cases 3767 Missing cases 17

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QUEST2 q2 Trips Today?

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Yes	1	3522	93.1	94.9	94.9
No	2	191	5.0	5.1	100.0
	.	71	1.9	Missing	
	Total	3784	100.0	100.0	

Valid cases 3713 Missing cases 71

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QUEST2A q2a Trip Start

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Home	1	3395	89.7	96.9	96.9
Other	2	107	2.8	3.1	100.0
	.	282	7.5	Missing	
	Total	3784	100.0	100.0	

Valid cases 3502 Missing cases 282

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QUEST3 q3 Car Driven

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Yes	1	3115	82.3	90.1	90.1
No	2	344	9.1	9.9	100.0
	.	325	8.6	Missing	
	Total	3784	100.0	100.0	

Valid cases 3459 Missing cases 325

QUEST4 q4 Anyone Else Drive

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Yes	1	145	3.8	16.6	16.6
No	2	684	18.1	78.2	94.7
No Drive/No Car	3	46	1.2	5.3	100.0
	.	2909	76.9	Missing	
	Total	3784	100.0	100.0	

Valid cases 875 Missing cases 2909

QUEST4A q4 Vehicle # Driven

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Vehicle 1	1	141	3.7	82.9	82.9
Vehicle 2	2	27	.7	15.9	98.8
Vehicle 6	6	2	.1	1.2	100.0
	.	3614	95.5	Missing	
	Total	3784	100.0	100.0	

Valid cases 170 Missing cases 3614

TODAYIS Today Is

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Sunday	1	522	13.8	13.9	13.9
Monday	2	541	14.3	14.4	28.3
Tuesday	3	545	14.4	14.5	42.8
Wednesday	4	546	14.4	14.5	57.3
Thursday	5	540	14.3	14.4	71.7
Friday	6	538	14.2	14.3	86.0
Saturday	7	527	13.9	14.0	100.0
	.	25	.7	Missing	
	Total	3784	100.0	100.0	

Valid cases 3759 Missing cases 25

VEH#A Vehicle A #

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Vehicle 1	1	2721	71.9	88.7	88.7
Vehicle 2	2	278	7.3	9.1	97.7
Vehicle 3	3	68	1.8	2.2	99.9
Vehicle 4	4	1	.0	.0	100.0
Vehicle 5	5	1	.0	.0	100.0
	.	715	18.9	Missing	
	Total	3784	100.0	100.0	

Valid cases 3069 Missing cases 715

VEH#B Vehicle B #

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Vehicle 1	1	28	.7	13.2	13.2
Vehicle 2	2	145	3.8	68.4	81.6
Vehicle 3	3	34	.9	16.0	97.6
Vehicle 4	4	4	.1	1.9	99.5
Vehicle 5	5	1	.0	.5	100.0
	.	3572	94.4	Missing	
	Total	3784	100.0	100.0	

Valid cases 212 Missing cases 3572

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VEH#C Vehicle C #

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Vehicle 1	1	1	.0	12.5	12.5
Vehicle 2	2	1	.0	12.5	25.0
Vehicle 3	3	6	.2	75.0	100.0
	.	3776	99.8	Missing	
	Total	3784	100.0	100.0	

Valid cases 8 Missing cases 3776

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RECORD 1

N1FUEL Vehicle 1 Fuel

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Unleaded	1	514	95.9	97.3	97.3
Diesel	2	7	1.3	1.3	98.7
Other	4	7	1.3	1.3	100.0
	.	8	1.5	Missing	
	Total	536	100.0	100.0	

Valid cases 528 Missing cases 8

N1YEAR   Vehicle 1 Year

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	65	4	.7	.7	.7
	66	3	.6	.6	1.3
	67	1	.2	.2	1.5
	68	1	.2	.2	1.7
	69	1	.2	.2	1.9
	70	1	.2	.2	2.1
	71	2	.4	.4	2.4
	72	1	.2	.2	2.6
	73	2	.4	.4	3.0
	74	1	.2	.2	3.2
	75	1	.2	.2	3.4
	76	8	1.5	1.5	4.9
	77	3	.6	.6	5.4
	78	4	.7	.7	6.2
	79	8	1.5	1.5	7.7
	80	6	1.1	1.1	8.8
	81	10	1.9	1.9	10.7
	82	13	2.4	2.4	13.1
	83	14	2.6	2.6	15.7
	84	29	5.4	5.4	21.2
	85	37	6.9	6.9	28.1
	86	41	7.6	7.7	35.8
	87	57	10.6	10.7	46.4
	88	42	7.8	7.9	54.3
	89	57	10.6	10.7	65.0
	90	46	8.6	8.6	73.6
	91	56	10.4	10.5	84.1
	92	51	9.5	9.6	93.6
	93	34	6.3	6.4	100.0
	.	2	.4	Missing	
	Total	536	100.0	100.0	

Valid cases   534   Missing cases   2

N2FUEL Vehicle 2 Fuel

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Unleaded	1	288	53.7	97.6	97.6
Diesel	2	2	.4	.7	98.3
Natural	3	1	.2	.3	98.6
Other	4	4	.7	1.4	100.0
	.	241	45.0	Missing	
		-------	-------	-------	
	Total	536	100.0	100.0	

Valid cases 295 Missing cases 241

N2YEAR Vehicle 2 Year

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	50	1	.2	.3	.3
	64	2	.4	.7	1.0
	65	4	.7	1.3	2.3
	69	2	.4	.7	3.0
	70	1	.2	.3	3.3
	71	2	.4	.7	4.0
	72	1	.2	.3	4.3
	74	1	.2	.3	4.7
	76	3	.6	1.0	5.6
	77	4	.7	1.3	7.0
	78	4	.7	1.3	8.3
	79	4	.7	1.3	9.6
	80	5	.9	1.7	11.3
	81	8	1.5	2.7	14.0
	82	3	.6	1.0	15.0
	83	12	2.2	4.0	18.9
	84	14	2.6	4.7	23.6
	85	27	5.0	9.0	32.6
	86	24	4.5	8.0	40.5
	87	22	4.1	7.3	47.8
	88	34	6.3	11.3	59.1
	89	35	6.5	11.6	70.8
	90	27	5.0	9.0	79.7
	91	19	3.5	6.3	86.0
	92	25	4.7	8.3	94.4
	93	17	3.2	5.6	100.0
	.	235	43.8	Missing	
	Total	536	100.0	100.0	

Valid cases 301 Missing cases 235

N3FUEL Vehicle 3 Fuel

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Unleaded	1	72	13.4	85.7	85.7
Diesel	2	3	.6	3.6	89.3
Other	4	9	1.7	10.7	100.0
	.	452	84.3	Missing	
		-------	-------	-------	
	Total	536	100.0	100.0	

Valid cases 84 Missing cases 452

N3YEAR Vehicle 3 Year

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	52	1	.2	1.1	1.1
	54	1	.2	1.1	2.3
	60	1	.2	1.1	3.4
	63	1	.2	1.1	4.5
	64	2	.4	2.3	6.8
	65	2	.4	2.3	9.1
	66	1	.2	1.1	10.2
	68	1	.2	1.1	11.4
	71	1	.2	1.1	12.5
	72	1	.2	1.1	13.6
	73	2	.4	2.3	15.9
	75	1	.2	1.1	17.0
	76	2	.4	2.3	19.3
	77	2	.4	2.3	21.6
	78	5	.9	5.7	27.3
	79	1	.2	1.1	28.4
	80	2	.4	2.3	30.7
	81	4	.7	4.5	35.2
	82	2	.4	2.3	37.5
	83	3	.6	3.4	40.9
	84	4	.7	4.5	45.5
	85	7	1.3	8.0	53.4
	86	5	.9	5.7	59.1
	87	8	1.5	9.1	68.2
	88	7	1.3	8.0	76.1
	89	2	.4	2.3	78.4
	90	2	.4	2.3	80.7
	91	8	1.5	9.1	89.8
	92	5	.9	5.7	95.5
	93	4	.7	4.5	100.0
	.	448	83.6	Missing	
	Total	536	100.0	100.0	

Valid cases 88 Missing cases 448

N4FUEL Vehicle 4 Fuel

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Unleaded	1	6	1.1	100.0	100.0
	.	530	98.9	Missing	
	Total	536	100.0	100.0	

Valid cases 6 Missing cases 530

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N4YEAR Vehicle 4 Year

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	64	1	.2	5.9	5.9
	71	1	.2	5.9	11.8
	74	2	.4	11.8	23.5
	79	1	.2	5.9	29.4
	80	1	.2	5.9	35.3
	87	1	.2	5.9	41.2
	89	1	.2	5.9	47.1
	90	3	.6	17.6	64.7
	91	1	.2	5.9	70.6
	92	3	.6	17.6	88.2
	93	2	.4	11.8	100.0
	.	519	96.8	Missing	
	Total	536	100.0	100.0	

Valid cases 17 Missing cases 519

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N5FUEL Vehicle 5 Fuel

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Unleaded	1	1	.2	100.0	100.0
	.	535	99.8	Missing	
	Total	536	100.0	100.0	

Valid cases 1 Missing cases 535

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N5YEAR Vehicle 5 Year

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	87	1	.2	100.0	100.0
	.	535	99.8	Missing	
	Total	536	100.0	100.0	

Valid cases 1 Missing cases 535

N6FUEL Vehicle 6 Fuel

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	.	536	100.0	Missing	
	Total	536	100.0	100.0	

Valid cases 0 Missing cases 536

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N6YEAR Vehicle 6 Year

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	.	536	100.0	Missing	
	Total	536	100.0	100.0	

Valid cases 0 Missing cases 536

RECORD 0

D1DATE Day 1 Date

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1	8	1.5	1.5	1.5
	2	33	6.1	6.1	7.6
	3	36	6.6	6.6	14.2
	4	12	2.2	2.2	16.4
	5	3	.6	.6	16.9
	6	4	.7	.7	17.7
	7	15	2.8	2.8	20.4
	8	6	1.1	1.1	21.5
	9	3	.6	.6	22.1
	10	22	4.0	4.1	26.2
	11	34	6.2	6.3	32.4
	12	43	7.9	7.9	40.3
	13	29	5.3	5.3	45.7
	14	21	3.9	3.9	49.5
	15	6	1.1	1.1	50.6
	16	4	.7	.7	51.4
	17	22	4.0	4.1	55.4
	18	21	3.9	3.9	59.3
	19	67	12.3	12.3	71.6
	20	26	4.8	4.8	76.4
	21	53	9.7	9.8	86.2
	22	20	3.7	3.7	89.9
	23	4	.7	.7	90.6
	24	14	2.6	2.6	93.2
	25	6	1.1	1.1	94.3
	26	7	1.3	1.3	95.6
	27	5	.9	.9	96.5
	28	7	1.3	1.3	97.8
	29	2	.4	.4	98.2
	30	1	.2	.2	98.3
	31	3	.6	.6	98.9
	99	6	1.1	1.1	100.0
	.	2	.4	Missing	
	Total	545	100.0	100.0	

Valid cases 543 Missing cases 2

D1DAYW Day 1 Day of Week

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Sun	1	9	1.7	1.7	1.7
Mon	2	86	15.8	15.9	17.6
Tue	3	76	13.9	14.1	31.7
Wed	4	123	22.6	22.8	54.4
Thur	5	104	19.1	19.3	73.7
Fri	6	118	21.7	21.9	95.6
Sat	7	24	4.4	4.4	100.0
	.	5	.9	Missing	
	Total	545	100.0	100.0	

Valid cases 540 Missing cases 5

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D1MONTH Day 1 Month

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Mar	3	73	13.4	13.4	13.4
Apr	4	35	6.4	6.4	19.8
May	5	308	56.5	56.5	76.3
Jun	6	105	19.3	19.3	95.6
Jul	7	18	3.3	3.3	98.9
	99	6	1.1	1.1	100.0
	Total	545	100.0	100.0	

Valid cases 545 Missing cases 0

D7DATE Day 7 Date

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1	6	1.1	1.1	1.1
	2	5	.9	.9	2.0
	3	3	.6	.6	2.6
	4	10	1.8	1.9	4.5
	5	1	.2	.2	4.6
	6	3	.6	.6	5.2
	7	7	1.3	1.3	6.5
	8	33	6.1	6.1	12.6
	9	35	6.4	6.5	19.1
	10	11	2.0	2.0	21.2
	11	4	.7	.7	21.9
	12	3	.6	.6	22.4
	13	15	2.8	2.8	25.2
	14	7	1.3	1.3	26.5
	15	3	.6	.6	27.1
	16	19	3.5	3.5	30.6
	17	31	5.7	5.8	36.4
	18	44	8.1	8.2	44.5
	19	33	6.1	6.1	50.6
	20	23	4.2	4.3	54.9
	21	6	1.1	1.1	56.0
	22	5	.9	.9	57.0
	23	19	3.5	3.5	60.5
	24	22	4.0	4.1	64.6
	25	66	12.1	12.2	76.8
	26	24	4.4	4.5	81.3
	27	51	9.4	9.5	90.7
	28	23	4.2	4.3	95.0
	29	5	.9	.9	95.9
	30	11	2.0	2.0	98.0
	31	5	.9	.9	98.9
	99	6	1.1	1.1	100.0
	.	6	1.1	Missing	
	Total	545	100.0	100.0	

Valid cases 539 Missing cases 6

D7DAYW Day 7 Day of Week

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Sun	1	79	14.5	14.6	14.6
Mon	2	69	12.7	12.8	27.4
Tue	3	122	22.4	22.6	50.0
Wed	4	109	20.0	20.2	70.2
Thu	5	122	22.4	22.6	92.8
Fri	6	30	5.5	5.6	98.3
Sat	7	9	1.7	1.7	100.0
	.	5	.9	Missing	
	Total	545	100.0	100.0	

Valid cases 540 Missing cases 5

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D7MONTH Day 7 Month

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Mar	3	72	13.2	13.3	13.3
Apr	4	31	5.7	5.7	19.0
May	5	290	53.2	53.6	72.6
Jun	6	122	22.4	22.6	95.2
Jul	7	20	3.7	3.7	98.9
	99	6	1.1	1.1	100.0
	.	4	.7	Missing	
	Total	545	100.0	100.0	

Valid cases 541 Missing cases 4