U.S. Department of Transportation

The Portland Mall Impact Study

Final Report

December 1982

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Prepared by
Kenneth J. Dueker, Pete Pendleton and Peter Luder
Center for Urban Studies
Portland State University
Portland, Oregon 97207

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Urban Mass Transportation Administration
U.S. Department of Transportation
Washington, D.C. 20590

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ABSTRACT

The final report of the Portland Mall Impact Study is a comprehensive analysis and evaluation of a wide range of impacts related to the Portland Transit Mall. This report assesses the primary, i.e., transit and traffic impacts and secondary, i.e., noise, air, land use and development impacts, and documents the significant impact the Portland Mall has had on revitalizing downtown. The report concludes with an economic analysis demonstrating the Portland Mall to be a good public investment, with benefits exceeding the cost.

The purpose of this study was to provide useful information for public and private organizations at the:

1) national level - on Portland's experience with a transit mall and possible applications to their locale by other local governmental agencies, and the transportation land use interaction that can be achieved through investment in transit; and,

2) local level - for assessing impacts on operation, maintenance and possible extension of the Transit Mall.

FOREWORD

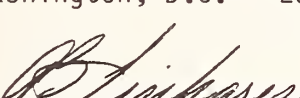
Many elected officials and transportation planners for large and medium size cities have expressed interest in implementing transit malls. The malls are frequently proposed as part of strategies to revitalize or stimulate the downtown, or to manage traffic in congested areas.

One of the most prominent of today's transit malls is located in an eleven block area in downtown Portland, Oregon. Well over two-thirds of the Portland transit operator's routes pass through the downtown using this mall. The Portland Mall is a key component of the area's strategy to intercept and divert downtown-bound traffic, encourage transit use, revitalize the downtown economically and aesthetically, and reduce noise and air pollution.

To learn how this approach was working, the Urban Mass Transportation Administration, in cooperation with the Metropolitan Service District, Portland's Bureau of Planning, and the Tri-County Metropolitan Transportation District of Oregon (Tri-Met), funded a project at Portland State University to explore the impacts of the transit mall. This study was intended to provide insights both for national consideration and for local use by decision-makers in Portland. It considers both the direct and indirect effects of the project in a wide variety of areas. These include transit and traffic effects, the physical and social environment, crime and personal safety, noise and air pollution, urban development and land use, and rental values.

We believe that this information should be useful to other jurisdictions considering transit malls, as well as those simply reviewing options for evolution of their transit systems. Copies are being made available now through the DOT's Technology Sharing Program, and will continue to be available at cost through the National Technical Information Service. When ordering the publication or citing the document, please be sure to refer to its UMTA publication number OR-09-7002-83-1.

Charles H. Graves
Director, Office of Planning Assistance
Urban Mass Transportation Administration
U.S. Department of Transportation
Washington, D.C. 20590



Alfonso B. Linhares
Director, Office of Technology and
Planning Assistance
Office of the Secretary of Transportation
U.S. Department of Transportation
Washington, D.C. 20590

THE PORTLAND MALL IMPACT STUDY
EXECUTIVE SUMMARY

INTRODUCTION

This study analyzes a wide range of impacts related to the Portland Transit Mall. It was a joint project funded by the Urban Mass Transportation Administration involving the Metropolitan Service District (Metro); City of Portland, Bureau of Planning; Tri-County Metropolitan Transportation District of Oregon (Tri-Met); and, the Center for Urban Studies, Portland State University.

The study provides useful information for public and private organizations at both the national and local level. At the national level, results of the study will help answer questions that are asked of Portland by other local governmental agencies. These agencies have expressed interest in Portland's experience with a transit mall and possible applications to their locale. They are also interested in the transportation-land use interactions that can be achieved through investments in transit. At the local level, information will be used in assessing impacts that relate to the operation, maintenance and possible extension of the Transit Mall.

The idea of a transit mall for Portland, Oregon was initiated in 1970 by a coalition of downtown business leaders and property owners. A transit mall concept was identified as an integral element in a report (Planning Guidelines--Portland Downtown Plan) and reiterated in the City's Transportation Control Strategy for Federal Air Quality Standards (1972). Through a program funded by UMTA, Tri-Met initiated a feasibility study for a Portland Transit Mall in January, 1973. The results of the study were favorable and the Mall was completed in 1978.

OBJECTIVES OF THE MALL

1. to provide more efficient, convenient transportation alternative for commuters and shoppers. Transit improvements were expected to increase transit use. This, in turn, was expected to promote more efficient land use, reduce energy consumption and reduce pollution;

2. to revitalize downtown in terms of growth in the number of retail firms, lower vacancy rates, lower turnover rates, increased retail sales and other business activity, greater private and public investments, and more jobs.

DESCRIPTION

1. The Transit Mall involved the reconstruction of 5th and 6th Avenues between Burnside on the north and Madison Street on the south, approximately 11 blocks on each avenue. They have an 80' right-of-way with widened sidewalks--26' along the right side where buses load; 18'-30' on the opposite side of the street where there is auto access.

2. Two continuous 12' bus lanes extend the length of 5th and 6th Avenues. Each block of the Mall has two bus loading areas. The Mall is designed to carry up to 200 buses per hour in each direction and up to 260 buses per half hour if, in the future, a simultaneous signal system is provided.

3. There are five bus stops on the Mall for each of the seven service areas in the Portland region. Bus shelters designed to provide rain protection for up to 60 persons, are located at most bus stops.

4. A Fareless Square provides free bus service to destinations within the downtown area.

IMPLEMENTATION

Historic Context

By 1970, many changes were underway in the Portland area. Oregon, particularly the Portland metropolitan area, was growing. The metropolitan population between 1950 and 1970 had grown from 619,522 to 878,676. The automobile had become the principal means of travel. The use of mass transit had decreased from 60 million riders in 1950 to less than 18 million riders by 1970; an expanding and increasingly mobile population headed for the downtown in their automobiles. Tight streets, small 200' x 200' blocks, lack of convenient parking, all added to congestion downtown. Buildings, many with historical significance, were torn down for surface parking. A regional freeway system designed to provide better access into the center city was nearing completion.

Downtown Portland had increasing difficulty in coping with traffic and parking, and changes in downtown began to appear. There was a growing realization that extensive accommodation of the automobile would not lead to the growth and revitalization desired in downtown.

In 1971, the Columbia Region Association of Governments (CRAG) applied for and received a federal grant from the Urban Mass Transportation Administration (UMTA) for the implementation of a regional unified transportation work program. Included in the grant was the sum of $230,790 to conduct a preliminary design location and environmental impact study for the 5th and 6th Avenues Transit Mall.

After nearly 26 months of construction work, the Transit Mall was completed and traffic and transit operations were initiated

on December 11, 1977. With the opening of the Mall, instant traffic improvements were experienced in and through downtown. Tri-Met bus supervisors were quoted in the press exclaiming the virtues of the Transit Mall and suggesting that buses were experiencing 10 to 20 minutes running time improvements through downtown. The change was dramatic and the perception was heightened by the contrast of the finished Mall as compared to the preceding 26-month period. The entire community was relieved to have the disruptions of construction work behind it.

TRANSIT EFFECTS

The Mall has made transit service more understandable and easier to use, reinforced downtown development objectives, and increased ridership levels and potential capacity. This has been achieved with no loss in service efficiency, in terms of the number of buses per hour passing through the Mall. The Mall is accommodating efficiently more buses than could be handled in downtown otherwise. This will be an important quality of the Mall as ridership demand grows in the future.

TRAFFIC EFFECTS

An analysis comparing 1980 simulated traffic conditions with the Mall against 1980 simulated traffic conditions without the Mall revealed that bus congestion and delays would cause a shift to the auto, which would result in the total vehicle miles of travel rising 4.9 percent and the number of vehicles entering and leaving downtown would rise 2.3 percent without the Transit Mall. However, those intersections congested in peak travel times under Mall conditions would see improvement without the Mall due to auto traffic being able to use 5th and 6th, but overall traffic speeds would be unlikely to change without the Mall. The Mall also has concentrated pedestrian activity to the Mall area and nearby portions of cross-streets as opposed to the more even distribution of pedestrian volumes to more downtown streets without the Mall.

PERCEPTIONS AND MEASUREMENTS OF MALL IMPACTS

In the overall assessment of the Mall, specific characteristics of pedestrians, transit riders and downtown employees were examined and their ratings were compared to the impressions of downtown business leaders. The responses to two statements, "the Transit Mall is attractive," and "the Transit Mall is an improvement to downtown," indicate a very positive perception of the Mall and its impact on downtown. Business leaders agreed that the Transit Mall was an extremely important component in the revitalization of downtown Portland. Virtually all of the respondents evaluated the Mall in highly positive terms, noting that the Mall had "given a lift" to the city and that it was a visible sign of revitalization.

Perceptions of the Physical and Social Environment

Most respondents were satisfied with the artwork, the appearance of the covered bus shelters, the widening of the sidewalks, and also thought the Mall was well maintained.

Evaluation of the social environment created by the Transit Mall is somewhat more detailed than assessment of its physical environment. Two elements of the social environment are examined--people and activities. In general, it appears that pedestrians, transit riders, employees and business leaders view the type of activities that occur on the Mall and which it encourages, to be fairly positive aspects of the Mall and part of the variety of a healthy downtown.

Crime and Personal Safety

The success and vitality of a downtown or public places in general are likely to be dependent on how safe they are. A comparison of before-Mall (1975) and after-Mall (1980) crime statistics for downtown Portland was undertaken to provide insight about the criminal activity patterns that may have resulted from the concentration of pedestrian and transit traffic created by the Mall.

Most respondents view the Mall as a fairly safe place, and definitely as a good place to walk, while crime statistics indicate an increase in the number of incidents in blocks adjacent to the Mall. This could indicate the crimes occurring near the Mall are not perceived by people using the Mall as a serious threat to their personal safety. Most people are on the Mall when pedestrian volumes are high and are less threatened.

NOISE EFFECTS

The majority of the users of the Mall find it a noisy place. However, perceptions of the noisiness of buses in particular are found to be less uniformly negative, with a very large proportion of those questioned expressing neutrality on the subject. Presumably, buses can be largely held to blame for the Mall being perceived as a noisy environment.

A comparison of before-Mall and after-Mall noise levels indicates that the Mall is noisier than the before-Mall streets. Furthermore, streets adjacent to and west of the Mall have also become noisier during the daytime and evening. The only reduction in noise levels occurred off the Mall during the peak period. Changes in evening period noisiness both on and off the Mall tend towards increases, but the number of occurrences of both increases and decreases are very close.

AIR QUALITY EFFECTS

A majority of all Mall users consider the bus fumes to be irritating, although a substantial proportion were neutral on the issue. In addition to the measurement of perceptions of air quality, a study to determine the effects of the Transit Mall on air quality in the downtown area was done by comparing the 1980 with-Mall emission density and a simulated 1980 without-Mall emission density. The findings indicate that implementation of the Mall has reduced concentration of hydrocarbon, carbon monoxide and nitrogen oxide pollutants on the Mall streets. This

improvement in pollution concentration levels has occurred at some expense of pollution levels and deterioration of air quality on streets paralleling and crossing the Mall.

DEVELOPMENT IMPACT

Many significant remarks made by business leaders could not be associated with a specific land use type, but indicate the perceived role of influence of the Mall on development. The consensus was that the Mall's stimulation of private investment through its symbolism of a public commitment to downtown was more beneficial than improved transit service to the downtown economy. It has provided a geographic focus for downtown, defining the spine of the office corridor. This has created a "center of gravity" avoiding more dispersed new development. The Mall and other transit improvements have improved the efficiency of transit access to and within the downtown. This is an important factor in encouraging businesses to select downtown sites and to favor sites on or near the Mall. The Fareless Square has worked with the Mall to increase bus usage and make bus riding socially acceptable. Finally, the Mall is seen to have brought Portland national recognition, which has contributed to its reputation as a desirable city in the eyes of company executives and conventioneers.

LAND VALUE AND RENTAL VALUES

An appraisal firm concluded that the Transit Mall construction appears to have had a minimal effect on the demand for office space in downtown, if any. Transit Mall construction had a positive impact on the ability to move rush hour transportation, and therefore, had significant positive impacts on maximum feasible population and resulting office and retail space capacities in the downtown area. Had the Transit Mall not been constructed, the appraiser concluded that two or three buildings,

or between 500,000 and 750,000 square feet of office space constructed in the downtown area during the study period would have been constructed elsewhere in the Portland SMSA.

The Mall was constructed through the high value area of the CBD and helped maintain those premium values, and the expansion of downtown occurred at the peripheral locations. Off-Mall locations saw larger increases in land values and rental rates than on-Mall locations. Slowest increases in land values were in the financial district and the largest increases in land values were at the south end of the Central Business District. Consequently, no value capture can be claimed.

COST-BENEFIT ANALYSIS

A cost-benefit analysis is used to assess the economic impacts of the Mall. The capital cost and annual maintenance cost total nearly $16 million and $0.2 million per year, respectively. The construction cost was shared by UMTA (80 percent) and Tri-Met (20 percent). The total length of the two Mall streets is 1.6 miles, which produces an average capital cost of $10 million per mile and $125,000 per mile for maintenance.

The question is whether the benefits exceed the costs. The various user impacts of the Mall are converted to estimates of benefit. User benefits are defined as the savings in vehicle operating costs, travel time value, and accident costs for users of the downtown transportation system. In the case of the Transit Mall, the reduction in travel time for transit users increased patronage over and above what would have been the level in the absence of the improvement.

User Benefits

The annual user benefits of the Transit Mall improvement is the reduction in transit user costs and highway user costs, both

calculated according to the consumers surplus concept of benefits. Thus, the estimate of user benefit is the reduction in transit costs less the increase in auto costs due to greater circuity in the street system with the Mall.

Annual User Benefit = $1.561 million

Transit System Operating Cost Savings

The impacts of transit improvements on the cost of implementing and operating a transit system are treated in two categories, capital costs and operating costs. The capital cost of the Mall itself was treated separately and no bus capital cost is attributable to the Mall.

The operating cost savings associated with the Mall in comparison to the without-Mall situation are calculated from the reduction in transit travel time due to Mall, times the marginal cost of transit per hour, times the number of buses.

The Traffic Effects Analysis finds a time saving of 4 minutes per bus for the with-Mall situation in comparison to the without-Mall situation. Although this amount of efficiency gain was not confirmed by Tri-Met's Mall versus cross-Mall comparison, the 4 minute estimate is used because the large volume of North-South buses would be difficult to accommodate in mixed traffic. In effect, the Mall may not have increased bus speeds downtown, but it has maintained speeds that would have deteriorated with the addition of large increases in bus volumes.

The 1977 operating cost factors, estimated by Tri-Met, was $18.23 per hour. This does not include capital or allocated administrative costs, and thereby approximates the marginal cost.

Annual transit operating cost savings = $1.664 million

Accident Costs

The costs of traffic accidents is estimated as a product of the unit cost of accidents, by degree of severity, and the accident rates for each accident type with and without the Mall.

Annual Accident Cost Savings = $156,000

Cost-Benefit Comparisons

A cost-benefit comparison requires that a discount rate be established to deflate or inflate costs and benefits to a common point in time. A discount rate of 3.0 percent is used in the analysis and both annual cost and benefit items are converted to a present value in 1976-77 dollars. This discount rate reflects the nominal interest rate less the expected rate of inflation, at the time resources were diverted from the economy.

A benefit-cost ratio of 2.29 is estimated showing the project to be viable. Given the difficulty and uncertainty in selecting a value of time, this estimate should not be considered precise. Instead, the benefit-cost ratio lies within a range of 1.80 to 2.80, which reflects approximately $\pm$ 20 percent.

IN CONCLUSION

The Portland Mall has had a significant impact on downtown. It has demonstrated a public commitment to downtown, an important signal to private investors in the area. It has proven to be a good public investment, with benefits exceeding the cost. However, transit users and Tri-Met are the major beneficiaries of the Portland Mall, as the analysis of land values and office rental rates does not indicate benefits to have been capitalized into land values of properties adjacent to the Mall. It has better served and increased transit patronage. Perhaps more significantly, the Mall has become a symbol for the continued revitalization of downtown Portland.

In terms of achievement of objective, the Mall has met expectations of increased transit efficiency. Meeting other objectives is less clearcut. This analysis has not shown, however, measurable impacts towards the objectives of promoting efficient land use, reducing energy consumption, and reducing pollution. The benefits accrue largely to transit users and the transit service provider.

While the Mall has contributed to the public image of a viable and attractive downtown, its limited capacity may prove a problem as the transit system expands. An early design decision where transit capacity was traded off with service to pedestrians and shoppers is affecting both the life of the Mall as constructed and its ability to serve as the transit focal point of downtown.

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TABLE OF CONTENTS

TABLE OF CONTENTS
(continued)

LIST OF TABLES

LIST OF TABLES
(continued)

LIST OF FIGURES

SECTION 1
INTRODUCTION

Background

Transit malls are a relatively new form of public projects that seek to revitalize downtowns and promote transit. Concern over deteriorating downtown business conditions in conjunction with increased concern over traffic congestion and environmental problems brought renewed interest in transit improvements. Recognizing that fixed guideway systems are expensive, most cities began to focus attention in the late 1970's on improving bus service by means of operational measures. Examples are: priority signalization, preferential lanes, improved loading facilities, route rationalization, and improved scheduling. In particular, there is a trend toward consolidation of routes onto fewer streets in order to make more efficient use of preferential treatment, while also simplifying the transit system and making transfers easier. Also, under the general heading of "Transportation Systems Management," public officials are encouraging carpools, transit usage, shorter trips and pedestrianization to otherwise mitigate the growth of auto congestion.

Transit malls represent a combination of: (1) pedestrian malls and (2) preferential treatment for buses on city streets. This combination consists of creating auto free areas while retaining a roadway reserved for transit vehicles. Auto access is denied or limited strictly to local traffic and cross-street traffic. Typically, sidewalks are widened and other pedestrian amenities are added. By addressing the needs of pedestrians and facilitating the operation of transit, the mall becomes an important part of the collection-distribution process of a city-wide or regional transit system.

A transit mall can be viewed as a compromise shopping mall, designed to satisfy merchants who may feel that some vehicular access is essential to their business. This compromise view is based on the notion that neither pedestrian needs nor transit volumes taken by themselves are sufficient to justify removing entire streets from automobile use, but together they are. Further, pedestrian and transit uses are considered complementary. By combining the two, a special focus may be created in the downtown area that brings people together, stimulates business, encourages bus ridership, improves transit service, enhances environmental quality, and stimulates development in a pattern that can be better served by transit.

Historical Development of Portland, Oregon's Transit Mall

The concept of segregating transit from auto traffic on Portland, Oregon's downtown streets was advanced as a solution to downtown traffic problems as early as the 1950's. The idea of a transit mall for Portland was initiated in 1970 by a coalition of downtown business leaders and property owners. A Downtown Plan Study Group followed.

After 15 months of discussion and study, a report (Planning Guidelines - Portland Downtown Plan) was published which included a transit mall concept for S.W. 5th and 6th Avenues.

The transit mall concept was identified as an integral element in the Downtown Plan and reiterated in the City's Transportation Control Strategy for Federal Air Quality Standards (1972). Therefore, the transit mall concept should not be viewed as an independent project but as a part of a much broader public and private investment plan.

Through a program funded by the Urban Mass Transportation Administration (UMTA), the Tri-County Metropolitan

Transportation District of Oregon (Tri-Met) initiated a feasibility study for a Portland Transit Mall in January of 1973. The results of the study were favorable. This effort was followed by a design, completed in December of 1975. The financing of the Transit Mall was federally assisted under the Urban Mass Transportation Act of 1964, as amended. This act authorized the Secretary of Transportation to provide additional assistance for the development of comprehensive and coordinated mass transportation systems, both public and private, in metropolitan and other urban areas, and for other purposes. The construction was a $15 million project funded 80 percent by UMTA and 20 percent by Tri-Met. Construction began in February, 1976, with partial operation starting in December, 1977. The Mall was completed early in 1978.

Project Description

The Portland Mall involved the reconstruction of 5th and 6th Avenues between Burnside Street on the north and Madison Street on the south, approximately 11 blocks on each avenue or a total of 22 blocks through the heart of downtown Portland (see Figure 1). In dimension, the Mall was an ambitious project to eliminate the private auto from a major segment of a Central Business District (CBD) street system and to dedicate those streets to transit usage.

Physically, the Transit Mall involved reconstructing all improvements within the street rights-of-way of 5th and 6th Avenues. This included reconstructing roadway pavements and widening existing 15' sidewalks to 26' along the right lane of each avenue where buses load. Sidewalks on the opposite side of the street were widened from 15' to 18' where there is an auto access lane and to 30' in other blocks. Sidewalks and pedestrian walking areas at each intersection were reconstructed with brick paving and granite feature strips.

FIGURE 1

PORTLAND CENTRAL BUSINESS DISTRICT

TRANSIT MALL

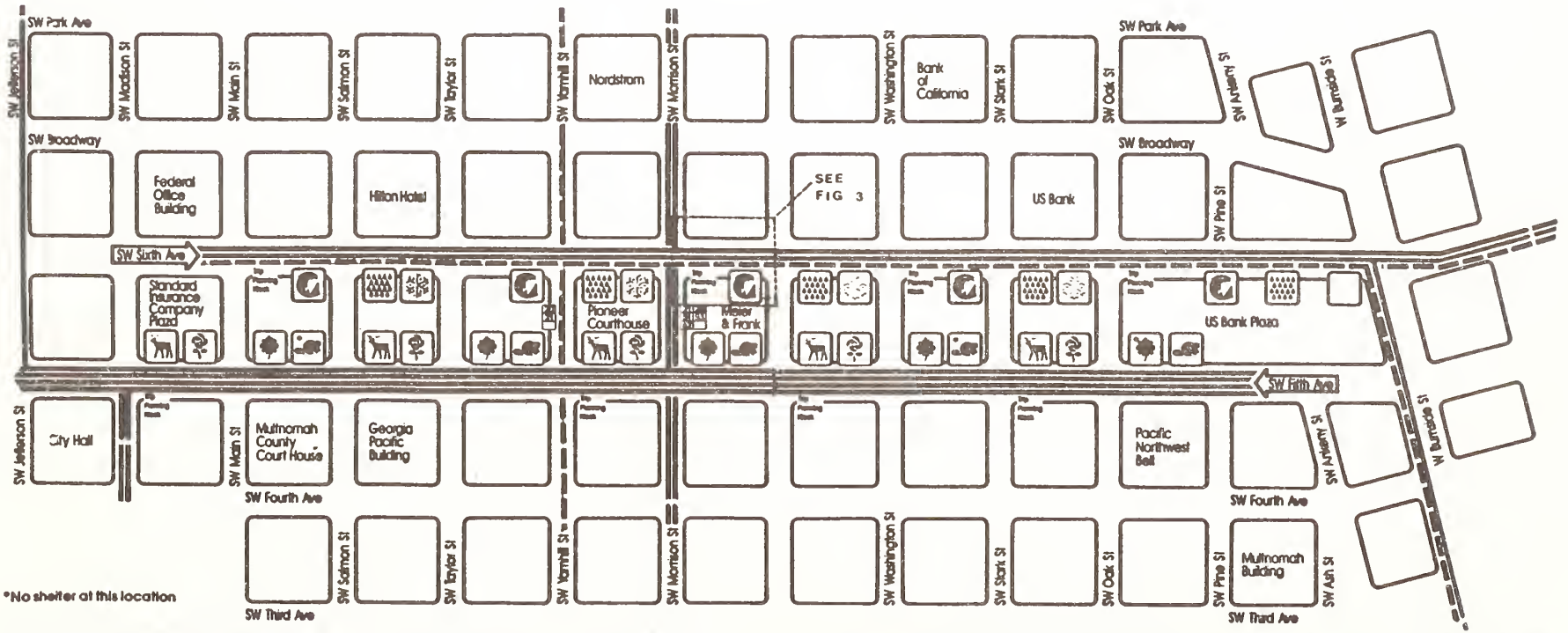
0 1200'

London plane trees, spaced approximately 25 feet apart, line the two avenues. The design treatment of the two streets is enhanced by refurbished historic street light standards and other elements of street furniture. Most significant among the items of street furniture are the 32 bronze-clad, glass roofed bus shelters located at each bus stop. The project also included over one hundred four- and six-foot diameter flower pots, planted seasonally by the City Park Bureau, and five decorative fountains that range from a quiet pool and sculpture to a roaring cascade. The project also includes 11 individual sculptures, display kiosks and special signage and graphics.

Fifth and Sixth Avenues have an 80' right-of-way with widened sidewalks. Two continuous 12' bus lanes extend the length of 5th and 6th Avenues. An intermittent auto lane on the left side of each avenue is situated to provide auto access in three-block segments. The Mall operates southbound on 5th and northbound on 6th, consistent with the downtown one-way grid pattern. Buses enter the south end of the Mall at Madison Street either from the Hawthorne Bridge in a single westbound exclusive bus lane along Madison or from the south on 6th. Buses enter the Mall on the north from Burnside or from 5th. Each block of the Mall has two bus loading areas. One stop is located on the north 80' and another on the south 80' of each block, with a 40' reserved area at the center of each 200' block. Each bus line has a stop every fourth loading area so that each bus stops every other block.

Lines are assigned to stops along 5th and 6th Avenues in accordance with their destination (see Figure 2). The regional bus system is divided into seven service areas. Each service area is assigned to one of four bus stops on 5th and three along 6th. A fourth bus stop on 6th is

Portland Mall Map



*No shelter at this location

The Portland Mall is designed to aid bus riders in easily identifying which bus to take to a particular destination.

On the Mall each bus stop is labeled with a symbol and the route numbers for buses stopping at that location. The symbol represents one of the seven service areas. Buses traveling to a particular service area stop only at the designated symbol. Stops are located every other block and may be in the middle or the end of the block.

Each passenger shelter displays general information on all routes, and specific information for buses stopping at that shelter.

Also located on the Portland Mall are eight Trip Planning Kiosks. They provide riders with complete route and schedule information for all routes in the Tri-Met system.

BUS CIRCULATION **FIG 2**

reserved for unloading only, which is for bus lines serving the southern service areas which loop in the downtown, unload on 6th and stop for riders boarding on 5th. There are five bus stops on the Mall for each service area. The Mall is designed to carry up to 200 buses per hour in the exclusive bus lanes on each avenue or up to 260 buses per hour if, in the future, the present downtown progressive signal system is abandoned in favor of a simultaneous signal system.

The allocation of bus stops according to service areas allows the bus patron destined for a specific location in the region to easily identify the correct bus stop. In addition, the allocation allows patrons destined for close-in locations served by several bus lines to access any one of those lines at a single bus stop. This includes people who are enjoying the convenience of free bus service to destinations within the downtown Tri-Met Fareless Square area. Fareless Square is the full downtown area bounded by the freeway loop on the south and west, Hoyt Street on the North and the Willamette River on the east.

Bus shelters, designed to provide rain protection for up to 60 persons, are located at most bus stops. The bus shelters are an important feature of the Portland Mall, particularly because of Portland's rainy climate. But the bus shelters also are important for their display and transit information function. They each contain maps and descriptions about the overall transit system and specific information about the individual service area, including video equipment that displays departure times for each bus utilizing that bus stop.

Objectives of the Portland Mall

Several objectives influenced the design of the Portland Mall. An important objective was to provide a more

efficient, convenient transportation alternative for commuters and shoppers. Transit improvements were expected to increase transit use. This, in turn, was expected to promote more efficient land use, reduce energy consumption and reduce pollution.

Another objective was to revitalize downtown. The completed Transit Mall was to stimulate growth in the downtown area, through stabilization or growth in the number of retail firms, lower vacancy rates, lower turnover rates, increased retail sales and other business activity, greater private and public investments, and more jobs.

The Portland Mall Impact Study

The Portland Mall Impact Study was funded by the Urban Mass Transportation Administration to analyze a wide range of impacts related to the Portland Mall. The study was a joint project involving the Metropolitan Service District; City of Portland, Bureau of Planning; Tri-County Metropolitan Transportation District of Oregon; and, the Center for Urban Studies, Portland State University.

The purpose of the study was to provide useful information for public and private organizations at both the national and local level. At the national level, results of the study will help answer questions that are asked of Portland by other local governmental agencies. These agencies have expressed interest in Portland's experience with a transit mall and possible applications to their locale. They are also interested in the transportation-land use interactions that can be achieved through investments in transit. At the local level, information will be used in assessing impacts that relate to the operation, maintenance and possible extension of the Transit Mall.

Organization of Report

This final report of the Portland Mall Impact Study reports the results of the various technical studies. The following sections report findings. Generally, the order of presentation is from primary to secondary impacts. After discussing issues in constructing the Mall, the primary transit and traffic impacts are presented. Then, the noise, air, land use and development impacts are presented. A listing of the individual technical reports from which these findings have been drawn is in Appendix C.

SECTION 2
IMPLEMENTATION ISSUES

Introduction

To gain an understanding of the process of planning and constructing the Portland Transit Mall, a report entitled, Planning and Constructing the Portland Mall was prepared by Roger Shiels, who served as Project Director. The report documents the implementation process and describes in detail the various steps, issues, and problems encountered. This section summarizes the way in which some of the key issues were addressed. Issues presented here are those any city might face in undertaking a transit mall.

Mall Design

In 1971, the Columbia Region Association of Governments (CRAG) applied for and received a federal grant from the Urban Mass Transportation Administration (UMTA) for the implementation of a regional unified transportation work program. Included in the grant was the sum of $230,970 to conduct a preliminary design location and environmental impact study for the 5th and 6th Avenues Transit Mall. In December, 1972, CRAG and Tri-Met entered an agreement providing that Tri-Met would direct and be responsible for the Transit Mall technical study and CRAG would pass through the federal funds received under the UMTA grant. Tri-Met was responsible for providing the 1/3 local match to the federal grant.

Design Team. During the Fall of 1972, in anticipation of approval of the UMTA grant, Tri-Met and the City of Portland agreed that the Transit Mall study should be conducted under the direct supervision of a two-member Transit Mall Review Board consisting of the President of Tri-Met, and the Portland City Commissioner of Public Works. The Transit Mall Review Board continued to guide the project until construction

began in late 1975. The authority of the Review Board to make "all authorizations and decisions" on the project was established in agreements between the City and Tri-Met. However, Tri-Met Board and City Council confirmations of Review Board decisions were frequently sought through the life of the project.

The initial step in carrying out the Transit Mall Feasibility Study was to obtain proposals and to select firms to carry out the technical and design work required in the study. The Review Board selected Skidmore, Owings & Merrill, Architects, (SOM) and Lawrence Halprin & Associates of San Francisco, planners and landscape architects, to design the project. Halprin's firm, a subconsultant to SOM, participated in the preliminary design of the Nicollet Mall in Minneapolis, Minnesota as well as the Market Street Redevelopment in San Francisco. In late 1972, Roger Shiels was retained by the City and Tri-Met to work with the Transit Mall Review Board in coordinating the work of project participants.

Citizens' Advisory Committee. In early 1973, the Downtown Plan Citizens' Advisory Committee was reactivated to advise on the design of the Transit Mall and other continuing elements of the Downtown Plan. It was intended that the Downtown Plan Citizens' Advisory Committee would act as a forum for public participation in the design of the Transit Mall project. The Committee planned to invite interested individuals and groups to a series of open meetings where current progress of the design could be reviewed.

At the first public meeting held by the CAC, the circulation options were presented by the design team and a discussion followed. While the meeting was well attended, members of the downtown business community were not present. It was apparent that property and business owners along the Mall

were unwilling to become involved in an open forum such as the one conducted by the CAC. Members of the design team concluded that the project would ultimately fail if it was not supported by the downtown business community and that the CAC would not be helpful in gaining this support.

Shortly after the first CAC meeting, the design team met with a small group of key downtown business interests and property owners in an attempt to open communications. After reviewing a presentation of the circulation alternatives, the businessmen at the meeting concluded that any scheme that did not include at least 2 auto lanes was totally unacceptable. They felt that even schemes with auto lanes had problems and that perhaps it would be best not to proceed with the project at all. There was a great deal of skepticism expressed about malls as well as mass transit. At this meeting, the design team discovered the nature of the challenge that lay ahead.

A plan was developed to work with property owners and businesses individually to gain a constituency for the project. Contact would begin with known supporters and gradually expand to the more skeptical as support broadened. Large group meetings and public hearings would be postponed until a favorable consensus could be achieved. Through 1973 and 1974 literally hundreds of meetings were held with the 58 property owners or their representatives along the Mall and with about an equal number of major ground floor tenants. These meetings were informal, allowing discussions of the overall Downtown Plan and the Transit Mall's relationship to it as well as specific problems of particular interest to the property or business owner such as loading, access, construction phasing and other details. Through these meetings, the design of the project began to mature and support for the project began to build.

How Many Autos?

Based on early contacts with the business community, a proposal for a street limited to only 2 lanes for exclusive bus use was dropped. Skidmore, Owings & Merrill developed three circulation alternatives with varying levels of auto use that became the focus of debate through 1973. The first was a so-called "3-1/2 Lane Scheme" which provided two exclusive bus lanes and a single auto lane with 8' wide pull outs for parking, loading and dropping off. Second was a "3-Lane Scheme" with 2 exclusive bus lanes and a single auto lane continuous between Burnside and Madison. The third, the so-called "2-1/2 Lane Scheme", had two continuous exclusive transit lanes with a third auto lane in all blocks except between Madison and Main, Yamhill and Washington, and Pine and Burnside.

The project team and Transit Mall Review Board agreed that the 3-1/2 Lane Scheme would result in too much crowding on the street and that the project should be sold based on the removal of all parking and loading from the mall streets. Attention was successfully directed to the two remaining schemes.

Future Third Bus Lane. The City Traffic Engineer, maintained that a continuous third lane as in the "3-Lane Scheme" must be reserved for future transit capacity when bus volumes would exceed immediate projections. The DeLeuw Cather "Immediate Bus Improvement Plan" report concluded that the capacity of an exclusive bus lane on the Mall would be 130 buses per hour. Two lanes would have a 260 buses per hour capacity, and three lanes a 390 buses per hour capacity. DeLeuw Cather projected bus volumes in 1975, when the Mall was scheduled to open, to be 150 buses per hour during the afternoon peak hour, but that 3 lanes would be required by 1990. Based on these projections, the City Traffic Engineer

concluded by a straight line method, that sometime in 1982, it would be necessary to designate all three lanes on the Transit Mall for exclusive bus use. The "3-Lane Scheme" allowed buses to operate in two lanes in one direction and when bus volumes warranted, the third lane could be cleared of autos and made available for buses in a counterflow direction. The City Traffic Engineer did not object to the 2-1/2 Lane Scheme provided that the third lane was only temporarily blocked by tree pots or other movable barriers.

The concept of assigning a third lane of buses to the Mall had difficulties. First, it implied that the third auto lane was not necessary. This notion was hard to accept for the downtown business community, particularly those property owners who would have but later lose, all direct access from 5th or 6th Avenues. Second, the use of the third lane for buses was an acceptance of the DeLeuw Cather premise that by 1990 Tri-Met would have a thousand bus fleet still operating on radial routes oriented to downtown. This was not supported by the City transportation planners who imagined a regional light rail system by 1990 supplemented by a bus feeder system with cross-town service oriented not to downtown, but to points along the light rail alignment. Third, buses loading trom a third lane would result in sidewalk congestion when buses began loading from 18' or 19' wide sidewalks on the left side of the street. Finally, members of the Citizens' Advisory Committee and ultimately, DEQ, were concerned about increased noise levels, odor and traffic congestion on the Mall caused by buses. They perceived the Mall primarily as a place for leisurely pedestrian activity. The prospect of 390 buses, more than 3 buses each minute during the afternoon rush hour, was unacceptable. During the process the requirement to reserve the third lane for future transit was set aside.

3-Lane Scheme. By May, 1973, the design team, under pressure from the Traffic Engineer and members of the downtown business community, had backed away from the "2-1/2 Lane Scheme". Further, the concept of two exclusive bus lanes began to erode. In reviewing the 2-1/2 and 3-Lane Schemes, the downtown business community proposed a joint use of the center bus lane, particularly in the beginning when bus volumes would be relatively low. A community consensus for a three lane Mall with one fulltime and one peak hour exclusive bus lane emerged.

On May 31, 1973, the Downtown Plan Citizens' Advisory Committee unanimously adopted its subcommittee's report endorsing the 3-Lane Scheme with off-peak use of the transit lanes albeit by taxis, airport limousines and other commercial vehicles only.

On June 14, 1973 the City Council and Tri-Met conducted a public hearing which was heavily attended by members of the downtown business community, particularly business and property owners along 5th and 6th. The business community overwhelmingly supported the joint use of transit lanes by private automobiles.

Within a week, the Commissioner of Public Works filed a resolution for City Council action specifying an operational plan and design based on the 3-Lane Scheme. The left lane would be used by autos during all hours. Initially, the center lane would be used by autos except during peak transit hours until such time that the two lane bus capacity was required. The right lane would be reserved for exclusive bus use except when needed by police and fire vehicles, ambulances, street and utility maintenance vehicles. Taxi and airport limousines would be allowed to use the exclusive bus lanes when such use would not impede the efficient flow of mass transit vehicles.

Significant support for the project had been gained during the first six months of June, 1973. While the business community was unwilling to support full transit use of the Mall, it was at least endorsing the mall concept in a 3-lane configuration.

Preliminary Grant Application. Tri-Met forwarded a preliminary grant application to UMTA on September 1, 1973 requesting UMTA to participate in the cost of the Transit Mall design and construction work then estimated to be $12,993,000. Within a short time, UMTA informally responded to the application indicating that the agency would participate in the project only to the extent that the community was willing to commit 5th and 6th Avenues to mass transit. Literally interpreted, this meant that UMTA would only fund 45 percent of the total cost for the Council adopted 3-Lane Scheme. Alternate local and federal funding sources were briefly investigated and found to be not readily available. This led to a reconsideration of the "3-Lane Scheme" with mixed bus and auto use of the lanes.

At its January 3, 1974 meeting and public hearing, the City Council adopted an ordinance revising its June 22, 1973 approval and authorizing the Commissioner of Public Works to negotiate with UMTA for maximum auto use on the Mall consistent with maximum UMTA funding. At a meeting with UMTA officials on January 16, 1974, it was conceptually agreed that full UMTA participation in the project would be available with the "2-1/2 Lane Scheme" utilizing two full time exclusive bus lanes the length of the Mall streets. This ended the debate over the circulation plan for the Mall and design work proceeded on the "2-1/2 Lane Scheme".

Final Design and Engineering

On April 1, 1974, Tri-Met submitted a final grant application to UMTA for federal funds for the final design and engineering and construction of the 2-1/2 Lane Transit Mall project. The grant application requested UMTA's participation in the final design and engineering costs of $891,820 and the construction of the project estimated to cost $12,945,845. On June 20, 1974 UMTA approved the grant for design and engineering work, but not the grant for construction which would be considered only after completion of engineering work, cost estimates and the Environmental Impact Statement. SOM was again retained and work began on contract documents for the project.

Utilities. The preliminary grant application contained Tri-Met counsel's August 1, 1973 legal opinion stating that the private utility companies were responsible to pay the cost of relocating their own facilities. Since Tri-Met was not obligated, UMTA declined to participate in the relocation costs. However, costs for relocating water and sewer facilities were eligible because they are owned by the City and their relocation would be Tri-Met's obligation under City Charter provisions.

Private utility companies affected by the project included Portland General Electric, Pacific Power & Light with both electrical and steam heat facilities, N.W. Natural Gas Co., Pacific N.W. Bell and Western Union. In the downtown, all utilities within the street right-of-way areas are underground.

Most utility relocations were of two types. First, there were relocations caused by grade changes. The new wider sidewalks resulted in lower grades at the curb and gutters to maintain drainage. This frequently dictated lower street

grades. Many utility vaults and lines were close to the surface and were lowered to accommodate the new grades. Second, there were relocations required to eliminate conflicts between manholes, vents and other surface elements of the utility systems and new locations of mall surface features such as curbs, gutters, feature strips, trees and other items.

There was general concern about the private utility work because of the potential for conflicts with the general construction work that might result in claims for delays and additional costs by the General Contractor. With the utilities paying their own cost, there would be no monetary lever to insure performance. The progress of utility work would depend on their willing cooperation which was successfully solicited from utility Executive Officers by the Mayor, President of Tri-Met, and other community leaders at a lunch meeting in May, 1974. The utilities agreed to accept the obligation of paying for relocating their facilities. They committed to assigning liaison staff and beginning their relocation design work to meet the project schedule. The project design team was directed to work closely with the utilities in designing details of the project to minimize cost to the companies. When completed, the cost of all of the work by the private utility companies was approximately $4.0 million.

Basement Extensions. From general knowledge, it was known that a number of buildings along 5th and 6th had basement areas under the sidewalk or basement extensions. In 1973, an effort was undertaken to obtain drawings of existing buildings along the Mall from the Building Bureau. However, the Building Bureau files were incomplete and good information was not available. Additional information for drafting contract documents was taken from drawings obtained from

building owners, visual inspection and test borings taken through the overhead sidewalk structure.

Meetings with the property owners began in early 1973 and continued through late 1975. Basement extensions were discussed in many of the meetings, and a variety of individual property owner desires and needs with regard to those spaces were identified.

Basement extensions had to be remodeled for two reasons. First, was to gain depth required for the new brick sidewalk surface where a topping slab was not present. Where a topping slab could simply be removed, little or no structural reconstruction was necessary. Where a monolithic structure existed, then the extension roof structure was rebuilt or where the structure allowed, sawcut to gain the needed depth. Second, niches were built into basement extension walls at many locations to provide space for the street tree roots.

As work on the final design and engineering progressed, it was clear that there was a need for an equitable policy for paying for reconstruction in the basement extensions. A policy was adopted which specified that the project would pay for structural changes involved in removing topping slabs, reconstructing roof structures above the top of the walls where no topping slab existed and constructing the tree niche structures. Owners would pay for relocating any mechanical, electrical or architectural elements in the basement extensions that interfered with the structural changes made by the mall contractor. The owner would also be given the option of abandoning the basement extension area, in which case by City Code the property owner would be responsible for constructing a concrete basement wall at the property line.

The City has the legal authority to require the vacation of basement extensions, which in effect gave the City the power to require the modifications needed for the project. However, it was argued that property owners should not be required to bear this cost. Inclusion of the changes in the project work probably resulted in cost savings because control rested with the mall contractor, insuring the timely and coordinated completion of the basement extension work.

By mid-December, 1975, all 20 property owners with extensions signed a standard 3-party agreement with Tri-Met and the City allowing access to the areas for construction, requiring each party to do its respective work, and allowing owners continued use of the basement extension areas excepting areas taken for tree niches and electrical and pump rooms required at several locations.

Pioneer Courthouse. The environmental impact statement began to appear as a critical item on the project schedule early in 1975. By March, 1975, a schedule was adopted calling for an award of a General Contract by October 20, 1975. Award was ultimately delayed 4 months until February 14, 1976 due to the environmental procedures, particularly the requirements of the National Historic Preservation Act of 1966 and the changes that the Mall project required in the Pioneer Courthouse.

The Pioneer Courthouse was built in 1869 and is located between 5th and 6th Avenues, Yamhill on the south and Morrison on the north. The Pioneer Courthouse is the oldest permanent federal building in the Northwest and reportedly west of the Mississippi River. Symbolically, it is the heart of the city and the scene of many historical events including court cases and speeches by U.S. presidents. It is a good and quite rare example of post-Civil War governmental architecture

in the Italianate style. Between 1970 and 1973 the General Services Administration restored the building for use by the federal courts and the U.S. Postal Service. The building is on the National Register of Historic Places.

Before the Mall was built, four off-street parking spaces and a loading dock for the post office had access by a wide curb cut along the east side of 6th Avenue. The Mall project would remove auto traffic from 6th and the operation of buses in two exclusive lanes along the east side of 6th Avenue would eliminate access to the west side of the Pioneer Courthouse.

SOM developed several alternate access proposals for the 6th Avenue post office. However, the U.S. Postal Service and General Services Administration maintained an uncompromising position about any changes in their loading dock access. This, at least indirectly, resulted in a finding by the President's Advisory Council on Historic Preservation in July, 1975 that the project would have a significant impact on the historic Pioneer Courthouse triggering a lengthy review procedure specified under the National Historic Preservation Act of 1966. This procedure would have to be completed prior to beginning the 30-day review period of the Final Environmental Impact Statement, which must precede any substantive act to commence the project, such as bidding.

By November, 1975, SOM had completed drawings and a report on its proposal for a driveway on Morrison for loading, a system of warning signs for bucking postal vehicles, reconstruction and restoration of the wall, landscaping along the west property line and other mitigations estimated at the time to cost the project $65,000. After public meetings, the review process was completed on December 9, 1975 when the Pioneer Courthouse improvements and mitigations were

agreed to by local and state historic preservation officials, UMTA and the President's Advisory Council.

Preliminary Work

During late 1975 and early 1976 there was considerable optimism that UMTA would approve the grant for constructing the project and that bids would be within the project budget. Based on this optimism, Tri-Met and the City took steps in advance of UMTA concurrence to begin critical work in meeting the project schedule. In October, 1975, the City began construction of a $360,000 project separating sanitary and storm sewers, long planned in the Mall area. Private utilities were authorized to begin their relocation work as early as December, 1975 under letters of agreement from Tri-Met, with Tri-Met agreeing to pay utilities for their costs if the project grant was not approved. Additionally, on February 1, 1976, the City and Tri-Met closed most of 5th and 6th Avenues between Burnside and Madison to normal traffic and began temporary exclusive operation of buses on 6th in two directions. This cleared 5th of traffic for increasingly intense private utility work.

The bidding of the project was delayed until mid-December, 1976 after completion of the Pioneer Courthouse review and approval. With bidding underway, UMTA approval of the grant and commencement of construction became pressing issues. Late in 1975 with an acknowledgement of the 4 months delay caused by the Pioneer Courthouse review, March 5, 1976 was established as the latest date on which a contractor could be authorized to begin construction without altering the contract schedule requirements. A principal feature of these requirements was the completing of segments of the project in the retail core between Yamhill and Stark on 5th Avenue prior to November 15, 1976 and the entire project before mid-November, 1977.

On January 14, 1976 bids were received from 5 general contractors. Hensel-Phelps Construction Co. was low bidder with a bid of $10,597,000; $559,000 below the budgeted amount. The bids were valid for 60 days, but March 5 remained the critical late start date to meet the principal schedule requirement. On February 24, 1976, after suffering weeks of anxiety, UMTA approved the capital grant for the project. The project construction budget was established at $14,965,205. On February 27, 1976, the contractor was notified to proceed with the project.

Marketing/Public Information. During the course of construction, Tri-Met was responsible for carrying out a public information program on the Mall construction and interim transit routing.

The public information program was many faceted. At the outset, there was a full page newspaper advertisement in both local daily newspapers, explaining the Mall and the forthcoming construction period, schedule and phasing. Prior to each of the five major changeovers, Tri-Met conducted aggressive on-bus and media information programs. Tri-Met personnel were on the street prior to and during the changeovers dressed in "Ask Me" aprons answering questions and directing confused bus patrons to their relocated bus stops. Temporary stops on 5th and 6th were identified by colorful, graphic bus stop signs with routes grouped under the "Streetlamp, Hardhat, Greentree and Horsecar" symbols.

Public information staff in the Tri-Met Marketing Department were assigned on a full-time basis to the project. They were responsible for writing press releases and scheduling periodic news conferences. The Project Director was available to answer individual questions and address the media on specific problems. An automated telephone system was

installed for the public to call 224-MALL for a weekly updated, recorded report on downtown traffic and construction conditions. The marketing staff arranged several ceremonies including the Governor's installation of the one-half millionth brick, reception for the Mall artists and the dedication celebration in March, 1978.

Schedule. The scheduling of construction work was based on the following general assumptions adopted by the City and Tri-Met during the course of the final design and engineering phase:

- Pedestrian access to all businesses and buildings as well as emergency vehicle access would be maintained during each phase of construction;

- At least one lane on east-west streets would remain open at all times except in special cases where complete closure may be allowed for short periods;

- Vehicular access would be retained to key facilities along the Mall;

- Buses operating on 4th, 5th, 6th and Broadway would be relocated to 5th and/or 6th during the construction period to establish downtown transit and traffic patterns for the Mall at the beginning of its construction; and,

- Construction work would not take place within the retail core defined as the areas on 5th and 6th between Yamhill and Stark during the holiday season, November 15 to January 15, when all construction work would cease and the area cleaned up.

The last requirement was a major concern of the downtown retailers because 60 percent of downtown retail sales are made during this period. Normally, no street work is allowed in the downtown area from Thanksgiving to early January, but the approved construction schedule permitted work on the Mall in areas outside the retail core during this season.

The construction work was scheduled in five segments--three on 5th and two on 6th. Each segment corresponded to transit routing on the Mall during construction and the moratorium during the Christmas holiday seasons of 1976 and 1977. The start and completion dates were also scheduled based on the estimated duration of utility and general construction work. Under the project schedule, utility work would be followed by general construction work beginning at 5th and Madison, and proceeding north. Once completed on 5th, utility work, again followed by general construction work, would begin on the south end of 6th at Madison and proceed north to Burnside.

The work in each block was phased to allow vehicular and pedestrian access to the individual properties along the Mall during construction. The first step of the construction was to remove the existing 50 foot wide asphalt roadway. This was followed by the excavation of a trench in the center of the street area for utilities serving the Mall including electrical conduits and wiring for street lights, kiosk and bus shelter lighting; video cable for shelter and trip planning kiosk CRTs; and telephone cable. Then a 10" deep concrete structural street slab was poured. During this period, pedestrians used the sidewalks in the normal fashion. In blocks where an automobile lane was needed, half of the roadway was demolished and reconstructed while the other half was used for vehicular traffic.

Once the roadway was completed, pedestrians were rerouted on the completed roadway slab through a system of wooden barricades. Then sidewalks were demolished and work on basement extensions and new sidewalks began. Pedestrians accessed doorways of adjacent buildings and stores via temporary bridges. Temporary lighting and signs for each business were located on movable wood kiosks at each access point.

Intersections were constructed in half sections to maintain a minimum of one lane of east and west bound traffic on cross streets. Intersections adjacent to blocks where an auto access lane was required, were constructed in one quarter sections.

Tri-Met committed itself to turning over individual blocks to the general contractor in sequence based on the start and finish time of utility relocations plus a two-week contingency period. The contractor, in turn, was required to complete each of the five segments by a specified deadline with the final completion on 6th and Burnside by November 11, 1977.

In most blocks, utility work was completed ahead of the scheduled dates. However, the general construction work did not progress as well. The project was plagued with numerous political and construction problems including problems with soils and street slab design, topographic survey dimensions, expansion joint construction, asphaltic concrete design mix approvals, granite settling bed materials and methods, brick installation, tree species selection, federal approval of artwork contracts, maintenance of safe and clean job site conditions, Tri-Met and the City communications and management responsibilities, and City acceptance of work it considered not to conform to contract requirements. Ultimately, the problems resulted in litigation between Tri-Met, Helsel-Phelps, SOM and the City which was not settled

until mid-1980 when the project was accepted by the City for maintenance.

During construction, the problems resulted in the extension of each of the milestone dates for completing the five segments. Despite these difficulties, the project was completed and began final bus operations on December 11, 1977, on budget and only one month behind the initial targeted completion date.

SECTION 3
TRANSIT EFFECTS

Introduction

Tri-Met examined the impact of the Mall on transit operations and on the safety levels of transit provision in the central downtown area. These analyses are found in the Transit Effects Report which contains all of the Transit Mall impact analyses performed by Tri-Met.

Tri-Met identified the expected transit operations for the Mall and discussed the changes in downtown and system-wide transit service that could be attributed to Mall operation. The success of the Mall in achieving its operating objectives was evaluated in comparison to cross-Mall bus operations.

Operational Expectations

Broadly speaking, the Transit Mall was conceived as being an element of an evolving strategy to reverse the post-War decline in transit use. The reason for promoting a return to transit is partly for energy conservation, partly to reduce automobile congestion within the downtown area, and partly to reduce pollution levels resulting from automobile emissions within downtown. The Transit Mall is instrumental in achieving the objectives of the Downtown Plan, the Downtown Circulation and Parking Policy, and the Portland Transportation Control Strategy. In evaluating the Mall's impact on transit operations, Tri-Met examined the following operating characteristics of the Mall:

- concentration of downtown transit service on a few streets;
- reduction of conflicts between bus and general downtown traffic;

- increased downtown transit service, attractiveness, understandability and ease of transferring;

- coordination of the most intensive transit service with the most intensive downtown activity and development;

- increased intra-downtown and system-wide ridership;

- improvement of downtown transit service commensurate with system-wide improvements.

Operations Effects Evaluation

The operational characteristics of before-Mall and with-Mall service could not be compared directly since the system now being operated downtown has been completely revised from the one which was operated before the Mall was built. Complicating this comparison further was the lack of quantitative, before-Mall operations data. Also, because some bus routes were lengthened and some shortened in their downtown portions when service was concentrated onto the Mall streets, their with-Mall downtown running times could not be meaningfully compared to before-Mall running times. Given these considerations, a limited evaluation of the Mall's effects on transit operations identified the following impacts:

- Concentration of downtown transit service onto a few streets. Implementation of the Mall has indeed had this effect on transit service. With the Mall, 88 percent of all downtown revenue service runs on the two Mall streets. This creates a linear strip of extremely high transit accessibility.

- Reduction of conflicts between bus and general downtown traffic. With the Mall, there are fewer

streets on which buses operate in mixed traffic. The Mall has physically separated most bus trips from general traffic in the congested core of downtown which reduces points of potential bus and auto traffic conflict.

- Increase in attractiveness of downtown transit service. Before the Mall was built, downtown transit routes were scattered over many streets which resulted in good area coverage but a confusing uncoordinated bus service with inadequate headways to effectively serve intra-downtown travel. Without an extensive understanding of routes and schedules, transferring was difficult and inconvenient because no on-street route and schedule information or sheltered passenger waiting areas were provided.

  The Mall has made transit service much more understandable, accessible and attractive to potential riders. The concentration of service on the Mall through the downtown core created an intra-downtown shuttle service of high frequency between Burnside and Madison Streets, the length of the Mall. Importantly, downtown transit service is more understandable with most routes running on 5th and 6th Avenues and the majority of non-Mall routes crossing the Mall on Morrison and Yamhill Streets. Contributing to the understandability of the transit service are the extensive color-coded route maps and electronic schedule displays located at all Mall bus stops. Consequently, transferring has become much easier.

  Furthermore, the Mall, which has the greatest concentration of transit rider trip destinations

and transfer points downtown, has been provided with many pedestrian amenities which alleviate the inconveniences of waiting for a bus, and reduce sidewalk conflicts between those waiting for buses and other pedestrians.

- Coordination of the most intense transit service and downtown land use activities. In the Portland Downtown Plan the area that has been designated for the most intensive development (the area bounded by Burnside, Columbia, 4th and Broadway) is centered on the Transit Mall, permitting adequate service by transit. The Downtown Plan and the Transit Mall, which it proposed, may have influenced the pattern and intensity of new downtown development by encouraging it to focus on the Mall rather than more widely throughout downtown.

- Increase in intra-downtown and system-wide transit ridership. From 1973 through 1980, Tri-Met's system-wide ridership increased at an average of about 30 percent per year, despite disruption by Mall construction from 1976 to 1978, and the implementation of two fare increases. The implication is that the Mall contributed to sustained, strong system-wide growth.

  No data exist for downtown patronage alone during this time period, but indications of transit ridership growth were identified from other sources. For example, data on changing downtown employment and traffic volumes indicate that while downtown employment increased at a rate of 3.5 percent annually from 1977 to 1980,

total traffic entering downtown increased by only 0.5 percent annually. The Downtown Parking and Circulation Plan (Portland Bureau of Planning, 1980) states that daily trips to work downtown by transit grew from 30 percent of the total in 1972 to 70 percent in 1979. The information strongly suggests that transit has been absorbing the increasing downtown travel demand generated primarily by growing downtown employment and retail functions.

- Insure downtown transit capacity is available to handle the ridership increases brought about by service improvements outside downtown. Downtown transit capacity is directly related to the number of buses able to move through the area in a given period of time. During one peak period it was found that 50 more buses moved through downtown in 1980 with the Mall than in 1975 before the Mall.

  The maximum potential capacity is also an important evaluative consideration. The Mall streets have a combined capacity of about 400 standard buses per hour (200 on each street). One-way streets, with buses operating in mixed traffic, have a capacity of about 90 standard buses per hour.

  Thus, theoretically, the Mall streets expand transit capacity in the most congested part of downtown by about 220 buses per hour over non-Mall conditions. This capacity on a single pair of one-way streets could not have been done without the physical improvements made to the Mall streets (i.e., exclusive bus lanes, special traffic signal sequencing and limited auto access).

The potential capacity is affected by the time required for a bus to move through downtown during a peak hour. Downtown running time (or average speed) is affected by maximum sustainable speed, (which is limited by traffic signals), the time a bus dwells at each stop and the time a bus is delayed by signals or vehicle congestion.

An analysis of bus operating speeds in downtown was conducted by Tri-Met. Speeds throughout the downtown area, including the Mall, are signal-limited to 11 or 12 miles per hour. However, special sequencing on the Mall allows a bus to travel the two blocks between stops and dwell at each stop for 15 seconds without being delayed by a traffic signal. This means a minimal run time for the eleven blocks of the Mall on 6th Avenue of 2.5 minutes. Theoretically, without the Mall and its special signal sequencing, but with the same bus stop spacing and 12 mile-per-hour downtown traffic signal timing, a bus dwelling for 15 seconds at each stop would require 3.67 minutes to travel those same eleven blocks on 6th Avenue. In theory, the physical improvements of the Mall have reduced the minimum achievable running time through the Mall by about 32 percent.

On-street observation and timing of bus circulation was undertaken in late 1981 to compare on-Mall bus movement to bus movements of the routes which cross the Mall running on Morrison and Yamhill Streets between 3rd and 13th Avenues. Table 1 summarizes the results obtained for peak hour and non-peak hour periods.

TABLE 1

BUS OPERATIONS COMPARISON: MALL STREETS TO CROSS-MALL STREETS

OPERATING CHARACTERISTIC	PEAK HOUR		NON-PEAK HOUR	
	Mall[1]	Cross-Mall[2]	Mall	Cross-Mall
Average Speed	4.4 mph	5.1 mph	5.1 mph	5.3 mph
Total Running Time	6.3 min.	5.4 min.	5.3 min.	5.2 min.
Delay Time	3.1 min.	2.8 min.	3.0 min.	2.5 min.
Delay as % of Running Time	49	51	57	40
Peak Bus Volume in 1981	167	32	--	--
Average Dwell per Passenger	2.6 sec.	2.7 sec.	2.6 sec.	2.7 sec.

[1]Mall streets: 5th and 6th Avenues from Main to Burnside.

[2]Cross-Mall streets: Morrison and Yamhill Streets from 3rd to 13th Avenues.

All entries represent averages of multiple observations/timings.

The slightly slower average operating speeds of on-Mall buses compared to cross-Mall buses reported in Table 1 were attributed to longer dwell times, particularly during peak periods, and bus queuing for access to bus stops for the on-Mall buses. Such problems are likely to occur repeatedly the length of the on-Mall bus runs whereas they only occur at the bus stops serving the Mall on the cross-Mall routes. However, on-Mall buses move at nearly the same speed as cross-Mall buses while their potential passenger capacity is more than five times as great as that of cross-Mall buses.

During the peak one-half hour of the afternoon peak travel time (5:00 p.m. to 5:30 p.m.) the capacity of 5th Avenue is slightly exceeded. Under these conditions it was noted that any bus stop dwell time exceeding the allotted 15 seconds (which is quite likely during the peak travel time) will probably cause queuing delay behind the bus. Thus, under current conditions the Mall does have a limit to the efficiency of its operation. However, these problems can be significantly mitigated by measures which reduce dwell time and the number of buses. The increasing use of articulated buses and the planned introduction of self service fare collection in September, 1982 are specific examples of current measures by Tri-Met to ensure that the Mall operates efficiently as ridership levels grow. In 1985, introduction of light rapid transit running across the Mall will replace some of the on-Mall bus routes.

Transit Effects Conclusions

The multiple objectives for the Mall to concentrate service in order to make the service more understandable and easier to use, to reinforce downtown development objectives, and to increase ridership levels and potential capacity, have been achieved with no loss in service efficiency. Operational improvements that reduce the number of buses per hour passing through the Mall and reduce dwell time can be effectively used on the Mall to increase service efficiency. This will be an important quality of the Mall as ridership demand grows in the future.

SECTION 4
TRAFFIC EFFECTS

Introduction

The Traffic Effects Analysis report (City of Portland, Bureau of Planning, 1981) addresses the effects within downtown Portland of the Transit Mall on traffic circulation, transit efficiency and use, pedestrian circulation, parking and local access and other transit-related matters. The analysis of traffic effects was concerned with several modes of travel in terms of the impact of the Mall on volumes, efficiency, congestion, ease of circulation and access to property. The questions addressed were related to whether the Mall had stimulated growth in transit patronage, whether traffic volumes and total downtown vehicular travel increased or decreased, whether the effects of removing on-street parking and direct access to some properties facing the Mall were of major significance, and whether the Mall had improved the speed and efficiency of downtown transit operations. This section includes an analysis of traffic accidents prepared by Tri-Met.

The most appropriate form of analysis of the traffic effects of the Mall was determined to be a comparison of 1980 modeled (or simulated) traffic conditions with the Mall against 1980 simulated traffic conditions had the Mall never been built. The traffic assignment model used had been previously developed by Metro to assess the impacts of various transit improvement proposals on downtown traffic.

Observations on Downtown and Regional Transportation Systems

There are significant natural barriers around downtown Portland that restrict the number of routes for entering and leaving downtown. Thus, travel oriented in the Central Business District (CBD) is concentrated compared to cities

where the downtown street grid extends out in all directions. And yet, Portland has been able to maintain its relative accessibility to a large share of regional travel as witnessed by the steady employment growth of the CBD over the last 15 years. Furthermore, projections indicate that the growth can continue if the transportation system can be improved as needed to support it.

Recent studies indicate that downtown traffic conditions are uncongested with the exception of a few morning peak-hour points, and a larger number of evening peak-hour congestion points which are located along Front Avenue, Burnside Street and at the Clay Street freeway entrance. In fact, it is the lack of peak-hour capacity of the freeway system and other major highways leading to downtown rather than downtown itself that may limit the growth of traffic volumes on downtown streets in future years. The sheer number of lanes available on downtown streets to carry traffic in any direction within and across the CBD far exceeds the theoretical capacity of the freeway system in the area, which is congested in all travel directions around downtown during peak hours. The downtown streets are slow due to traffic interruptions but are still far below their rated capacity.

In 1980, about 391,990 vehicles entered and left the CBD on an average weekday. Vehicle traffic at access points to downtown grew by about 2 percent per annum from 1976 through 1980. Total vehicle volumes showed no pattern of increase or decrease between 1960 and 1975. The growth has been on east-west routes in general, especially the non-freeway bridges over the Willamette River, probably because short-trip traffic is reverting back to the less congested downtown streets from the congested freeway loop around downtown.

Assumptions and Limitations

A basic understanding of the traffic analysis requires some knowledge of the limitations of traffic models, because most of the study results are based on interpreting the output of model calculations. Macro traffic models deal with overall travel in the region, to produce figures for traffic volumes and transit patronage entering and leaving an area such as a downtown. Such models cannot accurately simulate traffic turning volumes at intersections or traffic volumes on individual blocks, whereas micro assignment models are used for analysis of localized areas. The micro model used was based on a number of significant assumptions which simplified the modeling task, as listed below:

- The Morrison East and West public parking garages were not assumed to have been built under without-Mall conditions. These garages were built in part to replace on-street parking lost in construction of the Mall.

- Street and sidewalk dimensions, on-street parking and other curb uses which actually existed before the Mall was built were assumed for the 1980 without-Mall simulation.

- No changes in the way Tri-Met operated the system in 1975 were assumed for the 1980 without-Mall conditions, even when increased transit traffic appeared to warrant measures for improving operations. Instead, any excess of 90 buses per hour on any one street was reallocated to streets that could take the increase on the basis that higher bus volumes would be so inefficient as to defeat the objectives of increasing service on that street.

- No differences in downtown land use or employment totals by block were assumed between with-Mall and without-Mall conditions. Therefore, both sets of trip tables were virtually identical except for minor revisions in the without-Mall simulation.

- Fareless Square (free fare service in the CBD except between 3 p.m. and 7 p.m. weekdays) was assumed to be in effect for both conditions.

- No changes were assumed in the parking lid, an imposed limit of 38,870 parking spaces in the CBD.

- Changes in mode split and transit use were assumed to be minor. Therefore, no adjustments were made to the trip tables in the assignment of traffic to the with-Mall and without-Mall simulations.

- No differences in transit fares or parking costs were assumed between both conditions.

- Signalization changes made for improving transit operation on the Mall were not assumed for the without-Mall condition.

Analysis and Study Conclusions

Traffic circulation characteristics were described by daily vehicle-miles of travel, speeds, and traffic congestion. Data were compiled by street and for the downtown area as a whole.

Vehicle Miles of Travel. In terms of travel, Table 2 shows the comparison between the with-Mall and without-Mall systems for the downtown. The model output indicates that the Mall

has contributed to a 4.9 percent overall reduction of travel on downtown streets. However, it is reasonable to expect fewer miles of vehicle travel under with-Mall conditions because of the exclusive bus lanes.

TABLE 2

COMPARISON OF 1980 WEEKDAY VEHICLE MILES OF DOWNTOWN TRAVEL

(without transit)

With Mall			Without Mall			Percent Change		
East-West	North-South	Total	East-West	North-South	Total	East-West	North-South	Total
64,833	88,778	153,611	62,962	98,217	161,179	-2.9%	+10.6%	+4.9%

Daily Miles of Travel for Buses. For buses, weekday bus miles of travel in 1980 for all downtown streets under with-Mall conditions total 2,906. Without the Mall, the 1980 weekday figure would be 3,179, an increase of 9.4 percent. This increase is due to the higher incidence of 'loop routing' in the 1975 before-Mall system, where buses travel through downtown twice. Such routing is reduced under with-Mall conditions.

Traffic Volumes. The simulation indicates that under without-Mall conditions there is a 15 to 30 percent reduction of traffic volumes on Broadway and 4th Avenue, and a smaller reduction of 10 percent on Park and 3rd Avenues for average weekday and afternoon peak time periods. The changes to east-west streets do not fit a particular pattern although they experience an overall reduction in volume of 2.9 percent.

Dramatic increases in traffic volumes occur on 5th and 6th Avenues under without-Mall conditions. For the whole downtown traffic system there would be an increase in total traffic volumes because there is some added through traffic in downtown. This extra traffic is probably due to trips being diverted off the freeway loop to downtown streets because the opening of 5th and 6th Avenues under without-Mall conditions represents an advantage in travel time to some trips otherwise being made on the freeway. The 10.6 percent increase in north-south travel is probably due to this added through traffic.

Speeds. Traffic speeds in an urban grid of streets with signalized intersections are affected primarily by "signal offset" timing rather than traffic volume except when volumes or rates of flow approach capacity. The anticipated average speed of all non-transit vehicles on downtown Portland streets is close to 15 mph in the peak and midday travel time because the signals are timed for progressed movement at that speed. Actual average speeds can be lower because of traffic interference. There are no significant differences in the degree of traffic interference with or without the Mall, so there is no significant difference in average non-transit vehicle speeds either all day or in peak hours for both systems.

Traffic Congestion. Generally, with or without the Mall, no intersection in the CBD operates at volumes nearing capacity except those listed above in the observations of the system. The few afternoon peak hour traffic congestion points in downtown become less congested without the Mall, but all other streets experience "average" conditions with or without the Mall. Of particular note is the reallocation of 10,000 vehicles per day from Front Street to other CBD streets thereby reducing its level of congestion.

Parking and Local Access. From the imposition of the parking lid in 1975 to 1980, the downtown parking supply has remained fairly constant. The provision of new spaces has offset the loss of others. While the number of parking spaces has remained stable, their location has altered due to public and private actions. There has been a significant reduction in the number of dispersed curb spaces with corresponding increases in centralized off-street parking in private and public garages. This has increased the number of spaces in some downtown areas, particularly near the retail stores, as has been intended by the Downtown Plan. The Transit Mall required the removal of 308 curb parking spaces but these have been replaced by the retail-oriented public parking garages on Morrison Street. Although the Mall has eliminated parking right on the Mall streets, it has not adversely affected the number of parking spaces.

The changes in loading and access with the Mall were the greatest for those businesses and institutions on 5th and 6th Avenues that depended solely on sidewalk deliveries and a curbside loading zone. A few buildings have no frontage on a cross-street. These merchants are now required to hand-cart goods to and from new loading zones on the nearest cross-street. In no case is this distance greater than 100 feet. Most businesses facing the Mall also have 100 feet of frontage on an east-west cross-street. In these cases, placement of a loading zone was less important. Several relocated their sidewalk elevators to a side-street location. Two of the three department stores on 5th Avenue which loaded goods on Alder Street between 5th and 6th, created conditions that interfered with pedestrian use of the sidewalk. Both stores now operate more of their loading activity in the off-peak time and have developed warehousing outside of the CBD.

Delivery of bulky goods such as office furnishings and heavy machinery are allowed under a special permit that makes it possible for a van to operate and park on the Transit Mall during nighttime hours. Drop boxes used for collecting building remodeling waste are allowed special permits for placement on the Mall sidewalks. The boxes are dropped off and picked up during nighttime hours. Collection of ordinary refuse is at the cross-street loading zones adjacent to the Mall. Without the Mall, none of these provisions would be necessary. Restriction of loading to nighttime hours and cross-street loading zones has imposed some minor added costs for downtown businesses and buildings on and near the Mall.

Traffic Accident Experience

A fundamental objective of the Transit Mall design was to separate downtown bus traffic from other vehicles. This was to be achieved without producing an increase in the occurrence of accidents. Also, the Mall reflected particular attention to minimizing possible conflicts between buses and pedestrians, both of which are concentrated by the Mall onto the same two streets.

Tri-Met's study evaluated the effect of the Mall on accident occurrence downtown. The evaluation distinguished between different types and severity of accidents as well as the frequency. Data for both before-Mall (1975) and with-Mall (1980) situations were available.

Table 3 summarizes the accident characteristics of 4th, 5th, 6th, and Broadway before and after the Portland Transit Mall became operational. The data in the table has been organized to highlight changes in type, severity and frequency of traffic accidents from 1975 to 1980. Following are some of the more significant observations about the data in the table:

TABLE 3

TRAFFIC ACCIDENTS ON 4th, 5th, 6th, AND BROADWAY
(Burnside to Madison)

	Percent Change from 1975 to 1980					Number of Accidents	
	Non-Mall Streets		Mall Streets				
	4th	Broadway	5th	6th	Total (All Four Streets)	Total (All Four Streets) 1975	1980
Total Accidents	-40%	-47%	-60%	-54%	-50%	188	94
Bus Involved	-	-	-33.4%	+50%	-25.9%	27	20
Bus Not Involved	-28%	-46%	-74%	-71%	-54%	161	74
Auto/Auto	-40%	-43%	-81%	-78%	-56%	147	65
Auto/Pedestrian	-50%	-66.7%	-	-50%	-64.3%	14	5
Property Damage Only	-23%	-43.6%	-63%	-62.2%	-48.4%	128	66
Injury	-75%	-55%	-50%	-36.8%	-52.5%	59	28
Accident Rate[1]	-36%	-48%	-30%	+108%	-20%	1.85	1.48

Vehicle Miles	1975	27,184,689	27,072,999	20,814,745	25,899,597	100,972,030
	1981	25,797,762	37,136,216	6,346,620	5,765,175	65,035,773

[1]Accident rate represents the number of accident occurrences per million vehicles miles traveled between Madison and Burnside on each of the above streets.

Source: Tri-Met Transit Effects Report

- Total combined accidents on 4th, 5th, 6th, and Broadway showed a 20 percent decrease between 1975 and 1980. When the reported accident rates are related to traffic volumes, the decrease becomes smaller, but a statistically significant drop in the frequency of occurrence is still indicated.

- Total bus-involved accidents decreased 30 percent over the four street area, even though the 1980 bus volumes on the two Mall streets were greater than those on 4th, 5th, 6th and Broadway in 1975.

- Both property damage and injury accidents declined, 48 and 53 percent, respectively, between 1975 and 1980, with a proportionally greater decline in injury accidents.

- Both 4th and Broadway experienced decreases in accident occurrences. This decline resulted not only from the expected elimination of bus-involved accidents, but from a drop in all types of automobile related accidents as well. When comparing accident rates, the decrease on Broadway is statistically significant.

On 5th and 6th Avenues it should be noted that the opportunity for bus/auto collisions still exists at intersections, along auto access lanes on both streets, and for conflicts between pedestrians and buses or autos at intersections. The findings of the accident data compilation for the Mall streets are:

- Total accidents on 5th and 6th declined substantially between 1975 and 1980. However, the traffic volumes on both streets also decreased dramatically so that when accidents were compared to volumes, the frequency

of accident occurrences (accident rate) actually increased on both streets. The increase in the rate of accident occurrences on 6th is statistically significant.

- Bus-involved accidents decreased on 5th Avenue while they increased on 6th. However, from 1975 to 1980, 5th Avenue bus volumes increased by 88 percent during peak hours and 70 percent during daytime (non-peak) hours while on 6th Avenue, peak hour bus volumes increased sevenfold and daytime volumes more than five-fold. On both streets, over 80 percent of bus-involved accidents in 1980 were between bus and automobile.

- Although injury accidents on 6th Avenue decreased between 1975 and 1980, they comprised almost half of total accidents on 6th in 1980.

Conclusions from Traffic Effects Findings

The analysis was only as complete as permitted by the analytical limitations of the traffic models utilized.

Traffic Circulation. Total miles traveled would rise 4.9 percent and the number of vehicles entering and leaving downtown would rise 2.3 percent without the Transit Mall. Those intersections congested in peak travel times under Mall conditions would see substantial improvement without the Mall due to traffic rerouting, but overall traffic speeds would be unlikely to change without the Mall.

Transit. The Mall has concentrated bus volumes onto fewer streets, especially the Mall streets, producing a 10 percent decrease in downtown bus miles of travel. The Mall's concentration of bus routes to the most intensely developed

office and retail sector of downtown has decreased average walking distances of bus patrons by 158 feet, a 45 second saving. There is also a claim of a 1.8 percent increase in CBD bus patronage with the Mall. The simulated bus speed differences between with- and without-Mall conditions are not confirmed by Tri-Met's measurements of bus speeds on the Mall versus cross-Mall routes, however.

Pedestrian Circulation. The Mall has concentrated pedestrian activity to the Mall area and nearby portions of cross-streets as opposed to the more even distribution of pedestrian volumes to most downtown streets without the Mall.

Parking and Local Access. Parking supply has shifted from the more dispersed on-street parking with the Mall. Loading of goods has become a problem of varying degree to merchants located on the Mall because of their varied adaptability to side-street loading zones and nighttime hours.

Traffic Accident Experience. The drop in total accidents and the accident rate for the Mall streets and adjacent streets from 1975 to 1980 indicates that the Mall has had a positive impact. Possible reasons for this are:

- Separation of the major bus concentration from general traffic;
- Elimination of through traffic on 5th and 6th Avenues, thereby reducing the demand for turns to these avenues from cross-streets;
- Concentrating pedestrians on the Mall streets where traffic turning movements are fewer in number.

SECTION 5
PERCEPTIONS AND MEASUREMENTS OF MALL IMPACTS

Assessment of the Mall and its Impacts

This section of the final report presents findings and conclusions drawn from several of the component reports, which analyzed various aspects of the Mall. First, the Mall is evaluated in an overall sense, then as a physical environment. Subsequent sections deal with the social environment, crime and safety, and noise and air pollution.

A Dualistic Approach to the Assessment

In evaluating the Mall, two different approaches to assessment were employed. The first approach determines the attitudes toward the Mall of various groups of people. Questionnaires were used to obtain the perceptions of the Mall held by three populations or types of people found within the downtown: (1) pedestrians interviewed on the Transit Mall who drove and parked downtown for reasons other than work, (2) downtown transit users who are not downtown workers, and (3) downtown employees. These three non-overlapping populations constitute all potential users of the Transit Mall. Hereinafter, they will be referred to as the (1) pedestrians, (2) transit riders, and (3) downtown employees. The questionnaires, which dealt with attitudes, opinions and travel behavior were reported and analyzed in three reports which corresponded to the three types of sample populations. The Pedestrian/Parking Survey was prepared by the Portland Bureau of Planning, the transit rider survey is contained in the Transit Effects Report prepared by Tri-Met, and the Downtown Employee Survey was prepared by the Center for Urban Studies at Portland State University. A fourth source of personal opinions used in the study is the survey of downtown business leaders which formed the basis of the Impact of the Transit Mall on Downtown Revitalization prepared by the Center for Urban

Studies. Those structured interviews recorded some general attitudes of business people about the nature of the Mall and its influence on the downtown economy. These four reports are used to indicate the perceptions of people regarding the five environmental characteristics--physical, social, safety, noise level and air quality.

In contrast to this compilation of subjective attitudes and perceptions, the Mall Impact Study also included objective measurement. Changes from before-Mall to after-Mall conditions were measured or simulated for pedestrian circulation volumes, reported crime and arrests, noise levels and air quality. These changes are reported and analyzed in the Traffic Effects Analysis prepared by the Portland Bureau of Planning, the Transit Effects Report which contains the crime report, prepared by Tri-Met, and the Noise Impacts Report and Air Quality Impacts Report, both prepared by the Bureau of Planning. Both types of analysis are presented for characteristics of the Mall where compatible evaluation exists. The findings of both perception surveys and the objective measurement studies are compared in this final report.

Overall Subjective Assessment of The Transit Mall

Specific characteristics of the Transit Mall were examined in the surveys of pedestrians, transit riders and employees. These assessments were then compared to the impressions of downtown business leaders.

Respondents to the employee, pedestrian and transit rider surveys were asked to state their level of agreement on a scale of 1 (strongly disagree) through 5 (strongly agree) with the two statements "The Transit Mall is attractive", and "The Transit Mall is an improvement to downtown." Interviewees in the business leaders' survey were asked their general opinions on the Transit Mall and its impact.

The responses (Table 4) indicate a very positive perception of the Mall and its impact on downtown with respect to these overall concepts. The pedestrian respondents were most positive with 88.5 percent agreeing with both statements, followed by 87.2 percent of employee respondents and 86 percent of transit riders. The mean response on the 1 through 5 scale was 4.65, 4.23, and 4.38, respectively, indicating that there was a high level of agreement with these statements.

TABLE 4

Agreement with statements, "The Transit Mall is attractive," and "The Transit Mall is an improvement to downtown."

	Percent Agreement*	Mean Response*
Employees	87.2%	4.23
Transit Riders	86.0%	4.38
Pedestrians	88.5%	4.65

*Percent responding "agree" or "strongly agree"

**1 = strongly disagree
2 = disagree
3 = neutral
4 = agree
5 = strongly agree

Responses did vary somewhat within each survey by type of respondent, but all the figures remained high. For example, in the pedestrian survey, 83 percent of respondents over 55 years of age agreed that the Mall is attractive (and 11 percent found it unattractive) compared to 97 percent of those between the ages of 35 and 54.

Impressions of Business Leaders. Business leaders interviewed agreed that the Transit Mall was an extremely important component in the revitalization of downtown Portland. Virtually all of the respondents evaluated the

Mall in highly positive terms, noting that the Mall had "given a lift" to the city; that it had given the downtown a sense of quality previously lacking; that it was a visible sign of revitalization being undertaken which helped convince investors that downtown was a good location; that it increased the attractiveness of downtown which impacted core area real estate values; and that there was a ripple effect on surrounding streets. Yet, a number of criticisms were raised related to the encouragement of vagrancy, the increase in noise, dirt, air pollution and automobile congestion, and an over-reliance on the Mall to solve other downtown problems. Thus, there was an overwhelming approval of the general nature of the Mall and its impacts on downtown. However, there was also a degree of concern with the Mall's impacts by a small number of respondents.

Perceptions of the Physical Environment

The public's subjective perception and evaluation of the physical environment created by the Mall was expressed in the survey responses. The most detailed investigation of the Mall's physical appearance was undertaken in the employee survey.

The employee survey respondents were required to express their level of satisfaction with elements of the Mall's physical appearance. On a scale of 1 (highly dissatisfied) through 5 (highly satisfied), respondents were quizzed on their opinions of the widening of the sidewalks, the artwork, and the appearance of the covered bus shelters. The results showed that 80.3 percent of respondents were satisfied with these elements, 12.2 percent were dissatisfied and 7.5 percent were neutral.

As was apparent in the overall assessment of the Transit Mall, business leaders are generally very satisfied with

the appearance of the Mall. The appearance was mentioned almost unanimously as a benefit of the Mall because of the quality of its design, the brickwork, greenery, sculpture, fountains and kiosks. Most respondents thought the Mall was well maintained but a few felt it was dirty and, consequently, not an attractive place.

Evaluation of the Social Environment

Evaluation of the social environment created by the Transit Mall is somewhat more detailed than assessment of its physical environment. Two elements of the social environment are examined: People, indicating the type of social interaction that can take place on the Mall, and activities, indicating the type of activities that can be conducted on the Mall.

Perceptions of Social Interaction of People on the Mall.

The employee survey asked respondents for their level of satisfaction with vendors on the Mall, and the concentration of people and activities. On the scale of 1 (highly (dissatisfied) through 5 (highly satisfied), the mean response was found to be 3.57. When the percent distribution of responses is considered, those satisfied comprised 66 percent, as compared to 13.9 percent dissatisfied, and a fairly large neutral group of 20.1 percent. Thus, a sizeable majority is either satisfied with or not adverse to the concentration of people and activities that occur on the Mall.

Each of the three surveys--pedestrian, transit rider and employee--asked respondents for their level of agreement with the statement that the Mall sidewalks are crowded. Crowded sidewalks are interpreted here to be indicative of people's comfort with the social interactions they are exposed to on the Mall. People are likely to feel more crowded in environments where they are uncomfortable with the occurring social interactions.

The results of the three surveys are somewhat different. Respondents to both the transit rider and employee surveys showed a mean response of 3.5 on a 1 through 5 scale (with 5 representing strongly agree). In comparison, respondents to the pedestrian survey had a mean score of 2.8, indicating that they disagreed that the sidewalks are crowded.

Of transit rider survey respondents, 56.8 percent indicated agreement that the Mall sidewalks are crowded, compared to 49.4 percent of the respondents to the employee survey. In contrast, only 36 percent of pedestrian respondents agreed that the sidewalks are crowded. Those respondents least comfortable with crowding levels on the Mall appear to be people on the Mall during peak travel hours, such as transit riders, suburban residents and women.

Perceptions of Activities Occurring on the Mall. To determine attitudes toward the types of activities that occur on the Transit Mall, pedestrian, transit rider, and downtown employee respondents were asked to react to statements such as "The Mall is a good place to sit and relax." Reactions in all three surveys were most positive toward the Mall as a shopping place, and less so for activities. These perceptions are shown in Table 5.

The responses to the statement "The Mall is a good place to shop" indicate a very positive opinion by all respondents that the Transit Mall provides an activity space that is conducive to shopping. The lower rating by employees may be because they are more of a captive audience.

The response pattern to the statement "The Mall is a good place for entertainment" was not as positive as that for shopping and varied more by type of respondent. Pedestrians, those individuals who drove downtown for reasons other than

work, are more likely to express an opinion that the Mall provides a good place for entertainment. A large portion of employees and transit riders are neutral on this issue. In each survey, respondents were asked to evaluate the Mall as a place to sit and relax. Transit riders and pedestrians are in agreement that the Mall is a good place to sit and relax, more so than employees.

TABLE 5

PERCEPTIONS OF ACTIVITIES ON THE TRANSIT MALL

Statement	Percent Agreement	Mean Response
"The Mall is a good place to shop."		
Employees	54%	3.8
Transit Riders	74%	4.1
Pedestrians	80%	4.1
"The Mall is a good place for entertainment."		
Employees	29%	2.8
Transit Riders	32%	2.8
Pedestrians	46%	3.3
"The Mall is a good place to sit and relax."		
Employees	29%	2.5
Transit Riders	46%	3.2
Pedestrians	46%	3.2

*Percent responding "agree" or "strongly agree"

**1 = strongly disagree
2 = disagree
3 = neutral
4 = agree
5 = strongly agree

Overall, the respondents to all three surveys indicated they were in agreement that the Mall is a good place for shopping. The other two activities--entertainment and a place to sit

and relax--had a mixed pattern of responses. Pedestrians were more in agreement than employees or transit riders that the Mall is a good place for entertainment.

Impressions of Business Leaders. Among business leaders the food and flower vendors on the Mall were widely praised for creating "a lively urban scene". The effect of the Mall on pedestrian movements was seen as a further benefit since it created a "center of gravity" in the core of downtown bringing more action to the retail and office facilities. The increase in pedestrian traffic was seen to be a benefit to certain types of retailing which require high volume, drop-in commuter sales. However, these qualities of the Mall were viewed as negatively impacted by the concentration of people and activities on the Mall streets that had resulted from construction of the Mall. One respondent noted there was a basic incompatibility between bus-waiting crowds and pedestrian shopping traffic, a negative perception of the social environment created by the Mall. In general, however, it appears that both business leaders and the three survey respondent types view the type of activities that occur on the Mall, and which it encourages, to be fairly positive assets of the Mall and part of the variety of a healthy downtown.

Simulation of Pedestrian Movements on the Mall. An indication of how the Transit Mall has actually influenced the numbers of people found on the Mall is given by the pedestrian circulation simulation reported in the Traffic Effects study. The pedestrian circulation analysis does not examine the type or amount of interaction between individuals, but provides a quantified context in which to assess the perceptions of Mall crowding levels identified in the pedestrian and transit rider surveys.

The Transit Mall has focused pedestrian activity on the Mall streets. Bus rerouting has produced a larger proportion of downtown bus stops on the Mall. Thus, under Transit Mall conditions, an average of 13 passengers get on or off each bus at each stop on the Transit Mall during the afternoon rush hour. Consequently, approximately 600 people per hour board or alight from buses on each block of the Transit Mall during the afternoon rush hour. Since bus patrons represent 75 percent of total pedestrian volumes on the Mall during the rush hour, approximately 800 persons per hour pass along any block of the Transit Mall during the peak, compared with 600 persons per hour on Mall blocks at midday. By comparison, non-peak pedestrian volumes on other streets downtown are generally between 100 and 400 persons per hour along any one sidewalk, except within the primary blocks of the retail core centered on 5th and Morrison, where volumes are higher.

In the absence of the Mall, the distribution of buses per hour on the streets of the downtown core would have produced only 4 persons boarding or alighting from each bus per stop on the two Mall streets during afternoon peak travel times, according to the simulation of traffic movements used in the Traffic Effects Report. Consequently, hourly pedestrian volumes on non-Mall streets would increase by an average of 125 to 150 people in the peak hour, while on 5th and 6th Avenues the peak-hour pedestrian volumes would be reduced by about 33 and 66 percent respectively. Thus, without the Mall, there would have been a shift of hourly and peak hour pedestrian volumes away from the two Mall streets to 3rd, 4th and Broadway, and several east-west cross streets. The Mall has definitely increased pedestrian concentrations on 5th and 6th Avenues thereby increasing the level of social interaction on those streets over before-Mall conditions. This should be borne in mind when observing that gererally, respondents to the surveys were satisfied with the concentration of people, vendors and activities on the Mall.

Crime and Personal Safety on the Mall

The success and the vitality of a downtown or public places in general is likely to be dependent on how safe it is. Evaluation of the safety of a place can be assessed by measuring the perceptions of persons or by examining available data relating to reported crime and arrests. Perceptions are likely to be a stronger influence on the willingness of a person to be in an area than are published data.

Perceptions of Personal Safety on the Mall. The Pedestrian Survey, Transit Rider Survey and Downtown Employee Survey all included two questions that provide insight into the perceptions that respondents have about their safety on the Transit Mall. Respondents were asked for their reaction (recorded on a scale of (1) strongly disagree to (5) strongly agree) to the statements "The Mall is safe" and "The Mall is a good place to walk." Opinions about how "good" a place is to walk in are arguably influenced by how safe one perceives the area to be. There is a high correlation between responses to the two questions, which indicates they are addressing the same underlying concept.

The results indicate that the Mall is perceived as safer by pedestrian and transit rider respondents, than by employee respondents. The percent of responses agreeing with the statements and the mean responses on the 1 to 5 scale are shown in Table 6.

Stratification by type of transit rider respondent showed little variation in response patterns to "The Mall is safe" statement. Stratification by type of pedestrian respondent showed greater variation in response patterns. Types of pedestrians showing higher rates of agreement with the statement "The Mall is safe" were the 35-54 age group, males and City of Portland residents.

TABLE 6

PERCEPTIONS OF PERSONAL SAFETY ON THE TRANSIT MALL

Statement	Percent in Agreement*	Mean Response**
"The Mall is safe."		
Employees	36%	2.9
Transit Riders	47%	3.3
Pedestrians	65%	3.7
"The Mall is a good place to walk."		
Employees	69%	3.8
Transit Riders	75%	4.0
Pedestrians	88%	4.5

* Percent responding "agree" or "strongly agree"

** 1 = strongly disagree

2 = disagree

3 = neutral

4 = agree

5 = strongly agree

Stratification by type of employee respondent showed that women and employees having worked downtown between 4 and 10 years, were the groups showing the largest disagreement with the statement "The Mall is safe" (40.2 and 42.4 percent respectively). Males and employees having worked downtown less than 4 years were the groups showing smaller disagreement--32.3 and 32.7 percent respectively. In general, employees may be more negative about Mall safety than pedestrians because they may be forced to interact with more people than pedestrians while waiting for buses during peak travel periods.

The statement "The Mall is a good place to walk" was received more favorably in general, as shown in Table 6. This high level of agreement indicates that in practical terms the Mall functions well as a pedestrian pathway. Although other factors besides personal safety undoubtedly influence people's positive perception of the Mall as a place to walk, their perceptions are not being significantly tainted by a serious personal safety threat. Thus, in evaluating Mall safety perceptions in a more indirect "applied" manner rather

than through direct questioning, a more positive overall perception is identified.

Among pedestrians, there was more agreement that the Mall is a good place to walk than was found in the transit rider survey. The overall agreement for pedestrians was 88 percent. The 55 and over age group is in less agreement (83 percent) and suburbanites are most in agreement (91 percent). Analysis of agreement with "The Mall is a good place to walk" indicates a high rate of use and enjoyment of the Mall for the middle aged group if they are pedestrians who have driven downtown as opposed to being transit riders who are on the Mall to wait for a bus.

Employees are the least positive overall, with only 68.6 percent being in agreement that the Mall is a good place to walk. Those disagreeing make up 18.4 percent--slightly more than in the transit rider's survey. Variation from the overall response pattern was not significant. The high degree of consistency among all employee respondents indicates that in general, employees hold a more negative perception of the Mall environment than the other two populations. Nevertheless, a majority of respondents agreed that the Mall is a good place to walk.

The employee survey covers the perception of Mall safety in more detail than the other two surveys by adding two additional questions. Respondents were asked to state their degree of satisfaction on a scale of 1 (dissatisfied) to 5 (satisfied) with the safety of the Mall at night from possible criminal acts, and (the level of) harassment on the Mall by individuals other than solicitors.

The results are less positive toward the safety of the Mall than the "good place to walk" statement or the "Mall is

safe" statement. Nearly 49 percent of respondents were dissatisfied with the safety of the Mall at night from possible criminal acts, and 47.6 percent were dissatisfied with the level of harassment on the Mall. The mean responses 2.46 and 2.54, illustrate the level of dissatisfaction. When questioned about specific threatening activity, the perceptions become much more negative than those identified from reactions to the statements "The Mall is a good place to walk" or a "safe place" in general. However, a large percentage of respondents were neutral, 37 and 35 percent of all respondents, for the night criminal activity and harassment statements, respectively. This may reflect lack of knowledge of nighttime conditions, because 80 percent of employee respondents leave the Mall before the end of the afternoon peak travel time.

When the employee respondents were stratified by demographic characteristics three groups differed notably from the overall response pattern for satisfaction with safety from criminal acts. They were respondents with household incomes below $14,999 per year (53.8 percent of whom were dissatisfied) and females (55.4 percent dissatisfied). Males and non-whites had the highest levels of satisfaction. The dissatisfied seem to have different perceptions of what constitutes a threat to their person, and/or may usually be on the Mall at different times of the day.

With regard to the question of harassment from other individuals, the groups where distributions varied notably from the overall response pattern consist of several of the same groups identified previously. Females, low income households, employees working near the Transit Mall and employees who have worked downtown between 4 and 10 years were most dissatisfied (over 50 percent). Males were the least dissatisfied (41.2 percent). Although some of these

groups may feel less threatened by personal danger or being in contact with individuals likely to harass them, specific reasons for the variations are hard to discern. Further, the similarity between the response distributions in so many categories complicates interpretation. It is clear, however, that a consistently large proportion of employee respondents are dissatisfied with the safety level on the Mall related to specific activities. Yet, an equally large proportion are neutral on the issues or even, to a small degree, satisfied with their personal safety on the Mall.

Perceptions of Business Leaders. The opinions of business leaders regarding the existence and significance of crime on the Mall were identified in the Downtown Revitalization report. Interviewees were asked to discuss the problems they saw with the Mall. "Vagrancy" and "crime" were the most frequently mentioned Mall problems, although those most familiar with other major cities felt the problems were minor. No specific criminal activity except alleged drug-dealing was mentioned by respondents. Most of the concern related to dislike of "vagrants", "shabbily dressed people" and "a poor quality person" for whom business leaders felt the Mall acted as a magnet. Interviewees felt that such persons discouraged middle-class shoppers, especially women, who would view them as a threat to their personal safety.

Business leaders' perceptions of personal safety on the Mall are more negative than found in the transit rider, pedestrian, and employee surveys. Business leaders are concerned with the safety perceptions of these groups, who constitute the market for retail businesses located on the Mall.

The Measurement of Crime on the Transit Mall. A comparison of before-Mall (1975) and after-Mall (1980) crime statistics for downtown Portland was undertaken by Tri-Met and is

included in the Transit Effects Report. The analysis provides insight about criminal activity patterns that may have been influenced by the concentration of pedestrian traffic created by the Mall.

Crime statistics were examined for five north-south block strips centered on the Mall. Data for the strips were compiled from "Offense by Grid" tables supplied by the Planning and Research Division of the Bureau of Police, City of Portland. These crime statistics have limited utility to the Mall study because offenses occurring in street rights-of-way are not included.

Perceived Safety and Crime Statistics. In the case of criminal activity, there seems to be a difference between the threat to personal safety that questionnaire respondents perceive and the picture of criminal activity on the two Mall streets presented in the crime statistics report. Roughly one-half of the respondents view the Mall as a fairly safe place, and most believe it to be a good place to walk. Crime statistics, however indicate that the number of criminal incidents in the Mall vicinity are lower, but higher on the Mall blocks proper.

This comparison between perceived safety on the Mall and recorded criminal activity could indicate that the crimes occurring near the Mall are not perceived by people using the Mall as a serious threat to their personal safety. Also, the difference may indicate that the crimes are being committed in buildings and at times when the Mall is not busy, that is, outside regular office and retail hours. The Mall streets have the largest pedestrian volumes during the travel peaks and during lunch hours, and this particular image of the Mall (which may be less threatening than its nighttime image) could be the one held by the majority of

the respondents. Such an explanation is supported by employee survey responses, which indicated more about negative feelings about safety on the Mall at night, and about the problem of harassment, which could be more prevalent during nighttime hours.

Mall and Bus Shelter Perceptions

This section presents: (1) those aspects of the Transit Mall most liked and disliked by the respondents to the Downtown Employee Survey, (2) an evaluation of various attributes of the bus shelters provided on the Transit Mall, (3) a list of aspects of the bus shelter that could be improved, and (4) results of an analysis of variance of attitudes of subgroups of downtown employees.

Transit Mall: Likes and Dislikes. The respondents to the Downtown Employee Survey were asked in an open-ended question to list the aspects they liked most about the Transit Mall and then to list the aspects they disliked most about the Mall.

Table 7 presents the responses to the aspects most liked about the Transit Mall.

TABLE 7

ASPECTS MOST LIKED ABOUT THE TRANSIT MALL BY CATEGORY

	Number of Times Mentioned	Percent of Times Mentioned	Percent of Respondents to this Question Mentioning this Aspect	Percent of Total Sample Mentioning this Aspect
Appearance	1173	40.1%	62% (n=821)	38.9% (n=821)
Transit Facilities	479	16.4%	29% (n=381)	18.0% (n=381)
Accessibility/ Convenience	418	14.3%	29% (n=383)	18.2% (n=383)
Transit Service	374	12.8%	22% (n=289)	13.7% (n=289)
Activities/ People	330	11.3%	20% (n=265)	12.6% (n=265)
Traffic	154	5.3%	11% (n=145)	6.9% (n=145)
No Response				37.1% (n=783)
Totals	2928	100.0% (n=1326)	(n=1326)	(n=2109)

Table 8 presents the responses to the aspects most disliked about the Transit Mall.

TABLE 8

ASPECTS MOST DISLIKED ABOUT THE TRANSIT MALL BY CATEGORY

	Number of Times Mentioned	Percent of Times Mentioned	Percent of Respondents to this Question Mentioning this Aspect	Percent of Total Sample Mentioning this Aspect
Environmental Quality	520	22.7%	30.4% (n=368)	17.4% (n=368)
People/ Activities	519	22.7%	31.2% (n=377)	17.9% (n=377)
Transit Service	329	14.4%	22.8% (n=276)	13.1% (n=276)
Transit Facilities	260	11.4%	19.8% (n=237)	11.2% (n=237)
Crime	183	8.0%	13.0% (n=157)	7.4% (n=157)
Accessibility/ Convenience	180	7.9%	14.7% (n=178)	8.4% (n=178)
Traffic/Parking	170	7.4%	12.4% (n=150)	7.1% (n=150)
Appearance	126	5.5%	10.0% (n=121)	5.7% (n=121)
No Response				42.6% (n=899)
Totals	2287	100.0% (n=1210)	(n=1210)	(n=2109)

With respect to the categories utilized to detail the likes and dislikes the significant results are:

- The appearance of the Transit Mall was by far the most liked aspect, accounting for over 40 percent of the total number of responses and mentioned at least once by 38.9 percent of all respondents. Correspondingly, the appearance was cited as being disliked by only 5.7 percent of all respondents;

- Transit service and facilities were both liked and disliked. Over 29 percent of the liked responses were related to transit, and 25 percent of the total disliked responses cited transit-related aspects;

- The category related to People/Activities on the Transit Mall was mentioned as the aspect disliked by more respondents than those citing this aspect as a factor they liked about the Mall;

- The category of accessibility was cited by approximately twice as many individuals as being an aspect they liked about the Transit Mall than those who indicated a dislike;

- Environmental Quality was listed as the aspect disliked by over 17.4 percent of all respondents and accounted for 22.7 percent of items mentioned as being disliked.

Evaluation of Bus Shelters. Table 9 indicates six aspects of the bus shelters were rated as adequate or very adequate by 70 percent or more of the respondents: (1) the distribution of shelters, (2) attractiveness of shelters, (3) ease of identifying bus stops by symbols, (4) ease of using TV monitors, (5) usefulness of TV monitors in providing adequate bus schedule information, and (6) protection from rain. In addition, two other aspects of the bus shelters--usefulness of maps in determining appropriate bus routes and ease of using route maps--were rated as adequate or very adequate by 60 percent. This positive rating of these items would indicate that these design elements of the bus shelters have been successfully implemented.

TABLE 9

ASSESSMENT OF ATTRIBUTES OF BUS SHELTERS BY DOWNTOWN EMPLOYEES

	VERY INADEQUATE	INADEQUATE	NEUTRAL	ADEQUATE	VERY ADEQUATE
DISTRIBUTION					
(a) distribution of bus shelters	.5	4.3	10.1	51.9	33.2
ATTRACTIVENESS					
(a) attractiveness of bus shelters	1.6	3.7	18.3	41.6	34.8
SYMBOLS AND MAPS					
(a) ease of identifying bus stops by symbols	2.3	4.8	17.3	39.5	36.1
(b) usefulness of route maps in determining appropriate bus routes	3.6	8.8	23.4	39.6	24.7
(c) ease of using route maps	5.1	11.4	23.4	38.5	21.6
TV MONITORS					
(a) ease of using TV monitors	1.9	4.8	19.6	45.5	28.2
(b) usefulness of TV monitors	2.4	6.5	17.6	43.3	30.2
(c) amount of time TV monitors are in working order	4.4	14.8	30.9	38.2	11.8
PROTECTION FROM INCLEMENT WEATHER					
(a) protection from rain	2.8	11.3	8.8	50.6	26.5
(b) protection from cold	10.0	30.5	23.3	28.0	8.1
SEATING					
(a) amount of seating	19.1	46.8	17.2	14.9	2.0

The distribution of the bus shelters within the Transit Mall seems to have met with overwhelming approval. The design of the bus shelters seems to be attractive to the vast majority of downtown employees. The respondents rate the adequacy of using symbols to identify different route sectors of the overall transit systems positively. Also, the TV monitors which provide information concerning arrival and departure data for specific buses, is rated positively in terms of usefulness and ease of use. Finally, the adequacy of the bus shelters in providing protection from the rain received a high rating.

On the other hand, some aspects of the bus shelters have not been rated as adequate by more than the majority of the respondents. While the TV monitors were rated high on their ease of use and usefulness in providing information, the amount of time the TV monitors were working was thought to be adequate or very adequate by only 50 percent of the respondents. Also, only 36.1 percent of the respondents indicated that there was adequate protection from the cold provided by the bus shelters. Finally, just 16.9 percent of the respondents stated that the amount of seating provided by bus shelters was adequate.

Improve Usefulness of Transit Mall Bus Shelters. The respondents to the Downtown Employee Survey were asked to list anything they thought that could be done to improve the usefulness of the bus shelters on the Transit Mall.

Table 10 shows that 601 respondents answered this question. These 601 respondents represent 40 percent of the 1500 individuals who indicated that they used the transit system for trips to or from the Transit Mall.

Sixty percent of the respondents to the section on bus shelters did not provide any suggestions for improving

TABLE 10

SUGGESTIONS TO IMPROVE USEFULNESS
OF TRANSIT MALL BUS SHELTERS

	Number of Times Mentioned	Percent of Times Mentioned by Respondents to Improve Usefulness	Percent of Times Mentioned by Total Respondents
Provide more seating	211	35.1%	14.1%
Provide more protection from inclement weather	115	19.1%	7.7%
Provide larger shelters	70	11.7%	4.7%
Make maps easier to read	44	7.3%	3.0%
Keep TV monitors working	41	6.8%	2.7%
Provide more accurate description of bus routes	25	4.2%	1.7%
Keep bus shelters cleaner	23	3.8%	1.5%
Provide more shelters	22	3.7%	1.4%
Prevent vandalism	21	3.5%	1.4%
Make bus stops easier to distinguish	17	2.8%	1.1%
Provide printed schedules	12	2.0%	.8%
Total Times Mentioned	601	100%	59.9%
No Response	899		

the usefulness of the bus shelters. Of those 40 percent who did respond to this question, 35.1 percent indicated a need for more seating, 19.1 percent stated a need for more protection from inclement weather and 11.7 percent said the shelters need to be larger. The remaining responses were spread over a variety of suggestions.

Analysis of Variance: Attitudes of Subgroups. A set of indexes was constructed to analyze differences in attitudes among subgroups within the total sample of downtown employees. The indexes allow the summation of various attributes used to measure a comprehensive range of attitudes toward the

Transit Mall into a single score. The nine indexes constructed for this analysis were:

- Overall Evaluation - measuring a comprehensive viewpoint of the Mall without considering specific components.

- Aesthetic Design Features - measuring specific components of the physical design aspects of the Transit Mall.

- Place for Conducting Activities - measuring the ability of the Mall to provide an environment conducive to various activities.

- Social Interaction - measuring the types of interpersonal activities conducted on the Mall.

- Personal Safety - measuring the feeling of personal safety in the Transit Mall environment.

- Environmental Quality - measuring the level of environmental quality found on the Transit Mall.

- Ease of Travel by Transit - measuring the ability of transit facilities on the Mall to efficiently and effectively produce movement of transit passengers.

- Utility of Transit Information - measuring the effectiveness of the transit information system provided on the Transit Mall.

- Pedestrian/Transit Interaction - measuring the interaction between pedestrians and transit as facilitated by the Transit Mall.

To test for differences among subgroups of downtown employees, the total sample was disaggregated into the following set of subgroups: (1) Sex: male, female; (2) Household Income: low--0 to $14,999, middle--$15,000 to $34,999, high--$35,000 plus; (3) Age: young--18 to 34 years of age, middle--35 to 54 years of age, older--55 years of age and over; (4) Place of Residence: city, suburb, outside metropolitan area; (5) Number of Years Worked Downtown: 0 to 3 years, 4 to 10 years, 11 years plus; (6) Location of Firm of Employment: Zone One (less than one block to Mall), Zone Two (one to two blocks), Zone Three (three or more blocks); (7) Mode of Transportation: auto, carpooling, transit, mixed mode.

To test for statistical differences among the separate cagegories in each subgroup, an analysis of variance was performed for each subgroup. The analysis of variance statistical procedure tests the null hypothesis that no differences exist between the means of the various categories within each subgroup.

The results of the analyses of variance for the various subgroups show:

- For the five indexes that received a positive ranking from the total sample--Overall Evaluation, Ease of Travel by Transit, Social Interactions, Aesthetic Design Features, and Utility of Transit Information--females ranked the first four indexes more positively than did males;

- Female respondents were slightly positive about the Mall as a Place for Conducting Activities, while males were slightly negative about this attribute;

- For the three indexes that received a negative ranking from the total sample--Pedestrian/Transit

Interaction, Personal Safety and Environmental Quality--males were less negative than females;

- Subgroups based on household income exhibited almost no differences in their ranking of the indexes, the major exception was that the low-income group was slightly more positive than the middle or high-income group with regard to the Mall as a Place for Conducting Activities;

- The younger the age group the more positive the ranking for Aesthetic Design Features and Utility of Transit Information;

- The older age group was less negative regarding Environmental Quality and Pedestrian/Transit Interaction than the two other age groups;

- Subgroups based on place of residence showed little difference on their ranking of the indexes, the major exceptions were that residents of the city ranked Overall Evaluation, Aesthetic Design Features, Social Interactions and Place for Conducting Activities higher than suburban residents;

- Respondents working downtown 0 to 3 years rated the Mall more positively on most indexes than those working downtown for a longer period of time;

- Transit riders ranked the transit-related indexes--Ease of Travel by Transit, Utility of Transit Information and Pedestrian/Transit Interaction--more positively than those using other modes for work travel.

Conclusions

Although the Mall is perceived as a success by those who use it, women, older persons, and those downtown employees who have worked downtown for a longer time, are generally less satisfied with the more diverse activities the Mall attracts. These groups tend to be less secure and feel more threatened. by these activities. However, the strength of association of satisfaction and socio-economic groups is not strong. Thus, satisfaction with the Mall and tolerance for diverse activities downtown are largely independent of socio-economic characteristics.

SECTION 6

TRAVEL BEHAVIOR IMPACTS

Travel Characteristics of Downtown Employees

This section reports travel characteristics of downtown employees. It examines the existing patterns of work-related travel behavior and the changes in these patterns between 1978 and 1981.

Table 11 presents the distribution of travel modes used by downtown employees stratified by those socio-economic characteristics that influence mode choice. Choice of mode is influenced by sex, race, age, income, and residential location. Table 12 presents the distribution of travel modes used by downtown employees, stratified by those place of work characteristics that influence mode choice. These are years worked downtown and location of firm in terms of distance to the Mall.

Generally, Tables 11 and 12 indicate the following:

- Females are more likely than males to choose transit (47.3 percent to 34.4 percent) and correspondingly more males than females use auto for work-related trips;

- Over 60 percent of downtown employees in low-income households use transit, while only 26 percent of upper income households use transit;

- Residents of the city are more likely than suburban residents to use transit for work-related trips (49 percent to 38.5 percent) and as distance from the CBD increases the shift is from transit to carpooling;

TABLE 11

MODE OF TRAVEL TO WORK BY

SOCIO-ECONOMIC CHARACTERISTICS OF RESPONDENT

MODE OF TRAVEL	ALL RESPON-DENTS	Sex of Respondent		Race of Respondent		Age of Respondent				Household Income			Residential Location		
		Male	Female	White	Non-White	17-24	25-34	35-54	55 plus	0-14,999	15,000-34,999	35,000 plus	City	Suburbs	Outside Metro Area
AUTO	29.4% (n=607)	41.4%	21.1%	30.3%	16.1%	20.8%	26.5%	34.4%	31.9%	17.5%	28.9%	40.2%	26.8%	32.4%	29.5%
CARPOOL	15.7% (n=323)	14.6%	16.5%	15.9%	14.4%	11.4%	17.7%	19.0%	8.2%	9.4%	17.0%	20.0%	9.5%	17.0%	39.9%
TRANSIT	42.2% (n=868)	34.4%	47.3%	41.2%	53.4%	50.6%	41.7%	35.1%	50.0%	60.8%	41.2%	26.0%	49.0%	38.5%	25.4%
MIXED MODE	12.7% (n=261)	9.6%	15.1%	12.6%	16.1%	17.1%	17.1%	11.4%	9.9%	12.3%	12.9%	13.8%	14.7%	12.2%	5.2%
TOTAL	100% (n=2062)	100% (n=816)	100% (n=1185)	100% (n=1841)	100% (n=118)	100% (n=245)	100% (n=638)	100% (n=700)	100% (n=282)	100% (n=462)	100% (n=804)	100% (n=520)	100% (n=967)	100% (n=896)	100% (n=193)
PERCENT IN EACH CATEGORY		41%	59%	94%	6%	13%	34%	38%	15%	24%	48%	28%	47%	44%	9%

x^2, $p < .001$

TABLE 12

MODE OF TRAVEL TO WORK BY

EMPLOYMENT CHARACTERISTICS OF RESPONDENTS

MODE OF TRAVEL	ALL RESPON-DENTS	Years Worked Downtown			Firm Location		
		0-3 Years	4-10 Years	11+ Years	Zone 1	Zone 2	Zone 3
AUTO	29.4% (n=607)	27.2%	27.2%	37.4%	22.6%	27.6%	41.7%
CARPOOL	15.7% (n=323)	13.0%	19.5%	15.8%	12.3%	17.3%	17.9%
TRANSIT	42.2% (n=871)	46.5%	38.6%	38.1%	53.4%	41.9%	27.6%
MIXED MODE	12.7% (n=261)	13.2%	14.7%	8.7%	11.7%	13.3%	12.7%
TOTAL	100% (n=2062)	100% (N=937)	100% (n=661)	100% (n=449)	100% (n=700)	100% (n=852)	100% (n=503)
PERCENT IN EACH CATEGORY		46%	32%	22%	34%	41%	25%

X^2, $p < .001$

- Employees who have worked downtown for three years or less are more likely to use transit for work trips than employees who have worked downtown longer.

- Walking distance to the Transit Mall is an important determinant of mode choice. The closer to the Transit Mall an employee works, the more likely transit will be used for work-related trips--less than one block, 53.4 percent; one to two blocks, 41.9 percent; and three to four blocks, 27.6 percent.

- The location of an employee's firm with respect to distance from the Mall has a substantial impact across all socio-economic and employment variables. Socio-economic and employment variables were all influenced by the location of a firm. Employees within one block of the Mall were more likely to use transit for work-related trips and this likelihood of choosing transit decreases directly with distance from the Mall, irrespective of age, sex, income, place of residence, and length of time worked downtown.

Table 13 indicates the change of mode (or before- and after-Mall mode use) of employee respondents who worked downtown in both 1978 and 1981. Approximately two-thirds of those using either auto, carpooling or transit in 1978 used the same mode in 1981.

For those respondents who used autos in 1978, 16.1 percent changed to transit by 1981, and 8.4 percent changed to carpooling. Similarly, 18.7 percent of the respondents who carpooled in 1978 had changed to transit by 1981, and 9.4 percent changed to auto. For those using transit in 1978, 10.6 percent changed to auto and 12.4 percent changed to carpooling.

TABLE 13
CHANGES IN MODE USE
1978 to 1981

Mode of Travel for Work in 1978	Mode of Travel for Work in 1981				
	AUTO	CARPOOLING	TRANSIT	MIXED MODE	TOTAL
AUTO	68.8%	8.4%	16.1%	6.7%	100% (n=416)
CARPOOLING	9.4%	67.6%	18.7%	4.3%	100% (n=139)
TRANSIT	10.6%	12.4%	66.9%	10.2%	100% (n=540)
MIXED MODE	16.9%	18.8%	20.1%	44.2%	100% (n=154)

The analysis of travel mode change between 1978 and 1981 indicates the following:

- a decrease in the choice of auto and transit and an increase in the choice of carpooling for work-related trips;
- Approximately two-thirds of the respondents using auto, carpooling or transit in 1978 had not changed modes in 1981;
- Of those respondents changing modes between 1978 and 1981 the major shifts were: auto to transit, 16.1 percent; transit to auto, 10.6 percent; and, transit to carpooling, 12.7 percent;
- Of those respondents using carpooling in 1981 only 41.8 percent used this mode in 1978, 29.8 had used transit in 1978 and 15.6 percent had used auto;

- There was a small net diversion from auto to transit of 200 employees*;

- There was a larger net diversion to carpooling from auto and transit, 780 persons.

- The reasons respondents gave for changing mode were largely related to changes in job, house, or family situations, to some extent related to cost of parking and driving, and only slightly related to transit and Mall improvements.

Travel Behavior Conclusions

Nearness of an employee's work location to the Transit Mall is a major determinant of mode choice. This supports the City's policy of encouraging high density development along the Mall.

On the other hand, there is considerable leakage from transit to carpooling as length of time an employee has worked downtown increases. As employees become acquainted they tend to form ridesharing arrangements. Perhaps Tri-Met should analyze this leakage in ridership to determine what service characteristics cause the flow.

The Mall appears to be a significant influence on new job-holders who work near the Mall. They are more likely to ride transit. This group constitutes a high priority market segment.

*Ten respondents times sampling rate of 20.

SECTION 7

NOISE AND AIR QUALITY LEVELS ON THE MALL

Perceptions of Noise Characteristics of the Mall

The various populations surveyed were questioned only briefly with regard to their opinions on the current noise levels of the Mall. Therefore, perceptions on this characteristic of the Mall, although clear, are not based on detailed analysis.

The Pedestrian Survey, Transit Rider Survey and Downtown Employee Survey all included a statement regarding noise levels on the Mall. Respondents were asked for their level of agreement on a scale of 1 through 5 (with 5 representing strong agreement) with the statement "The Transit Mall is noisy."

Results were similar across the three surveys. The average responses are shown in Table 14. When the pedestrian group was stratified by demographic characteristics, it was found that pedestrians under the age of 35 and women agree in a higher proportion with the statement that the Mall is noisy (75 percent and 72 percent respectively).

TABLE 14

PERCEPTIONS OF THE NOISE CHARACTERISTICS
OF THE TRANSIT MALL

Statement	Percent in Agreement*	Mean Response**
"The Transit Mall is noisy."		
Employees	71%	3.9
Transit Riders	64%	3.7
Pedestrians	69%	3.8

* Percent responding "agree" or "strongly agree"

** 1 = strongly disagree
2 = disagree
3 = neutral
4 = agree
5 = strongly agree

When the employee group was stratified, only three demographic characteristics showed much variation in response to the statement that the Mall is noisy. By age, agreement was greatest in the youngest group (74 percent of those aged 17 through 34), and declined steadily with age groups to include only 60 percent of those over 55 years. The change in distribution of opinions was taken up mostly by the neutral response. By mode of travel to work, those using cars or carpools showed less agreement that the Mall is noisy (64 and 65 percent respectively) than those using transit or mixed modes (74 and 76 percent). The third grouping with significant changes was location of place of work. Those employees in firms located along the Mall or on adjoining streets agreed the Mall is noisy in greater numbers (72 percent) than those working on streets further away (64 percent).

The analysis of subgroups indicates that people who come into contact with the Mall the most are more negative about the Mall. For other categories--household income, years worked downtown, home location, race and sex--the response patterns are fairly similar to the overall distribution of 71 percent agreeing the Mall is noisy, 8 percent disagreeing, and 21 percent being neutral.

The employee survey went on to ask level of satisfaction with the noise created specifically by buses moving through the Mall. The results of this question were that 47 percent of respondents were dissatisfied with bus noise, while 14 percent were satisfied and 38 percent were neutral.

Stratification by demographic characteristics shows that within seven specific groups more than 50 percent of the respondents are dissatisfied with bus noise, these being the 17 to 34 age group (51 percent), commuters using cars,

carpools, or mixed modes (50, 51, and 52 percent), employees having worked downtown between 4 and 10 years (56 percent), employees working in firms located on the two streets paralleling the Mall (52 percent) and those in households earning between $15,000 and $34,999 per annum. Those most satisfied with the level of bus noise were the over 55 age group (20 percent) and those working downtown over 11 years (19 percent), two groups who are perhaps "resigned" to downtown noise.

In the pedestrian, transit rider and employee surveys there was on the average, stronger or equal agreement that the Mall is noisy than for the other environmental complaints raised about the two streets, (such as their being polluted or crowded). This indicates that the majority of users of the Mall find it a noisy place. However, perceptions of the noisiness of buses in particular are found to be less uniformly negative, with a very large proportion of those questioned expressing neutrality on the subject.

Presumably, buses can be largely held to blame for the Mall being perceived as a noisy environment. This view was shared by several of the business leaders who were interviewed for the Impact of the Transit Mall on Downtown Revitalization report. The noise of buses was seen as one of several problems that limit the Mall's effectiveness in aiding the retail sector of the downtown economy.

Measurement of the Noise Impact of the Transit Mall

The purpose of the Noise Impacts Report was to determine what the impacts of the Transit Mall had been on noise levels both on the Mall and on nearby streets. Noise measurements for the relevant streets exist for both the before-Mall and with-Mall environments. Change in noise levels* resulting

*"Noise Level" refers to the weighted sound pressure level as measured by a standard sound level meter and expressed in terms of decibels, symbolized dB, or dBA if weighted.

from the comparison of these two environments was assumed to be directly related to vehicular traffic noise resulting from changing volumes and composition of traffic.

Before-Mall Noise Levels in Relation to Acceptable Standards. The Final Environmental Impact Statement (FEIS) of the Transit Mall developed acceptable noise standards in order to predict the noise impacts of the Mall after its completion on pedestrian conversation, office worker functioning and hotel room sleep. A threshold of noise levels not exceeding 70 dBA more than 10 percent of the time (L_{10} of 70 dBA)* is the limit for conducting a normal conversation without difficulty on the sidewalk. It was found that pedestrians were having difficulty conversing under existing before-Mall conditions, because the L_{10} noise levels exceeded the standard both on and off the Mall more often than not. Thus, the predominant attitude that the Transit Mall is a noisy place (as recorded in the perception of noise sub-section) must be interpreted in light of the findings that pedestrian speech standards were being exceeded before the Mall was built.

The FEIS standard for office worker functioning required that noise levels not exceed 46 dBA for 50 percent of the time to avoid noise disturbance to office workers. Before-Mall measurements taken in buildings located along the Mall streets indicated that in certain "noisiest" locations the noise levels reached 49 dBA when windows were open, thereby occasionally exceeding the standard.

A peak noise level of 45 dBA occurring inside hotel sleeping rooms caused by a transit vehicle passby was established as

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*L_x is the sound level which is exceeded x percent of the time during a measurement period.

the standard for sleep interference in hotels on the Mall. The peak noise level inside a building caused by the passby of a diesel bus is 16 dBA in excess of the standard. Thus, hotel sleep interference existed prior to construction of the Mall.

Since introduction of the Transit Mall would increase the number of buses on the Mall streets, the FEIS predicted that all three standards would continue to be exceeded either to a larger or more frequent extent.

Findings. In using noise measurement in order to compare specific locations at different times, the Noise Impacts Report acknowledges that this is not a common use for such a procedure, and details a series of considerations and assumptions that apply to the use of measured noise level comparisons. Section IV of the Noise Impacts Report contains a detailed account of the procedures followed and the considerations made in comparing the noise level data, which should be considered when reviewing these findings.

The number of occurrences of increases and decreases in noise levels were tallied together in order to provide an indication of what impacts the Transit Mall has had on the noise environment. These occurrences are summarized in Table 15 for both on-Mall and off-Mall locations.

Results of the tallies in Table 15 indicate that noise levels have increased on the Mall during the daytime, peak and nighttime measurement periods. The on-Mall comparisons resulted in equal numbers of noise level increases and decreases during the evening measurement period, making it difficult to determine what noise level changes may have occurred, if any, during evenings under with-Mall conditions.

TABLE 15

SUMMARY OF OCCURRENCES OF L_{eq}* NOISE LEVEL
INCREASES AND DECREASES WITH-MALL
ON-MALL AND OFF-MALL

	ON-MALL						OFF-MALL					
PERIOD	INDIVIDUAL SITE COMPARISONS		AGGREGATED SITE COMPARISONS		TOTAL		INDIVIDUAL SITE COMPARISONS		AGGREGATED SITE COMPARISONS		TOTAL	
	+	-	+	-	+	-	+	-	+	-	+	-
Day	4		1		5	0	1		1		2	0
Peak	4		2		6	0		2		1	0	3
Eve	2	1		1	2	2	2			1	2	1
Night	3		1		4	0	NA		NA		NA	

The tallies of off-Mall comparisons indicate that noise levels have increased during the daytime but decreased during the peak period. The evening period tally indicates by a 2-to-1 margin that noise levels have increased off the Mall. There were no data available for the nighttime period off the Mall.

Overall, the results of the noise comparisons indicate that the Mall is noisier than the before-Mall streets for all measurement time periods with the possible exception of the evening one. Furthermore, streets adjacent to and west of the Mall have also become noisier during the daytime and evening. The only reduction in noise levels occurred off the Mall during the peak period. Evening period noisiness both on and off the Mall has increased, but the numbers of occurrences of both increases and decreases are very close.

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*L_{eq} is the Equivalent Sound Level, defined as the steady, constant sound level which contains the same sound energy as intensity-varying sound during a specified measurement period. It was the only noise descriptor used to compare noise levels for the Noise Impacts Report.

On the Mall, the day long changes expressed by the L_{eq} indicate that noise levels increased after the Mall was constructed and continued to increase during the next three years, resulting in an overall day long increase of 1.4 dBA between 1976 and 1981. This increase in noise levels is less than the minimum increase of 3 dBA which can generally be perceived by most humans, and therefore may not appear to be significant. However, since the L_{eq} on SW 5th Avenue was 72.2 dBA before the Mall was constructed, a figure above the 70 dBA which most people perceive as noisy, even relatively small increases in the noise levels under with-Mall conditions mean that the Mall area is becoming a noisier place. The Mall noise levels are getting closer to the 80 dBA threshold above which noise can result in extra-auditory physiological effects.

Given the L_{eq} increase of 1.4 dBA on the Mall, the report found that FEIS standards for pedestrian speech and office worker functioning are being exceeded slightly more under with-Mall conditions, as expected. Also hotel sleep interference on the Mall has become more frequent, as predicted. The noise levels at certain measurement sites also exceeded the 72 dBA standard proposed by the Oregon Department of Environmental Quality to protect against hearing loss when exposed to a noise level for long periods of time, and the 67 dBA standard for avoiding speech interference. Both of these standards were exceeded to a lesser degree before the Mall was built.

Evaluation of the Perceived and Measured Noise Level

Speech interference on the Mall is an important consideration because the Mall is intended to be an attractive place for pedestrians, shoppers and waiting transit riders. However, the fact that an average day-long noise level is used ignores the important fact that noise generation on the

Mall is not continuous, but rather fluctuates periodically, in correspondence with the passby of buses, in particular. Given the reported perceptions of people regarding noise level on the Mall, it appears that feelings are influenced more by the discomforting level of noise generated when the bus volumes are high on the Mall rather than the quiet noise level existing when buses are absent. This may be partly due to the fact that pedestrian volumes are likely to be highest during the peak travel hours when bus volumes are also at their highest.

Concentration of both people and buses on the Mall leads naturally to a perceived bus noise problem. Although the actual increase in noise is not great, the discontinuous level of noise caused by a bus passby is more noticeable than the continuous traffic on streets.

Perceptions of Air Quality on the Mall

The Pedestrian Survey, Transit Rider Survey, and Downtown Employee Survey all included a question regarding air quality on the Mall. Respondents were asked for their level of agreement on a scale of 1 through 5 with the statement "The Transit Mall has bus fumes which are irritating." The Pedestrian and Employee surveys also asked for reaction to the statement "The Transit Mall has clean air."

Generally, the results indicate that people do consider the bus fumes to be irritating. The mean response to the statement on a scale of 1 (strongly disagree) to 5 (strongly agree) and the percent in agreement with the statement is shown in Table 16. These responses indicate a fairly strong opinion that the bus fumes are an irritation, although transit riders are bothered less.

TABLE 16

PERCEPTIONS OF AIR QUALITY ON THE TRANSIT MALL

Statement	Percent in Agreement*	Mean Response**
"The Transit Mall has bus fumes which are irritating."		
Employees	66%	3.8
Transit Riders	56%	3.5
Pedestrians	60%	3.6
"The Transit Mall (does not have) clean air."***		
Employees	63%	3.9
Pedestrians	45%	3.3

* Percent responding "agree" or "strongly agree"

** 1 = strongly disagree
2 = disagree
3 = neutral
4 = agree
5 = strongly agree

*** The statement "The Transit Mall has clean air" was inverted for comparison to the bus fumes statement.

When the pedestrian survey was stratified by demographic groups, it was found that the bus fumes are most irritating to those under age 35, (66 percent) and those living within the City of Portland (65 percent). In the employee survey, groups finding bus fumes most irritating were the under 35 age group (69 percent), women (68 percent), residents of the City of Portland (67 percent), households earning under $15,000 per annum (70 percent), those using a mixed mode of travel to reach work (70 percent) and those having worked downtown between 4 and 10 years (72 percent). In terms of the broader issue of clean air on the Mall, results from the pedestrian and employee surveys were compiled to the inverted statement "The Transit Mall does not have clean air" in order to facilitate comparison with the statement relating to bus fumes. The results are also shown in Table 16. The mean responses in both surveys show that employees are more negative toward general air quality. Pedestrians (who do not work downtown) consider air quality to be better than do employees.

There were several business people interviewed in the Impact on Downtown Revitalization report who felt that air pollution is a continuing problem within the Mall area--a factor which may have discouraged some investment by retailers or developers in the vicinity.

In sum, it was found that a majority of all respondents consider the bus fumes to be irritating, although a substantial proportion were neutral on the issue. In contrast, there is less agreement that the Mall does not have clean air. Employee survey respondents were consistent and most in agreement that the air is not clean, while pedestrian survey respondents were more evenly divided.

Measurement of Air Quality on the Mall

The purpose of the Air Quality Impacts Report was to determine the effects that the Transit Mall has had on air quality in downtown Portland. The report evaluated one of the original objectives of the Mall, which was a contribution to the reduction of air pollution in downtown. This required an analysis of 1980 with-Mall emission density*, and a simulated 1980 without-Mall emission density. This analysis compared 1980 traffic volumes assigned to a with-Mall street network, to traffic assigned to a without-Mall street network. The emission densities were calculated directly from traffic volumes derived from a traffic assignment model, reported in the Traffic Effects Analysis. Existing traffic and air quality monitoring data were inadequate to determine the before and after impacts of the Mall on downtown air quality. Thus, it was necessary to model (or simulate) 1980 without-Mall traffic conditions. The analysis did not determine

*An emission density is the mathematically calculated amount of pollutant within a specific area. The major inputs to the calculation are traffic volumes, speeds and pollutant emission factors by type of motor vehicle.

how pollution levels on the Mall had changed since its construction, but rather what the air quality conditions might have been had the Mall not been built.

Although the reasons for Portland's air pollution problems are many and complex, they are tied to two main factors: the city's location and climate, and the nature of certain activities that take place within that location--mainly transportation. The Portland-Vancouver Air Quality Maintenance Area (AQMA) contains a high percentage of transportation-related emission sources with 91 percent of carbon monoxide, and 63 percent of both hydrocarbon and total suspended particulate coming from transportation sources. This high proportion of air pollution derived from transportation sources implies that a significant variation in traffic volumes and vehicle type, resulting from Mall operations, would impact air pollution levels.

Only four motor vehicle related pollutants (hydrocarbon, carbon monoxide, nitrogen oxides and suspended particulate) out of the seven major air pollutants, were analyzed in the Air Quality Impacts Report because emission factors by type of vehicle were not available for the other three major pollutants (ozone, oxides of sulfur, and lead).

Before-Mall Air Quality Levels in Relation to Acceptable Standards. The U.S. Environmental Protection Agency has developed standards for each of the seven major types of air pollution. These standards are divided into two classes: primary standards, being designed to protect public health, and secondary standards to protect the public welfare (i.e., more stringent). Oregon has adopted state standards at least as stringent as the federal secondary standards for all pollutants except lead, which the state is reviewing.

Overall, air quality in the Portland area has been steadily improving since the implementation of clean air programs in the early 1970s, although the improvements have varied by year and location. Currently, the Portland-Vancouver AQMA contains areas in which concentrations of three of the major pollutants (carbon monoxide, total suspended particulate and ozone) violate federal standards. Control strategies have been developed to bring these areas into compliance with the federal standards.

Findings of the With/Without Mall Pollution Level Simulations. The Transit Mall caused automobile traffic to be diverted from the two North-South streets to other streets throughout the downtown, thereby affecting emission densities over a wide area. While the study area does not include all impacted streets, it is centrally located within the broader impacted area, and consequently the results are indicators of the effects of the Mall on pollutant emissions in the whole downtown area.

The findings indicate that the Mall has resulted in overall reductions in the vehicular emissions of the four pollutants in the study area, and probably in the whole downtown area. The effect of the Mall is not uniform on all streets because of the variations in the mix of vehicles which emit different quantities of each pollutant. Some streets have been both negatively and positively impacted by the Mall for different pollutants.

The greatest impact has been on the Mall streets, where emissions of all pollutants except nitrogen oxides would have been at least 50 percent and frequently over 100 percent greater without the Mall. Nitrogen oxide emissions would have been only 12 percent higher on SW 5th and 2 percent lower on SW 6th without the Mall because far more

nitrogen oxides are emitted by buses than automobiles. Immediate parallel streets to the Mall--Broadway and 4th--have been impacted the most because of the increase in automobile traffic on these streets.

Broadway has been negatively impacted by the Mall for all pollutants except nitrogen oxides because it carries more automobiles. The Mall has increased hydrocarbon and carbon monoxide emissions but reduced nitrogen oxide and tailpipe particulate concentrations on SW 4th due to the removal of buses from that street.

- Hydrocarbon. Hydrocarbon emissions would be almost 250 percent higher on SW 5th and 360 percent higher on SW 6th without the Mall because total traffic volumes on those streets would rise. Emissions would be 7 percent less on SW 4th and 19 percent less on Broadway without the Mall since total traffic volumes would be lower on those streets.

- Carbon Monoxide. Carbon monoxide emissions would be 600 and 1400 percent higher on SW 5th and 6th, but decrease by 15 and 22 percent on SW 4th and Broadway without the Mall. Of the four pollutants analyzed, the Mall has had the most beneficial impact on carbon monoxide emissions. This is partly explained because cars emit more carbon monoxide than buses, and automobile use of SW 5th and 6th has declined substantially.

- Nitrogen Oxides. Change in nitrogen oxide emissions on individual streets are very closely related to changes in bus volumes.

Emissions would increase 19, 50, and 3 percent on SW 5th, 4th and Broadway, respectively, without the Mall, while they would actually decrease on SW 6th by 2 percent.

- Suspended Particulate (Tailpipe). There would be increases of tailpipe particulate emissions of 50 percent on SW 5th and 6th and 18 percent on SW 4th, but a decrease on Broadway without the Mall. This is partly explained by the higher emission rate of buses over automobiles.

Thus, it appears that implementation of the Mall has reduced concentrations of hydrocarbon, carbon monoxide, and nitrogen oxide pollutants on the Mall streets. Suspended particulate emissions have not been affected by operation of the Mall in the same way. This improvement in pollution concentration levels has occurred at the expense of pollution levels and the deterioration of air quality on streets paralleling and crossing the Mall.

Perceptions and Model Simulations of Mall Air Quality

In comparing the image of Mall air quality presented in the two analyses it can be concluded that bus fume irritation is perceived to be more objectionable than the replaced auto fumes. While air pollutants on the two Mall streets themselves have been reduced considerably, over 60 percent of transit rider, pedestrian and employee respondents agree that bus fumes on the Mall are irritating.

The Mall is not perceived as having clean air, which is inconsistent with the results of the traffic simulation-based emission estimates. The emission study indicates air quality on the streets around the Mall has deteriorated slightly as a result of traffic diverted from Mall streets.

At a general level, the perception of Mall air quality is more negative than are the results of the model simulation.

Findings. Although users of the Mall do not perceive an improvement in air quality, the Mall has separated autos and pedestrians and has actually achieved a significant improvement. Total emissions are approximately the same. The diversion of vehicles to peripheral streets has shifted the emissions to places where it does not affect as many people.

SECTION 8
LAND VALUES, RENTAL RATES AND DEVELOPMENT IMPACTS

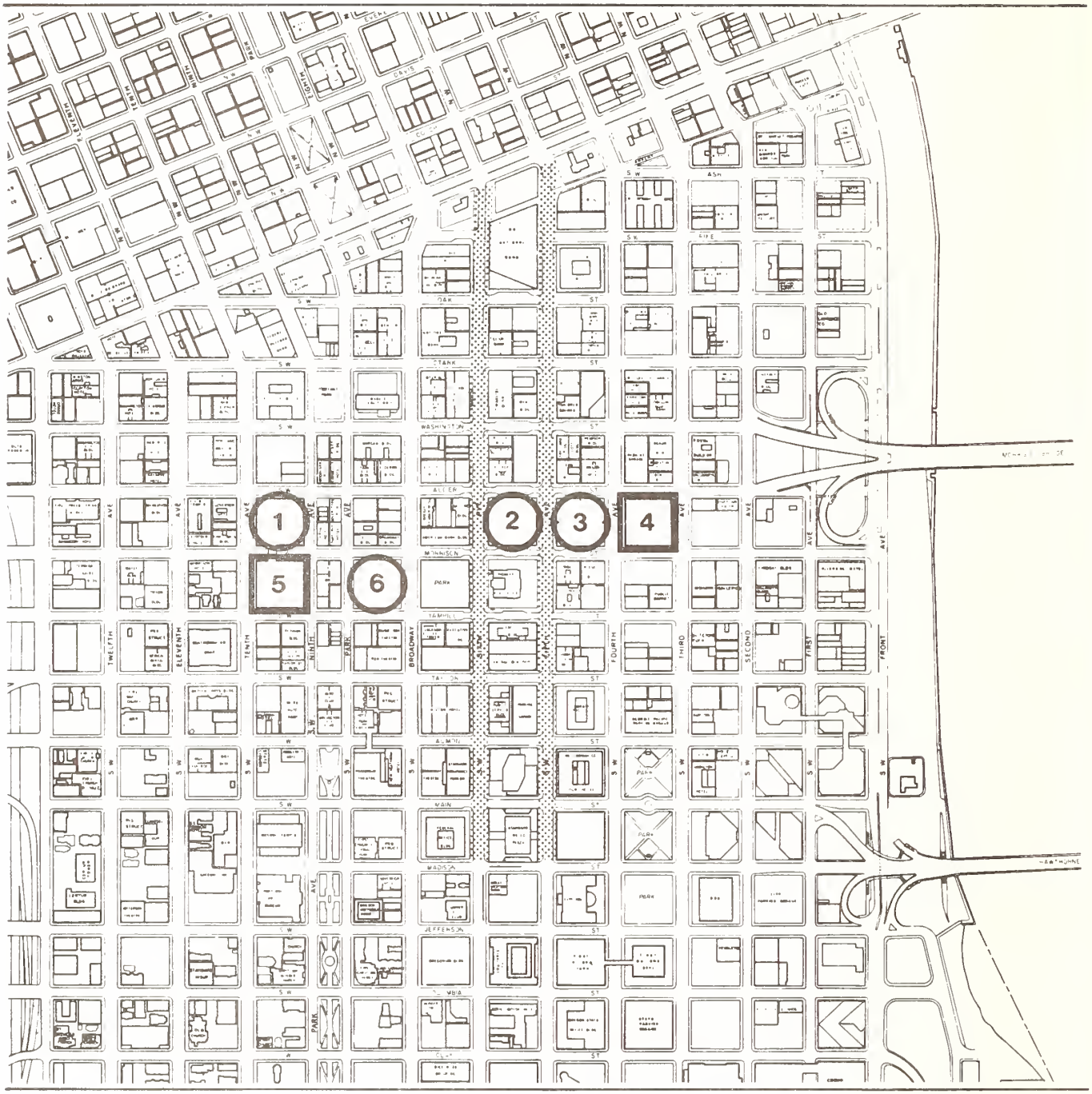
Land Values and Rental Rates

A Portland appraisal firm, Property Counselors, examined land values and office rental rates in downtown Portland. They examined sales as a basis for appraising properties on- and off-Mall, and both before and after construction of the Mall, in an attempt to isolate the effect of the Mall on land values. Similarly, they examined office leases on and off the Mall, and before and after construction of the Mall. The following discussion is drawn from their analysis, which is reported in Impact Analysis: Part 3 - Analysis and Conclusions, (Property Counselors, 1982).

The relative desirability of on-Mall versus off-Mall locations is examined primarily through a comparison of office rental rates. Land value changes, on the other hand, provide an understanding of development trends in the functional districts (retail, financial, historic) within downtown Portland. The central city's competitive position to suburban communities rests on inferential data drawn from a comparison with other cities.

The activities and impacts of public policy on the CBD during the period of the study were significant and generally beneficial. A series of infrastructure changes such as the Transit Mall, Morrison Park East and West parking structures, and the Waterfront Park development have taken place which have enhanced the physical plant and appearance of the CBD. The establishment of the Yamhill and Skidmore Historic Districts has facilitated renovation in those areas and has retained a lower density of development in those areas (see Figure 3).

FIGURE 3



1 GALLERIA
2 MEIER AND FRANK
3 JC PENNEY
4 MORRISON PARK EAST
5 MORRISON PARK WEST
6 NORDSTROMS

KEY INVESTMENTS IN THE REVITALIZATION OF DOWNTOWN PORTLAND, OREGON

○ DEPARTMENT STORE
□ PARKING GARAGE

600'

TRANSIT MALL

The Downtown Plan created an atmosphere in the CBD that both encouraged renovation of existing structures and attracted development of new projects. As a result, the appraisal analyst asserts that, had market forces been left to themselves, it appears likely that the level of retail renovation and development would have been less than has taken place, and that housing stock would have continued to decline without any sign of a turnaround. Development in a relatively unregulated state would be almost entirely in the form of high-rise offices. The planning process has both directly and indirectly created a physical and legal atmosphere that has encouraged more diversity of development.

The decision to construct a Transit Mall was a very significant change in downtown Portland's traffic and land use patterns. Mobility within downtown Portland was greatly improved, and the ability to move larger numbers of people during rush hours resulted in additional capacity for office space. Nevertheless, the Mall cannot be viewed in isolation from the other public policy actions and decisions which occurred during the study period.

Comparison of Portland With Other U.S. Cities. Comparison of land value and rental rate increases in downtown Portland with data available from other cities (Seattle, Spokane, Denver, San Francisco, San Diego, and Salt Lake City) suggests that Portland's real estate economy was neither stronger nor weaker than comparable urban areas. Increases in rental income, market rental rates, and land values in Portland have occurred at rates very similar to the increases experienced in the Pacific Northwest Region, and the nation.

When comparing the experience of the Portland Central Business District to the Seattle Central Business District (the most comparable city, both have a free fare downtown transit

zone) over the study period, no measurable positive or negative effect on either rental rates or land values can be attributed to Transit Mall construction. A similar observation can be made when comparing rental income data between Portland, Seattle, the Pacific Northwest Region, and U.S. averages.

This methodology, however, is incapable of measuring several important economic matters which affect supply and demand, and, therefore, pricing of both land and rental rates. Specifically, this methodology does not account for the fact that most of Portland's increased demand for Class A office space was met in downtown Portland, as opposed to the suburban and near-downtown construction which occurred in Seattle and several other West Coast cities.

During the study period (1973 to 1980), downtown Portland experienced a considerable increase in demand for office and retail space. However, the portion of this demand increase that was directly caused by the Transit Mall is unclear. Transit Mall construction in 1976-77 did immediately precede a period of very strong demand growth in 1978-79. Many other central business districts throughout the United States experienced similar demand increases and development and renovation activity with widely varying levels of public policy involvement. Therefore, it would appear that, although Portland's development pattern might have been different, the increased demand which was central to private improvements in the downtown area might have occurred independently of the Mall or most other public policy decisions.

The Mall probably did help create conditions that allowed for a greater intensity of development to occur in the Central Business District. This greater potential supply of space in downtown Portland has probably impacted and reduced development of office space in other parts of the Portland

urbanized area. In the absence of the Transit Mall, the appraisers think it likely that development East of the river near downtown and in the Lloyd Center area would have proceeded more rapidly, given their relatively high level of highway accessibility.

Analysis of Land Values. By means of an analysis of sales of property downtown, selected properties were appraised, before (1973) and after (1980) construction of the Mall. These appraised properties were compared to assess the impact of the Mall on property values.

Of the 21 sites appraised, seven were on-Mall sites and 14 were off-Mall sites. The deflated value change over the study period for on-Mall sites ranges from a decline of 11.4% to an increase of 30%. Off-Mall sites exhibited a range of deflated value changes from +13.9% to +74.5%.

Therefore, on the basis of land value changes over the study period, it can be concluded that off-Mall locations outperformed on-Mall locations. It should be noted that the Mall was placed in the area that was the heart of the downtown district in 1973. This area began at a higher base and with a generally much higher level of acceptance than did most of the off-Mall locations.

Analysis of Office Rents. The office rent survey utilized a July 1, 1975 valuation date for the before-Mall measurement, contrasted to the July 1, 1973 date utilized in the land valuations study. The rationale for this approach was that market participants in leasing markets are less sensitive to possible neighborhood changes three and five years in the future than are potential purchasers or sellers of vacant land. Therefore, the 1975 date was chosen for rental rate comparison, so that measurement could be made just prior to Transit Mall construction.

A way of looking at the data is to compare the average market rent in each time period for all off-Mall buildings versus all on-Mall buildings. That calculation is presented in Table 17.

TABLE 17

OFFICE RENTAL RATE[1] COMPARISON
OF ON-MALL VERSUS OFF-MALL LOCATIONS

	1975	1980	Percent Increase
All Off-Mall Buildings	$6.88	$12.58	82.8%
All On-Mall Buildings	$6.75	$12.27	81.9%

[1]Dollars per square foot per year.

Differences in performance between rental rates for all off-Mall buildings compared to all on-Mall buildings are relatively minor. What differences exist can probably be explained by physical or functional differences between buildings and in the four samples.

Another way to examine the rental data is to compare building rentals for similar aged buildings in different locations for any locational premiums that might exist. Table 18 is a comparison of building rental data which attempts to examine the rental rate premiums which buildings are able to command for on-Mall locations, and notes any changes in those premiums.

Table 18 tends to indicate that on-Mall building locations commanded slight rental premiums in both 1975 and 1980. For both old and new buildings, however, the amount of this premium seems to be decreasing rather than increasing during the study period. Several possible explanations exist. The one which seems most reasonable to the appraiser is the suggestion that a general enlargement of acceptable Class A

TABLE 18

OFFICE RENTAL RATE COMPARISON OF ON-MALL VERSUS OFF-MALL LOCATIONS BY AGE OF BUILDING

	Location Re Mall		
	Off	On	Mall Premium
0-10 Year Old Buildings in 1980	$13.64	$15.05	10.3%
0-10 Year Old Buildings in 1975	$ 7.57	$ 8.75	15.6%
Change in percent Mall premium:			(4.5%)
50-70 Year Old Buildings in 1980	$ 9.40	$ 9.50	1.1%
50-70 Year Old Buildings in 1975	$ 5.50	$ 5.75	4.5%
Change in percent Mall premium:			(3.3%)

locations has occurred, benefiting off-Mall locations more than on-Mall locations, and thereby reducing rental premiums on the Mall.

Office rental data seem to indicate very little sensitivity to the location of an office within downtown Portland, although a slight premium for on-Mall locations exists. The primary market factors which seem capable of explaining differences in market rent are the age, construction quality, and physical condition of the building, with the building location carrying secondary importance in market rental rate.

Summary of Appraiser Findings. Based on the analysis, knowledge of downtown, and professional judgment the appraiser draws a number of conclusions. These conclusions are drawn from a mix of empirical data and prior knowledge:

- The key factors which influence the size of the downtown Portland real estate market are the demand for office space and the constraints

that transportation systems place on maximum feasible population.

- Transit Mall construction appears to have had a minimal effect on the demand for office space downtown, if any. However, it appears probable that more office space demand was met by downtown construction because the Transit Mall, Fareless Square, and increased transit service, gave downtown a competitive advantage at a critical time when demand for office space increased rapidly.

- Transit Mall construction had a significant positive impact on the ability to move rush hour transportation, and therefore, had significant positive impacts on maximum feasible population and resulting office and retail space capacities in downtown Portland.

- The spatial extent of both the general office area and the retail core in Portland's downtown area have significantly expanded during the study period. For offices, this is largely attributable to the Transit Mall and to Fareless Square. For retail development, the location of the public parking ramps built to replace parking the Mall removed, has directed retail development.

- Had the Transit Mall not been constructed, the appraiser concludes that 2 or 3 buildings, or between 500,000 and 750,000 square feet of office space constructed in downtown Portland during the study period would have been

constructed elsewhere in the Portland SMSA. Competing nearby office locations such as the Lloyd Center and Central East Side have probably developed more slowly as a result of Mall construction. Also, Mall construction may have been one factor in the differences between the slower growth of Portland's suburban office market in comparison to other West coast suburban markets.

- Off-Mall locations saw larger increases in land values and rental rates than on-Mall locations. This is probably attributable to the increased size of the Central Business District rather than any lack of desirability of Mall locations.

- Slowest increases in land values were in the financial district, partially due to the Southerly expansion of the Central Business District from Madison to Mill Streets, and partially because the financial district's land values were at the upper end of the study area's price range at the start of the study period.

- Largest increases in land values were at the South end of the Central Business District, particularly for whole block office sites. Strong increases in land values were also recorded in smaller sites in and around the Skidmore and Yamhill Historic Districts.

Implications for Value Capture. Mall projects, if part of a larger downtown plan with other elements, are difficult to isolate in terms of capitalization of benefit into land values. The appraisal firm could not detect increases accruing

to land adjacent to the Mall. Rather, the benefit extends to the periphery of the office core area, rather than being confined to adjacent properties. Nevertheless, a more rigorous analysis would be needed to isolate the effect of the Mall upon all downtown properties.

The difficulty in identifying the value to capture suggests a more arbitrary approach of allocating the cost of Mall projects to all downtown properties in proportion to their assessed values. This approximates the benefits received adequately, as assessment of new development would help retire bonds.

Development Impacts

The growth trends of major sectors of the downtown economy and the history of downtown building activity were reported in the Land Use and Economic Effects component of the Transit Mall Impact Study. The Economic Overview, prepared by the City of Portland Planning Bureau details recent economic development downtown, tracing the trends from 1960 to the present. However, given the difficulty of accurately isolating the effect of one specific facility or investment, the report does not attempt to assess the impact of the Mall on these economic trends. The Downtown Buildings: New Construction, Major Renovation and Demolition report, also prepared by the City Planning Bureau, inventories downtown buildings affected by building activity between 1973 and 1980. The occurrence of building activity was discussed relative to the location of the Transit Mall, but the report does not attribute any specific impact to the introduction of the Mall.

The findings of the above reports are summarized below. Additional material from the opinions of business leaders on the "psychology" behind downtown investment in the 1970's,

and on the probable role of the Transit Mall and related public investments in downtown revitalization is included. These opinions are contained within the report prepared by the Center for Urban Studies entitled The Impact of the Transit Mall on Downtown Revitalization which was intended as a supplement to the general, quantitative assessment of the Mall. The viewpoints expressed by business leaders provides some insight into the possible impact the Mall had on economic and building activity trends of the 1970's. The report on building activity examined the data by location within five study zones: by type of land use, and by three time periods (before, during, and after the Mall construction). Figure 4 illustrates the boundaries of the zones used in the study, with the Transit Mall (Zone 1), being in the center.

Office Development Trends. In 1960 the total office inventory of the Portland CBD was 1,600,000 square feet. From 1960 to 1970 another 1,700,000 square feet were added, and from 1970 to 1980 an additional 3,813,000 square feet were added. Over 2,600,000 square feet of new office space is planned for construction between 1980 and 1984. Demand has always been sufficient to fill the new offices. Thus, from 1960 to 1970, 280,000 square feet of new Class I office space was leased per year, rising to over 500,000 square feet annually during the early 1970's. The demand has increased for several reasons: the growth in office-based employment in the SMSA and the CBD; a process of internal expansion of firms which were overcrowded; and an increase in office space per employee from 126 square feet in 1960 to 215 square feet in 1980. The CBD currently contains 51 percent of all office space in the SMSA, and has one of the best occupancy ratios of all office districts in the SMSA. Suburban office space development within the Portland SMSA has not, therefore, adversely affected office development downtown.

FIGURE 4

INTERNAL ZONES WITHIN PORTLAND CBD

TRANSIT MALL

0 400'

Within downtown, new floor area was constructed for office use in all the three time periods identified above. The two periods before and after Mall construction each show gains of more than 800,000 new square feet in office space, while the period during construction gained just under 29,000 square feet. Ninety-five percent of the new office space was located in two zones, Zone 3E along the Willamette River and Zone 1 along the Mall.

The period after Mall construction showed the most floor area of renovated office space: over 290,000 square feet versus 190,000 square feet before Mall construction and 145,000 square feet during Mall construction. Zone 1 on the Transit Mall had the greatest amount of renovated office floor area. However, Zones 3E, 2W and 3W experienced more significant percentage office space renovation gains than Zone 1. Zone 2E was the only zone which lost office space, from the conversion of one large structure to housing.

The period before Mall construction experienced the largest amount of office space demolition (64,000 square feet), during construction the least amount (8,500 square feet), and after Mall construction, 18,000 square feet. Demolition activity claimed office floor area in every zone except Zone 2W. The greatest amount of demolished square footage in office use occurred in Zone 2E (38,000 square feet). Demolition of all office space in the study area totaled less than 100,000 square feet, with only 16,000 square feet being on the Transit Mall, Zone 1.

The strong office market and the prominence of the Transit Mall was identified by the business leaders interviewed. They cited several factors as important in making downtown the premier office location of the metropolitan area, some

of which give an indication of why the Transit Mall area has experienced such office sector growth.

- Transit Access. Downtown's central location and Tri-Met's improved transit service were viewed as facilitating the commutes of office workers. This variable was considered especially important for offices employing large numbers of low-wage clerical workers, and hence likely to have drawn them to locations close to the Mall.

- Fear of Auto-Dependent Locations. Downtown was said to be favored, in part, because of concerns about being trapped in locations with inconvenient transit access in the event of gasoline shortages.

- Proximity to Private Clubs, and Status Addresses. Some respondents stated that the social contacts provided by private clubs were vital to the conduct of business. These clubs are concentrated in the downtown area. The status image of the downtown core was also noted by the businessmen, and was viewed as contributing to downtown momentum.

- The Transit Mall. Most interviewees felt that the Mall has influenced office locations because it defined a dense North-South office spine. The Mall was not thought to have caused the office expansion, but did concentrate development activity. Surprisingly, businessmen felt that the core area was becoming too office-dominated, and really needed more mixed use.

Downtown zoning and building regulations as developed by the Downtown Plan in 1972, tend to encourage denser office

development along the Transit Mall at the expense of other downtown areas which are destined for lower density and more mixed use.

Retail and Commercial Development Trends. Although total retail sales in the Portland SMSA rose from $1.3 million in 1963 to $4.4 million in 1977 (in constant dollars), the CBD share of SMSA retail sales fell from 11 percent in 1963 to 4 percent in 1977.* The CBD share of SMSA retail employees fell from 19 to 6 percent during those years. Despite these trends, the CBD remains the largest retail facility within the SMSA, with 3.5 million square feet of the SMSA's total 40 million. CBD sales' figures in 1977 were the second largest in the SMSA, after the various malls in Beaverton.

Definite improvements, including retail reinvestment, occurred during the 1970's, which suggests that the decline apparent in the census figures may be reversing. However, stabilization of downtown retailing is not a proven trend. The paucity of recent data makes assessment of current conditions difficult.

The largest amount of new floor area constructed for commercial use, out of a total of 377,000 square feet, was 188,000 square feet added during construction of the Transit Mall. This compared to 112,000 after construction of the Mall and 77,000 square feet before construction of the Mall. Apart from the new Nordstrom Department Store, the remainder was located primarily on the ground floors of office and parking structures.

Renovated commercial floor area totaled 609,000 square feet during Mall construction, 308,000 after Mall construction and 104,000 before Mall construction. In the periods during

*Figures from the Census of Retail Trade.

and after construction of the Mall, renovated space for commercial use was greater than for any other building use. By study zone, over 790,000 square feet of floor area in Zone 1 on the Transit Mall was renovated for commercial use, while commercial floor area renovated in the other four zones ranged between 96,000 and 19,000 square feet of space. The two zones the farthest from the Mall Zone, Zones 3W and 3E, experienced the next largest gains in commercial space through conversion to retail from other uses.

Downtown retail activity was viewed by business leaders as struggling to maintain or improve its regional share. While not dropping precipitiously, downtown retail sales were acknowledged to be a less significant portion of the regional total than they were prior to the construction of the major shopping centers. Those interviewed differed in their diagnoses of the downtown retail problems. In addition to the general economic climate, the following factors were cited as liabilities specifically associated with downtown locations: the availability and cost of parking (indicating that a better transit service provided by the Transit Mall was not a benefit for retailers); the distance between stores and lack of weather protection; an insufficient number of speciality stores; insufficient downtown housing; the high cost of space and short retail hours; and, deficient marketing. Thus, many of the problems would exist with or without the Transit Mall. The Mall was seen to directly benefit some retailers--those with high volume drop-in sales targeted at commuters--and to hinder other retailers where the loading and unloading of cumbersome merchandise has been made inconvenient, or where the volume and character of bus waiters discouraged customer patronage at luxury item stores.

Once again the impact of the Downtown Plan's building regulations should be mentioned, although they only became

effective during Mall construction. The designated "retail core" of downtown stretches East-West, crossing the Transit Mall, thereby passing through all five study zones. Within the designated retail core, all buildings must have at least 50 percent of their ground floor area in retail use. This may have resulted in more retail space in new and renovated buildings toward the end of the study period than otherwise would have existed.

Additional Business Opinions on the Impact of the Mall. Many significant remarks made by business leaders could not be associated with a specific land use type, but indicate the perceived role or influence of the Mall on development. They are:

- Multi-faceted Reinvestment. The Transit Mall was viewed as the largest single piece of an integrated public and private investment program, but consequently, it was felt that the Mall would not have been influential on downtown vitality by itself.

- The Need for Public Investment. There was general agreement that public investment was critical in stimulating private investment and that the Mall was a clear symbol of that necessary public involvement.

- Symbolic Role Greater Than Transit Function. The consensus was that the Mall's stimulation of private investment through its symbolism of a public commitment to downtown was more beneficial than improved transit service to the downtown economy.

- Mall Attracts Outside Development Money. Development in Portland is more easily financed by East coast money because of the City's commitment to public transit shown via the Transit Mall.

- High Density Spine Definition. The Mall has provided a geographic focus for downtown, defining the spine of the office corridor. This has created a "center of gravity" avoiding more dispersed new development.

- Improved Transit Access and Intra-core Mobility. The Mall and other transit improvements have improved the efficiency of transit access to and within the downtown. This is an important factor in encouraging businesses to select downtown sites and to favor sites on or near the Mall. The Fareless Square has worked with the Mall to increase bus usage and make bus riding socially acceptable.

- National Recognition. The Mall was seen to have brought Portland national recognition, which has contributed to its reputation as a desirable city in the eyes of company executives and conventioneers.

While the overall assessments of the Mall's impacts were very positive, several criticisms were widely expressed. Some respondents see the Mall as an attraction for undesirables and vagrants, a congested place with people waiting for buses blocking retail and office doorways. This makes the Mall a poor location for high class stores. The perceived increases in noise and air pollution and inaccessibility by car compared to shopping malls, are also detrimental to the downtown's retail sector. There was concern that too much reliance has been made on the Mall to solve downtown's problems. However, some of the problems identified with

the Mall which discourage investment in the area, at least in the retail sector, were seen by others as part of the vitality and diversity of downtown. Overall, the Transit Mall was viewed as an integral component in downtown's revitalization, and a strong influence on outside financial, development and business investment in the core of downtown.

SECTION 9
ECONOMIC ANALYSIS

Introduction

The preceding sections of the report provide a detailed description of impacts of the Portland Transit Mall. This section draws together, in a comparative cost-benefit format, those impacts. The cost of constructing and maintaining the Mall and its impacts are displayed in an annual benefit format.

Cost and Benefit Framework

The capital cost and the annual maintenance cost are shown in Table 19. Capital costs approximate $16 million with an annual maintenance cost of $0.2 million. The construction costs were shared by UMTA (30 percent) and Tri-Met (20 percent). The total length of the two Mall streets is 1.6 miles, which produces an average capital cost of $10 million per mile and $125,000 per mile for maintenance.

The question is whether the benefits exceed the costs. The various user impacts of the Mall are converted to dollar estimates of benefit. User benefits are defined as dollar savings in vehicle operating costs, travel time value, and accident costs for users of the downtown transportation system. The Transit Mall reduced travel time for transit users and increased patronage over and above what would have been the level in the absence of the improvement. This with and without comparison becomes the basis for the benefit estimation.

Estimation of User Benefit

The user benefit of the Transit Mall improvement is the reduction in transit user costs and highway user costs,

TABLE 19

CAPITAL AND MAINTENANCE COST
OF THE PORTLAND TRANSIT MALL

CAPITAL COST ITEMS	
Final Design and engineering of Transit Mall City of Portland - $173,184 Architectural/Engineering - $608,660 Marketing and Graphic Design - $58,356 Project Administration - $42,000 Transit Staff Work - $51,520	$ 888,451
City of Portland expenses for Mall construction activities	837,803
Construction of a Transit Mall on Fifth and Sixth Avenues between Burnside and Madison Streets and on Yamhill and Morrison between Fifth and Sixth Avenues	9,276,493
Street furniture and structures, landscaping, transit information system and related passenger amenities	3,160,665
Street lighting and utility work by companies	124,260
Construction Management	942,149
Appraisal Services	4,205
Force account work related to construction	505,577
Cost Allocation Plan	126,312
Total Capital Cost	$15,865,915
MAINTENANCE COST ITEMS (1981 dollars)	
Sidewalk repairs	10,500
Benches, etc.	5,100
Lighting	4,700
Paving	5,300
Sewer cleaning	2,300
Cleaning	162,100
Total Annual Maintenance Cost	$ 190,000

both calculated according to the consumers surplus concept of benefits:*

$$\text{User Benefit} = N(\Delta TU) + V(\Delta HU) \qquad (1)$$

where:

N = average number of person trips via transit with the Mall, N_w and without the Mall, N_{wo} or $(N_w + N_{wo})/2$.**

V = average vehicular traffic level (or $(V_w + V_{wo})/2$) in the downtown.**

ΔTU = reduction in transit costs per person trip comparing with the Mall to without the Mall, or $TU_w - TU_{wo}$.

ΔHU = reduction in highway user costs per vehicle due to changes in transit service, or $HU_w - HU_{wo}$.

Transit user costs (TU) consist of the travel time value and money costs of a trip made by transit. The reduction in transit costs per person trip is:

$$\Delta TU = v\ (\Delta VT + w\Delta WT) + \Delta F \qquad (2)$$

where:

v = value of in-vehicle travel time.

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*See American Association of State Highway and Transportation Officials, A Manual on User Benefit Analysis of Highway and Bus-Transit Improvements, 1977, for a description of the methodology used for this economic analysis.

**See Appendix A for the with- and without-Mall estimates of person trip and vehicle trip estimates.

w = value of time for waiting, walking, and transferring relative to in-vehicle time, a factor to equate excess time with travel time.

ΔVT = reduction in time spent in vehicles per person trip.

ΔWT = reduction in time spent walking, waiting and transferring per person trip.

ΔF = reduction in money costs per person trip, e.g., difference in bus fare.

The with- and without-Mall traffic assignment analysis performed by Wilsey and Hamm, Inc. as reported in the Traffic Effects Analysis report, found ΔVT = 1.5 minutes per transit trip and ΔWT = 45 seconds or 0.75 minutes per transit trip. The ΔVT stems from a nearly four minute savings in run time through the Mall in comparison to the without-Mall situation. Similarly, the ΔWT results from a shorter average walk time to transit for users of the Mall for the with-Mall case. $\Delta F = 0$, there is no reduction in user cost of riding transit.

The value of travel time, v, for small increments of time savings (less than five minutes per trip) recommended by AASHTO in 1977 was 6.4 percent of average hourly family income. Applying the 6.4 percent to the average family income from the downtown employee survey, of \$17,400 ÷ (50 weeks x 40 hours) equals \$0.55 per hour. Another frequently used value for travel time saved is one-third of wage income. This yields an estimate of \$1.75 per hour.*

The value of time for waiting and walking relative to in-vehicle time, w, of 1.5 to 2.5 is normally applied to reflect the more

*Using percentage of income derived from wages, 90%; secondary wage income as a percentage of primary wage income, 60%, percentage of two wage earner households in sample, 65%.

onerous effect of delays. Using w values of 1.5 and 2.5, v values of \$0.55 and \$1.75, ΔVT = 1.5 min. /60 min. per hour, and ΔWT = 0.75/60 yields a reduction in transit costs per person trip ΔTU as shown in Table 20.

Table 20

Reduction in Transit Costs
Per Person Trip (ΔTU)

Value of Time, v	Waiting and Walking Factor, w	
	1.5	2.5
\$0.55	\$0.0238	\$0.0309
\$1.75	\$0.0757	\$0.0984

Clearly the estimate of reduction in transit costs per person trip is quite sensitive to the value of time and to a lesser extent to the factor for excess or waiting time. An average of the four values contained in Table 20 \$0.0572 is used to estimate the benefit to transit users.

$$\text{Annual Transit User Benefit} = \$0.0572 \left(\frac{107,700 + 101,500}{2}\right) (330)^*$$

$$= \$1.97 \text{ million}$$

The transit user benefit could be as low as \$0.82 million using the lower value of time and the lower factor for waiting and walking time or as high as \$3.38 million using the high values from Table 20.

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*To annualize daily traffic 330 weekday equivalents is used.

Highway user costs (HU) consist of the travel time value and money costs of a vehicle trip. The reduction in highway costs per vehicle trip is:

$$\Delta HU = v\ (\Delta VT + w\Delta WT) + \Delta AC \qquad (3)$$

where v, w are the same as defined above, ΔVT and ΔWT refer to vehicle trips rather than person trips, and ΔAC is the reduction in auto operating cost.

The Traffic Effects Analysis report and the Downtown Employee Survey report show no change in walk time to transit, thus ΔWT should be zero. ΔVT is derived from VMT and volume estimates from the Traffic Effects Analysis report:

$$\Delta VT = VMT_w/V_w - VMT_{wo}/V_{wo} \qquad (4)$$

where:

ΔVT = reduction in time spent per vehicle trip.

VMT = vehicle miles of travel in CBD with, w; and without, wo, the Mall.

V = total CBD cordon traffic volumes with, w; and without, wo, the Mall.

ΔVT = 153,611/396,664 - 161,179/405,069 = -0.01 mi.
= -0.04 minutes at 15 mph (average CBD speed)

$$\Delta AC = (\Delta VT)\ (AC) = (-0.01)\ (\$0.20 \text{ per vehicle mile}) \qquad (5)$$

$$\Delta HU = (v\ (\Delta VT + w\Delta WT) + \Delta AC) \begin{pmatrix}\text{average vehicle}\\ \text{occupancy of 1.3}\end{pmatrix}$$

$= -0.00308$ if value of time, v = \$0.55

$= -0.00310$ if value of time, v = \$1.75

The negative benefit results from slightly longer trips in the CBD due to closure of 5th and 6th to vehicular traffic and increasing circularity for some vehicle trips. Using the average of the two estimates of ΔHU, the

$$\text{Annual Auto User Benefit} = -0.00309 \left(\frac{396{,}664 + 405{,}069}{2}\right) (330)$$

$$= -409{,}000$$

Thus, the estimate of user benefit is the reduction in transit costs, less the increase in auto costs due to greater circuity in the street system with the Mall.

$$\text{Annual User Benefit} = N\ (\Delta TU) + V\ (\Delta HU)$$

$$= 1{,}970{,}000 - 409{,}000$$

$$= \$1.561 \text{ million}$$

Transit System Operating Cost Savings

The impacts of transit improvements on the cost of implementing and operating a transit system are treated in two categories, capital costs and operating costs. The capital cost of the Mall itself was treated separately, above, and no bus capital cost is attributable to the Mall.

The operating cost savings associated with the Mall in comparison to the without-Mall situation are calculated from the reduction in transit travel time due to the Mall, times the marginal cost of transit per hour, times the number of buses:

$$OC = (\Delta TT)\ (MCT)\ (B) \qquad (6)$$

where:

OC = transit operating cost savings

ΔTT = reduction in transit travel time due to Mall

MCT = marginal cost of transit per hour

B = average number of buses $(B_w + B_{wo})/2$

The Traffic Effects Analysis finds a time saving of 4 minutes per bus for the with-Mall situation in comparison to the without-Mall situation. This efficiency gain was not confirmed by Tri-Met's Mall versus cross-Mall comparison, nevertheless the 4 minute estimate is used. The large volume of north-south buses would be difficult to accommodate in mixed traffic. In effect, the Mall may not have increased bus speeds downtown, but it has maintained speeds that would have deteriorated with large increases in bus volumes.

The 1977 operating cost factor, estimated by Tri-Met, was $18.23 per hour. This does not include capital or allocated administrative costs, and therefore better approximates the marginal cost.

$$OC = \frac{4}{60} \quad (\$18.23) \quad \left(\frac{4300-4000}{2}\right) \quad (330)$$

Annual transit operating cost savings = $1.664 million

Accident Costs

The costs of traffic accidents are estimated as a product of the unit cost of accidents, by degree of severity, and the accident rates for each accident type with and without the Mall.

The unit cost of accidents is taken from the AASHTO report (p. 64) using CALTRANS estimates for urban accidents--$3,500

for injury accidents and $1,000 for property damage accidents (1975 dollars).

Table A-2 shows the calculation of reduction of accidents on the Mall streets and adjacent parallel streets. The accident rates were calculated and applied to with- and without-Mall volumes on the affected streets to determine the expected number of accidents. The Mall achieves a reduction of 54.30 property damage accidents and 29.06 injury accidents annually.

$$\text{Annual Accident Cost Savings} = 54.30\ (1{,}000) + 29.06\ (3500)$$
$$= \$156{,}000$$

Other Impacts of the Mall

Table 21 displays the summary of impacts of the Portland Transit Mall on land use and economic activity, and the environmental impacts. These impacts are discussed below.

Air. Environmentally, the Transit Mall has a redistribution effect. The impact on total air quality of a slight VMT reduction in the CBD is imperceptible. The shift in vehicular traffic from the Mall to other streets does not impact total air quality. There were estimated reductions in emissions on the Mall due to fewer autos. This should be an important benefit to the large numbers of pedestrians on the Mall. Yet, the perceived increase in bus fumes negated the reduced emissions on the Mall. Consequently, a benefit for reduced air pollution is not claimed.

Noise. Similarly, an increase in perceived bus noise negated reduction in background noise produced by a steady flow of vehicular traffic. More irregular bus movements created a perception of greater noise, although the noise measurements before and after the Mall were not appreciably different. Consequently, a benefit for reduced noise pollution is not claimed.

TABLE 21
SUMMARY OF PORTLAND TRANSIT MALL LAND USE,
ECONOMIC AND ENVIRONMENTAL IMPACTS

Category of Impact	Description of Impact	Type and Amount of Impact	Impacted Population	Annual Benefit
Environmental Air Pollution	Reduction in vehicular emissions	Reduction in emissions; redistribution to adjacent and by-pass streets	CBD	None claimed
Noise Pollution	Reduction in noise levels	Reduction of background noise; higher short term noise, especially in evening hours on the Mall	Transit Mall	None claimed
Land Use and Economic Land Values	Capitalization of benefits into land value of properties	Redistribution of values within downtown	CBD	None claimed
	Growth of downtown values at a higher rate than suburbs or other regions	Redistribution within urbanized area or among downtowns in other regions	Metropolitan region	
Investment	Volume of construction and Renovation investment in major buildings	450,000 square feet more new construction; 460,000 square feet more renovation than before Mall period	CBD	None claimed
Development Impacts on Transportation Costs	Change in transportation cost for downtown development vs. development in outlying centers	Transportation cost savings due to higher rate of transit use in downtown developments	500,000 square feet office development and 200,000 retail development	($274,000) (see Appendix B)

Land Use. No quantifiable benefits of the Mall were found capitalized in land values, indicating the Mall has not redistributed values within downtown. Nor, did the Mall cause downtown to grow faster than comparable downtowns. The professional appraisers who examined downtown land values and office rental rates, claim the Mall and related public policies stemmed a suburbanization of offices for several years. They claim, that without the Mall, the equivalent of one major office building (500,000 square feet) that was built in downtown, would have been built outside of downtown.

The Transit Mall represented a public commitment that was instrumental in strengthening downtown retailing. Based on the public commitment of the Mall and associated parking ramps, two department stores relocated within downtown instead of fleeing to suburban centers. As a result, downtown retailing made modest gains in comparison to potential deterioration.

The two department stores, Nordstroms and Penney's (a total of 200,000 square feet) both relocated within downtown, where both employees and shoppers utilize transit intensively. For example, 49.6 percent of home-based work trips attracted to the Portland CBD use transit, whereas the comparable rate of transit use for a large suburban shopping center, Washington Square is 2.9 percent. Even a large in-town shopping center, Lloyd Center, has a transit use rate of only 5.9 percent for employees.

Clearly, maintaining and strengthening the CBD produces greater transit ridership than if the development were to go elsewhere in the urban area. This benefits the transit provider, Tri-Met, and to the extent transit is more efficient than the auto, society benefits. However, this is only partially borne out as shown in Appendix B. The total transportation bill is more, not less, to serve downtown space, in spite of higher rates of transit use.

The conventional wisdom that transit-dependent downtown development is more transportation efficient than similar development in outlying centers is highly dependent on the average trip length. Trip length data were obtained from Metro's transportation planning models and estimates of transportation costs for comparable retail centers were developed. Long-run average cost per passenger mile data were calculated by mode for downtown versus outlying centers. This analysis is reported in Appendix B. The analysis dispels claims of large benefits of downtown versus suburban centers. In fact, the total transportation cost for downtown retail centers is shown to be more expensive than in outlying areas.

This difference in total transportation cost between downtown and outlying areas cannot be incorporated into the cost-benefit analysis. The effects of the private transportation cost are already accounted for in the calculation of user benefit. However, tables B-5 and B-6 show the calculation of the external operating transportation cost. This identifies the externality effect as negative, that is the development in downtown has a higher social transportation cost than similar development in outlying areas. Again, the effect of longer trip lengths for downtown travel overwhelms the greater transit use in downtown. Consequently, a negative present value benefit of $4,076,000 (in 1976-77 dollars) is estimated.

Cost-Benefit Comparison

Comparison requires that a discount rate be established to deflate or inflate costs and benefits to a common point in time. In an inflationary period great care must be exercised in the analysis. One has the choice of inflating annual costs and benefits and using nominal interests rates or using constant dollar estimates and using a real rate of interest; one that reduces the nominal rate by the expected rate of inflation at that time.

Table 22 displays the quantifiable costs and benefits of the Transit Mall. Annual cost and benefit items are converted to a present value in 1976-77 dollars using a discount rate of 3.0 percent. In 1976 and 1977 when resources were being diverted from the economy to build the Transit Mall the nominal interest rate was 8.6 percent (Moody's Corporate Industrial Bond average) and the expected future rate of inflation was 5.8 percent (Livingston Surveys, Philadelphia Inquirer). Thus, the real rate of interest is the nominal rate minus the expected rate of inflation, which produces a 2.8 percent real rate of interest.* Three percent is used in the analysis, which is displayed in Table 22.

Both benefits and costs were converted to present value in 1976-77 dollars. The personal consumption expenditures implicit price deflator is used.**

A benefit-cost ratio of 2.29 is estimated showing the project to be viable. Given the difficulty and uncertainty in selecting a value of time, this estimate should not be considered precise. Instead, the benefit-cost ratio lies within the range of 1.80 to 2.80, which reflects approximately $\pm$ 20 percent. Similarly, the benefit-cost ratio is very sensitive to the interest rate one selects. The real rate of interest was systematically varied and the results are displayed in Table 23. This variation does not affect project feasibility.

This analysis shows the Portland Mall to be an economic success. Largely, the benefits accrue to the users of the transit system and to the transit operator. Other benefits are small or negative.

*Taylor, H. "Interest Rates: How Much Does Expected Inflation Matter," Business Review, Federal Reserve Bank of Philadelphia (July/August, 1982).

**Survey of Current Business, U.S. Department of Commerce.

TABLE 22
PRESENT VALUE OF COSTS AND BENEFITS

Cost/Benefit Items	Current Dollars	Current Year	1976-77 Constant Dollars Annual Amount	1976-77 Constant Dollars Present Value i=3%; n=20 yrs.
Cost Items				
Construction Cost	$15,866,000	1976-77		$15,866,000
Maintenance Cost	190,000	1981	$ 134,000	1,994,000
				$17,860,000
Benefit Items				
User Benefits	1,561,000	1980	1,192,000	17,734,000
Transit Operating Cost Savings	1,664,000	1977	1,664,000	24,756,000
Accident Cost Savings	156,000	1975	168,000	2,499,000
Transportation Cost Saving (increase) to serve retained/new development downtown	(403,000)	1982	(274,000)	(4,076,000)
			$2,750,000	$40,913,000
				B/C = 2.29

TABLE 23
INTEREST RATE SENSITIVITY ANALYSIS

	Real Interest Rate	
	5.0 percent	8 percent
Present Value of $1 million of Benefit	$12,460,000	$ 9,818,000
Present Value of $134,000 Maintenance Cost	1,670,000	1,316,000
Cost	$17,536,000	$17,182,000
Benefits	$34,265,000	$27,000,000
Benefit/Cost Ratio for Transit Mall	1.95	1.57

N = 20 years

SECTION 10
CONCLUSIONS

Introduction

The Portland Mall has had a significant impact on downtown. It has demonstrated a public commitment to downtown, an important signal to private investors in the area. It has generated benefits that justify the public investment. However, transit users and Tri-Met are the major beneficiaries of the Portland Mall, as the analysis of land values and office rental rates does not indicate benefits have been capitalized into land values of properties adjacent to the Mall. Nevertheless, increased transit patronage has allowed downtown to grow substantially without increased congestion. Thus, the Mall has achieved its purpose of making transit more efficient and providing a focal point for users of downtown, while protecting downtown from decline.

The Mall as a Commitment to Downtown

The major issue, tangible or intangible, concerning public investment in downtowns, is the perceived need for public commitments to the maintenance of downtown as the premier economic location within the metropolitan area. The private sector seems to need constant assurances and public commitment to the maintenance of downtown's competitive position.

The leveraging effect of the Mall is often identified in terms of decisions of businesses to stay, expand or move to downtown. It was not possible to isolate the effect of the Mall from the other features of the Downtown Plan or from the integrity of the whole plan. Yet, according to business leaders interviewed and reported in The Impact of the Transit Mall on Downtown Revitalization, revitalization of retailing in downtown Portland would not have occurred had it not been for the Downtown Plan. The Transit Mall is an integral

element of the Plan and it provided a signal to major retailers that the City was committed to improving the vitality of downtown. This has helped to retain retailing and make downtown Portland more than an office center.

During the planning and construction of the Mall there was considerable opposition to it, stemming largely from a decrease in auto access. Now the protracted debates about how many lanes should be reserved for buses and how many for autos have been forgotten and the Mall has been accepted. It is viewed generally as a benefit to downtown and the larger metropolitan community.

Perceptions of Downtown Population

The Mall serves to concentrate a wide variety of people. Some see this diversity as a positive feature of the Mall while others see it as threatening. Despite a mix of perceptions the majority of downtown users view the Mall positively, and find it to be an attractive element of downtown Portland. Some specific aspects of the Mall, such as bus fumes, bus noise, personal security and seating in bus shelters are viewed less positively. Nevertheless, these specifics do not detract from the overall favorable impression.

Benefits of the Mall

An economic analysis was performed to evaluate the feasibility of the Mall. The analysis identified and measured the direct benefits to transit users, and transit operating cost and safety savings, issues important to economists and planners to assess project feasibility. However, local decisionmakers and citizens are not particularly concerned with the aggregation of small savings of time, costs, or accidents. Rather, they are concerned with using transportation investments to maintain and strengthen the

downtown area. Often investing in transportation is an expensive way to provide a competitive advantage. However, the Portland Mall has met the economic expectations well and is also extremely popular with citizens and politicians.

The benefits of the Transit Mall are based on estimates of conditions that could be expected without the Mall. This is preferable to a comparison of before the Mall to after the Mall. Significant increases in transit service were made during construction of the Mall, which makes the before to after comparison less useful.

The primary beneficiaries of the Portland Mall have been downtown transit users and the transit provider, Tri-Met. The persons most impacted are relatively new employees who work near the Mall. This group constitutes a high priority market segment for Tri-Met. Similarly, those blocks adjacent to the Mall constitute an area in which the City should continue to encourage high density development and concentrate downtown employment where transit has a high market penetration.

The development impacts of the Mall are not confined to adjacent properties but extend to the whole downtown. Land value and rental rate increases are not attributable to the Mall. They occurred throughout the downtown. Yet, these development impacts are small in comparison to user benefits.

Implications for Value Capture and Joint Development

The analysis of land values and office rental rates does not lend support to the application of the value capture concept. There was no increase in adjacent property values attributable to the Mall to capture. Even without measurable benefits to properties adjacent to the Mall, there is justification for joint development of land and transit improvements. That

is, transit usage is high for employees who work near the Mall, but declines rapidly as the walk distance from the Mall increases. Hence, joint development would permit integration of appurtenant facilities and office/retail activities into an effective transit system to maximize time savings and ridership. However, this analysis indicates public participation should be funded from direct transit beneficiaries, with less reliance on assessments to the downtown property owners.

Implications for the Future

The economic analysis was based on a twenty-year project life. The actual life of the Mall is conditioned by the growth of transit as the Mall is nearing capacity. Articulated buses are relieving the pressure to add more buses to the Mall, as will the Banfield Light Rail Transit (LRT) cross-Mall alignment. This will permit the Mall to function efficiently while handling growth in bus traffic from other corridors. If however, LRT vehicles from the other major transit corridors are added to the Mall, the twenty-year life span may be shortened.

The Mall is a functioning short-term solution to transit capacity problems in the downtown. Decisions made in the design of the Mall limit its capacity. Capacity was traded off with pedestrian and shopping livability, and the expandability of the Mall to absorb new demand was compromised. This compromise now threatens the North-South transit spine concept. The Mall has limited options for planning LRT, resulting in a cross-Mall alignment, which modifies the transit spine element of the Downtown Plan.

In Sum

The Mall has been well received and has allowed the downtown to develop with less congestion. It has better served and increased transit patronage. Importantly, the Portland Mall has proven to be a good public investment, with benefits exceeding the cost. Perhaps more significantly, however, the Mall has become a symbol for the continued revitalization of downtown Portland.

In terms of achievement of objectives, the Mall has met expectations of increased transit efficiency. Meeting other objectives is less clearcut. This analysis has not shown, however, measurable impacts toward the objectives of promoting efficient land use, reducing energy consumption, and reducing pollution. The benefits accrue largely to transit users and the transit service provider.

While the Mall has contributed to the public image of a viable and attractive downtown its limited capacity may prove self-defeating. If the functional capacity of the Mall is not modified, it may require a significant revision of the Downtown Plan. Thus, an early design decision to limit transit capacity is affecting both the life of the Mall as constructed and its ability to serve as the Transit focal point of downtown.

APPENDIX A

TABLE A-1
PERSON AND VEHICLE TRIPS TO PORTLAND CBD
WITH- AND WITHOUT-MALL BY MODE

Mode of Travel	Daily		Peak Hour	
	With Mall	Without Mall	With Mall	Without Mall
Person Trips				
Transit	107,700	101,500	16,500	15,800
Single Person Vehicles	143,000	147,000	12,500	12,900
Two Person Vehicles	65,200	67,000	5,700	5,900
Three + Person Vehicles[1]	31,500	32,200	2,800	2,850
Vehicle Trips				
Transit	4,300	4,000	400	390
Single Person Vehicles	143,000	147,000	12,500	12,900
Two Person Vehicles	32,600	33,800	2,900	2,950
Three + Person Vehicles[1]	8,800	9,000	800	800

[1] 3.58 person per vehicle

Source: Mode Split Analysis by Wilsey & Ham in Traffic Effects Analysis

TABLE A-2
CALCULATION OF TRAFFIC ACCIDENTS
WITH- AND WITHOUT-MALL

	Non-Mall Streets		Mall Streets		
	4th	Broadway	5th	6th	Source
Vehicle Miles					
VMT_{wo}	24,601,000	24,007,000	20,760,000	24,647,000	Calculation from Traffic Effects Analysis
VMT_{w}	25,798,000	27,126,000	6,347,000	5,765,000	Table 5, Transit Effects Report
Accident Rate					Per million VMT
Property Damage					Calculation from
PDR_{wo}	0.956	1.44	1.30	1.43	before-Mall accident experience
PDR_{w}	0.775	0.811	1.58	2.43	Calculation from after-Mall accident experience
Injury					
IR_{wo}	0.441	0.739	0.384	0.734	
IR_{wo}	0.116	0.332	0.630	2.12	
Estimated Accidents					
PD_{wo}	23.52	34.57	26.99	35.25	(PDR) (VMT)
PD_{w}	19.99	22.00	10.03	14.01	
I_{wo}	10.85	36.81	7.97	18.09	(IR) (VMT)
I_{w}	2.99	25.54	4.00	12.22	
Accident Reduction					
ΔPD	3.53	12.57	16.96	21.24	$PD_{wo} - PD_{w}$
ΔI	7.95	11.27	3.97	5.87	$I_{wo} - I_{w}$

$\Sigma \Delta P = 54.30$
$\Sigma I = 29.06$

APPENDIX B

TABLE B-1
MODAL SHARES PER 100 EMPLOYEES

Mode Share per 100 Employees	1980 Home-Based Work Attractions		
	Downtown Portland	Lloyd Center	Washington Square
Employees	100	100	100
Transit Person Trips	50	6	3
Auto Person Trips	50	94	97
Drive alone	35	70	74
Shared ride	15	24	23

Source: Metro

TABLE B-2
NUMBER OF DOWNTOWN EMPLOYEES IMPACTED BY RETAIL AND OFFICE SPACE SHIFT TO OUTLYING CENTERS

Floor Area	Amount of Floor Space per employee	No. of Employees
500,000 square feet of Office Space	200 square feet per employee	2,500 employees
200,000 square feet of Retail Space	500 square feet per employee	400 employees
	Total employees	2,900

TABLE B-3

1981 - 1982 LONG-RUN AVERAGE COST COMPARISON
BY MODE PER PASSENGER MILE

	TRANSIT			AUTO (Drive Alone)			CARPOOL (2.51 person/carpool)		
	CBD	Lloyd Center	Beaverton Mall	CBD	Lloyd Center	Beaverton Mall	CBD	Lloyd Center	Beaverton Mall
Private Costs									
Average weekday fare-system wide		$0.54							
Operating cost per boarding person		$1.27							
Average number of boardings	1.2	1.28 1.3	1.4						
Average trip length	7.13	7.01	7.15	8.26	6.59	6.74	11.1	8.9	9.1
Auto operating cost (intermediate size auto, less parking) ($ per passenger-mile)				0.23	0.23	0.23	0.095	0.095	0.095
Parking cost (out of pocket) per day				$2.00	$1.00	0			
per passenger-mile				0.24	0.12	0	0.096	0.048	0
Bus Capital (Source: Lee)	0.014	0.018	0.023						
Private operating cost (per passenger-mile)	$0.228	$0.254	$0.272	$0.47	$0.35	$0.23	$0.191	$0.143	$0.095
External Costs									
Transit Subsidy (per passenger mile)	0.123	0.135	0.143						
Parking-opportunity cost per square foot, less parking income				$20.00	$15.00	$12.00			
per passenger mile				$ 0.060	$ 0.050	$ 0.045	0.050	0.040	0.019
Highway (Source: Lee)	0.020	0.019	0.020	0.071	0.057	0.058	0.040	0.032	0.033
Environmental (Source: Lee)	0.006	0.006	0.006	0.020	0.016	0.017	0.017	0.011	0.009
External operating cost	0.149	0.160	0.169	0.151	0.123	0.120	0.107	0.083	0.061
Long-run average cost per passenger (social cost)	$0.377	$0.414	$0.441	$0.621	$0.473	$0.350	$0.298	$0.226	$0.156

Source: Metro
Tri-Met
FHWA
Lee (Inflation: 82-75 = 1.54

TABLE B-4

EMPLOYEE TRANSPORTATION COST DIFFERENCE FOR
DOWNTOWN AND NON-DOWNTOWN LOCATION
1982 LONG-RUN AVERAGE COST PER 100 EMPLOYEES

	Downtown Portland	Lloyd Center	Beaverton Mall
Transit Users	50	6	3
Cost per passenger-mile	$0.377	$0.414	$0.441
x trip length	7.13	7.01	7.15
= cost per trip	2.69	2.90	3.15
x no. transit users x 2 trips per day			
= transit cost per day	$269.00	$34.80	$18.90
Auto users (drive alone)	35	70	74
Cost per passenger-mile	$0.682	$0.518	$0.350
x trip length	8.26	8.59	6.74
= cost per trip	$5.63	$3.41	$2.36
x no. auto users x 2 trips per day			
= auto cost per day	$394.33	$477.91	$349.13
Carpool users (2.4 persons)	15	24	23
Cost per passenger-mile	$0.298	$0.226	$0.156
x trip length	11.1	8.9	9.1
= cost per trip	$3.31	$2.01	$1.42
x no. carpool users x 2 trips per day			
= carpool cost per day	$99.23	$95.55	$65.30
Total transportation cost per 100 employees	$762.56	$608.26	$433.33

TABLE B-5
EXTERNAL OPERATING TRANSPORTATION COST DIFFERENCE
FOR DOWNTOWN AND NON-DOWNTOWN LOCATION

	Downtown Portland	Lloyd Center	Beaverton Mall
Transit Users	50	6	3
External operating cost per passenger-mile	$0.149	$0.160	$0.169
x trip length	7.13	7.01	7.15
= external cost per trip	$1.06	$1.12	$1.21
x no. transit users x 2 trips per day			
= external transit cost per day	$106.00	$13.44	$7.25
Auto users (drive alone)	35	70	74
External operating cost per passenger-mile	$0.151	$0.123	$0.120
x trip length	8.26	8.59	6.74
= external cost per trip	$1.30	$1.06	$0.81
x no. auto users x 2 trips per day			
= external auto cost per day	$90.90	$147.92	$119.70
Carpool users (2.4 persons)	15	24	23
External operating cost per passenger-mile	$0.107	$0.083	$0.061
x trip length	11.1	8.9	9.1
= external cost per trip	$1.19	$0.739	$0.555
x no. carpool users x 2 trips per day			
= external carpool cost per day	$35.63	$35.46	$25.53
Total external operating transportation cost per 100 persons	$232.53	$196.82	$152.48

TABLE B-6

CALCULATION OF TRANSPORTATION COST DECREASE (INCREASE)
TO SERVE RETAINED OR NEW DEVELOPMENT DOWNTOWN

$S = (RS/D)\ (1 - P_e)\ (A)$

S = Number of shoppers per year

RS = Retail sales per square foot of gross floor area per year

D = Dollar sales per shopper

P_e = Proportion of customers who work downtown

A = Retail floor area

S = (50/20) (1 - .26) (200,000)

= 370,000 shoppers per year

Type of Trip	Number	Days Per year	No. of round trips per year
Shopping			370,000
Retail Employees	400	312	125,000
Office Employees	2,500	250	625,000
Total			1,120,000

C_{nd} = total external operating transportation cost for non-downtown location ($1.97 for Lloyd Center, Table B-5)

C_d = total external operating transportation cost for downtown location ($2.33 from Table B-5)

Annual transportation cost decrease (increase) to serve retained or new development downtown = $(C_{nd} - C_d)\ T$

= (1.97 - 2.33) 1,120,000

= ($403,200) in 1982 dollars

= ($274,000) in 1976-77 dollars

= ($4,076,000) present value

APPENDIX C

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