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UMTA/TSC Project Evaluation Series

Evaluation of Denver RTD Route Restructuring Project

Final Report
July 1981

Service and Methods Demonstration Program

U.S. DEPARTMENT OF TRANSPORTATION
Urban Mass Transportation Administration and
Research and Special Programs Administration
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16. Abstract

In February 1978, the Denver Regional Transit District (RTD) eliminated the 25-cent off-peak fare and retained a 50 cent peak hour fare for bus boardings during the morning two-hour rush period and evening two-hour rush period. The experiment in innovative transit pricing continued for one year as a Federally-assisted demonstration project to determine the effects of free off-peak transit in a major urban area. During the demonstration, RTD also undertook a complete transformation of its network of bus routes and schedules. Following two years of planning, in September 1978, RTD accomplished the restructuring of its transit services from a network of mostly historic radial routes serving the old central business district to one more closely conformed to a grid system. This report summarizes the evaluation of the route restructuring project in Denver with respect to the implementation requirements of a major redesign of fixed-route transit services and its effects on: 1) travel behavior; 2) bus operations; 3) quality of service; 4) costs and revenues; 5) secondary effects on the environment; and 6) public support for transit services and improvements. The extensive data collection activities conducted by RTD as part of the demonstration, included transit operations monitoring, surveys of transit users onboard, and follow-up telephone. General population surveys are documented and their results analyzed. Principal findings of the evaluation are reported and their implications for transit operations and service planning are discussed. Both the short-term effects of implementing major changes in existing transit service, as well as the long-term supply and demand characteristic of the grid concept applied to transit operations in Denver are addressed. Evaluation of the off-peak free fare experiment is provided in an earlier report of this project: "Denver Off-Peak Free Fare Public Transit Experiment - Interim Report", May 1979 (PB 298-783, A04).

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This report summarizes the evaluation of the route restructuring project in Denver with respect to the implementation requirements of a major redesign of fixed-route transit services and its effects on 1) travel behavior 2) bus operations, quality of service, costs and revenues; and 3) secondary effects on the environment and public support for transit services and improvements.

The extensive data collection activities conducted by RTD as part of the demonstration, including transit operations monitoring, surveys of transit users on-board and follow-up telephone, and general population surveys are documented and their results analyzed. Principal findings of the evaluation are reported and their implications for transit operations and service planning discussed. Both the short-term effects of implementing major changes in existing transit service, as well as the long term supply and demand characteristic of the grid concept applied to transit operations in Denver are addressed. Evaluation of the off-peak free fare experiment is provided in an earlier report of this project.

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Preface

This report presents findings of the evaluation of the Denver RTD comprehensive route and schedule changes implemented during 1978. The route restructuring project occurred within the timeframe of the systemwide off-peak free fare transit demonstration which began on February 1, 1978, and continued for 12 months, ending on January 31, 1979. The evaluation included investigation of the effects of both the elimination of off-peak fares and route restructuring on ridership, transit operations and costs, user characteristics, public attitudes, and regional travel. Findings of the free fare demonstration project evaluation were presented in an earlier report.

The project was sponsored under the Urban Mass Transportation Administration's (UMTA) Service and Methods Demonstration (SMD) program, under authorization from Title II of the National Mass Transportation Assistance Act of 1974. The evaluation was conducted by De Leuw, Cather & Company for the Transportation Systems Center (TSC) of the U.S. Department of Transportation under Technical Task Directive DOT-TSC-1409-15. The principal researcher for the evaluation project was Bob Donnelly; the report was co-authored by Bob Donnelly and Paul Ong.

Acknowledgement is also due to other persons for their assistance and cooperation during the demonstration project and the evaluation period: Bruce Spear, Technical Monitor -- Transportation Systems Center; John Gaudette (and Staff), Assistant General Manager and Director of the Office for Policy Analysis -- RTD; other RTD Staff too numerous to mention; Stewart McKeown, SMD project manager--UMTA. Acknowledgement is also due to several current and former De Leuw, Cather & Company staff members for their assistance in the evaluation: Sherrill Swan, Bob Knight, Steve Colman, Tom Stone, Dave Connor, and Gordon Shunk.

METRIC CONVERSION FACTORS

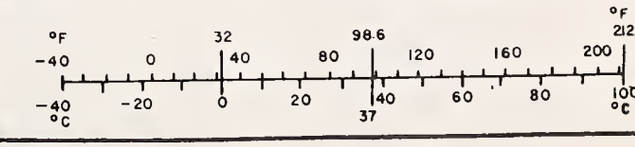
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilogrems	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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EXECUTIVE SUMMARY

The motivation for the route restructuring in Denver was to provide better bus service for more people through a modernized, simplified transit system. By reorganizing the bus route network from its historic radial pattern to more of a grid-like configuration, RTD planners hoped to better serve both existing and future transit demand. Concern over the ability of the existing system to attract new transit riders provided much of the impetus for the route restructuring project. The study of route restructuring in Denver contributes to the body of evaluation work sponsored by SMD in the area of conventional transit service innovations; in particular, the study of transit service improvement strategies designed to improve the productivity, level of service and coverage of conventional fixed-route bus operations.

Project Description and Overview

During 1978, the Regional Transportation District (RTD) implemented two major systemwide transit service innovations. A Federally assisted off-peak free fare demonstration was begun on February 1, and ended one year later on January 31, 1979. This experiment had major ridership and operational impacts which are the subject of an evaluation presented in an earlier report of this research effort. The focus of this report is the systemwide restructuring of routes and schedules which RTD undertook in two phases. The first implementation step consisted of the comprehensive changes made in the Boulder and the Northeast quadrant of Denver on March 5, 1978. Even greater changes were made on September 10, 1978 in the transit system serving the remaining sectors of the Denver Metropolitan Area. In making these changes, RTD completed what is perhaps the most comprehensive restructuring of bus routes ever undertaken by a major transit property. The Denver experience is unique in that the system was completely revised in just two steps rather than through a series of gradual incremental improvements phased in over an extended period of time.

The principal effect of the route restructuring project was the establishment of a more grid-like transit network primarily utilizing the arterial street and highway system. Most of the local bus routes, the backbone of the transit system, were placed on major north/south and east/west arterials. The rerouting of the local service onto major roadways and the elimination of unnecessary stops and turns was intended to increase travel speeds. The local service system has been designed to maintain a high level of accessibility to the downtown area while at the same time facilitating crosstown movements. Under the new system "regular" service local routes continue to either terminate or pass through downtown Denver. These are routed along a major street until it comes into the vicinity of the downtown. At that point, the route is diverted into and through downtown, then continued back along its original roadway. "Crosstown" locals, on the other hand, are not diverted into the downtown

area but continue from one side of the metropolitan area to the other along the north/south and east/west grid. Circulator routes were also modified. These provide access to neighborhood facilities in four outlying areas and serve a collection/ distribution function for local and express routes. Express routes into the downtown area were also changed. More direct routes and reduced collection/distribution significantly decreased express travel times.

In conjunction with the routing changes, efforts were made to improve inter-line coordination through the development of transit centers and improved scheduling including "pulse-point" or timed transferring. Route restructuring also had an effect on the average spacing between bus stops, increasing it from about 650 feet to 1000 feet. One effect of shifting many routes onto major or minor arterial routes wherever possible was to concentrate service on fewer streets than previously. RTD estimated that the planned system would result in a 26 percent reduction in total route miles. Improvements of comparable magnitude in average headways reduction and operating speeds on these routes, however, were intended to compensate for increased average walking distance with shorter wait and on-board travel times.

Route Restructuring Evaluation

The evaluation of the route restructuring project conducted by the Transportation System Center (TSC) and the Urban Mass Transportation Administration (UMTA) focuses on four major subject areas of interest to transit planning and operations.

- Implementation Requirements
- Travel Demand Impacts
- Transportation Supply and Cost Issues
- Indirect or Secondary Effects

The evaluation seeks to document the changes which were made to the transportation system (supply), and to specify what were the travel impacts of those changes (demand).

Area Characteristics

The population of the Denver Metropolitan Area was about 1.6 million in 1978. On a typical weekday in 1975, there were an estimated 4.66 million person trips made, 3.20 million vehicle trips, and 17.1 million vehicles miles of travel (VMT). The average household in the eastern half of Boulder County made 7.7 trips per average workday in 1975. The Denver Regional Transportation District (RTD) covers 2,284 square miles and is comprised of the City and County of Denver, the Counties of Boulder and Jefferson, the western portions of Adams and Arapahoe Counties, and the northeast portion of Douglas County. While the District is smaller in size than the DMA, the populations of the two areas are essentially identical.

Implementation

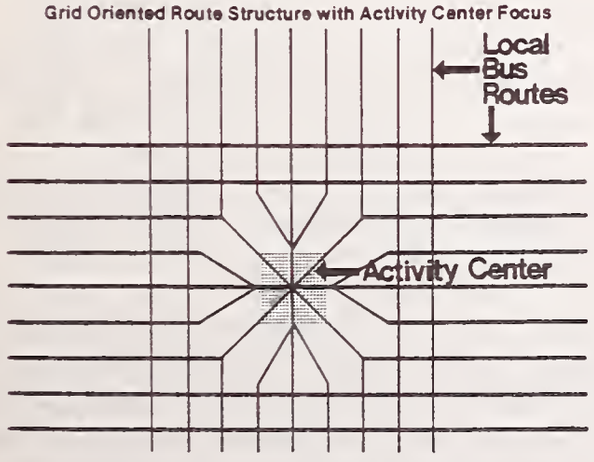
Following the mid-1976 UMTA rejection of RTD's application for federal funding assistance for its proposed automated rapid transit system, RTD's staff recognized the need to develop a new planning framework for the bus system. Further, the existing route structure had evolved into a rather cumbersome network of indirect, uncoordinated lines as the metropolitan area expanded. Slow and circuitous routing of service was identified by RTD Marketing as a major impediment to increased utilization of the transit system.

A planning study was undertaken which proposed a set of planning guidelines:

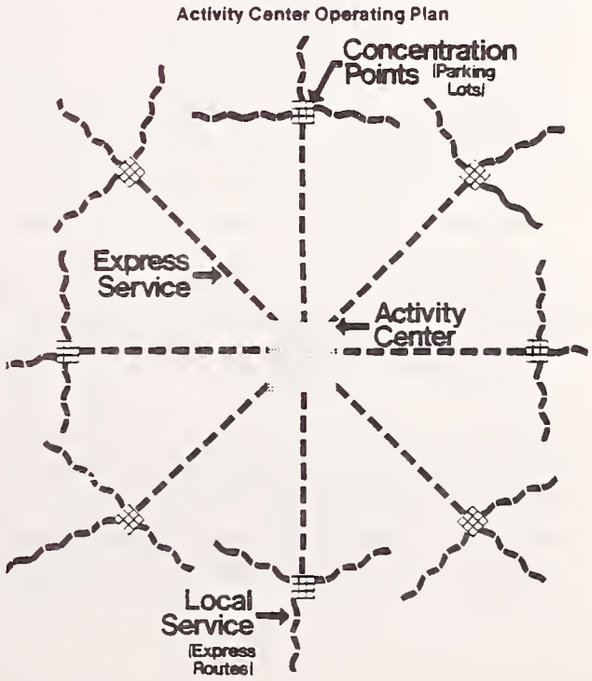
- Increase the speed of bus routes without changing their transit service characteristics.
- Develop user-oriented timetable schedules.
- Modify the local route system to a form which is primarily grid-oriented.
- Modify low frequency routes so their schedules are clock-time oriented.
- Maximize express bus frequencies from RTD Park-n-Ride facilities.
- Balance service frequency and coverage to minimize the sum of walking and waiting times.

The basic transit service concept of the modified grid system proposed and implemented in Denver is shown in the following schematic.

INITIAL ROUTE RESTRUCTURING CONCEPT: MODIFIED GRID



Source: RTD, "Frontier" September 1977



Following development of a set proposed routes and scheduling concepts, RTD initiated a major community involvement program in October 1977. By September 10, when the major changes in Denver went into effect, over 200 meetings had been held by RTD staff with elected officials, community organization representatives, municipal staffs, employers and the general public. As a result of the involvement program, revisions were made which retained some characteristics of the old network that were not in the initial plan detailed by RTD staff. However, the overall grid/activity center focus concept remained the essence of the route restructuring plan.

A major effort was made to involve vehicle operators and other RTD staff at an early stage in the planning process and later in the implementation phase of the route and schedule changes. A massive public information program was also undertaken by RTD to explain the workings of the restructured transit system to the public. RTD reports that over 2.5 million different pieces of information were mailed out as part of the route restructuring project. In the weeks preceding the September 10 changes, RTD extended the hours of its downtown transit information center. An expanded customer assistance staff handled as many as 510 requests for information per half-hour when the new system just went into effect, about twice the normal rate of user requests. RTD's information program and the publicity surrounding the route changes created a high degree of public visibility for the project; about 93 percent of the general public were aware of the changes.

RTD established three principal mechanisms to monitor the effects of the route restructuring:

- Bus drivers and dispatchers
- Customer Assistance records
- Public follow-up forums

During the Fall of 1978, RTD conducted twenty-two follow-up forums after the route changes had been implemented. These forums provided an opportunity for riders to express their dissatisfaction with bus service in general, or the September changes in particular. The concept of the new grid generally continued to receive public support. Expressions of need for improved service generally took the form of requests for more frequent service, more crosstown service, or additional operating hours in the early morning, late at night, and on weekends. The results of these public meetings had a major impact on the first quarter run-board changes following restructuring in December 1978, when a relatively large number of changes were made.

The principal source of support for the route restructuring project came initially from planners and management of RTD. The climate of the public forum in which the route changes were planned was generally favorable, with no strong expressions of opposition on the one hand, or exceptionally enthusiastic support on the other. Some opposition from organized

groups developed over the course of the community involvement process. These groups included informal neighborhood associations and some organizations representing the elderly. In most cases, the focus of the opposition expressed by these groups was on specific characteristics of an individual route or schedule to be affected by the changes, rather than objection to the overall concept of the plan.

Travel Demand

The impacts of route restructuring on travel demand were small compared to those of the elimination of off-peak fares during the one year demonstration when the route changes took place. Total ridership on RTD scheduled service during the one year demonstration is estimated at 34.3 million bus trips, of which about 8.2 million were trips which would not have been made without the elimination of off-peak weekday and all-day Saturday and Sunday fares. Total bus travel during a typical week, including both peak and off-peak periods, was an estimated 32 percent higher than projected base ridership without free fares. Approximately 70 percent of the 670,000 bus trips made each week were made during the free fare hours of service. Off-peak ridership, including the weekend, increased by an estimated 52 percent during a typical week.

Route restructuring in Denver resulted in both a modest short-term ridership loss and an apparent small long-term loss based on the data available in the one year period following the changes. While a ridership increase in the range of about 10 percent had been projected, a net ridership loss of as much as 7 percent or about 45,000 revenue passengers per week may have occurred during the first four months after the changes. This, however, probably represents an upper-limit estimate of restructuring's short-term effects on total ridership. A lower-bound estimate is about a 4 percent loss in ridership, or about 25,000 revenue passengers per week. The best estimate of long-term ridership loss is about 3 percent; however, it may have been too early to accurately estimate long-term effects at the time this evaluation was conducted.

It appears that about 2 percent of weekday trips, or about 2,300, were made by new riders who began using transit primarily because of route restructuring. The average bus use frequency of new riders was 5.2 transit trips per week among those who made at least one bus trip per week. This is a higher rate of bus use than reported by either new riders who started for reasons unrelated to route restructuring (4.0) or all prior riders (3.2).

In the first month following route restructuring, about 20 percent of prior riders had changed their travel behavior because of system changes. Almost twice as many former riders reported that they had decreased their use of the bus (9%) as reported having increased it (5%) because of the system modifications. A sizeable number (6%) of prior riders said they had stopped using the bus entirely because of restructuring. During the demonstration about 10 percent of the population of the Denver metropolitan area used transit at least once during a typical week. If as indicated in the discussion above, 5 percent of former

riders quit and 2 percent of post-route restructuring riders were new because of the changes, the net effect was probably about a 3 percent shrinkage in the total transit user population. This would have affected less than half of one percent of the total population of the RTD service district population. Of prior riders who quit because of route restructuring the most common problems cited were that bus stop locations were now too far to walk to, service was less frequent or buses ran behind schedule.

Comparison of the ridership profiles of weekday passengers before and after route restructuring (during off-peak free fare demonstration) shows little difference in the distribution of income, sex, age, or auto availability characteristics of RTD riders. There were, however, some changes in ridership patterns. Changes in ridership generally varied with age, income, and race. There appears to have been no clear cut pattern of adverse and beneficial impacts among socio-economic and demographic groups. However, by and large, younger riders were more likely to change their transit use, as were, to a somewhat lesser extent, males and non-whites.

The survey data available is not conclusive regarding the impacts of route restructuring on bus trip characteristics. Seasonal variations inherent in the data probably account for most of the differences observed between surveys conducted before and after the route restructuring. Trips diverted from other modes, predominantly automobile, were slightly more work oriented than those previously made by bus. New trips reportedly induced by the route changes were few in number, but more discretionary in nature and more likely to be non-home based.

There appears to have been a geographic shift in bus travel following route restructuring. The survey data supports the expectation of planners that route restructuring would result in a higher proportion of bus trips made to non-CBD locations, as a result of the increased transit accessibility provided these areas. Differences between the before and after surveys suggest that Northwest Denver, West Colfax and the Southern Broadway corridor generated a higher percentage of RTD's total boardings and alightings after route restructuring. A correspondingly smaller share of total ridership following route restructuring was accounted for by downtown Denver, Southeast Denver and the East Colfax corridor.

Transportation Supply and Cost

As a result of the one year free fare demonstration during which the route changes were made there was a clear reduction in service levels provided during the off-peak hours. Without any major changes in service, the additional transit patronage resulted in higher passenger loads on many RTD off-peak buses, increasing vehicle productivity but causing some problems associated with over-crowding on the system. Longer travel times, as well as diminished schedule adherence, were more common than before the demonstration. Passenger comfort also deteriorated somewhat due to increased crowding on the buses, and an apparent increase in on-board harassment by rowdies and drunks. The extensive surveys conducted as part of the evaluation indicate that route restructuring was also

perceived negatively by a substantial portion of transit users, and by a considerably larger number than viewed it as having improved bus service. Close to half (44%) of RTD users thought that the restructuring had caused a deterioration in service when interviewed one month following the September changes. Less than one-quarter (22%) viewed the new system as providing an overall improvement in service. As time progressed, riders evidenced somewhat more favorable opinions about the effects of the route restructuring, but even as late as eight months afterward, only about one-quarter (26%) of those persons who had used the bus before route restructuring perceived an improvement in service levels; a larger group of prior riders (38%) continued to think that it had caused a deterioration in transit service.

Despite the predominant perception that the route restructuring had caused a decline in the quality of bus service, a majority of RTD users remained on the whole satisfied with the transit service they received. The percentage of prior RTD users who were either very or somewhat satisfied with bus service, went from about 57 percent to about 64 percent from October 1978 to May 1979. New riders were overwhelmingly satisfied with the bus service they had begun to use since September.

Comparison of the proportions of riders who viewed the changes as bringing about an improvement with those who perceived a deterioration in a particular service aspect reveals that the major negative effects of concern to riders were:

- Longer waiting times/less frequent headways (35% worsened/ 17% improved).
- Greater walking distance to bus stops (25% worsened/18% improved)
- Longer transfer delay (18% worsened/11% improved)
- Poorer schedule reliability (25% worsened/19% improved)

Most of the negative effects of route restructuring perceived by users of the system were apparently more intense in the period immediately following the changes in September than later on. Some initial service problems appeared to be an inescapable consequence of disrupting transit riders' travel habits and daily bus operations. RTD planners anticipated short-term negative effects and took measures to minimize their intensity and duration. Even with the extensive public information campaign undertaken to explain the new system to the public, as well as the driver training efforts, service problems did occur in the first several weeks following the September restructuring of the system.

The restructuring of bus routes in Denver also resulted in some long-term impacts on the quality of service which stem from the transit service concepts operationalized in the establishment of the new system.

The average distance to a bus stop was increased as a result of buses operating on fewer streets with more widely spaced stops. However more frequent service was intended to reduce waiting times at the bus stops, and if not reduce total access time in most cases, at least off-set increased walking distance and time. Furthermore, improved travel speeds resulting from straighter routes operating on streets with faster traffic flow and fewer stops would decrease the total travel time for most transit rides. Implicit in this planning guideline were 1) the expectation that major service headway and schedule speed improvements could be achieved with reduced route mileage, and 2) the notion that the "typical" person values each component of total travel time equally. Because of the relatively wide spacing of routes, dissatisfaction was expected by some riders with increased walking distances, but probably not of the magnitude found in the user surveys conducted after the route restructuring.

The post-restructuring surveys indicate that more riders than not perceived a deterioration in all components of trip time, especially in waiting time and walking distance. The average bus trip following the service changes required 14.6 minutes in total time spent at the bus trip origin. The average distance walked to the stop was 2.6 blocks, or about 3.9 minutes in time. The average wait time was 10.7 minutes, about a 15 percent increase over that reported in August. Increases in waiting time at the trip origin resulted in part because of the fact that service frequency improvements were not implemented as extensively as initially planned. This may be attributed to modifications in the initial routing concept made to accommodate public and official demands for retention of service in specific areas, and to other traffic flow factors which made it difficult to achieve the increases in schedule speed that were planned. Problems with schedule adherence probably contributed most to the perceived longer waiting times. Corner count observations made by field observers once before, and at two points in time after, the major changes in service suggest that schedule reliability problems were worse two months after route restructuring than before with about two-thirds of all outbound CBD buses running late, about 35 percent more than 5 minutes. With the end of free fare, the Round 3 observations still showed persistent schedule reliability problems, of about the same magnitude as those observed in November.

On-board travel times were improved for some trips served by the new transit network, but the typical trip was unaffected. Independent of seasonal effects, the system average schedule speed actually declined 2.5 percent from 13.6 mph in the seven months of the demonstration prior to route restructuring to 13.2 mph in the remaining months of the demonstration after route restructuring. Operating speeds on express routes were increased, however, while average speeds on Locals, Circulators, and Intercity routes were somewhat slower. As a consequence of the increased walking and waiting times and the absence of improvement in vehicle operating speeds, total bus travel times increased for the typical trips served.

Reorientation of transit service from an essentially radial system serving the CBD best to a more grid-like network was expected to affect interline transfer rates and patterns. The percentage of total trips served by transit which did not require a transfer declined slightly from about 77 to 75 percent of all boardings. Trips involving one transfer increased, as was anticipated with the grid-like system. A small increase in trips requiring two or more transfers also is evident from the on-board survey data which probably was not expected since the grid system should virtually eliminate back-tracking and multiple transfering. The rate of transfering for trips to or from the CBD remained the lowest, but increased somewhat with the reduced radial orientation of the system. For non-CBD trips, single transfers also increased, but the elimination of some trips requiring multiple interline transfering is indicated.

The most substantial change in transfer patterns were for trips using local crosstown routes. Trips using transfers on these routes went from about 27 percent in August to about 41 percent of total in November after route restructuring. These findings are consistent with the service function intended for the new local Crosstown routes.

There was about a 2.2 percent increase in total service miles provided with route restructuring; total hours of service increased by about 4.5 percent. Service on circulator routes was reduced, while the total miles and hours of service operated on local routes were increased the most.

Most service performance indicators improved dramatically during the off-peak free fare demonstration. However, increases in service provided in March and September were not accompanied by corresponding increases in patronage. Consequently, there was about a 7 percent decline in passengers per hour of service, and about a 5 percent decline in passengers per mile of service associated with route restructuring. This counters normal seasonal fluctuations. However, the September changes and those subsequently made in December did promote greater productivity on routes with the lowest patronage levels. With the exception of the two most heavily used local lines (15-Colfax and 0-Broadway) which carry about one-quarter of all transit passengers, a smaller share of total loadings is now required of the nine most heavily used routes, with a concomitant improvement in on-board comfort.

The route changes and added service levels implemented in September 1978 resulted in more buses in service than before the changes. Fewer buses could be taken out of service at any one time. This reportedly caused some increase in the efficiency of maintenance operations, but it also meant that vehicles could not be rotated in and out of service as often. As a result, each vehicle accrued mileage and wear-and-tear at a somewhat faster rate than it would have otherwise.

Bus drivers were generally negative about route restructuring, but considerably less so than about the off-peak free fare program. However, there is an indication that drivers' opinions of the new system had improved following the three or four month learning period required of both drivers and riders, and that a consensus favoring the restructuring eventually developed among transit operators.

Marketing and public information expenses accounted for the largest share of non-recurring route restructuring costs. RTD estimates that about $.5 million was spent on marketing activities and dissemination of information. An equal amount or more in free promotions was provided by the local media. Adequate data is not available which would allow a determination of the costs of the two year planning effort or the operational adjustments required for the changeover. It is assumed that these costs combined were probably on the same order as the marketing expenses for the project. A rough estimate, then, of total one-time costs may be in the range of about one million dollars over the two year period, or slightly more than about 1 percent of the total annual budget each year.

Route restructuring effects may account for about an additional $2,400 per weekday or about a 1.7 percent increase in normal operating costs. This estimate seems reasonable considering an only slightly larger decrease (-2.5%) in average schedule speed for RTD bus service systemwide. This indicates an additional cost per year on the order of $600,000, as a result of the operating characteristics of the restructured transit network. Revenue impacts were apparently even smaller. A 3 to 5 percent decrease in ridership was more than off-set by an 18 percent increase in the average fare paid from 12.3 cents to 14.3 cents per passenger, reflecting a shift toward more full fare regular and express route riders. Average weekday revenues therefore showed an absolute increase following route restructuring.

Secondary Effects

Unlike the off-peak free fare demonstration which caused relatively large impacts on transit ridership, route restructuring in Denver had only a small overall impact on transit use. A small ridership loss, which apparently has lasted at least one year after the changes, probably accounted for no more than an increase in the range of one-tenth of one percent of total travel within the metropolitan area. Consequently, with an even smaller increase in total area vehicle miles of travel (VMT) indicated, no measurable secondary environmental impacts have been identified on the regional scale.

The principal indirect impacts of the route and schedule changes which can be measured are those which are related to public opinion about existing bus services or the level of support for new transit improvements. Although more RTD users were unhappy than pleased with the system modifications, route restructuring does not appear to have

undermined a generally positive opinion among the general public about transit services in the Denver metropolitan area. In fact, public opinion was more favorable nine months after the change than it was before. This suggests that it is possible to implement needed transit improvements which will generate a fair degree of controversy, while maintaining a reasonably high level of positive public opinion about transit services.

A surprisingly small number, only 15 percent, indicated opposition to new transit taxes. Nearly three-quarters (73%) of transit users favor taxes to provide more bus service; about half of the general public agree (52%). A somewhat larger majority of the public supports taxes for some type of "rapid rail" transit (59%), with a comparable level of support from current bus riders (61%). A majority of each group would prefer a future transit system which provides an integration of both bus and rail operations.

There are two major issue areas relevant to the effectiveness of route restructuring in Denver and its implications for other metropolitan areas. The first encompasses planning, implementation and short-term transitional issues; the second relates to the long-term travel behavior and transit operations characteristics of the particular hybrid-grid network of transit routes created by the restructuring project in Denver.

The key service concepts which characterize the most important differences in emphasis between the former radial network and the new grid-like one are outlined in the figure below.

COMPARISON OF KEY SERVICE CONCEPTS EMPHASES:
BEFORE "RADIAL" AND AFTER "GRID" TRANSIT NETWORKS

Service Concept	"Radial"	"Grid"
CONFIGURATION	• Direct Routing to Serve the Predominant Travel Patterns. Minimize transfers for CBD trip.	• Simplified East/West and North/South Routing to Serve All Potential Trip Origins and Destinations. Provide for easy transfer.
OPERATIONAL EMPHASIS	• Geographic Coverage (Density) of Existing Transit Use Areas (local residential streets, closely spaced bus stops). Results in:	• System Speed/On-Board Travel Time Savings (arterial streets, fewer turns, less frequent stops). Results in:
	---	• Ability to Extend Routes to New Areas (Extensiveness), and
ACCESS CHARACTERISTIC	• Short Walk Distances	• Short Headways/More Frequent Service

Some of the more important conclusions from the Denver experience are:

- It is possible to make radical, comprehensive changes in existing transit services in one or a series of individual steps.

- An intensive planning and public information program of extended duration is required to effectively implement comprehensive changes with a minimum of disruption to transit users.

- While the overall concept of a plan may be accepted, public response will generally be focused on particular operational changes proposed or put into effect.

- Despite the most successful planning and informational efforts, significant short-term disruptive effects are to be expected and plans should be made to deal with them.

- A series of post-change public forums such as those used in Denver provide a good mechanism to obtain public comment and suggestions on the need for further refinements.

- A number of factors appear to have resulted in a restructured network less like the idealized grid network than initially planned, with somewhat different operating characteristics. These include transit user protests about removal of service on some residential streets, extension of service to less productive areas, difficulty in achieving ideal traffic flow speeds or major headway reductions. Futhermore, the basic notion about traveler preferences underlying the new system concept may be valid for a smaller potential transit user group than expected.

- The grid system developed in Denver has resulted in a transit service which is more readily understandable to the new transit user. Moreover, it provides new capacity for transit use by a choice ridership diverted from other modes as future energy constraints continue to result in less single-occupant driving and greater demands on public transportation.

- Any transit service change which disrupts existing established service is bound to have short-term negative impacts. However, in the Denver case, the apparent positive impact of route restructuring on new choice riders to the system suggests that the long-term effect of the changes may ultimately be positive.

- The Denver experience shows that it is possible to make dramatic, and in some instances controversial, changes in existing bus transit services and maintain strong public support for transit improvements and their required fiscal support, while providing a framework for long-term operational improvements, including introduction of rapid transit system elements.

1.0 INTRODUCTION

1.1 Objectives of Route Restructuring

The goal of the route restructuring program in Denver was basic -- to provide better bus service for more people through a modernized transit system.[1] By reorganizing and simplifying the bus route network from its historic radial pattern to more of a grid-like configuration, RTD planners hoped to serve existing and future transit demand more efficiently than would be possible with the confusing, and in some cases redundant, network of routes that had evolved over time. Concern over the ability of the existing system to attract new transit riders provided much of the impetus for route restructuring project.

The general objectives of the route restructuring program sought by RTD were to:

- Improve bus routing to increase the level of service and to simplify the route structure.
- Improve interline coordination and minimize transfer delay.
- Distribute service more equitably over the entire service area.
- Improve transit travel times.
- Increase the operating efficiency of vehicles and drivers.
- Increase transit ridership.

These objectives are consistent with those of Service and Methods Demonstration (SMD) Program of the Urban Mass Transportation Administration (UMTA).[2] Federal interest in the route restructuring project in Denver, and the evaluation of effects is related directly to three of the SMD objectives:

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[1] William A. Wild. "Unified Planning Work Program: Task 12.3, Sector Routing and Scheduling Analysis." Office of Policy Analysis. Denver RTD, July 1978.

[2] Spear, Bruce D. (Editor). Service and Methods Demonstration Program Annual Report. Report No. UMTA-MA-06-0049-79-8, August 1979.

- Provide more efficient public transportation service.
- Provide more effective public transportation service.
- Develop information to assist local, state and Federal policy formulation.

The study of route restructuring in Denver contributes to the body of evaluation work sponsored by SMD in the area of conventional transit service innovations; in particular, the study of transit service improvement strategies designed to improve the productivity, level of service and coverage of conventional fixed-route bus operations. These objectives have provided the basis for developing a set of evaluation issues relevant to both local and national interest. Findings of the evaluation are intended to provide information about the Denver experience which will be relevant to other transit systems across the county.

1.2 Project History and Overview

During 1978, the Regional Transportation District (RTD) implemented two major systemwide transit service innovations. A federally assisted off-peak free fare demonstration was begun on February 1, and ended one year later on January 31, 1979. This experiment had major ridership and operational impacts which are the subject of an evaluation presented in an earlier report of this research effort.[3]

The focus of this report is the systemwide restructuring of routes and schedules which RTD undertook in two phases.[4] The first implementation step consisted of the comprehensive changes made in the Boulder and the Northeast quadrant of Denver on March 5, 1978. Even greater changes were made on September 10, 1978 in the transit system

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[3] De Leuw, Cather & Company. Evaluation of the Denver RTD Off-Peak Free Fare Transit Demonstration. UMTA/TSC Project Evaluation Series: Final Report No. UMTA-MA-06-0049-80-7. February 1980.

[4] No Federal demonstration assistance funds were involved in the implementing the route restructuring project.

serving the remaining sectors of the City of Denver. In making these changes, RTD completed what is perhaps the most comprehensive restructuring of bus routes ever undertaken by a major transit property. The Denver experience is unique in that the system was completely revised in just a two step transformation of the system rather than through a series of gradual incremental improvements phased in over an extended period of time.

The new planned system of routes and schedules was intended to better fit current travel demand patterns and the metropolitan street and highway network than did the former system which had evolved over Denver's history of development. The pre-Route Restructuring network was essentially an amalgamation of the long-standing routes operated by the seven separate bus systems which provide bus service in the region prior to 1974-75 when RTD acquired these systems.[5] As in many other American cities, streetcars were originally the principal transit mode in the Denver metropolitan area. When the streetcars were replaced by buses, bus routes continued to operate along the same radial pattern with the downtown as the hub. However, since the roads outside the center city area are laid out in grid configuration, it was necessary to design indirect, zig-zag routes in order to maintain the radial service patterns.

Over time, as the region grew, employment and retail activities became more decentralized. The radial system seemed less and less able to serve the emerging travel patterns efficiently. While the downtown area remains the largest single employment center, in recent years non-radial travel had increased dramatically, creating demands for new transit service. Recognizing these problems, in 1976 the RTD designated a Route Restructuring Task Force to evaluate the bus system and to recommend improvements. More than two years of planning followed including an extensive citizen involvement program.

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[5] Regional Transportation District. Transit Development Program; 1975-1980. March 1975.

The principal effect of the route restructuring project was the establishment of a more grid-like transit network primarily utilizing the arterial street and highway system. Most of the local bus routes, the backbone of the transit system, were placed on major north/south and east/west arterials. The rerouting of the local service onto major roadways and the elimination of unnecessary stops and turns was intended to increase travel speeds. The local service system has been designed to maintain a high level of accessibility to the downtown area while at the same time facilitating crosstown movements. Under the new system, most regular service local routes continue to either terminate or pass through downtown Denver. These are routed along a major street until it comes into the vicinity of the downtown. At that point, the route is diverted into and through downtown, then continued back along its original roadway. "Crosstown" locals, on the other hand, are not diverted into the downtown area but continue from one side of the metropolitan area to the other along the north/south and east/west grid. Circulator routes were also modified. These provide access to neighborhood facilities in four outlying areas and serve a collection/distribution function for local and express routes. Express routes into the downtown area were also changed. More direct routes and reduced collection/distribution significantly decreased express travel times.

In conjunction with the routing changes, efforts were made to improve inter-line coordination through the development of transit transfer centers and improved scheduling including "pulse-point" or timed transferring. Route restructuring also had an effect on the average spacing between bus stops, increasing it from about 650 feet to 1000 feet. One effect of shifting many routes onto major or minor arterial routes wherever possible was to concentrate service on fewer streets than previously. RTD estimated that the planned system would result in a 26 percent reduction in total route miles. Improvements of comparable magnitude in average headway reduction and operating speeds on these routes, however, were intended to compensate for increased average walking distance with shorter wait and on-board travel times.

1.3 Route Restructuring Evaluation Issues

The evaluation of the route restructuring project in Denver and this report have been organized around four major subject areas of interest to transit planning and operations.[6] These are:

- Implementation Requirements
- Travel Demand Impacts
- Transportation Supply and Cost Issues
- Indirect or Secondary Effects

The major evaluation issues addressed in the study may be listed within each category.

1.3.1 Implementation Issues

- Program Planning

  How were service objectives, guidelines and standards formulated and how did they affect the proposed system implemented?

  How effective in mitigating transitional problems was the exceptionally comprehensive and detailed planning/ community involvement process followed by RTD?

- Program Initiation

  What techniques of RTD's marketing and promotional program were most effective in developing support for the project and disseminating information, and how important were they?

  What was the nature and level of resources required for staff training?

- Program Monitoring

  Did the post-route restructuring system of program monitoring work effectively in providing a basis for making further system modifications as required?

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[6] De Leuw, Cather & Company. Evaluation Plan for the Denver Free Fare Demonstration and Route Restructuring Project, prepared for the Transportation Systems Center, March 1979.

- Program Influences

  What were the sources and bases of support for and resistance to the route restructuring project?

1.3.2 Travel Demand Issues

- Ridership Impacts

  What were the short-term and long-term impacts of route restructuring on ridership levels?

  How many new riders and trips were attracted to the restructured transit system? How many were lost due to the changes?

- Traveler Characteristics

  Who benefited and who was adversely impacted by the project?

  Were the service changes equitably distributed among the population?

  What distinguished new and lost riders due to route restructuring from those changing their bus use reflecting "normal" turnover?

- Other Travel Demand Issues

  What were the previous modes of travel for those persons making new transit trips as the result of the changes?

  Has implementation of the new transit system resulted in significant changes in bus trip characteristics such as travel purposes, or the geographic distribution of transit trip origins and destinations?

1.3.3 Transportation Supply and Cost Issues

- Transit Operations

  How did route restructuring affect vehicle and driver productivity and operating efficiency?

  Did the major route changes increase fleet or scheduling requirements?

- Program Costs

  What was the net cost of the route restructuring? What were the impacts on operating, capital, and overhead/ administrative costs?

  How did restructuring affect the system's average operating costs per unit of operations (miles, hours, riders)?

- Access to Transit

  Was coverage of the region's trip ends and population reduced by the route restructuring program?

  How were riders affected by increasing bus stop spacing, shifting of bus routes onto fewer streets, and improvements in bus service frequencies?

- Other Level of Service Measures

  How were the various components of total transit travel time affected? Were longer access times offset by shorter in-vehicle travel times?

  Was the overall directness of trip routing improved?

  Was the total number of trips requiring one, two or more transfers reduced, particularly for non-CBD crosstown trips? Were inter-line transfer delays improved?

  Was schedule reliability or on-board comfort affected by the restructuring?

  How did the implementation of the new system affect driver courtesy, especially in the "learning" phases of the project for both operators and passengers needing information?

1.3.4 Indirect or Secondary Effects

- Transit User Attitudes

  How did the route restructuring affect the attitudes of prior riders toward RTD generally and bus service?

  What were the attitudes of new riders attracted to the bus system? How did these differ from those of prior riders?

  Did the route restructuring project result in improved general public opinion about RTD? How was support for potential new transit improvements and taxes affected?

- Environmental Effects

  Were there any measurable indirect environmental, neighborhood quality of life, or energy conservation impacts?

1.4 The Evaluation Process

The essence of the evaluation process consists of comparing travel behavior and system operations prior to and after the route restructuring project, while controlling for measurable factors affecting transit but unrelated to the subject changes. The analytical framework used is based upon the general philosophy and approach to demonstration evaluation specified by the Transportation Systems Center.[7] The evaluation seeks to document the changes which were made to the transportation system (supply), and to specify what were the travel impacts of those changes (demand). To the extent feasible, the cause-and-effect relationship between the two is identified. The evaluation methodology was designed in order to control for several factors unique to the Denver demonstration which could affect the validity of free fare findings. The primary factors taken into account in the evaluation were the off-peak free fare demonstration, major changes in operations not related directly to the route restructuring project, and variation in the quality of data available from different time periods.

The September route restructuring occurred in the eighth month of the off-peak free fare demonstration. Consequently, before/after comparisons are generally drawn from the seven month period preceding the route changes and the five month period following. To the extent that free fare and post-free fare effects can be isolated, the longer-term effects of the restructured transit network are inferred from observations taken after the end of the demonstration on January 31, 1979. The analysis has also used where appropriate projections of base

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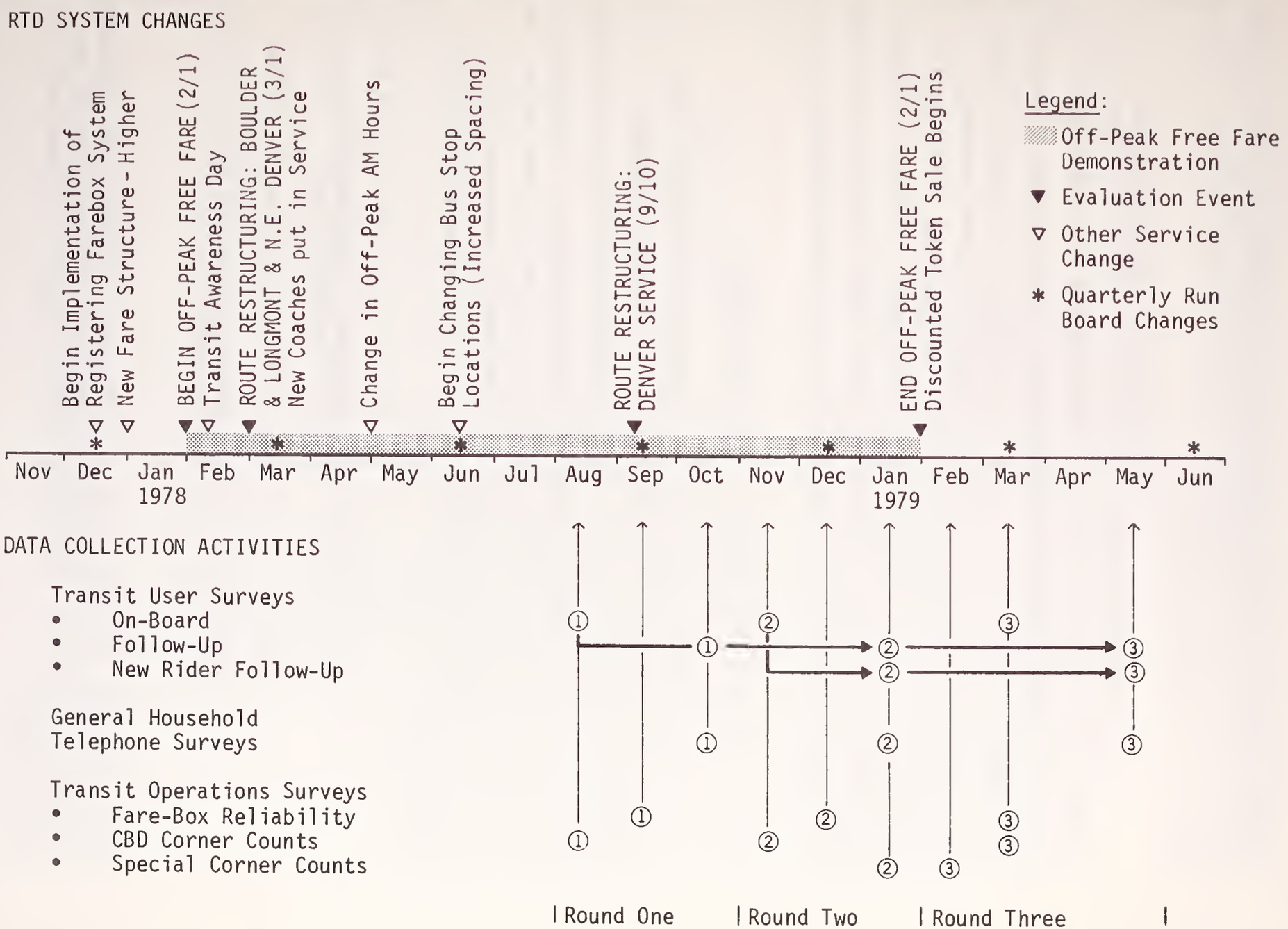
[7] Abkowitz, Mark; Carla Heaton and Howard Slavin. Evaluation of Service and Methods Demonstration Projects: Philosophy and Approach. UMTA/TSC Project Evaluation Series, Report No. UMTA-MA-06-0049-77-5. May 1977.

Figure 1.2
RELATIONSHIP OF DEMONSTRATION EVENTS AND OTHER TRANSIT SYSTEM CHANGES TO EVALUATION PROJECT DATA COLLECTION



(without Free Fare) ridership developed from estimates of secular growth trends, service and price related ridership responses in Denver. (See Appendix B, "Ridership Estimates.")

As described in detail in Appendix A, "Data Collection and Reliability," an extensive data collection effort was undertaken by RTD and its data collection contractors as part of the evaluation process.[8] Three rounds of transit user, general household and transit operations data were conducted. Each round of data collection was designed to provide timely information or the effects of both areas of interest in the evaluation - free fare and route restructuring. Figure 1.1 shows the overall relationship of the scheduling of data collection activities with major events occurring before, during and after the demonstration.

1.4.1 Free Fare Demonstration and Other Factors

In order to reduce conflicts between free fare and route restructuring effects, the evaluation employed several different approaches. A follow-up panel of prior and new transit users over three rounds of on-board surveys provided for before, during and post-demonstration longitudinal data. Direct adjustments to the data were applied as necessary to account for a number of system changes which occurred during or around the demonstration in addition to the elimination of off-peak fares.

- January 1978 fare increases which went into effect just before the free fare experiment began.
- Changes in the RTD bus fleet and bus miles of service.
- Redefinition of RTD's morning peak period from 7-9 a.m. to 6-8 a.m. in early May, 1978.

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[8] Data collection activities and a description of the data sets developed in the evaluation are documented in Appendix A. A discussion of the confidence limits of results taken from the analysis of these data is also provided.

- Implementation and debugging of RTD recording-farebox patron count procedure in December 1977, with full change-over to the new system in February.

1.4.2 Data Limitations and Adjustments

A problem in the evaluation of the free fare impacts was the lack of extensive and compatible pre-demonstration ridership data. As discussed in Appendix B, "Ridership Estimates," demonstration passenger count data were adjusted to provide a consistent data base over time. The January 1978 fare increases precluded extrapolation of pre-demonstration ridership revenues or ridership, so fare elasticities were used to hypothesize ridership without the fare-free demonstration. Post-demonstration data were also applied to extrapolation of the baseline ridership profile.

Standard adjustments to the direct survey data were necessary. These included adjustment to correct for various sources of response bias, for example, to account for different rates of response in the on-board survey for different routes surveyed. Adjustments were also made in the analysis of the on-board surveys to avoid over-sampling of transfer users. Follow-up survey responses of transit users who were selected from the on-board surveys were adjusted for probability of selection bias based on average weekly trip frequency rates. Second and third rounds of follow-up surveys were reweighted to maintain a similar income distribution over the life of the panel since differential rates of attrition were apparently related to income levels.

2.0 THE SETTING

2.1 Geography and Climate

The Denver Metropolitan Area (DMA) is defined in this document as the five-county region of Adams, Arapahoe, Boulder, Denver, and Jefferson Counties. Three additional counties were added to the Denver-Boulder SMSA following the 1970 census. Because of the compatibility between the five-county region and the RTD service area, as well as the availability of adequate demographic data for this area, these three additional counties are not included as part of the DMA definition for the purposes of this report.

The DMA encompasses two major climatic and topographic zones: mountain and plains. Situated in the north-central portion of Colorado along the easterly base of the Rocky Mountains, much of the urbanized area lies along the South Platte River, which runs northeast. A ridge mass extends from the foothills of the Rockies around the southern edge of the metropolitan area and continues northeast. Consequently, the CBD and its surrounding area lies in a basin. Denver has a dry and generally mild climate; the mountains inhibit strong wind movements.

Because of its situation, Denver experiences very low air mixing and frequent temperature inversions, especially in the Fall and Winter. These combined with restricted wind movement, tend to concentrate air pollutants and hold them over the urbanized area, causing periods of acute air pollution often lasting for several days until a major weather change occurs to dissipate the stagnant air mass.

2.2 Population and Employment

Well over half of Colorado's population lives in the Denver Metropolitan Area, which is the transportation, cultural, educational, and political center of the state, as well as the business and financial

center of the Rocky Mountain region. The population of the DMA during the demonstration was about 1,592,000 persons. Population growth in the DMA has outpaced that in the nation as a whole in recent decades, increasing by over 30 percent per decade since 1960, to 1.59 million in 1978. (This growth is almost 2.5 times the national average.)[1] Denver Metropolitan Area population and employment statistics are summarized in Table 2.1.

While the City of Denver remains the principal activity center for the metropolitan area, in recent years, most of the DMA's population growth has taken place in the surrounding suburban counties. In 1978, about 530,000 persons were residents of the City of Denver; 140,000 Aurora; 137,000 Lakewood; 92,000 Boulder; 41,000 Longmont; and 84,000 Arvada. Other important minor civil divisions within the RTD service district with sizeable population concentrations include Broomfield, Commerce City, Englewood, Golden, Littleton, Longmont, Northglenn, Westminister, and Wheat Ridge. Between 1970 and 1978 the population of the four surrounding counties increased by 47 percent while the population in Denver County (which includes the City of Denver) increased by approximately 2 percent.

With nearly three-fourths of Colorado manufacturing employment, the DMA is the historical manufacturing center of the state. Denver has also become the center of energy resource development activity in the West and the base of operations for coal, oil, oil shale, and natural gas exploration and development efforts in Colorado, Utah, Wyoming, and Montana. Indeed, the region is the state's employment center, accounting for about 7.3 million jobs, or 60 percent of the Colorado work force. The DMA also includes the state capital, with an estimated one-fourth to one-third of Colorado government jobs located in and around the State Capitol Building in the Denver CBD.

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[1] White, Weld & Co., et al, RTD (Colorado) Sales Tax Revenue Board Series 1977, October 27, 1977.

DMA growth in employment has outpaced that of population. While the Denver CBD remains the major employment center, growth in government, trade and service employment -- the fastest growing employment sectors in the region -- has followed trends in population distribution to some extent, with the result that there are now a number of peripheral activity centers complementing the CBD. The Denver Regional Council of Governments (DRCOG) forecasts, however, that the Denver CBD share of areawide employment will increase to 10 percent by the year 2000.

Table 2.1
SUMMARY POPULATION AND EMPLOYMENT STATISTICS, DENVER METROPOLITAN AREA

Year	DMA Population	Annual Growth Rate	DMA Employment	Annual Growth Rate
1960	921,000		387,000	
		2.8%		3.4%
1970	1,229,800		543,000	
		3.9%		4.2%
1975	1,473,800		668,100	
		2.6%		2.7%
1978	1,592,100		723,700	
		3.0%		2.7%
1980	1,690,000		763,200	
		1.7%		2.2%
1985	1,847,700		848,700	
		1.7%		2.2%
1990	2,020,500		944,200	

Source: White, Weld & Co., DRCOG, "Notations."

The distribution of the DMA's major ethnic groups is presented by county in Table 2.2. On the basis of recent population migration patterns, DRCOG projects an overall increase in the areawide proportion of non-whites. While the suburban counties are expected to increase their proportions of these groups, Denver will remain the center of regional non-white population concentrations.

Table 2.2
DMA ETHNIC GROUPS BY COUNTY

County	White	Spanish-Surnamed	Black	Asian-American	American Indian
Adams	80.0%	17.0%	1.3%	1.2%	0.5%
Arapahoe	92.4	4.6	1.7	1.0	0.2
Boulder	91.8	6.3	0.7	0.9	0.3
Denver	61.0	22.7	14.3	1.4	0.6
Jefferson	94.8	3.9	0.3	0.7	0.3
Total DMA	80.6%	12.5%	5.4%	1.1%	0.4%

Source: Colorado Division of Planning, July 1978 Estimates based on 1970 Census, March, 1979, Colorado Business Review.

The age distribution of the regional population is shown in Table 2.3. Approximately 30.6 percent of the population is under 18 years of age. Elderly persons (over 60 years of age) represent about 11 percent of the five county population and this proportion is expected to double by the year 2000.

Table 2.3
DMA POPULATION BY AGE

Age Group	DMA[a]		USA[b]
Under 17 years	28.7%		29.0%
17-24	15.9	46.4	39.8
25-44	30.5		
45-65	17.7		20.1
Over 65 years	8.0		11.0
All ages	100.0		100.0

Sources: a) DRCOG, "Notations." January, 1978
b) U.S. Bureau of Census "Estimates to the Population by States." July, 1978.

The DMA ranks high in per capita personal income compared to other U.S. metropolitan areas. The average DMA household income is also higher than the state average, reflecting the area's concentrations of white-collar, upper income population. Table 2.4 presents this household income distribution for the five-county area.

Table 2.4
INCOME DISTRIBUTION

Income	DMA[a]	Per Capita Personal Income (1975)	
Less than $ 5,000	14.7%	DMA	$6,641
$ 5,000 - 9,999	17.6		
$10,000 - 14,999	19.1	USA	$5,903
$15,000 - 24,999	29.2		
$25,000 and Over	19.4		
Total	100.0%		

Source: a) Bureau of Census, Areawide Housing Survey, 1976.

2.3 Regional Travel Characteristics

The best available estimates of the travel within the Denver Urbanized Area (excluding Boulder and Longmont) are from survey data collected in January 1975.[2] On a typical weekday, there were an estimated 4.66 million person trips made, 3.20 million vehicle trips, and 17.1 million vehicle miles of travel (VMT). The Denver central business district attracted about one half million person trips on a typical weekday. A survey taken in Boulder and Longmont in 1971 found that about 360 thousand and 95 thousand person trips, respectively, were made by auto or bus within each community. The average household in the eastern half of Boulder County made 7.7 trips per average workday in 1975. Similar information is unavailable for the remaining portions of the Denver Metropolitan Area.

[2] DRCOG, "A Typical Day of Travel in Denver," February, 1979.

Perhaps the single most distinctive feature of person travel in the Denver metropolitan area is the dominance of automobiles as the primary mode of trip-making. The area has one of the highest rates of auto ownership per capita of any major metropolitan center in the United States. Only 7 percent of households reportedly do not possess automobiles.[3] Transit ridership in the region accounts for only about 3 percent of all internal trips. Reflecting increasing suburban development, average auto travel distance increased from 5.4 to 5.9 miles between 1971 and 1975. During this same period, vehicle miles of travel per person increased from 12.1 to 13.4 miles.

While traffic conditions have deteriorated substantially compared to those experienced even four or five years ago, congestion is still not an acute problem. The peak travel periods in the morning and evening are relatively short -- 7:00 to 8:00 a.m. and 4:00 to 5:30 p.m. generally -- and congestion dissipates rapidly beyond the peaks. It is estimated that just under 40 percent of all trips to and from the Denver CBD occur during these peak periods.

Pre-demonstration ridership counts show a steady increase in transit ridership, from 28 million passenger trips in 1975, to 34 million one year prior to free fare in 1977. Transit travel patterns parallel auto travel patterns in that peak period bus capacity is heavily utilized.

As shown in Table 2.5, transit users in Denver differ substantially from the general population. About one-half of weekday bus users are captive riders. RTD riders are generally poorer, younger, and less likely to be white than the general DMA population.

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[3] Random Household Survey (5/79).

Table 2.5
COMPARATIVE PROFILE OF TRANSIT USER AND GENERAL POPULATION

Percent of Group With:	Average Weekday Bus Rider[a]	General Population[b]
No access to car (16 years or older)	48%	5%[c]
Income less than $10,000	39%	33%
Non-white	25%	19%
Between 17 and 45 Years of Age	66%	46%

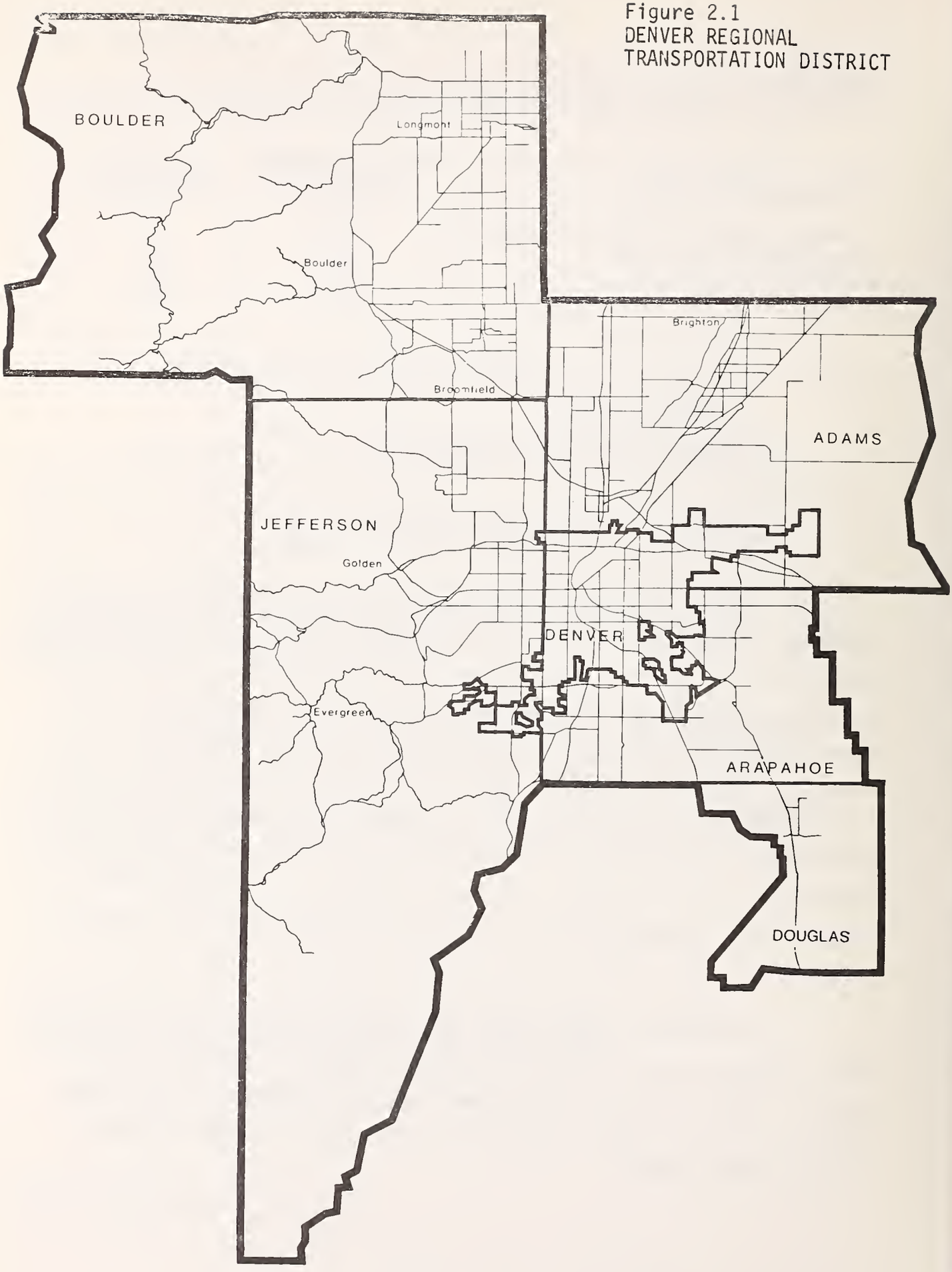
Sources: a) On-Board Survey (5/79); adjusted for probability of selection bias.
b) U.S. Census (1970). See Tables 2.3 to 2.5.
c) Random Household Survey (5/79)

2.4 The Regional Transportation District (RTD)

The Denver Regional Transportation District (RTD) was established by the Colorado State Legislature under the Regional Transportation District Act in 1969. Under this Act (Colorado Revised Statutes, 1973, 32-9-010, et seq.) the RTD is empowered to develop, maintain, and operate a mass transportation system for the benefit of the inhabitants of the District. The District (see Figure 2.1) covers 2,284 square miles and is comprised of the City and County of Denver, the Counties of Boulder and Jefferson, the eastern portions of Adams and Arapahoe Counties and northeastern Douglas County. While the District is smaller in size than the DMA, the populations of the two areas are essentially identical.

A twenty-one member Board of Directors governs District operations; representation includes ten members appointed from the City and County of Denver, two each from Adams, Arapahoe, Boulder, and Jefferson Counties, one from Douglas County and two at-large members elected by the other Board members.

Figure 2.1
DENVER REGIONAL
TRANSPORTATION DISTRICT



The RTD is charged with developing and adopting a comprehensive plan for transit service in the region, in coordination with the land use and highway plans developed respectively by DRCOG and the Colorado Department of Highways (CDH). Local funding sources available to the District include a one-half cent sales tax, with revenues applied to operations, capital improvements and equipment, and debt service. The RTD also has ad valorem tax levying authority of up to two mills on each dollar of assessed property valuation within the District, for deficit payments against operating and maintenance costs, and one-half mill for other expenses except debt service. The sales tax is being collected, but mill levies have not been imposed since 1975.

In 1978, the Board adopted a five-year Transit Development Program which is consistent with the long-range RTD Public Transportation Plan. The new five-year program included a rapid expansion of the bus fleet, early construction of additional maintenance and storage facilities, and further improvement of RTD's service. These programs can be implemented within the revenues that are currently available to the District and make full use of the Federal financial assistance offered by the Urban Mass Transportation Administration. RTD's share of the capital projects is being financed from the proceeds of a sale of $45,145,000 in sales tax revenue bonds late in 1977. Implementation of the year-long free-fare program necessitated some short-term shifts in TDP element priorities.

Both before and after the route restructuring, RTD operated bus service throughout the Denver metropolitan region, providing virtually all population and employment centers with some level of transit service. The District is divided into the Metropolitan Operating Group (MOG) serving Denver and surrounding suburbs, and the Northern Operating Group (NOG), serving Boulder, Longmont, and intercity routes.

By 1978, RTD had more than doubled ridership in the four years after assuming public ownership of the region's transit operations. The number of bus miles operated has increased steadily from 14.8 million in

1975 to approximately 21.4 million miles in 1978. RTD accepted delivery on 231 new coaches during the early months of 1978. These acquisitions and subsequent retirements increased the fleet to 592 vehicles and reduced the average vehicle age from 8.5 to 3.6 years. Five hundred and five (505) buses were deployed in the Metro Operations Group and 87 in the Northern Operators Group.

Continuing high priority is being given to improvement of maintenance and storage facilities. Four major park-and-ride facilities have been completed; several are in the process of design or construction, and more are programmed for implementation by 1982. Also planned are transfer terminals at high activity areas, improved on-street transfer/stop facilities and joint-use park-and-ride sites where parking is available for shared use by transit riders and other commuters.

During the demonstration period, RTD was in the process of designing and engineering a $15 million Transitway/Mall project on the 16th Street spine of the Denver Central Business District. Also in the planning stages were nine community transit center off-street transferring facilities to be located in various outlying locations within the metropolitan area.

3.0 IMPLEMENTATION

3.1 Project Description

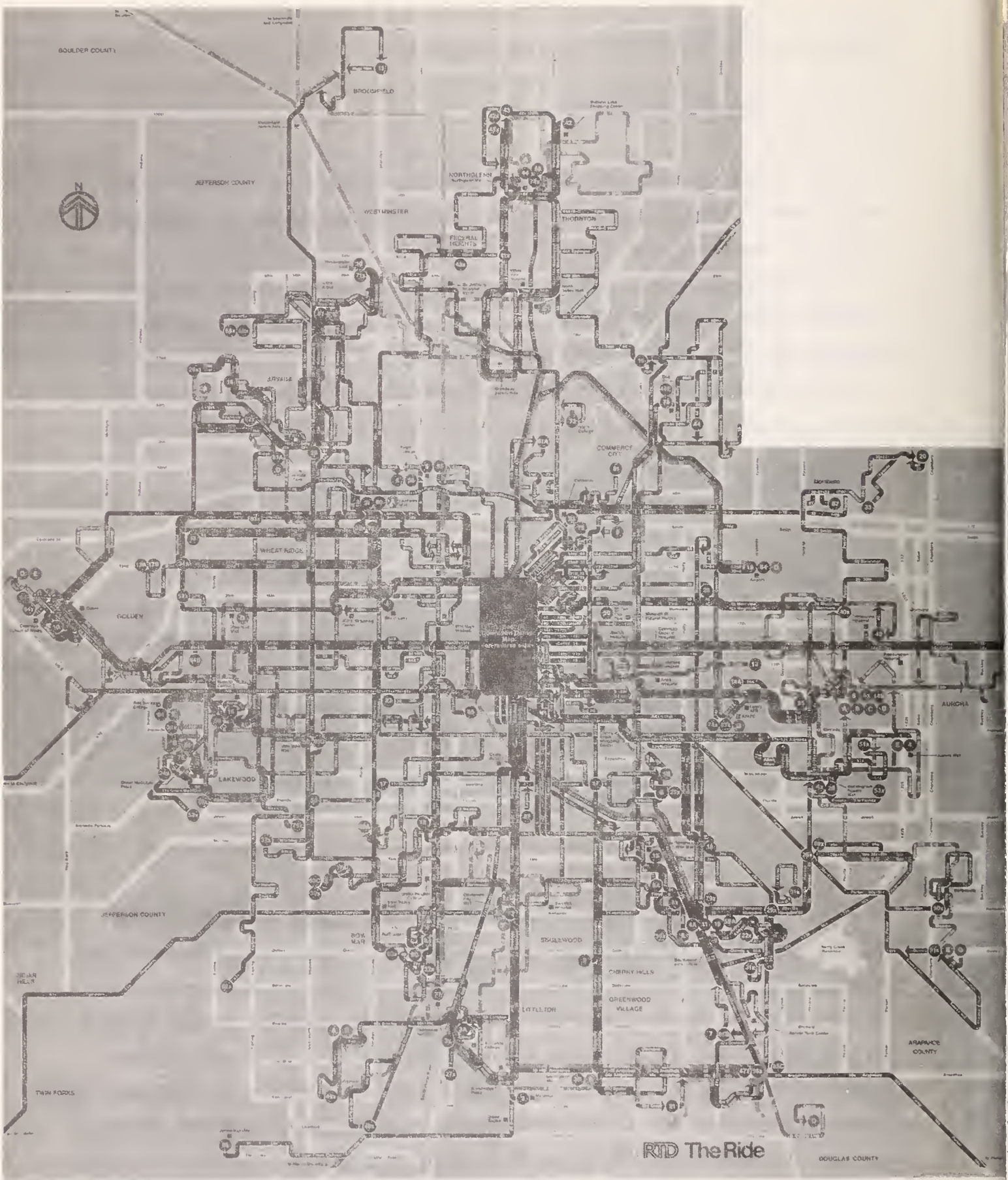
During 1978 RTD made substantial changes in its operations which transformed the transit system, its route network and schedules. Together these changes constitute the route restructuring project which is the subject of this evaluation. The most extensive modifications were made on September 10, 1978, in all but the Northeast quadrant of Denver, Boulder and Longmont where a smaller first round of route restructuring had taken place earlier on March 5, 1978.

Table 3.1
CHRONOLOGY OF SYSTEM CHANGES: ROUTE RESTRUCTURING

Date	System Modification
March 5:	Comprehensive changes in Boulder, Longmont, and N.E. Denver routes and schedules.
June 1:	Begin reducing the number and changing the location of bus stops.
September 10:	Comprehensive changes in routes and schedules for balance of Denver (N.W., S.W., and S.E. quadrants).
December 1:	1st Quarterly Run-board Changes following Route Restructuring. Some modifications of routes and schedules.

Figures 3.1 and 3.2 show the route network in Denver before (1977) and after (1978) route restructuring. Comparison of the two maps illustrates the transformation of the network toward a more grid-like orientation in the outlying portions of the city and the overall simplification of the system. The new network consists of a much higher proportion of routes operating on major or minor East/West or North/South arterials conforming to the predominant grid of the street and highway system. Faster operating speeds and more frequent service were essential

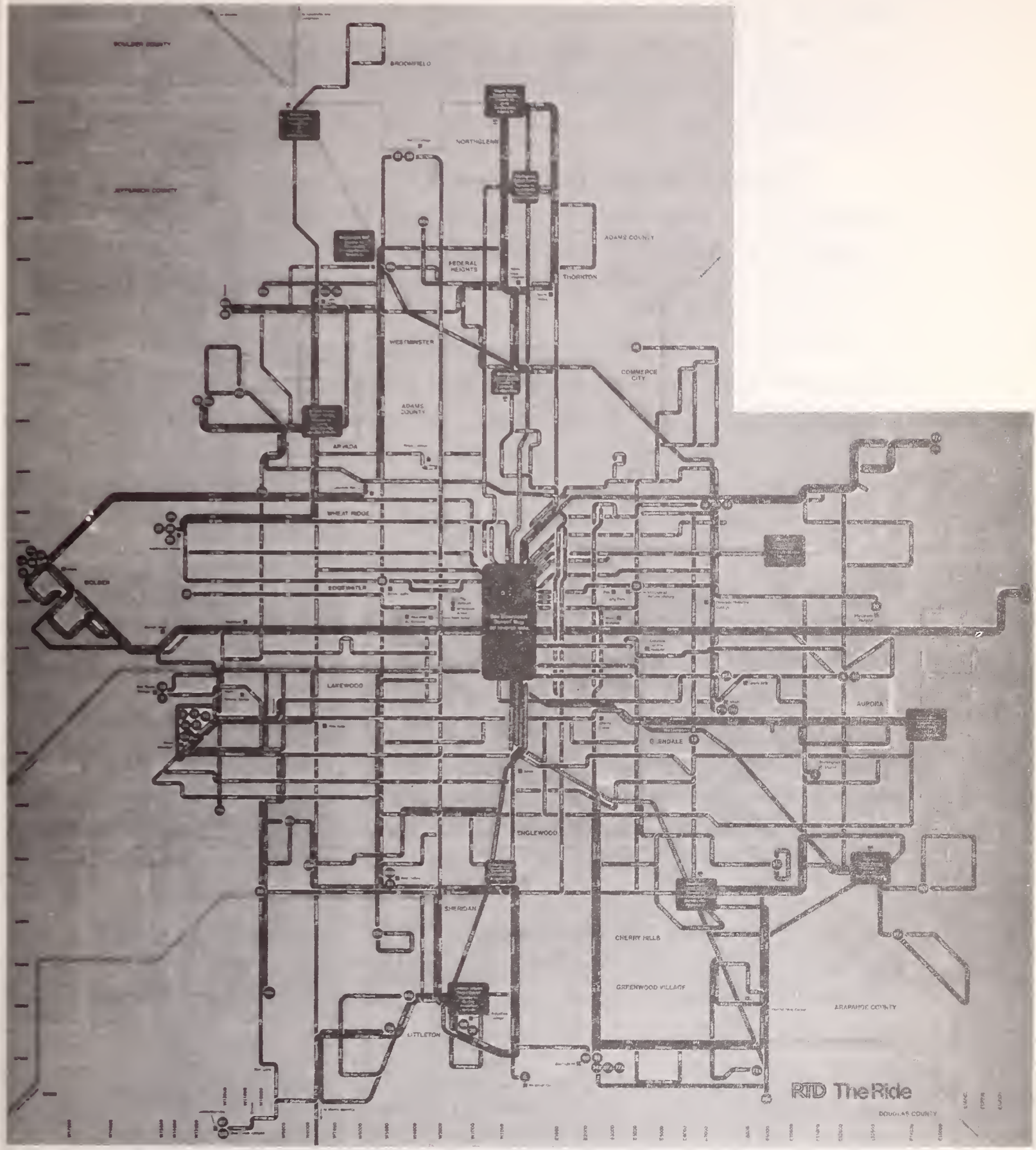
Figure 3.1
BEFORE ROUTE RESTRUCTURING: DENVER



SCALE IN MILES

0 1 2 3 4 5

Figure 3.2
AFTER ROUTE RESTRUCTURING: DENVER



SCALE IN MILES

0 1 2 3 4 5

elements of the route restructuring project planning to provide compensation for the reduced coverage -- about a 25 percent reduction in route miles and increasing of the average distance between bus stops from 650 feet to 1000 feet.[1]

A similar reorganization concept of transit services on a smaller scale is illustrated in the maps shown in Figures 3.3 and 3.4 for the City of Boulder before and after route changes in that community. Only minor changes in bus service within Longmont were made during 1978.

Local regular routes serving the CBD were transformed to routes which generally now travel the same arterial street from one side of the metropolitan area to the other. The route numbering system was changed to be consistent with street number designations of the Denver grid street system. While the local route restructuring was revised to operate in a grid-like structure, the system still retains a strong radial orientation. As local routes approach the Denver CBD, they are diverted into the downtown area. The restructured route system actually routes a slightly higher number of buses through the downtown core than did the previous structure.

Circulator service which previously followed rather circuitous routes and random schedules in Adams and Arapahoe Counties in Aurora, and in Golden, were enhanced by the incorporation of pulse scheduling. Routes of approximately equal length were operated at regular intervals to and from major RTD transit centers, making direct transfer possible.

Express service to downtown Denver was changed with straighter and faster routes, reduced collection and distribution zones, and more concentration of service to and from RTD transit centers. Supplementing

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[1] Route miles are the total number of street miles on which bus service is provided. Service miles are the total number of vehicle miles operated during a given time period.

Table 3.2
SUMMARY OF ROUTE RESTRUCTURING SERVICE CHANGES:
DENVER ROUTES EFFECTIVE SEPTEMBER 10, 1978

Service Type	Before Route Restructuring	After Route Restructuring	
LOCAL REGULAR (CBD)	March*	September	December
• Routes	21	18	20
• Bus Trips	2213	2190	N.A.
• Service Hours	3,734**	3,817**	4,013**
• Weekday Pass. (Unlinked)	110,200	108,500	109,400
Percent Total Pass.	78.1%	79.5%	80.6%
LOCAL CROSSTOWN			
• Routes	16	11	12
• Bus Trips	658	667	N.A.
• Service Hours	- **	- **	- **
• Weekday Pass (Unlinked)	16,500	14,900	14,100
Percent Total Pass.	11.7%	10.9%	10.3%
EXPRESS			
• Routes	52	50	55
• Bus Trips	258	248	N.A.
• Service Hours	422	421	426
• Weekday Pass. (Unlinked)	10,700	9,000	9,480
Percent Total Pass.	7.6%	6.6%	6.9%
CIRCULATOR			
• Routes	22	17	18
• Service Hours	498	347	339
• Unlinked Weekday Passengers	3,600	4,000	2,700
Percent Total Pass.	2.6%	2.9%	2.0%
TOTAL DENVER			
• Routes	111	96	105
• Bus Trips	3,129	3,105	N.A.
• Service Hours	4,654	4,586	4,778
• Weekday Pass. (Unlinked)	141,000	136,400	135,600
Percent Total	100.0%	100.0%	100.0%

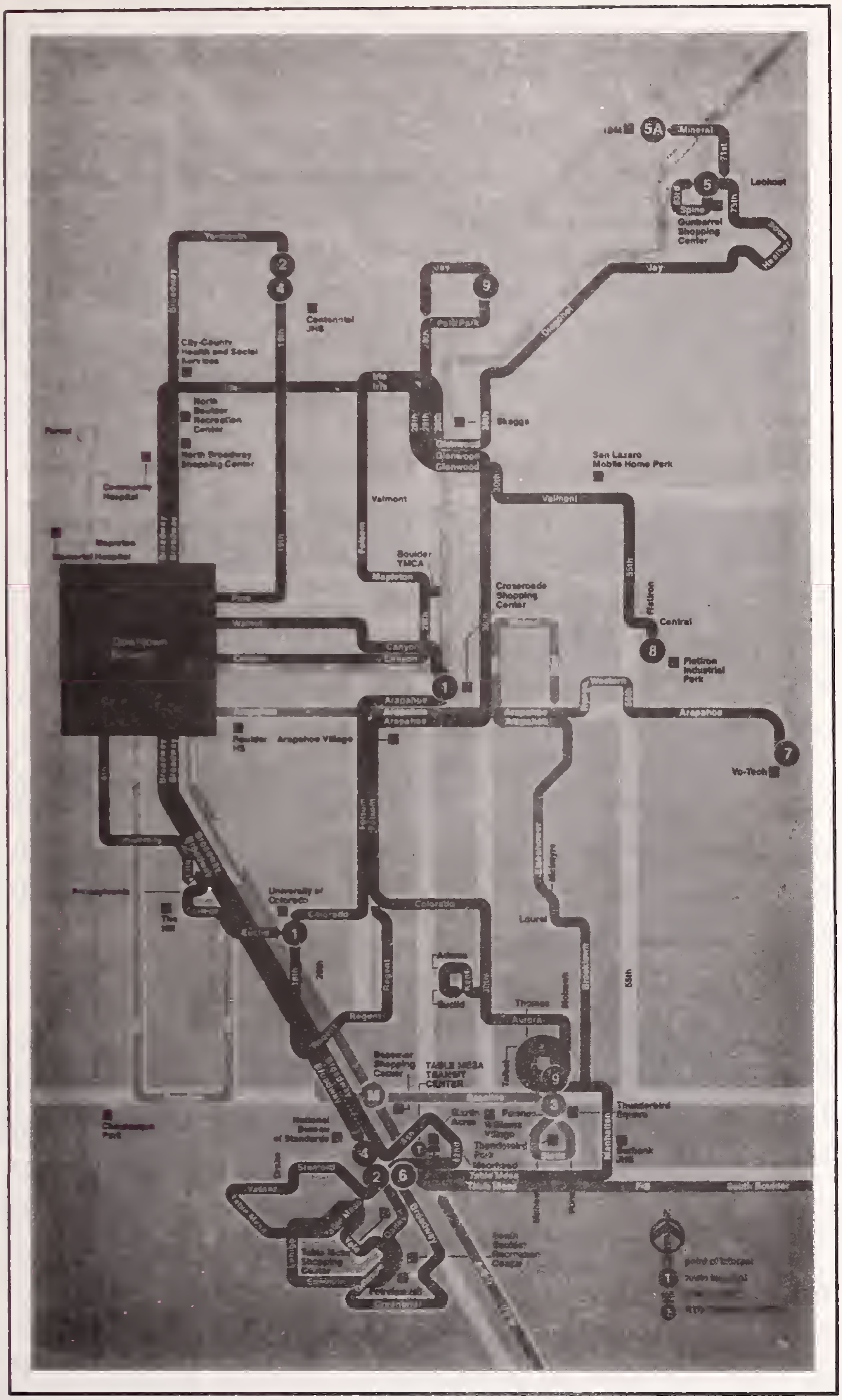
*Includes changes made in N.E. Denver, March 5.
**Total Regular. Breakdown by Regular and Crosstown routes unavailable.
Source: RTD Office of Policy Analysis:"Monthly Ridership Reports". Scheduling Department: Headway Sheets. DCCO Ridership Estimates (Appendix B).

Figure 3.3
BEFORE ROUTE RESTRUCTURING:BOULDER

SCALE IN MILES

0 1 2

Figure 3.4
AFTER ROUTE RESTRUCTURING:BOULDER



SCALE IN MILES

0 1 2

the downtown Denver service, reverse commute routes were devised to serve such large secondary employment concentrations as the Airport with frequent peak-hour service.

Within the City of Denver (MOG), one effect of the route change was reduction in the total number of routes, while there was virtually no change in the amount of service provided as measured by total hours of service (vehicle hours) provided. As shown in Table 3.2 five relatively unproductive local crosstown routes were eliminated (one was later added in December). A reduced number of local regular (service CBD) routes, generally somewhat longer than before, also resulted from the reorganization. The number of express routes and service hours were the least changed by the restructuring. There was a substantial decrease in both the number of Circulator routes operating and the amount of service provided by them. As shown in the table, there resulted a small but measurable shift in patronage from local crosstown routes and circulator routes to the new local regular routes.[2]

Table 3.3 summarizes the service level changes which occurred in Boulder and Longmont (NOG). While no major changes were made within Longmont, transit service was nearly doubled in Boulder in conjunction with the restructuring of the routes operating there. Two routes were added to the Boulder system.

Table 3.3
SUMMARY OF ROUTE RESTRUCTURING SERVICE CHANGES:
BOULDER AND LONGMONT: EFFECTIVE MARCH 5, 1978

Boulder & Longmont	Before Route Restructuring February		After Route Restructuring March	
	Boulder	Longmont	Boulder	Longmont
• Routes	7	7	9	7
• Service Hours	215	72	418	74
• Weekday Pass. (Unlinked)	9,900	1,500	12,100	1,700

Source: RTD Office of Policy Analysis: "Monthly Ridership Reports."
Scheduling Department: Headway Streets. DCCO Ridership Estimates (Appendix B)

[2]The apparent decrease in Express ridership shown in Table 3.2 reflects free fare ridership on express routes in March which was subsequently prohibited by clarification of free fare off-peak hours.

The reorganization of routes went far beyond a renaming of bus routes with minor substitutions in rates. As shown in Figure 3.5, a new route typically provides service within a grid corridor which previously may have been served by three or four routes in different areas of the new routes. Only in a few cases were routes virtually unchanged, e.g., the major East/West Colfax route and some crosstown routes such as those serving Monaco and Havana Avenues. Another important feature of the restructuring was to increase the crosstown function in outlying areas of many local routes which also serve the downtown. Examples of this are the elimination of the 16-Kipling crosstown by the new 11-Mississippi regular.

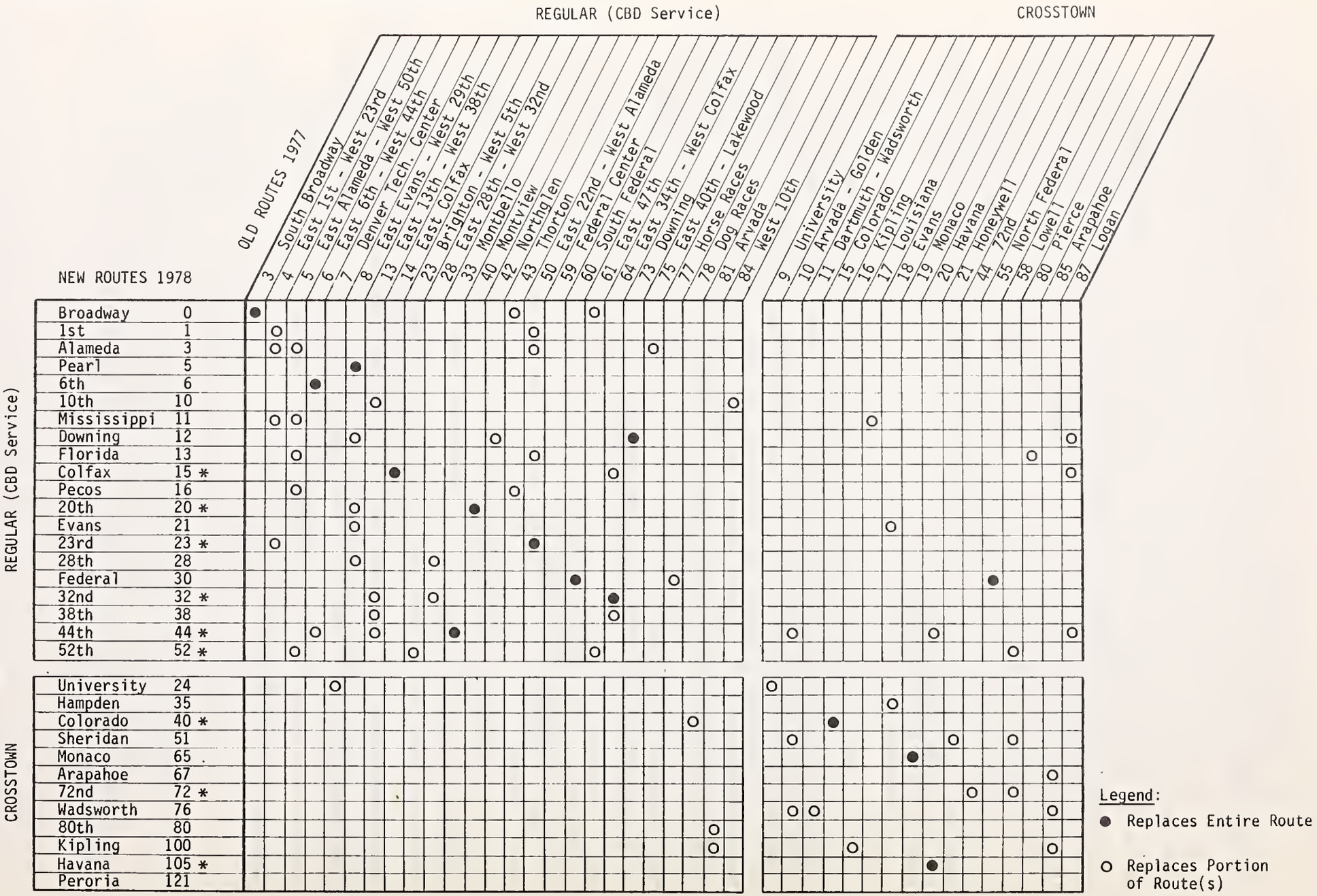
Also illustrated by the figure is the establishment of a simplified route nomenclature, with new bus line numbers generally conforming to numbering system of the streets and avenues on which the bus is operated. A simpler route designation system as part of the new grid orientation was designed with the objective of making the system more understandable, particularly for new riders or prior riders making trips they had not previously made by bus.

3.2 Project Development

The route and schedule changes that occurred in 1978 were the result of nearly two years of planning and over 100 meetings with citizen groups, transit users, local planners and representatives of major employers. It appears that the intensive planning process which RTD undertook both determined the specific elements of the restructured transit service and was a prerequisite for public understanding and acceptance of the major changes made.

Figure 3.5

CROSS-REFERENCE OF OLD AND NEW ROUTES FOLLOWING ROUTE RESTRUCTURING:
LOCAL ROUTES-REGULAR (CBD) AND CROSSTOWN



*Changes Made In Northwest Denver: March 5, 1978
Other Changes In Denver Effective September 10, 1978

3.2.1 The Initial Planning Process: Planning Standards and Guidelines

Following the mid-1976 UMTA rejection of RTD's application for federal funding assistance for its proposed automated rapid transit system, RTD's staff recognized the need to develop a new planning framework for the bus system. The long range plans for the bus network had been based upon the need for compatibility with the fixed guideway system. Further, the existing route structure had evolved into a rather cumbersome network of indirect, uncoordinated lines as the metropolitan area expanded. Slow and circuitous routing of service was identified by RTD Marketing as a major impediment to increased utilization of the transit system. Special concern was expressed for the need to improve service in order to attract the choice rider -- the potential bus user who has a private auto available, but might be persuaded to take advantage of a good transit alternative.

In late 1976, RTD contracted with R.H. Pratt Associates, Inc., of Kensington, Maryland, to develop a transit planning framework for the RTD bus system for the time frame of 1977 through 1987. The guidelines and standards developed were the basis of planning for route restructuring.

The Pratt Report proposed three categories of standards; system, route, and geographical.[3] System standards dealt with stop spacing, broad service characteristics, safety, reliability, passenger amenities, and transit information. Route standards specified schedule adherence, passenger loading, and transit vehicle speed. Finally, geographic standards specified the minimum transit service which should be provided an area based upon its land use and socio-economic characteristics. These standards were quantified in terms of route spacing and vehicle frequency stratified by type of service.

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[3] R.H. Pratt Associates, Inc., A Transit Planning Framework, prepared for the RTD, January 1977.

The framework study also proposed a set of planning guidelines which were generally followed in the development of the route restructuring project.

- Increase the speed of bus routes without changing their transit service characteristics.
- Develop user-oriented timetable schedules.
- Modify the local route system to a form which is primarily grid-oriented.
- Modify low frequency routes so their schedules are clock-time oriented.
- Maximize express bus frequencies from RTD Park-n-Ride facilities.
- Balance service frequency and coverage to minimize the sum of walking and waiting times.

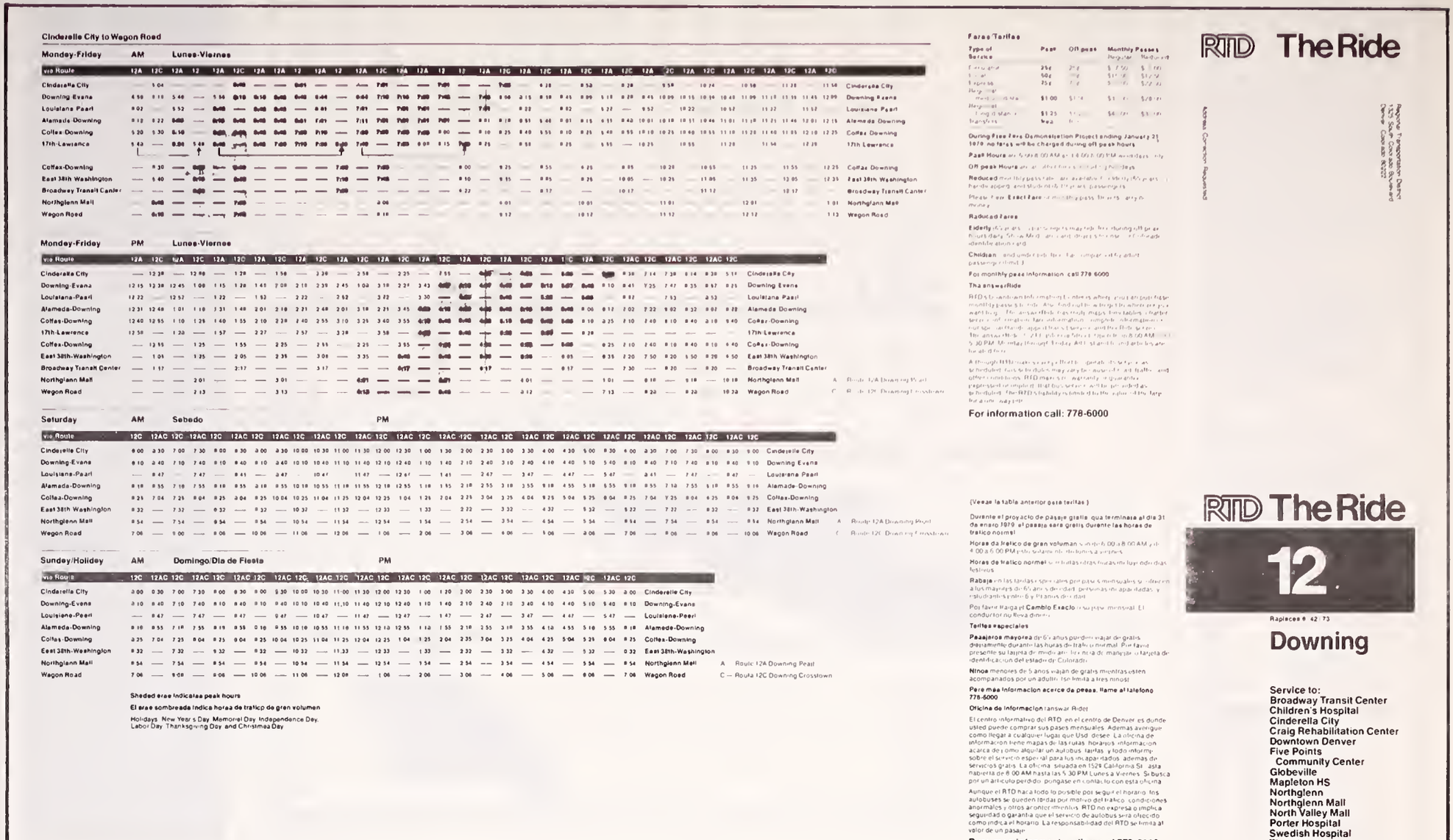
3.2.1.1 User-Oriented Timetables

The new timetables for route restructuring were to have several modifications that made them easier to use. The route maps show major streets, connecting routes, major attractors, points of interest, and high schools. Timetables are color-coded bilingual, and a fare information panel is included. An example of the published map and schedule for a typical route following Route Restructuring is shown in Figures 3.6A and 3.6B.

3.2.1.2 Schedule Speed

The average speed of local routes was planned to increase immediately after route restructuring due to reduced turning movements, increased use of major arterial streets, and greater average stop spacing. Before route restructuring, average stop spacing was about 650 feet; after route restructuring it averages about 1,000 feet. A parametric study of bus average speed indicated that stop spacing had more impact on average speed than any other readily controlled variable.

Figure 3.6A
EXAMPLE OF ROUTE MAP AND SCHEDULE-TYPICAL ROUTE (FRONT SIDE)



Cinderella City to Wagon Road

Monday-Friday AM — Lunes-Viernes

via Route	12A	12C	12A	12	12A	12C	12A	12A	12	12A	12	12A	12C	12A	12A	12	12	12A	12C	12A	12C	12A	12C	12A	2C	12A	12C	12A	12C	12A	12C	12A	12C	
Cinderella City		5 04				6 48			6 51				7 01			7 01			7 18		6 38		8 58		9 28		9 58		10 28		10 58		11 28		11 58	Cinderella City
Downing-Evans	4 59	5 10	5 40		5 55	6 10	6 40	6 40	6 40	6 44		6 44	7 10	7 10	7 25	7 25	7 25	7 25	8 06	8 15	8 10	8 45	8 09	9 15	9 45	10 09	10 15	10 39	10 45	11 09	11 15	11 39	11 45	12 09	Downing Evans
Louisiana-Pearl	5 02		5 52		6 12		6 42	6 42		6 46		7 01		7 01	7 26			7 26		8 22		8 52		9 27		9 57		10 27		10 57		11 27		11 57	Louisiana-Pearl
Alameda-Downing	5 12	5 22	6 02		6 22	6 42	6 52	6 52	6 51	6 57		7 11	7 31	7 31	7 46	7 46	7 46	7 46	8 01	8 18	8 51	9 22	9 01	9 37	10 01	10 18	10 31	10 46	11 01	11 18	11 31	11 46	12 01	12 16	Alameda-Downing
Colfax-Downing	5 20	5 30	6 10		6 30	6 50	7 00	7 00	7 00	7 05	7 10	7 20	7 40	7 40	7 55	7 55	7 55	7 55	8 10	8 25	8 40	9 55	9 10	9 25	9 40	9 55	10 10	10 25	10 40	10 55	11 10	11 25	11 40	11 55	12 10	12 25	Colfax Downing
17th-Lawrence	5 42		6 34	6 49	6 49		7 22	7 22	7 22	7 26	7 32	7 42		7 42	7 57	7 57	7 57	7 57	8 08	8 15	8 32		9 32		9 56		10 26		10 56		11 26		11 56			17th Lawrence
Colfax-Downing		5 30																																
East 38th Washington		5 40																																
Broadway Transit Center																																		
Northglenn Mall																																		
Wagon Road		5 48																																

Monday-Friday PM — Lunes-Viernes

via Route	12A	12C	12A	12C	12A	12C	12A	12C	12A	12C	12A	12C	12A	12C	12A	12C	12A	12C	12A	12C	12A	12C	12AC	12C	12AC	12C	12AC	12C		
Cinderella City		12 38		12 58		1 28		1 58		2 28		2 58		3 25		3 55		4 25		4 55		5 25		5 55		6 38		7 14	7 38	8 14	8 38	9 14	Cinderella City
Downing-Evans	12 15	12 38	12 45	1 00	1 15	1 28	1 45	2 00	2 15	2 28	2 45	3 02	3 18	3 25	3 43	3 55	4 09	4 25	4 39	4 55	5 09	5 25	5 39	5 55	6 10	6 41	7 25	7 47	8 25	8 47	9 25	9 47	10 25	Downing Evans
Louisiana-Pearl	12 22		12 52		1 22		1 52		2 22		2 52		3 22		3 30		4 02		4 46		5 02		5 46		6 02		6 52		7 53		8 53		9 53	Louisiana Pearl
Alameda-Downing	12 31	12 48	1 01	1 18	1 31	1 48	2 01	2 18	2 31	2 48	3 01	3 18	3 31	3 45	4 03	4 18	4 33	4 48	5 03	5 18	5 33	5 48	6 03	6 18	6 33	6 48	7 02	7 22	8 02	8 32	9 02	9 32	10 02	Alameda Downing
Colfax-Downing	12 40	12 55	1 10	1 28	1 40	1 55	2 10	2 28	2 40	2 55	3 10	3 25	3 40	3 55	4 10	4 25	4 40	4 55	5 10	5 25	5 40	5 55	6 10	6 25	6 40	6 55	7 10	7 40	8 10	8 40	9 10	9 40	10 10	Colfax-Downing
17th-Lawrence	12 58		1 20		1 57		2 27		2 57		3 28		3 58		4 28		4 58		5 28		5 58		6 28		6 58		7 28		8 28		9 28		10 28	17th-Lawrence
Colfax-Downing		12 55		1 25		1 55		2 25		2 55		3 25		3 55		4 25		4 55		5 25		5 55		6 25		6 55		7 25		8 25		9 25		10 25	Colfax-Downing
East 38th-Washington		1 05		1 25		2 05		2 35		3 05		3 35		4 05		4 35		5 05		5 35		6 05		6 35		7 05		7 35		8 35		9 35		10 35	East 38th Washington
Broadway Transit Center		1 17				2 17				3 17				4 17				5 17				6 17				7 30		8 20		8 20					Broadway Transit Center
Northglenn Mall				2 01				3 01				4 01				5 01				6 01				7 01		8 18		9 18		10 18					Northglenn Mall
Wagon Road				2 13				3 13				4 12				5 12				6 12				7 13		8 28		8 28		10 28					Wagon Road

A — Route 12A Downing Pearl

C — Route 12C Downing Crosstown

Saturday AM — Sabado

via Route	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	
Cinderella City	6 00	6 30	7 00	7 30	8 00	8 30	9 00	9 30	10 00	10 30	11 00	11 30	12 00	12 30	1 00	1 30	2 00	2 30	3 00	3 30	4 00	4 30	5 00	5 30	6 00	6 30	7 00	7 30	8 00	8 30	9 00	Cinderella City
Downing-Evans	6 10	6 40	7 10	7 40	8 10	8 40	9 10	9 40	10 10	10 40	11 10	11 40	12 10	12 40	1 10	1 40	2 10	2 40	3 10	3 40	4 10	4 40	5 10	5 40	6 10	6 40	7 10	7 40	8 10	8 40	9 10	Downing Evans
Louisiana-Pearl		6 47		7 47		8 41		9 47		10 47		11 47		12 47		1 41		2 47		3 47		4 47		5 47		6 41		7 47		8 47		Louisiana Pearl
Alameda-Downing	6 18	6 55	7 18	7 55	8 18	8 55	9 18	9 55	10 18	10 55	11 18	11 55	12 18	12 55	1 18	1 55	2 18	2 55	3 18	3 55	4 18	4 55	5 18	5 55	6 18	6 55	7 18	7 55	8 18	8 55	9 18	Alamade-Downing
Colfax-Downing	6 25	7 04	7 25	8 04	8 25	9 04	9 25	10 04	10 25	11 04	11 25	12 04	12 25	1 04	1 25	2 04	2 25	3 04	3 25	4 04	4 25	5 04	5 25	6 04	6 25	7 04	7 25	8 04	8 25	9 04	9 25	Colfax-Downing
East 38th Washington	6 32		7 32		8 32		9 32		10 32		11 32		12 33		1 33		2 32		3 32		4 32		5 32		6 32		7 32		8 32		9 32	East 38th-Washington
Northglenn Mall	6 54		7 54		8 54		9 54		10 54		11 54		12 54		1 54		2 54		3 54		4 54		5 54		6 54		7 54		8 54		9 54	Northglenn Mall
Wagon Road	7 06		8 06		9 06		10 06		11 06		12 06		1 06		2 06		3 06		4 06		5 06		6 06		7 06		8 06		9 06		10 06	Wagon Road

A — Route 12A Downing Pearl

C — Route 12C Downing Crosstown

Sunday/Holiday AM — Domingo/Dia de Fiesta

via Route	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	
Cinderella City	8 00	8 30	9 00	9 30	10 00	10 30	11 00	11 30	12 00	12 30	1 00	1 30	2 00	2 30	3 00	3 30	4 00	4 30	5 00	5 30	6 00	6 30	7 00	7 30	8 00	8 30	9 00	Cinderella City
Downing-Evans	8 10	8 40	9 10	9 40	10 10	10 40	11 10	11 40	12 10	12 40	1 10	1 40	2 10	2 40	3 10	3 40	4 10	4 40	5 10	5 40	6 10	6 40	7 10	7 40	8 10	8 40	9 10	Downing-Evans
Louisiana-Pearl		8 47		9 47		10 47		11 47		12 47		1 47		2 47		3 47		4 47		5 47		6 47		7 47		8 47		Louisiana-Pearl
Alameda-Downing	8 18	8 55	9 18	9 55	10 18	10 55	11 18	11 55	12 18	12 55	1 18	1 55	2 18	2 55	3 18	3 55	4 18	4 55	5 18	5 55	6 18	6 55	7 18	7 55	8 18	8 55	9 18	Alamede-Downing
Colfax-Downing	8 25	9 04	9 25	10 04	10 25	11 04	11 25	12 04	12 25	1 04	1 25	2 04	2 25	3 04	3 25	4 04	4 25	5 04	5 25	6 04	6 25	7 04	7 25	8 04	8 25	9 04	9 25	Colfax-Downing
East 38th-Washington	8 32		9 32		10 32		11 32		12 33		1 33		2 32		3 32		4 32		5 32		6 32		7 32		8 32		9 32	East 38th-Washington
Northglenn Mall	8 54		9 54		10 54		11 54		12 54		1 54		2 54		3 54		4 54		5 54		6 54		7 54		8 54		9 54	Northglenn Mall
Wagon Road	9 06		10 06		11 06		12 06		1 06		2 06		3 06		4 06		5 06		6 06		7 06		8 06		9 06		10 06	Wagon Road

A — Route 12A Downing Pearl

C — Route 12C Downing Crosstown

Shaded area indicates peak hours

El area sombreada indica horas de trafico de gran volumen

Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day.

Fares/Tarifas

Type of Service	Peak	Off-peak	Monthly Passes Regular	Monthly Passes Reduced
[illegible]	35¢	25¢	$ 7.00	$ 3.50
[illegible]	50¢	35¢	$11.00	$5.50
[illegible]	75¢	50¢	$15.00	$7.50
Regional [illegible]	$1.00	$.75	$20.00	$10.00
Regional [illegible]	$1.25	$1.00	$25.00	$12.50

During Free Fare Demonstration Project ending January 31, 1979 no fares will be charged during off peak hours.

Peak Hours are [illegible]

Off peak Hours are [illegible]

Reduced [illegible]

Please have Exact Fare [illegible]

Reduced Fares

Elderly [illegible]

Children [illegible]

For monthly pass information call 778-6000

The answer is Ride

RTD's [illegible]

The answer is Ride

[illegible]

Although [illegible]

For information call: 778-6000

(Vease la tabla anterior para tarifas.)

Durante el proyecto de pasaje gratis que terminara el dia 31 de enero 1979 el pasaje sera gratis durante las horas de trafico normal.

Horas de trafico de gran volumen [illegible]

Horas de trafico normal [illegible]

Rebaja en las tarifas especiales [illegible]

Pase Especial [illegible]

Tarifas especiales

Pasajeros mayores [illegible]

Ninos menores de 5 anos viajan de gratis mientras esten acompanados por un adulto. Son limite a tres ninos.

Para mas informacion acerca de precios, llame al telefono 778-6000

Oficina de Informacion Transit Ride

El centro informativo del RTD en el centro de Denver es donde usted puede comprar sus pases mensuales. Ademas averiguar como llegar a cualquier lugar que Usd. desee. La oficina de informacion tiene mapas de las rutas, horarios, informacion acerca de como alquilar un autobus, tarifas, y todo en forma sobre el servicio especial para los incapacitados, ademas de servicios gratis. La oficina, situada en 1529 California St., esta abierta de 8:00 AM hasta las 5:30 PM Lunes a Viernes. Si busca por un articulo perdido, pongase en contacto con esta oficina.

Aunque el RTD hace todo lo posible por seguir el horario, los autobuses se pueden tardas por motivo del trafico, condiciones anormales y otros acontecimientos. RTD no expresa o implica seguridad o garantia que el servicio de autobus sera ofrecido como indica el horario. La responsabilidad del RTD se limita al valor de un pasaje.

Para mas informacion, llame al 778-6000.

RTD The Ride

Regional Transportation District
1325 S. Colorado Boulevard
Denver, Colorado 80222

Address Correction Requested

RTD The Ride

12

Rapicesa 42 73

Downing

Service to:
Broadway Transit Center
Children's Hospital
Cinderella City
Craig Rehabilitation Center
Downtown Denver
Five Points
Community Center
Globeville
Mapleton HS
Northglenn
Northglenn Mall
North Valley Mall
Porter Hospital
Swedish Hospital
Thornton
Thornton HS
Wagon Road Transit Center
Washington Park
Webster Lake

For information call: 778-6000
December 3, 1978

Figure 3.6B
EXAMPLE OF ROUTE MAP AND SCHEDULE-TYPICAL ROUTE (BACK SIDE)

Wagon Road to Cinderella City

Monday-Friday AM Lunes-Viernes

Route	12C	12AC	12C	12A	12C	12A	12C	12A	12	12A	12C	12A	12C	12A	12C	12A	12C	12A	12C	12A	12C	12A	12C	12A	12C	12A	12C	12A	12C	12A	
Wagon Road	—	—	—	—	5 41	—	—	—			—	—	—	9 34	—	—	—	9 34	—	—	—	10 34	—	—	—	11 34					Wagon Road
Northglenn Mall	—	—	—	—	9 52	—	—	—			—	—	—	9 46	—	—	—	9 46	—	—	—	10 46	—	—	—	11 46					Northglenn Mall
Broadway Transit Center	—	5 33									—	—	8 22	—	—	8 32	—	—	10 32	—	—	11 32	—	—						Broadway Transit Center
East 38th-Washington	5 13	5 45									6 14	—	9 44	—	8 14	—	8 44	—	10 14	—	10 44	—	11 14	—	11 44	—	12 14				East 38th-Washington
Colfax-Ogden	5 29	5 59									6 29	—	9 55	—	9 25	—	8 58	—	10 35	—	10 55	—	11 25	—	11 55	—	12 25				Colfax-Ogden
17th-Lawrence	—	—									—	6 29	—	9 34	—	8 29	—	9 58	—	10 29	—	10 34	—	11 29	—	11 58	—				17th-Lawrence
Colfax-Corona	9 25	9 59							9 10	9 25	9 40	9 55	8 10	9 26	8 40	8 55	10 10	10 29	10 40	10 55	11 10	11 25	11 40	11 55	12 10	12 25					Colfax-Corona
Alameda-Downing	5 34						9 04	6 18	9 34	6 49	9 04	8 18	9 34	8 49	10 04	10 18	10 34	10 49	11 04	11 19	11 34	11 48	12 04	12 19	12 34						Alameda-Downing
Louisiana-Pearl	—						—	9 29	—	6 58	—	8 29	—	8 58	—	10 29	—	10 58	—	11 29	—	11 58	—	12 29	—						Louisiana-PAarl
Downing-Evans	9 41						9 05	9 11	6 35	9 42	9 08	8 12	9 34	8 42	10 08	10 12	10 34	10 42	11 08	11 12	11 34	11 42	12 08	12 13	12 38	12 42					Downing-Evana
Cinderella City	5 51						—	9 21	—	6 52	—	8 22	—	8 52	—	10 23	—	10 52	—	11 22	—	11 52	—	12 22	—	12 52					Cinderella City

A Route 12A Downing Pearl
C Route 12C Downing Crosstown

Monday-Friday PM Lunes-Viernes

Route	12A	12C	12A	12	12A	12C	12A	12C	12A	12C	12A	12C	12A	12	12	12A	12A	12C	12A	12A	12	12	12A	12A	12C	12A	12A	12	12	12A	12A	12C	12C	12AC	12C	12AC	12C	
Wagon Road	—	—	—	12 34	—	—	—	1 34	—	—	—	2 34	—	—	—	—	—	3 29	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6 44	—	7 44	—	9 44	
Northglenn Mall	—	—	—	12 46	—	—	—	1 46	—	—	—	2 46	—	—	—	—	—	3 41	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6 54	—	7 54	—	8 54	
Broadway Transit Center	—	12 32			—	1 32	—	—	—	2 33	—	—	—	—	—	3 32	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9 40	—	7 40	—	9 40	—
East 38th-Washington	—	12 44	—	1 14	—	1 44	—	2 14	—	2 44	—	3 14	—	—	—	3 44	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8 20	9 50	f 20	f 50	9 20	9 50	9 20
Colfax-Ogden	—	12 55	—	1 25	—	1 53	—	2 25	—	2 55	—	3 25	—	—	—	3 55	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9 30	f 00	7 30	9 00	9 30	9 00	9 30
17th-Lawrence	12 28	—	12 58	—	1 29	—	1 58	—	2 28	—	2 58	—	3 29	3 44	3 48	3 34	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6 00	—	—	—	—	—	—	—
Colfax-Corona	12 40	12 55	1 10	1 25	1 40	f 55	2 10	2 25	2 40	2 55	3 10	3 25	3 40	3 50	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9 00	—	9 00	9 19	9 30	7 00	7 30	9 00	9 30	9 00	9 30
Alameda-Downing	12 49	1 04	1 18	1 34	1 48	2 04	2 18	2 34	2 48	3 04	3 20	3 35	3 50	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6 00	—	9 10	6 29	6 29	7 08	7 38	9 08	9 39	9 08	9 39
Louisiana-Pearl	12 34	—	1 29	—	1 58	—	2 29	—	2 58	—	3 29	—	3 58	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9 00	—	—	6 19	9 35	—	7 18	—	9 18	—	9 17	—
Downing-Evans	1 08	1 12	1 34	1 42	2 08	2 12	2 34	2 42	3 08	3 13	3 37	3 43	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6 08	9 08	—	6 29	6 42	9 48	7 35	7 48	9 28	9 49	9 24	9 45
Cinderella City	—	1 22	—	1 52	—	2 22	—	2 52	—	3 22	—	3 53	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9 19	—	6 34	—	6 55	7 34	7 55	9 34	9 55	—	8 54	

A — Route 12A Downing Pearl
C — Route 12C Downing Crosstown

Saturday AM Sabedo PM

Route	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	
Wagon Road	—	9 15	—	7 15	—	9 15	—	9 15	—	10 15	—	11 15	—	12 15	—	1 15	—	2 15	—	3 15	—	4 15	—	5 15	—	6 15	—	7 15	—	8 15	—	9 15	Wagon Road
Northglenn Mall	—	9 25	—	7 25	—	9 35	—	9 25	—	10 25	—	11 25	—	12 25	—	1 25	—	2 25	—	3 25	—	4 25	—	5 25	—	9 25	—	7 25	—	9 25	—	9 25	Northglenn Mall
East 38th-Washington	—	9 49	—	7 49	—	8 49	—	8 49	—	10 49	—	11 49	—	12 49	—	1 49	—	2 48	—	2 49	—	4 49	—	5 49	—	9 49	—	7 48	—	8 49	—	8 49	East 38th-Washington
Colfax-Corona	8 17	8 56	7 17	7 56	9 17	9 56	8 17	9 56	10 17	10 56	11 17	11 56	12 17	12 56	1 17	1 56	2 17	2 56	3 17	3 56	4 17	4 56	5 17	5 56	8 17	8 56	7 17	7 56	9 17	8 56	9 17	8 56	Colfax-Corona
Alameda-Downing	9 26	7 05	7 26	9 05	9 26	9 05	8 26	10 05	10 26	11 05	11 29	12 05	12 26	1 05	1 29	2 05	2 26	3 05	3 26	4 05	4 26	5 05	5 26	8 05	9 29	7 05	7 25	8 05	9 28	9 05	8 26	10 05	Alameda-Downing
Louisiana-Pearl	9 34	—	7 34	—	9 34	—	9 34	—	10 34	—	11 34	—	12 34	—	1 34	—	2 34	—	3 34	—	4 34	—	5 34	—	9 34	—	7 34	—	9 34	—	8 34	—	Louisiana-PAarl
Downing-Evans	8 41	7 11	7 41	9 11	9 41	9 11	8 41	10 11	10 41	11 11	11 41	12 11	12 41	1 11	1 41	2 11	2 41	3 11	3 41	4 11	4 41	5 11	5 41	9 11	9 41	7 11	7 41	8 11	9 41	8 11	9 41	10 11	Downing-Evana
Cinderella City	8 51	7 21	7 51	9 21	8 51	8 21	8 51	10 21	10 51	11 21	11 51	12 21	12 51	1 21	1 51	2 21	2 51	3 21	3 51	4 21	4 51	5 21	5 51	8 21	8 51	7 21	7 51	8 21	9 51	8 21	9 51	10 21	CinderAlls City

A Route 12A Downing Pearl C - Route 12C Downing Crosstown

Sunday/Holiday AM Domingo/Dia de Fiesta PM

Route	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	12AC	12C	
Wagon Road	—	8 15	—	7 15	—	9 15	—	9 15	—	10 15	—	11 15	—	12 15	—	1 15	—	2 15	—	3 15	—	4 15	—	5 15	—	6 15	—	7 15	—	8 15	—	9 15	Wagon Road
Northglenn Mall	—	9 25	—	7 25	—	9 25	—	8 25	—	10 25	—	11 25	—	12 25	—	1 25	—	2 25	—	3 35	—	4 25	—	5 25	—	8 25	—	7 25	—	9 25	—	9 25	Northglenn Mall
East 38th-Washington	—	8 49	—	7 48	—	9 49	—	9 49	—	10 49	—	11 48	—	12 49	—	1 49	—	2 49	—	2 48	—	4 49	—	5 49	—	6 49	—	7 48	—	8 49	—	8 49	East 38th-Washington
Colfax-Corona	8 17	8 56	7 17	7 56	9 17	9 56	8 17	9 54	10 17	10 56	11 17	11 56	12 17	12 56	1 17	1 56	2 17	2 56	3 17	2 56	4 17	4 56	5 17	5 56	9 17	8 56	7 17	7 56	9 17	8 56	9 17	8 56	Colfax-Corona
Alameda-Downing	9 26	7 05	7 26	9 05	9 26	9 05	8 26	10 05	10 26	11 05	11 26	12 05	12 26	1 05	1 26	2 05	2 26	3 05	3 26	4 05	4 26	5 05	5 26	8 05	9 26	7 05	7 25	8 05	9 26	9 05	8 26	10 05	Alameda-Downing
Louisiana-Pearl	9 34	—	7 34	—	9 34	—	8 34	—	10 34	—	11 34	—	12 34	—	1 34	—	2 34	—	3 34	—	4 24	—	5 34	—	5 24	—	—	—	—	—	—	—	Louisiana-PAarl
Downing-Evans	8 41	7 11	7 41	8 11	8 41	9 11	9 41	10 11	10 41	11 11	11 41	12 11	12 41	1 11	1 41	2 11	2 41	2 11	3 41	4 11	4 41	5 11	5 41	9 11	8 41	7 11	—	—	—	—	—	—	Downing-Evans
Cinderella City	9 51	7 21	7 51	9 21	8 51	9 21	9 51	10 21	10 51	11 21	11 51	12 21	12 51	1 21	1 51	2 21	2 51	2 21	3 51	4 21	4 51	5 21	5 51	8 21	5 51	7 21	—	—	—	—	—	—	Cinderella City

A — Route 12A Downing Pearl
C — Route 12C Downing Crosstown

Shaded area indicates peak hours.

El area sombreada indica horas de trafico de gran volumen

Holidays New Year's Day Memorial Day Independence Day Labor Day Thanksgiving Day and Christmas Day

How to read your bus schedule.

This timetable is designed to give you all the information you need to ride the bus. The map indicates the streets the bus takes. When a bus branches from the main route or runs only during the day, that branch is marked on the map and timetable with an A B etc.

Bus stops are designated with signs and are usually on or near street corners. Bus numbers and route names are displayed above the front window of the bus. Also a destination sign is located on the side of the bus near the door and in the back window. To determine when to catch a bus at any given corner, follow the easy steps below.

1 **Aurería to Aurore**

2 **Monday-Friday PM**
Lunes-Viernes PM

via Route por Ruta	15A	15	15B	15	15A	15
Aurería	12 00	12 07	12 15	12 22	12 30	12 37
3 Broadway-Colfax	12 11	5 12 18	12 28	12 33	12 41	12 49
Colfax-York	12 20	12 27	12 35	12 42	12 50	12 57
Colfax-Colorado	12 25	12 32	12 40	12 47	12 55	1 02
Colfax-Duabac	—	12 38	12 49	12 52	—	1 08
AFAFC	12 40	—	—	—	1 10	—
Lowry AFB	12 50	—	—	—	1 20	—
Colfax-GenAva	—	12 48	12 54	1 01	—	1 19
4 ~~Fitzsimons Hospital~~	→	5 12 52	—	—	—	1 22
Chamber-Colfax	—	—	—	1 11	—	—

1 Determine which way you are traveling (For example: to downtown or from downtown?)

2 What day of the week? (Monday-Friday Saturday Sunday or holiday?)

3 Find the time point listed that is closest to where you are. These are usually listed as activity centers or as major street intersections.

4 Next find the timepoint closest to where you want to go.

5 Follow across the page until you have found the time that coincides with when you want to arrive at the destination timepoint.

6 Follow up the column until you meet the timepoint you are starting from. If your bus stop is not the timepoint listed you need to adjust the time accordingly. Try to arrive at your stop a few minutes before the time your bus is scheduled to arrive.

If you have any questions, ask a bus driver or call 778-6000

Como Leer Su Itinerario

Este horario esta diseñado para darle toda la informacion que usted necesita para viajar por autobus. El mapa indica las calles por donde pasa el autobus. Cuando el autobus se desvia de la ruta de vez en cuando durante el dia, este ramal se señala en el mapa y el horario con una A B etc.

Las paradas del autobus se indican con un signo y normalmente se encuentran en las esquinas o cercanamente. El numero del autobus y el nombre de la ruta se exhibe sobre la ventana al frente del autobus. Ademas un signo indicando la destinacion se encuentra en el lado del autobus cerca de la puerta y en la ventana trasera. Para determinar cuando llega al autobus a cualquier esquina siga los pasos siguientes.

(Usa la tabla anterior como ejemplo.)

1 Determine en que direccion usted viajara (por ejemplo ¿hara usted rumbo o desde el centro?)

2 ¿Cual dia de la semana? (¿Lunes a Viernes Sabado Domingo u Dia Festivo?)

3 En frente el punto mas cercano a usted en la lista. Estos puntos estan listados normalmente como centros de actividad o bien calles principales.

4 Ahora con frente el punto mas cercano a donde usted quiera ir.

5 Siga atraves de la pagina hasta que encuentre la hora que coincida con cuando usted quiere llegar al punto de su destino.

6 Entonces siga la columna hacia arriba hasta llegar en frente el punto donde comenzara su viaje. Si la parada de autobus donde usted se encuentra no coincide entonces necesita ajustar la hora. Trate de llegar a la parada unos minutos antes del tiempo indicado en su horario.

Si Uad. tiene cualquier pregunta pidala ayuda al conductor o llama al telefono 778-6000

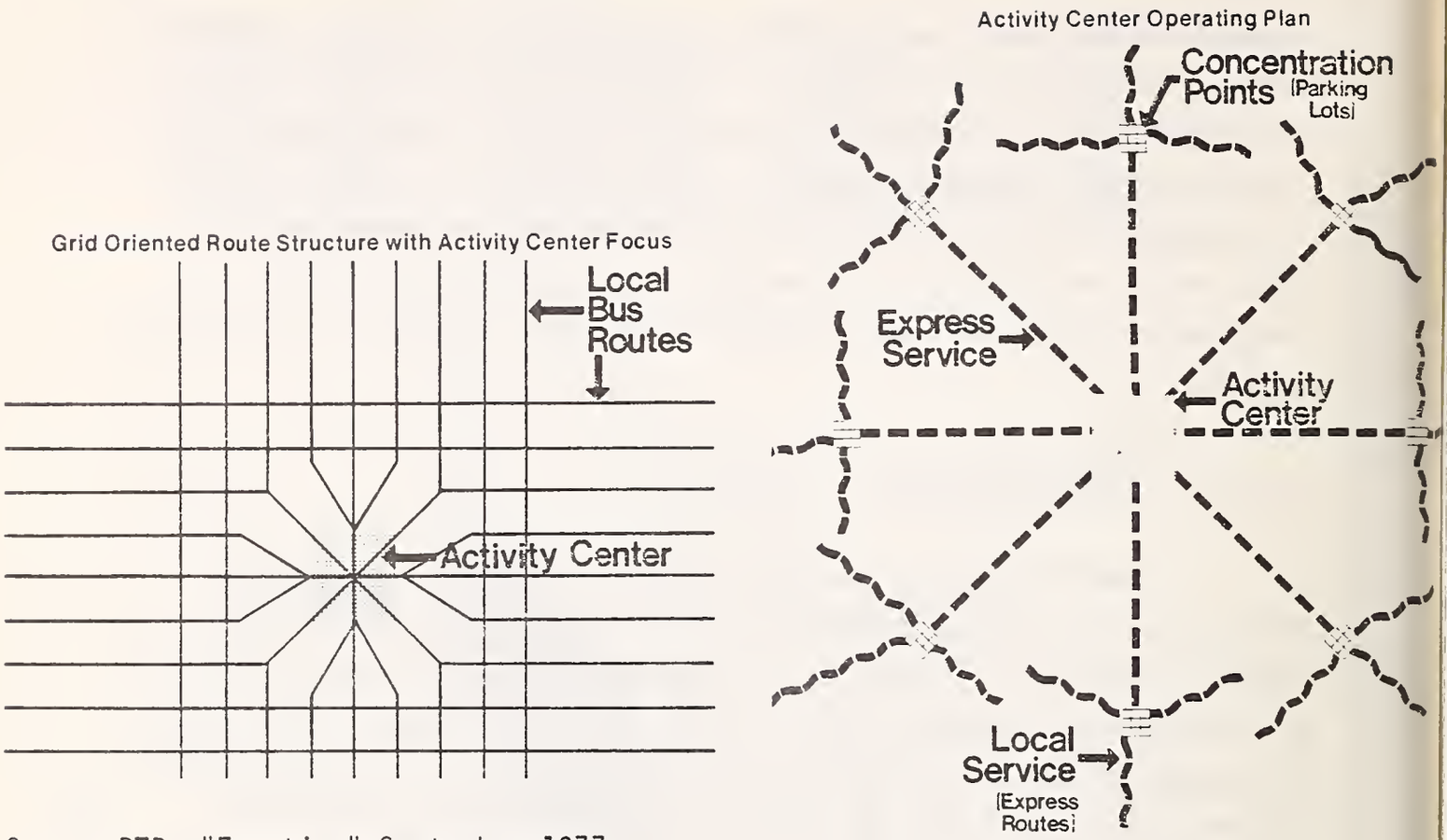
Express average speeds were shown to be capable of increasing somewhat since, following the guidelines, line-haul mileage could be increased and collection and distribution mileage decreased. Before route restructuring, the average express route was about 13 miles in length, 45 percent of which was spent in local collection and distribution. After route restructuring the average route length remained about the same but the collection and distribution portion was reduced to about 36 percent.

3.2.1.3 Grid-Orientation

Modification of the local route system to a form which is primarily grid-oriented became the most significant objective of the project. The basic concept was to create a system of routes rather than a collection of unrelated routes. Many connections among routes could be created by the grid structure, thereby allowing single transfer trip between almost any origin-destination pair. The grid system was intended to distribute services more equitably than the previous route structure. Some people fortuitously had transfer free bus service for many of their trips, but many others could not use the buses or could do so only with difficulty, particularly for non-CBD trips. With the previous route structure many crosstown trips could only be made by transferring downtown.

As shown in Figure 3.7, the local grid system which was developed from the guidelines was modified from a strict rectangular pattern to focus on major activity centers, principally the central business district. All local routes within about four miles of the CBD were routed to the CBD. This was also true to a lesser degree at other activity centers. Routes within about one mile of major shopping centers divert into the center.

Figure 3.7
INITIAL ROUTE RESTRUCTURING CONCEPT: MODIFIED GRID



Source:RTD, "Frontier" September 1977

3.2.1.4 Understandable Timetables and Timed-Transfers

Another restructuring guideline was to modify low frequency routes so that their schedules became clock-time oriented. New circulator routes were to have uniform half-hour headways, and except for a few high frequency routes, local bus headways were to be evenly divisible by 5 minutes. Related to this feature was the "pulse-point" schedule concept for low frequency routes where possible to minimize transfer time. The concept was to rendevous the neighborhood circulator routes at an activity center (usually a major shopping center) on the half hour, thereby allowing easy transfer between them. The circulator buses then would travel outward from the pulse point to various directions to serve the low density surrounding neighborhoods. Clock-time oriented headways were developed to make this low density, low frequency service more cost effective and attractive than it otherwise would be.

3.2.1.5 Express Park-n-Ride Service

Express bus frequencies from RTD Park-n-Ride facilities were to be maximized. After route restructruing, about 54 percent of all express buses were routed to serve Park-n-Ride lots, a considerable increase over the previous route structure. In addition, some express buses were to begin serving informal "joint use" Park-n-Ride lots. In concert with more service to Park-n-Ride lots a 29 percent reduction in miles of local collection/distribution service was planned. The concentration on Park-n-Ride pick-up at the expense of neighborhood collection was planned to allow many express buses to make two productive runs per peak period rather than only one. Another benefit to the restructured express system was that the improved local service in the inner core was expected to allow a reduction of express stopping in that area and a further increase in express bus average speed.

3.2.1.6 Coverage vs. Service Frequency Trade-Off

A very important guideline in shaping the new transit service was the objective of balancing local bus service frequency and coverage to minimize the sum of walk time and waiting time. The premise was that for a given amount of bus-miles of service, either many route miles of coverage could be provided at relatively poor frequency or less coverage could be provided at relatively high frequency. The former means a patron walks less and waits more, while the latter means a patron walks more and waits less. The Pratt guidelines suggested that the objective should be to minimize the sum of total walk and wait time in order to provide the average patron with the shortest total time for his journey. This guideline was analyzed and converted to a service frequency versus coverage service criterion. The criterion showed that to minimize walk plus wait time for a given one-mile wide corridor, the service should be provided on only one street until the schedule peak hour service frequency exceeded seventeen buses per hour; and further, that the service should be provided on only two streets (half-mile spacing) until the frequency exceeded thirty-six buses per hour.

This guideline led to a great deal of discussion during the planning stages of route restructuring. Many staff members felt that the guideline did not provide enough coverage -- that many people, particularly the elderly, would not want to walk as far as proposed by the guideline for frequency versus coverage. Consequently, it was felt that public reaction would be negative, although theoretically everyone would benefit from reduced transit travel time. In the end a compromise was reached which relaxed the frequency versus coverage criterion, but still reduced route miles of coverage about 25 percent with corresponding improvement in average service frequency.

Following completion of the Pratt report, RTD created a special internal task force to evaluate the existing bus system in Metro Denver relative to the proposed guidelines and recommend improvements. The Route Restructuring Task Force recommended the following:

- Structure. A simpler grid-like layout should be adopted with local and express routes concentrated on continuous arterial streets.
- Implementation. Route restructuring should begin in Northeast Denver, followed by simultaneous conversion of the rest of the Metro system in late 1978.
- Resources. Additional new vehicles should be used to enhance the new grid system, and route restructuring should be the primary focus of RTD's 1978 Marketing program.

After establishing their planning framework, RTD marketing, planning, and scheduling staff undertook a lengthy process of route and schedule development and citizen participation review meetings which led to the 1978 changes.

3.2.2 Community Involvement Mechanisms

Following development of a set of proposed routes and scheduling concepts, RTD initiated a major community involvement program in October 1977. By September 10, 1978, when the major changes in Denver went into effect, over 200 meetings had been held by RTD staff with elected officials, community organization representatives, municipal staffs, employers and the general public. Two or three RTD staff members were usually present at these meeting to explain the proposed project and to obtain feedback from the meetings.[4]

The concerns expressed at the advance public forums were documented, and RTD's response was noted and circulated among the operations and planning staff. As a result of the involvement program, revisions were made in the specific routing of some lines, bus stop locations and transfer points, and service levels on particular routes. These revisions resulted in a system which retained some characteristics of the old network that were not in the initial plan detailed by RTD staff. However, the overall grid/activity center focus concept remained the essence of the route restructuring plan.

3.3 Implementing the Changes

3.3.1 Staff Training

A major effort was made to involve vehicle operators at an early stage in the planning process and later in the implementation phase of the route and schedule changes. Three voluntary night meetings were held with drivers during the period of the demonstration. The first of these evening forums, held in January 1978, served to provide an initial orientation for drivers to the planned changes. A second

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[4] RTD, Marketing Division. Memorandum from D. Zobel to Distribution. Route Restructuring (4/28/78).

evening forum, attended by about 200 drivers, was held in July, two months prior to restructuring; a third was conducted in January at the end of the free fare program. In addition to these voluntary (unpaid) meetings, each driver received eight hours of classroom instruction about the new system while working the extra board.

3.3.2 Public Information Program

A massive public information program was undertaken by RTD to explain the workings of the restructured transit system to the public. RTD reports that over 2.5 million different pieces of information were mailed out as part of the route restructuring project. Twice as many schedules were printed than would be normal for a year. One of the more effective techniques of RTD's campaign appears to have been the establishment of about 100 different sites throughout the metropolitan area for the distribution of new route maps and schedules. A mobile information bus was also used to supplement this effort.

In the weeks preceding the September 10 changes, RTD extended the hours of its downtown transit information center. Three full-time public relation consultants were used in the two weeks before restructuring as part of an intensification of the promotional effort. By the day the changes were implemented,nearly all the new bus signs had been installed and temporary notices were posted to alert riders of the changes at stops no longer served. Customer Assistance staff was expanded from fifteen to twenty persons for a period of two weeks before and two weeks after the route changes.

The expanded customer assistance staff handled as many as 510 requests for information per half-hour when the new system first went into effect. This was about twice the normal rate of user requests. Complaints were logged and incorporated in summaries circulated among RTD management.

Table 3.4
AWARENESS OF ROUTE AND SCHEDULE CHANGES

	Transit Users		
	Prior Riders (A)	New Riders (B)	General Public (C)
SEPTEMBER 1978 CHANGES			
• Round 1 (10/78) After 1 month	91%	NA	93%
• Round 2 (1/79) After 5 months	-	NA	90%
• Round 3 (5/79) After 9 months	91%	NA	83%
CHANGES FOLLOWING SEPTEMBER			
• Round 2 (1/79) 1st Quarter Changes	42%	19%	NA
• Round 3 (5/79) 2nd Quarter Changes	26%	24%	NA

Sources: (A) Transit User Follow-Up Surveys: From On Board Survey 1 (8/78)
(B) New Rider Follow-Up Surveys: From On-Board Survey 2 (11/78)
(C) Random Household Surveys

RTD's information program and the publicity surrounding the route changes created a high degree of public visibility for the project. No data are available for any point in time prior to the implementation. Table 3.4 shows that one month after the changes were made, as much as 93 percent of the general public, about the same proportion as RTD ridership, were aware of the changes. By the third round of surveys, an overwhelming majority remained aware that restructuring had occurred. The drop in percentage of the general public which were aware of the route changes by May 1979 probably reflects the unfamiliarity of new residents with the area's recent transit history as much as it does the fading memories of former residents. Awareness of subsequent adjustments to the new system was also quite high among RTD ridership, both prior and new bus users.

3.4 Monitoring

RTD established three principal mechanisms to monitor the effects of the route restructuring:

- Bus drivers and dispatchers
- Customer Assistance records
- Public follow-up forums

Drivers were provided with forms to be used in making suggestions for route and schedule modifications. Operation problems in the first days of the project were to be called in to the dispatchers; these were monitored by RTD management in a special "command post" set-up in the main Platte garage. Additionally, union representatives were requested to solicit opinions and comments from drivers during this time.

During the Fall of 1978, RTD conducted twenty-two follow-up forums after the route changes had been implemented. Comments received at these public meetings were recorded and organized in summary documentation by the Community Affairs Coordinator. While these forums provided an opportunity for riders to express their dissatisfaction with bus service in general, or the September changes in particular, the concept of the new grid generally continued to receive public support. Expressions of need for improved service generally took the form of requests for more frequent service, more crosstown service, or additional operating hours in the early morning, late at night, and on weekends. The results of these public meetings had a major impact on the first quarter run-board changes following restructuring in December 1978, when a relatively large number of changes were made.

3.5 Post-Implementation Changes

As a result of operating experience, citizen input and staff review, RTD made sixty-two service changes at the time of the December 1978 run-board, the first of the quarter-annual run-board changes

programmed to occur after route restructuring. These revisions in some way affected nearly all local regular routes (30), about half of all express routes (25) and about half of all local crosstown lines (7). Most of the changes involved corrections in errors published in the September time tables; some were exclusively of this nature. A large number of the changes in published informational materials reflected revisions in either run times required, and/or added, deleted or relocated bus stop locations. Routing changes, mostly confined to segment modifications, affected eighteen routes. The overall concept of the new grid-like system remained intact. A total of eleven new trips were added to five local routes. Two trips were added to four express routes to relieve overcrowding and/or improve run times. A new crosstown route (72-72nd Crosstown) was also added to the system.

Revisions in the restructured system continued in subsequent quarter-annual run-board changes. The March 1979 revised operations included thirteen changes of various types on local regular routes, four on express runs, two on circulators, and none on crosstown lines. By the June 1979 run-board, the total number of revised route/schedules was only twelve affecting only five local regular routes, one circulator, and no express. The changes in June discontinued one crosstown route (35-Hampden) and restored service within the Yale Street and Holly Street corridors by adding two new crosstown routes (27-Yale and 56-Holly).

3.6 Program Influences

The principal source of support for the route restructuring project came initially from planners and management of RTD. The climate of the public forum in which the route changes were planned was generally favorable, with no strong expressions of opposition on the one hand, or exceptionally enthusiastic support on the other. Following the Federal decision in 1976 not to fund an automated rapid transit project in Denver, RTD's planning was reoriented toward improvement and reorganization of the existing fixed-route bus system. While the concept of a

revised, grid-like transit network appears to have been generally endorsed, no highly visible constituency was evident outside the District's board members and management staff.

Some opposition from organized groups developed over the course of the community involvement process which which intensified following the initial March 1978 changes in Northeast Denver. These groups included informal neighborhood associations and some organizations representing the elderly. In most cases, the focus of the opposition expressed by these groups was on specific characteristics of an individual route or schedule to be affected by the changes, rather than objection to the overall concept of the plan or the need to make comprehensive improvements to the system.

4.0 TRAVEL DEMAND IMPACTS

4.1 Transit Ridership Levels

Before presenting the findings regarding the impacts of route restructuring on ridership, it is useful to outline the ridership estimation procedures and assumptions used in the evaluation.

4.1.1 Adjustments to Ridership Data Base

Estimates of ridership impacts of the Denver free fare demonstration and route restructuring project were developed from passenger count and revenue data routinely collected by RTD and summarized monthly by type of transit operation.[1] While providing the only continuous source of bus ridership data available for the before, during and post demonstration periods, these estimates of unlinked transit trips are subject to certain inherent limitations which required special consideration in the evaluation. Based on farebox reliability survey data collected in the project, adjustments were made to improve the ridership data base and the estimations of demonstration effects.[2]

These adjustments were intended to account, on the one hand, for suspected pre-demonstration over-estimation resulting from a bias in the average fare survey method of passenger count estimation used by RTD prior to January 1978. Passenger counts available from the during and post-free fare period, on the other hand were adjusted to reflect possible undercounting associated with the implementation and subsequent procedural changes in a driver-actuated registering farebox system. Other measures were also taken to estimate average weekly, weekday, Saturday, and Sunday ridership. Information regarding transit trips and user

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[1] Denver, Colorado RTD. "Monthly Performance Reports," January 1976-October 1979.

[2] A discussion of these techniques and of the confidence limits of these data is provided in Appendix A. Documentation of ridership estimation methods and data base is presented in Appendix B.

characteristics has been obtained from on-board and telephone survey data as well as from aggregate ridership counts available from RTD. In all, travel data available to the evaluation was found in a variety of forms which required adjustments to assure compatibility.

4.1.2 Impact of Off-Peak Free Fare Demonstration

The impacts of route restructuring were small compared to those of the elimination of off-peak fares during the one year demonstration when the route changes took place. Free fare ridership effects are discussed in detail in the earlier report of this evaluation. However, a brief discussion of the demand analysis methodology and results of the free fare study is useful to put route restructuring findings in their appropriate context and in perspective.

Off-peak free fare ridership impacts were defined as the difference between observed "actual" ridership during the free fare demonstration and ridership levels estimated to have occurred had off-peak fares never been eliminated - projected "base" ridership. Base ridership projections represent an attempt to isolate all factors which may have affected ridership after the "before" demonstration period other than the implementation of off-peak free fares. These include service improvements, fare structure changes and secular growth controlling for seasonal variation. The impacts of implementing free fare, the dynamics of ridership during the one year demonstration, and the residual effects following the reinstatement of off-peak fares were examined by comparing these observed and hypothetical ridership levels.

Total ridership on RTD scheduled service during the one year demonstration is estimated at 34.3 million bus trips, of which about 8.2 million were trips which would not have been made without the elimination of off-peak weekday and all-day Saturday and Sunday fares. Total bus travel during a typical week, including both peak and off-peak periods, was an estimated 32 percent higher than projected base ridership without

free fares. Approximately 70 percent of the 671 thousand bus trips made each week were made during the free hours of service. Off-peak ridership, including the weekend, increased by an estimated 52 percent during a typical week (see Appendix B, Table B.7).

While the impact on transit ridership was dramatic, the overall effect on transit's share of regional travel was modest. The effect of the demonstration was to increase the portion of the 3.8 million weekday intra-regional trips captured by transit from about 2.4 percent to 3.1 percent of total. However, the impact on travel to and from the downtown was somewhat greater, with the buses carrying around 11 percent of all CBD trips during the demonstration. It is estimated that less than 9 percent of CBD trips would have been made by transit without off-peak fare elimination.[3]

4.1.3 Impacts of Route Restructuring

Figure 4.1 shows average weekday ridership on all of RTD's scheduled bus service for the three year period beginning January 1977. It illustrates both the magnitude of the free fare ridership increases, as well as typical month-to-month seasonal fluctuations. In 1977 and 1979, bus ridership in the Fall of the year exceeded Spring and Summer ridership levels. However, in the Fall of 1978, after the September restructuring, ridership was somewhat lower than during the earlier months of the year. The initial first two months impact was the greatest. Ridership began to recoup relatively quickly, however; increases were experienced in both November and December 1978, in contrast to the month-to-month decreases for those months in the previous year. While the overall negative effect on ridership appears to have been modest, it was more persistent than was expected by RTD planners. A ridership increase in the range of about 10 percent had been projected.

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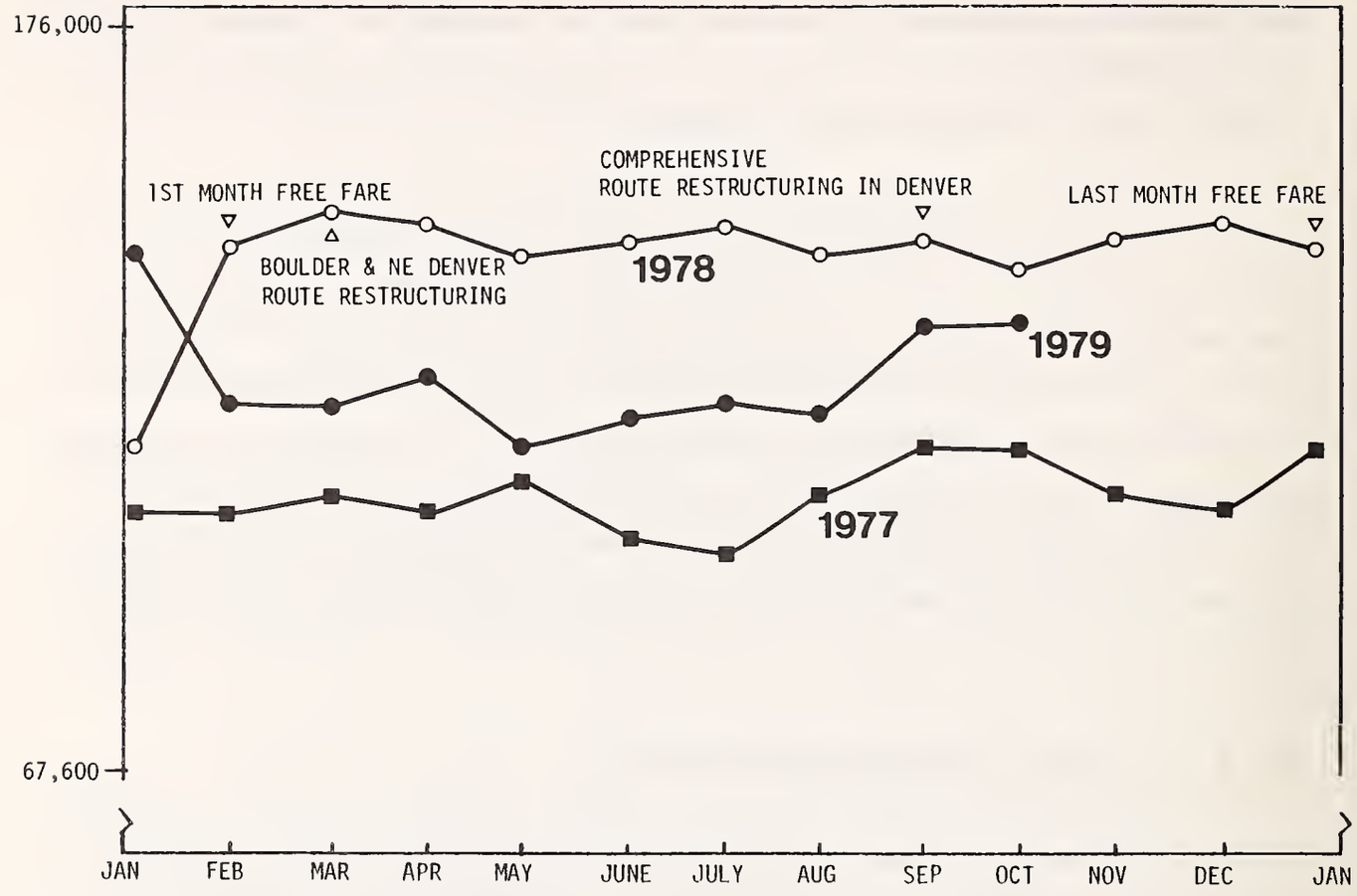
[3]DRCOG: "A Typical Day of Travel in Denver," February 1978.

Figure 4.1
AVERAGE WEEKDAY PASSENGERS (UNLINKED TRIPS): TOTAL SCHEDULED SERVICE



4.1.3.1 Total Ridership Levels

Table 4.1 presents weekly ridership estimates developed for the evaluation for each month of the demonstration. For the purpose of comparing before and after route restructuring ridership, the calculation of averages excludes both the first and last months of the demonstration, reflecting start-up and termination effects of the free fare demonstration. On this basis, ridership prior to route restructuring was about 38 percent higher than during the same period in 1977. Following the route and schedule overhaul, demonstration ridership was about 31 percent greater than the previous year. This suggests a net impact of as much as 7 percent or about 45,000 revenue passengers per week during the first four months after the changes. This, however, probably represents an upper-limit estimate of restructuring's short-term effects on total ridership. A lower-bound estimate is about a 4 percent loss in ridership for this period, or about 25,000 revenue passengers per week.

Table 4.1
RIDERSHIP LEVEL COMPARISONS: TOTAL RTD WEEKLY PASSENGERS (LINKED) DURING DEMONSTRATION

Months During Demonstration	Weekly Total Passengers 1978	Percent Increase Over Last Year 78/79	Previous Month 1978	Previous Month 1977
BEFORE ROUTE RESTRUCTURING				
February	652,800	+54%	+20.5%	+0.8
March	676,800	35	3.7	+3.0
April	681,900	39	0.7	-2.0
May	659,300	30	- 3.3	+3.3
June	673,200	42	+ 2.1	-6.1
July	681,100	47	+ 1.2	-2.1
August	670,000	35	- 1.6	+7.1
o Average	673,700	+38%		
AFTER ROUTE RESTRUCTURING				
September	674,700	+29%	+ 0.9	+5.9
October	659,400	26	- 2.4	-0.9
November	668,200	33	+ 1.3	-3.8
December	667,200	34	- 1.5	-0.6
January 1979	652,400	20	- 2.2	+8.7
o Average	667,400	+31%		

*Excludes February, the first month of Free Fare Demonstration and all day free "Transit Awareness Day."
**Excludes January, the last month of Free Fare Demonstration
Source: DCCO Ridership Estimates (Appendix B)

The detection of long-term ridership effects is problematic; several factors must temper our confidence in any single-point estimates of permanent ridership losses. These include: 1) the fact that the study timeframe may not have been long enough to allow ridership to fully adjust to the fundamental supply changes made; b) the interaction with the free fare program effects; and c) the accumulation over time of post-change exogeneous factors which may constitute more powerful influences on travel habits (e.g., continued inflation, gasoline price increases, etc.).

On the other hand, analyses of ridership count and the extensive direct survey data reflected in the evaluation appear to have resulted in generally reasonable indications of long run effects.

While the long-term ridership effects are much more difficult to estimate, they appear to have remained at about the same level as those experienced after the first several months. A multivariate regression model of RTD weekday ridership since 1977 suggests that ridership levels have not returned to what they would have been if the system had not been modified. The results of this analysis are shown in Table 4.2

Table 4.2
RESULTS OF RTD WEEKDAY RIDERSHIP (UNLINKED) REGRESSION ANALYSIS: January 1977 to October 1979 - Total Scheduled Service

Variable	Effect on Ridership	Significant at Alpha Level
Monthly Increases (Secular Growth)	+ 900	.002
Summer	- 5,600	.001
Free Fare	+26,500	.000
Route Restructuring	- 8,700	.003
Constant	98,900	.000
Average Weekday Total (Unlinked)		
• 1978	152,800	
• 1979	135,200	

Source: DCCO Ridership Estimates (Appendix B)

This analysis needs to be viewed with some caution. While the specific estimated values of the parameters could vary substantially the indicated directions of effects (coefficient sign) seems to be reliable. Overall, the model has a high degree of significance (adjusted R square = .95), and each of the parameter estimates are also highly significant. The model indicates that the effect of route restructuring was negative and in the range of about 6 percent of weekday ridership. Analysis of residuals (difference between predicted and observed values for each month) does not indicate any clear pattern of ridership recovery over the one year period following route restructuring. In addition to the inherent limitations of the regression

model, the determination of long term effects is confounded by the possible impacts on bus ridership of the unprecedented price increases in gasoline which began in February 1979. In all, RTD's estimate of a 3 percent ridership loss appears to be a reasonable assessment of the long term effect of route restructuring on ridership levels.[1]

4.1.3.2 Weekday and Weekend Ridership

It appears that route restructuring's negative ridership effects were also somewhat greater on weekends than on weekdays. As shown in Table 4.3, ridership loss due to route restructuring may have been two to three times that of weekdays. This is probably accounted for by the fact that discretionary travel, higher on weekends, may have been more affected by the revamping of transit services than non-discretionary trips. Other factors which may have been operating to depress weekend ridership levels include weather conditions, higher inflationary effects on household budgets, and the dynamics of the free fare program. Figures 4.2 and 4.3 show the three year trend for Saturday and Sunday ridership.

Table 4.3
ESTIMATED SHORT-TERM EFFECT OF ROUTE RESTRUCTURING ON RTD RIDERSHIP
TOTAL RTD PASSENGERS (LINKED):DAY OF WEEK

Period	Annual Average 1978	Percent Change* End of Year 1977	Beginning of Year 1978	Estimated RR Effect
Total Week	658,800	+ 6.0%	- 0.9%	4 to 7 %
o Weekday	116,400	+ 5.0	- 0.7	3 to 6 %
o Saturday	51,100	+16.4	- 0.8	5 to 10%
o Sunday	41,400	+20.8	- 5.7	10 to 20%

*Ratio of five month period September through January (following year) with seven month period February through August (same year).
Source: DCCO Ridership Estimates (Appendix B).

[1] Memo to John Simpson from Dick Montague. "Route Restructuring Interim Evaluation," October 13, 1978.

Figure 4.2
AVERAGE SATURDAY PASSENGERS (UNLINKED TRIPS): TOTAL SCHEDULED SERVICE

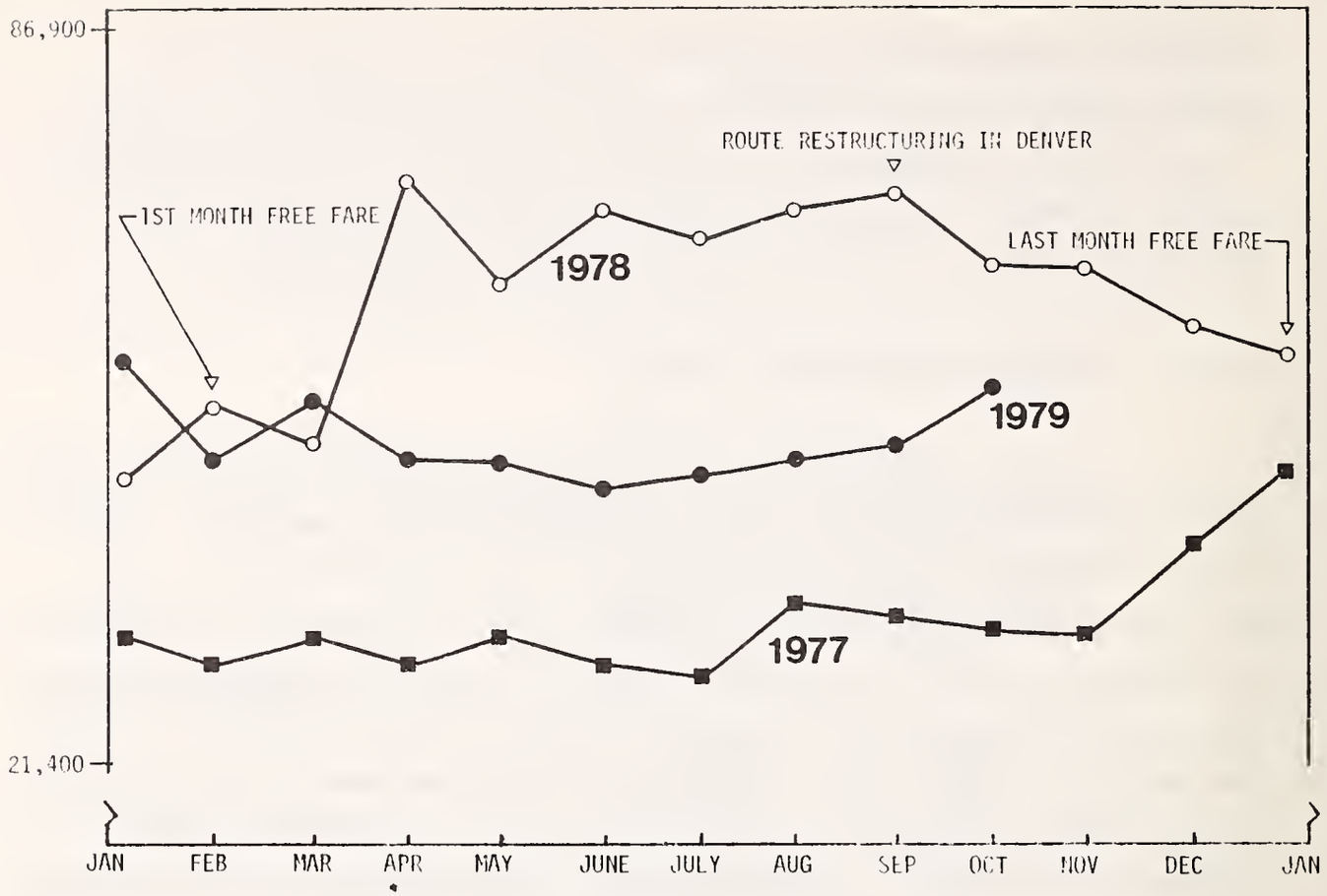
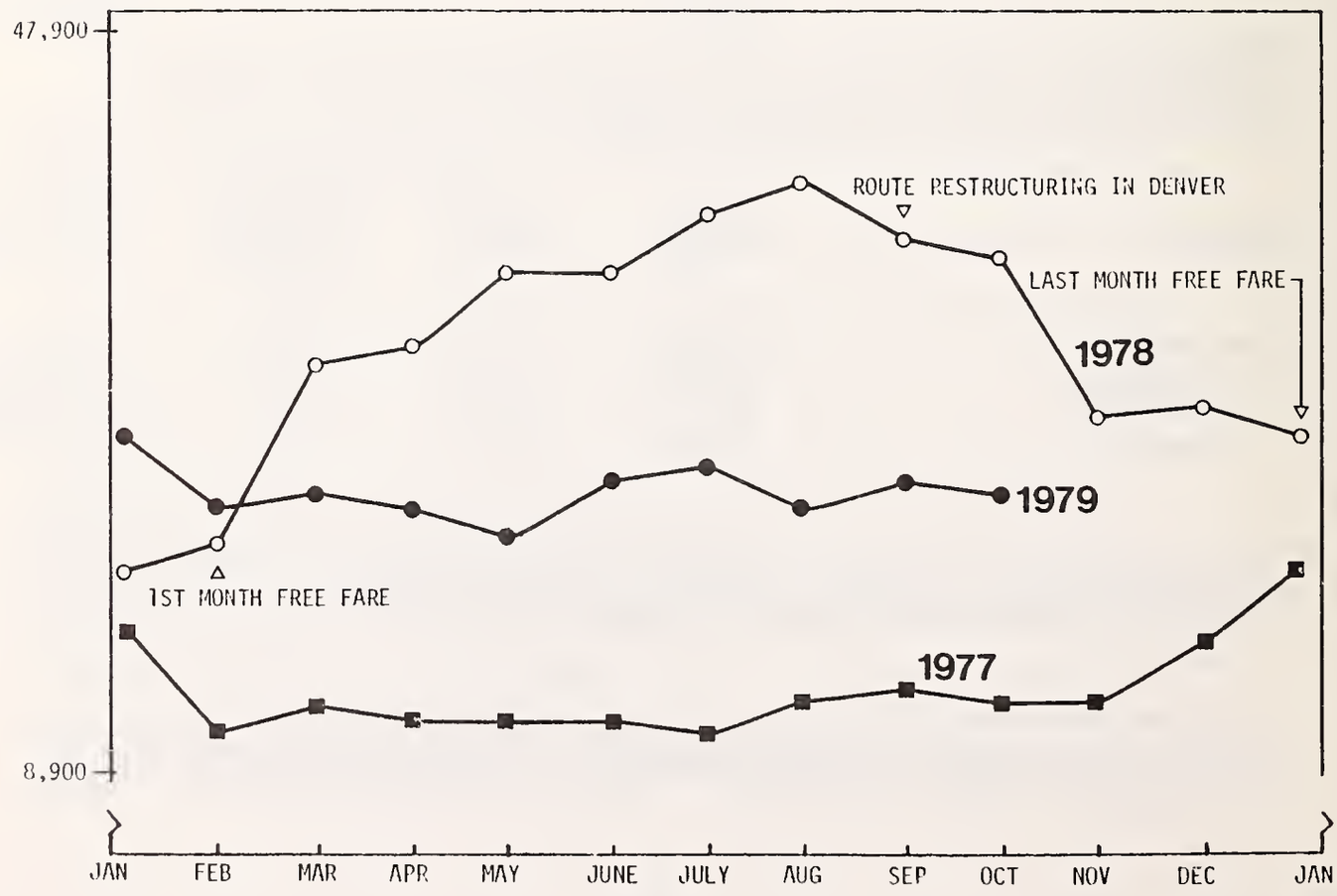


Figure 4.3
AVERAGE SUNDAY PASSENGERS (UNLINKED TRIPS):
TOTAL SCHEDULED SERVICE



4.2 Effects on Travel Behavior

The net ridership effects of route restructuring are the sum of bus trips made by new riders, plus additional bus trips made by prior riders, minus trips no longer made by prior riders. Eliminated bus trips result from former riders who either reduced their bus use or discontinued it entirely. RTD ridership appears to have a relatively high turnover rate, most of which reflects life-style factors unrelated to transit service, such as changes in home, school, or work locations. Only a relatively small portion of the change in RTD's ridership base before and after route restructuring can be directly attributable to the system changes based on available data.

4.2.1 New Riders

About 7 percent of the weekday riders surveyed in November as part of the on-board survey reported that they began using the bus after the September changes. By March 1979, about 19 percent were new to the bus since route restructuring. However, in the detailed follow-up telephone survey of new riders identified in the November on-board survey, only about 29 percent attributed beginning bus use to the system changes. Consequently, it appears that about 2 percent of weekday trips, or about 2300, were made by new riders who began using transit primarily because of route restructuring. The average bus use frequency of new riders was 5.2 transit trips per week among those who made at least one bus trip per week. This is a higher rate of bus use than reported by either new riders who started for reasons unrelated to route restructuring (4.0) or all prior riders (3.2).

4.2.2 Prior Riders

In the first month following route restructuring, a telephone survey indicated that the system changes had affected the travel behavior of about 20 percent of those persons who used the bus before restructuring.

As shown in Table 4.4, almost twice as many former riders reported that they had decreased their use of the bus (9%) as reported having increased it (5%) because of the system modifications. A sizeable number (6%) of prior riders said they had stopped using the bus entirely because of restructuring.

By the January 1979 telephone follow-up survey, about 10 percent of the prior riders who had initially changed their bus habits because of route restructuring had stopped using the bus (1% of total weekday). Of the 80 percent of prior weekday riders who had initially reported no effect in the first month following the changes, about 15 percent had also stopped using the bus by January, about one-quarter of them stating that the reason was dissatisfaction with the new transit service (3% of total weekday). On the other hand, by January, about one-third of those riders who had initially discontinued using the bus had begun to use it again (2%) of total. As shown in Table 4.4, the estimated net "long-term" effect on prior weekday riders was that about 6 percent stopped using transit and had not resumed its use six months after route restructuring had taken place.

Table 4.4
EFFECT OF ROUTE RESTRUCTURING ON BUS TRIP MAKING OF PRIOR USERS

	Percent of Total Weekday		
	1st Month Round 1 (10/78)	About 5 Months After RR Round 2 (1/79)	
	Change Due to RR	Stopped Due to RR	Restarted Due to RR
Trip Making			
Unchanged	80%	3%*	N/A
Increased	5	1%**	-
Decreased	9		
Stopped Bus Due to RR	6	(4)	2***
	100%	8%	2%

*(.15 x .80 x .25 = .03)
**(.10 x .14 = .01)
***(.33 x .06 = .02)

Source: Transit User Follow-Up Surveys

Table 4.5 shows some of the reasons why former transit users stopped using the bus. By March 1979, six months following route restructuring, about one-half of prior riders had quit for reasons not directly attributable to the quality of transit service provided. Only a small proportion, 5 percent, quit because off-peak fares had been reinstated. Of the 44 percent who quit because of dissatisfaction with transit service characteristics, the most common problems cited were that bus stop locations were now too far to walk to, service was less frequent or buses ran behind schedule. (See Section 5.0 for detailed discussion of rider perceptions of the level of service impacts of route restructuring.)

Table 4.5
REASONS PRIOR RIDERS STOPPED USING TRANSIT

Reasons	N	General*	Specific*
Due to Bus Service:	17	44%	-
• Bus Stop Too Far	7		41%
• Bus Not on Time	5		29%
• Trip Takes Too Long	1		6%
• Less Frequent Service	5		29%
• System Confusing	3		18%
Because Free Fare Ended:	4	5%	100%
Other Reasons:	20	51%	-
• New Work or School Location	9		45%
• Car Now Available	6		30%
• Carpool	2		10%
• No Need Now for Transportation	3		15%

N=39
*Percentages do not accumulate to 100% because of multiple responses.

Source: Transit User Follow-Up Survey 3 (5/79)

4.2.3 Size of Transit Market

During the demonstration about 10 percent of the population of the Denver metropolitan area used transit at least once during a typical week. (Random Household Surveys, 10/78 and 1/79) If, as indicated in the discussion above, 6 percent of former riders quit and 2 percent of post-route restructuring riders were new because of the changes, the net effect was probably about a 4 percent shrinkage in the total transit user population affecting less than half of one percent of the total population of the RTD service district population.

This conclusion is consistent with the 3 percent estimate of "long-term" transit trip loss, because it was found that new riders attracted to the system were more frequent users than either prior riders who stopped or prior riders who continued to use the RTD buses. (Telephone surveys, adjusted for probability of selection bias.)

4.3 Source of Transit Trips after Route Restructuring

Table 4.6 presents the results of the on-board survey conducted one month following route restructuring. It indicates that about two-thirds of November weekday bus trips were made by former riders who made the trips surveyed previously by bus. About 16 percent were reportedly made before September by some other mode; about 7 percent or 7800 weekday trips by automobile. Most of these diverted trips, however, must be attributed to normal ridership dynamics or to the off-peak free fare incentive, rather than to route restructuring. About 17 percent of all bus trips were reported by riders as new trips which were not made before September; about 2 percent were, according to riders, induced specifically because of route restructuring improvements.

Table 4.6
SOURCE OF WEEKDAY BUS TRIPS TWO MONTHS AFTER ROUTE RESTRUCTURING*

Source of Person Trip	Percent	Number
Prior Bus Trip	66.6%	79,000
Other Mode		
• Auto Driver	5.0	5,900
• Auto Passenger	1.6	1,900
• Walk	2.0	2,400
• Other	5.8	6,900
• No Response	2.1	2,500
	16.4%	19,500
New Bus Trip Since RR		
• Induced by RR	2.0	2,400
• Other Reason Specified	10.8	12,800
• No Response	4.3	5,100
	17.1%	20,300
Total	100.0%	118,600
N (Weighted) =	10,070	-

*During Off-Peak Free Fare Demonstration

Source: On-Board Survey (11/78): Analysis units are weekday bus trips. No adjustments have been made to reflect variable trip-making frequencies among passengers since probability of selection bias is not a problem in this case.

4.4 Effects on User Characteristics

Comparison of the ridership profiles of weekday passengers before and after route restructuring (during off-peak free fare demonstration) shows little difference between the distribution of income, sex, age, or auto availability characteristics of RTD riders. There was,however, a significantly smaller proportion of non-white riders in the second survey; a decline from about 22 to 18 percent of total between the two on-board surveys. These aggregate cross-sectional comparisons, in fact, mask a fairly complex pattern of responses to the route changes among different subgroups of the population. Changes in ridership generally varied with age, income, and race.

People who were younger, poorer, or non-white were more likely to have changed their usage of RTD because of route restructuring; i.e., increases in both the percentage of persons who rode more and the percentage of those who rode less because of restructuring are found among these groups. For example - while only 8 percent of riders whose trip making was unaffected were 16 years of age or younger, 13 percent of those who rode less often and 19 percent of those who rode more often were in this young age category.

Table 4.7 shows the distribution of different user characteristics for riders using RTD before route restructuring and those who began after the changes. Compared to prior riders who report that their rate of bus use has been unaffected by route restructuring, new riders tended to be considerably younger, somewhat more affluent, more likely to be male, and have an automobile available as an alternative mode. The most noticeable difference between the two groups is that only 1 percent were elderly. Racial differences between new riders and prior riders who were unaffected were modest, a slightly higher percentage of non-whites than found in the new rider group.

Prior riders who began using the bus more often following restructuring were generally younger, less affluent and included a higher percentage of non-whites and males than unaffected users. Prior riders who report less frequent bus travel as a result of restructuring were more likely to have an automobile available, but were also, like more frequent users, younger, and poorer. Similarly, the highest rates of ridership attrition due to route restructuring were among the young and minorities. However, those with incomes greater than $15,000 were the most likely to discontinue using the bus. In conclusion, there appears to have been no clear cut pattern of adverse and beneficial impacts among socio-economic and demographic groups. However, by and large, younger riders were more likely to change their transit use, as were, to a somewhat lesser extent, males and non-whites.

Table 4.7
USER CHARACTERISTICS OF PRIOR AND NEW RIDERS
AFTER ROUTE RESTRUCTURING

User Characteristics	Prior Riders			New Riders
	More Often	Less Often	Same As Before	Service RR
AGE				
• 16 or Younger	19	13	8	11
• 17-24	35	34	28	31
• 25-44	31	33	36	43
• 45-64	11	14	21	13
• 65 or Older	5	6	6	1
	100%	100%	100%	100%
INCOME*				
• Under $5,000	34	22	20	16
• $5-9,999	23	27	26	24
• $10-14,999	15	17	19	18
• $15-24,999	16	19	20	21
• $25,000 or more	12	15	15	21
	100%	100%	100%	100%
ACCESS TO AUTO*				
• As Driver	36	45	41	53
• As Passenger	14	11	8	7
• No Car Available	50	44	50	40
	100%	100%	100%	100%
RACE*				
• White	63	72	78	76
• Black	21	15	11	12
• Hispanic	11	8	8	7
• Other	6	5	4	5
	100%	100%	100%	100%
SEX*				
• Male	49	41	40	53
• Female	51	59	60	47
	100%	100%	100%	100%
n =	1410	1543	4278	518
Percent Weekday Total Trips Represented	(18%)	(20%)	(55%)	(7%)
Estimated Weekday Trips	21,300	23,700	65,200	8,300

*Riders 17 years of age or older

Source: On-Board Survey 2 (11/78)
During Off-Peak Free Fare Demonstration

A similar socio-economic pattern is shown in Table 4.8 for post-route restructuring bus users making trips that were previously made either by bus, some other mode or not made at all. New trips made due to perceived route restructuring improvements (2% of total) and other new trips since route restructuring (15% of total) were made by a generally younger, lower-income and more transit-dependent group than prior riders. Trips attracted from other modes (14% of total) were made by a group with a higher average income, rate of auto availability, and male, non-white percentages. In all, the data suggest that the net effect of route restructuring on the user profile of RTD ridership was small, but in the direction of a somewhat more captive ridership.

Any action which reduces transit ridership will mostly affect the travel behavior of those with an alternative. However, a sizeable proportion of the more disadvantaged users were affected and did report reducing their bus use as a result of the changes. The one group that is of particular concern is the elderly. Compared to all other groups, the elderly were more likely to believe that bus service had deteriorated, but they were also less likely to alter their number of trips.

4.5 Effects on Trip Characteristics

The survey data available is not conclusive regarding the impacts of route restructuring on bus trip characteristics. Seasonal variations inherent in the data probably account for a large but indeterminate proportion of the differences observed between the surveys conducted before and after the route restructuring.

Table 4.8
USER CHARACTERISTICS OF RIDERS MAKING BUS TRIPS
AFTER ROUTE RESTRUCTURING: PRIOR BUS, OTHER MODES
AND NEW TRIPS

User Characteristics	Prior Trips By:		New Trips	
	Bus	Other Mode	Due to RR	Other Reason
AGE				
• 16 or younger	10	19	34	16
• 17-24	28	32	27	40
• 25-44	35	34	25	34
• 45-64	20	13	9	7
• 65 or older	7	2	4	3
	100%	100%	100%	100%
INCOME*				
• Under $5,000	22	19	31	26
• $5-9,999	25	24	20	29
• $10-14,999	18	16	12	19
• $15-24,999	20	21	21	16
• $25,000 or More	15	19	16	10
	100%	100%	100%	100%
ACCESS TO AUTO*				
• As Driver	41	52	35	36
• As Passenger	10	16	9	7
• No Car Available	50	32	56	57
	100%	100%	100%	100%
RACE*				
• White	74	68	68	75
• Black	13	17	12	14
• Hispanic	8	10	15	6
• Other	4	6	6	5
	100%	100%	100%	100%
SEX*				
• Male	41	54	45	45
• Female	59	46	55	54
	100%	100%	100%	100%
n =	6056	1216	136	1291
Percent of Total Weekday Trips Represented	(70%)	(14%)	(2%)	(15%)
Estimated Weekday Trips	83,000	16,600	2,400	17,800

*Riders 17 years of age or older

Source: On-Board Survey 2 (11/78)
During Off-Peak Free Fare Demonstration

4.5.1 Trip Purposes

As presented in Table 4.9, the on-board survey conducted in August before route restructuring showed that about one-half (50.1%) of all weekday bus trips were home-based work trips. Approximately the same proportion (49.9%) of post-route restructuring trips in November were also between home and work. The principal differences in the trip purpose distributions between the two surveys is the greater number of school trips as would be expected in the Fall, and the considerably smaller proportion of shopping and social-recreational trips (see Table 4.9).

Table 4.9
TRIP PURPOSE DISTRIBUTION BEFORE AND AFTER RESTRUCTURING:
Weekday Bus Trips

Trip Purpose	Before Round 1* (8/78)	After Round 2* (11/78)
Home Based:		
• Work	50.1%	49.9%
• Shopping	15.7	8.4
• Social-Recreational	7.9	4.5
• School	3.6	15.6
• Other	9.0	7.6
Non-Home Based:	13.8	14.0
All Purposes	100.0%	100.0%

*During Off-Peak Free Fare Demonstration

Source: On-Board Surveys 1 (9/78) and 2 (11/78)

Most of this difference can be attributed to seasonal variations in trip patterns between Summer and Fall. Consequently, it appears that if route restructuring had any, it had only a negligible impact on changes in trip purpose.

4.5.2 Geographic Distribution

The impacts of route restructuring on the spatial distribution of bus trips in the Denver metropolitan area were examined using three generalized origin-destination areas for intra-regional bus travel shown in Figure 4.4. They include downtown Denver (CBD), other portions of the central city core (Inner Area) and all remaining areas of the Denver MOG service district (Peripheral Areas).

As shown in Table 4.10 there appears to have been a sizeable geographic shift in bus travel following route restructuring. The survey data supports the expectation of planners that route restructuring would result in a higher proportion of bus trips made to non-CBD locations. As a result of the increased transit accessibility provided these areas. However, seasonal fluctuation and perhaps response (or coding procedure) bias in the survey data may be the primary source of variation between the two distributions; note the substantial difference between the two surveys in the rate of useable questionnaires with encoded trip origins and destinations. As a result of these problems, the conclusions regarding the effect of the project on the spatial distribution of bus travel remain tentative.

Table 4.10
GEOGRAPHIC DISTRIBUTION BEFORE AND AFTER ROUTE RESTRUCTURING:
Weekday Bus Trips

Geographic Type To or From	Before Round 1* (8/78)	After Round 2* (11/78)
CBD/Downtown	47.6%	39.2%
Inner Area (non CBD)	36.1	37.1
Other/Peripheral	16.3	23.7
	100.0%	100.0%
Sample with O & D coded	2,170	6,359
Total Sample (N)	8,794	10,492
Completion Rate	24.8%	61.0%
Average Weekday Transit Trips during Month	116,200	118,600

*During Off-Peak Free Fare Demonstration

Source: On-Board Surveys 1 (8/78) and 2 (11/78)

Figure 4.4
MAJOR ORIGIN AND DESTINATION AREAS: City of Denver

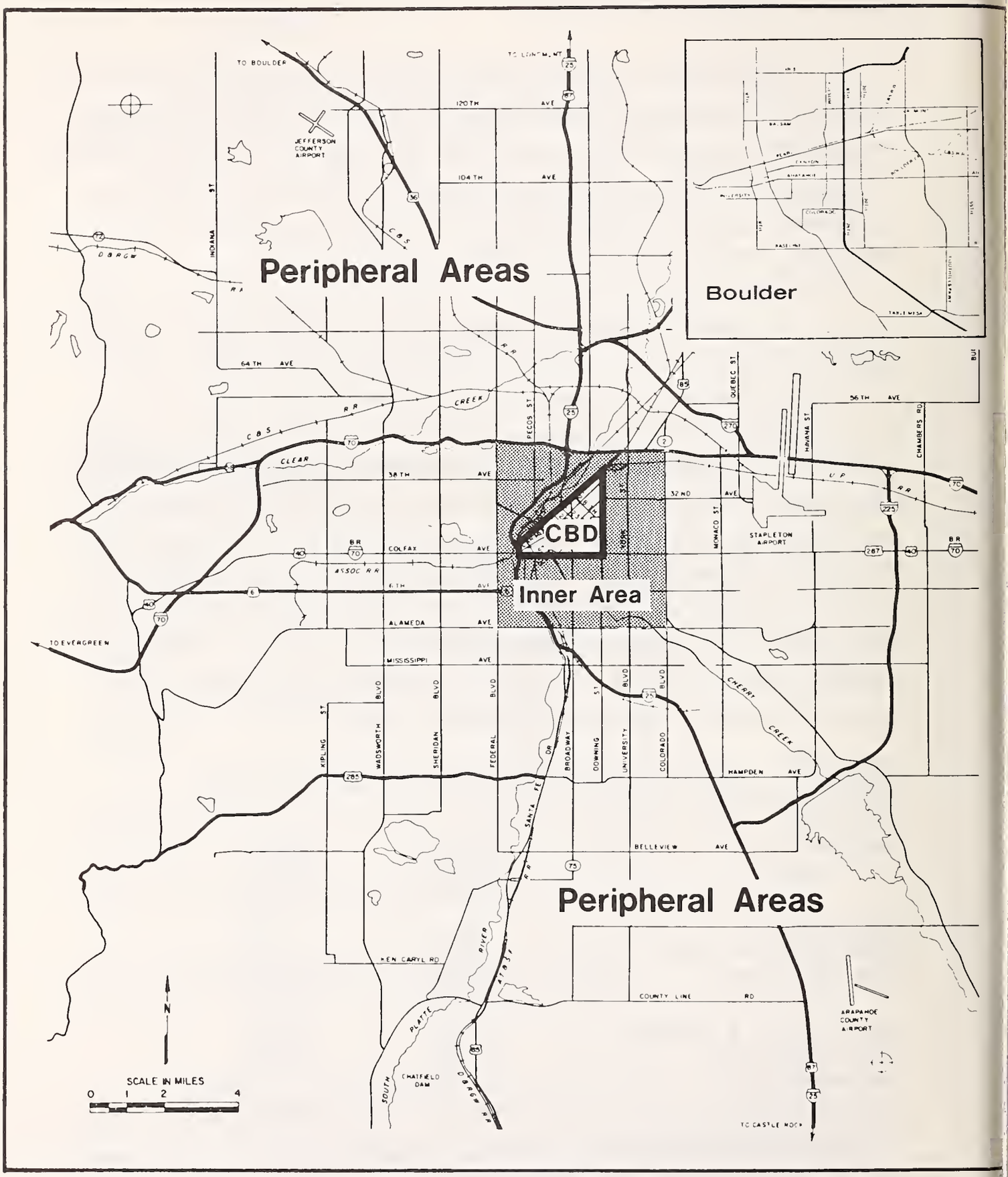


Table 4.11 shows the distribution of total bus trip ends (origins plus destinations) on a somewhat more disaggregated geographic basis. The differences between the before and after surveys suggest that Northwest Denver, West Colfax and the Southern Broadway corridor generated a higher percentage of RTD's total boardings and alightings after route restructuring. A correspondingly smaller share of total ridership following route restructuring was accounted for by downtown Denver, Southeast Denver and the East Colfax corridor. Because of potential seasonal and survey-related bias, these results may not accurately capture the true effect of the route changes on geographic trip patterns. However, they are consistent with one intended effect of the project, to enhance transit service levels to non-downtown commercial and employment centers not well served previously by the old CBD-focused radial network.

Table 4.11
GEOGRAPHIC DISTRIBUTION OF TRIP ENDS (SUM OF FINAL ORIGINS AND DESTINATIONS): BEFORE AND AFTER ROUTE RESTRUCTURING

General Area Within Denver	Before Round 1* (8/78)	After Round 2* (11/78)	Change Percentage Points
Northwest	5.6%	6.7%	+1.1%
Northeast	2.3	2.5	+ .2
West Colfax	5.8	6.8	+1.0
East Colfax	9.1	8.4	- .7
Core/Inner Area	29.2	28.6	- .6
CBD	24.2	21.4	-2.8
South Broadway	6.1	8.7	+2.6
Southwest	7.2	8.1	+ .9
Southeast	10.6	8.9	-1.7
	100.0%	100.0%	100.0%
n =	4,352	11,621	-

*During Off-Peak Free Fare Demonstration

Source: On-Board Surveys

5.0 TRANSPORTATION SUPPLY AND COST

5.1 Effects on Quality of Service

It is important to remember that the route restructuring occurred in the middle of the off-peak free fare one year demonstration. As a result of the free fare demonstration there was a clear reduction in service levels provided during the off-peak hours. Without any major changes in service, the additional transit patronage frequently resulted in higher passenger loads on many RTD off-peak buses. Longer travel times, as well as diminished schedule adherence, were more common than before the demonstration. Passenger comfort also deteriorated somewhat due to increased crowding on the buses and an apparent increase in on-board harassment by rowdies and drunks. Degradation of service levels was reflected in bus user and bus driver attitudes, as well as in field observations made as part of the evaluation.

5.1.1 Riders' Perceptions of Service Impacts

The extensive surveys conducted as part of the evaluation indicate that route restructuring was also perceived negatively by a substantial portion of transit users, and by a considerably larger number than viewed it as having improved bus service. As shown in Table 5.1, close to half (44%) of RTD users thought that the restructuring had caused a deterioration in service when interviewed one month following the September changes. Less than one-quarter viewed the new system as providing an overall improvement in service. As time progressed, riders evidenced somewhat more favorable opinions about the effects of the route restructuring, but even as late as eight months afterward, only about one-quarter (26%) of those persons who had used the bus before route restructuring perceived an improvement in service levels; a larger group of prior riders (38%) continued to think that it had caused a deterioration in transit service. Table 5.1 also shows,

however, that riders who began using RTD after the changes were less negative, but were not on the other hand especially positive about the service impacts. The perceptions of the general public, the majority of which do not use the bus system in Denver, were quite similar to those of the new riders, about evenly balanced between those who saw an improvement and those who believed it had gotten worse, with a large share indifferent. Without direct transit user experience, the perceptions of the non-riding Denver resident were apparently based on information gained from the RTD public information program, news accounts or word-of-mouth reports from acquaintances.

Table 5.1
PERCEIVED OVERALL EFFECT OF ROUTE RESTRUCTURING ON TRANSIT SERVICE: FORMER RIDERS, NEW RIDERS, AND GENERAL POPULATION

Effect	Prior Riders (A)			New Riders (B)	General Population (C)
	Round 1* (10/79)	Round 2* (1/79)	Round 3 (5/79)	Round 3 (5/79)	Round 3 (5/79)
Improved	22	27	26	20	22
Worsened	44	41	38	18	20
Had No Effect	18	27	30	26	20
No Answer/ No Opinion	16	5	6	37	40
	100%	100%	100%	100%	100%
n =	644	644	232	96	835

*During Off-Peak Free Fare Demonstration

Sources: (A) Transit User Follow-Up Survey: From On-Board 1 (8/78)
(B) New Rider Follow-Up Survey (5/79): From On Board 2 (11/78)
(C) Random Household Survey

Despite the predominant perception that the route restructuring had caused a decline in the quality of bus service, a majority of RTD users remained on the whole satisfied with the transit service they received. Table 5.2 shows that the percentage of prior RTD users who were either very or somewhat satisfied with bus service, went from about 57 percent to about 64 percent from October 1978 to May 1979. However, a sizeable number of these former riders were "very" dissatisfied after the route changes, although their numbers decreased with time. New riders were overwhelmingly satisfied with the bus service they had begun to use in September.

Table 5.2
LEVEL OF SATISFACTION WITH TRANSIT SERVICE:
FORMER AND NEW RIDERS

Satisfaction with RTD	(a) Prior Riders			(b) New Riders Since RR	
	Round 1* (10/78)	Round 2* (1/79)	Round 3 (5/79)	Due to RR (1/79)	Other (1/79)
Very Satisfied	25	21	21	26	40
Somewhat Satisfied	32	38	43	62	46
Somewhat Dissatisfied	21	25	21	10	11
Very Dissatisfied	22	16	15	2	4
	100%	100%	100% **	100%	100%
N=	639	639	233	42	83

*During Off Peak Free Fare Demonstration
**Adjusted: 10 percent of sample reported no longer riding the bus

Sources: a) Transit Users Follow-Up Surveys: From On-Board 1 (8/78).
b) New Rider Follow-Up Survey (1/79):From On-Board (11/78).

Table 5.3 shows prior riders' perceptions of the effects of route restructuring on specific attributes of bus service. Comparison of the proportions of riders who viewed the changes as bringing about an improvement with those who perceived a deterioration in a particular service aspect reveals that the major negative effects of concern to riders were:

- Longer waiting times/less frequent headways (35% worsened/ 17% improved).
- Greater walking distance to bus stops (25% worsened/18% improved)
- Longer transfer delay (18% worsened/11% improved)
- Poorer schedule reliability (25% worsened/19% improved)

A fairly large, but nearly equal number of riders, thought crowding and on-board travel times had either been improved or worsened by the changes. Nearly three-quarters of riders, on the other hand, did not think that route restructuring had affected either driver

Table 5.3
PERCEIVED EFFECT OF ROUTE RESTRUCTURING
ON SERVICE ATTRIBUTES:PRIOR USERS

Effect of Route Changes	Walk Distance	Wait Time	Schedule Reliability	Transfer Delay	Seat Availability	On-board Travel Time	Sense of Security	Driver Courtesy
Much Better	8	5	6	3	9	8	5	8
Somewhat Better	10	12	13	8	14	13	9	9
Same/No Effect	56	49	56	22	55	57	74	71
Somewhat Worse	16	23	17	11	13	14	8	10
Much Worse	10	12	8	7	10	9	3	3
Does Not Apply	-	-	-	48	-	-	-	-
	100%	100%	100%	100%	100%	100%	100%	100%

N (Unweighted) = 829

Source: Transit User Follow-Up Survey 1 (10/78): From On-Board 1 (8/78)

Table 5.4
LEVEL OF SATISFACTION WITH BUS SERVICE: PRIOR USERS

Opinion	Walk Distance	Wait Time	Schedule Reliability	Transfer Delay	Seat Availability	On-board Travel Time	Sense of Security	Driver Courtesy
Very Satisfied	43	24	32	9	43	37	49	48
Somewhat Satisfied	33	32	38	18	31	43	36	35
Somewhat Dissatisfied	13	23	17	15	12	12	11	12
Very Dissatisfied	10	21	13	12	13	9	5	5
Does Not Apply	-	-	-	46	-	-	-	-
	100%	100%	100%	100%	100%	100%	100%	100%

N = 967

Source: Transit User Follow-Up Survey 1 (10/78) From On-Board 1 (8/78)

courtesy or security on board. A slightly larger minority thought that these service attributes had improved rather than had declined with the route changes.

Riders using the system after route restructuring reported similar opinions on the on-board surveys regarding the specific effects of route restructuring on service levels. While perceptions of diminished service levels became somewhat less pervasive over time, they remained relatively persistent. About one-fourth (20%) of the weekday riders surveyed on board two months after route restructuring indicated they now waited longer for their bus, more than twice as many as those who reported waiting less (8%). By March 1979, 16 percent still thought they waited longer than before; about 9 percent less. The on-board surveys also indicated that while the majority (one-half to two-thirds) felt that neither walk distance nor on-bus travel times had been affected, about twice as many as not thought these had worsened rather than improved as a result of route restructuring.

Table 5.4 shows the level of satisfaction of prior RTD users with specific aspects of transit service one month after route restructuring. Despite the negative effects perceived by some riders, a majority of riders were either very or somewhat satisfied with every attribute of the bus service. However, a substantial proportion (44%) was dissatisfied with waiting times, a much greater degree of dissatisfaction than with any of other service attributes, including those which were thought to have also declined because of route restructuring.

5.1.2 Short-Term Service Effects

As discussed above, most of the negative effects of route restructuring perceived by users of the system were apparently more intense in the period immediately following the changes in September than later on. Some initial service problems appeared to be an inescapable consequence of disrupting transit riders' travel habits

and daily bus operation. RTD planners anticipated short-term negative effects and took measures to minimize their intensity and duration. Even with the extensive public information campaign undertaken to explain the new system to the public, as well as the driver training efforts, major service problems did occur in the first several weeks following the September restructuring of the system.

Readjustment of transit demand to the new routing resulted in serious overcrowding on some routes, leading to major schedule adherence problems on these lines. The severe initial problems were substantially reduced within the first two weeks. However, some routes, such as the 15-Colfax (the most heavily used line), continued to run late as a result of overcrowding even after extra service was added in December.

A total 1588 complaints were received by RTD's Customer Assistance during the month of September.[1] This represented a 45 percent increase over August, but only 8 percent higher than the number of complaints received in June following the relatively minor service cut-backs implemented with that quarterly run-board change. However, about five times as many scheduling complaints were received as in June, and complaints about bus stop locations were also especially high. Complaints in both these categories declined substantially by October; about a 60 percent and 35 percent reduction respectively.

5.1.3 Long-Term Effects: Service Implications of Restructured Grid System

The restructuring of bus routes in Denver has resulted in some long-term impacts on the quality of service which stem from the transit service concepts operationalized in the establishment of the new system. These effects relate primarily to differences between the former radial route network and the more grid-like new system achieved. The perceived service effects cited by survey respondents eight months after the

[1] RTD. Marketing Department, "Customer Assistance Summaries," 1978.

September changes appear to primarily reflect opinions about the nature of transit service provided under the new system per se, as opposed to reflecting lingering opinions related to the disruptive nature of a major change and the adjustments required of riders. These longer term effects are primarily relevant to the evaluation of the transit service concepts installed, rather than the process of their implementation.

5.1.3.1 Transit Access

As discussed in some detail in Section 3.2.1, a major underlying notion of the restructured grid-like system was the fact that total access time to transit consists of both the time required to get to a bus stop and the time spent waiting at the stop for the transit vehicle to arrive. The average distance to a bus stop was increased as a result of buses operating on fewer streets with more widely spaced stops. However, more frequent service was intended to reduce waiting times at the bus stops, and if not reduce total access time in most cases, at least off-set increased walking distance and time. Furthermore, improved travel speeds resulting from straighter routes operating on streets with faster traffic flow and fewer stops would decrease the total travel time for most transit rides. Implicit in this planning guideline were 1) the expectation that major service headway and schedule speed improvements could be achieved with reduced route mileage, and 2) the notion that the "typical" person values each component of total travel time equally.

Because of the relatively wide spacing of routes (see Table 5.5), dissatisfaction was expected by some riders with increased walking distances, but probably not of the magnitude found in the user surveys conducted after the route restructuring.

Table 5.5
TYPICAL ROUTE SPACING AFTER ROUTE RESTRUCTURING
(1978 NETWORK): LOCAL SERVICE

East/West Grid (Between Sheridan & Federal/ 52nd and Hampden)	.6 Miles	5 Blocks (lengths)
North/South Grid (Youngfield & Federal/ 26th & 38th)	2.1 Miles	20 Blocks (widths)
Broadway Corridor (Between Federal & University)	1.3 Miles	12 Blocks (widths)
Colfax Corridor (Between Alameda & 26th)	.9 Miles	7 Blocks (lengths)

Source: RTD Route Map, September 1978

The post-restructuring surveys indicate that more riders than not perceived a deterioration in all components of trip time, especially in waiting time and walking distance. Table 5.6 shows the reported characteristics of access to weekday bus trips in the on-board survey conducted before and after the route restructuring. The average bus trip following the service changes required 14.6 minutes in total time spent at the bus trip origin. The average distance walked to the stop was 2.6 blocks, or about 3.9 minutes in time. The average wait time was 10.7 minutes, about a 15 percent increase over that reported in August. The table suggests that peak hour effects were greater than off-peak impacts.

Table 5.6
EFFECT ON TRANSIT TRIP ACCESS
CHARACTERISTICS (TRIP ORIGINS)

TOTAL WEEKDAY	Before Round 1*	After Round 2*	Percent Increase
Walk Distance (Blocks)	2.5	2.6	+ 3.6
Walk Time (Minutes)	3.8	3.9	+ 3.6
Wait Time (Minutes)	9.3	10.7	+14.5
Total Terminal Time	13.1	14.6	+11.5%
PEAK WEEKDAY			
Walk Distance (Blocks)	2.4	2.6	+ 8.6
Walk Time (Minutes)	3.7	4.0	+ 8.6
Wait Time (Minutes)	8.0	9.3	+16.0
Total Terminal Time	11.7	13.3	+13.7%
OFF-PEAK WEEKDAY			
Walk Distance (Blocks)	2.5	2.6	+ 1.2
Walk Time (Minutes)	3.8	3.9	+ 1.2
Wait Time (Minutes)	9.9	11.3	+13.8
Total Terminal Time	13.7	15.2	+10.9%

*During Off-Peak Free Fare Demonstration
Source: On-Board Surveys (8/78) and (11/78)

Increases in waiting time at the trip origin resulted in part because of the fact that service frequency improvements were not implemented as extensively as initially planned. This may be attributed to modifications in the initial routing concept made to accommodate public and official demands for retention of service in specific areas, and to other traffic flow factors which made it difficult to achieve the increases in schedule speed that were planned. Problems with schedule adherence probably contributed most to the perceived longer waiting times.

Table 5.7 presents the results of the corner count observations made by field observers once before, and at two points in time after the major changes in service. Round 1 and Round 2 observations were both conducted during the free fare demonstration when off-peak schedule reliability problems were especially aggravated by increased passenger loads and crowding. However, the results of the November (Round 2) survey suggest schedule reliability problems were worse two months after route restructuring than before with about two-thirds of all outbound CBD buses running late, about 35 percent more than 5 minutes. With the end of free fare, the Round 3 observations still showed persistent schedule reliability problems, of about the same magnitude as those observed in November.

Table 5.7
RESULTS OF SCHEDULE ADHERENCE OBSERVATIONS:
BEFORE AND AFTER ROUTE RESTRUCTURING:
PERCENT OF CBD OUT BOUND SERVICE

Deviation from Schedule (minutes)	Before Route Changes	After Route Changes	
	Round 1* (8/78)	Round 2* (11/78)	Round 3 (3/79)
6 or More Early	1	(1)	(1)
5 to 2 Early	6	2	3
1 Early	5	6	4
Subtotal: EARLY	12%	8%	7%
0 to 2 Late: ON TIME	35%	26%	27%
3 to 5 Late	29	31	30
6 to 9 Late	18	17	21
10 or More Late	6	18	15
Subtotal: LATE	53%	66%	66%
	100%	100%	100%
N (Buses Observed)	312	472	366

*During Off-Peak Free Fare Demonstration

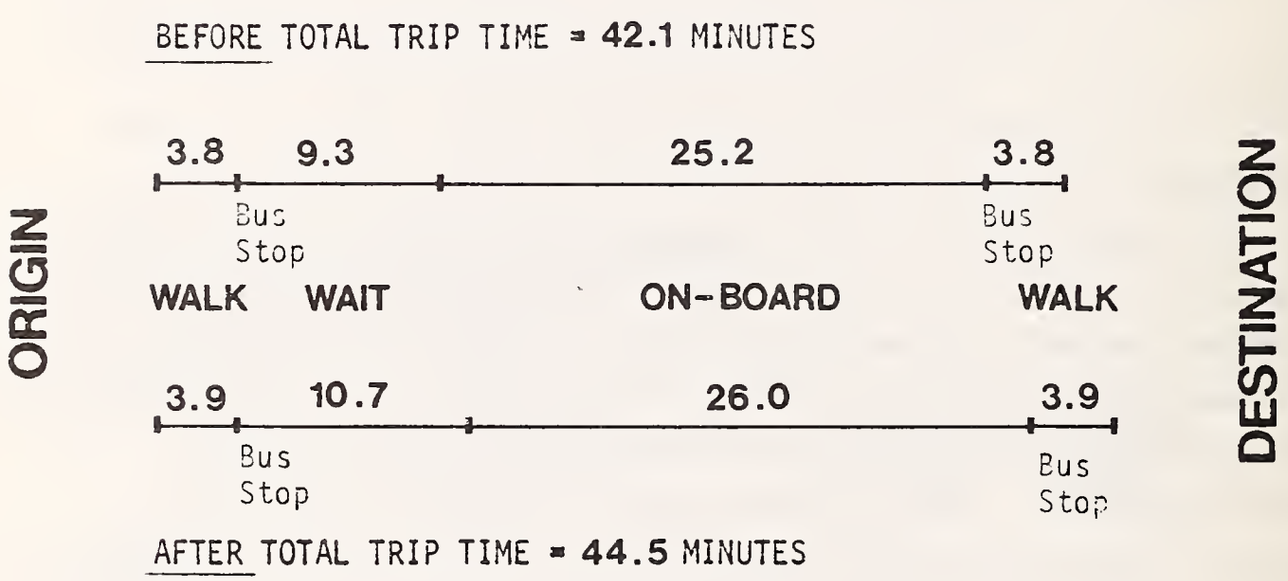
Source: CBD Cordon Corner Counts

5.1.3.2 On-Board and Total Travel Times

On-board travel times were improved for some trips served by the new transit network, but the typical trip was unaffected. The system average schedule speed actually declined 2.5 percent from 13.6 mph in the seven months of the demonstration prior to route restructuring to 13.2 mph in the remaining months of the demonstration after route restructuring. Operating speeds on express routes were increased, however, while average speeds on Locals, Circulators, and Intercity routes were somewhat slower.

As a consequence of the increased walking and waiting times and the absence of improvement in vehicle operating speeds, total bus travel times increased for the typical trips served. Figure 5.1 shows that between August and November, total trip time increased slightly for the typical Denver bus trip average distance (about 6 miles) from about 42 minutes to 45 minutes. While some seasonal effects may have affected the data, the negative direction of impacts is the same for all components of total trip time. By March 1979, average wait times had returned to the pre-route restructuring level, as had average walking distance. These findings probably reflect an indeterminate mixture of improved operating reliability; restored coverage, bus stops, added trips, and corrected published schedules; and ridership adjustment to new service supply characteristics.

Figure 5.1
EFFECT OF ROUTE RESTRUCTURING ON TOTAL TRAVEL TIME (MINUTES):
AVERAGE BUS TRIP 6 MILES IN LENGTH



Source: On Board Surveys (8/78) and (1/79).

5.1.3.3 Overcrowding

Table 5.8 presents the results of the load factor observations made as part of the three rounds of corner counts conducted by RTD. It shows that the percentage of overcrowed buses observed before and after route restructuring increased for Express and peak period Local Regular routes. After the reinstatement of off-peak fares in February 1979, non-rush hour crowding improved, but the proportion of overcapacity rush hour buses remained relatively constant, even six months after the restructuring.

Table 5.8
RESULTS OF LOAD FACTOR OBSERVATIONS
PERCENT OF CBD OUTBOUND BUSES OBSERVED WITH
LOADINGS IN EXCESS OF SEATED CAPACITY

Service Type	Before Route Changes		After Route Changes			
	Round 1* (8/78)		Round 2* (11/78)		Round 3 (3/79)	
	Total No.	% Over-crowded	Total No.	% Over-crowded	Total No.	% Over-crowded
Regular Routes	247	21%	412	19%	302	16%
• Peak	140	21%	231	24%	177	23%
• Off Peak	107	21%	181	12%	125	6%
Express	65	17%	60	27%	64	28%
All Buses Observed	312	20%	472	20%	366	18%

*During Off-Peak Free Fare Demonstration

Source: CBD Cordon Corner Counts

5.1.3.4 Transfer Rates

Reorientation of transit service from an essentially radial system serving the CBD best to a more grid-like network was expected to affect interline transfer rates and patterns. Table 5.9 shows that the percentage of total trips served by transit which did not require a transfer declined slightly from about 77 to 75 percent of all boardings. Trips involving one transfer increased, as was anticipated with the grid-like system. A small increase in trips requiring two or more transfers also is evident from the on-board survey data which probably was not expected since the grid system should virtually eliminate backtracking and multiple transferring.

Table 5.9
COMPARISON OF TRANSFER RATES BEFORE AND AFTER ROUTE CHANGES: TOTAL SCHEDULED SERVICE

Number of Transfers	Before Route Changes	After Route Changes	
	Round 1* (8/78)	Round 2* (11/78)	Round 3 (3/79)
No Transfer	76.5	74.6	74.9
1 Transfer	17.1	18.7	18.6
2 or More	6.4	6.7	6.5
Total Linked Trips (Revenue Passengers)	100.0%	100.0%	100.0%
Percent Linked Trips of Unlinked Trips	76.2%	75.0%	75.2%
Average Number of Trip Segments per Linked Trip	1.31	1.33	1.33

*During Off-Peak Free Fare Demonstration

Source: On-Board Surveys

Table 5.10 shows the changes in transfer rates which occurred for trips to and from different parts of the urban area following route restructuring. The rate of transferring for trips to or from the CBD remained the lowest, but increased somewhat with the reduced radial orientation of the system. For non-CBD trips, single transfers also increased, but the elimination of some trips requiring multiple interline transferring is indicated.

Table 5.10
TRANSFER RATES BY GEOGRAPHIC TYPE OF TRIP

Number of Transfers	TO OR FROM CBD			TO OR FROM INNER AREA		
	Round 1* (8/78)	Round 2* (11/78)	Round 3 (3/79)	Round 1* (8/78)	Round 2* (11/78)	Round 3 (3/79)
No Transfers	92.9	89.6	86.9	78.0	70.8	61.5
1 Transfer	5.9	7.8	10.3	18.2	24.1	32.9
2 or More	1.2	2.6	2.8	3.8	5.1	5.6
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
N =	1036	2499	3349	779	2363	1047

Number of Transfers	OTHER ORIGIN AND DESTINATION		
	Round 1* (8/78)	Round 2* (11/78)	Round 3 (3/79)
No Transfer	67.1	69.3	64.2
1 Transfer	22.7	21.6	27.9
2 or More	10.2	9.1	7.9
Total	100.0%	100.0%	100.0%
N =	355	1507	1115

Source: On-Board Surveys

As shown in Table 5.11, the most substantial change in transfer patterns were for trips using local crosstown routes. Trips using transfers on these routes went from about 27 percent in August to about 41 percent of total in November after route restructuring. These findings are consistent with the service function intended for the new local Crosstown routes.

Table 5.11
TRANSFER RATES BEFORE AND AFTER ROUTE CHANGES BY SERVICE TYPE

Number of Transfers	LOCAL-REGULAR			LOCAL- CROSSTOWN		
	Round 1* (8/78)	Round 2* (11/78)	Round 3 (3/79)	Round 1* (8/78)	Round 2* (11/78)	Round 3 (3/79)
No Transfers	75.9	75.3	74.8	73.1	58.6	61.8
1 Transfer	17.5	17.8	18.3	19.4	32.0	29.6
2 or more	6.6	6.9	6.9	7.5	9.4	8.6
Total	100.0	100.0	100.0	100.0	100.0	100.0
N =	6518	10,415	8162	2650	1895	1446

Number of Transfers	EXPRESS			CIRCULATOR		
	Round 1* (8/78)	Round 2* (11/78)	Round 3 (3/79)	Round 1* (8/78)	Round 2* (11/78)	Round 3 (3/79)
No Transfers	96.5	96.8	92.9	71.1	70.0	76.0
1 Transfer	3.4	2.1	6.1	20.9	27.0	20.9
2 or More	0.1	0.1	1.0	8.0	3.0	3.1
Total	100.0	100.0	100.0	100.0	100.0	100.0
N =	660	709	765	581	137	375

*During Off-Peak Free Fare Demonstration

Source: On-Board Surveys

5.2 Effects on Service Operations

5.2.1 Fleet Requirements and Utilization

As of January 1978, Denver RTD had a fleet inventory of 504 motor coaches. By March, 231 new coaches had been received, expanding RTD's fleet to about 590 buses after retiring about 145 of its former coaches. However, as a result of the impacts of increased off-peak patronage, in April RTD determined the need to put 18 additional coaches into off-peak weekday service, representing a 5 percent increase in off-peak vehicle assignment. After March, about 420 coaches were utilized during peak hours and about 260 during off-peak hours on a typical weekday. Saturday and Sunday service were increased substantially in March with about 180 and 75 buses used for each of these days, respectively.

RTD reports that the extra service implemented with the March run-board changes, particularly the expanded weekend service, resulted in an over-committed fleet which led to increased maintenance problems. Much of this new service was cut back in June, resulting in a more workable active-to-spare vehicle ratio. Implementation of route restructuring in September required additional vehicle assignments which brought fleet utilization to a level approaching that of March. Temporary maintenance scheduling problems resulted, which were apparently eased as RTD continued to expand its fleet to a total of 640 buses by the end of 1979.

5.2.2 Service Rates and Hours

Table 5.12 summarizes the total miles and hours of service provided by RTD in Denver before and after route restructuring. It shows that while there was about a 2.2 percent increase in total service

miles provided, total hours of service increased by about 4.5 percent. Service on circulator routes was reduced, while the total miles and hours of service operated on local routes were increased the most.

Table 5.12
AVERAGE WEEKDAY MILES AND HOURS OF SERVICE BY SERVICE TYPE BEFORE AND AFTER ROUTE RESTRUCTURING - DENVER

	Local	Express	Circulator	Total
SERVICE MILES				
• Before (2/78-8/79)	48,800	9,810	6,250	62,900
• After (9/78-1/79)	52,000	8,160	4,090	64,300
• Percent Change	+6.6%	+4.5%	-34.6%	+2.2%
SERVICE HOURS				
• Before(2/78-8/78)	3,600	414	416	4,475
• After (9/78-1/79)	3,940	423	313	4,676
• Percent Change	+9.4%	+2.2%	-32.1%	+4.5%

Source: RTD Office of Policy Analysis. "Monthly Ridership Report".

Table 5.13 shows the percentage which "extra" and "lost" hours comprised of total service hours during the free fare demonstration in 1978. While it is not clear that the small increase in lost hours (from 17.8 percent to 18.5 percent) is significant, there was a reasonably large increase in extra hours (primarily overtime driver hours) during the first three months following route restructuring.

Table 5.13
EXTRA AND LOST HOURS AS PROPORTION OF TOTAL SERVICE HOURS: METROPOLITAN OPERATING GROUP ONLY

Month During Demonstration	Percent Total Service Hours	
	Extra Hours*	Lost Hours**
Before Route Restructuring		
February	7.0%	17.5%
March	3.6%	14.1%
April	3.4%	17.6%
May	3.4%	18.6%
June	4.0%	18.0%
July	4.8%	19.0%
August	5.7%	19.5%
Average	4.6%	17.8%
After Route Restructuring		
September	7.5%	17.3%
October	6.4%	18.5%
November	7.0%	18.6%
December	5.9%	19.7%
Average	6.9%	18.5%

*Extra hours primarily reflect driver overtime.
** Lost hours include sicktime, vacation & holiday, and instruction and relief.

Figure 5.2 shows the trend on weekday service miles since January 1977. It indicates that except for the major service expansions in March which were later cut-back (primarily weekend and evening hours), a steady increase in total service is indicated. Route restructuring in September accounts for only a relatively small portion of the increase in total service provided.

Figure 5.2
AVERAGE WEEKDAY MILES of SERVICE: TOTAL SCHEDULED SERVICE

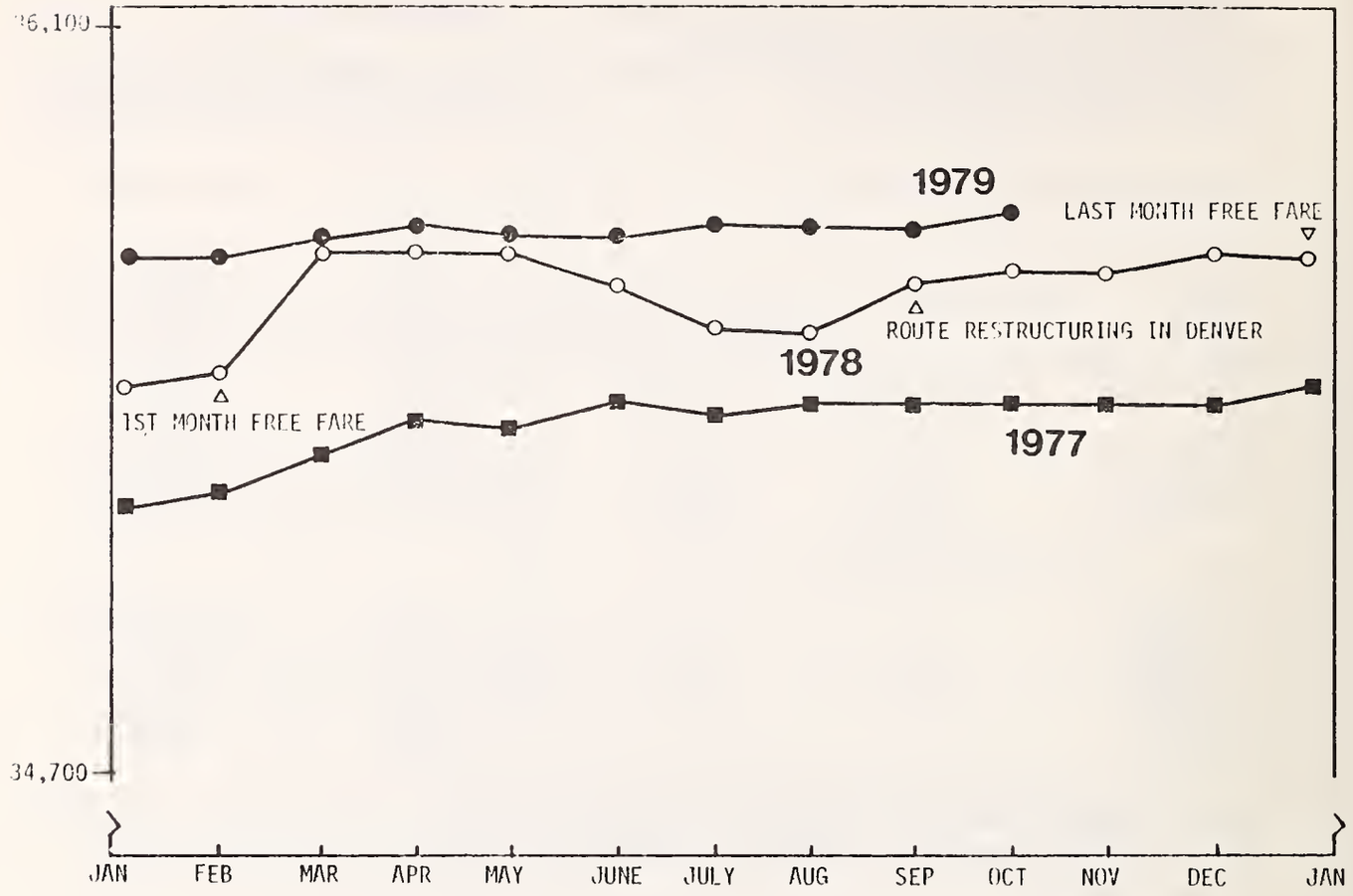
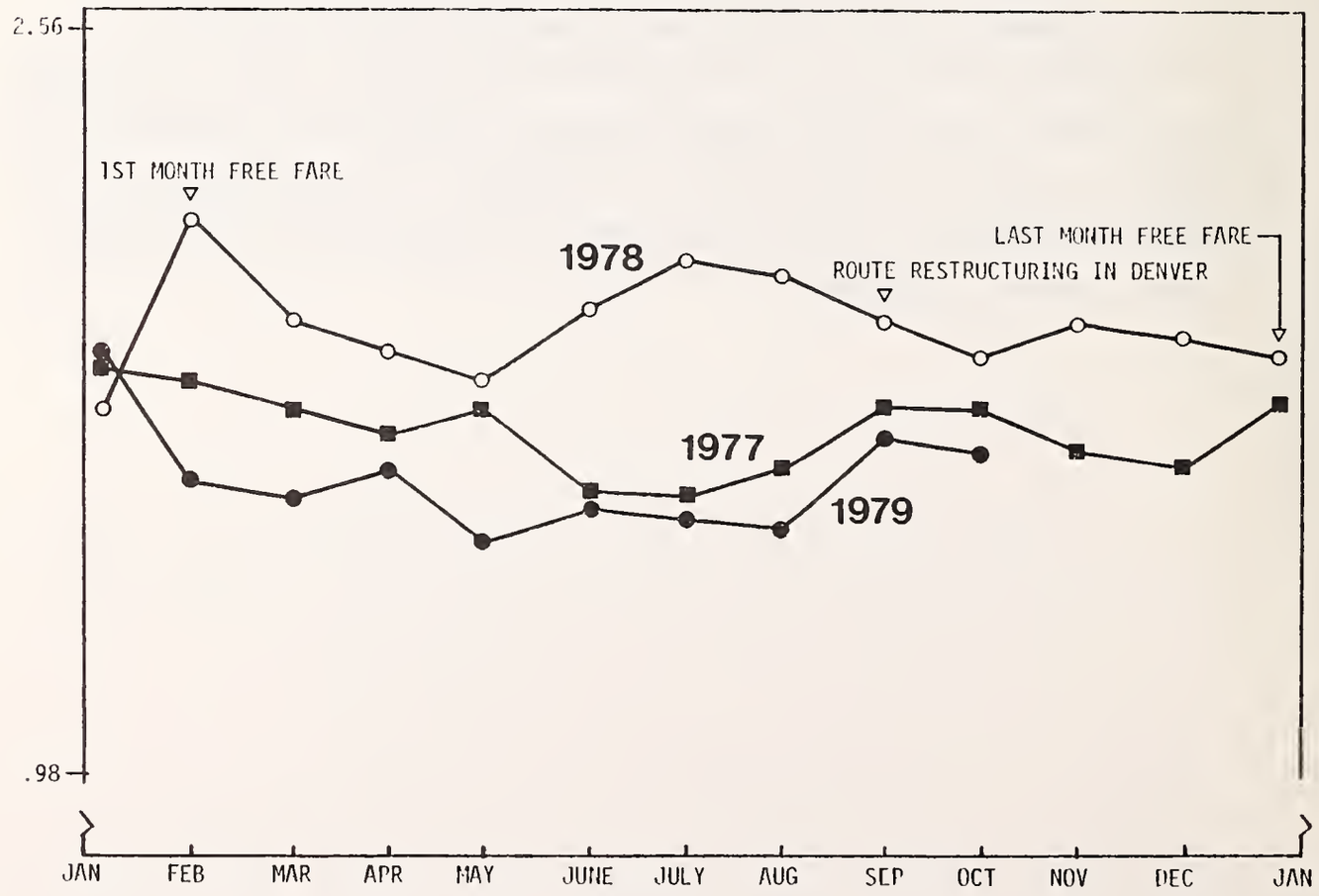


Figure 5.3
AVERAGE WEEKDAY PASSENGERS (UNLINKED TRIPS) per MILE of SERVICE:
TOTAL SCHEDULED SERVICE



5.2.3 System Performance Indicators

Most service performance indicators improved dramatically during the off-peak free fare demonstration. However, increases in service provided in March and September were not accompanied by corresponding increases in patronage. Consequently, as shown in Table 5.14 there was about a 7 percent decline in passengers per hour of service, and about a 5 percent decline in passengers per mile of service after September, representing the maximum effect of route restructuring. This trend counters normal seasonal fluctuations; the later months of the previous year (1977) saw a small increase over the earlier months in both these indicators. However, the actual impact of route restructuring may be less due to the effect on the indicators of the high Summer 1978 ridership levels during the free fare demonstration. Figure 5.3 illustrates the three year trend in ridership per service miles for all of RTD's scheduled service.

Table 5.14
EFFECTS ON PRODUCTIVITY: DENVER BUS SERVICE
AVERAGE WEEKDAY PERFORMANCE INDICATORS

Indicator	Unlinked Trips Per Unit			
	Local	Express	Circulator	Total
PASSENGERS PER MILE				
• Before (2/78-7/79)	2.56	1.29	.54	2.20
• After (8/78-1/79)	2.35	1.14	.76	2.09
• Percent Change	-8.20%	-11.6 %	+40.7 %	-5.0 %
PASSENGERS PER HOUR				
• Before(2/78-7/78)	34.13	24.41	7.15	30.91
• After (8/78-1/79)	30.23	20.42	9.53	28.76
• Percent Change	-11.4 %	-16.3 %	+.33%	-6.9 %

Source: Appendix B and Appendix C

Figures 5.4A through 5.4E show the passenger per mile indicator value for each of the types of transit service operated by RTD during each month since January 1977. Route restructuring and the cut-back in circulator service improved the productivity of Circulator routes. While express route productivity dropped with route restructuring, by May 1979 it had surpassed its pre-system change level. Productivity of local routes, on the other hand, continued to decline after route restructuring and fell below 1977 levels following the end of the off-peak free fare demonstration.

Figure 5.4A
AVERAGE WEEKDAY PASSENGERS (UNLINKED TRIPS) per MILE of SERVICE:
DENVER REGULAR ROUTES

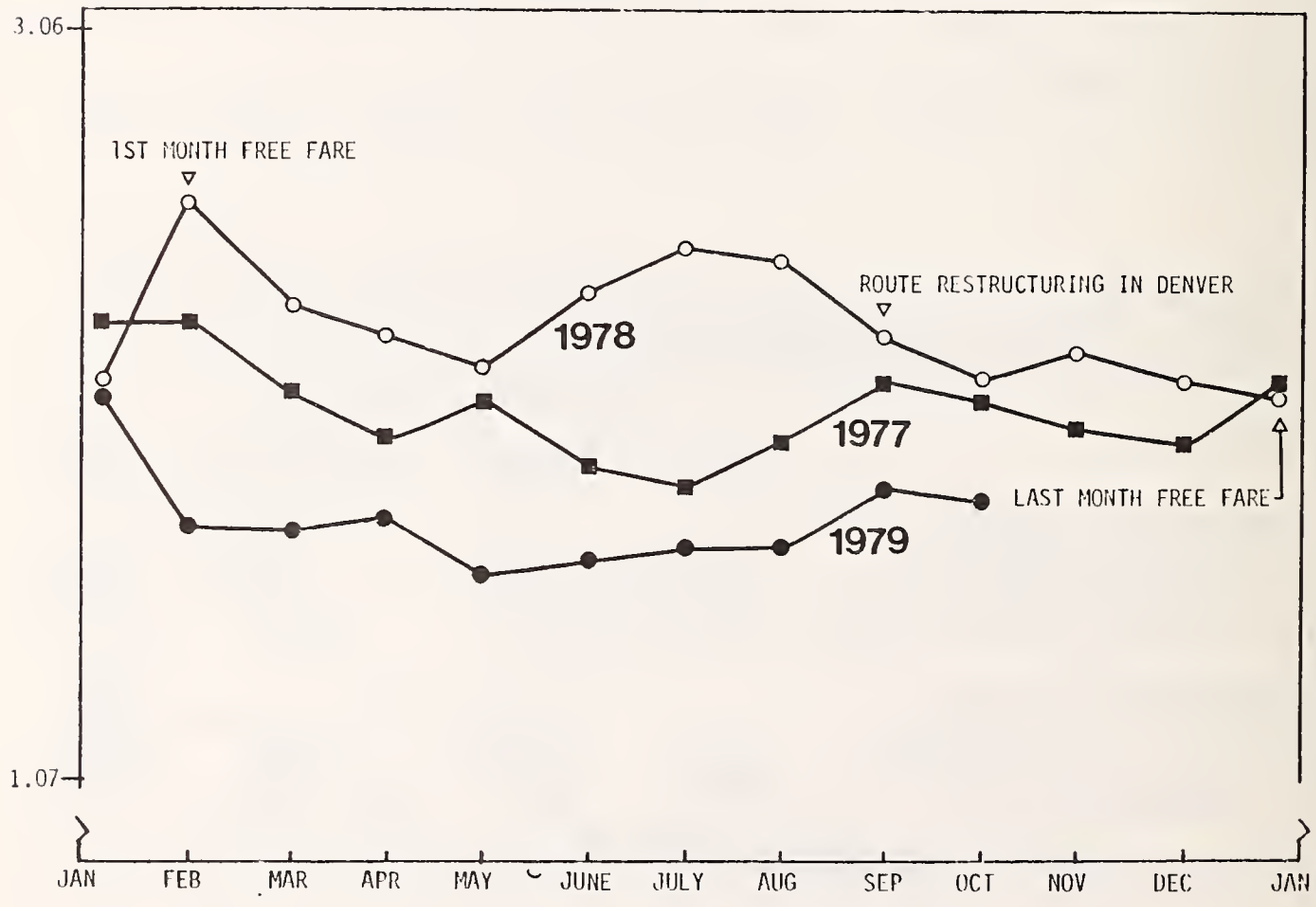


Figure 5.4B
AVERAGE WEEKDAY PASSENGERS (UNLINKED TRIPS) per MILE of SERVICE:
DENVER EXPRESS ROUTES

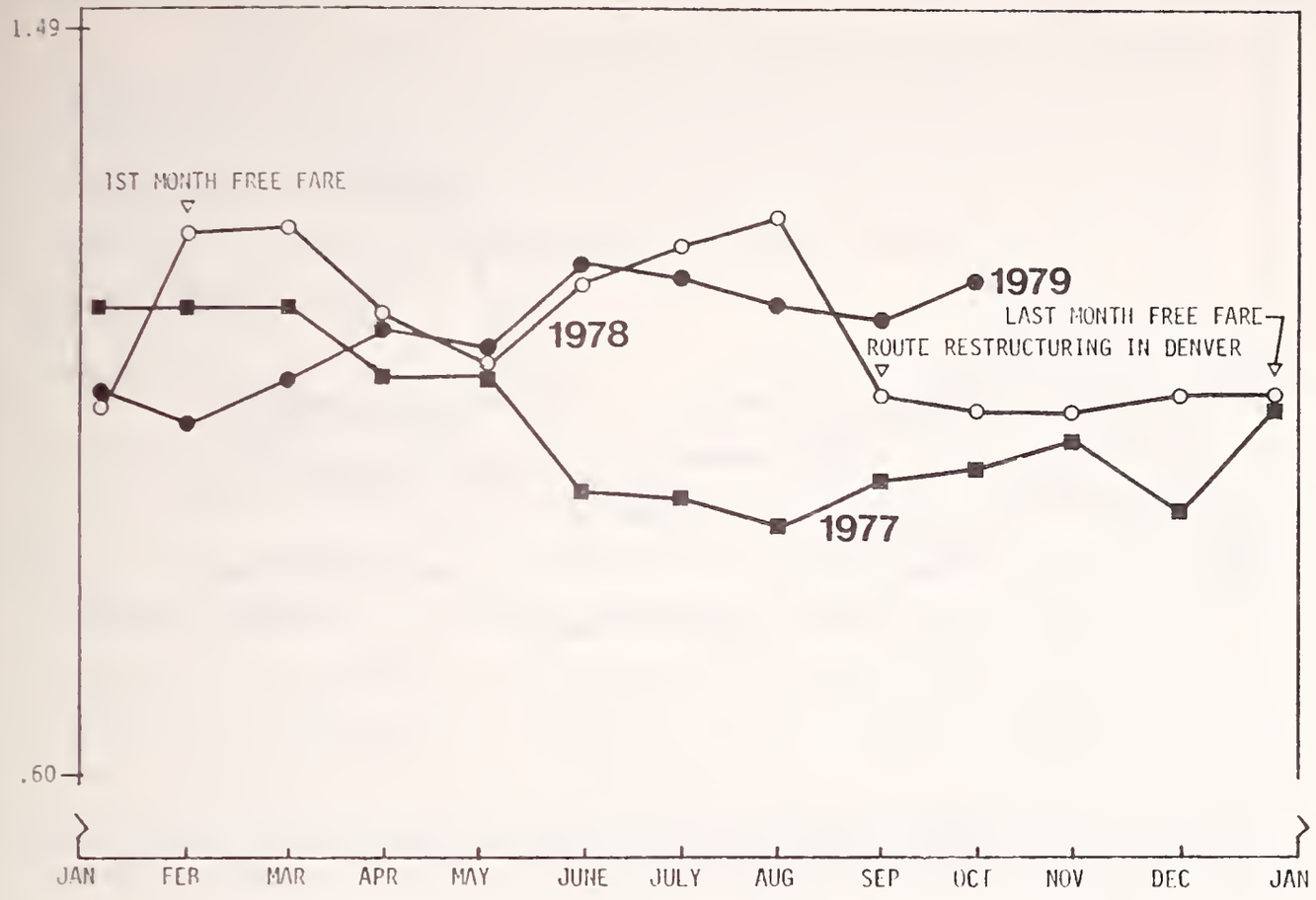


Figure 5.4C
AVERAGE WEEKDAY PASSENGERS (UNLINKED TRIPS) per MILE of SERVICE:
DENVER CIRCULATOR ROUTES

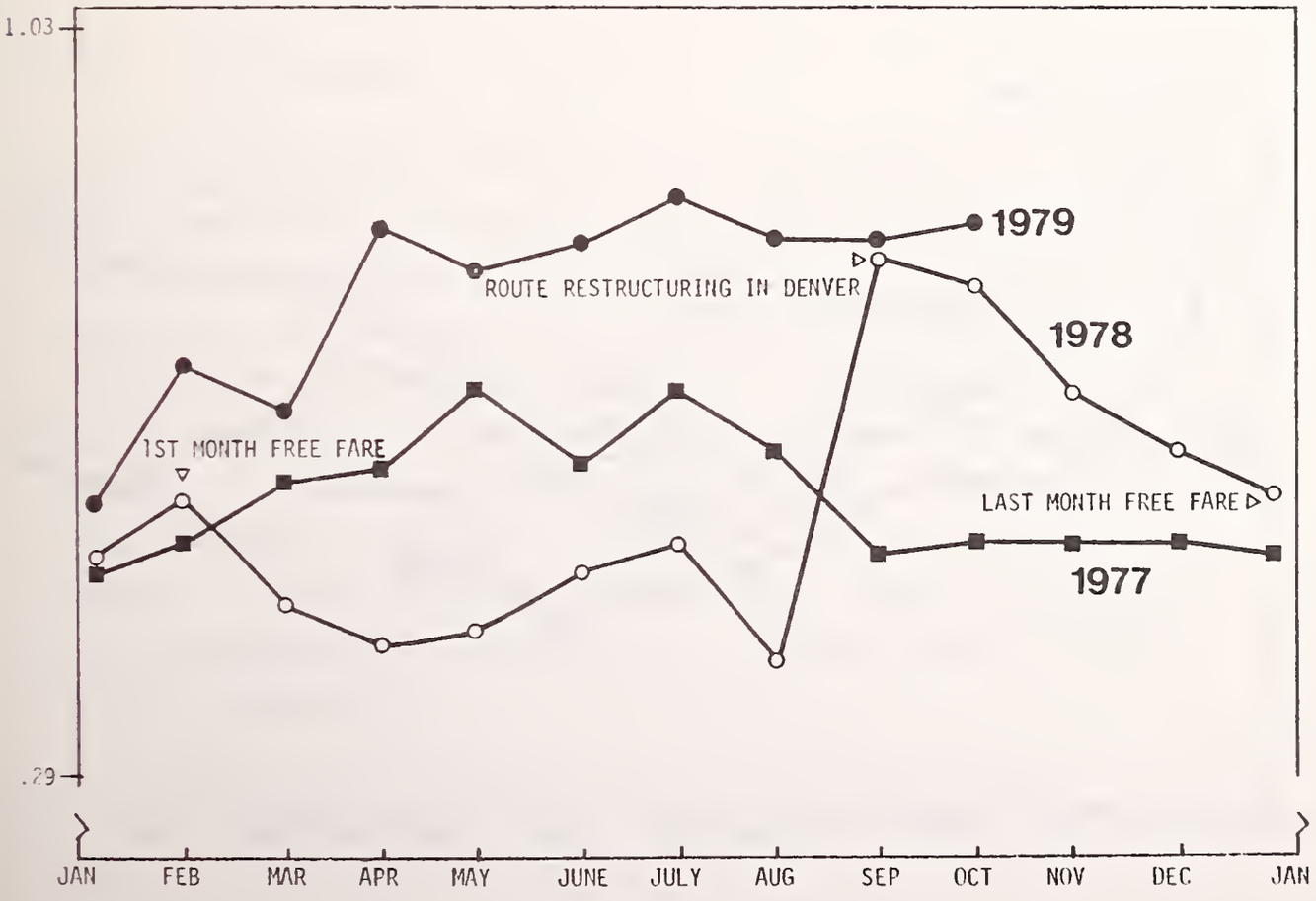


Figure 5.4D
AVERAGE WEEKDAY PASSENGERS (UNLINKED TRIPS) per MILE OF SERVICE:
INTERCITY SERVICE

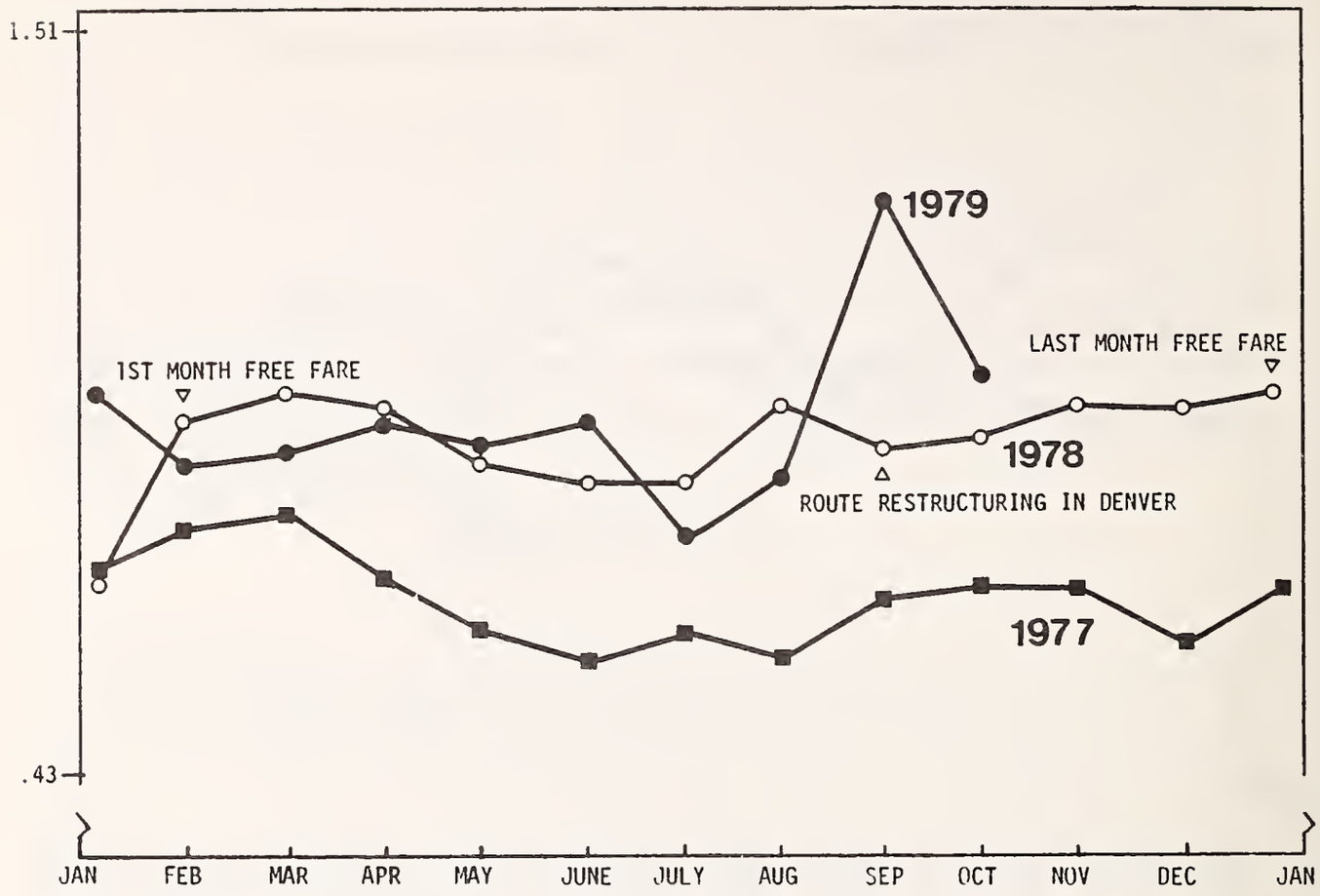
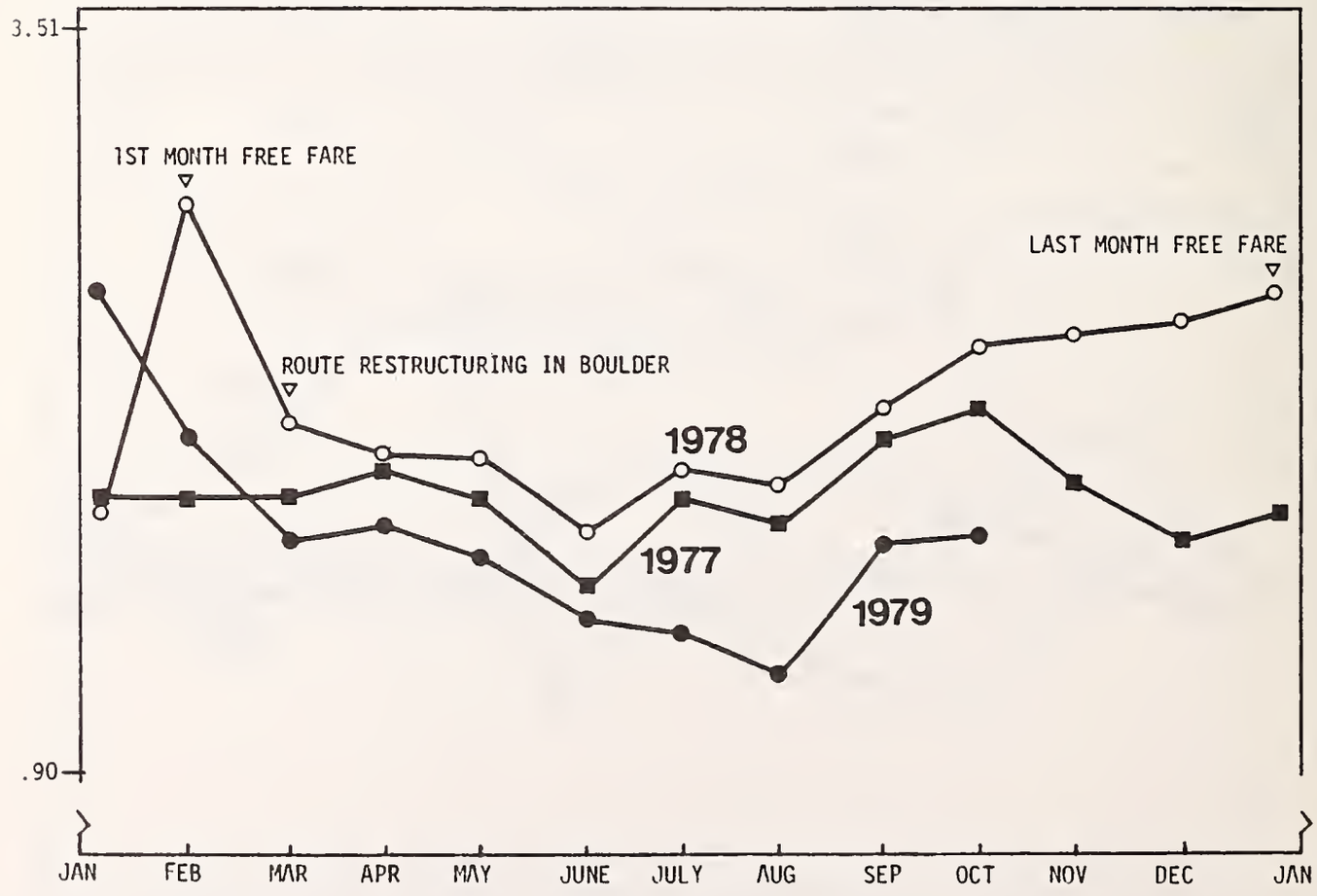


Figure 5.4E
AVERAGE WEEKDAY PASSENGERS (UNLINKED TRIPS) per MILE:
BOULDER and LONGMONT



Another measure of changes in transit system performance related to the restructuring is the difference between the distribution of systemwide ridership on routes before and after the changes were made. This provides an indication of the extent to which the changes have lead to a more balanced network in terms of individual route productivity.

As shown in Table 5.15, the September changes and those subsequently made in December have promoted greater productivity on routes with the lowest patronage levels. With the exception of the two most heavily used local lines (15-Colfax and 0-Broadway) which carry about one-quarter of all transit passengers, a smaller share of total loadings is now required of the nine most heavily used routes, with a concomitant improvement in on-board comfort. While 10 routes served about 73 percent of all bus rides before route restructuring, the top ten carried about 66 percent after the changes. Before route restructuring 18 routes (12 of which were crosstowns) served less than 1 percent of total passengers each, and combined only about 6 percent of total. Afterwards, there were only 10 local routes (8 of which were crosstowns) with comparable low-patronage levels.

5.2.4 Maintenance

As discussed previously, the route changes and added service levels implemented in September 1978 resulted in more buses in service than before the changes. MOG maintained a fleet of about 53 operating spares prior to restructuring available during the base period. With only 39 spares available afterwards, there were noticeable effects on vehicle maintenance. Fewer buses could be taken out of service at any one time. This reportedly caused some increase in the efficiency of maintenance operations, but it also meant that vehicles could not be rotated in and out of service as often. As a result, each vehicle accrued mileage and wear-and-tear at a somewhat faster rate than it would have otherwise.

Table 5.15
DISTRIBUTION OF WEEKDAY PASSENGERS (UNLINKED) BY ROUTES IN RANK ORDER OF PATRONAGE LEVELS: BEFORE AND AFTER ROUTE RESTRUCTURING: 1978

	Before Route Restructuring		After Route Restructuring			
Rank	February		September		December	
Routes	Abs.Freq.	Cum.Freq.	Abs.Freq.	Cum.Freq.	Abs.Freq.	Cum.Freq.
1	14.8%		17.1%		16.7%	
2	8.1		8.7		7.9	
3	7.8		6.9		6.5	
4	7.3		5.3		5.6	
5	7.1	45.1%	5.3	43.3%	5.4	42.1%
6	6.2		4.9		5.2	
7	5.9		4.9		5.1	
8	5.5		4.7		4.6	
9	5.2		4.2		4.5	
10	4.9	72.8%	4.1	66.1%	4.4	65.9%
11	4.7		4.0		4.1	
12	4.2		3.8		3.9	
13	2.3		*3.3		3.2	
14	2.3		3.2		*3.2	
15	*2.3	88.6%	2.8	83.2%	2.7	83.0%
16	*2.0		2.6		2.4	
17	*2.0		2.2		2.2	
18	*1.2	93.8%	*2.1		*2.1	
19	-	-	1.8		1.9	
20	-	-	1.4	93.3%	1.6	93.2%
21	-	-	*1.3	94.6%	*1.2	94.4
22	-	-	-	-	*1.1	95.5%
23	-	-	-	-	-	
Less Than 1.0% Pass. (Total/Cross town)	6.0% (14/8)	99.8%	5.4% (8/8)	100.0%	4.4% (8/7)	99.9
Less Than 0.1% Pass. (Total/Cross town)	.2% (4/4)	100.0%	- -	- -	(2/1)	100.0%
Routes						
• Regular	-	20	-	18	-	20
• Crosstown	-	16	-	11	-	12
• Total	-	36	-	29	-	32

*Crosstown Routes

Source: RTD Office of Policy Analysis."Monthly Ridership Reports".

RTD maintenance supervisors, however, reported no increase in the rate of repairs as a result of route restructuring (about 5000 work orders typically per month). Acts of vandalism and accidents continued to decline during the free fare demonstration after reaching a maximum during the Spring of 1978, and showed no sign of having been affected significantly by route restructuring.

5.2.5 Effects on Drivers

Bus drivers were generally negative about route restructuring, but considerably less so than about the off-peak free fare program. In the January 1979 survey conducted of RTD drivers (see Appendix D) more than half (54%) thought that restructuring had caused bad effects on their job, while a much smaller number (18%) reported good effects. More than three-quarters, however, thought that the overall effect of free fares was bad for drivers. About 17 percent said they had requested reassignment because of restructuring. The most commonly cited problems were the increased number of passenger requests for information and the difficulty they encountered in explaining the new system to riders.

The president of the drivers' union, however, indicates that drivers' opinion of the new system had improved following the three or four month learning period required of both driver and riders. He reports that a consensus favoring the restructuring eventually developed among transit operators.

5.3 Financial Impacts

5.3.1 Project Costs: Implementation

It is not possible to sort out all the one-time costs of planning, marketing, training, and operational reorganization that might be attributed to the restructuring. However, some order of magnitude estimates are feasible based on reports of various RTD staff persons. The total RTD annual budget and two principal components -- operating expenses and planning, administration and development (P.A.D.)--are shown in Table 5.16 for the last three years. The financial data indicate a steady increase in the RTD budget, with only a slightly increasing share allocated to P.A.D functions. The data make it clear that RTD was able to program the one-time costs of route restructuring over a number of years in an orderly fiscal manner.

Table 5.16
ANNUAL RTD EXPENDITURES BUDGET

Year	Operating Expenses ($ million)	Planning, Administration and Development ($ million)	% Total	Total RTD ($ million)
1977	32.2	6.9	17.6%	39.1
1978*	37.4	8.5	18.5%	45.8
1979**	45.1	10.8	19.3%	55.9

*Includes $.765 million in costs attributed to free fare P.A.D. (.358) and operating (.407).
**Projection based on January through October data available.

Source: RTD. "Interim Statement of Operations, Excluding Noncash Items." January 1977-October 1979.

Marketing and public information expenses accounted for the largest share of non-recurring route restructuring costs. RTD estimates that about $.5 million was spent on marketing activities and dissemination of information as part of the route changes. An equal amount or more in free promotions was provided by the local media. Adequate data are not

available which would allow a determination of the costs of the two year planning effort or the operational adjustments required for the change-over. It is assumed that the planning and operating costs combined were probably on the same order as the marketing expenses for the project. A rough estimate, then, of total one-time costs of the route changes may be in the range of about one million dollars over the two year period, or slightly more than about 1 percent of the total annual budget each year.

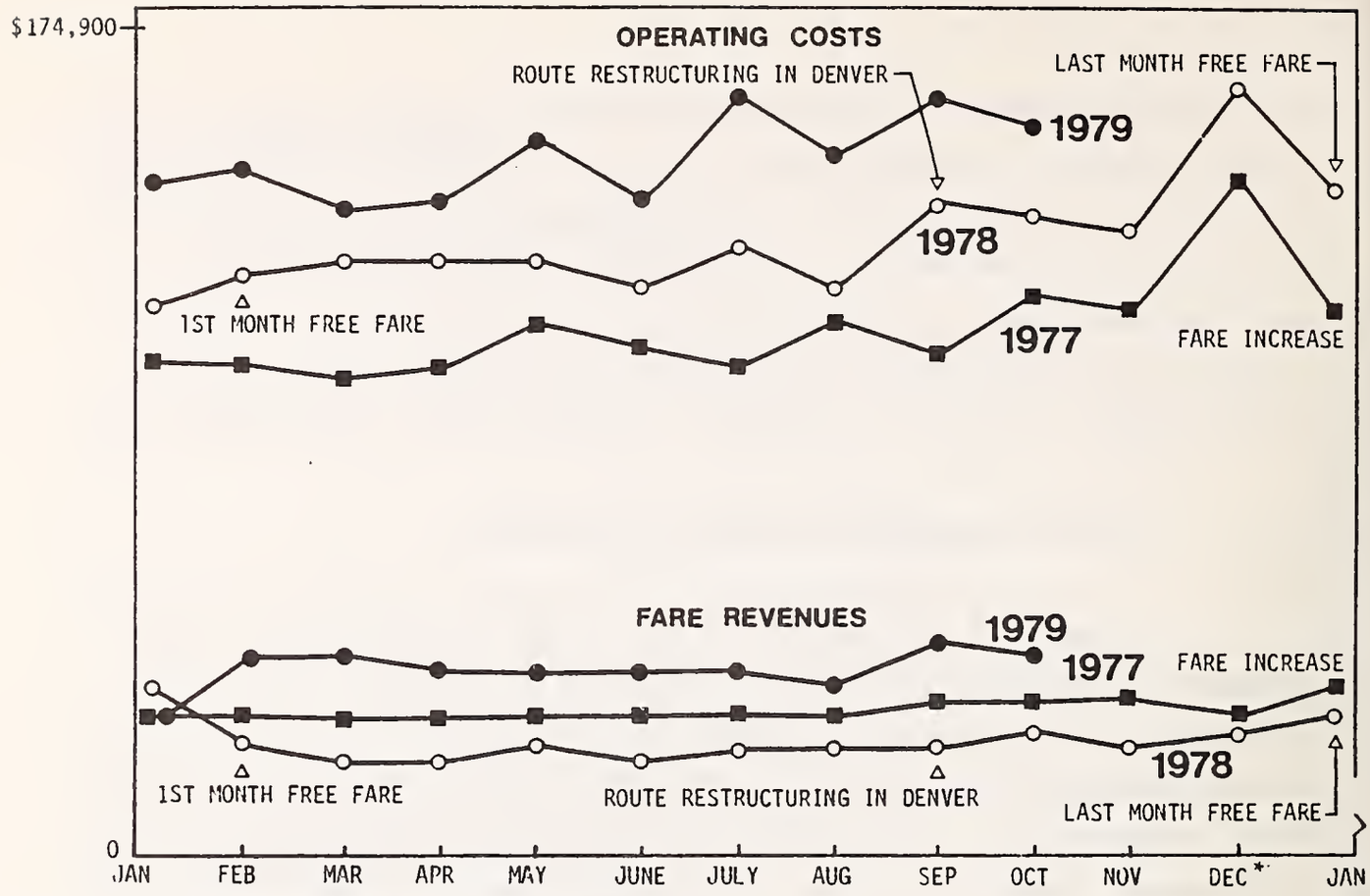
5.3.2 Effects on Operating Costs and Revenues

Figure 5.5 displays the trend in average weekday operating costs and revenues which RTD has experienced in the past three years. It shows a relatively steady increase in operating costs and no major impact associated with either the off-peak free fare experiment or with route restructuring. The impact of eliminating off-peak fares in 1978 on revenues, however, is clear. Figure 5.6 shows the revenues and costs per passenger carried for the three year period. Figures 5.7 and 5.8 show revenues and costs per service mile for the same timeframe.

While average weekday costs (1978 average = $124,400) increased by about 17 percent in the months of the demonstration after the route changes compared to those before, this is only slightly higher than the normal seasonal changes reflected in the 15 percent increase over the same months in the previous year. This suggests that route restructuring effects may account for about an additional $2,400 per weekday or about a 1.7 percent increase in normal operating costs. This estimate seems reasonable considering an only slightly larger decrease (-2.5%) in average schedule speed for RTD bus service systemwide. This indicates an additional cost per year on the order of $600,000, as a result of the operating characteristics of the restructured transit network.

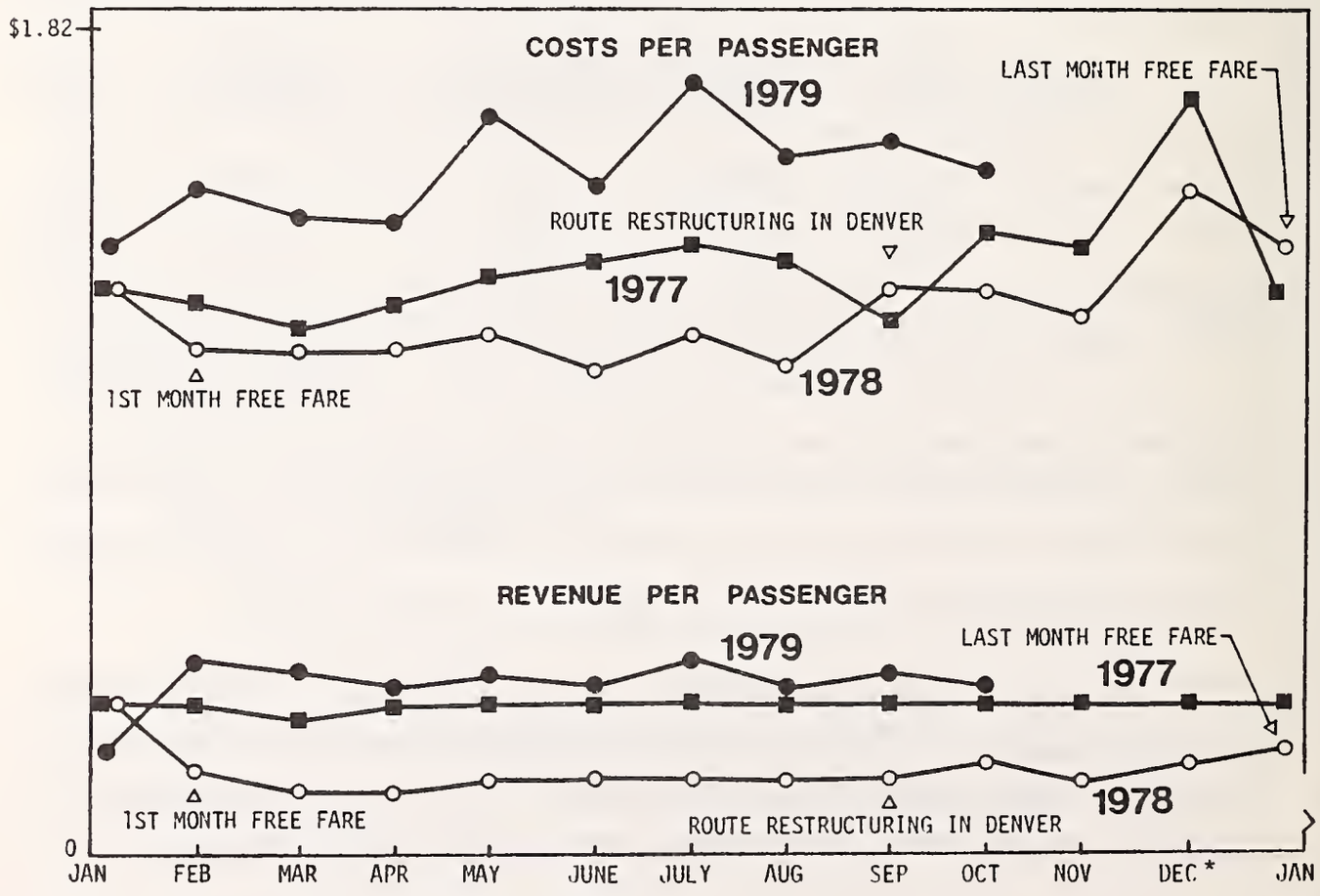
Revenue impacts were apparently even smaller. A 3 to 5 percent decrease in ridership was more than off-set by an 18 percent increase in the average fare paid, from 12.3 cents to 14.3 cents per passenger (during off-peak free fare). Average weekday revenues

Figure 5.5
WEEKDAY FARE REVENUE and OPERATING COSTS: TOTAL SCHEDULED SERVICE



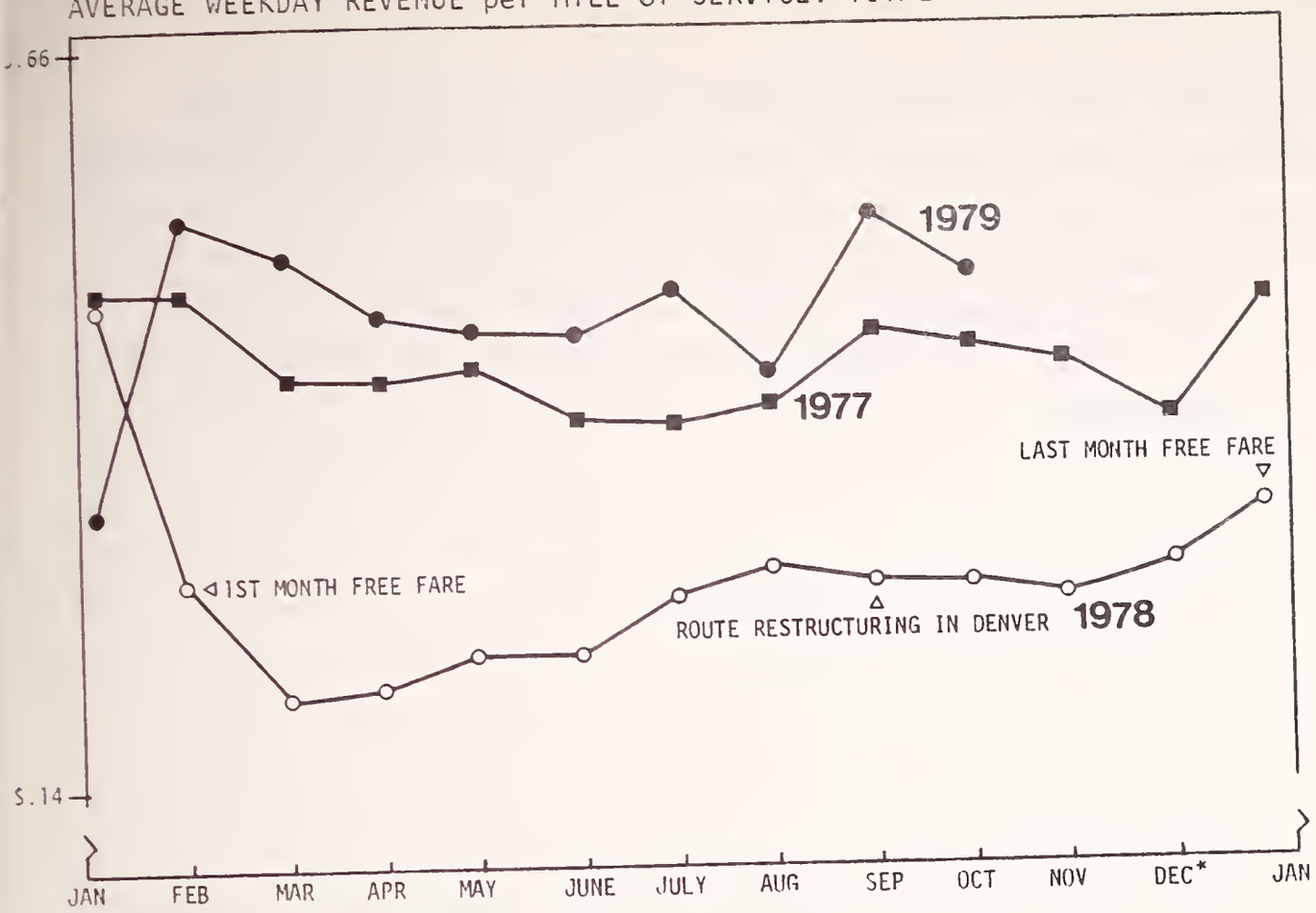
* Reflects end-of-year fiscal adjustments.

Figure 5.6
REVENUE and COSTS per PASSENGER (LINKED TRIP): TOTAL SCHEDULED SERVICE



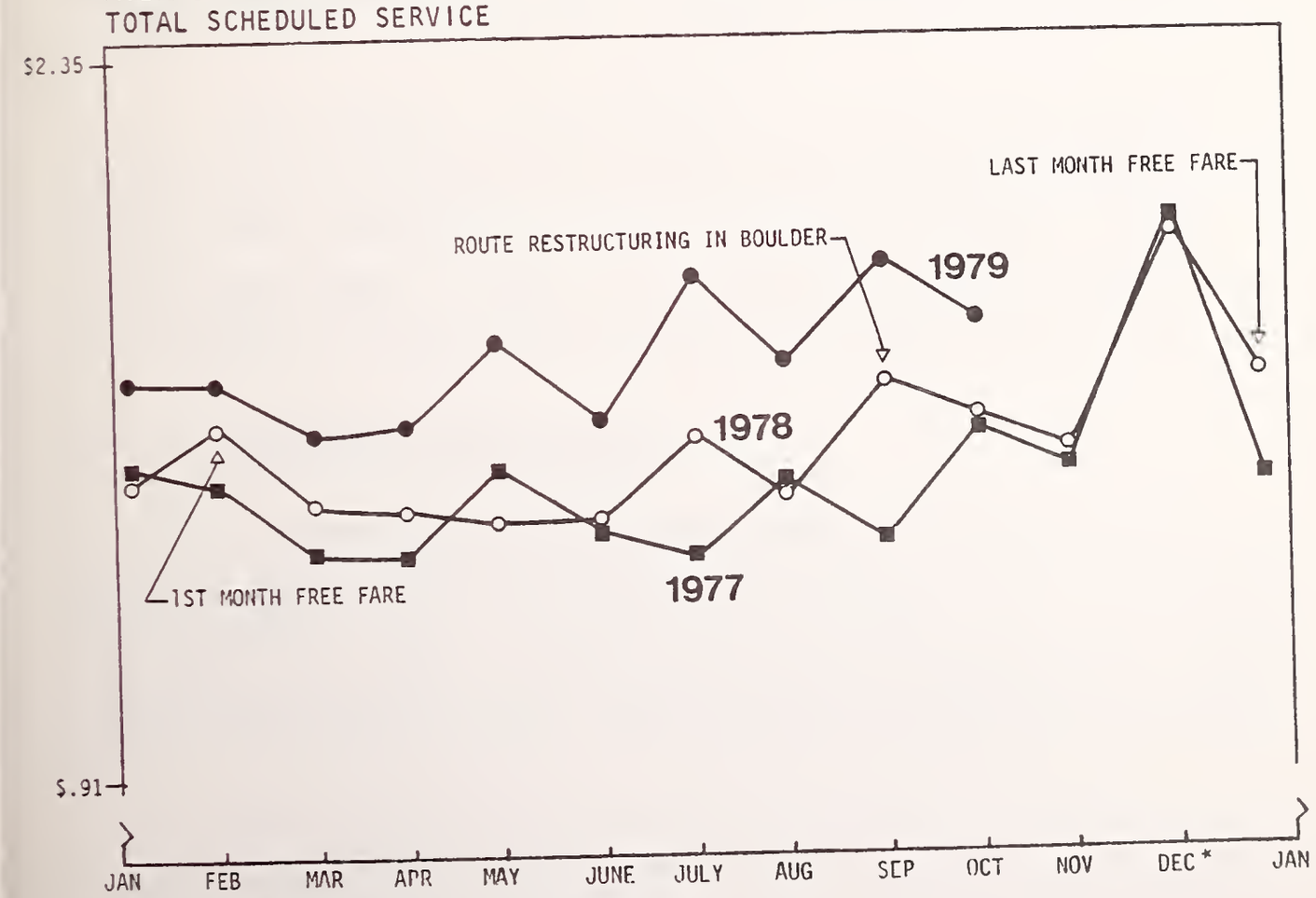
* Reflects end-of-year fiscal adjustments.

Figure 5.7
AVERAGE WEEKDAY REVENUE per MILE of SERVICE: TOTAL SCHEDULED SERVICE



* Reflects end-of-year fiscal adjustments.

Figure 5.8
AVERAGE WEEKDAY OPERATING COST per MILE OF SERVICE:
TOTAL SCHEDULED SERVICE



* Reflects end-of-year fiscal adjustments.

therefore showed an absolute increase following route restructuring. Under the unlikely proposition that none of the increase in average fare can be attributed to route restructuring, the maximum impact on revenues of the ridership loss would be about $1000 per weekday 1978 (free fare) or about $1500 per weekday in 1979. This would represent, at most, 1 percent of the total weekday costs of providing transit services in the RTD district.

6.0 SECONDARY EFFECTS

Unlike the off-peak free fare demonstration which caused relatively large impacts on transit ridership, route restructuring in Denver had only a small overall impact on transit use. A small ridership loss, which apparently has lasted at least one year after the changes, probably accounted for no more than an increase in the range of one-tenth of one percent of total travel within the metropolitan area. Consequently, with an even smaller increase in total area vehicle miles of travel (VMT) indicated, no measurable secondary environmental impacts have been identified on the regional scale. On the micro-environmental level, no data were collected which would permit evaluation of the potential positive and negative impacts on neighborhood quality which may have resulted from the relocation of transit routes from many residential streets to predominantly arterial streets. Without such information it has not been possible to analyze such probably small effects as diminished nuisance from transit operations to nearby residence (noise, vibration, safety) on the one hand; or the effects of reduced transit accessibility on the other.

The principal indirect impacts of the route and schedule changes which can be measured are those which are related to public opinion about existing bus services or the level of support for new transit improvements. There is also some quantitative indication of a minor secondary effect on the regional distribution of retail sales.

6.1 Opinion of Transit Service

Three attitude and awareness surveys were conducted by RTD among the general population during the evaluation period. These surveys were conducted: first, in the middle of the off-peak free fare demonstration during the month following the comprehensive route changes in Denver; second, during the last month of the free fare demonstration; and finally,

four months following the end of free fares and eight months after the September route changes. About 10 percent of the population used the bus once a week or more during the demonstration; about 39 percent may have used it at least once during the free fare year.[1] Following the end of the demonstration, about 7 percent of the general population reported that they used the system regularly (one or more rides per week).

Table 6.1
LEVEL OF SATISFACTION WITH TRANSIT SERVICE: GENERAL POPULATION

Satisfaction with RTD	DMA Households		
	Round 1* (10/78)	Round 2* (1/79)	Round 3 (5/79)
Very Satisfied	13	13	19
Somewhat Satisfied	24	28	26
Somewhat Dissatisfied	19	17	16
Very Dissatisfied	11	18	12
No Opinion	33	24	28
	100%	100%	100%
N =	408	402	1001

*During Off-Peak Free Fare Demonstration

Source: Random Household Surveys.

Despite these indications of a relatively small proportion of the public which represent frequent users (direct beneficiaries) of transit services, awareness of and positive attitudes toward RTD service were fairly high among the general population. As shown in Table 6.1, the proportion of the public which had no opinion about bus services declined from about one-third in October 1978 to about one-quarter in the 1979 surveys. Despite a significant jump in the percentage of those very dissatisfied with the bus service from the October to the January surveys (11% to 18%), a majority of those with an opinion were either very

[1] This represents a maximum estimate. There are some indications that the source, the third random household survey, is biased toward the transit user sub-population.

or at least somewhat satisfied in each round -- 55 percent first round, 54 percent second round, and 63 percent third round. Although, more RTD users were unhappy than pleased with the system modifications, route restructuring does not appear to have undermined a generally positive opinion among the general public about transit services in the Denver metropolitan area. In fact, public opinion was more favorable nine months after the change than it was before. This suggests that it is possible to implement needed transit improvements which will generate a fair degree of controversy, while maintaining a reasonably high level of positive public opinion about transit services.

6.2 Support for Future Transit Improvements

Table 6.2 shows the percentage of both transit users and the general population who, following the free fare program and route restructuring project, reported that they would approve new taxes above the existing one-half percent district sales tax to fund future transit improvements. A surprisingly small number, only 15 percent, indicated opposition to new transit taxes. Nearly three-quarters (73%) of transit users favor taxes to provide more bus service; about half of the general public agrees (52%). A somewhat larger majority of the public supports taxes for some type of "rapid rail" transit (59%), with a comparable level of support from current bus riders (61%). A majority of each group would prefer a future transit system which provided an integration of both bus and rail operations.

Table 6.2
ATTITUDE TOWARD FUTURE TRANSIT IMPROVEMENTS AND TAXES

Favor More Taxes For:	Percent Transit Users (a)	Percent General Population (b)
Free Fare	51%	48%
More Buses	73%	52%
Exclusive Bus Lanes	60%	50%
Rail Rapid Transit	61%	59%
Other Transit	3%	4%
Not in Favor of More Taxes	11%	15%
(Percentages Reflect Multiple Responses)		
Preferred Long-Term System		
Buses Only	12%	10%
Rapid Rail Only	13%	20%
Buses and Rail	62%	54%
Other System	5%	3%
No Answer/No Opinion	7%	13%
	100%	100%
N =	256	1001

Source: a) Transit User Follow-Up Survey 3 (5/79).
b) Random Household Survey 3 (5/79).

6.3 Effect on Retail Sales Districts

The results of the transit user surveys regarding the direct impacts of route restructuring on trip purpose are inconclusive regarding the magnitude of shifts in the geographic distribution of transit level (see Section 4.5.2). However, they do indicate an increased share of regional transit travel to and from non-downtown areas of Denver. This was expected as a result of the improved relative accessibility to outlying areas provided by extended routes and the modified grid system implemented by the restructuring project. An even greater proportional increase in non-CBD bus travel is indicated for shopping trips made by bus.

Table 6.3
EFFECTS ON THE GEOGRAPHIC DISTRIBUTION OF SHOPPING TRIPS BY BUS

Geographic Type	Shopping		All Purposes	
	Before RR (8/78)	After RR (11/78)	Before RR (8/78)	After RR (11/78)
CBD/Downtown Denver	41%	27%	48%	39%
Non-CBD				
• Inter City	24	40	36	37
• Peripheral	35	33	16	24
	100%	100%	100%	100%
Trips Represented	18,300	10,000	116,200	118,600

*During Off-Peak Free Fare Demonstration

Source: On-Board Surveys.

As shown in Table 6.3, the total number of shopping trips made by bus decreased substantially from August, before route restructuring, to November after route restructuring. This is probably accounted for mostly by seasonal variation On the other hand, while a large decline

in CBD shopping trips is indicated, only a small absolute decrease in non-downtown shopping trips is shown due to the larger share of shopping trips attracted to these areas. While the evidence is mixed and incomplete, it appears that route restructuring has in fact improved the position of non-downtown retail outlets by a not insignificant amount, both in terms of transit use potential (accessibility) and actual transit travel (observed demand).

Conversely the reorientation of the transit network appears to have "worsened" the commercial position of downtown Denver relative to the rest of the metropolitan area. In fact, the downtown may have experienced an absolute decline in transit served shopping, at least in the short-term for which data is available. Any negative effect, however, was probably quite small in comparison to the overall retail sales volume of CBD merchants. Furthermore, downtown revitalization was not an objective of the route restructuring project. Any minor temporary effects which may have resulted should more than be compensated by the completion of the Downtown Transitway/Mall Project, a CBD amenity made possible by the improved operational characteristics of the restructured transit network.

7.0 CONCLUSIONS

7.1 Transferability of Findings

A major objective of the evaluation is to provide findings which are of general value to other areas and to national transit policy. Results of Denver's experience with route restructuring, however, are of greatest relevance to metropolitan areas which share common demographic and travel characteristics. The important aspects of the Denver setting which are noteworthy include:

- Auto-dominance: Only 7 percent of households own no vehicle compared to the 17 percent national average for metropolitan areas.[1] The Denver metropolitan area is a relatively low-density region with a diffusion of activity centers not easy to serve effectively with public transit.

- Transit Service Characteristics: The Denver RTD operates an extensive transit system which provides a relatively high level of service, in a medium density urban/low density suburban setting, for a clientele that is mainly transit captive. Consequently, performance indicators (passengers per mile, fare revenues as percent of costs, etc.) are generally lower than the national average.[2]

7.2 Effectiveness of Route Restructuring

There are two major issue areas relevant to the effectiveness of route restructuring in Denver and its implications for other metropolitan areas. The first encompasses planning, implementation and short-term transitional issues; the second relates to the long-term travel behavior and transit operations characteristics of the particular hybrid-grid network of transit routes created by the restructuring project in Denver.

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[1] U.S. Bureau of Census, "Selected Characteristics of Travel to Work in 20 Metropolitan Areas," 1976.

[2] American Public Transit Association, "Transit Fact Book," 1978.

7.2.1 Planning and Implementation

Findings in the Denver evaluation regarding the planning and implementation of restructuring are of interest to other locales to the extent that they provide an indication of resource requirements, relative effectiveness of various measures and a sense of the magnitude and direction of short-term effects. In general, they should be relevant to any major revision of an existing set of transit services in which public acceptance and adjustment will be needed to effectively carry out the project.

Some of the more important conclusions from the Denver experience are:

- It is possible to make radical, comprehensive changes in existing transit services in one or a series of individual steps. The advantage is quick transformation of the system to a logically consistent, interdependent network. The advantage of a "phased-in" approach, on the other hand, is that implementation resources need not be focused entirely at one period in time, with the risk of overburdening planning and community involvement capabilities. The approach taken in Denver appears to have been the most desirable one for Denver and, all else being equal, it may also be so for most other areas.

- Proper planning will require an intensive effort to bring about comprehensive changes. A relatively lengthy advance public involvement campaign, with a varied and probably costly approach is necessary to stimulate helpful feedback from the transit-using public in planning phases, as well as to disseminate information needed to use the new system effectively.

- While the overall concept of a plan may be accepted, public response will generally be focused on particular operational changes proposed or put into effect. Neighborhood or other transit use sub-areas are good settings for public forums in the planning of changes at a detailed level.

- Despite the most successful planning and informational efforts, significant short-term disruptive effects are to be expected and plans made to deal with them. Some

short-term ridership loss is almost certain; however, it need not be severe or of extended duration. Similarly, transit operational problems will occur, mostly related to misjudgement of run-time requirements and temporary load imbalances resulting in overcrowding and late runs.

- A series of post-change public forums provide a good mechanism to obtain public comment and suggestions on the need for further refinements. These meetings, supplemented by provision for driver feedback and other special operations monitoring mechanisms, will generate the type of information needed to make subsequent modifications in the new system.

7.2.2 "Grid" vs. "Radial" Transit Networks

It is assumed in this report that travel demand and supply findings of the Denver route restructuring from the period 6 to 12 months after the September changes reflect long-term impacts associated with the operational characteristics of the modified grid transit network installed in Denver. This is not to say that some transitional effects of disrupting the status quo were not still operating a half-year after implementation, but rather that most of the differences were the result of differences between the former more radial system of routes and the newly developed more grid-like network.

These findings therefore provide some indications about the relative effectiveness of these two transit system concepts in a metropolitan setting such as Denver. While the old former network was not purely radial, the new system is not strictly a grid -- most local routes which serve as crosstown grid routes in the outlying area portions of the urban area are diverted into the core area. However, differences between the two are instructive and represent the kind of trade-offs transit planners frequently must confront on a variety of scales - regional, corridor level or for individual transit routes.

The concept of the hybrid-grid system implemented in Denver appears to be basically sound and achievable, but has service implications which are somewhat different than those of the radial. Not all of these differences were anticipated in Denver, nor was the degree of others explicitly projected. The different service emphases incorporated in the two concepts are shown in Table 7.1.

Table 7.1
COMPARISON OF KEY SERVICE CONCEPT EMPHASES:
BEFORE "RADIAL" AND AFTER "GRID" TRANSIT NETWORKS

Service Concept	"Radial"	"Grid"
Configuration	Direct Routing to Serve the Predominant Travel Patterns. Minimize transfers for CBD trip.	Simplified East/West and North/South Routing to Serve All Potential Trip Origins and Destinations. Provide for easy transfer.
Operational Emphasis	Geographic Coverage (Density) of Existing Transit Use Areas (local residential streets, closely spaced bus stops). Results in:	System Speed/On-Board Travel Time Savings (arterial streets, fewer turns, less frequent stops). Results in:
	--	Ability to Extend Routes to New Areas (Extensiveness), and
Access Characteristic	Short Walk Distance	Short Headways/More Frequent Service

A number of factors appear to have resulted in a restructured network less like the idealized grid network than initially planned, with somewhat different operating characteristics. These include transit user protests about removal of service on some residential streets, extension of service to less productive areas, difficulty in achieving ideal traffic flow speeds or major headway reductions.

Furthermore, the basic notion about traveler preferences underlying the new system concept may be valid for a smaller potential transit user group than expected. The choice rider transit market may in fact be more likely to leave their automobiles at home with improved bus travel times. The more transit dependent user may be more concerned about a high standard of certain transit service attributes, in particular short walk distances from both origin and destination. Only major time savings improvements will effectively compete with the convenience and speed of the automobile for most intra-regional travel. Also, there is some evidence that most transit users value on-board travel time as less onerous than terminal time -- walking to or from and waiting at the stop.[3]

Despite these considerations, the grid system developed in Denver has resulted in a transit service which is more readily understandable to the new transit user. Moreover, it provides new capacity for transit use by a choice ridership diverted from other modes as future energy and constraints continue to result in less single-occupant driving and greater demands on public transportation. It also enhanced the potential to better serve transit dependent ridership needs by providing a rational and sound framework for future service expansions.

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[3]Transportation Research Board, "Behavioral Demand Modeling and Valuation of Travel Time," Special Report No. 149, Washington, D.C., 1974.

7.3 Relation to Future Transit System Changes

The Denver experience shows that it is possible to make dramatic, and in some instances controversial, changes in existing transit services and maintain strong public support for transit improvements and their required fiscal support. A large and somewhat greater majority of both the bus users and the general public (many of whom never use transit) were willing to support new taxes in Denver for additional transit improvements after the route restructuring effort. After many years of planning for and discussion of various forms of rail transit in Denver, public support for the introduction of light rail appears to be strong now and higher following the restructuring project than before its implementation. This may reflect both a general public commitment to expanded transit services and a perception of the enhanced feeder service capability of the new fixed route modified grid system to make light rail operations effective within heavy demand travel corridors.

Denver RTD was not able to make all the long-range improvements during six months following route restructuring which might have compensated for the initial negative ridership effects of the changeover. However, the route restructuring project did establish the foundation for future improvements. For example, such elements as running buses on major arterials will make subsequent improvements more feasible and cost-effective. Future transit operational opportunities made possible by the route restructuring project may include HOV priority treatment on transit high volume streets and highways, better timed-transfers, good feeder support for light-rail or other higher capacity line-haul elements introduced into the system, and continued improvements in passenger informational aides. Until the feasibility of such future improvements can be fully tested, it may be too early to make a final assessment of the long-range service improvements begun with the route restructuring project in Denver.

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Appendix A: Data Collection and Reliability

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A.4 Denver RTD Drivers Survey

Appendix A
DATA COLLECTION AND RELIABILITY

Under the terms of the demonstration grant agreement, the Denver RTD was responsible for all data collection needed for the evaluation. With technical assistance in the design of survey instruments and procedures from the evaluation contractor, RTD and its data collection contractor administered surveys of transit operations, transit users and the general population.

The number and complexity of the issues to be addressed in the evaluation of free fare and route restructuring in Denver required that an extensive and integrated system of data collection activities be employed. The validity of the evaluation results was contingent upon the survey samples being designed to insure both randomness(or at least control of biases) and the isolation of free fare and route restructuring effects. Three rounds of data collection were undertaken in the evaluation: Round One during the Off-Peak Free Fare Demonstration prior to Route Restructuring, Round Two during the Demonstration after Route Restructuring, and Round Three after both the Demonstration and Route Restructuring. A chronology of data collection activities is shown along with the sample size of each data set in Figure A.1.1.

The following sub-sections provide brief descriptions of the nature and limits of statistical confidence for each of the principal data collection activities. The survey instruments used in each round of on-board surveys are included in this appendix. Because of their excessive length, only Round One telephone surveys are included in this document by way of example.

On-Board Surveys

Three successive self-administered on-board surveys were conducted. Each was designed in a similar manner. The sample for each survey was essentially systemwide (with the exception of the Boulder and Longmont areas), and only weekday service was included. Ridership was sampled at different rates on each of the three intra-area service route types - Regular, Circulator, and Express. For example, the Round One sample was drawn from 120 randomly selected half-day driver assignments. The selected assignments were checked to insure that there was adequate representation with respect to the type of route, time of day, and geographical area. An unexpectedly high response rate was achieved in all three rounds of on-board surveys with about 8500 returns each.

Generally, the information obtained through the survey included trip characteristics and socio-economic data. The two surveys had many uses including estimating the impact of the fare-free program on various socio-economic groups such as low-mobility persons; other uses included analyses of new trip generation and changes in mode choice, impacts on group ridership, time-of-day shifts in travel, fare savings, and changes in trip lengths, purposes, and patterns.

Figure A.1.1
DATA COLLECTION CHRONOLOGY

Date	Data Collection Activity	Sample Size
Round One: During Demonstration/Pre-Route Restructuring		
8/21-25,27, 30/78	On-Board Survey 1	8,692[a]
8/28-29/78	CBD Cordon Corner Counts	360 Buses
9/26-29/78*	Random Household Telephone Survey 1	408
9/25-29/78	Transit User Follow-Up Telephone Survey 1	1011
Round Two: During Demonstration/Post-Route Restructuring		
9/25-29/78	Farebox Verification Survey 1	284 Bus Run Assignments
11/13-17/78	On-Board Survey 2	8,545[b]
11/20-21/78	CBD Cordon Corner Counts 2	471 Buses
12/11-15/78	Farebox Verification Survey 2	277 Bus Run Assignments
1/79	Random Household Telephone Survey 2	402
1/79	Transit User Follow-Up Telephone Survey 2 o Prior Rider 2 (from Follow-Up) o New Rider 1 (from On-Board 2)	 647 169
1/30,31/79	Special Corner Counts 1 (CBD, Route-Midpoint and Terminal Locations)	967 Buses
1/79	RTD Bus Drivers Survey	162
Round Three: Post-Demonstration/Post-Route Restructuring		
2/28, 3/1/79	Special Corner Counts 2 (CBD, Route-Midpoint and Terminal Locations)	967 Buses
3/12-16/79	On-Board Survey 3	8,682[c]
3/19-21/79	CBD Cordon Corner Counts 3	479 Buses

The weighted sample size was: a. 13,295; b. 14,692; c. 13,768. (Cases weighted to correct for non-response biases; weight equals number of forms distributed per assignment/number of usable forms returned.)

Figure A.1.1 (Cont'd)

Date	Data Collection Activity	Sample Size
3/19-23/79	Farebox Verification Survey 3	291 Bus Run Assignments
5/79	Random Household Telephone Survey 3	1001
	Transit User Follow-Up Telephone Survey 3	
5/79	o Prior Rider (from Prior Rider 2)	256
5/79	o New Rider (from New Rider 1)	96

Follow-Up Bus Rider Telephone Survey

Following each round of on-board surveys, telephone interview surveys were conducted in order to augment the general travel perceptual and response data obtained in the on-board surveys with more detailed information. The telephone surveys of bus riders were of a panel nature, i.e., the same persons were called during each survey to determine how their transit trip making had been changed or been affected by the service innovations. The initial Transit User Follow-Up Survey was a stratified random sample drawn from the On-Board Survey 1 respondents who provided telephone numbers. The initial panel comprised 1000 respondents; however, the attrition rate of this logitudinal sample was higher than expected. The sample size of willing respondants in Prior Rider 2 Follow-Up and Prior Rider 3 Follow-Up declined to around 650 and then to around 260 cases. A panel of approximately 200 transit users who began using RTD since Route Restructuring was drawn from the On-Board 2 sample. This data set and the post-free fare follow-up is primarily relevant to the evaluation of Route Restructuring impacts.

Random Household Telephone Surveys

At the same time as the follow-up bus rider telephone survey was conducted, general surveys of Denver area households were conducted. A sample of approximately 400 households was selected at random from the general population for the first two rounds of data collection. This sample size was determined to be sufficient for reliable detection of small changes in public attitudes. In Round 3, a random sample of around 1000 households was drawn in order to obtain more detailed travel behavior data and to allow greater sample stratification within acceptable confidence limits.

Field Surveys

Two separate field surveys were conducted: transit corner surveys and farebox (passenger) counter verification. Corner count surveys provided data relevant to several operational attributes; schedule adherence, passenger load factors, and time distribution of passenger boardings. Two sets of corner count data were collected, 1) CBD cordon counts and 2) special location counts. The CBD counts sampled the majority of the bus trips travelling outbound from the CBD during the hours of 2:30 p.m. to 6:30 p.m. on weekdays. The CBD counts provide observations of crowding and transit schedule deviation of the maximum load points for service routes. The special location corner count surveys were taken in late January 1979 just prior to the end of free fare and in late February 1979, one month after the reinstatement of off-peak fares. Selected CBD, route-midpoint, and route-terminal locations were observed during both a.m. and p.m. peak and mid-day off-peak periods: 8:00 a.m. to 11:00 a.m. and 2:00 p.m. to 6:00 p.m. These counts provide general systemwide load count data for the during and after demonstration periods controlling for seasonal variation.

Field surveys were also done to determine the accuracy rate of the farebox counters of Regular and Circulator routes. The farebox counters provide all of the basic ridership statistics for the during and post-free fare period. To derive the best estimates of ridership impacts, it was essential that both the level and direction of inaccuracy be measured, as well as any improvement in the farebox counting system over time. These field surveys were conducted by randomly selecting driver assignments and making 15-minute "unannounced" observations of the driver's use of counters. A systemwide sample of around 300 drivers (approximately half of all drivers) was surveyed in three rounds of data collection.

Bus Drivers Survey

A survey of RTD bus operators was conducted during a safety training session in January 1979. This survey was used to supplement other data regarding the operational impacts of the free fare demonstration, as well as to obtain data on transit operators' perceptions of the route restructuring program. Approximately one-quarter of the RTD bus drivers were administered the survey instrument shown in Figure A.4.

Analysis of Confidence

The level of confidence that can be placed in the inferences drawn from the data used in this study is related to two reliability issues: 1) the quality of the data (degree of measurement error, absence of biases, etc.) and 2) the nature of the sample drawn from the universe in which we are interested (sample size, design, etc.). Only the first issue is relevant to the analysis of passenger count, and most of the supply-side data in this project. As discussed in Appendix B special efforts

have been made to eliminate known biases in this data. However, with respect to the survey data used in the evaluation, both the issue of measurement error, e.g., the precision and consistency of interview questions; and confidence in real differences among sampled groups and with their parent population are germane. Careful design of survey instruments with emphasis on precision and consistency of questions have hopefully minimized measurement error; however it remains a problem of largely indeterminate magnitude. In terms of statistical reliability, findings reported in the evaluation generally have been determined statistically significant at the .95 probability confidence level, unless otherwise noted.

Figure A.1.2 summarizes the generalized confidence intervals for the respective data sets. In general, the on-board surveys, because of large sample sizes, have the smallest estimated errors. However, other considerations have entered into the selection of data for analytical tasks. As a rule, the need for accuracy in the estimate of the population parameters was subordinate to other considerations, including data processing costs and the more common and greater need to measure changes, with links among socio-economic and travel characteristics.

Figure A.1.2
CONFIDENCE OF MEANS AND PROPORTIONS

	Approximate Sample Size	Reliability of 95% Confidence		
			Proportions	
		Means[1]	P=50%[2]	P=10%[2]
On-Board Surveys	8,600	±1% S	±1%	±.5%
Transit User Follow-Up Telephone Surveys:		±1% S	±1%	±.5%
o Follow-Up 1	1,000	±7% S	±4%	±2%
o Prior Rider 2	650	±8% S	±4%	±3%
o Prior Rider 3	260	±12% S	±4%	±4%
o New Rider 1	170	±16% S	±8%	±5%
o New Rider 2	100	±21% S	±11%	±6%
Random Household				
o Random 1 and 2	400	±10% S	±5%	±3%
o Random 3	1,000	±7% S	±4%	±2%
Corner Count Surveys	400	±10%	±5%	±3%
Farebox Verification Surveys	300	±11%	±5%	±3%

1. S = Standard deviation of sample for ratio type data.

2. P = 50%: for proportions of total equal to 50%.

   P = 10%: for proportions of total equal to 10%.

Figure A.2.1
ON-BOARD SURVEY 1 (8/78)

Dear Rider: The RTD is interested in providing you with the best possible bus service. Please help us by completing and returning this questionnaire before you get off the bus. All responses will be kept confidential. Thank you for your cooperation.

1. I am coming from: ☐ Home ☐ Work ☐ Shopping ☐ Recreational or Social ☐ School ☐ Other _____

2. After leaving that place, I walked . . . . . _____ Blocks to get to the bus stop ☐ I did not walk

3. I waited _____ minutes for the bus. 4. I have transferred to this bus. ☐ Yes ☐ No 5. I will transfer to another bus. ☐ Yes ☐ No

6. The place I am going to: ☐ Home ☐ Work ☐ Shopping ☐ Recreational or Social ☐ School ☐ Other _____

7. Instead of using the bus, I could have gone to this place by car. ☐ Yes, as a driver ☐ Yes, as a passenger ☐ No, car not available

IF YOU BOARDED THE BUS BETWEEN 6:00 A.M. AND 8:00 A.M. OR 4:00 P.M. TO 6:00 P.M., PLEASE SKIP TO QUESTION 12.

8. Before the "Free Fare Program" began in February, I was traveling to this place . . . . .

☐ Yes. If Yes, how? ☐ By bus ☐ By car, as a driver ☐ By car, as a passenger ☐ By walking ☐ Other _____

☐ No. If No, why? ☐ The bus was not free ☐ Other _____

9. I have changed the time of day that I travel to this place to take advantage of the free fare. ☐ Yes ☐ No

10. If the "Free Fare Program" is stopped, I would continue to travel to this place for the same reason.

☐ Yes. If Yes, How? ☐ By bus ☐ By car, as a driver ☐ By car, as a passenger ☐ By walking ☐ Other _____ ☐ No

11. I used RTD buses prior to the "Free Fare Program". ☐ Yes ☐ No

If Yes; because of the Free Fare Program, I now use the bus: ☐ More often ☐ Less often ☐ No change due to free fare

12. The total annual income of all persons in my household is:

☐ Under $5,000 ☐ $5,000 – $9,999 ☐ $10,000 – $14,999 ☐ $15,000 – 24,999 ☐ $25,000 or more

13. My age is: _____ 14. My race is: ☐ White ☐ Black ☐ Chicano ☐ Other

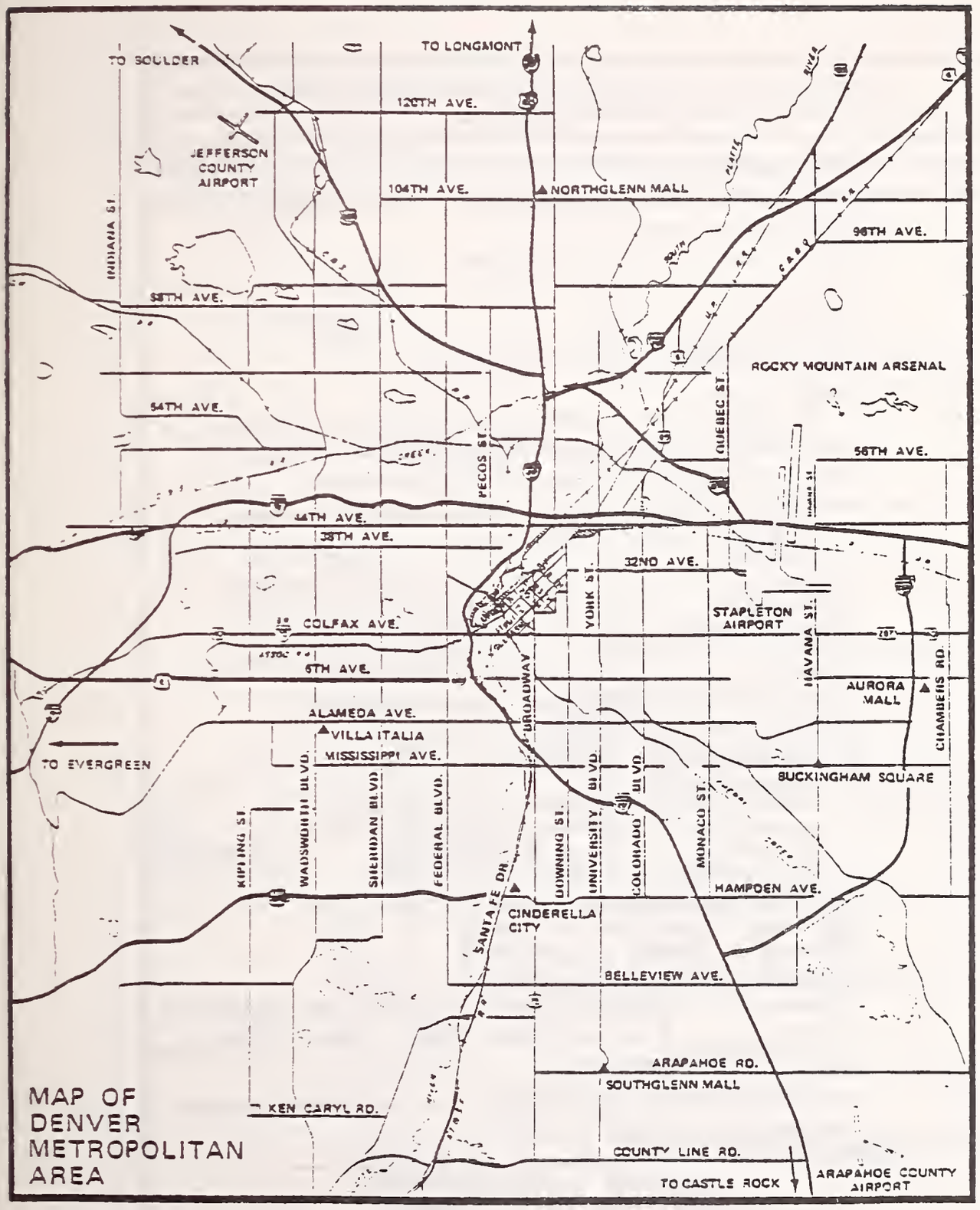
---

WE MAY NEED MORE INFORMATION ABOUT YOUR USE OF THE RTD. MAY WE CONTACT YOU BY PHONE?

Telephone No. _____ ☐ Day ☐ Evening Whom should we ask for (your name)? _____

SEE OTHER SIDE

Figure A.2.1 (cont.)
ON-BOARD SURVEY 1 (8/78)
(Reverse Side of Form)



Please mark with an X where this trip first began (bus stop).

Please mark with a circle where this trip finally ended (bus stop).

Figure A.2.2
ON-BOARD SURVEY 2 (1/79)

Dear Rider:

The RTD is interested in providing you with the best possible bus service. Please help us by completing and returning this questionnaire before you get off the bus. All responses will be kept confidential.

---

1. The place I am coming from:
   ☐ Home ☐ Work ☐ Shopping ☐ Recreational or Social ☐ School ☐ Other _____

2. After leaving that place, I walked . . .
   ____ blocks to get to the bus stop ☐ I did not walk

3. I waited ____ minutes for the bus.

4. I have transferred to this bus. ☐ Yes ☐ No

5. I will transfer to another bus. ☐ Yes ☐ No

6. The place I am going to:
   ☐ Home ☐ Work ☐ Shopping ☐ Recreational or Social ☐ School ☐ Other _____

7. Instead of using the bus, I could have traveled between these places by car.
   ☐ Yes, as a driver ☐ Yes, as a passenger ☐ No, car not available

8. Before September 10, when major changes were made in bus routes and schedules, I was traveling between these places. ☐ Yes ☐ No

   If Yes, how?
   ☐ By bus
   ☐ By car, as a driver
   ☐ By car, as a passenger
   ☐ By walking
   ☐ Other _____

   If No:
   I started riding the bus to travel between these places because of the bus service changes.
   ☐ Yes ☐ No

9. The September bus service changes have affected my bus travel between these places.
   ☐ Yes ☐ No (if no, skip to Question 11).

10. My bus travel between these places has changed because:

Time spent getting to the bus stop where I got on the bus:	☐ Less Now	☐ Same	☐ Takes Longer	
Time waiting for the bus:	☐ Less Now	☐ Same	☐ Takes Longer	
Transfers needed:	☐ Fewer Now	☐ Same	☐ More	☐ Never Used Transfers
Time spent on the bus:	☐ Less Now	☐ Same	☐ More	

11. I used RTD buses before the September bus service changes: ☐ Yes ☐ No
    If Yes: Because of the bus service changes, I now use the bus:
    ☐ More Often ☐ Less Often ☐ No Change

12. The total annual income of all persons in my household is:
    ☐ Under $5,000 ☐ $5,000-$9,999 ☐ $10,000-$14,999 ☐ $15,000-$24,999 ☐ $25,000 or More

13. My age is: _____ 14. My race is: ☐ White ☐ Black ☐ Chicano ☐ Other _____

15. My Sex: ☐ Male ☐ Female

We may need more information about your use of the RTD. May we contact you sometime later by phone?

Telephone No. _____ ☐ Day ☐ Evening

Whom should we ask for (your name)? _____

OTHER SIDE PLEASE

№ 06070

Figure A.2.2 (cont.)
ON-BOARD SURVEY 2 (1/79)
(Reverse Side of Form)

1. MARK THE PLACE YOU ARE COMING FROM WITH AN "X".

2. MARK THE PLACE WHERE YOU ARE GOING TO WITH AN "O".

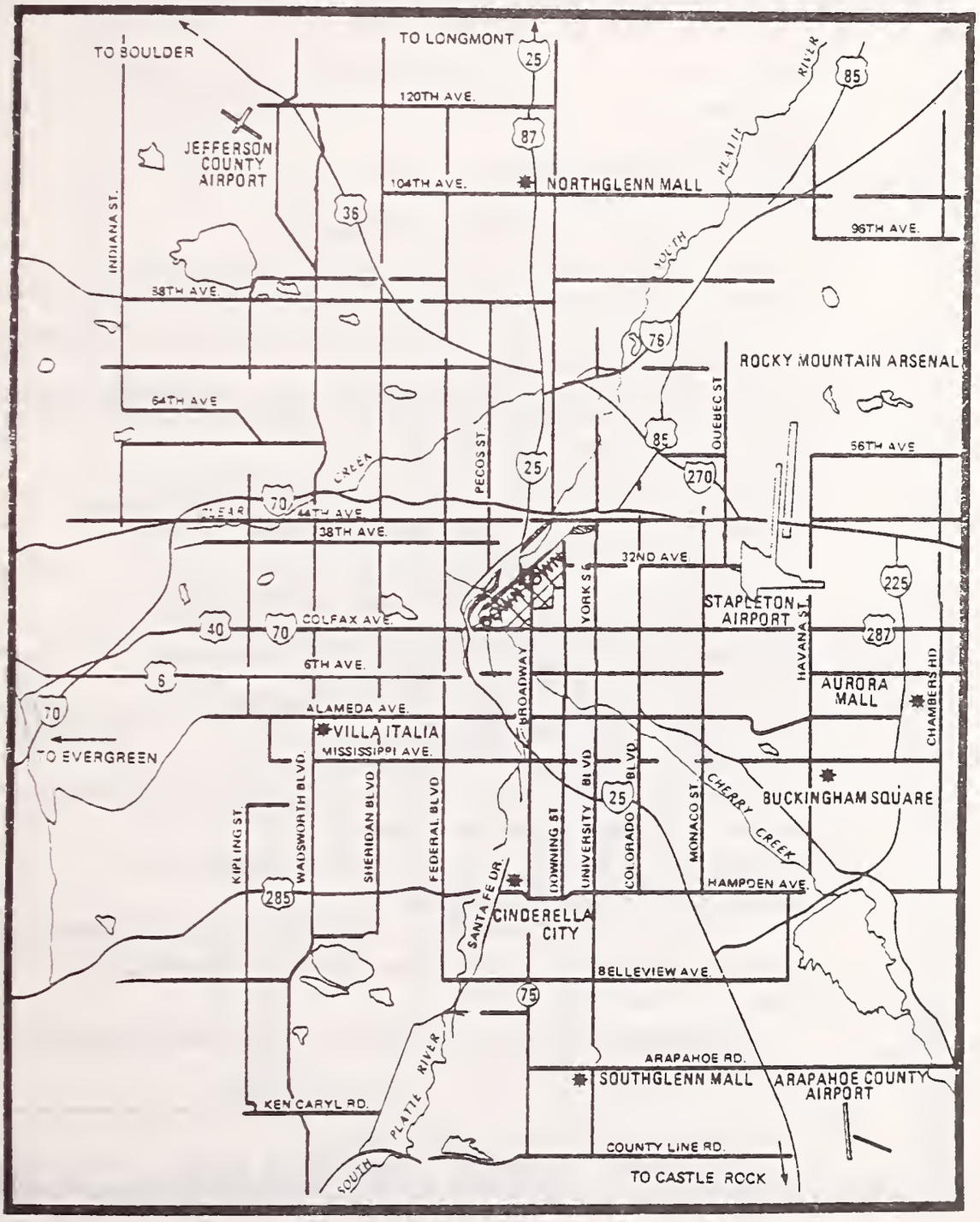


Figure A.2.3
ON-BOARD SURVEY 3 (3/79)

Dear Rider:

The RTD is interested in providing you with the best possible bus service. Please help us by completing and returning this questionnaire before you get off the bus. All responses will be kept confidential.

The place I am coming from:

☐ Home ☐ Work ☐ Shopping ☐ Recreational or Social ☐ School ☐ Other _____

2. After leaving that place I walked . . . _____ blocks to get to the bus stop ☐ I did not walk

3. I waited ____ minutes for the bus. 4. I paid for this trip by: ☐ Cash: _____ ¢ (how much) ☐ Token ☐ Monthly Pass

5. I have transferred to this bus: ☐ Yes ☐ No 6. I will transfer to another bus. ☐ Yes ☐ No

7. The place I am going to:

☐ Home ☐ Work ☐ Shopping ☐ Recreational or Social ☐ School ☐ Other

8. Instead of using the bus, I could have traveled between these places by car:

☐ Yes, as a driver ☐ Yes, as a passenger ☐ No, car not available

9. On September 10, 1978, major changes were made to bus routes and schedules. Before that time, I was making this bus trip:

☐ Yes, I made this bus trip before service changes. ☐ No, I started making this bus trip because of service changes

☐ No, I started making this trip because of other reasons

10. Since September 10, more bus service changes have been made. The bus service changes made in September and more recently have affected the convenience of this bus trip for me. ☐ Yes ☐ No – skip to question 12

11. Convenience of this bus trip has changed in these ways:

Time spent getting to the bus stop where I got the bus:	☐ Less Now	☐ Same	☐ Takes Longer	
Time waiting for the bus:	☐ Less Now	☐ Same	☐ Takes Longer	
Transfers needed:	☐ Fewer Now	☐ Same	☐ More	☐ Never Used Transfers
Time spent on the bus:	☐ Less Now	☐ Same	☐ More	

12. I used RTD buses before the September bus changes: ☐ Yes ☐ No
If Yes: because of the bus service changes in September and later, I now use the bus:

☐ More Often ☐ Less Often ☐ No Change

13. RTD's Free Fare Program ended February 1, 1979. Because the Free Fare Program has ended, I have made the following change in the time of day when I make this bus trip:

☐ No Change ☐ Changed from free fare hours to rush hours (6–8 AM or 4–6 PM)

☐ Changed from rush hours to what were free fare hours ☐ This bus trip not made during Free Fare Program

14. Because the Free Fare Program has ended, I now use the bus:

☐ More often ☐ Less often ☐ No change ☐ Did not use bus before February 1

15. The total annual income of all persons in my household is:

☐ Under $5,000 ☐ $5,000–$9,999 ☐ $10,000–$14,999 ☐ $15,000–$24,999 ☐ $25,000 or More

16. My age: _____ My Race is: ☐ White ☐ Black ☐ Chicano ☐ Other _____

17. My Sex: ☐ Male ☐ Female

We may need more information about your use of the RTD. May we contact you sometime later by phone?

Telephone No. _____ ☐ Day ☐ Evening

With whom should we ask for (your Name)? _____

OTHER SIDE PLEASE

№ 01805

Figure A.2.3 (cont.)
ON-BOARD SURVEY 3 (3/79)
(Reverse Side of Form)

1. MARK THE PLACE YOU ARE COMING FROM WITH AN "X".

2. MARK THE PLACE WHERE YOU ARE GOING TO WITH AN "O".

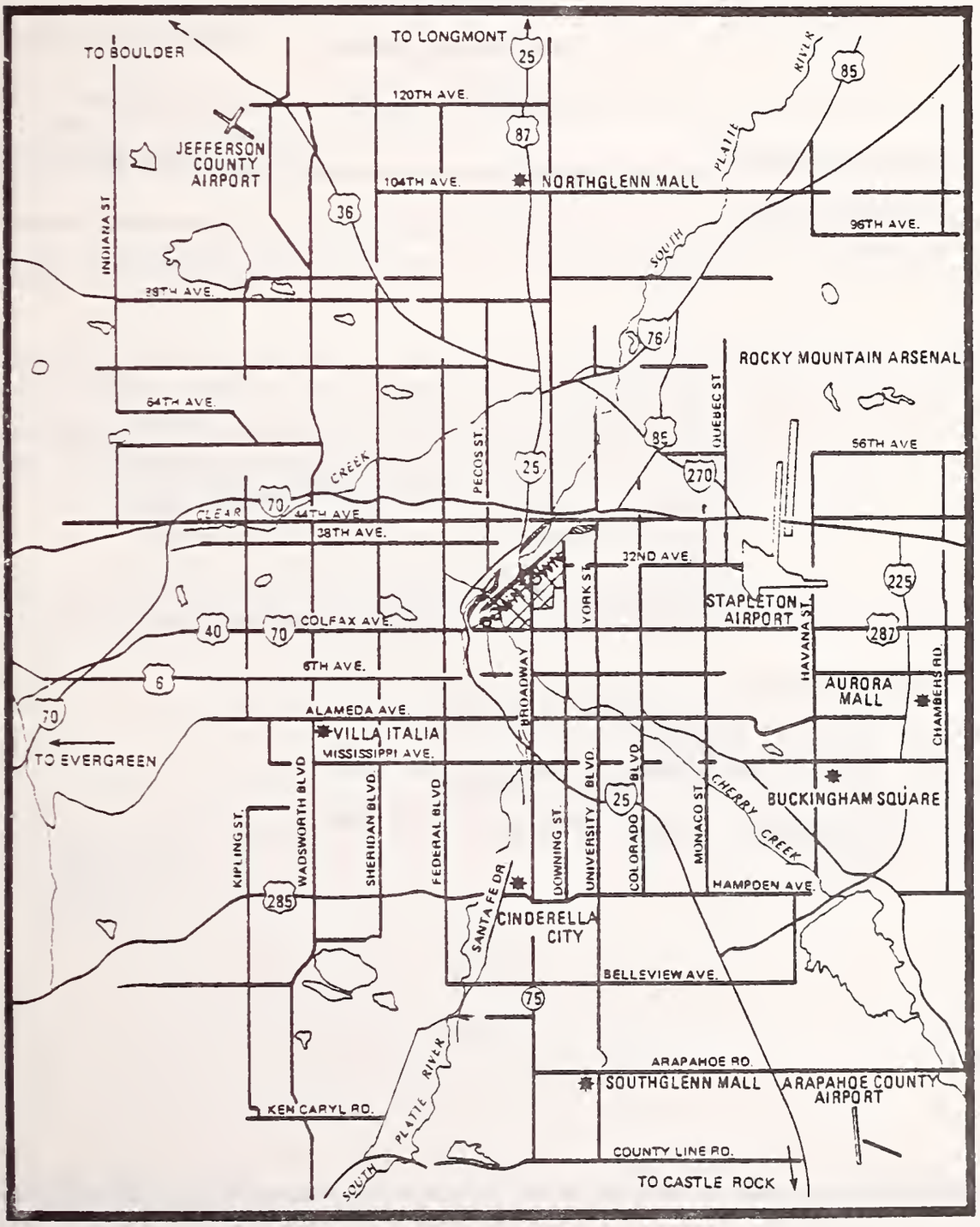


Figure A.2.4
TRANSIT USER FOLLOW-UP SURVEY 1 (10/78)*

NATIONAL ANALYSTS
A Division of Booz·Allen &
Hamilton Inc.

CARD 34

Study 1-275
Fall, 1978

DENVER STUDY

(BUS RIDER SURVEY)

- Call Report Form -

(Circle Code)

RESPONDENT NUMBER: _____ LIST: A B C D E F G H I
11-15

RESPONDENT NAME: _____

TELEPHONE #: _____

	1	2	3	16
TIME	AM PM	AM PM	AM PM	
DATE				17
RESULT*				

*RESULT OF CALL

1. Interview completed
2. Interview refused
4. Eligible respondent not home
5. No answer
7. Busy after 10 rings (call again in ½ hour)
8. Non-working number
9. Other

END CARD 34

*Similar transit user follow-up surveys were administered (1/79) and (5/79).

Figure A.2.4 (continued)
TRANSIT USER FOLLOW-UP SURVEY 1

CARD 05

NATIONAL ANALYSTS
A Division of Booz-Allen & Hamilton Inc.

Study 1-275
Fall, 1978

DENVER STUDY

- BUS RIDER SURVEY -

(Circle Code)

RESPONDENT NUMBER: _____ List: A B C D E F G H I
11-15

RESPONDENT NAME: _____

TELEPHONE NUMBER: _____

INTERVIEWER NAME: _____

DATE OF INTERVIEW: _____

INTRODUCTION: Hello, may I speak with (RESPONDENT'S NAME). My name is _____ and I am calling as part of a federally funded bus demonstration project in Denver. As you may recall, a few weeks ago you filled out a questionnaire on one of the RTD buses and gave us your name and phone number in case we had more questions.

1. At that time, what was the address or street corner closest to the place you were coming from?

_____
STREET 16-40

_____
STREET 41-65

END CARD 05

2. What was the address or street corner closest to the place you were going to?

CARD 06

_____
STREET 11-35

_____
STREET 36-60

END CARD 06

Figure A.2.4 (continued)
TRANSIT USER FOLLOW-UP SURVEY 1

CARD 07

3. Have you made that trip again since Sunday, September 10th? 11

	Yes	1
(SKIP TO Q.6)	No	2
	Don't Know	3

4. Since September 10th, how have you usually made that trip? (IF "CAR", PROBE: As a driver or as a passenger?) (CIRCLE ONLY A SINGLE CODE) 12

(SKIP TO Q.6)	Bus	1
	Car, as a driver	2
	Car, as a passenger	3
	Walking	4
	Other (PLEASE EXPLAIN):	0

5. Why don't you now use the bus for that trip? 13

Bus is too crowded	1
Don't know where to get the bus	2
Harder to get to work, shopping, etc.	3
Bus stops are further from origin or destination of trips	4
Reason not related to bus service	5
Other (EXPLAIN)	0

Now I have a few questions about your use of the bus service last week.

6. How many one-way bus trips did you make last week? By one-way bus trips I mean trips in just one direction and not round trips.

_____
OF ONE-WAY TRIPS
14,15

IF "NONE", SKIP TO Q.9

Figure A.2.4 (continued)
TRANSIT USER FOLLOW-UP SURVEY 1

7. How many of these one-way bus trips started outside the rush hours, that is, other than between 6 to 9 AM and 4 to 6 PM weekdays?

\# OF ONE-WAY TRIPS
16,17

IF "NONE", SKIP TO Q.9

8. How many of these one-way trips were for: (READ)

		RECORD NUMBER
18,19	Work or school?	
20,21	Shopping?	
22,23	Other activities?	
	TOTAL	

TOTAL SHOULD EQUAL ANSWER TO Q.7. IF IT DOES NOT ASK RESPONDENT TO CORRECT.

9. How satisfied or dissatisfied are you with the way the bus service in Denver is serving the public? Would you say you are: (READ)

24

	Very satisfied,	1
	Somewhat satisfied,	2
	Somewhat dissatisfied, or	3
	Very dissatisfied?	4
DO NOT READ	Don't know	5

10. Have you heard that the RTD has recently made major changes in many of the bus routes and schedules?

25

	Yes	1
(SKIP TO Q.21)	No	2

Figure A.2.4 (continued)
TRANSIT USER FOLLOW-UP SURVEY 1

11. In your opinion, have the route changes: (READ)

		26
	Improved bus service	1
	Made it worse, or	2
(SKIP TO Q.13)	Had no effect?	3
(DO NOT READ)	No opinion	4

12. In what ways has service been made (better/worse)?

	27
Can get to work, shopping, etc. more easily	1
Bus stops are nearer to origin or destination of trips	2
Harder to get to work, shopping, etc	3
Bus stops are further from origin or destination of trips	4
Bus is too crowded	5
Bus is late, does not run on time	6
Trips take longer now	7
Other (EXPLAIN)	0

13. Because of the changes in bus service, have you changed the number of one-way bus trips that you make?

		28
	Yes	1
(SKIP TO Q.18)	No	2

14. Do you make more one-way bus trips, fewer one-way trips or have you stopped riding the bus?

		29
	More one-way trips	1
(SKIP TO Q.16)	Fewer one-way trips	2
(SKIP TO Q.21)	Stopped riding bus	3

Figure A.2.4 (continued)
TRANSIT USER FOLLOW-UP SURVEY 1

15. How many more one-way bus trips do you make in a typical week for: (READ)

		NUMBER OF ADDITIONAL TRIPS
30,31	Work or school?	
32,33	Shopping?	
34,35	Other activities?	

SKIP TO Q.17

16. How many fewer one-way bus trips do you now make in a typical week for: (READ)

		NUMBER OF FEWER TRIPS
36,37	Work or school?	
38,39	Shopping?	
40,41	Other activities?	

17. What is it about the bus route changes which has caused you to ride (more/less) often?

42

Bus is too crowded	1
Don't know where to get the bus	2
Harder to get to work, shopping, etc.	3
Bus stops are further from origin or destination of trips	4
Other (EXPLAIN)	0

18. Because of the bus route changes, do your one-way trips require more transfers, about the same or fewer transfers?

43

More	1
About the same	2
Fewer transfers	3
Never used transfers	4

Figure A.2.4 (continued)
TRANSIT USER FOLLOW-UP SURVEY 1

19. How about the locations of the bus stops you usually use. Because of the bus route changes, have most of these stops been moved to a better or to a worse place for you? 44

Moved to better place	1
Moved to worse place -	2
No change	3

20. Because of the route changes, do you or do you not: (READ)

		Yes	No
a.	Go to any different places than you used to? 45	1	2
b.	Ride the bus to downtown Denver more often? 46	1	2
c.	Make trips more often? 47	1	2

21. Now I have a few more questions. Have you heard about the free fare bus program which allows everyone to ride the bus for free except between 6 to 8 AM and 4 to 6 PM weekdays? 48

	Yes	1
(SKIP TO Q.30)	No	2

22. How do you feel about the free fare program? Would you say you are: (READ) 49

	Strongly in favor,	1
	Somewhat in favor,	2
	Somewhat opposed, or	3
	Strongly opposed?	4
(DO NOT READ)	Don't know, no opinion	9

23. Why do you (favor/oppose) the program? 50

Encourages more people to ride buses	1
Lets me (personally) ride free	2
Lets people, in general, ride free	3
Relieves traffic congestion	4
Encourages undesirable/unruly people to ride bus	5
Cannot ride free all the time	6
Other (EXPLAIN)	0

Figure A.2.4 (continued)
TRANSIT USER FOLLOW-UP SURVEY 1

24. Because of the free bus fares, do you or do you not: (READ)

		Yes	No
a. Go to any different places than you used to?	51	1	2
b. Ride the bus to downtown Denver more often?	52	1	2
c. Make trips more often?	53	1	2

25. When the free fare program ends do you think that: (READ)

		Should	Should Not
a. Elderly people should or should not still get to ride free?	54	1	2
b. Handicapped people should or should not get to ride free?	55	1	2
c. Young people, up to age 16, should or should not get to ride free?	56	1	2
d. People with low income, regardless of age, should or should not get to ride free?	57	1	2

26. Do you think that the free fare program should be continued as it is for everyone?

	58
Yes	1
No	2

27. Should it be expanded to include <u>all hours</u> of the day?

	59
Yes	1
No	2

28. (IF "YES" TO Q.26 <u>AND</u> Q.27, SKIP TO Q.29, OTHERWISE:) Should it be completely discontinued?

	60
Yes	1
No	2

END CARD 1

Figure A.2.4 (continued)
TRANSIT USER FOLLOW-UP SURVEY 1

29. Continuation of free fares would have to be paid for somehow. CARD 18
Suppose the additional tax per household were between $10 and $20 per year. How do you feel about paying this amount? Would you say you are: (READ)

11

	Stongly in favor,	1
	Somewhat in favor,	2
	Somewhat opposed, or	3
	Strongly opposed?	4
(DON'T READ)	Don't know	9

30. Now I am going to read a list of different things about bus service. Please tell me how satisfied or dissatisfied you are with each of these. Would you say you are very satisfied, somewhat satisfied, somewhat dissatisfied or very dissatisfied with: (READ)

		Very satisfied	Somewhat satisfied	Somewhat dissatisfied	Very dissatisfied	Does not apply
a. The time spent getting to the bus stop?	12	1	2	3	4	
b. The time spent waiting for the bus?	13	1	2	3	4	
c. The bus arriving on time?	14	1	2	3	4	
d. The amount of delay while transferring to another bus?	15	1	2	3	4	9
e. Seat availability?	16	1	2	3	4	
f. The amount of time spent on the bus?	17	1	2	3	4	
g. A sense of security?	18	1	2	3	4	
h. Driver courtesy?	19	1	2	3	4	

Figure A.2.4 (continued)
TRANSIT USER FOLLOW-UP SURVEY 1

31. (IF "YES" TO Q.21, ASK. OTHERWISE SKIP TO Q.32) Please tell me whether the bus route changes have made any of these things better or worse for you? Considering only the effect of the route changes. Would you say (READ STATEMENTS a-h, is much better, somewhat better, about the same, somewhat worse or much worse?

(READ)		Much Better	Some-what Better	About the Same	Some-what Worse	Much Worse	Does not apply
a. The time spent getting to the bus stop?	20	1	2	3	4	5	
b. The time spent waiting for the bus?	21	1	2	3	4	5	
c. The bus arriving on time?	22	1	2	3	4	5	
d. The amount of delay while transferring to another bus?	23	1	2	3	4	5	9
e. Seat availability?	24	1	2	3	4	5	
f. The amount of time spent on the bus?	25	1	2	3	4	5	
g. A sense of security?	26	1	2	3	4	5	
h. Driver courtesy?	27	1	2	3	4	5	

32. (IF "YES" TO Q.21, ASK OTHERWISE, SKIP TO Q.33) Has the free fare program made any of these things better or worse for you? Consider only the effect of the free fare program? Would you say (READ STATEMENTS a-f) is much better, somewhat better, about the same, somewhat worse, or much worse?

		Much Better	Some-what Better	About the Same	Some-what Worse	Much Worse	Does not apply
a. The bus arriving on time?	28	1	2	3	4	5	
b. The amount of delay while transferring to another bus?	29	1	2	3	4	5	9
c. Seat availability?	30	1	2	3	4	5	
d. The amount of time spent on the bus?	31	1	2	3	4	5	
e. A sense of security?	32	1	2	3	4	5	
f. Driver courtesy?	33	1	2	3	4		

Figure A.2.4 (continued)
TRANSIT USER FOLLOW-UP SURVEY 1

33. When you have to go somewhere, is a car usually available to you as a driver or as a passenger or as both a driver and a passenger?

34

SKIP TO Q.35	Yes, as driver	1
	Yes, as passenger	2
	Yes, both	3
	No, not available	4

34. Do you have a driver's license?

35

Yes	1
No	2

END CARD 08

35. Please tell me the names of the two streets at the corner closest to your residence. What city is that?

CARD 09

STREET 11-35 _____ STREET 36-60 _____

CITY 61-75 _____

THANK YOU FOR HELPING US WITH THIS QUESTIONIARE.

END [illegible]

Figure A.2.5
RANDOM HOUSEHOLD SURVEY 1 (10/78)*

NATIONAL ANALYSTS
A Division of Booz-Allen & Hamilton Inc.

CASE 01

Study 1-275
Fall, 1978

SCREENING FORM

TELEPHONE NUMBER: _____

INTERVIEWER NAME: _____

DATE OF SCREENING: _____

SCREENING FORM NUMBER: _____

CONFIRM TELEPHONE NUMBER, THEN READ INTRODUCTION

INTRODUCTION: Hello, my name is _____ and I am calling as part of a federally funded bus demonstration project in Denver. Is this a private residence? 18

	Yes	1
(TERMINATE)	No	2

We are trying to find out how people feel about the RTD, the public bus service here in Denver. We are interested in your opinions and would appreciate your help in answering a few questions. The information you give to us will remain confidential.

1. So I may know whom to interview, please tell me how many persons live in your household who are 18 years old or older. Be sure to include yourself.

_____ # OF PERSONS 19-20

2. Please tell me the first name or initials of each of the males living here who are 18 years old or older, beginning with the oldest. What is the first name and age of the (next) oldest male? (RECORD NAME OR INITIALS AND AGE OF EACH MALE IN TABLE A. IF "NONE", CHECK BOX A)

TABLE A
MALES

BOX A
(IF NO MALES, CHECK HERE) ☐

21	NAME OF MALES	AGE	SELECTION NUMBER
1.	22-23		
2.	24-25		
3.	26-27		
4.	28-29		
5.	30-31		

3. Please tell me the first name or initials of each of the females living here who are 18 years old or older, beginning with the oldest. What is the first name and age of the (next) oldest female? (RECORD NAME OR INITIALS AND AGE OF EACH FEMALE IN TABLE B. IF "NONE", CHECK BOX B.)

TABLE B
FEMALES

BOX B
(IF NO FEMALES, CHECK HERE) ☐

32	NAME OF FEMALES	AGE	SELECTION NUMBER
1.	33-34		
2.	35-36		
3.	37-38		
4.	39-40		
5.	41-42		

BE SURE THE NUMBER OF MALES AND FEMALES IN TABLE A AND TABLE B EQUAL THE NUMBER OF PERSONS GIVEN IN Q.1. IF DIFFERENT, ASK RESPONDENT TO CORRECT ANSWERS.

IF THIS IS A BLUE FORM, SELECT AS THE RESPONDENT THE MALE IN TABLE A WITH THE LOWEST NUMBER (THE NUMBER CLOSEST TO "1") IN THE SELECTION NUMBER COLUMN. ASK TO SPEAK TO THAT PERSON. IF NO MALES IN THE HOUSEHOLD, INTERVIEW THE FEMALE WITH THE SMALLEST SELECTION NUMBER.

IF THIS IS A PINK FORM, SELECT AS THE RESPONDENT THE FEMALE IN TABLE B WITH THE LOWEST NUMBER (THE NUMBER CLOSEST TO "1") IN THE SELECTION NUMBER COLUMN. ASK TO SPEAK TO THAT PERSON. IF NO FEMALES IN THE HOUSEHOLD, INTERVIEW THE MALE WITH THE SMALLEST SELECTION NUMBER.

*Similar random household surveys were administered (1/79) and (5/79).

Figure A.2.5 (continued)
RANDOM HOUSEHOLD SURVEY 1

CALL REPORT FORM

	1	2	3	
TIME				
DATE				
RESULT*				

RESULT OF CALL

1. Interview completed
2. Interview refused
3. Screening refused
4. Eligible respondent not home
5. No answer
6. Business phone
7. Busy after 10 rings (call again in ½ hour)
8. Non-working number
9. Other

Figure A.2.5 (continued)
RANDOM HOUSEHOLD SURVEY 1

NATIONAL ANALYSTS
A Division of Booz-Allen & Hamilton Inc.

CARD 02

Study: 1-075
Fall, 1979

Denver Study

Male	1
Female	2

Respondent Name: _____

Screening Form Respondent Line #: _____

Respondent Telephone #: _____

Interviewer Name: _____

Date of Interview: _____

REPEAT INTRODUCTION IF INTERVIEW RESPONDENT IS DIFFERENT FROM SCREENING RESPONDENT.

INTRODUCTION: Hello, my name is_____and I am calling as part of a federally funded bus demonstration project in Denver. Is this a private residence? 12

	Yes	1
(TERMINATE)	No	2

1. How many blocks or miles from your home is the nearest RTD bus stop? 15

NUMBER OF 13,14	Blocks	1
	Miles	2

2. About how many one-way bus trips were made by all the members of your household last week? By one-way trips, I mean trips in just one direction and not round trips.

NUMBER OF ONE-WAY TRIPS 16,17

IF "NONE", SKIP TO Q.5

3. About how many of these one-way bus trips did you, yourself, make?

NUMBER OF ONE-WAY TRIPS 18,19

IF "NONE", SKIP TO Q.5

Figure A.2.5 (continued)
RANDOM HOUSEHOLD SURVEY 1

4. About how many of your one-way bus trips last week were made using the bus service between 6 to 8 AM and 4 to 6 PM weekdays?

NUMBER OF ONE-WAY TRIPS ____ 20,21

5. How satisfied or dissatisfied are you with the way the bus service in Denver is serving the public? Would you say you are: (READ)

		22
	Very satisfied,	1
	Somewhat satisfied,	2
	Somewhat dissatisfied, or	3
	Very dissatisfied?	4
(DON'T READ)	Don't know	9

6. Have you heard about the free fare bus program which allows everyone to ride the bus for free except between 6 to 8 AM and 4 to 6 PM weekdays?

		23
	Yes	1
(SKIP TO Q.14)	No	2

7. How do you feel about the free fare program? Would you say you are: (READ)

		24
	Strongly in favor,	1
	Somewhat in favor,	2
	Somewhat opposed, or	3
	Strongly opposed?	4
(DON'T READ)	Don't know	9

Figure A.2.5 (continued)
RANDOM HOUSEHOLD SURVEY 1

8. Why do you say that you (favor/oppose) the program? (CODE ONLY FIRST RESPONSE) [25]

Encourages more people to ride buses	1
Lets me (personally) ride free	2
Lets people, in general, ride free	3
Relieves traffic congestion	4
Encourages undesirable/unruly people to ride bus	5
Cannot ride free all the time	6
Other (EXPLAIN)	0

9. When the free fare program ends, do you think that: (READ)

	Should	Should Not	
a. Elderly people should or should not still get to ride free?	1	2	[26]
b. Handicapped people should or should not get to ride free?	1	2	[27]
c. Young people, up to age 16, should or should not get to ride free?	1	2	[28]
d. People with low incomes, regardless of age, should or should not get to ride free	1	2	[29]

10. Do you think that the free fare program should be continued as it is for everyone? [30]

Yes	1
No	2

11. Should it be expanded to include all hours of the day? [31]

Yes	1
No	2

Figure A.2.5 (continued)
RANDOM HOUSEHOLD SURVEY 1

12. (IF "YES" TO Q.10 AND Q.11, SKIP TO Q.13, OTHERWISE)
Should it be completely discontinued?

32

	Yes	1
	No	2

13. Continuation of free fares would have to be paid for somehow. Suppose the additional tax per household were between $10 and $20 per year. How do you feel about paying this amount? Would you say you are: (READ)

33

	Strongly in favor,	1
	Somewhat in favor,	2
	Somewhat oppose, or	3
	Strongly oppose	4
(DON'T READ)	Don't know	9

14. Have you heard that the RTD has recently made major changes in many of the bus routes and schedules?

34

	Yes	1
(SKIP TO Q.17)	No	2

15. In your opinion, have the route changes: (READ)

35

	Improved bus service,	1
	Made it worse, or	2
(SKIP TO Q.17)	Had no effect?	3
(DON'T READ SKIP TO Q.17)	No opinion	9

Figure A.2.5 (continued)
RANDOM HOUSEHOLD SURVEY 1

16. In what ways has service been made (better/worse)? (CODE ONLY FIRST RESPONSE.

36

Can get to work, shopping, etc. more easily	1
Bus stops are nearer to origin or destination of trips	2
Harder to get to work, shopping, etc.	3
Bus stops are further from origin or destination of trips	4
Other (EXPLAIN)	0

17. When you have to go somewhere, is a car usually available to you as a driver or as a passenger or as both a driver and a passenger?

37

Yes, as driver	1
Yes, as passenger	2
Yes, both	3
No, not available	4

18. Do you have a driver's license?

38

Yes	1
No	2

19. Please stop me when I read the range that includes <u>your</u> age: (READ)

39

18 to 24 years,	1
25 to 44 years,	2
45 to 64 years, or	3
65 or older?	4

Figure A.2.5 (continued)
RANDOM HOUSEHOLD SURVEY 1

20. Please stop me when I read the range that includes the <u>total</u> annual income of all members of your household: (READ)

40

Under $5,000,	1
$5,000 to $9,999,	2
$10,000 to $14,999,	3
$15,000 to $24,999,	4
$25,000 or more.	5

END CARD 02

21. Please tell me the names of the two streets at the corner closest to your residence. What city is that?

CARD 03

STREET 11-35 STREET 36-60

CITY 61-75

Thank you for helping us with this questionnaire.

END CARD 03

Figure A.3
RTD FREE FARE DEMONSTRATION
BUS CORNER COUNTS

OBSERVER ______________________ SUPERVISOR ______________________

DAY ______________________ DATE ______________________

LOCATION ______________________ DIRECTION ______________________

TIME START ____________ TIME END ____________ WEATHER ____________

				Passenger Counts		
					Count One Only	
Bus Route	Bus Number	Scheduled Time of Arrival	Actual Time of Arrival	Standees	Occupied Seats	Empty Seats

Figure A.4
DENVER RTD DRIVERS SURVEY

Time _____

Dear Bus Operator,

The impacts of the Free Fare Program and Route Restructuring are now being evaluated. It is important that your opinion of the effects of these programs be part of the evaluation. Please complete this form and then return it to the surveyor.

Thank you for your help.

1. How long have you been a bus operator for RTD?

_____ years _____ months

THE FREE FARE PROGRAM

2. What runs have you driven during the Free Fare Program?

- ☐ split
- ☐ matinee
- ☐ daylight
- ☐ night
- ☐ other _____ (please specify)

3. What route or routes have you driven during the Free Fare period?

_____

4. Has the Free Fare Program had a good or bad effect on on your job?

- ☐ good effect
- ☐ bad effect
- ☐ no effect

5. During your runs, has the Free Fare Program had a good or bad effect on any of the following factors?

	Good Effect	No Effect	Bad Effect
a. Run times	☐	☐	☐
b. Layovers	☐	☐	☐
c. Schedule Adherence	☐	☐	☐
d. Number of required stops	☐	☐	☐
e. Crowding on the bus	☐	☐	☐
f. Crime on the bus	☐	☐	☐
g. Types of persons using service	☐	☐	☐
h. Passenger arguments or fights with drivers	☐	☐	☐
i. Passenger arguments or fights with others	☐	☐	☐
j. Smoking, eating, or drinking on the bus	☐	☐	☐
k. Offensive language, harassment, benavior	☐	☐	☐
l. Vandalism on the bus	☐	☐	☐
m. Frequency of joyriding by children	☐	☐	☐
n. Frequency of joyriding by elderly	☐	☐	☐
o. Number of people riding the bus for very short trips	☐	☐	☐
p. Respect for the bus system	☐	☐	☐
q. Any other effects? _____ _____			

6. What is the most important good effect?

_____

_____

_____

7. What is the most important bad effect?

_____

_____

_____

8. Has the Free Fare Program caused your buses to run late more or less often than before?

- ☐ more often
- ☐ less often
- ☐ no change

9. How often are comments made to you by passengers about the Free Fare Program?

	Positive Comments	Negative Comments
a. Daily	☐	☐
b. At least once a week	☐	☐
c. At least once a month, but not weekly	☐	☐
d. Less often than once a month	☐	☐
e. Never	☐	☐

10a. Have you made a special request to change the runs or routes you drive because of the Free Fare Program?

- ☐ no
- ☐ yes

If assignment change was made:

route and run shifted from:	route and run shifted to:

10b. What is about the Free Fare Program that caused you to make a request?

_____

_____

_____

OVER

Figure A.4 (continued)
DENVER RTD DRIVERS SURVEY

ROUTE RESTRUCTURING

11. What runs have you driven since route restructuring began in September?

- ☐ split
- ☐ matinee
- ☐ daylight
- ☐ night
- ☐ other _____ (please specify)

12. What route or routes have you driven since route restructuring?

_____

13. Has the route restructuring had a good or bad effect on your job?

- ☐ good effect
- ☐ bad effect
- ☐ no effect

14. During your runs, has route restructuring had a good or bad effect on any of the following factors?

	Good Effect	No Effect	Bad Effect
a. Run times	☐	☐	☐
b. Layovers	☐	☐	☐
c. Schedule Adherence	☐	☐	☐
d. Number of required stops	☐	☐	☐
e. Crowding on the bus	☐	☐	☐
f. Number of passengers asking route, schedule information	☐	☐	☐
g. Your ability to provide information to patrons	☐	☐	☐
h. Respect for the bus system	☐	☐	☐
i. Any other effects?			

_____

_____

15. What is the most important good effect?

_____

_____

16. What is the most important bad effect?

_____

_____

16. Listed below are a number of possible effects of route restructuring. Which effects are occurring more or less often because of route restructuring?

	More Often	About the Same	Less Often
a. Shortened layovers	☐	☐	☐
b. Longer layovers	☐	☐	☐
c. Buses running late	☐	☐	☐
d. Buses running early	☐	☐	☐
e. More frequent stops required	☐	☐	☐
f. Less frequent stops required	☐	☐	☐

17. How often are comments made to you by passengers about route restructuring?

	Positive Comments	Negative Comments
a. Daily	☐	☐
b. At least once a week but not daily	☐	☐
c. At least once a month but not weekly	☐	☐
d. Less often than once a month	☐	☐
e. Never	☐	☐

18e. Have you made a special request to change the runs or routes you drive because of route restructuring?

- ☐ no
- ☐ yes

If assignment change was made:

route and run shifted from:	route and run shifted to:

18b. What is it about route restructuring that caused you to make a request?

_____

_____

ANY COMMENTS OR SUGGESTIONS?

_____

_____

_____

_____

_____

_____

_____

Appendix B: Ridership Estimates
LIST OF TABLES

B.1 Revised Average Fare Calculation: August, 1977 (Weekday)

B.2 Accuracy Rate of Registering Farebox System

B.3 Adjustment Factors to Account for Estimated Counting Biases in RTD Monthly Performance Report Passenger Count Data

B.4 Summary of Peak/Off-Peak Ridership Split (Unlinked Trips)

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B.6 Summary of Factors Accounted for in Projection of Base 1978 and 1979 Ridership

B.7 Summary of Estimated Free Fare Ridership Impacts

B.8 Estimated Net Effect of Off-Peak Free Fare on Travel Behavior: Peak and Off-Peak Average Weekday

B.9 Linked and Unlinked Adjusted Ridership Estimates: Total Monthly Scheduled Service--MOG and NOG

Unlinked Trips Adjusted by Type of Scheduled Service:
B.10.1 Monthly Total --MOG
B.10.2 Monthly Total --NOG

Unlinked Trips Adjusted by Type of Service
B.11.1 Weekdays--MOG
B.11.2 Weekdays--NOG

Weekdays, Saturdays, Sundays and Week Total

B.12.1 Unlinked Trips (Adjusted)
B.12.2 Linked Trip (Adjusted)

APPENDIX B

RIDERSHIP ESTIMATES

B.1 Estimation of Before, During and Post-Demonstrations Ridership

In order to estimate the ridership impacts of the free fare demonstration, it was necessary to take several measures to improve the quality of the ridership count data available from the transit operator. These steps included: 1) adjustments to reduce or eliminate counting biases, 2) normalization of monthly counts through the estimaion of weekly trips (average weekday, Saturday, and Sunday), 3) determination of peak and off-peak period ridership splits, and 4) conversion of adjusted unlinked trips (boarding) to linked trips (person-trips).

B.1.1 Adjustments to Reduce Counting Biases

Special efforts were made to account for suspected counting and transcription errors in RTD's passenger data (unlinked trips). In order to develop an estimate of the impact of off-peak fare elimination it was necessary to determine the magnitude of error in passenger count estimates prior to and during the free fare demonstration, particularly since overcounting was thought to be a problem in the pre-free fare period and undercounting was considered a potential source of error for during and after the demonstration period. The adjustment coefficients derived from the following passenger count reliability analyses are documented in Table B.3.

B.1.1.1 Pre-Free Fare

Prior to March 1978 (NOG) and January 1978 (MOG) RTD used the average fare method of estimating passenger boardings on its local, circulator and intercity routes. Analysis of the distribution of bus hours of service during August 1977 indicates that the average fare survey used by RTD under-sampled peak period riders by a factor of .95. Due to higher fares during peak hours this resulted in approximately a 2 percent under-estimation of the average fare for unlinked trips, and consequently a 2 percent over estimation of ridership based on the August 1977 average fare survey. It is assumed that ridership counts based on the average fare method of calculation during 1976 and 1977 reflect this same direction and magnitude of error.

Table B.1
REVISED AVERAGE FARE CALCULATION, AUGUST 1977 (WEEKDAY)

	No. of Passengers			Revenue	
	Original Survey	Adjusted Total	Weekday Fare ($)	Original Survey	Adjusted Total
Adult Peak	2,620	3,010	.35	$ 917.00	$1,053.50
Adult Off-Peak	3,630	3,445	.25	907.50	861.25
Adult Passes	521	NC	.2425	126.34	NC
Senior Citizens Peak	210	241	.25	52.50	60.25
Senior Citizens Off-Peak	450	427	.15	67.50	64.05
E&H Peak	55	63	.25	13.75	15.75
E&H Off-Peak	131	124	.15	19.65	18.60
E&H Passes	378	NC	.1531	57.87	NC
Student Regular	708	NC	.20	141.60	NC
Student Passes	296	NC	.1724	51.03	NC
Transfers	1,803	NC	.05	90.15	NC
Corrections (Free)					
Under 6	403	NC	0	0	NC
Free Transfers	141	NC	0	0	NC
Elderly	231	NC	0	0	NC
TOTAL	11,577	11,791	-	$2,444.89	$2,540.39

Average Fare:
Original Survey = $.2112
Adjusted Survey = $.2155

NC: No Adjustment Made

Source: RTD; Average Fare Survey, August 1977.

B.1.1.2 During and Post Free Fare

Prior to the Farebox Verification Surveys, it was suspected that the implementation of the registering farebox counting system, in which passenger boardings are counted manually by drivers, would result in a fairly substantial level of miscounting. Furthermore, it was expected that problems were greatest during the initial months of the farebox system and would be aggravated during months in which major changes occurred in either counting and/or transcription procedures, such as in December 1978; or in bus service operations, such as, the beginning of free fare in February 1976 or the implementation of the route and schedule changes in March (NOG) and September (MOG) 1978. In general, improvement in accuracy rate over time was expected as machinery malfunctions were corrected and drivers learned the new procedures.

Three data points were obtained to provide an indication of the extent of miscounting and to detect any trend in improvement that might be measured. Farebox Verification Surveys were conducted during each round of data collection in the evaluation. These produced the following net measures of under-counting during the periods surveyed.

Table B.2
ACCURACY RATE OF REGISTERING FAREBOX SYSTEM

Week Surveyed	Boardings Observed	Farebox Recordings	Net Accuracy Rate
September 25-29, 1978	3291	2988	91
December 11-15, 1978	4353	3746	86
March 19-23, 1979	3184	3065	96

Source: Farebox Verification Survey; see Appendix D, Table D.1

Analyses of the frequency distribution of these data by time of day, loading conditions on buses, and by drivers performance shows considerable variation among the three surveys but with no clear causal patterns. In general, the three surveys do not provide an indication of improvement in accuracy rates over time. It appears that the September and December data reflect the impact of Route Restructuring and farebox system changes respectively. It appears that since the implementation of the registering farebox systems, it is reasonable to assume that RTD typically reports a 4 percent underrepresentation of actual passenger boardings (unlinked trips) in its Monthly Performance System. However, during times of special circumstances affecting driver

Table B.3
ADJUSTMENT FACTORS TO ACCOUNT FOR ESTIMATED COUNTING BIASES IN RTD MONTHLY PERFORMANCE REPORT PASSENGER COUNT DATA

TIME PERIOD	TYPE OF SERVICE						REASON/EVENT
	Local	Express	Circulator			Inter-City	
			Denver	Boulder	Longmont		
January 1977 through October 1977	.980	1.040[a]	.980	.980	.980	.980	Average fare method of passenger count over-estimated ridership
November				1.040	1.040		Begin registering farebox system in Boulder and Longmont
December							
January 1978	1.040	1.040	1.040			1.040	Begin registering farebox system in Denver
February	1.065	1.065	1.065	1.065	1.065	1.065	Begin free fare
March	1.045	1.045	1.045	1.065	1.065	1.045	Route restructuring: Boulder, Longmont, and one-quarter Denver
April	1.040	1.040	1.040	1.040	1.040	1.040	Stable rate of undercounting
May							
June							
July							
August							
September	1.065	1.065	1.065				Route restructuring: Denver (data point)
October	1.040	1.040	1.040				Stable rate of undercounting
November							
December	1.065	1.065	1.065	1.065	1.065	1.065	Change in farebox counting system (data point)
January 1979 through June 1979	1.040	1.040	1.040	1.040	1.040	1.040	Stable rate of undercounting--March (data point)

[a] Average fare method not used for express passenger counts. Four percent undercounting estimated.

attitudes or responsibilities, undercounding may be significantly higher, perhaps as much as 10 percent of actual. The estimate used for the adjustment of monthly RTD data in this evaluation, however was an average 6 percent rate of undercounting during these special months.[1] It should be noted that the 4 and 6 percent adjustment factors may in fact understate the extent of undercounting which occurred during some months of the demonstration. However, without stronger indication of the magnitude of this error, a conservative approach to manipulation of the data base seems to be appropriate in order not to mask potentially significant, but small, ridership effects.

B.1.2 Estimation of Weekly Ridership

Because of variation from month-to-month in the total number and composition of days (weekdays, weekend days, holidays) represented in monthly passenger current data, it was necessary to estimate average weekly ridership per month to provide for normalized comparisions. Average weekday, Saturday, and Sunday ridership counts were estimated for the period from January, 1978 to June 1979 using weekday equivalents derived from RTD estimates of weekday and weekend passenger count ratios by service type.[2] For 1976 and 1977, fare revenues and average fare data by day of week were used to calculate average weekday, Saturday and Sunday equivalents. The results of this work were a complete set of adjusted average daily ridership estimates (unlinked trips) by service type, for each month from 1976 to present.

B.1.3 Determination of Peak/Off-Peak Weekday Ridership Distribution

The estimation of ridership levels during the peak and off-peak hours of weekday operations is critical to the evaluation of the demonstration. Estimates of the peak/off-peak passenger split have been derived for the before, during, and post-demonstration typical weekday.

B.1.3.1 Pre-Demonstration and Base

Analysis of RTD's 1977 headway sheets indicated that 29.3 percent of the all day (weekday) hours of local service were provided during the peak hours from 7:00 to 9:00 a.m. and from 4:00 to 6:00 p.m. From average fare survey data passenger boardings per hour were determined for this time frame - 15.9 peak and 9.0 off-peak. Adjusting for the fact that virtually all express ridership occurs during the peak period, the best pre-demonstration period estimate of the total RTD scheduled service peak to off-peak split is 46 percent peak and 54 percent off-peak.

---

[1] If higher adjustment factors were used, the magnitude of estimated free fare impacts on RTD ridership would be proportionately larger. A larger differential between "normal" and "special" months would tend to amplify month-to-month seasonal variation.

[2] RTD weekday and weekend estimates could not be used directly in the analysis because they are only available from January 1978 on.

This serves as the basis for the estimation of the projected base without free fare peak to off-peak split for during and after the demonstration periods. Adjusting for the redefinition of the morning peak in May 1978 (6:00 to 8:00 a.m.) and for the effect of higher peak fares relative to off-peak fares (January, 1978 fare structure change), it is projected that off-peak ridership would have increased to 58 percent of total unlinked trips on a typical weekday in 1978 or 1979.

B.1.3.2 During and Post-Demonstration

A similar method was used to derive an estimate for the demonstration and post-demonstration period. Analysis of the hours of bus operation showed a slight increase in the percent of total service provided during the off-peak for both the during-demonstration period (71.3%) and for the post-demonstration period (72.1%). When applied to passenger boarding rates taken from the Farebox Verification surveys of local routes, it is estimated that the peak to off-peak ridership split for total scheduled service (unlinked trips) was 32 percent to 68 percent during the demonstration. Applying a similar method, a 42 percent to 58 percent split is estimated for the period after the reinstatement of off-peak fares.

A summary of the estimated weekday distribution of passenger boardings by time of day is given below:

Table B.4
SUMMARY OF PEAK/OFF-PEAK RIDERSHIP SPLIT (UNLINKED TRIPS)

	Observed		Base	
	Peak	Off-Peak	Peak	Off-Peak
Before: (August 1977)	46%	54%	45%	55%
During: (August, 1978)	32%	68%	42%	58%
After: (March, 1979)	43%	57%	42%	58%

Calculation of Linked Trips

Linked (person) trips were estimated using rates of transferring information obtained in On-Board Survey (8/78). The differential rates of peak and off-peak transferring have been incorporated in the calculations converting unlinked to linked ridership estimates.

Table B.5
RATE OF TRANSFERRING BY TIME OF DAY

Number of Links (Boardings)	Peak	Off-Peak	Weekday Total
1 No Transfer	82.2%	71.5%	75.2
2 Transfer Once	12.9	20.9	18.1
3 Transfer Twice	4.6	7.2	6.3
4+Transfer Three or More	.3	0.4	.4
Person Trips	100.0%	100.0%	100.0%
Linked Trips as Percent of Unlinked Trips	(82.1%)	(73.2%)	(76.8%)

Source: On-Board Survey (8/78)

B.2 Projection of Base Ridership

The general method used in the projection of base ridership is outlined in the free fare project report. Table B.6 supplements this discussion with a summary of the important factors which affect transit ridership and were accounted for prior to the estimation of free-fare effects. The table documents specific values assumed or estimated from available data. Detailed ridership estimates of estimated actual, base and free fare effect are provided for reference in the remaining tables in this appendix.

Table B.6
SUMMARY OF FACTORS ACCOUNTED FOR IN PROJECTION OF BASE 1978 AND 1979 RIDERSHIP

Factors	Weekday Total	Weekday Peak	Weekday Off-Peak	Saturday	Sunday
Secular Growth					
1977-78[a] (Feb-Aug)	2.3%	-	-	3.0%	3.0%
1978-79[b] (Feb-June)	2.3%	-	-	3.0%	3.0%
Service Improvements					
Mileage Increase					
1977-78[a]	14.0%	-	-	85.0%	70.0%
1978-79[b]	7.0%	-	-	0	-15.0%
Estimated Service Elasticity	.6	-	-	.3	.3
New Fare Schedule (January, 1978)					
Average Fare Increase	43.0%	5%	25%	5.0%	5.05
Estimated Price Elasticity	-	-.3	-.4	-.4	-.4
Route Restructuring					
Ridership Impact	-4.0%	-	-	-4.0%	-4.0%

Table B.7
SUMMARY OF ESTIMATED FREE FARE RIDERSHIP IMPACTS

Evaluation Period		Projected Base	Actual	Estimated Free Fare Effect	
				Number	% Increase (% retained)
Weekday	1977[a]	(89,800)	89,800	-	-
	1978[a]	92,200	118,500	26,300	+29%
	1979[b]	96,100	101,100	5,000	(19%)
o Off-Peak	1977	(46,800)	46,800	-	
	1978	51,800	77,500	25,800	+50%
	1979	54,000	54,800	800	(3%)
o Peak	1977	(43,000)	43,000	-	
	1978	40,400	40,900	500	1%
	1979	42,200	46,400	4,200	(-)
Saturday	1977	(27,700)	27,700	-	
	1978	34,700	52,000	17,200	+50%
	1979	34,200	40,900	6,700	(39%)
Sunday	1977	(11,500)	11,500	-	
	1978	14,000	27,000	13,000	93%
	1979	13,100	19,000	5,900	(45%)
Week TOTAL	1977	(488,000)	488,000	-	
	1978	510,000	671,000	162,000	+32%
	1979	528,000	567,000	37,900	(23%)
o Off-Peak and Week-Ends	1977	(273,000)	273,000	-	
	1978	308,000	467,000	159,000	52%
	1979	317,000	334,000	17,000	(11%)
o Peak Week-days	1977	(215,000)	215,000	-	
	1978	202,000	205,000	3,000	1.5%
	1979	211,000	232,000	21,000	(-)

[a]Mean Average: February to August Pre-Route Restructuring.

[b]Mean Average: February to June only

Table B.8
ESTIMATED NET EFFECT OF OFF-PEAK FREE FARE ON TRAVEL BEHAVIOR
PEAK AND OFF-PEAK AVERAGE WEEKDAY

Before Demonstration (Base Ridership)		During Demonstration (Estimated Ridership)		
Source Mode	Total	Changed To	Number From Source	Total
Peak Bus	41,200	Peak Bus	31,200	40,900
		Off-Peak Bus	10,000	
		Other Mode	-	
		Trip Not Made	-	
			41,200	
Off-Peak Bus	51,500	Peak Bus	3,900*	77,500
		Off-Peak Bus	45,500	
		Other Mode	1,200	
		Trip Not Made	1,000	
			51,500	
Other Mode (Increment)	21,900	Peak Bus	5,400*	-1,200
		Off-Peak Bus	16,500	
			21,900	
Trip Not Made (Increment)	6,000	Peak Bus	500*	1,000
		Off-Peak Bus	5,500	
			6,000	

*On-Board Survey 5/79).

Sources: On-Board Survey (8/78); DCCO Ridership Estimate.

TABLE B.9
LINKED AND UNLINKED RIDERSHIP ESTIMATES:
TOTAL MONTHLY SCHEDULED SERVICE--MOG AND NOG
(EXCLUDING SPECIAL, CHARTER,ELDERLY & HANDICAP)

Year and month		Unlinked RTD Counts	Unlinked Adjusted	Linked Adjusted
	October	3477103.	3616187.	2771977.
	September	3030017.	3151218.	2410071.
	August	3185361.	3312775.	2539236.
	July	3018755.	3139505.	2403639.
	June	2958610.	3076954.	2355635.
	May	2968420.	3087157.	2364853.
	April	3087453.	3210951.	2459866.
	March	3173474.	3300413.	2526686.
	February	2849024.	2962985.	2270004.
1979	January *	3637455.	3782953.	2865242.
	December *	3431351.	3654389.	2764195.
	November *	3574465.	3717444.	2814412.
	October *	3681457.	3828715.	2897796.
	September **	3470035.	3685024.	2785528.
	August *	3846690.	4000558.	3026526.
	July *	3615206.	3759814.	2841334.
	June *	3718956.	3867714.	2928169.
	May *	3680586.	3827809.	2897430.
	April *	3575236.	3718245.	2811323.
	March *	3874152.	4055101.	3073446.
	February *	3236130.	3446478.	2611245.
1978	January	2678979.	2994138.	2297384.
	December	2822740.	2776292.	2129993.
	November	2785606.	2740830.	2106622.
	October	2935483.	2887428.	2218025.
	September	2923032.	2874280.	2209059.
	August	2982799.	2933772.	2255818.
	July	2515574.	2474753.	1899881.
	June	2730416.	2685940.	2065286.
	May	2833255.	2787179.	2141876.
	April	2748988.	2704767.	2078375.
	March	3009464.	2961268.	2277449.
	February	2569403.	2527310.	1943042.
1977	January	2750670.	2705422.	2077681.

* Free Fare Off-Peak Demonstration

** Route Restructuring Implemented in Denver

TABLE B.10.1
UNLINKED ADJUSTED TRIPS BY TYPE OF SCHEDULED SERVICES:
MONTHLY TOTAL - METROPOLITAN OPERATING GROUP (MOG)

Year and month		Regular Denver	Express Denver	Circulator Denver	Total Denver (MOG)
	October	2817628.	264157.	80438.	3176743.
	September	2492209.	207638.	67079.	2780525.
	August	2627957.	244271.	80619.	2970027.
	July	2483411.	227682.	76484.	2804159.
	June	2418152.	231395.	78076.	2742497.
	May	2393568.	223642.	83226.	2717102.
	April	2501094.	216238.	82148.	2815811.
	March	2580835.	225162.	70813.	2899628.
	February	2313295.	186368.	66381.	2581605.
1979	January *	2992082.	215118.	60219.	3267419.
	December *	2905052.	187262.	59428.	3169363.
	November *	2968598.	189899.	67588.	3237652.
	October *	3044729.	200658.	79300.	3337370.
	September **	2981124.	180715.	83770.	3255738.
	August *	3265116.	225692.	71141.	3574620.
	July *	3092807.	194272.	74303.	3370946.
	June *	3164977.	213188.	80740.	3469802.
	May *	3104693.	210774.	79324.	3405888.
	April *	3015238.	198552.	74931.	3300222.
	March *	3223146.	246016.	88281.	3569274.
	February *	2775730.	224206.	73179.	3083439.
1978	January	2461331.	197139.	69209.	2737968.
	December	2289379.	173445.	71381.	2544449.
	November	2217771.	189568.	69919.	2487364.
	October	2344368.	184675.	71392.	2611249.
	September	2364685.	168280.	67546.	2608871.
	August	2403198.	184240.	83820.	2681990.
	July	1994098.	164507.	79092.	2245815.
	June	2183751.	175632.	78421.	2445113.
	May	2274260.	183536.	83197.	2550452.
	April	2168647.	186477.	81689.	2446350.
	March	2383307.	208230.	88113.	2680967.
	February	2030181.	161119.	86441.	2286057.
1977	January	2196721.	169264.	86634.	2460182.

* Free Fare Off-Peak Demonstration

** Route Restructuring Implemented in Denver

TABLE B.10.2
UNLINKED TRIPS ADJUSTED BY TYPE OF SCHEDULED SERVICE
MONTHLY TOTAL - NORTHERN OPERATING GROUP (NOG)

Year and month	Boulder Only	Longmont Only	Boulder and Longmont	Inter-City	Total (NOG)
October	275282.	27736.	303018.	150947.	454918.
September	232544.	21902.	254446.	129845.	385097.
August	202667.	19687.	222354.	137574.	360809.
July	209828.	20629.	230458.	121471.	352663.
June	214031.	21148.	235179.	114152.	351448.
May	242655.	28738.	271373.	115347.	387677.
April	269282.	31427.	300709.	110763.	412216.
March	273753.	31271.	305024.	112580.	418581.
February	267679.	32132.	299811.	97130.	397746.
1979 January *	342856.	53895.	396751.	118786.	516505.
December *	331648.	51099.	382747.	119900.	503543.
November *	316657.	50446.	367103.	124256.	492260.
October *	332799.	48211.	381010.	123018.	505124.
September **	291194.	39062.	330256.	109160.	440587.
August *	280712.	40887.	321598.	117009.	439665.
July *	264574.	35866.	300440.	97992.	399296.
June *	272637.	38102.	310740.	98070.	409855.
May *	286993.	41215.	328208.	104810.	433954.
April *	278306.	37607.	315914.	113612.	430566.
March *	310043.	42042.	352085.	145574.	498703.
February *	226604.	35255.	261859.	111504.	374207.
1978 January	156807.	23831.	180638.	85822.	267239.
December	139712.	24982.	164694.	77393.	242695.
November	135495.	41948.	177443.	86129.	264367.
October	169430.	31167.	200597.	86396.	287729.
September	158400.	29624.	188025.	85744.	274462.
August	146695.	34692.	181387.	81126.	263303.
July	133541.	29902.	163442.	73614.	237630.
June	139847.	30870.	170717.	77420.	248791.
May	143868.	33020.	176908.	69278.	246970.
April	155334.	39633.	194967.	72956.	268657.
March	162993.	38068.	201061.	80578.	282414.
February	147127.	34532.	181660.	67910.	250253.
1977 January	152260.	36676.	188942.	63861.	253475.

* Free Fare Off-Peak Demonstration

** Route Restructuring Implemented in Denver

TABLE B.11.1
UNLINKED TRIPS (ADJUSTED) BY TYPE OF SCHEDULED SERVICE
WEEKDAYS - MOG

Year and month		Regular Denver	Express Denver	Circulator Denver	Total Denver (MOG)
	October	109211.	11485.	3284.	123979.
	September	110473.	10928.	3220.	124621.
	August	101872.	10620.	3239.	115732.
	July	102366.	10842.	3371.	116579.
	June	99524.	11019.	3385.	113928.
	May	95544.	10166.	3520.	109229.
	April	104747.	10297.	3651.	118696.
	March	101928.	10235.	2934.	115097.
	February	102134.	9318.	3099.	114552.
1979	January *	120365.	9778.	2581.	129604.
	December *	123538.	9363.	2723.	135624.
	November *	123552.	9043.	2956.	135551.
	October *	119563.	9121.	3318.	132001.
	September **	123433.	9036.	3960.	136429.
	August *	123282.	9813.	2776.	135871.
	July *	126458.	9714.	3438.	139609.
	June *	124990.	9690.	3451.	138132.
	May *	122022.	9581.	3458.	135060.
	April *	125741.	9928.	3440.	139109.
	March *	126697.	10696.	3554.	140947.
	February *	124371.	11210.	3339.	138921.
1978	January	102102.	9388.	3016.	114506.
	December	94668.	8259.	3072.	105999.
	November	95608.	9027.	3116.	107751.
	October	99808.	8794.	3138.	111740.
	September	101930.	8013.	3012.	112955.
	August	95562.	8010.	3416.	106989.
	July	87809.	8225.	3631.	99665.
	June	90778.	7983.	3345.	102106.
	May	97666.	8740.	3712.	110118.
	April	92971.	8880.	3593.	105443.
	March	95137.	9053.	3605.	107796.
	February	92533.	8056.	4046.	104635.
1977	January	92863.	8060.	3857.	104781.

* Free Fare Off-Peak Demonstration

** Route Restructuring Implemented in Denver

TABLE B.11.2
UNLINKED TRIPS (ADJUSTED) BY TYPE OF SCHEDULED SERVICE
WEEKDAYS - NOG

Year and Month	Boulder and Longmont	Inter-City	Total NOG
October	11907.	6043.	17950.
September	11548.	6005.	17553.
August	8642.	5463.	14106.
July	9610.	5111.	14720.
June	9789.	4824.	14613.
May	10835.	4712.	15547.
April	12727.	4764.	17492.
March	11883.	4602.	16484.
February	13181.	4353.	17535.
1979 January *	15899.	4786.	20685.
December *	16000.	4945.	20945.
November *	15276.	5077.	20353.
October *	15029.	4873.	19902.
September **	13616.	4608.	18224.
August *	12451.	4521.	16972.
July *	12762.	4142.	16905.
June *	12700.	3986.	16685.
May *	13118.	4199.	17317.
April *	13201.	4937.	18138.
March *	13757.	5763.	19520.
February *	11359.	4958.	16316.
1978 January	7450.	3691.	11141.
December	6936.	3286.	10222.
November	7768.	3776.	11545.
October	8667.	3757.	12424.
September	8233.	3758.	11991.
August	7295.	3283.	10578.
July	7337.	3312.	10649.
June	7181.	3274.	10455.
May	7733.	3023.	10756.
April	8457.	3198.	11655.
March	8118.	3270.	11387.
February	8383.	3150.	11533.
1977 January	8182.	2740.	10922.

* Free Fare Off-Peak Demonstration

** Route Restructuring Implemented in Denver

TABLE B.12.1
UNLINKED TRIPS (ADJUSTED) FOR RTD SCHEDULED SERVICE
WEEKDAYS, SATURDAYS, SUNDAYS AND WEEK TOTALS

Year and Month	Average Weekday	Average Saturday	Average Sunday	Average Week
October	141930.	61043.	26907.	797599.
September	142174.	55970.	28342.	795185.
August	129838.	55210.	26418.	730816.
July	131299.	53066.	28327.	737888.
June	128541.	52819.	28375.	723899.
May	124776.	54680.	24673.	703233.
April	136187.	55113.	26113.	762163.
March	131581.	59455.	27089.	744449.
February	132086.	54174.	26140.	740746.
1979 January *	153409.	63772.	30573.	861391.
December *	156569.	66251.	31958.	881056.
November *	155904.	71512.	31482.	882514.
October *	151903.	71659.	39881.	871257.
September **	154653.	78075.	40317.	891658.
August *	152843.	77714.	43580.	885507.
July *	156514.	75080.	42356.	900006.
June *	154817.	76542.	38894.	889520.
May *	152378.	70427.	38758.	871074.
April *	157247.	79267.	35395.	900896.
March *	160468.	56608.	34479.	893425.
February *	155237.	60672.	24761.	861620.
1978 January	125647.	53923.	23312.	705467.
December	116221.	47426.	19704.	648235.
November	119296.	38830.	16060.	651369.
October	124164.	39598.	16397.	676817.
September	124946.	40938.	17331.	683001.
August	117567.	41384.	16051.	645268.
July	110314.	35741.	14963.	602272.
June	112562.	37101.	15295.	615204.
May	120874.	38943.	15508.	658822.
April	117098.	36937.	15254.	637683.
March	119183.	38968.	16049.	650934.
February	116168.	36166.	14821.	631828.
1977 January	115703.	38636.	20186.	637337.

* Free Fare Off-Peak Demonstration

** Route Restructuring Implemented in Denver

TABLE B.12.2
LINKED TRIPS (ADJUSTED) FOR TOTAL RTD SCHEDULED SERVICE
WEEKDAYS, SATURDAYS, SUNDAYS AND WEEK TOTALS

Year and Month		Average weekday	Average Saturday	Average Sunday	Average Week
	October	109324.	44683.	19696.	611001.
	September	109513.	40970.	20746.	609280.
	August	100010.	40414.	19338.	559801.
	July	101136	38844.	20736.	565258.
	June	99011.	38664.	20771.	554490.
	May	96111.	40026.	18060.	538642.
	April	104901.	40342.	19114.	583963.
	March	101353.	43521.	19829.	570115.
	February	101742.	39656.	19135.	567501.
1979	January *	116665.	46681.	22379.	652383.
	December *	119068.	48496.	23393.	667228.
	November *	118562.	52346.	23045.	668201.
	October *	115520.	52601.	29193.	659391.
	September **	117611.	57151.	29512.	674717.
	August *	116234.	56887.	31900.	669956.
	July *	119026.	54958.	31004.	681092.
	June *	117735.	56029.	28470.	673175.
	May *	115880.	51552.	28371.	659325.
	April *	119583.	58024.	25909.	681848.
	March *	122032.	41437.	25238.	676837.
	February *	118055.	44412.	16125.	652811.
1978	January	97005.	39472.	17064.	541563.
	December	89729.	34716.	14423.	497781.
	November	92102.	28423.	11756.	500691.
	October	95861.	28986.	12003.	520294.
	September	96465.	29966.	12686.	524977.
	August	90767.	30293.	11749.	495879.
	July	85168.	26162.	10953.	462953.
	June	86903.	27158.	11196.	472870.
	May	93321.	28507.	11352.	506463.
	April	90406.	27038.	11166.	490233.
	March	92016.	28525.	11748.	500351.
	February	89688.	26473.	10849.	485760.
1977	January	89328.	28282.	14776.	489700.

* Free Fare Off-Peak Demonstration

** Route Restructuring Implemented in Denver

Appendix C: Monthly Revenue, Operating and Performance Indicator Data
LIST OF TABLES

C.1 Estimated Monthly Revenues and Operating Costs: Total RTD Scheduled Service

C.2 Estimated Monthly Revenues and Operating Costs per Linked Trip: Total RTD Scheduled Service

Estimated Monthly Service Hours, Service Miles and Average System Speed: Total RTD Scheduled Service

C.3.1 Denver Regular

C.3.2 Denver Express

C.3.3 Denver Circulator

C.3.4 Boulder & Longmont

C.3.5 Intercity

C.4.1 Denver Regular

C.4.2 Denver Express

C.4.3 Denver Circulator

C.4.4 Boulder & Longmont

C.4.5 Intercity

C.6 Estimated Average Weekday Miles of Scheduled Service

C.7 Estimated Average Weekday Hours of Scheduled Service

C.8 Estimated Average Weekday Passengers (Adjusted Unlinked) Per Miles of Scheduled Service

C.9 Estimated Average Weekday Passengers (Adjusted Unlinked) Per Scheduled Service Hour

TABLE C.1
ESTIMATED MONTHLY AND WEEKDAY REVENUES AND OPERATING COSTS
TOTAL RTD SERVICE (INCLUDES SPECIAL, CHARTER AND E&H)

Year	and month		Monthly Operating Cost	Monthly Revenue	Weekday Revenue	Weekday Operating Cost
	October		4036934.	1104974.	43369.	152683.
	September		3756044.	1016525.	45863.	159020.
	August		3846265.	940494.	36861.	145471.
	July		4023855.	998530.	41764.	160441.
	June		3353127.	933632.	39003.	134232.
	May		3815293.	962314.	38895.	146109.
	April		3356511.	939012.	39827.	135562.
	March		3433089.	1078699.	43006.	132144.
	February		3288130.	1007462.	44911.	140279.
1979	January	*	3595938.	640139.	29097.	139594.
	December	*a	3975949.	512002.	25600.	161493.
	November	*	3138611.	501986.	23904.	126761.
	October	*	3391792.	539058.	24503.	131669.
	September	**	3262561.	488523.	24426.	134262.
	August	*	3005718.	550109.	23918.	113681.
	July	*	3018235.	458241.	22912.	122593.
	June	*	2869556.	452625.	20574.	112797.
	May	*	3080212.	479564.	21798.	119573.
	April	*	2961954.	407285.	20364.	121891.
	March	*	3224962.	427711.	18596.	121973.
	February	*	2756293.	441208.	22060.	117589.
1978	January		2717459.	835428.	35058.	108655.
	December	a	3563421.	700293.	29316.	140847.
	November		2687164.	731529.	31840.	108528.
	October		2908147.	752554.	32361.	114947.
	September		2471548.	766834.	33335.	99820.
	August		2860302.	754967.	30254.	108181.
	July		2444829.	646769.	28830.	96634.
	June		2577715.	686869.	28785.	101325.
	May		2650671.	716259.	31063.	105731.
	April		2400039.	701451.	30368.	96078.
	March		2474522.	741144.	29829.	93590.
	February		2238055.	683963.	31438.	95480.
1977	January		2420489.	731780.	31296.	96280.

a Reflects end-of-year accounting adjustments.

* Free Fare Off-Peak Demonstration

** Route Restructuring Implemented in Denver

TABLE C.2
ESTIMATED MONTHLY REVENUES AND OPERATING COSTS PER LINKED TRIP
TOTAL RTD SERVICE (INCLUDES SPECIAL CHARTER AND E&H)

Year and Month	Average Fare per Unlinked Trip	Revenue per Linked Trip	Operating Costs per Linked Trip	Subsidy per Linked Trip
October	.306	.399	1.456	1.058
September	.323	.422	1.558	1.137
August	.284	.370	1.515	1.144
July	.318	.415	1.674	1.259
June	.303	.396	1.423	1.027
May	.312	.407	1.613	1.206
April	.292	.382	1.365	.983
March	.327	.427	1.359	.932
February	.340	.444	1.449	1.005
1979 January *	.169	.223	1.255	1.032
December *a	.140	.185	1.438	1.253
November *	.135	.178	1.115	.937
October *	.141	.186	1.170	.984
September **	.133	.175	1.171	.996
August *	.138	.182	.992	.811
July *	.122	.161	1.062	.901
June *	.117	.155	.980	.825
May *	.125	.166	1.063	.898
April *	.110	.145	1.054	.909
March *	.105	.139	1.049	.910
February *	.128	.169	1.056	.887
1978 January	.279	.364	1.183	.819
December a	.252	.329	1.673	1.344
November	.267	.347	1.276	.928
October	.261	.339	1.311	.972
September	.267	.347	1.119	.772
August	.257	.335	1.268	.933
July	.261	.340	1.287	.946
June	.256	.333	1.248	.916
May	.257	.334	1.238	.903
April	.259	.337	1.155	.817
March	.250	.325	1.087	.761
February	.271	.352	1.152	.800
1977 January	.270	.352	1.165	.813

a Reflects end-of-year accounting adjustments.

* Free Fare Off-Peak Demonstration

** Route Restructuring Implemented in Denver

TABLE C.3.
ESTIMATED MONTHLY SERVICE HOURS, MILES AND AVERAGE SYSTEM SPEED
PASSENGERS AND REVENUE PER HOUR AND PER MILE
TOTAL RTD SERVICE (INCLUDES SPECIAL CHARTER AND E&H)

Year and month		Service Hours	Service Miles	Average Speed
	October	131525.	2034553.	15.47
	September	126978.	1771010.	13.95
	August	142485.	2024225.	14.21
	July	135046.	1913178.	14.17
	June	132317.	1875846.	14.18
	May	137782.	1924580.	13.97
	April	132471.	1860967.	14.05
	March	139018.	1949606.	14.02
	February	124183.	1741245.	14.02
1979	January *	134796.	1911344.	14.18
	December *	130936.	1813577.	13.85
	November *	129111.	1803139.	13.97
	October *	134327.	1877021.	13.97
	September **	124032.	1738864.	14.02
	August *	128513.	1820520.	14.17
	July *	120662.	1692461.	14.03
	June *	120662.	1819610.	15.08
	May *	136490.	1935229.	14.18
	April *	129088.	1629154.	14.17
	March *	139131.	1978701.	14.22
	February *	107319.	1525321.	14.21
1978	January	113736.	1598922.	14.06
	December	114854.	1612571.	14.04
	November	112183.	1575577.	14.04
	October	114624.	1608496.	14.03
	September	111472.	1569084.	14.08
	August	119629.	1697080.	14.19
	July	110308.	1563180.	14.17
	June	114069.	1621166.	14.21
	May	110428.	1541631.	13.96
	April	110796.	1549399.	13.98
	March	115652.	1609446.	13.92
	February	100939.	1336798.	13.24
1977	January	107949.	1416750.	13.12

* Free Fare Off-Peak Demonstration

** Route Restructuring Implemented in Denver

TABLE C.3.1
ESTIMATED MONTHLY SERVICE HOURS, MILES AND AVERAGE SYSTEM SPEED
DENVER REGULAR SERVICE

Year and month		Service Hours	Service Miles	Average Speed
	October	1440262.	107072.	13.45
	September	1279354.	95699.	13.37
	August	1436745.	107112.	13.41
	July	1357779.	101579.	13.37
	June	1348318.	100799.	13.38
	May	1371441.	104202.	13.16
	April	1317938.	100385.	13.13
	March	1379957.	105339.	13.10
	February	1244846.	93653.	13.29
1979	January *	1368498.	103386.	13.24
	December *	1299666.	98789.	13.16
	November *	1282168.	97246.	13.18
	October *	1335076.	101080.	13.21
	September **	1231510.	92742.	13.28
	August *	1243052.	92533.	13.43
	July *	1166314.	87122.	13.39
	June *	1236522.	87122.	14.19
	May *	1329299.	97880.	13.58
	April *	1256355.	92518.	13.58
	March *	1334119.	98739.	13.51
	February *	1047875.	79616.	13.16
1978	January	1097729.	84666.	12.97
	December	1110339.	85466.	12.99
	November	1072479.	82618.	12.98
	October	1097703.	85069.	12.90
	September	1078004.	82815.	13.02
	August	1166283.	88304.	13.21
	July	1085543.	82111.	13.22
	June	1107045.	84423.	13.11
	May	1072952.	82666.	12.98
	April	1072955.	82826.	12.95
	March	1105752.	85689.	12.90
	February	879022.	72100.	12.19
1977	January	942233.	77324.	12.19

* Free Fare Off-Peak Demonstration

** Route Restructuring Implemented in Denver

TABLE C.3.2
ESTIMATED MONTHLY SERVICE HOURS, MILES AND AVERAGE SYSTEM SPEED
DENVER EXPRESS

Year and Month		Service Hours	Service Miles	Average Speed
	October	204249.	9671.	21.12
	September	168810.	7988.	21.13
	August	194124.	9046.	21.46
	July	177648.	8264.	21.50
	June	178414.	8392.	21.26
	May	187962.	9027.	20.82
	April	179259.	8626.	20.78
	March	193550.	9014.	21.47
	February	168769.	8237.	20.49
1979	January *	187694.	9098.	20.63
	December *	164767.	8524.	19.33
	November *	169268.	8955.	18.90
	October *	177832.	9381.	18.96
	September **	157232.	8427.	18.66
	August *	166925.	9351.	17.85
	July *	146260.	8200.	17.84
	June *	166785.	8200.	20.34
	May *	178882.	9270.	19.30
	April *	161617.	8462.	19.10
	March *	183320.	9715.	18.87
	February *	167207.	8796.	19.01
1978	January	174364.	9293.	18.76
	December	174142.	9245.	18.84
	November	174413.	9480.	18.40
	October	175507.	9000.	19.50
	September	163779.	8472.	19.33
	August	186148.	9417.	19.77
	July	161960.	8178.	19.80
	June	171858.	8856.	19.41
	May	156022.	8237.	18.94
	April	158412.	8227.	19.26
	March	167306.	9032.	18.52
	February	128788.	8021.	16.06
1977	January	134667.	8422.	15.99

* Free Fare Off-Peak Demonstration

** Route Restructuring Implemented in Denver

TABLE C.3.3
ESTIMATED MONTHLY SERVICE HOURS, MILES AND AVERAGE SYSTEM SPEED
DENVER CIRCULATOR

Year and month		Service Hours	Service Miles	Average Speed
	October	91480.	7970.	11.48
	September	79092.	6901.	11.46
	August	91493.	7767.	11.75
	July	84583.	7206.	11.74
	June	89073.	7567.	11.77
	May	98965.	8337.	11.87
	April	94913.	7992.	11.88
	March	99936.	8483.	11.78
	February	89400.	7609.	11.75
1979	January *	97839.	6327.	15.46
	December *	90702.	7759.	11.69
	November *	94018.	7231.	13.00
	October *	95025.	7549.	12.59
	September **	103210.	7883.	13.09
	August *	146992.	11251.	13.06
	July *	133238.	10186.	13.08
	June *	149350.	10186.	14.66
	May *	168814.	12635.	13.36
	April *	159454.	12004.	13.28
	March *	169187.	12535.	13.50
	February *	116365.	8179.	14.23
1978	January	123305.	8539.	14.44
	December	123144.	8810.	13.98
	November	124143.	8802.	14.10
	October	126898.	9048.	14.02
	September	121654.	8912.	13.65
	August	125874.	9981.	12.61
	July	114426.	9027.	12.68
	June	121768.	9408.	12.94
	May	119011.	8794.	13.53
	April	125518.	9015.	13.92
	March	139455.	10098.	13.81
	February	152960.	11433.	13.38
1977	January	160643.	11947.	13.45

* Free Fare Off-Peak Demonstration

** Route Restructuring Implemented in Denver

TABLE C.3.4
ESTIMATED MONTHLY SERVICE HOURS, MILES AND AVERAGE SYSTEM SPEED
BOULDER AND LONGMONT

Year and month		Service Hours	Service Miles	Average Speed
	October	11211.	155282.	13.85
	September	10694.	140129.	13.10
	August	11621.	152380.	13.11
	July	11257.	147556.	13.11
	June	11287.	144879.	12.84
	May	11197.	144858.	12.94
	April	11235.	155297.	13.82
	March	11778.	157716.	13.39
	February	10710.	133708.	12.48
1979	January *	11728.	143154.	12.21
	December *	11577.	143506.	12.40
	November *	11252.	138891.	12.34
	October *	11713.	145408.	12.41
	September **	10845.	134615.	12.41
	August *	11258.	150466.	13.37
	July *	11310.	140503.	12.42
	June *	11310.	161296.	14.26
	May *	12660.	148185.	11.70
	April *	11983.	140324.	11.71
	March *	12999.	152172.	11.71
	February *	6725.	83471.	12.41
1978	January	7097.	89077.	12.55
	December	7154.	88977.	12.44
	November	7104.	88134.	12.41
	October	7251.	89805.	12.39
	September	7106.	88159.	12.41
	August	7512.	94318.	12.56
	July	6952.	87126.	12.53
	June	7132.	100812.	14.14
	May	7153.	90897.	12.71
	April	7313.	94453.	12.92
	March	7443.	102138.	13.72
	February	6454.	93162.	14.43
1977	January	7322.	95773.	13.08

* Free Fare Off-Peak Demonstration

** Route Restructuring Implemented in Denver

TABLE C.3.5
ESTIMATED MONTHLY SERVICE HOURS, MILES AND AVERAGE SYSTEM SPEED
INTERCITY SERVICE

Year and month		Service Hours	Service Miles	Average Speed
	October	143280.	6632.	21.60
	September	103625.	5696.	18.19
	August	149483.	6919.	21.60
	July	145612.	6740.	21.60
	June	115162.	4272.	26.96
	May	121354.	5019.	24.18
	April	113560.	4233.	26.83
	March	118447.	4404.	26.90
	February	104522.	3974.	26.30
1979	January *	114159.	4257.	26.82
	December *	114936.	4287.	26.81
	November *	118794.	4427.	26.83
	October *	123680.	4604.	26.86
	September **	112297.	4135.	27.16
	August *	113085.	4120.	27.45
	July *	106146.	3844.	27.61
	June *	105657.	3844.	27.49
	May *	110049.	4045.	27.21
	April *	111404.	4121.	27.03
	March *	139903.	5143.	27.20
	February *	110403.	4003.	27.58
1978	January	114447.	4141.	27.64
	December	115969.	4179.	27.75
	November	116408.	4179.	27.86
	October	118583.	4256.	27.86
	September	117488.	4167.	28.19
	August	124457.	4415.	28.19
	July	114125.	4040.	28.25
	June	119683.	4250.	28.16
	May	102749.	3578.	28.72
	April	98061.	3415.	28.71
	March	94795.	3390.	27.96
	February	82846.	2931.	28.27
1977	January	83434.	2934.	28.44

* Free Fare Off-Peak Demonstration

** Route Restructuring Implemented in Denver

TABLE C.4
ESTIMATED SERVICE PERFORMANCE INDICATORS -
PASSENGERS AND REVENUE PER HOUR AND PER MILE
TOTAL RTD SERVICE (INCLUDES SPECIAL CHARTER AND E&H)

Year and Month	Unlinked Trips per Hour	Unlinked Trips per Mile	Revenue per Hour	Revenue per Mile
October	25.367	1.777	7.751	.543
September	24.817	1.779	8.006	.574
August	23.250	1.637	6.601	.465
July	23.248	1.641	7.394	.522
June	23.254	1.640	7.056	.498
May	22.406	1.604	6.984	.500
April	24.239	1.725	7.088	.505
March	23.741	1.693	7.759	.553
February	23.860	1.702	8.113	.579
1979 January *	26.064	1.979	4.749	.335
December *	27.910	2.015	3.910	.282
November *	28.793	2.062	3.888	.278
October *	28.503	2.040	4.013	.287
September **	29.710	2.119	3.939	.281
August *	31.130	2.197	4.281	.302
July *	31.160	2.222	3.798	.271
June *	32.054	2.126	3.751	.249
May *	28.045	1.978	3.514	.248
April *	28.804	2.033	3.155	.223
March *	29.146	2.049	3.074	.216
February *	32.114	2.260	4.111	.289
1978 January	26.325	1.873	7.345	.522
December	24.172	1.722	6.097	.434
November	24.432	1.740	6.521	.464
October	25.190	1.795	6.565	.468
September	25.785	1.832	6.879	.489
August	24.524	1.729	6.311	.445
July	22.435	1.583	5.863	.414
June	23.547	1.657	6.022	.424
May	25.240	1.808	6.486	.465
April	24.412	1.746	6.331	.453
March	25.605	1.840	6.408	.460
February	25.038	1.891	6.776	.512
1977 January	25.062	1.910	6.779	.517

* Free Fare Off-Peak Demonstration

** Route Restructuring Implemented in Denver

TABLE C.4.1
ESTIMATED SERVICE PERFORMANCE INDICATORS -
PASSENGERS AND REVENUE PER HOUR AND PER MILE
DENVER REGULAR

Year and Month	Unlinked Trips per Hour	Unlinked Trips per Mile	Revenue per Hour	Revenue per Mile
October	26.315	1.956	NA	NA
September	26.042	1.948	NA	NA
August	24.535	1.829	NA	NA
July	24.448	1.829	NA	NA
June	23.990	1.793	NA	NA
May	22.970	1.745	NA	NA
April	24.915	1.898	NA	NA
March	24.557	1.875	NA	NA
February	24.701	1.858	NA	NA
1979 January *	28.941	2.186	NA	NA
December *	29.407	2.235	2.590	.197
November *	30.527	2.315	2.600	.197
October *	30.122	2.281	2.960	.224
September **	32.144	2.421	2.876	.217
August *	35.286	2.627	3.356	.250
July *	35.500	2.652	3.064	.229
June *	36.328	2.560	3.061	.216
May *	31.719	2.336	3.352	.247
April *	32.591	2.400	2.890	.213
March *	32.643	2.416	3.152	.233
February *	34.864	2.649	2.501	.190
1978 January	29.071	2.242	6.422	.495
December	26.787	2.062	5.286	.407
November	26.844	2.068	5.714	.440
October	27.558	2.136	5.850	.453
September	28.554	2.194	6.090	.468
August	27.215	2.061	5.794	.439
July	24.285	1.837	5.148	.389
June	25.867	1.973	5.515	.421
May	27.511	2.120	5.924	.456
April	26.183	2.021	5.648	.436
March	27.813	2.155	6.015	.466
February	28.158	2.310	6.083	.499
1977 January	28.409	2.331	6.142	.504

* Free Fare Off-Peak Demonstration

** Route Restructuring Implemented in Denver

TABLE C.4.2
ESTIMATED SERVICE PERFORMANCE INDICATORS -
PASSENGERS AND REVENUE PER HOUR AND PER MILE
DENVER EXPRESS

Year and month		Unlinked Trips per Hour	Unlinked Trips per Mile	Revenue per Hour	Revenue per Mile
	October	27.314	1.293	NA	NA
	September	25.994	1.230	NA	NA
	August	27.003	1.258	NA	NA
	July	27.551	1.282	NA	NA
	June	27.573	1.297	NA	NA
	May	24.775	1.190	NA	NA
	April	25.068	1.206	NA	NA
	March	24.979	1.163	NA	NA
	February	22.626	1.104	NA	NA
1979	January *	23.645	1.146	NA	NA
	December *	21.969	1.137	13.284	.687
	November *	21.206	1.122	13.131	.695
	October *	21.390	1.128	13.245	.699
	September **	21.445	1.149	9.484	.508
	August *	24.136	1.352	10.931	.612
	July *	23.692	1.328	10.730	.602
	June *	25.998	1.278	11.774	.579
	May *	22.737	1.178	9.548	.495
	April *	23.464	1.229	10.741	.562
	March *	25.323	1.342	11.537	.611
	February *	25.490	1.341	11.387	.599
1978	January	21.214	1.131	13.252	.706
	December	18.761	.996	8.488	.451
	November	19.997	1.087	9.033	.491
	October	20.519	1.052	9.284	.476
	September	19.863	1.027	8.986	.465
	August	19.565	.990	8.851	.448
	July	20.116	1.016	9.101	.460
	June	19.832	1.022	8.972	.462
	May	22.282	1.176	10.237	.540
	April	22.666	1.177	10.414	.541
	March	23.055	1.245	10.597	.572
	February	20.087	1.251	9.229	.575
1977	January	20.098	1.257	9.233	.577

* Free Fare Off-Peak Demonstration

** Route Restructuring Implemented in Denver

TABLE C.4.3
ESTIMATED SERVICE PERFORMANCE INDICATORS -
PASSENGERS AND REVENUE PER HOUR AND PER MILE
DENVER CIRCULATOR

Year and month	Unlinked Trips per Hour	Unlinked Trips per Mile	Revenue per Hour	Revenue per Mile
October	10.093	.879	NA	NA
September	9.720	.848	NA	NA
August	10.353	.881	NA	NA
July	10.614	.904	NA	NA
June	10.318	.877	NA	NA
May	9.983	.841	NA	NA
April	10.279	.866	NA	NA
March	8.348	.709	NA	NA
February	8.724	.743	NA	NA
1979 January *	9.518	.615	NA	NA
December *	7.659	.655	.262	.022
November *	9.347	.719	.327	.025
October *	10.505	.835	.384	.031
September **	10.627	.812	.221	.017
August *	6.323	.484	.140	.011
July *	7.295	.558	.160	.012
June *	7.927	.541	.172	.012
May *	6.278	.470	.139	.010
April *	6.242	.470	.138	.010
March *	7.043	.522	.156	.012
February *	8.947	.629	.190	.013
1978 January	8.105	.561	.596	.041
December	8.102	.580	.870	.062
November	7.944	.563	.843	.060
October	7.890	.563	.848	.060
September	7.579	.555	.724	.053
August	8.398	.666	.726	.058
July	8.762	.691	.753	.059
June	8.336	.644	.754	.058
May	9.461	.699	.868	.064
April	9.061	.651	.837	.060
March	8.726	.632	.857	.062
February	7.561	.565	.839	.063
1977 January	7.252	.539	.833	.062

* Free Fare Off-Peak Demonstration

** Route Restructuring Implemented in Denver

TABLE C.4.4
ESTIMATED SERVICE PERFORMANCE INDICATORS -
PASSENGERS AND REVENUE PER HOUR AND PER MILE
BOULDER AND LONGMONT

Year and month		Unlinked Trips per Hour	Unlinked Trips per Mile	Revenue per Hour	Revenue per Mile
	October	27.029	1.951	NA	NA
	September	23.793	1.816	NA	NA
	August	19.134	1.459	NA	NA
	July	20.472	1.562	NA	NA
	June	20.836	1.623	3.296	.257
	May	24.236	1.873	3.059	.236
	April	26.765	1.936	2.966	.215
	March	25.898	1.934	3.025	.226
	February	27.994	2.242	3.585	.287
1979	January *	33.829	2.771	1.359	.111
	December *	33.061	2.667	1.176	.095
	November *	32.626	2.643	1.466	.119
	October *	32.529	2.620	1.279	.103
	September **	30.452	2.453	1.262	.102
	August *	28.566	2.137	1.203	.090
	July *	26.564	2.138	.954	.077
	June *	27.475	1.927	.916	.064
	May *	25.925	2.215	1.060	.091
	April *	26.363	2.251	1.205	.103
	March *	27.086	2.314	.921	.079
	February *	38.938	3.137	2.018	.163
1978	January	25.453	2.028	2.603	.207
	December	23.021	1.851	3.101	.249
	November	24.978	2.013	2.906	.234
	October	27.665	2.234	3.259	.263
	September	26.460	2.133	3.362	.271
	August	24.146	1.923	2.856	.227
	July	23.510	1.876	2.874	.229
	June	23.937	1.093	2.782	.197
	May	24.732	1.946	3.295	.259
	April	26.660	2.064	3.391	.263
	March	27.013	1.969	3.509	.256
	February	28.147	1.950	3.789	.263
1977	January	25.805	1.973	3.330	.255

* Free Fare Off-Peak Demonstration

** Route Restructuring Implemented in Denver

TABLE C.4.5
ESTIMATED PERFORMANCE INDICATORS -
PASSENGERS AND REVENUE PER HOUR AND PER MILE
INTERCITY SERVICE

Year and month	Unlinked Trips per Hour	Unlinked Trips per Mile	Revenue per Hour	Revenue per Mile
October	22.760	1.054	NA	NA
September	22.796	1.253	NA	NA
August	19.884	.920	NA	NA
July	18.022	.834	NA	NA
June	26.721	.991	11.341	.421
May	22.982	.951	9.158	.379
April	26.167	.975	11.660	.435
March	25.563	.950	13.276	.494
February	24.441	.929	13.927	.530
1979 January *	27.903	1.041	7.818	.292
December *	27.968	1.043	9.207	.343
November *	28.068	1.046	8.226	.307
October *	26.720	.995	9.477	.353
September **	26.399	.972	9.993	.368
August *	28.400	1.035	9.150	.333
July *	25.492	.923	8.946	.324
June *	25.512	.928	8.552	.311
May *	25.911	.952	8.803	.324
April *	27.569	1.020	7.238	.268
March *	28.305	1.041	4.963	.182
February *	27.855	1.010	7.606	.276
1978 January	20.725	.750	18.666	.675
December	18.519	.667	18.144	.654
November	20.610	.740	20.410	.733
October	20.300	.729	15.957	.573
September	20.577	.730	15.780	.560
August	18.375	.652	17.955	.637
July	18.221	.645	16.289	.577
June	18.216	.647	18.253	.648
May	19.362	.674	19.521	.680
April	21.372	.744	20.078	.699
March	23.769	.850	22.405	.801
February	23.170	.820	22.929	.811
1977 January	21.766	.765	25.078	.882

* Free Fare Off-Peak Demonstration

** Route Restructuring Implemented in Denver

TABLE C.5
ESTIMATED PERFORMANCE INDICATORS -
SUBSIDY PER HOUR AND MILE OF SERVICE
TOTAL RTD SERVICE (INCLUDES SPECIAL CHARTER AND E&H)

Year and Month		Operating Costs per Hour	Operating Costs per Mile	Subsidy per Hour	Subsidy per Mile
	October	28.318	1.984	20.567	1.441
	September	29.580	2.121	21.575	1.547
	August	26.994	1.900	20.394	1.435
	July	29.796	2.103	22.402	1.581
	June	25.342	1.788	18.286	1.290
	May	27.691	1.982	20.706	1.482
	April	25.338	1.804	18.249	1.299
	March	24.695	1.761	16.936	1.208
	February	26.478	1.888	18.365	1.310
1979	January *	26.677	1.881	21.928	1.546
	December *a	30.366	2.192	26.455	1.910
	November *	24.309	1.741	20.421	1.462
	October *	25.250	1.807	21.237	1.520
	September **	26.304	1.876	22.366	1.595
	August *	23.388	1.651	19.108	1.349
	July *	25.014	1.783	21.216	1.513
	June *	23.782	1.577	20.031	1.328
	May *	22.567	1.592	19.054	1.344
	April *	22.945	1.619	19.790	1.397
	March *	23.179	1.630	20.105	1.414
	February *	25.683	1.807	21.572	1.518
1978	January	23.893	1.700	16.547	1.177
	December a	31.026	2.210	24.928	1.776
	November	23.953	1.706	17.433	1.241
	October	25.371	1.808	18.806	1.340
	September	22.172	1.575	15.293	1.086
	August	23.910	1.685	17.599	1.241
	July	22.164	1.564	16.300	1.150
	June	22.598	1.590	16.576	1.166
	May	24.004	1.719	17.517	1.255
	April	21.662	1.549	15.331	1.096
	March	21.396	1.537	14.988	1.077
	February	22.172	1.674	15.396	1.163
1977	January	22.423	1.708	15.644	1.192

a Reflects end-of-year accounting adjustments.

* Free Fare Off-Peak Demonstration

** Route Restructuring Implemented in Denver

TABLE C.6
ESTIMATED AVERAGE WEEKDAY HOURS OF SCHEDULED SERVICE

Year and Month	Total RTD	Regular Denver	Express Denver	Circulator Denver	Boulder and Longmont	Inter-City
October	4050.	420.	317.	424.	251.	5462.
September	4052.	420.	315.	453.	241.	5481.
August	4051.	393.	309.	440.	262.	5455.
July	4050.	394.	306.	449.	269.	5467.
June	4035.	400.	322.	452.	171.	5380.
May	4045.	410.	342.	435.	195.	5427.
April	4054.	411.	342.	454.	171.	5432.
March	4055.	410.	346.	453.	170.	5433.
February	3995.	412.	343.	457.	170.	5377.
1979 January *	4013.	414.	260.	455.	165.	5307.
December *	4013.	426.	339.	470.	174.	5422.
November *	3928.	426.	309.	454.	179.	5297.
October *	3924.	426.	310.	455.	179.	5294.
September **	3817.	421.	347.	446.	170.	5201.
August *	3500.	407.	447.	426.	156.	4935.
July *	3539.	410.	445.	459.	156.	5009.
June *	3425.	373.	421.	445.	151.	4814.
May *	3800.	421.	518.	491.	157.	5388.
April *	3807.	423.	529.	493.	170.	5422.
March *	3734.	422.	498.	492.	195.	5341.
February *	3397.	440.	369.	287.	171.	4663.
1978 January	3385.	443.	363.	284.	166.	4640.
December	3378.	440.	372.	283.	165.	4638.
November	3337.	451.	377.	287.	169.	4621.
October	3362.	429.	382.	287.	168.	4627.
September	3345.	403.	381.	287.	168.	4585.
August	3340.	409.	397.	284.	167.	4597.
July	3245.	409.	387.	275.	160.	4476.
June	3319.	403.	389.	280.	167.	4558.
May	3297.	392.	373.	285.	143.	4491.
April	3316.	392.	383.	293.	137.	4520.
March	3241.	393.	401.	262.	128.	4445.
February	3076.	401.	516.	275.	125.	4393.
1977 January	3076.	401.	506.	291.	117.	4391.

* Free Fare Off-Peak Demonstration

** Route Restructuring Implemented in Denver

TABLE C. 7
ESTIMATED AVERAGE WEEKDAY MILES OF SCHEDULED SERVICE

Year and Month	Regular Denver	Express Denver	Circulator Denver	Boulder and Longmont	Inter-City	Total RTD
October	54473.	8880.	3635.	5873.	5419.	78280.
September	54164.	8885.	3610.	5933.	4387.	76978.
August	54340.	8440.	3635.	5763.	5654.	77832.
July	54138.	8459.	3589.	5883.	5806.	77875.
June	53976.	8496.	3789.	5800.	4610.	76671.
May	53239.	8544.	4061.	5623.	4711.	76178.
April	53229.	8536.	4062.	6272.	4586.	76685.
March	53116.	8798.	4078.	6071.	4559.	76621.
February	53108.	8438.	4033.	5704.	4459.	75743.
1979 January *	53125.	8532.	4015.	5557.	4432.	75660.
December *	52789.	8238.	3959.	5829.	4668.	75484.
November *	51764.	8060.	4023.	5609.	4798.	74275.
October *	51927.	8083.	3899.	5645.	4801.	74256.
September **	50679.	7862.	4545.	5540.	4621.	73247.
August *	47014.	7258.	5841.	5691.	4277.	70080.
July *	47373.	7313.	5816.	5707.	4311.	70519.
June *	48605.	7581.	6180.	6340.	4153.	72860.
May *	51603.	8131.	6927.	5753.	4272.	76686.
April *	51702.	8081.	7022.	5775.	4585.	77164.
March *	50458.	7970.	6723.	5755	5291.	76198.
February *	44705.	8360.	5249.	3561.	4710.	66585.
1978 January	43892.	8303.	5241.	3562.	4576.	65574.
December	43887.	8292.	5194.	3517.	4584.	65474.
November	43315.	8305.	5312.	3560.	4701.	65194.
October	43387.	8357.	5352.	3550.	4687.	65334.
September	43538.	7799.	5206.	3561.	4745.	64849.
August	44111.	8093.	5002.	3567.	4707.	65480.
July	42907.	8098.	4903.	3444.	4511.	63862.
June	43516.	7812.	5039.	3963.	4705.	65033.
May	42798.	7430.	5051.	3626.	4098.	63003.
April	42953.	7543.	5340.	3781.	3926.	63542.
March	41821.	7274.	5541.	3863.	3585.	62085.
February	37501.	6439.	6901.	3974.	3534.	58350.
1977 January	37479.	6413.	6805.	3810.	3319.	57825.

* Free Fare Off-Peak Demonstration

** Route Restructuring Implemented in Denver

TABLE C.8
ESTIMATED AVERAGE WEEKDAY PASSENGERS (ADJUSTED UNLINKED)
PER MILES OF SCHEDULED SERVICE

Year and Month	Total RTD	Regular Denver	Express Denver	Circulator Denver Longmont	Boulder and Longmont	Inter-City
October	1.81	2.00	1.29	.90	2.03	1.12
September	1.85	2.04	1.23	.89	1.95	1.37
August	1.67	1.87	1.26	.89	1.50	.97
July	1.69	1.89	1.28	.94	1.63	.88
June	1.68	1.84	1.30	.89	1.69	1.05
May	1.64	1.79	1.19	.87	1.93	1.00
April	1.78	1.97	1.21	.90	2.03	1.04
March	1.72	1.92	1.16	.72	1.96	1.01
February	1.74	1.92	1.10	.77	2.31	.98
1979 January *	2.03	2.27	1.15	.64	2.86	1.08
December *	2.07	2.34	1.14	.69	2.75	1.06
November *	2.10	2.39	1.12	.73	2.72	1.06
October *	2.05	2.31	1.13	.65	2.66	1.02
September **	2.11	2.44	1.15	.87	2.46	1.00
August *	2.18	2.62	1.35	.46	2.19	1.06
July *	2.22	2.67	1.33	.59	2.24	.96
June *	2.12	2.57	1.28	.56	2.00	.96
May *	1.99	2.36	1.18	.50	2.28	.96
April *	2.04	2.43	1.23	.49	2.29	1.06
March *	2.11	2.51	1.34	.53	2.39	1.09
February *	2.33	2.78	1.34	.64	3.19	1.05
1978 January	1.92	2.33	1.13	.58	2.09	.81
December	1.78	2.16	1.00	.59	1.97	.72
November	1.83	2.21	1.09	.59	2.18	.80
October	1.90	2.30	1.05	.59	2.44	.80
September	1.93	2.34	1.03	.58	2.31	.79
August	1.80	2.17	.99	.68	2.04	.70
July	1.73	2.05	1.02	.74	2.13	.73
June	1.73	2.09	1.02	.66	1.81	.70
May	1.92	2.28	1.18	.73	2.13	.74
April	1.84	2.16	1.16	.67	2.24	.81
March	1.92	2.27	1.24	.65	2.10	.91
February	1.99	2.47	1.25	.59	2.11	.89
1977 January	2.00	2.48	1.26	.57	2.15	.83

* Free Fare Off-Peak Demonstration

** Route Restructuring Implemented in Denver

TABLE C.9
ESTIMATED AVERAGE WEEKDAY PASSENGERS (ADJUSTED UNLINKED)
PER SCHEDULED SERVICE HOUR

Year and Month	Total RTD	Regular Denver	Express Denver	Circulator Denver	Boulder and Longmont	Inter-City
October	25.99	26.97	27.31	10.37	28.08	24.09
September	25.94	27.27	25.99	10.22	25.51	24.90
August	23.80	25.15	27.00	10.47	19.66	20.88
July	24.02	25.27	27.55	11.03	19.02	27.16
June	23.89	24.66	27.57	10.51	21.66	28.21
May	22.99	23.62	24.77	10.29	24.93	24.18
April	25.07	25.84	25.07	10.68	28.05	27.87
March	24.22	25.14	24.98	8.48	26.21	27.15
February	24.57	25.56	22.63	9.03	28.85	25.68
1979 January *	28.32	23.64	16.10	9.94	34.92	28.91
December *	28.88	30.79	21.97	8.04	34.03	28.40
November *	29.43	31.46	21.21	9.55	33.61	28.40
October *	28.70	30.47	21.39	10.71	33.05	27.27
September **	29.73	32.34	21.44	11.41	30.51	27.08
August *	30.97	35.23	24.14	6.21	29.24	29.01
July *	31.25	35.74	23.69	7.73	27.78	26.53
June *	32.16	36.50	26.00	8.19	28.57	26.38
May *	28.28	32.11	22.74	6.67	26.69	26.74
April *	29.00	33.03	23.46	6.51	26.77	29.11
March *	30.04	33.93	25.32	7.14	27.98	29.63
February *	33.29	36.62	25.49	9.05	39.59	29.03
1978 January	27.08	30.16	21.21	8.31	26.25	22.29
December	25.06	28.02	18.76	8.27	24.53	19.89
November	25.82	28.65	20.00	8.27	27.08	22.37
October	26.83	29.68	20.52	8.22	30.24	22.33
September	27.25	30.48	19.86	7.90	28.69	22.33
August	25.58	28.61	19.56	8.61	25.68	19.66
July	24.65	27.06	20.12	9.39	26.70	20.74
June	24.70	27.36	19.83	8.59	25.62	19.60
May	26.92	29.62	22.28	9.95	27.10	21.18
April	25.90	28.04	22.67	9.37	28.89	23.39
March	26.82	29.36	23.05	8.99	28.84	25.50
February	26.44	30.08	20.09	7.85	30.44	25.19
1977 January	26.35	30.19	20.10	7.62	28.09	23.48

* Free Fare Off-Peak Demonstration

** Route Restructuring Implemented in Denver

Appendix D: Results of Operational Monitoring Surveys Not Reported in Text

LIST OF TABLES

D.1 Results of Farebox Verification

D.2 Results of Bus Driver Survey (1/79) Route Restructuring Effects

Table D.1
RESULTS OF FAREBOX VERIFICATION SURVEY

		September 1978	December 1978	March 1979
A.	Passenger Boardings Observed	3,291	4,353	3,184
B.	Farebox Recordings	2,988	3,746	3,065
C.	Net Error	-303	-607	-119
D.	Net Accuracy Rate (B/A)	90.8%	86.1%	96.3%
E.	Mean per Driver Observed	92.5%	85.2%	94.9%
F.	Undercounted Boardings	-363	-825	-287
G.	Overcounted Boardings	60	218	168
H.	Gross Error	423	1,043	455
I.	Gross Accuracy Rate	87.1%	76.0%	85.7%

Table D.2
RESULTS OF BUS DRIVER SURVEY (1/79):
ROUTE RESTRUCTURING EFFECTS

Route Restructuring Effect on Driver's Job

	Boulder		Alameda		Platte		Total	
	#	%	#	%	#	%	#	%
Good Effect	4	16.7	5	18.5	18	18.4	27	18.1
Bad Effect	18	75.0	9	33.3	54	55.1	81	54.4
No Effect	2	8.3	13	48.2	26	26.5	41	27.5
No Response	2	(8.3)	3	(10.0)	8	(7.5)	13	(8.0)
Total	26	100.0	30	100.0	106	100.0	162	100.0

Drivers Requesting Reassignment Because Of Route Restructuring

	Boulder		Alameda		Platte		Total	
	#	%	#	%	#	%	#	%
Yes	4	20.0	3	11.1	16	18.0	23	16.9
No	16	80.0	24	88.9	73	82.0	113	83.1
No Response	(6	23.1)	(3	10.0)	(17	16.0)	(26	16.0)*
Total	26	100.0	30	100.0	106	100.0	162	100.0

*Progressively larger rates of non-response occurred on the latter half of the questionnaire.

Table D.2 (Continued)
RESULTS OF BUS DRIVER SURVEY (1/79)
ROUTE RESTRUCTURING EFFECTS

Most Important Positive and Negative Effects of Route Restructuring

	Boulder		Alameda		Platte		Total	
	No.	%	No.	%	No.	%	No.	%
Positive Effects								
More Comprehensible System			1	14.3	8	25.0	9	19.6
Improves Run Times			1	14.3	4	12.5	5	10.9
Improves Layout of Route	2	28.5	1	14.3	4	12.5	7	15.2
Serves Larger Area	2	28.5	1	14.3	4	12.5	7	15.2
Others	3	42.9	3	42.9	12	37.5	18	39.1
Total	7	100.0	7	100.0	32	100.0	46	100.0
Negative Effects								
Lengthens Run Times					7	10.3	7	6.7
Worsens Schedule Adherence	2	12.5	2	9.5	2	2.9	6	5.7
Increased No. of Passengers Asking Questions	4	25.0	7	33.3	12	17.6	23	21.9
Difficulty of Providing Information to Passengers	3	18.8	1	4.8	11	16.2	15	14.3
Causes Poor Transfer Connections	1	6.3	1	4.8	7	10.3	9	8.6
Others	6	37.5	10	47.6	29	42.6	45	42.9
Total	16	100.0	21	100.0	68	100.0	105	100.0

Appendix E: Selected Results of Transit User and General Household Survey Responses
LIST OF TABLES

E.1 Summary Tabulations of Response to On-Board Surveys

E.2 Reported Trip Frequencies: Random Household Surveys
General Population 18 years of Age and Older

E.3 Reported Trip Frequencies: Transit User Follow-Up Survey
Panel of Bus Users Drawn From On-Board Survey (8/78)

Table E.1

Summary Tabulations of Responses to On-Board Surveys: Three Rounds

1. USER CHARACTERISTICS

	DENVER SURVEY ONLY			BOULDER
Auto Availability	One (8/78)	Two (11/78)	Three (3/79)	Three (3/79)
Driver	34.6	36.7	37.8	32.0
Passenger	12.7	12.3	12.9	12.1
No Car	52.6	51.8	49.3	55.9
	100.0%	100.0%	100.0%	100.0%
n=	8439	10193	9075	669
Income				
Under 5k	21.7	22.5	18.3	27.3
5 - 9999	23.2	24.8	22.2	20.2
10 - 14999	20.1	17.9	20.3	13.0
15 - 24999	19.9	19.6	20.9	19.6
25k +	15.0	15.2	18.2	19.9
	100.0%	100.0%	100.0%	100.0%
n=	6777	8530	7773	572
Age				
Under 17	14.3	12.9	12.4	19.7
17 - 24	29.3	31.3	31.2	41.2
25 - 44	34.0	34.0	36.0	25.8
45 - 64	16.5	16.3	15.5	7.2
65+	6.0	5.5	4.9	6.2
	100.0%	100.0%	100.0%	100.0%
n=	8076	9697	8302	680

Round One (8/78); Round Two (11/78); and Round Three (3/79).

	DENVER SURVEY ONLY			BOULDER
Race	One (8/78)	Two (11/78)	Three (3/79)	Three (3/79)
White	67.8	72.0	71.6	92.1
Black	15.6	14.2	14.7	1.9
Hispanic	11.6	9.1	9.0	2.5
Other	4.9	4.6	4.7	3.5
	100.0%	100.0%	100.0%	100.0%
n=	8009	9506	8608	644
Sex				
Male	-	43.6	44.3	41.4
Female	-	56.4	55.7	58.6
		100.0%	100.0%	100.0%
n=		10412	8702	647

2. TRIP CHARACTERISTICS

	DENVER SURVEY ONLY			BOULDER
Transfer Required	One (8/78)	Two (11/78)	Three (3/79)	Three (3/79)
Yes	23.5	25.5	25.1	19.5
No	76.5	75.5	74.9	80.5
	100.0%	100.0%	100.0%	100.0%
n=	8373	10292	8629	653
Route Type				
Local Regular	62.0	79.8	76.8	-
Local Crosstown	24.8	12.8	11.6	-
Express	7.3	6.6	8.3	-
Circulator	5.9	.9	3.4	-
	100.0%	100.0%	100.0%	-
n=	2184	10429	9253	-
Time of Day				
Peak	31.8	34.7	46.4	33.4
Off-Peak	68.2	65.3	53.6	66.6
	100.0%	100.0%	100.0%	100.0%
n=		10429	9253	
Geographic Type				
CBD Origin or Dest.	47.6	39.2	60.8	-
Non-CBD:				
• Inner City	36.1	37.1	19.0	-
• Peripheral Only	16.3	23.7	20.2	-
	100.0%	100.0%	100.0%	-
n=	2170	6359	5511	-

Boardings and Alightings (Total Trip Ends)	DENVER SURVEY ONLY One (8/78)	Two (11/78)	Three (3/79)	BOULDER Three (3/79)
Northwest	5.6	6.7	7.0	-
Northeast	2.3	2.4	1.9	-
West Colfax	5.8	7.0	5.7	-
Core Colfax	29.2	28.7	18.8	-
East Colfax	9.2	8.5	10.1	-
South Broadway	6.2	8.9	6.1	-
Southwest	7.2	8.2	8.0	-
Southeast	10.6	8.9	9.8	-
CBD	24.1	20.9	32.7	-
	100.0%	100.0%	100.0%	-
n=	1022	5930	3605	-
Blocks Walked				
1 or less	32.4	31.0	32.8	43.1
2	23.5	24.2	24.3	22.2
3	13.5	13.3	13.1	11.1
4	8.6	7.9	8.3	6.3
5 or more	11.0	12.5	11.4	10.0
Did not Walk	11.0	11.1	10.2	7.1
	100.0%	100.0%	100.0%	100.0%
n=	8525	9043	9024	671
Mean	2.51	2.59	2.50	2.21

Time Waited (Minutes)	DENVER SURVEY ONLY One (8/78)	Two (11/78)	Three (3/79)	BOULDER Three (3/79)
Less than 5	23.1	20.4	26.0	37.5
5	23.6	21.4	24.9	29.2
6 - 10	26.2	26.9	25.0	20.0
11 - 15	12.4	13.4	11.7	9.2
16 - 29	9.4	11.1	7.9	3.5
30 or more	5.3	6.8	4.5	-
	100.0%	100.0%	100.0%	100.0%
n=	8531	9961	9082	680
Mean	9.30	10.65	9.11	6.25
Fare Type				
Cash				
• Reduced (E+H)	-	-	5.4	3.1
• Regular Adult	-	-	57.1	67.9
Token	-	-	11.7	3.1
Monthly Pass	-	-	25.8	25.7
			100.0%	100.0%

3. PERCEIVED CHANGE IN SERVICE ATTRIBUTES DUE TO ROUTE RESTRUCTURING

	DENVER SURVEY ONLY			BOULDER
Access Time at Origin	One (8/78)	Two (11/78)	Three (3/79)	Three (3/79)
Less now	-	9.8	8.7	6.6
Same or Not Affected	-	53.0	67.8	80.3
Longer Now	-	17.0	11.8	3.2
No Response	-	20.2	11.7	9.9
		100.0%	100.0%	100.0%
Wait Time at Origin				
Less Now	-	8.2	8.9	9.2
Same or Not Affected	-	51.3	63.6	73.2
Longer Now	-	20.0	15.7	8.5
No Response	-	20.5	11.8	9.1
		100.0%	100.0%	100.0%
Transfers Needed				
Fewer Now	-	5.6	4.5	3.4
Same or Not Affected	-	47.3	58.1	72.9
More Now	-	8.3	6.0	2.5
Never Use Transfers	-	14.5	17.6	10.7
No Response	-	24.3	13.8	10.5
		100.0%	100.0%	100.0%

On-Board Travel Time	DENVER SURVEY ONLY One (8/78)	Two (11/78)	Three (3/79)	BOULDER Three (3/79)
Less Now	-	8.3	7.0	5.2
Same	-	51.5	67.6	76.9
Longer Now	-	17.4	12.4	6.9
No Response	-	22.8	13.0	11.0
		100.0%	100.0%	100.0%
n=		10429	9253	680
Change in Bus Use				
Former Riders	*			
o More	65.8	19.7	18.2	19.1
o Less	3.3	20.1	17.2	11.6
o No Change	31.3	53.4	51.8	50.5
New Riders	22.2[a]	6.6[b]	12.3[c]	18.8[d]
n=	6890	9034	8877	651

* Off-Peak trips only

a) Did not use before 2/1/78 (7 months after Free Fare Program).

b) Did not use before 9/10/78 (2 months after Route Restructuring).

c) Did not use before 9/10/78 (6 months after Route Restructuring).

d) Did not use before 3/5/78 (One year after Route Restructuring in Boulder).

Table E.2
REPORTED TRIP FREQUENCIES: RANDOM HOUSEHOLD SURVEYS
GENERAL POPULATION 18 YEARS OF AGE AND OLDER

Respondent One-Way Trips Per Week	Total Trips		Off-Peak Trips	
	Mean	% Once per Week+	Mean	% Once per Week+
Random 1 (10/79): Last Week	.35	8	.15	6
Random 2 (1/79): Last Week	.74	13	.40	9
Pooled (During Free Fare)	.55	10.7%	.28	7.5%*
Random 3 (5/79) (Post Free Fare)		19%		
Last Week	1.07	19%	N/A	N/A
Work/School	.77	12%	N/A	N/A
Shop	.14	5%	N/A	N/A
Other	.16	4%	N/A	N/A
Typical Week Now	1.26	23%	N/A	N/A
Typical Week During Free Fare	1.72	31%	N/A	N/A
Household Trips: Last Week				
Random 1 (10/78)	.61	14	N/A	N/A
Random 2 (1/79)	1.50	23	N/A	N/A
Pooled (During Free Fare)	1.08	19%		
Random 3 (5/79) (Post Free Fare)	1.74	25%		

N/A = Not Asked.

*Peak Trips = 5.3%

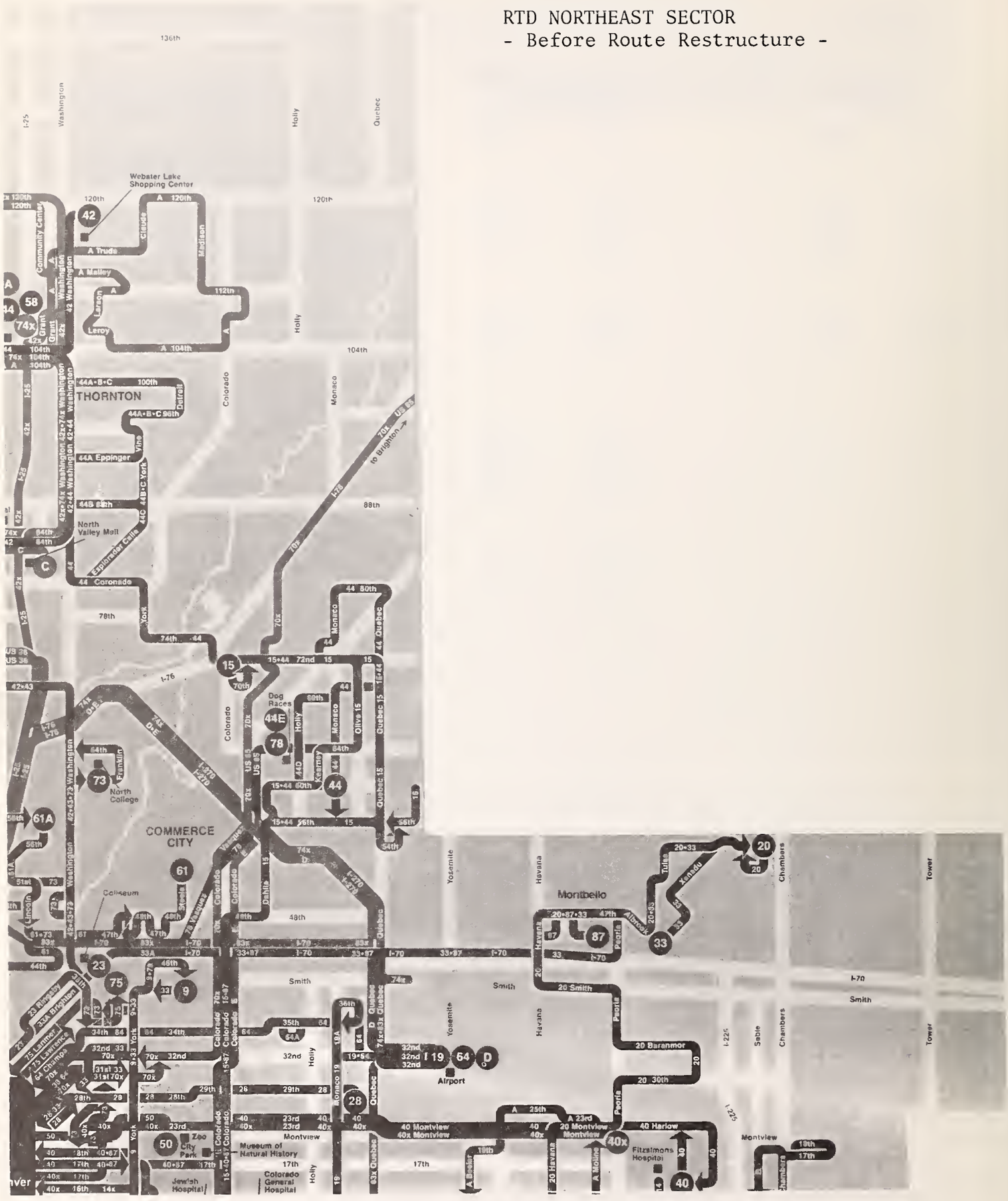
Table E.3
REPORTED TRIP FREQUENCIES: TRANSIT USER FOLLOW-UP SERVEYS
(Adjusted for Selection Probability Bias)

Respondent One-Way Trips Last Week	Use at Least Once per Week		Total Panel	
	Mean	S.D.	Mean	S.D.
Follow-Up 1 (10/78): From On-Board 1 (8/78)				
o All Prior Riders	3.22	2.78	2.59	2.81
o Prior Riders before FF	3.07	2.77	2.52	2.77
o Prior Riders before RR, But New Since FF	2.51	2.31	1.96	2.29
o Change Due to RR	3.17	2.93	2.92	2.93
o No Change Due to RR	2.32	2.32	2.13	2.30
New Rider Follow-Up (1/79): From On-Board 2 (11/78)				
o All New Riders	4.35	3.28	-	-
o Due to RR	5.17	3.13	-	-
o Other Reason	4.04	3.29	-	-
New Rider Follow-Up (5/79): From On-Board 2 (11/78)				
o All New Riders	5.65	4.04	-	-

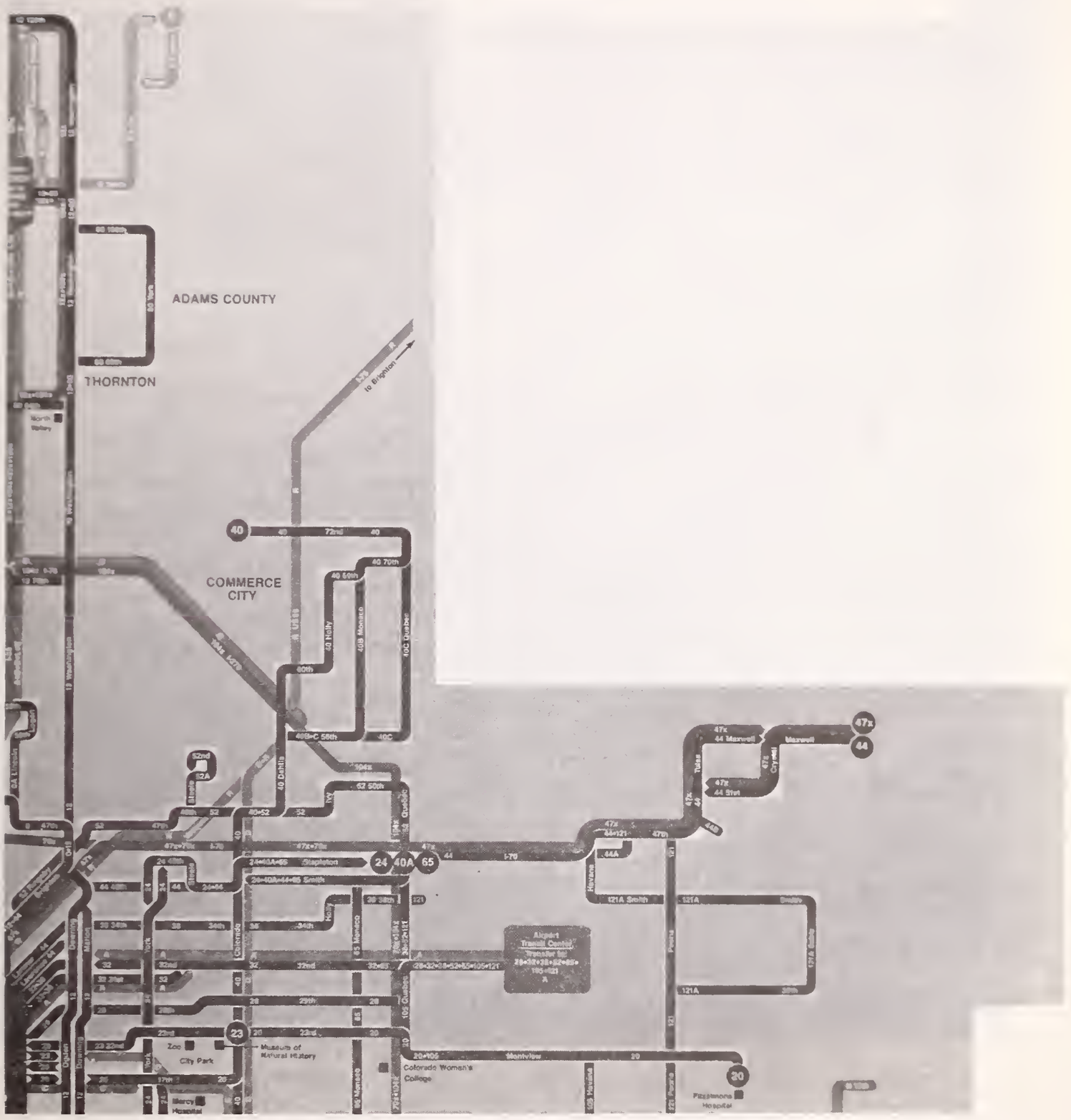
Appendix F:

Detailed Bus Route Network Maps by Sector:
Before and After Route Restructuring

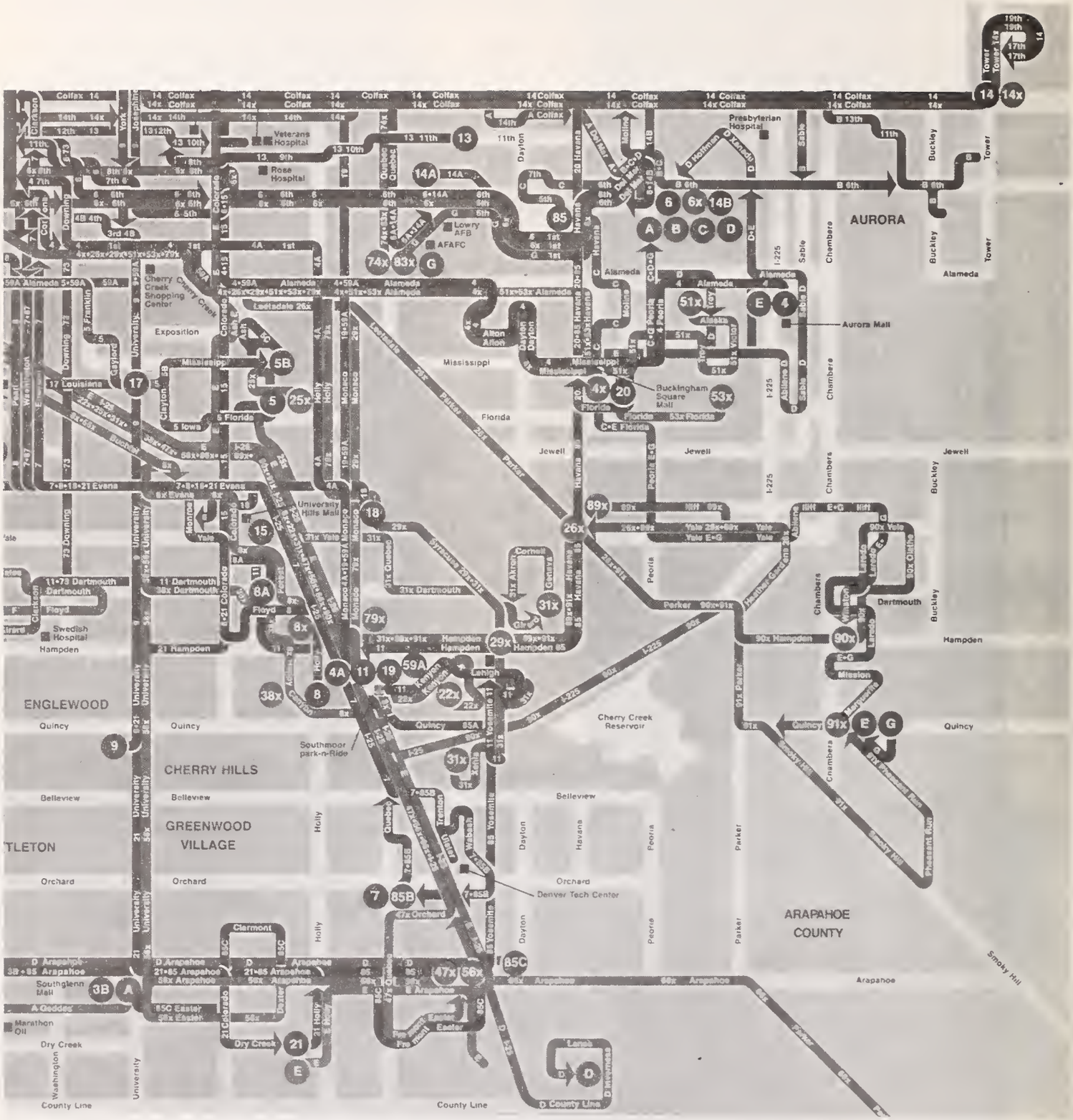
RTD NORTHEAST SECTOR
- Before Route Restructure -



RTD NORTHEAST SECTOR
- After Route Restructure -

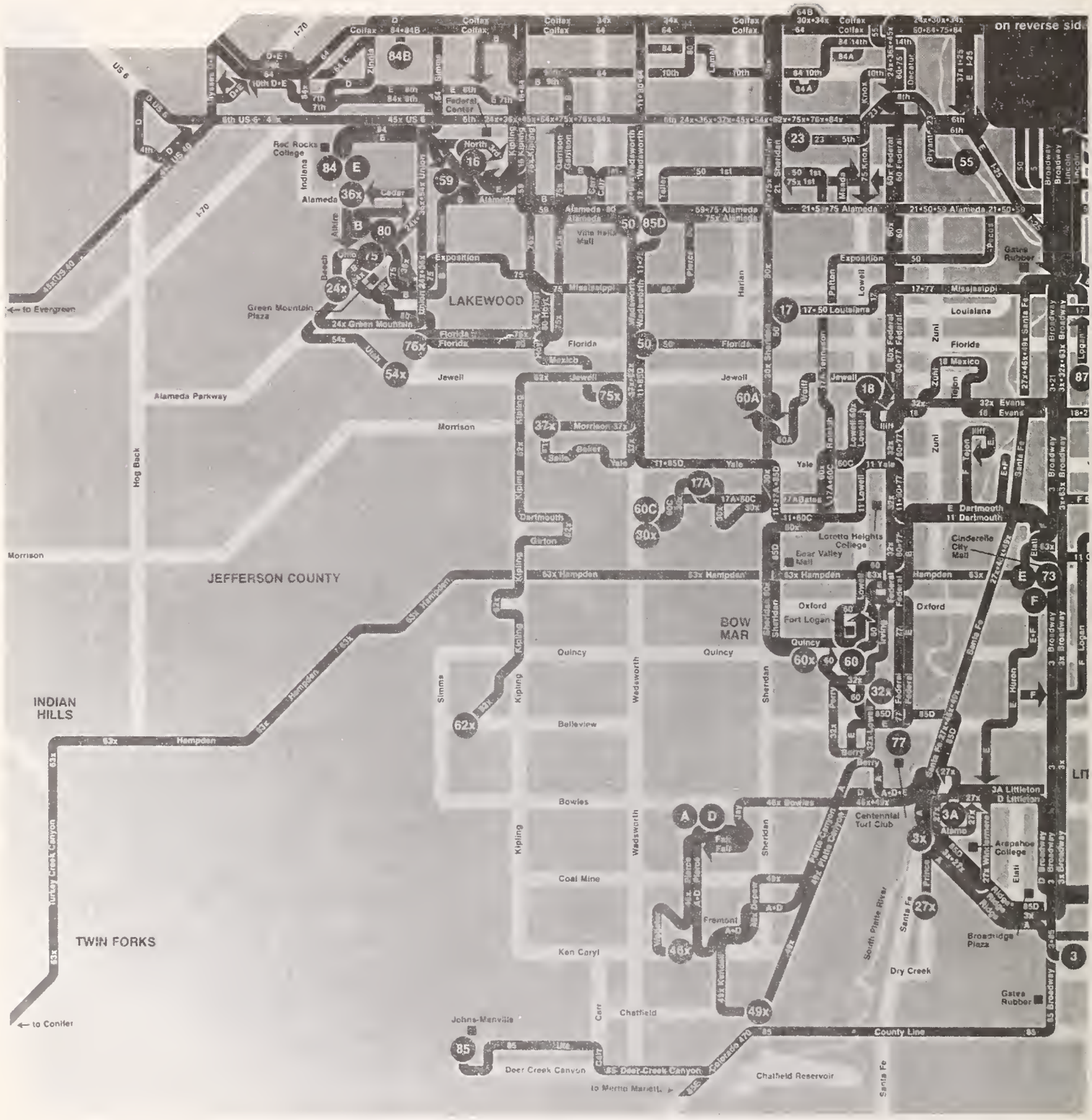


RTD SOUTHEAST SECTOR
- Before Route Restructure -

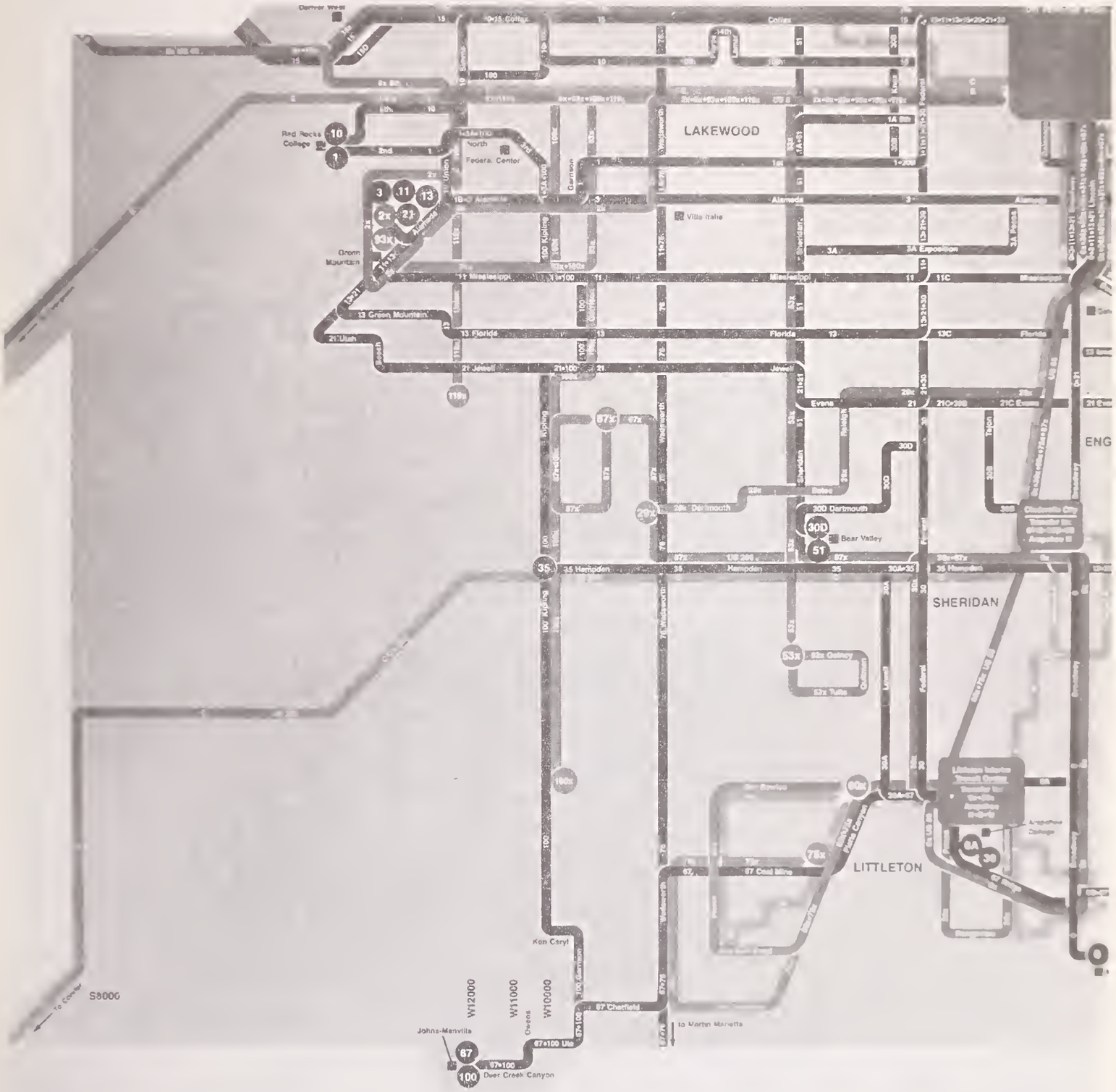


RTD SOUTHEAST SECTOR
- After Route Restructure -

RTD SOUTHWEST SECTOR
- Before Route Restructure -

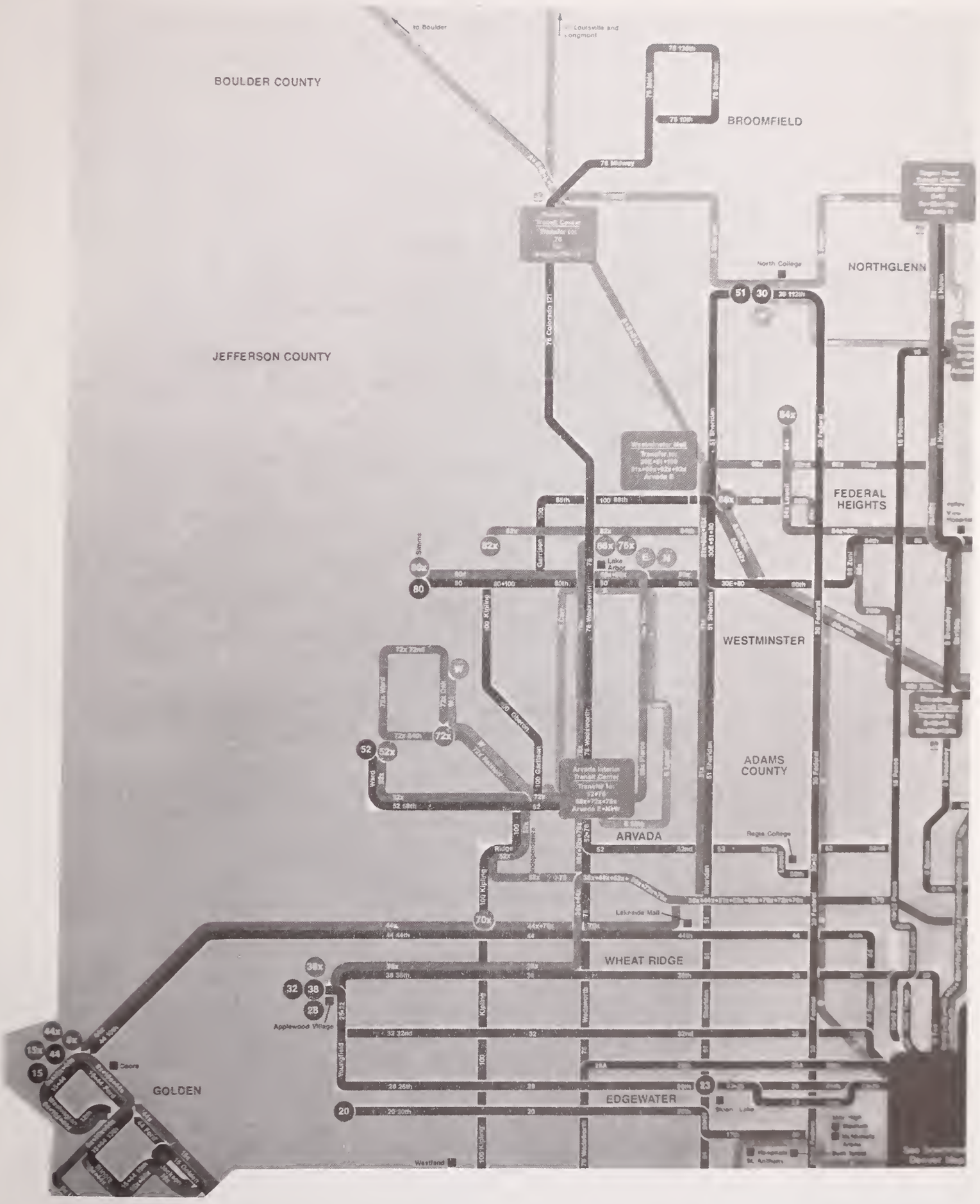


RTD SOUTHWEST SECTOR
- After Route Restructure -



RTD NORTHWEST SECTOR
- Before Route Restructure -

RTD NORTHWEST SECTOR
- After Route Restructure -



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