town of vail

FEASIBILITY OF A PEOPLE MOVER SYSTEM TO REPLACE THE IN-TOWN SHUTTLE BUS ROUTE

Prepared for

TOWN OF VAIL
DEPARTMENT OF PUBLIC WORKS / TRANSPORTATION

by

Charles P. Elms and Daniel Dunoyé

LEA, ELLIOTT, McGEAN & COMPANY
Washington, D.C.
February 16, 1987

Lea, Elliott, McGean & Company transportation engineers

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1.0 EXECUTIVE SUMMARY

The primary purpose of this study was to examine the feasibility of replacing the Vail In-Town Shuttle bus system by an Automated People Mover System, also referred to in the industry as an Automated Guideway Transit (AGT) System.

Representative People Mover Replacements for the Shuttle

A representative People Mover System for replacing the In-Town Shuttle has been conceptually defined and analyzed and is believed to be both technologically and physically feasible. Competitive commercially available equipment has been identified and a feasible representative alignment defined. The capital cost of such a system has been estimated to be on the order of $20 million.

Recognizing it may be necessary to minimize the capital costs for the initial installation of a people mover, study was made to identify a Starter Line which has the potential to solve the immediate congestion problem and fulfill the need for growing demand. This was done and a Starter Line defined which can carry 78 percent of the In-Town Shuttle demand, connecting the LionsHead area with the Vail Village and Transportation Center. The capital cost of the Starter Line was estimated at $15 million. This Starter Line was defined in a way that can be logically extended to the West towards Cascade Village and to the East through Golden Peak.

Based on the system requirements discussed between the Town of Vail officials and LEM, the feasibility of an AGT system was investigated. The proposed system would be elevated. Its representative alignment follows the In-Town Shuttle bus route. The major restrictions of such an alignment are the small turn radii and the narrowness of the right of way.

While there are possibilities to use portions of Gore Creek as part of the alignment, such was not studied in depth because of problems fitting in stations and the need for pedestrian access. For purposes of this feasibility analysis, the definition of a "feasible representative alignment" was considered of primary importance. Should the Town of Vail then find the project to be feasible, improvements to the alignment should be studied and defined during preliminary design when there is sufficient budget.

Physical constraints limit the number of systems that could be used in Vail. Also, it was found that the average speed of the system will be only slightly better than the bus unless passengers are allowed to carry their skis on-board the trains. Section 7.4 of this report discusses this concern and concludes that the system can be designed where skis can be safely carried on-board a fixed-guideway people mover by passengers. Another constraint on the people mover system is related to the space required to locate the columns and the stations, while maintaining road access to all the buildings alongside the alignment.

After examining these restrictions, LEM identified alternate technologies that would be applicable in Vail. Full descriptions of the systems using these technologies were prepared. A description of an operating plan was also prepared. Based on these descriptions, both capital and operation & maintenance (O&M) costs were developed.

Demand/Ridership Analysis

A detailed analysis of existing population/visitor data and bus ridership was carried out to establish the characteristics of current Shuttle demand and that which can be expected for the future. This demand was analyzed for "peak days" and "design days," terms used by Vail Associates, Inc. for planning and sizing its facilities. The peak day is essentially a factor of 1.26 times higher than a design day. The design capacity is the capacity to which a facility can be filled before crowding begins to take place.

Shuttle demand during the 1985-86 ski season was found to be 17,600 passengers on a peak day and 14,000 passengers on a design day. When Category I and II improvements are completed, ridership demand is expected to increase by 23 percent for the 1995-96 ski season and by 43 percent for the 2003-04 ski season. The 1995-96 time frame was selected for defining a design condition for the people mover system. The people mover systems, upon which feasibility has been studied, were sized to meet the 1995-96 peak period demand for a peak day. Expansion to meet the 2003-04 peak period peak day demand can be easily met by adding only three trains.

The peak period for demand on the Shuttle bus is in the late afternoon (3:30-5:30 p.m.) as skiers come from the slopes when the lifts close. Approximately 24 percent of the entire day's demand occurs then -- 4,259 riders on a peak day and 3,380 on a design day.

The morning peak is much lighter, approximately one-third the rate of the late afternoon peak.

Peak demand was analyzed to determine the following directional line capacity requirements for a peak day.

Season	Directional Line Capacity Required
1985-86	1,065
1995-96	1,310
2003-04	1,523

Review of In-Town Shuttle Operations and Service

A detailed review was made of the existing Shuttle bus operations. Our findings indicate that the system is well operated and that the quality of service on design days during the ski season is generally acceptable. However, on peak days, the service was rated by visitors as "poor" which is confirmed by the following:

- Single direction line capacity is 841 passengers/hour on a design day and 982 passengers/hour on a peak day. Therefore, while the system is capable of meeting the design day peak period demand, its capacity falls 8 percent short of meeting the peak day peak period demand.

- Average speed, a factor in quality of service, falls to 6 mph which is 30 percent slower than the uncongested average speed of 8.5 mph during off-season.

- The major limitations of the bus system were the dwell times and shared use of the road with the pedestrians. This results in low average speed and reduced vehicle productivity. Because of existing physical limitations, increasing the vehicle capacity or the number of vehicles is considered to be only a short term solution to handling increasing demand. Tight curve radii, limited curb space and general road congestion at peak hours are the major limiting factors in making significant improvements to the In-Town Shuttle bus service.

- Theoretically, eight additional 35-foot buses would be needed to meet the 1995-96 peak day peak period demand, assuming additional problems that cause further average speed reduction are not encountered.

Alternative Express Links to Handle Peak Demand

The source of the high afternoon peak demand has been identified as cross movements between the Village and LionsHead area. Analyses have identified that 23 percent of this demand are skiers whose first lift of the day is in one of these two areas opposite their origin. This could easily account for the morning peak; therefore, it is surmised that 77 percent of the afternoon peaks could easily be skiers who, on their last ski run of the day, end at an area opposite the area where they are overnighting or where their car is parked, or have chosen to use the Shuttle for commercial and/or eating/entertainment destinations. It is also noted that 45 percent of all Shuttle boardings are at LionsHead and Covered Bridge. All of this suggests that the peak demand, which is causing degradation of Shuttle service, might be carried by an express link connecting the two parking structures.

The possibility of using large capacity buses, operating on the Frontage Road, in express service between the two parking structures has been identified. However, the current congestion at the four-way stop is an impediment to this solution. Signalization of the four-way stop is expected to increase its level of service from condition "F" to condition "C" during the evening peak, and would remove this impediment.

Also, a simplified point-to-point express shuttle type people mover has been defined that could connect the two parking structures, with a capital cost estimated at $6 million. The feasibility of such a system rests upon (1) verification by additional data and analysis that a sufficient portion of the peak demand can be carried by such an express link and (2) that an alignment, either on Colorado DOT I-70 right-of-way or along the south side of the Frontage Road is feasible.

Financial Analyses and Feasibility

Representative People Mover Systems for replacing the In-Town Shuttle bus service are believed to be technologically and physically feasible. There will be some hard problems in fitting the system within the landscape and existing built up real estate. Therefore, feasiblity of the project essentially hinges on financial considerations. The annual cash requirements to meet the capital costs of a people mover system, at either $20 million or $15 million, has been examined and found to be within the range of the Town's ability to raise revenues. Final decision of affordability and feasibility rests with the Town's leaders in considering the availability of such revenues compared with other needs.

Alternative ways of funding such a system were briefly examined. It is LEM's conclusion that concession arrangements based totally on private investment are unlikely. The cost to the private sector would be in the range of $2.00 to $2.55 per annual visitor. It is not likely that implementation of a people mover will substantially increase the spending habits of visitors. Therefore, any benefits provided to the private sector will be judged as those which permit continued expansion of the resort and its economic growth. If the private sector were willing to commit 10 percent of said economic growth to a people mover system, the annual amount of growth in gross revenues would be on the order of $27 to $36 million. Any private concession would, therefore, be expected to require substantial subsidy from the Town of Vail.

The potential for Federal or State grants was briefly considered and discarded as a source of funding. No State grants are available and analyses suggest that the system does not meet current Federal thresholds for justifying fixed guideway transit systems. The current Administration in Washington has been reducing the Federal Budget for transit.

A more traditional approach would be to finance the construction of the system by issuing bonds. Whether this will be feasible or not depends mainly on the Town of Vail indebtedness level. Retirement of the bonds and covering the O&M costs could be done as it is now or by creating a mix of visitor taxes. Installation of a fare collection system was not considered because it impedes boarding performance, increases station size and is an inefficient means to obtain revenue since it increases both capital and O&M costs. For example, a 25 cent fare is estimated to be required to cover these extra costs.

A financial analysis was carried out examining the potential to derive funds by increasing various local taxes (e.g. sales taxes, property taxes, lift/resort taxes). Four scenarios were postulated, two of which appear reasonable. For example, a one cent additional sales tax was found totally sufficient to fund the capital and additional O&M costs of the $15 million Starter Line People Mover System. Under another scenario a combination of tax increases, additional one cent sales tax and additional 3.88 millage points to the property tax, could completely fund the capital and additional O&M costs of the $20 million Representative People Mover replacement of the Shuttle.

Conclusions and Recommendations

As a result of this study, the following conclusions and recommendations are made.

- The people mover, as a replacement for the In-Town Shuttle is considered technically and physically feasible. Final feasibility is a financial matter which must be determined by the leaders of the Town of Vail.
- The quality of service of the existing In-Town Shuttle bus is falling below an acceptable level, particularly on peak days. Some of this problem may be solved by increasing bus size and adding buses to the route. However, demand is expected to increase to a level at which such measures will probably no longer be effective. It is recommended that the Town investigate this issue to more depth to determine precisely the limit to which service on the Shuttle can be improved.
- It is recommended that additional study of demand be carried out to determine if significant portions might be carried by an express link connecting the two parking structures.

- The four-way stop should be signalized as it would aid in decreasing traffic congestion which would improve the operation of bus services. It would also make possible a test of express bus services between the two parking structures. Previous experiments with such services are believed to have failed primarily because of congestion at the four-way stop.

- Finally and most importantly, the Town should carry out detailed financial analyses of funding the two concepts for people mover replacements of the Shuttle. These analyses should include the following:

  A. Development of a Project Implementation Plan upon which financial analyses can be carried out.

  B. Study of the Town's current level of indebtedness and potential for increasing it without raising taxes.

  C. Study of potential revenues from various tax increases and how such will allow an increase in the Town's indebtedness level.

  D. Examination of other needs of the Town that will require raising additional revenues and a prioritization of these needs versus the people mover project.

  E. Development of a financial plan, including some alternatives for funding the people mover project, assuming that the Town assesses the project to be feasible.

2.0 INTRODUCTION

2.1 PURPOSE OF THE STUDY

In view of the traffic congestion problems associated with the large influx of skiers into the Town of Vail during the 160-day ski season, Lea, Elliott, McGean & Company (LEM) was engaged to assess the feasibility of utilizing Automated Guideway Transit (AGT) -- or people mover -- technology to improve the circulation of skiers and the visitors within the Town. Projections indicate a growth in the population of the Town of Vail and the peak period In-Town Shuttle demand of 23% by the 1995-96 season and 43% by the 2003-04 season. Therefore, it is imperative that, if the current level of service provided to Vail visitors is to be maintained, transportation system alternatives be examined. In addition, Vail will host the World Skiing Championships in 1989 and there is a concern that the influx of skiers and spectators, coupled with current conditions and growth, will exacerbate the problem of an already overloaded transportation system.

2.2 THE VAIL RESORT ENVIRONMENT

Vail is a young community which owes its existence to the development of Vail Mountain for alpine skiing in 1962 by the Vail Associates, Inc. (VAI). VAI is responsible for the development of the ski-related facilities throughout the Mountain environment. VAI is also engaged in other commercial developments in the area and in other ski facility developments in nearby Beaver Creek.

The Town of Vail is the local government unit in the area; it borders on the ski slopes and provides a full range of municipal functions and facilities, including public transportation. In this role the Town is responsible for the local roads and traffic and operates and maintains the bus system.

During the ski season the Vail bus system, in particular the In-Town Shuttle, serves as a circulator for skiers and visitors, connecting the three lift areas, the two large municipal parking garages, parking lots, and other major traffic generators in Vail. The Shuttle operates primarily on streets with restricted private auto access which limits interference from other vehicles; however, during the ski season these streets become primary pedestrian arteries and the buses are often in conflict with the pedestrian traffic. The relatively few alternative walkways are inaccessible as a result of the accumulation of snow. Adding to the problem is the winding nature of the streets and the fact that they are narrow.

2.3 THE TRANSPORTATION PROBLEM

The primary transportation problem in Vail is associated with the circulation of skiers during peak periods in the ski season. Day skiers arrive in automobiles, Shuttle buses, and intercity buses in the morning and attempt to make their way together with destination (overnight visitors) and local skiers to the three major lift areas. The Town of Vail operates two major public parking garages, one at the Vail Transportation Center with a capacity of 800 cars and one at LionsHead with a capacity of 1,200 cars. In addition, the Town provides an additional 200 public parking spaces on landing mats located in Ford Park and at other locations.

The arrival of the skiers in the morning creates somewhat of a peaking problem because skiers want to get to the slopes as quickly as possible and make optimum use of their lift passes. However, the morning peak is only about one-third as heavy as the afternoon peak. The major parking facilities, the Transportation Center and LionsHead structure, are located within the vicinity of the lift areas. It is observed that many skiers overnighting in the Vail Village/LionsHead area can and do walk to the lift of their choice and that a number of skiers parking do likewise. Inasmuch as the parking facilities and the Transportation Center are not located directly adjacent to any of the lift areas, the travel patterns merge, diverge, and intersect at a number of locations. Moreover, the paths that can be used by the pedestrian skiers are few and often concurrent with the bus paths. Thus, although the Shuttle system provides a means for skiers to circulate through the Town, the Shuttle operates on streets that are primary pedestrian arteries as well and, as a result, conflicts and delays are inevitable.

Actually, the most intense demand upon the bus system occurs during late afternoon/early evening because skiers tend to stay on the slopes as long as possible, but the day tends to end quickly in the mountains and many skiers try to leave at the same time. To absorb the high demand surge, the number of buses in revenue service is increased 100 percent. Buses are stockpiled at heavy demand points and dispatched as soon as they are filled with passengers.

Approximately 23 percent of the peak period Shuttle ridership can be identified as specific cross-movements by skiers whose first lift of the day is opposite of the location of their origin. This leaves 77 percent of the peak demand not specifically identified. Noting that the problem does not occur in the morning suggests that many of the afternoon peak riders (77 percent) may be ending their skiing day at locations opposite from their first lift of the day and require transportation to return either to their cars or overnight locations.

Travel patterns of the skiers fluctuate as facilities on the Mountain are changed and improved. For example, the introduction of the Vista Bahn has greatly affected the attractiveness of the Vail Village lift area. Thus, this area has become a more desirable destination (or "first lift of the day" location) for many of the Vail skiers. The faster quad lifts also make it possible to cross the mountain (Village to LionsHead) on the mountain easier. The effect could be that a number of skiers then end their day opposite of their first lift of the day.

In addition to the above, VAI has currently received approval for improvements that are expected to increase the visitor demand by 23 percent by the 1995-96 ski season. There are additional planned improvements which will increase visitor demand by 43 percent by the 2003-04 ski season.

2.4 CURRENT AND FUTURE DEVELOPMENTS

2.4.1 Mountain Developments

Mountain developments have a significant impact upon the skier population. Mountain developments are primarily of two types: (1) expansion of the ski terrain by opening up additional portions of the Mountain for skiing; and (2) improvement of the skier delivery system through more and/or faster ski lift equipment. The latter, however, has the greatest impact on the skier population because it alone can result in the movement of more persons up the mountain in the same amount of time. This is important because daily lift passes cost a fixed amount and less time in transit results in more time available for skiing. Also, faster lift systems result in an increase in lift capacity, resulting in a higher demand being placed on the slope space and a demand for more slope development.

The VAI Master Plan provides ample evidence of the impact upon capacity of the faster lift systems. The newer detachable grip lifts are capable of moving 2,100 to 2,800 skiers per hour, while fixed grip lifts have a capacity of 1,200 to 1,800 skiers per hour.

VAI has found its new detachable grip lift located at Vail Village to be highly successful and plans to install additional lifts of this type. In addition to higher capacity these lifts make possible longer chairlift lengths, further reducing lift travel time making remote Mountain locations more accessible which is expected to increase cross-mountain ski travel. This capability is quickly recognized by the skiers as shown by the increased percentage of skiers using the Vail Village lifts as the first lift of the day in the 1985-86 season.

We have assumed that the VAI Master Plan provides the best estimate of future skier demand because skier demand will be dependent upon the mountain developments which are accomplished and moreover, since the VAI is dependent upon the skier population for its revenues and development capital.

VAI has indicated that they plan to have in operation at least two new detachable grip lifts by the time of the World Championships. Since the championships are planned to take place in the Vail Village lift area, these two lifts will help to alleviate the skier congestion that could develop as a result of the dislocation of skiers from the Vail Village lift area.

2.4.2 Cascade Village Development

Westin Hotels is developing a major hotel complex in the Cascade Village area which will generate a significant amount of travel on the existing West Vail South Bus Route. There are Mountain development plans which, if carried out, will provide a lift connection up Vail Mountain and could lessen the need for an additional transit connection with Cascade Village. Since the peak demand occurs between the LionsHead area and Vail Village area, one could consider extending the In-Town Shuttle into Cascade Village without seriously affecting the quality of service so long as the fleet size is increased.

2.4.3 Ford Park Developments

Portions of Ford Park in eastern Vail will be used in the ski season 1986-87 for vehicle parking with the installation of aircraft landing mats. In addition, when it is completed, the Gerald R. Ford Amphitheater will become a traffic generator but only during the summer season.

2.4.4 Development of Beaver Creek

VAI is currently pursuing the development of the Beaver Creek area which is near Avon west of Vail. This area is growing faster than Vail in terms of skier population and must be considered a source of competition for the skier population. Interstate 70 is the primary connection between Vail and Avon; there is no transmountain connection between the two facilities.

2.5 STUDY SCOPE

As previously stated, the purpose of this study is to examine the transportation situation in the Town of Vail and to determine the feasibility and cost-effectiveness of installing an Automated Guideway Transit System as a replacement for the In-Town Shuttle. In order to accomplish this purpose, the following tasks were carried out:

- Establish the fundamental transportation requirements in terms of a definition of the current service to be replaced and any improvements in the quality of that service, and estimate needed future capacity.
- Identify the site-specific constraints which must be considered in the development of a people mover system.
- Identify the applicable people mover technologies which might be implemented.
- Identify an appropriate alignment for defining a representative people mover system, upon which feasibility can be examined.

- Prepare preliminary estimates of capital and operating and maintenance (O&M) costs for a representative people mover system which could replace the In-Town Shuttle bus route.
- Develop recommendations regarding feasibility of a people mover system, particularly how such may be determined.

The primary goal of this study is to determine the feasibility of replacing the Vail In-Town Shuttle with a people mover system. This preliminary feasibility study will provide a basis for future decisions regarding public transit provision in Vail and, if appropriate, more detailed engineering design and implementation projects.

3.0 BUS SYSTEM CHARACTERISTICS

This section provides a description of the Vail In-Town Shuttle bus system, which is being studied for replacement by a people mover. Discussions below concentrate upon the physical characteristics of the route, its performance and possibilities for improvement and growth. Ridership is not discussed here as it is treated in detail together with an assessment of demand in Section 4.

3.1 VAIL BUS OPERATIONS

The Town of Vail operates a free municipal bus service which includes the Vail In-Town Shuttle, the East Vail (Bighorn) Service, the Sandstone Route, and the West Vail North and South Service. The Vail bus system is the third largest in the State of Colorado. The bulk of resources, service, and ridership is related to the Shuttle. It is the primary means of passenger circulation in Vail and consequently is of major importance during the ski season.

In addition to the buses operated by the Town of Vail there are other transportation services which are operated principally to accommodate the Vail skiers. These include buses which transport skiers from Denver and other locations; hotel shuttles (vans) which deliver guests/skiers from the outlying hotels; and taxi and limo services. These services deliver passengers to the Vail Transportation Center near Vail Village and to the LionsHead Parking Structure. The hotel shuttles and taxis may also deliver passengers to Golden Peak.

While this study concentrates on the In-Town Shuttle, the other bus routes operated by the Town of Vail cannot be and were not ignored. These routes transfer a number of their passengers to the In-Town Shuttle. Therefore, peak ridership on the West Vail, Bighorn and Sandstone routes was tabulated and analyzed to determine the impact on the peak demand for the In-Town Shuttle. Exhibits 3-1 and 3-2 depict the routes for the West Vail, Bighorn and Sandstone routes. Saturday ridership data is provided in Exhibit 4-7 of Section 4.

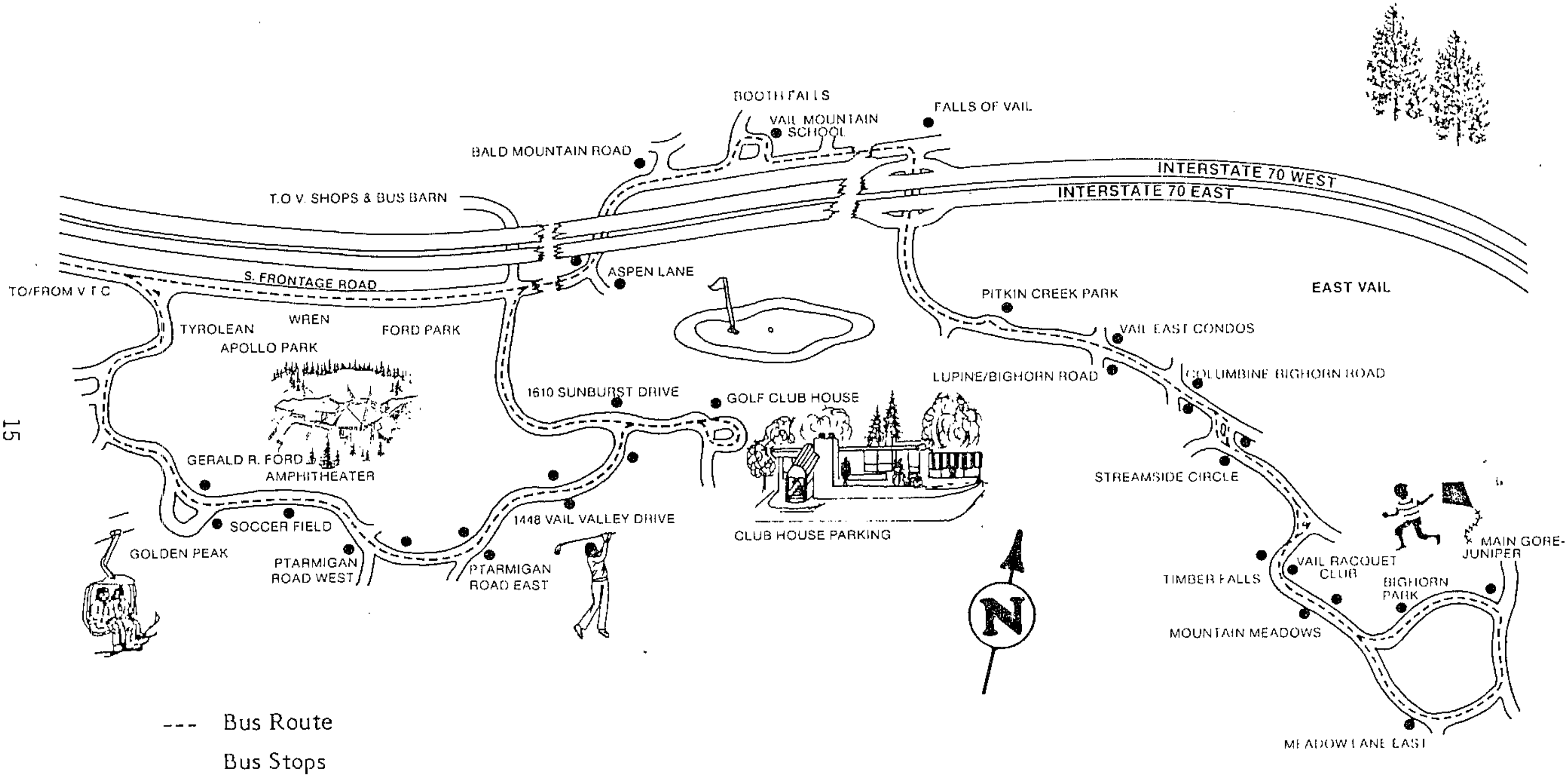
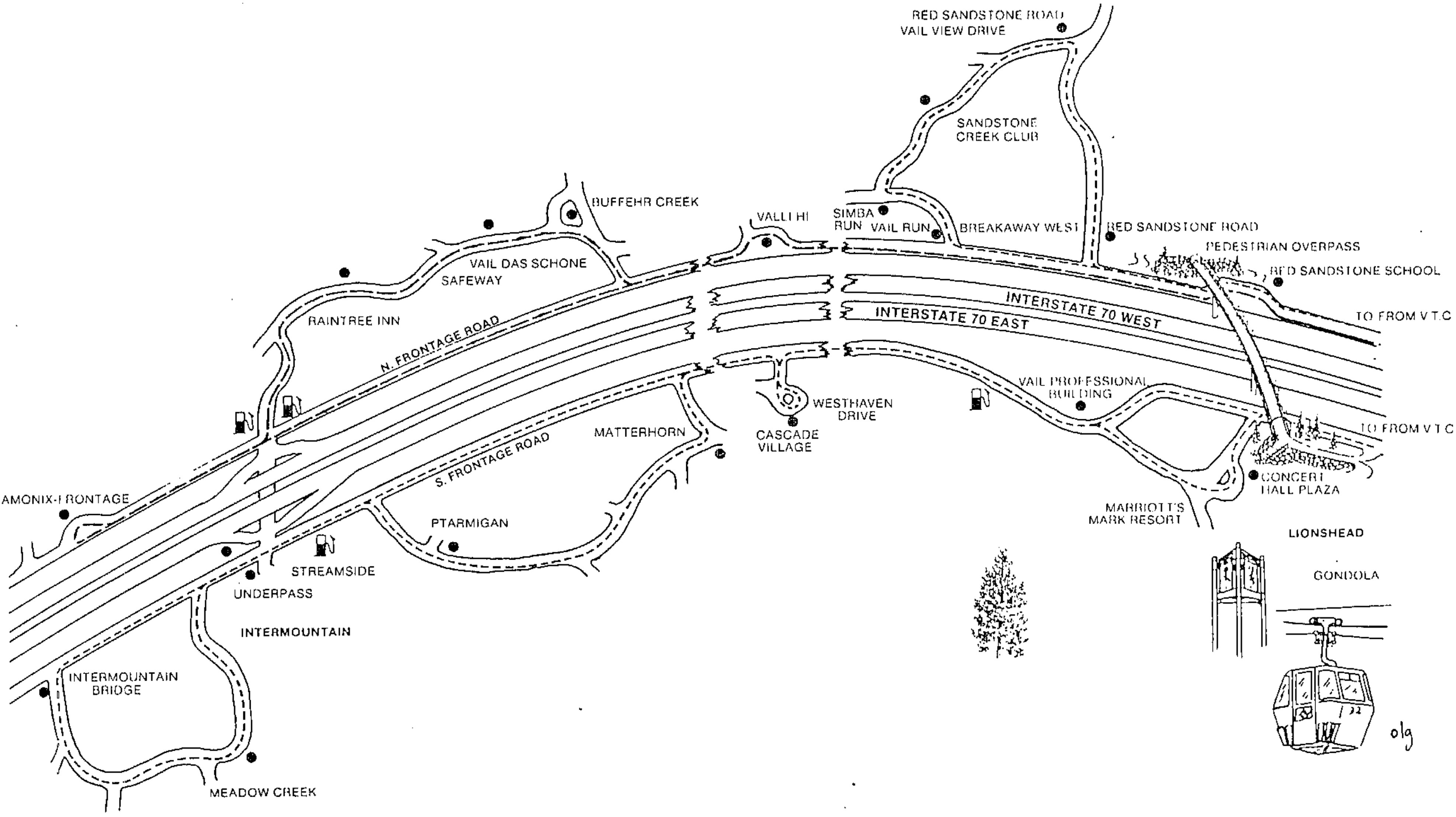


EXHIBIT 3-1: BIGHORN (EAST VAIL) ROUTE



--- Bus Route

● Bus Stops

EXHIBIT 3-2: WEST VAIL AND SANDSTONE ROUTES

3.2 VAIL IN-TOWN SHUTTLE

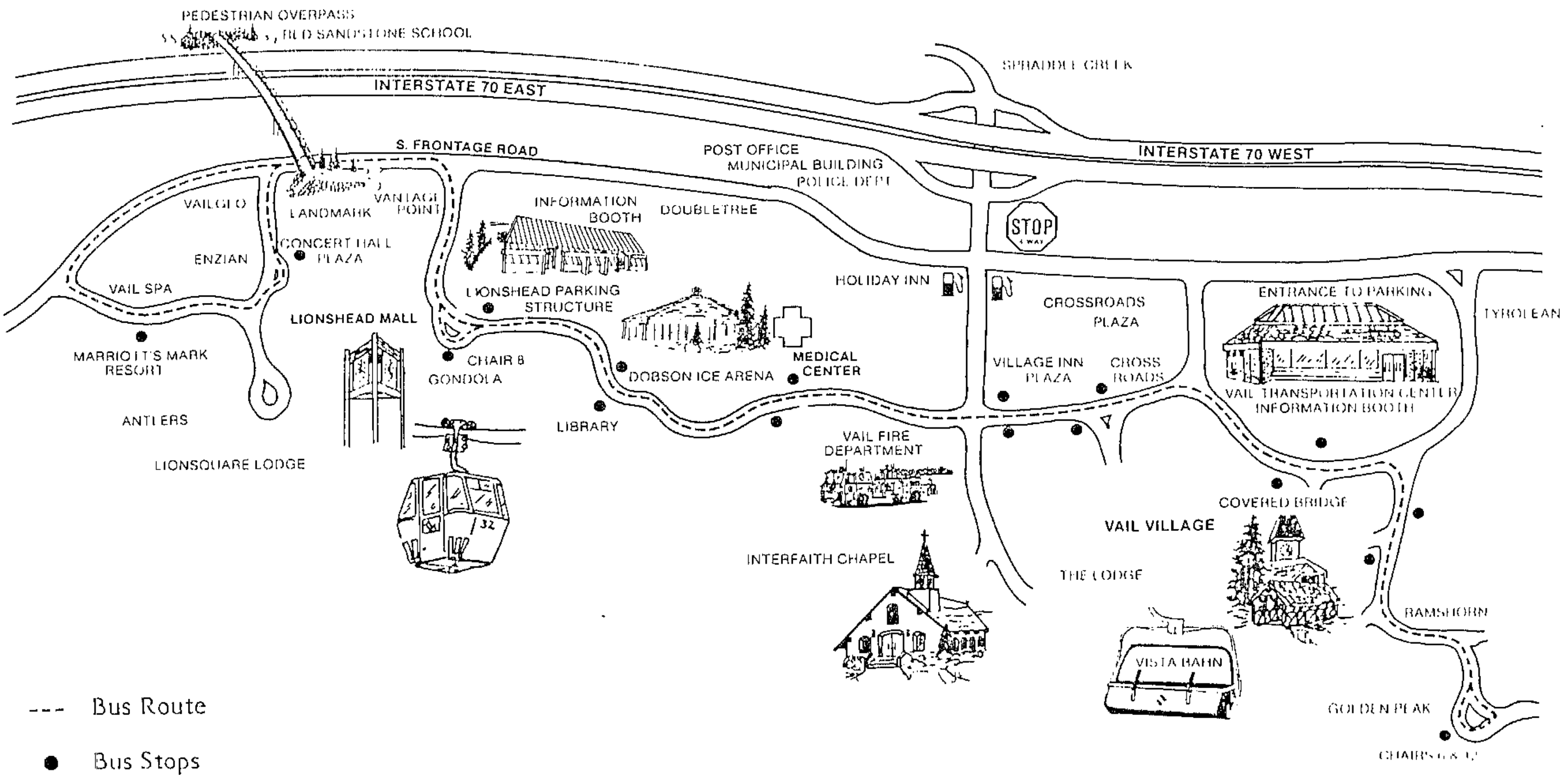
The purpose of the Vail In-Town Shuttle is to provide a circulation system within the center of the Town of Vail. The restriction on vehicular traffic in much of Vail helps to enhance the "European Village" atmosphere and encourages a large amount of pedestrian movement in the Town. The Shuttle offers an alternative to walking for specific point-to-point travel which the bus can accommodate.

The Shuttle is a special purpose system that operates over a 3.5 mile route which is basically a pinched-loop. It operates from 6:45 a.m. to 1:30 a.m. with a planned 5-minute headway during peak periods. Otherwise the buses attempt to maintain uniform spacings. The route is illustrated in Exhibit 3-3. Note that the nature of the street system yields a circuitous route which is not amenable to larger or articulated buses. The Shuttle is the backbone of the Vail Transit System in that it connects the two main focal points -- Vail Village/Golden Peak and LionsHead, which are where most of the lifts are located. The Village and LionsHead are also the main commercial centers. The Shuttle also serves Golden Peak which is the third lift area.

The unique nature of the Shuttle service makes it difficult to compare or evaluate in terms of other bus systems in the U.S., either urban or suburban. Surveys have indicated that the quality of service on the entire bus system provided is rated high by visitors and local residents alike, even though the buses are often in a condition of "standing room only" during the peak periods. However, recent surveys made on peak days have found that the quality of service on the Shuttle was rated as "poor". The manager of the bus system indicated that the longest queue waiting time during the 1985-1986 season was about 15 minutes and that it occurred only once. Generally during peak periods the queue waiting time was not more than 7 to 8 minutes. Ridership/demand on the Shuttle is increasing and causing more crowding of the buses. This will cause further deterioration of the quality of the current service which is falling below the standard desired.

The Vail Shuttle is essential during the ski season because it connects all the entry points to the Town with the three lift areas. The Vail buses are equipped with ski racks and hosts/hostesses are assigned to the major stops along the Shuttle route

EXHIBIT 3-3: IN-TOWN SHUTTLE BUS ROUTE



to assist skiers by establishing waiting lines and taking any other steps to accomplish quick and orderly access and egress by the skiers. During peak periods the skiers must wait from 5 to 10 minutes before boarding a bus.

The time for passenger access and egress is higher during the ski season than during the off-season because skiers must store and retrieve their equipment from the ski racks and because walking in ski boots hampers movement.

The Vail Transportation Center and the LionsHead Parking Structure provide focal points for those skiers arriving via Trailways, Greyhound and Beaver Creek Transit buses, hotel shuttles, and taxis and limos. Persons arriving by auto and parking in the two garages will begin their Vail visit here. The other three Town of Vail bus routes terminate at the Vail Transportation Center.

The Shuttle can be somewhat flexible in terms of route design to meet travel demand because of the restrictions on other vehicular traffic. However, there are few potential route changes that could be made. The most general variation in the route is to turn back some buses at LionsHead toward Vail Village during peak periods.

3.3 SHUTTLE OPERATIONS AND PERFORMANCE

The Shuttle follows a circuitous route as depicted in Exhibit 3-3. Most of the street network consists of two lane pavement with a width varying between 20 and 24 feet and there are generally no sidewalks. Buses and pedestrians (in great number) must share the same space. On heavy demand days during the ski season the streets become congested with pedestrians causing delays to the buses.

The Shuttle is operated from a fleet of ten 1979 model and fifteen 1982 model TMC 30 foot buses, except for one 1982 Orion 35 foot. The schedule of buses operated on the Shuttle route is given in Exhibit 3-4. While as many as 14 buses are assigned to the Shuttle during heavy peak days, the maximum for design conditions is 12. Recommendations were made in the Transit Development Plan Update to purchase six more 35 foot transit buses immediately and then one more per year through 1991.

EXHIBIT 3-4: VEHICLES ASSIGNED TO TOV SHUTTLE BY TIME OF DAY

TIME OF DAY	NUMBER OF VEHICLES ON SHUTTLE	
6:45 A.M.	XX	(2)
7:30 A.M.	XXX	(3)
8:00 A.M.	XXXXX	(5)
8:30 A.M.	XXXXXX	(6)
10:30 A.M.	XXXXX	(5)
11:00 A.M.	XXXX	(4)
12:00 P.M.	XXXX	(4)
1:00 P.M.	XXXX	(4)
2:30 P.M.	XXXXX	(5)
3:00 P.M.	XXXXXXX	(7)
3:30 P.M.	XXXXXXXXXXXX	(12)
4:00 P.M.	XXXXXXXXXXXX	(12)
5:30 P.M.	XXXXXXX	(7)
6:00 P.M.	XXXXXX	(6)
7:00 P.M..	XXXXXX	(6)
8:00 P.M.	XXXXXX	(6)
9:00 P.M.	XXXX	(4)
10:30 P.M.	XXXXX	(5)
11:00 P.M.	XXXX	(4)
12:00 A.M.	XX	(2)
1:30 A.M.	XX	(2)

During 1987, the Shuttle is expected to operate 22,000 bus-hours and 166,000 bus-miles, carrying 2,400,000 passengers. Bus productivity averages 109 passenger-trips per bus hour at a bus average speed of 7.54 mph. At this average speed, a 36 passenger bus (31 seats plus 5 standees) can produce a capacity rate of 77 passengers/hour per direction. If the average trip length is one half the route length, then the bus can handle a total of 308 passenger-trips/hour. At an average of 109 passenger-trips/hour the buses on the Shuttle route are experiencing an average annual load factor of 35 percent which is much higher than that experienced in cities. Considering that during the 160 day ski season the Shuttle carries 3.1 times more passengers than off season, the load factors would be 18 percent off-season and 56 percent during the season. At such a high seasonal average load factor, one can expect extreme crowding during peak periods.

The average speed of the Shuttle route buses during off season is 8.5 mph. During the ski season, this drops to 6.0 mph due to delays caused at boarding/deboarding and increased pedestrians also using the streets.

Exhibit 3-5 tabulates the Shuttle's directional line capacity under various conditions. The yearly average has been chosen as the design condition to illustrate what happens when the buses become overcrowded during the ski season. As the bus fills to a crush condition, there is less room in the aisles for movement. Also, the larger number of passengers require more time in storing their skis and in boarding. These delays are a major cause of the reduced average speed which diminishes bus productivity. The net effect is a 9 percent reduction in line capacity and at least a 20 percent reduction in the quality of service. The phenomenon is similar to the effect of increasing traffic on roads whereby a road will reach its maximum throughput capacity and then diminish rapidly together with slower average speeds as congestion occurs. One can conclude that the Shuttle bus route is being operated over its capacity limits during the peak periods of the ski season. In Section 4.7, this is evident since the 1985-86 peak day demand averages 1,065 passengers/hour, exceeding the Shuttle's capacity by 8 percent with 14 buses operating .

EXHIBIT 3-5: IN-TOWN SHUTTLE DIRECTIONAL LINE CAPACITY

CONDITION	AVG. SPEED (MPH)	BUS CAPACITY (PASSENGERS)	BUS ROUND TRIPS/HR	NO. OF BUSES	CAPACITY PAX/HR
Peak Day Ski Season	6.0	41 (Crush Capacity)	1.71	12	841
				14	982
Yearly Avg.	7.5	36 (Design Condition)	2.14	12	924
				14	1,079
Off Season	8.5	31 (Seated Only)	2.43	12	904

3.4 INCREASING SHUTTLE PERFORMANCE

Demand on the Shuttle route is expected to increase to require a capacity of 1,310 passengers/hour by the 1995-96 ski season and as high as 1,523 passengers/hour by the 2003-04 ski season (See Section 4.7). Demand at 1,310 passengers/hour would require an increase in current Shuttle capacity of 56 percent for 12 buses operating and 33 percent for 14 buses operating.

Initial observations would suggest that the system capacity might be increased by increasing the vehicle size (i.e., by using a 40-foot bus or an articulated bus), increasing the number of vehicles operated during the peak periods and/or by increasing the fleet productivity. The first two options have already been tried and found to be unworkable due to space constraints. The relatively narrow streets and the lack of ski rack equipment of appropriate capacity are the primary reasons that larger capacity buses cannot be used. The 35-foot Orion bus has been operated on the route and is considered to be the largest size bus possible. Changing all buses on the route to the larger size 35-foot buses could potentially increase capacity by about 15 percent. A direct linear increase in capacity will not occur with simply increasing bus capacity because there will be additional delay for a greater number of skiers to store their skis on the outside racks.

Discussions with the transportation system manager and the Town planning staff, as well as our observations on the site, indicate that increasing the number of vehicles beyond a specific point may not result in a significant increase in capacity because the roadway is already congested with buses and pedestrians during the peaks. Because some sections of the bus route are effectively single lane operation and because the roadway width is further constrained during the winter months (snow accumulation) the operational speed of the system could be reduced even further if more buses were added. Also, additional buses would mean less space for pedestrians.

Theoretically, to meet the 1995-96 peak day peak period demand of 1,310 passengers/hour per direction at least six of the larger 35-foot buses would have to be added to the current operating fleet of twelve. Otherwise, a minimum of 17 of the larger 35-foot buses would be required, not accounting for any decreased productivity due to longer dwell time to board the larger bus. When the additional dwell time is taken into account an additional two buses would be required. The greatest potential to reduce dwell time at the stop would be in reducing the need for passengers to store their skis in racks. However, if the skis were carried on-board (a condition which has safety implications) the bus capacity will be diminished. Buses equipped with double wide doors front and rear and lower floors could aid in reducing boarding/deboarding time.

Potential options for increasing vehicle productivity, including reducing the number of bus stops, allowing passengers to board the buses with their skis and providing exclusive bus lanes, were discussed at length with Town of Vail officials. As a result of these discussions, the following can be stated:

- The number of bus stops might be reduced by eliminating one or two if some bus stops were relocated.
- Shared used of the roadway by buses and pedestrians is given; there is essentially no other space for pedestrians to walk.
- Allowing passengers to board the buses with their skis (which would require removing seats to ease circulation of passengers within the vehicle) was ruled out because of the risk of accidents as well as the increased difficulty in boarding.

A final option, decreasing the dwell time, was also considered and found to be of merit. The long dwell time observed during peak periods is primarily due to high passenger demand, crowding on-board the buses and to the time required to store the ski gear on the side of the vehicle. The act of boarding is slowed because it is quite cumbersome to climb the steps of the bus in ski boots. Alighting from a crowded bus also takes more time particularly where passengers are standing in the aisle. Thus, dwell time could be substantially reduced if either the peak demand on the bus system is reduced or if the vehicle boarding time could be reduced, or both.

The overall situation may be improved if residents are provided with ski-gear storage facilities near the lifts. These facilities would allow resident skiers to travel about more freely by providing overnight storage of skis, etc. VAI personnel indicated that VAI was looking at this possibility. We do anticipate that a properly designed storage facility or facilities could substantially reduce the number of destination skiers riding the buses with their skis. If VAI decides to pursue the option of providing a ski gear storage area near the lift facilities, Shuttle operations will be improved as the dwell time is reduced.

3.5 OPERATING AND MAINTENANCE COSTS

The costs to operate and maintain the complete Town of Vail bus system is stated in the Transit Development Plan Update to be $25.03 per bus hour; therefore, the Shuttle at 22,000 bus hours is expected to cost about $550,000 for 1987.

4.0 TRAVEL DEMAND AND RIDERSHIP

Sketch planning type analyses of population, demand and ridership have been carried out utilizing data from other recent reports (Ref. 1, 3 and 4). The objectives of these analyses were as follows:

A. To determine the market base of demand for the Shuttle and any people mover which might replace it, under current conditions and in the future.

B. Characterize current ridership as a function of the market base.

C. Assess the ability of the Shuttle to meet demand and the impact upon quality of service.

D. Develop the required design capacity and points of service for any people mover replacement of the Shuttle.

4.1 THE RESORT ENVIRONMENT AND POPULATION CHARACTERISTICS

As a ski resort Vail is dependent upon the skiing tourist and the 160-day ski season for income generation. The natural beauty of the location and the ambiance of the community make it a summer attraction as well, but to a lesser degree. Transportation problems in Vail are primarily related to the ski season and its peculiar travel characteristics.

Exhibit 4-1 provides a distribution of the peak-day Vail population by type of person for four separate ski seasons. The 1985-86 season population is provided as the base year. Three projection years are provided for the following reasons:

1991-92: Category I and Category II improvements are to be completed by 1992. This includes replacement and upgrading of existing facilities and services and expansion of Vail Mountain and its special permit into the China, Upper Two Elk and Mushroom Bowls.

EXHIBIT 4-1: POPULATION BY TYPE ON PEAK DAYS

TYPE		1985-86		1991-92		1995-96		2003-04	
		PERSONS	%	PERSONS	%	PERSONS	%	PERSONS	%
Skiers	Local	1,445	5.7	1,626	5.7	1,777	5.7	2,060	5.7
	Day	2,408	9.5	2,710	9.5	2,962	9.5	3,434	9.5
	Overnight	12,200	48.3	13,734	48.3	15,007	48.3	17,397	48.3
	Total	16,053	63.5	18,070	63.5	19,746	63.5	22,891	63.5
Nonskiers		2,928	11.6	3,296	11.6	3,602	11.6	4,175	11.6
Employees		5,619	22.2	6,324	22.2	6,911	22.2	8,012	22.2
Employee Dependents		678	2.7	763	2.7	834	2.7	967	2.7
TOTAL		25,278	100	28,453	100	31,093	100	36,045	100

1.1256 in 6 years; 2% growth/year

1.230 in 10 years; 2.1% growth/year

1.426 in 18 years; 2% growth/year

Source: Reference 3

1995-96: A ten-year point to use as the design condition for any initial portion of a people mover system.

2003-04: When Category III improvements are completed -- expansion into Super Bowl.

From this data it is important to note that skiers dominate the population at 63.5 percent and are believed to dominate the In-Town Shuttle ridership during the peak hours. Employees and non-skiers are observed to be riding the shuttle mainly at hours different than the peak periods. Growth projections, based upon the Category I, II and III expansion projects, were apparently averaged out to be 2 percent per year.

Exhibit 4-2 provides a distribution of employees and visitors according to four geographical areas of the Town, which are depicted in Exhibit 4-3. While the data of Exhibits 4-1 and 4-2 do not match arithmetically, apparently due to the modeling procedures (Ref. 3), they are sufficiently close for use in stratifying the market base of demand for the In-Town Shuttle to make the following observation:

> The LionsHead/Vail Village area, served by the In-Town Shuttle, is 98 percent occupied by visitors which represent 59 percent of all visitors in the town. This does not appreciably change for the 6, 10 and 18 year projections. Therefore, one may anticipate that shuttle peak hour ridership to be dominated by skiers who begin the day as overnight residents and day skiers parking in the LionsHead/Vail Village Area.

Exhibit 4-4 provides a distribution of skiers only coming from the four geographical areas. While these data do not arithmetically match exactly the data of Exhibit 4-1, apparently due to the modeling procedures (Ref. 3), they are sufficiently close. Here it is noted that overnight skiers from the LionsHead/Vail Village area are 57 percent of all resident skiers, dropping only to 55 percent in 1995-96 and 53 percent in 2003-04.

4.2 PARKING

The current parking capacity reported by (Ref. 4) in the LionsHead/Vail Village area is as follows:

EXHIBIT 4-2: DISTRIBUTION OF EMPLOYEES AND VISITORS

TYPE	1985-86 PERSONS	%	1991-92 PERSONS	%	1995-96 PERSONS	%	2003-04 PERSONS	%
West Vail Area:								
Employee	1,495	33	1,741	33	2,185	34	2,613	33
Visitor	3,098	67	3,552	67	4,303	66	5,280	67
Total	4,593	100	5,293	100	6,488	100	7,893	100
LionsHead/Vail Village Area:								
Employee	266	2	275	2	313	3	329	2
Visitor	11,127	98	11,474	98	13,041	97	13,749	98
Total	11,393	100	11,749	100	13,354	100	14,078	100
Vail Golf Course Area:								
Employee	654	21	671	22	763	22	791	22
Visitor	2,390	79	2,443	78	2,687	78	2,768	78
Total	3,044	100	3,114	100	3,450	100	3,559	100
East Vail Area:								
Employee	1,686	42	1,775	42	2,058	42	2,260	42
Visitor	2,287	58	2,462	58	2,821	58	3,182	58
Total	3,973	100	4,237	100	4,879	100	5,442	100
Total:								
Resident Employees	4,101	16	4,462	16	5,319	18	5,993	17
Visitors	18,902	75	19,931	70	22,852	73	24,979	69
Out of Town Employees	1,518	6	1,862	6	1,592	5	2,019	6
Difference from Exhibit 4-1	757	3	2,198	8	1,330	4	3,054	8
TOTAL	25,278	100	28,453	100	31,093	100	36,045	100

Source: Reference 3, except that the number of out-of-town employees was calculated to force the data to match with Exhibit 4-1

EXHIBIT 4-3: TOWN OF VAIL RESIDENTIAL AREAS

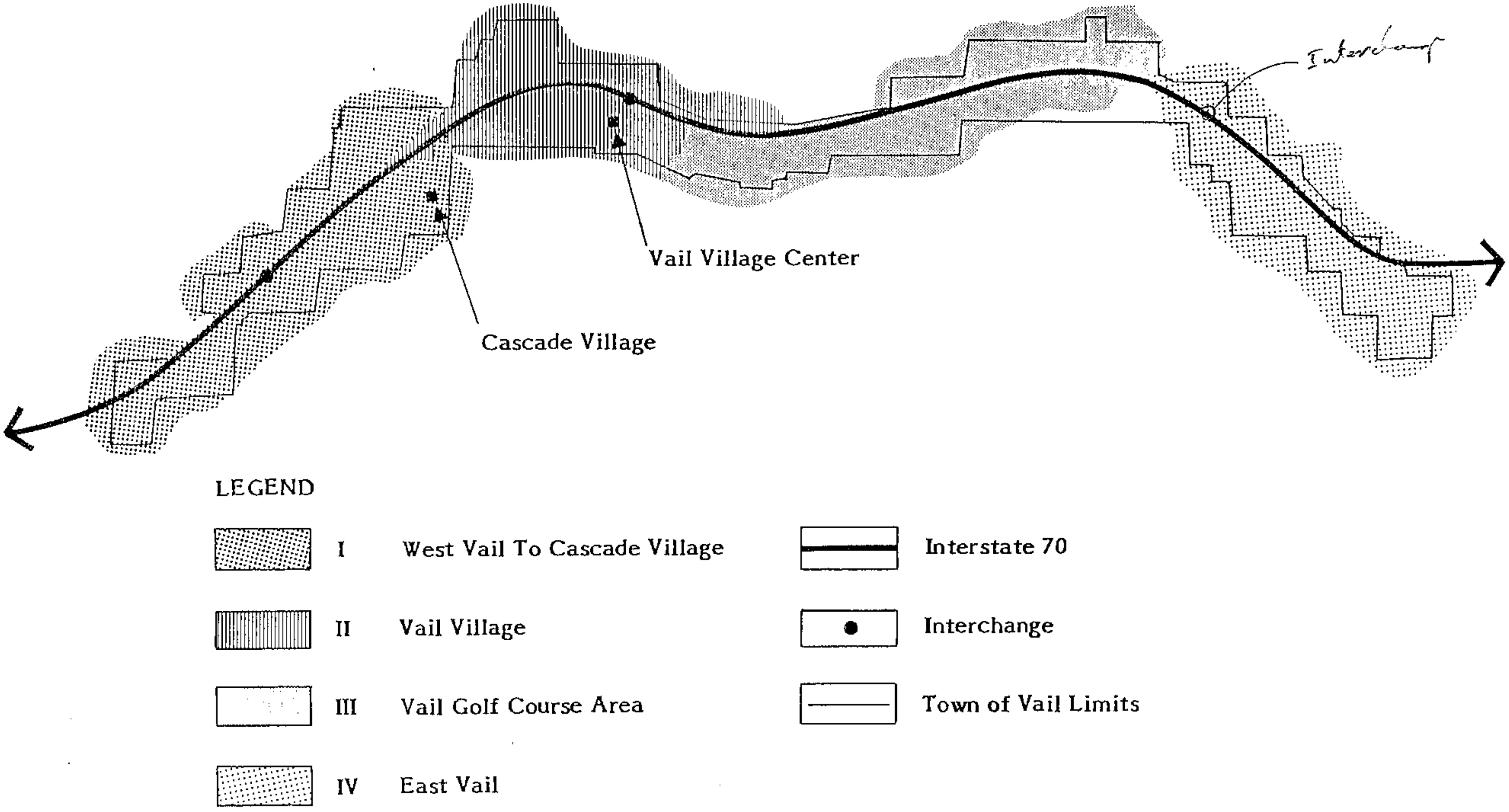


EXHIBIT 4-4: DISTRIBUTION OF PEAK DAY SKIERS

ORIGIN OF SKIER		NUMBER OF SKIERS			
		1985-86	1991-92	1995-96	2003-04
West Vail Area:					
	Overnight	2,354	2,700	3,269	4,012
	Local	149	174	219	261
LionsHead/Vail Village:					
	Overnight	8,456	8,720	9,911	10,449
	Local	27	27	31	33
Vail Golf Course Area:					
	Overnight	1,816	1,857	2,042	2,103
	Local	65	67	76	79
East Vail Area:					
	Overnight	1,738	1,871	2,145	2,418
	Local	169	178	206	226
TOTAL		14,774	15,594	17,899	19,581

Source: Reference 3

Vail Village and Golden Peak

2,170 private spaces (condos/lodges/commercial level)
800 public spaces in Transportation Center
287 other public spaces

LionsHead

2,538 private spaces (condos, lodges, and VAI lots)
1,200 public spaces in LionsHead Structure

Also the following parking use by skiers was reported in (Ref. 4) as the response to the question "Where is your car parked today?" from a 1985 survey:

Transportation Center	21%
LionsHead Structure	13
LionsHead West Day Lot	4
Golden Peak	3
Condo/lodge/home	35
Frontage Road	0
Beaver Creek	1
Other	5
NA/Have no car in town	18

The most important fact from these data is that approximately 53% of all skiers do not park cars at the beginning of the ski day. Therefore, it must be concluded that they either walk or ride the bus to reach their first lift of the day.

From five separate license plate surveys conducted from December 21, 1985 to March 15, 1986 by the Department of Public Works, it was found that 24 percent of the Transportation Center's capacity and 15 percent of the LionsHead Structure's capacity is utilized by locally registered automobiles, which are assumed to be employees and local residents. The remaining spaces are expected to be utilized primarily by visitors. It was also reported by the Department of Public Works that the Transportation Center either filled (or almost filled) to capacity 83 times in 1984-85 and 97 times in 1985-86, whereas the LionsHead Structure filled to capacity only once in 1984-85 and 15 times in 1985-86.

Exhibit 4-5 presents the results of a VAI survey taken during the 1985-86 season correlating where skiers park with the first lift they use during the day. These data indicate that cross traffic was small on the day the survey was made. Skiers arriving in cars were parking close to the location of their first lift of the day. For example, only 7.6 percent of the skiers parking at the LionsHead Structure used lifts in the Village Center or Golden Peak area as the first lift of the day. Similarly, only 7.6 percent of skiers parking at the Transportation Center used Lionshead area lifts first in the day. However, it is not known if these data correlate with a peak or average day. Data from a survey taken in the 1984-85 season (Table 14.1 of Ref. 3) seems to indicate cross-movements for a day having 15,513 skiers.

Discussions with Town officials indicate an average automobile occupancy of cars parking to be about 2.5. Calculations using data from (Ref. 3) were made as follows:

$$\frac{\text{11,455 skiers parking}}{\text{3,117 cars}} = \text{3.68 skiers/car}$$

2,135 other cars parking, assumed to have only the driver as the occupant

$$\frac{\text{2,135 non-skiers + 11,455 skiers}}{\text{2,135 + 3,117 cars}} = \text{2.59 persons/car}$$

The calculated average of 2.59 persons/car appears to confirm the average occupancy indicated in discussions with Town officials and the calculations of 3.68 skiers/car. Further calculations from (Ref. 3) project a future occupancy of 3.2 skiers per parked car. Therefore, an occupancy rate of 3.6 skiers per car has been assumed for the analyses of demand in this report.

4.3 IN-TOWN SHUTTLE RIDERSHIP

In-Town Shuttle annual ridership reported in the Transit Development Plan (TDP) Update (Ref. 1) was as follows:

1983	1,906,878 riders

EXHIBIT 4-5: QUESTIONNAIRE RESULTS INDICATING SKIER PARKING LOCATION AND FIRST LIFT OF THE DAY

(1985-86 SEASON)

Question : q57

Where is your car parked today?		BASE	What was your first lift today?					
			Gondola	Lift 8 Lions-Head	Lift 1 Village	Vista Bahn Express	Lift 12 Gopher Hill	Lift 6 Gold Peak
BASE		950	278	133	25	442	13	54
N/A-no car in Vail	1	186	53	33	6	74	4	15
		19.6	19.1	24.8	24.0	16.7	30.8	27.8
			28.5	17.7	3.2	39.8	2.2	8.1
Beaver Creek	2	4	1	0	1	2	0	0
		0.4	0.4	0.0	4.0	0.5	0.0	0.0
			25.0	0.0	25.0	50.0	0.0	0.0
Golden Peak	3	22	0	0	0	11	5	5
		2.3	0.0	0.0	0.0	2.5	38.5	9.3
			0.0	0.0	0.0	50.0	22.7	22.7
Transport. Center	4	210	12	4	5	183	0	5
		22.1	4.3	3.0	20.0	41.4	0.0	9.3
			5.7	1.9	2.4	87.1	0.0	2.4
LionsHead Parking	5	118	79	30	2	6	1	0
		12.4	28.4	22.6	8.0	1.4	7.7	0.0
			66.9	25.4	1.7	5.1	0.8	0.0
LionsHead West	6	42	22	17	0	3	0	0
		4.4	7.9	12.8	0.0	0.7	0.0	0.0
			52.4	40.5	0.0	7.1	0.0	0.0
Condo/lodge/home	7	308	98	42	9	133	2	22
		32.4	35.3	31.6	36.0	30.1	15.4	40.7
			31.8	13.6	2.9	43.2	0.6	7.1
Other	9	60	13	7	2	30	1	7
		6.3	4.7	5.3	8.0	6.8	7.7	13.0
			21.7	11.7	3.3	50.0	1.7	11.7
			LionsHead		Village Center		Golden Peak Area	

Source: Vail Associates, Inc.

1984	2,069,162 riders (8.5% increase)
1985	2,141,734 riders (3.5% increase)

The TDP also projected ridership increases at 3.5 percent per year.

The Department of Public Works reported* the following ridership for the In-Town Shuttle during the ski season only:

1984-85	1,618,791 riders, average of 10,117/day**
1985-86	1,623,397 riders, average of 10,146/day

Ridership data was provided on a daily basis from January 1, 1985 through November 30, 1986. These data are a result of counts and estimates made and reported by the bus drivers, as no fare is collected or other mechanical means of counting passengers is utilized. The accuracy of the data cannot be verified; therefore, it can be treated only as representative data.

The primary transportation problems of the ski season are associated with a regular occurrence of peak traffic demands on the weekends. It is recognized that heavier demands occur depending upon snow conditions and on holidays. For the purposes of analyzing demand and developing transit system capacity requirements a "design condition" must be defined. This design condition has been defined for Vail to be the regular occurring peak ridership, which is observed from ridership data to be best represented by that occurring on Saturdays.

Exhibit 4-6 provides the ridership counts for Saturdays during the 1985 and 1986 ski seasons. The average of 13,962 for 1986 is 8.9 percent higher than the average of 12,826 for 1985.

VAI, with respect to data, refers to a "peak day" and a "design day" for planning and sizing facilities. Demand for a peak day is approximately 1.27 times that of a design day. The daily ridership data for December 26, 1986 was 17,585 and also annotated with "every bus was out and still couldn't handle the crowds." If

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* Source: May 7, 1986 Memo by Stan Berryman

** Calculated on basis of 160 days per season

EXHIBIT 4-6: REGULARLY OCCURRING IN-TOWN SHUTTLE PEAK RIDERSHIP DURING SKI SEASON

(Saturdays Only -- Excluding Holidays)

1985		1986	
JAN 5	14,361	JAN 4	14,124
12	11,328	11	12,913
19	10,118	18	13,955
26	12,263	25	12,359
FEB 2	9,378	FEB 1	13,944
9	10,709	8	12,565
16	13,786	15	15,864
23	11,888	22	15,601
MAR 2	14,569	MAR 1	14,991
9	14,639	8	13,825
16	14,303	15	15,597
23	15,769	22	17,019
30	13,996	29	16,858
APR 6	14,750	APR 5	11,495
13	10,532	12	8,314
TOTAL	192,385	TOTAL	209,424
AVERAGE	12,826	AVERAGE	13,962

Source: Ridership data provided by Public Works Department

17,600 riders is used as the "peak day" condition and 14,000 riders used as the "design day" condition, then a ratio of 1.26 results for peak/design. Therefore, for analyzing demand data a peak ridership of 17,600 passengers will be assumed which can be correlated with peak day population statistics. The current design condition, however, is assumed to be 14,000 riders/day and will be the basis for projecting future design capacity requirements.

Exhibit 4-7 provides the Saturday ridership on the other three Vail bus routes. Since some of these passengers may be transferring to the Shuttle, correlated data has been tabulated.

In addition, there were 808,444 passengers carried by taxis and lodge-owned vehicles in 1985. With 75 percent being carried during the 160 day ski season, the season average is calculated to be 3,790 passengers per day.

4.4 RIDERSHIP DEMAND AND SHUTTLE CAPACITY

Data distributing the passengers over the day was not available. Therefore, Exhibit 4-8 provides an estimate of this distribution using the scheduled fleet allocation. This procedure is believed to be sufficient for evaluating demand during the peak period of the day. It is noted that a ridership rate of 1,694 passengers/hour occurs over the time 3:30 to 5:30 p.m. as skiers are leaving the slopes on a design day. Most lifts are closed by 3:30 p.m. If ridership is evenly balanced in both directions, the ridership rate per direction would be 847 passengers/hour; which is consistent with the directional capacity of 841 passengers/hour calculated in Exhibit 3-3 for a design day.

For a "peak day" condition with ridership of 17,600 passengers, the single direction rate during the peak period will be 1,067 passengers/hour. When this occurs additional buses are diverted from other routes to the In-Town Shuttle route. For each bus diverted the directional capacity can be increased by 70 passengers/hour. Local officials say that usually two buses are added. This would increase the capacity to only 981 passengers/hour per direction which is still insufficient to handle the peak day peak period demand as it occurs. The result is overcrowding of the buses, longer queues for boarding, longer waits and a spreading of the peak period -- all of which can be considered as a degradation in the quality of service.

EXHIBIT 4-7: RIDERSHIP ON OTHER BUS ROUTES

(1986 Ski Season -- Saturdays Only)

DAY	ROUTE		
	West Vail (Peak = Design)	Bighorn (East Vail) (Peak = 1.26 x Design)	Sandstone
JAN 4	2,614	2,044	1,734
11	2,461	1,898	1,140
18	2,372	1,940	991
25	2,301	1,591	1,096
FEB 1	2,063	1,807	1,201
8	2,476	2,186	1,124
15	2,349	2,503	1,726
22	2,585	2,017	1,469
MAR 1	2,641	2,081	1,719
8	2,452	1,830	1,443
15	2,629	2,297	1,818
22	2,741	1,903	1,499
29	2,153	1,950	1,548
APR 5	1,888	825	994
12	1,346	685	648
TOTAL	35,071	27,557	20,150
AVERAGE	2,338	1,837	1,343
Terminus	Vail Transp. Ctr.	Vail Transp. Ctr.	Vail Transp. Ctr.
Headway at Terminus During Peak	12 min. 180/hr	15 min. 144/hr	17 min. 127/hr

Source: Ridership data provided by Public Works Department

EXHIBIT 4-8: DISTRIBUTION OF SHUTTLE RIDERSHIP OVER PERIOD OF DESIGN DAY

TIME PERIOD	PERCENT TOTAL RIDERSHIP %	 %/hr	DEMAND RATE Passengers/hr
6:45 - 7:30 a.m.	1.5	2.0	280
7:30 - 8:00 a.m.	1.5	3.0	420
8:00 - 8:30 a.m.	2.5	5.1	714
8:30 - 10:30 a.m.	12.1	6.1	854
10:30 - 11:00 a.m.	2.5	5.1	714
11:00 - 2:30 p.m.	14.1	4.0	560
2:30 - 3:00 p.m.	2.5	3.0	420
3:00 - 3:30 p.m.	3.5	7.1	994
3:30 - 5:30 p.m.	24.2	12.1	1,694
5:30 - 6:00 p.m.	3.5	7.1	994
6:00 - 9:00 p.m.	18.2	6.1	854
9:00 - 10:30 p.m.	6.1	4.0	560
10:30 - 11:00 p.m.	2.5	5.1	714
11:00 - 1:30 a.m.	5.0	2.0	280

Source: Calculated using the scheduled fleet allocation

If an "acceptable quality of service" is defined as provided by a capacity of 841 passengers/hour per direction one can easily observe that "unacceptable levels of service" will exist on peak days. Increasing the bus size to the larger 35-seater Orions may increase capacity by 15 percent (1,009 passengers) but will still not be sufficient to handle peak day demand. Also, it is not clear that adding additional buses during the peak period will result in increased capacity, particularly if there is any reduction in overall average speed due to congestion along the route.

4.5 TRAVEL DEMAND CHARACTERISTICS

Prior to a description of the travel demand characteristics of interest to this study, it is instructive to describe in general terms the travel scenario in Vail. The primary travel demand involves the movement of skiers to the three lift areas in the morning and their return in the afternoon. Destination skiers overnighting in the Village/LionsHead area move from their room/condo/apartment/home to the lift of their choice (first lift of the day); they move on foot or on foot and by bus. Destination skiers overnighting in other areas of the Town and day skiers leave their access mode (personal auto, limo, van, bus, etc.) primarily at Vail Transportation Center or LionsHead Structure and move on foot or on foot and by bus to the lifts. The lifts can begin operation at 7:30 a.m., but normally begin at 8:30 a.m. and cease operation at 3:30 p.m. Thus the skiers, in attempting to maximize their time on the slopes, generate a travel demand pattern quite similar to the diurnal work travel pattern of an urban area or large employment center, i.e., a high inbound movement in the morning but higher outbound movement in the late afternoon when the lifts close. This is reflected by the bus assignment schedule for the Shuttle which was shown in Exhibit 3-4.

Thus, travel demand as it relates to this study focuses on the movement of skiers into the Vail Village/LionsHead area and the movement of skiers from their access mode of travel to the ski lift areas in the morning and the return movements in the late afternoon. It is the identification and understanding of these movements which are essential to the determination of fixed guideway transit system feasibility.

Peak demands on the Shuttle at each of its stops provide an indication of the major demand points along the shuttle route. (See Exhibit 4-9.) These data are also

EXHIBIT 4-9: DISTRIBUTION OF PASSENGER BOARDINGS BY BUS STOP

	BUS STOP	PERCENT
1.	Gold Peak	8.0
2.	Tivoli/Garden of the Gods VAC)	2.0
3.	Covered Bridge	20.0
4.	Crossroads	16.0
5.	Vail Village Inn Plaza	9.0
6.	Vail Valley Medical Center	4.0
7.	Ice Arena	6.0
8.	LionsHead-East	25.0
9.	Marriott's Mark	6.0
10.	LionsHead-West (Concert Hall Plaza)	4.0

Source: Reference 1, Transit Development Plan Update presented on the route map in Exhibit 4-10. The high passenger boardings (45 percent) at Covered Bridge (Vail Transportation Center) and the LionsHead-East are reflective of each of these stops being both a parking terminal and a gateway to a major lift area. It is also noted that 78 percent of the demand occurs along the route between LionsHead and Covered Bridge. This has been recognized by the Transit Department by having empty buses turning back at these points. One could also consider that any initial people mover system be constructed between these two points and be extended in the future only as demand occurs. Buses could then be used as feeders operating on short routes in the Golden Peak area and the loop to Marriott's Mark Resort and possibly to Cascade Village.

Exhibits 4-11 and 4-12 provide an estimate of the market base of demand for ridership on the In-Town Shuttle. Data is given for a peak day as defined by VAI. Similarly, shuttle ridership on a peak day would be 17,600 passengers. Only the visitor population has been counted in determining the market base. Observations and discussions with city officials suggest that the peak period shuttle ridership is dominated by visitors (mainly skiers) since employees ride at different hours of the day. The main purpose of the demand estimate is to determine the capacity requirements for people mover replacement of the shuttle, which will be dictated by the demand during the peak period.

From Exhibit 4-12, it is noted there is a predominance of the market (64.3 percent when including day visitors) contained within the Village/LionsHead area. While the total market base increases by 23 percent in 1995-96 and 43 percent in 2003-04, the Village/LionsHead area remains predominate. The most significant shift due to growth is projected for the West Vail area.

Many of the visitors shown as originating in the Village/LionsHead area can walk to their first lift of the day. However, the other 36 percent of visitors outside the central area must use some vehicular means to do so. Exhibit 4-13 is an estimate of how the peak day visitors may be accessing the Village/LionsHead area. The 1,622 visitors arriving by hotel/lodge vans and taxis are dropped off at destinations of their choice: either the LionsHead Structure, the Transportation Center or Golden Peak; therefore, they are not counted as part of the specific peak period demand for the Shuttle.

EXHIBIT 4-10: PASSENGER DEMAND OVER THE IN-TOWN SHUTTLE ROUTE

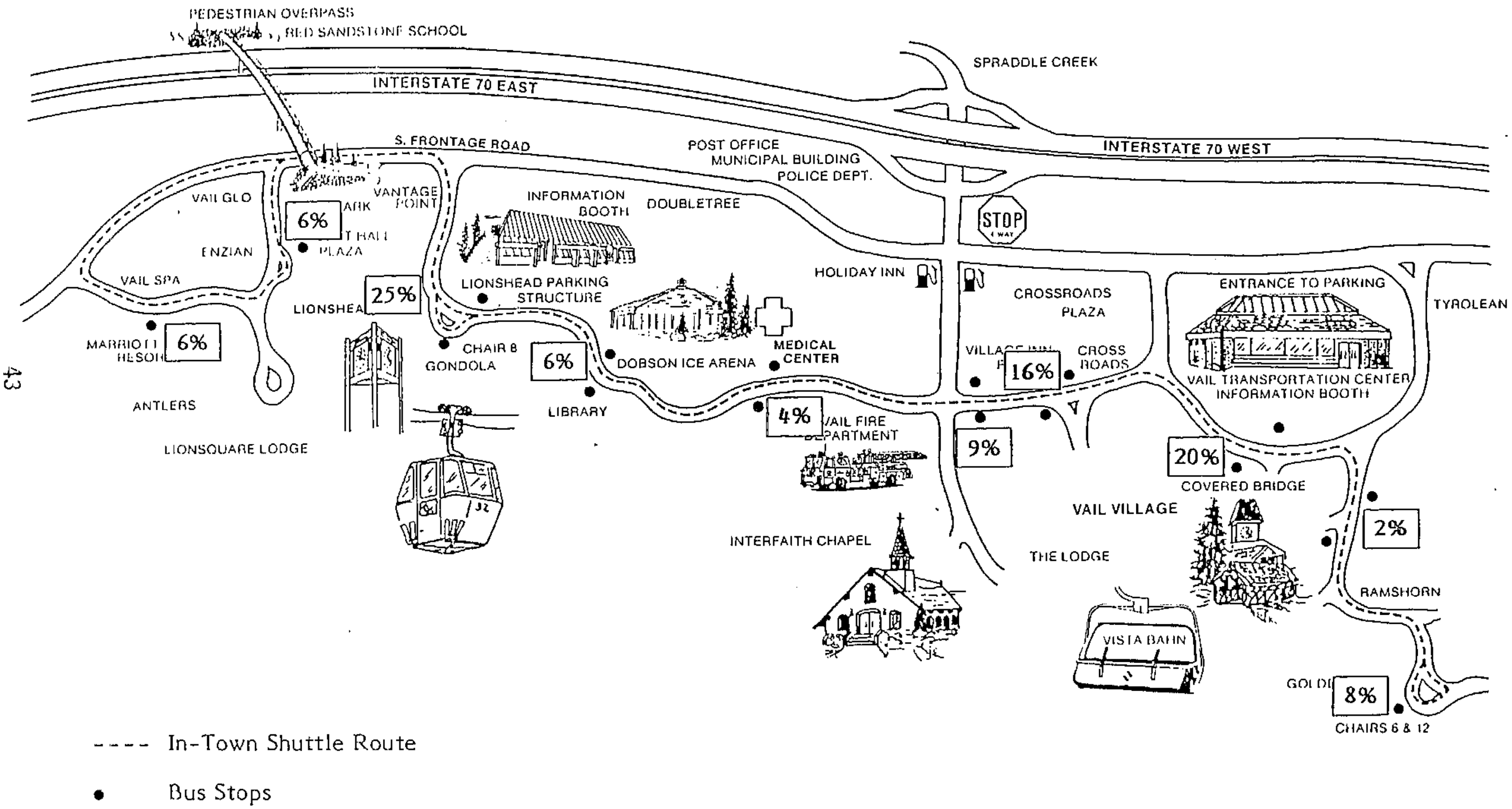


EXHIBIT 4-11: PEAK DAY MARKET BASE OF DEMAND FOR IN-TOWN SHUTTLE

(1985-86 Ski Season)

Assumption: Peak Period Demand (3:30 - 5:30 p.m.) is dominated by visitors; employees travel at different times.

TYPE VISITOR		SKIERS	NON-SKIERS	TOTAL
1985-86	Day	2,408	483	2,891
	Overnight	12,200	2,445	14,645
	Total	14,608	2,928	17,536
1995-96	Day	2,962	594	3,556
	Overnight	15,007	3,008	18,015
	Total	17,969	3,602	21,571
2003-04	Day	3,434	688	4,122
	Overnight	17,397	3,487	20,884
	Total	20,831	4,175	25,006

EXHIBIT 4-12: DISTRIBUTION OF PEAK DAY MARKET BASE OF DEMAND FOR SHUTTLE

(1985-86 Ski Season)

LOCATION	OVERNIGHT VISITORS		DAY VISITORS	TOTAL	
	NUMBER	%		NUMBER	%
1985-86					
West Vail	2,329	15.9	0	2,329	13.3
Village/LionsHead	8,377	57.2	2,891	11,268	64.3
Golf Couse/East Vail	3,939	26.9	0	3,939	22.4
TOTAL	14,645	100	2,891	17,536	100
1995-96					
West Vail	3,279	18.2	0	3,279	15.2
Village/LionsHead	9,962	55.3	3,556	13,518	62.7
Golf Course/East Vail	4,774	26.5	0	4,774	22.1
TOTAL	18,015	100	3,556	21,571	100
2003-04					
West Vail	4,260	20.4	0	4,260	17.0
Village/LionsHead	11,152	53.4	4,122	15,274	61.1
Golf Course/East Vail	5,472	26.2	0	5,472	21.9
TOTAL	20,884	100	4,122	25,006	100

EXHIBIT 4:13: ESTIMATE OF PEAK-DAY VISITORS ARRIVING OR DEPARTING VAIL VILLAGE/LIONSHEAD AREA

(1985-86 Ski Season)

ORIGINATING AREA	BY TOV[1] BUS	BY PRIVATE[2] SERVICES	BY CAR (to be parked)	TOTAL
West Vail	896	603	830	2,329
Golf Course/ East Vail	408	1,019	2,512	3,939
Outside (Day Visitor)	0	?[3]	2,891	2,891
TOTAL	1,304	1,622	6,233	9,159

NOTES:

1. Exhibit 4-7 ridership averages were used for the West Vail, Bighorn and Sandstone Routes. Ridership was reduced by one-third, the same ratio of employees living in the originating area. Each rider assumed to make 3 trips/day (one round trip for skiing plus half made round trips for eating/entertainment).
2. Private services carrying 3,790 passengers/day were factored according to the distribution of overnight visitors in Exhibit 4-12.
3. There are intercity and chartered buses bringing day-skiers. These data were not available.

Exhibit 4-13 estimates that 1,304 visitors are brought to the Transportation Center by the other three bus routes. Based on a 43 percent split to LionsHead lifts (Ref. 4) the number of transfers to the Shuttle is estimated to be about 560.

From Reference 4, there are 1,087 public parking spaces in the Village Center/Golden Peak area and 1,200 at LionsHead Structure -- a total of 2,287 spaces. If 20 percent of all public parking is used by employees and locals, there remain 1,830 spaces for visitors. At 3.6 visitors per car (see Section 4.2), there is parking capacity for 6,588 visitors. This capacity is close to and not exceeded by the estimate in Exhibit 4-13 that 6,233 visitors arrive in the Town center by car, which should be the case since LionsHead Structure is generally not filled to capacity. As a check, this lends credibility to the estimate of Exhibit 4-13.

During the 1984-85 season, the Transportation Center was found to fill to 765 cars on weekends while LionsHead Structure filled only to 600 cars (Ref. 3). During the 1985-86 ski season the Transportation Center was reported to be filled to capacity over half the time. Two sample calculations are of interest when the Transportation Center and all public spaces in the Village/Golden Peak area are filled.

Sample Calculation I: Utilization of LionsHead Structure

All spaces in Village Center/Gold Peak filled		1,087
Less spaces filled by Employees/Locals at 20 percent		217
Net spaces for Visitors		870
Number of Visitors arriving by car (Exhibit 4-13)		6,233
Less Visitors parking in Village Center/Golden Peak	3.6 x 870 =	3,132
Net Visitors diverted to LionsHead Structure		3,101
Spaces in LionsHead Structure occupied by Visitors	3,101/3.6 =	861
Total spaces in LionsHead Structure occupied by Visitors, Employees and Locals, noting that Visitors and Locals occupy 15 percent of those spaces	861/0.85 =	1,013

Sample Calculation II: Diversion of Cars to LionsHead

When public parking in the Transportation Center and Golden Peak area fill to capacity, traffic is diverted to LionsHead. The utilization of LionsHead is estimated to be 627 cars when this occurs.

Total spaces in LionsHead		1,200
Less spaces utilized		627
Net spaces for Overload		573
Less spaces for employees/locals at 15 percent of 573		86
Net spaces for skiers		487
Overload capacity in skiers	3.6 x 487 =	1,753

If the 43 percent split to LionsHead lifts and 57 percent to Village Center/Gold Peak lifts remained constant then the overload skiers capacity using the Shuttle would be

0.57 x 1,753 = 999

From sample Calculation I, there are 1,013 spaces in LionsHead Structure utilized, 84 percent of its capacity. The 999 extra shuttle riders in Sample Calculation II was calculated for the case when LionsHead Structure fills to capacity. Since Sample Calculation I was made on the basis of a 17,600 peak day ridership, the share of demand generated from LionsHead Structure might be calculated to be 84 percent of 999 or 839 riders.

Exhibit 4-14 provides the results of a survey which correlates skier overnight location with the first lift of the day. These data can be used to determine the demand for cross movements on the In-Town Shuttle between LionsHead and Vail Village/Golden Peak which are as follows:

LionsHead to Village/Golden Peak	32
Village/Gold Peak to LionsHead	43
Total Portion	75
Base 202 + 173	375

Portion of Base as Cross movements 75/375 = 0.20

EXHIBIT 4-14: RESULTS OF 1985-86 SURVEY CORRELATING SKIER OVERNIGHT LOCATION WITH FIRST LIFT OF DAY

LOCATION	BASE (%)	FIRST LIFT OF DAY		
		LionsHead	Village/Gold Peak	None
Base	672 (100)	285 (42.4)	374 (55.7)	13 (1.9)
Vail Village	209 (31.1)	43	159	7
LionsHead	176 (26.2)	141	32	3
East Vail	120 (17.9)	22	96	2
West Vail	96 (14.3)	48	47	1
Sandstone	54 (8.0)	20	34	--
Cascade Village	17 (2.5)	11	6	--

Source: Vail Associates, Inc.

EXHIBIT 4:15: DISTRIBUTION OF SHUTTLE DEMAND DURING PEAK PERIOD

(3:30 - 5:30 1985-86 Season)

		PEAK DAY	DESIGN DAY
	TOTAL RIDERS 17,600 x 0.242 =	4,259	3,380
A.	Visitors Transferring to Other TOV routes		
	1. West Vail and Sandstone Routes	385	352
	2. Bighorn Route (Golf Course/East Vail)	175	139
B.	Village/LionsHead Area Overnight Visitors making cross movements	405	321
C.	Overnight Visitors in Village/LionsHead Area and Day Visitors (total x 0.643) - B	2,334	1,852
D.	Overnight Visitors from West Vail arriving by private services and automobile (total x 0.133) - A.1	181	98
E.	Overnight Visitors from Golf Course and East Vail arriving by private services and automobiles (total x 0.224) - A.2	779	618

Exhibit 4-15 provides a calculated distribution of the peak period Shuttle demand based on the foregoing analyses and estimates. Specific estimates are provided for cross movements between the two main lift areas as lines A and B. The dominant demand source remains as being generated by overnight visitors in the Town center and day visitors. Any additional breakdown and insight must be determined by conducting surveys of riders during the peak period. Observing from Exhibit 4-8 that the morning peak period demand rate is only one-third that of the evening rate suggests that cross-movements in the morning are minimal, i.e. skiers choose their first lift of the day on the basis of minimum access time and path of least resistance. Therefore, one might conclude that the dominant number of cross-movements in the afternoon peak period are by skiers who do not end their skiing day at their point of origin.

4.6 DESIGN AND PEAK CAPACITY REQUIREMENTS

As discussed above in Section 4.4 the current In-Town Shuttle capacity can meet the peak period demand for a design day. However, it cannot meet the peak period demand for a peak day. It is also questionable if the Shuttle route capacity can be increased sufficiently to meet the peak day peak period demand, even if the fleet is increased with larger capacity buses.

The following are the peak period single direction capacity requirements which have been calculated on the basis of the above ridership and demand analyses.

	Peak Period Single Direction Capacity (Passengers/Hour per Direction)	
SEASON	PEAK DAY	DESIGN DAY
1985-86	1,065	845
1995-96	1,310	1,039
2003-04	1,523	1,208

5.0 THE VAIL ENVIRONMENT

To assess feasibility it is not necessary to determine the best alignment. Only a "representative alignment," which in itself is feasible, need be determined. Detailed alignment studies are carried out during preliminary design, after a project has been approved and funded. Feasibility of the project will hinge primarily on costs and financing. Therefore, any people mover project which follows the representative alignment and is found to be feasible will be more successful when improvements in the alignment are determined.

Examination of the Vail environment indicates that there are two major physical contraints which will affect the feasibility of the people mover system in Vail. These are the restricted public right of way in Vail and the nature of this right of way, consisting of winding and sometimes narrow streets.

5.1 DESCRIPTION OF RIGHT OF WAY RESTRICTIONS

The primary objective of the study was to evaluate the feasibility of a people mover system as a replacement for the in-town shuttle bus system. This fundamental requirement essentially fixes both the people mover route alignment and potential station locations. Therefore, the route followed by the In-Town Shuttle was studied primarily to determine a feasible representative alignment. As previously discussed, only elevated systems were considered in this study.

On-site investigations and review of aerial photos of Vail indicate that the development pattern is well established and that there exists little room for roadway expansion, especially in the vicinity of the two major retail centers. These investigations also indicated that the existing street right of ways along the In-Town Shuttle route are very narrow. At some locations, buildings appear to be located very close to the roadway edge. Further, we observed that at some locations along the shuttle route, there are no sidewalks bordering the streets. (See Exhibit 5-1.)

Most of the street network used by the Shuttle consists of two lane pavement with a width varying between 20 and 24 feet. The stretch of pavement between the Civic Arena and the northwest end of the LionsHead parking structure is one lane only with no room for expansion. (See Exhibit 5-2.)

EXHIBIT 5-1: EXAMPLE OF NARROW STREET WITHOUT SIDEWALK

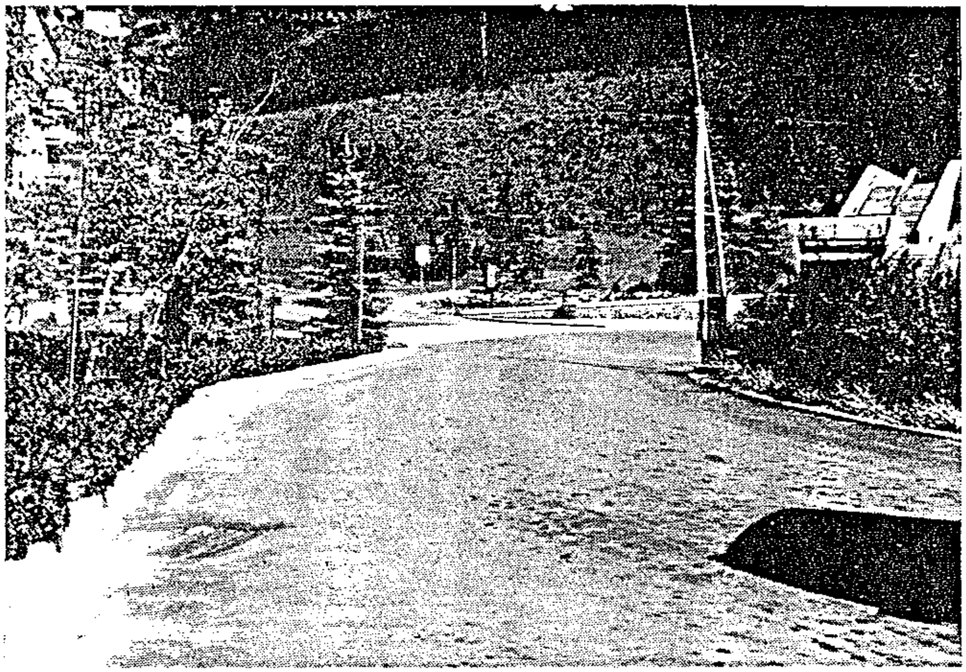


EXHIBIT 5-2: ONE-LANE ROAD ALONG THE CIVIC CENTER

A people mover guideway along the Shuttle route would consist of about 40 curved sections and a few tangent sections. The minimum curve radius will be around 40 feet and the largest one around 625 feet. Exhibit 5-3 presents an analysis of the distribution of the curve radii. This distribution shows that 50 percent of the curves have a radius of 150 feet or less.

Unless a route along Gore Creek can be determined, the people mover will have to follow the South Frontage Road and go under or over the pedestrian overpass to serve the areas west of the LionsHead parking structure.

These restrictions will affect the design of the guideway and station structures, the system operation, and the technology that can be used. The following sections examine these aspects in further detail.

5.2 IMPACT ON GUIDEWAY STRUCTURE DESIGN

While many parameters contribute to the design of the guideway, a major consideration is how and where the structural loads are transmitted to the ground. In Vail, the paucity of public real estate on which the foundations and columns can be built will have an impact on the guideway structure design. There are several locations where the foundations and columns can only be installed on the roadbed. At these locations, the guideway structure will require special design provisions. For example, it will be necessary to maintain clearances compatible with existing vehicles such as snow removal, sanitation, and rescue vehicles. This compatibility requirement pertains to both lateral and vertical clearances as well as to ability to operate safely and efficiently. Exhibit 5-4 presents typical steel columns that could be used.

Curved guideway structures require more columns. For a Vail people mover system, the average span length will be about 50 feet. This means that about 150 columns will be required to handle dual guideway structure and about 50 for single guideway structure.

The design of the guideway structure will be complicated further by the difficulty of accommodating a dual lane guideway. This complication arises due to the closeness of buildings to the proposed system structure, the lack of air space

EXHIBIT 5-3: DISTRIBUTION OF CURVE RADII ON IN-TOWN AGT

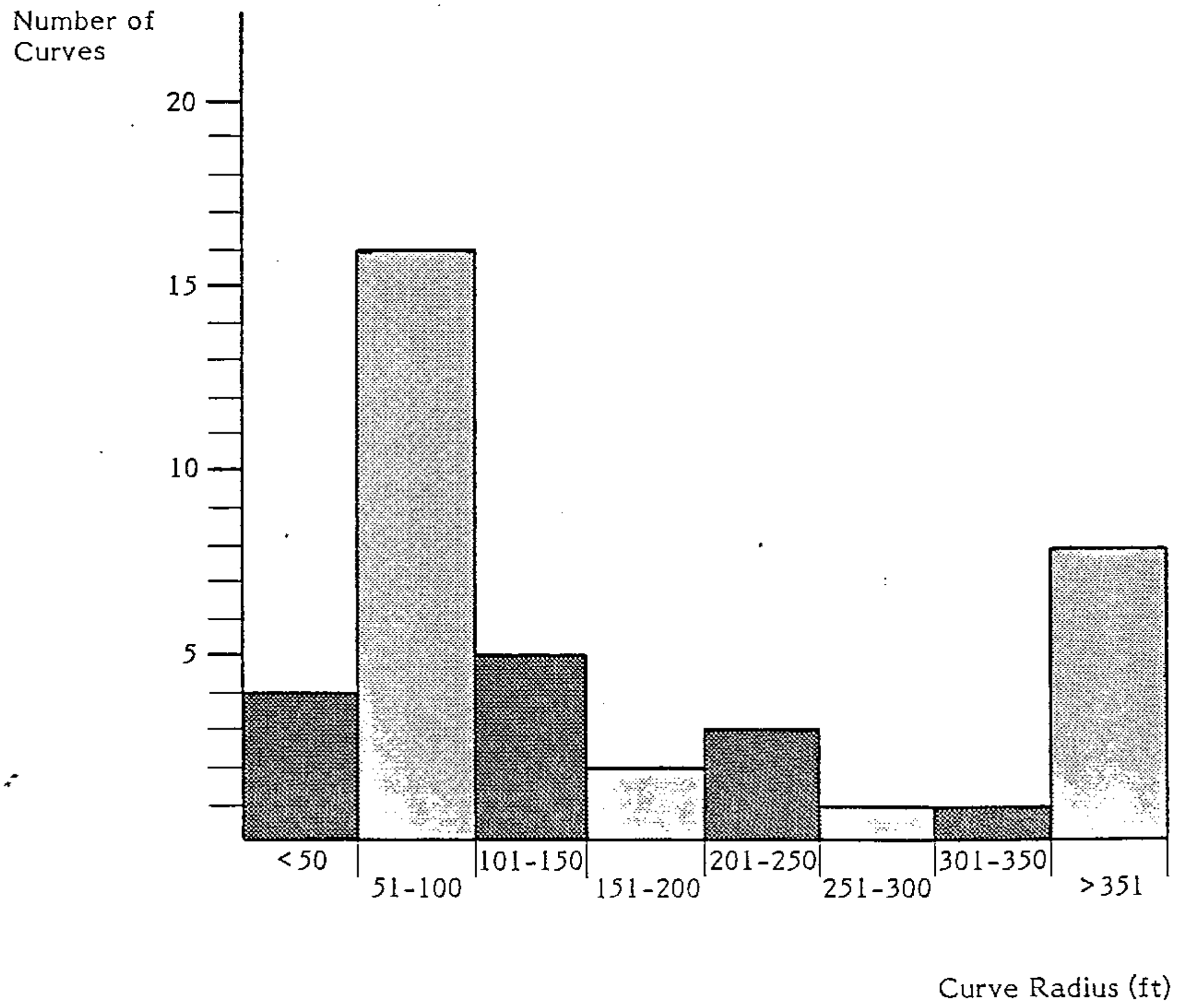
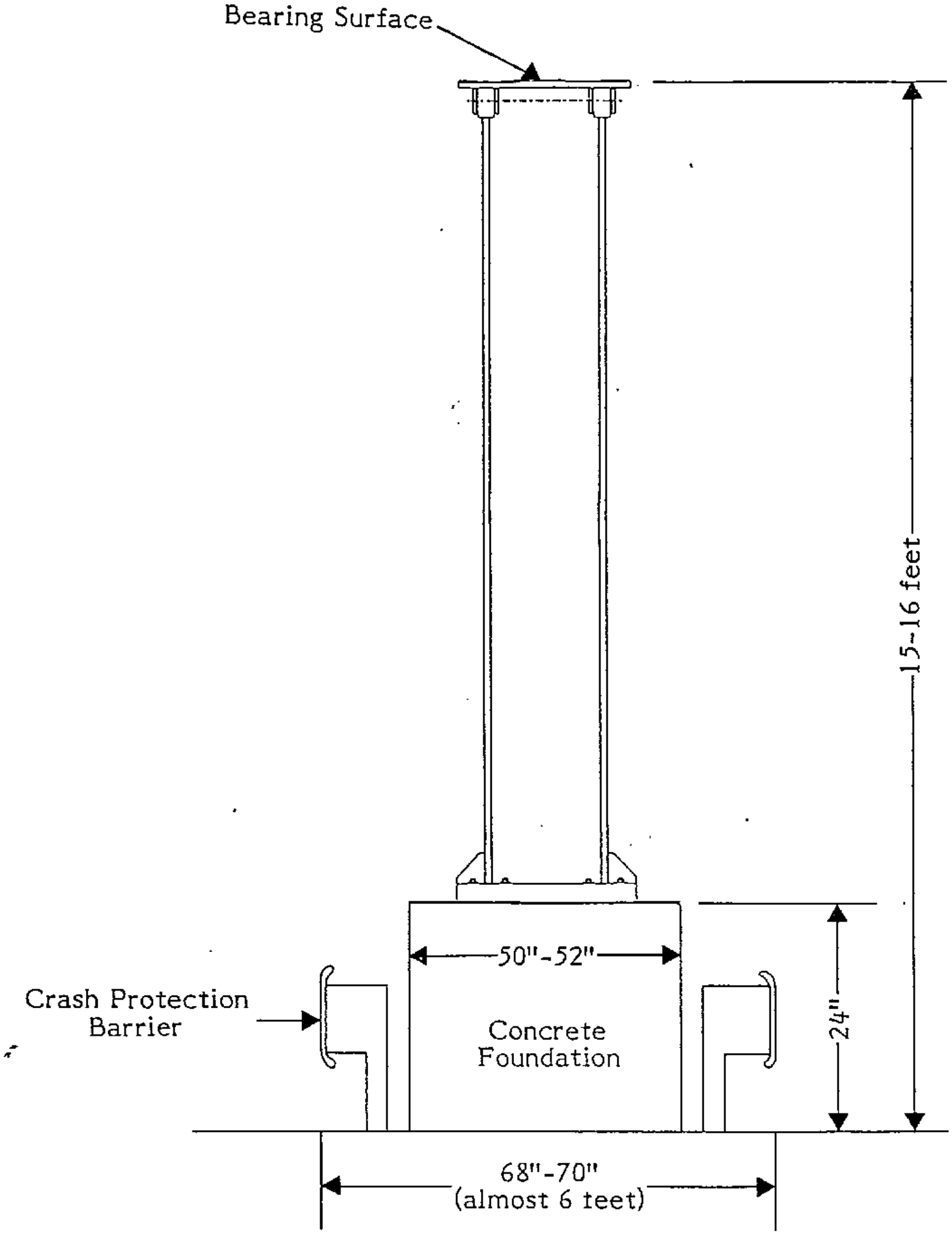


EXHIBIT 5-4: EXAMPLE OF SPACE REQUIREMENT FOR STEEL COLUMN STRUCTURES



Note: This construction would be applied for single or dual track system on wide road. The concrete foundation is above ground and protected for safety and maintenance reasons.

over narrow roads, and the necessity to provide access space for rescue vehicles during emergencies. In particular, it has been our experience building other people movers that fire departments will resist having access restricted to the floors of the buildings located along the people mover system route. Also, the guideway design must be such that people mover vehicles can be accessible by the fire department along the entire length of the system in the event of an emergency. The latter is particularly important for monorail-type technologies which do not have an emergency walkway along the guideway for passenger evacuation.

5.3 IMPACT ON STATION STRUCTURES

With regard to stations, space requirements as determined by platform space requirements and access from the street are functions of the type of vehicle and the type of system operation. For example, applications utilizing long trains require a long station structure to accommodate the train. The width of the platform will be determined by train capacity, traffic volume, and the headways.

The overall station width is a function of the configurations of the guideway (single or dual lane) and of the platform type (center or side). When a dual lane guideway is present, a central platform is usually more compact. However, in an elevated system, access from the street level is complicated if the station is over a roadway. To provide safe access, an intermediate level linking the platform and the street level above the sidewalks must be added. While feasible, this option increases the height of the station as well as its costs.

A side platform layout allows access from the sidewalk. However, from a service point of view, the user must know where to go, as each side of the station serves a different destination. Again this disadvantage can be eliminated by adding an intermediate level that will allow passengers to access either platform from either sidewalk. In this case, the height of the station will have to be increased. However, in Vail, this access requirement will not be necessary since the street can easily be crossed.

Another constraint for station layout is that the platform area should be either a tangent alignment or along a curve of large radius. If the platform area is located between two short radius curves, it is necessary to extend the tangent alignment beyond each end of the platform. These precautions are necessary to ensure that the gap between the platform edge and the vehicle floor remains small. Exhibit 5-5 gives approximate station foot prints that would be required for the people mover in Vail.

EXHIBIT 5-5: APPROXIMATE STATION DIMENSIONS FOR VAIL PEOPLE MOVER

STATION TYPE	NUMBER OF TRACKS	WIDTH RANGE (FT.)	LENGTH RANGE (FT.)
Lateral Platform	2	30-35	25-40
	1	15-20	25-40
Central Platform	2	20-25	25-40

5.4 IMPACT ON VEHICLE DESIGN

The extremely short turn radii found along the people mover alignment preclude the use of wide vehicles with long wheelbases. Thus, only technologies using short and narrow vehicles can be considered for the Vail people mover. Because of the restrictions resulting from the station requirements, i.e., the need for and limited availability of tangent sections, operation of long trains is likely to be severely constrained. Limitations on vehicle length result in limited space availability in the vehicle underframe. This lack of space will further constrain the type of system that can be used. Thus, self-propelled, automated vehicles which require an electric motor, a transmission, a differential, a power conditioning unit, a control system, a braking system, electrical switchgear, a power collection system, a low voltage power supply, etc., might require configuration in married pair units.

Alternate propulsion configurations in which all the traction, braking and control functions are provided through the guideway are also possible. These configurations usually result in very simple, low-weight vehicles which are totally unpowered. Examples of such systems are the WEDway system at Houston International Airport, Otis Tampa Harborplace, the SK system at Expo '86 in Vancouver and at the Villepinte Fairgrounds in Paris. A drawback of this approach is that these vehicles usually do not have heating, air conditioning, or lighting on board. However, such amenities can be obtained by installing a light-duty power collection system for running the auxiliaries, assuming that there is room to install them.

5.5 IMPACT ON OPERATION

The short turning radii will have an impact on the type of operation envisioned. For example, available space at Golden Peak may prevent the use of a unidirectional loop as it will require an extremely short turn radius. This is not a problem at LionsHead or in Vail Village because turnaround loops would not be used there. Other alternatives such as switches and/or a turntable might need to be used. Use of operational switching limits the applicability of available technologies. Various factors, including the operating mode, will determine if doors will be required on one or both sides of the vehicles.

The small vehicle requirement has a direct impact on headway as well. For a given capacity, the smaller vehicle capacity requires shorter headways. Very short headways are difficult to implement with self-propelled vehicles because the control system must be extremely sophisticated. Certain guideway based propulsion systems, such as cable driven systems, allow for short headway operations. The Vail Vista Bahn is one example of short headway operation with a track based propulsion system. However, in such a system, it is necessary to detach the vehicle from the cable, and move it sufficiently out of the way, so that the next arriving vehicle does not collide with it. Thus, in these systems vehicles usually move at a slow speed along the platform.

The large number of curves will have an impact on vehicle travel time. Again, depending on the propulsion technology used, the maximum speed might be constrained by the smallest turning radius, as in cable drawn systems, or can be adjusted as a function of the local conditions. This is the case of the self-propelled vehicles or track-propelled vehicles with a speed program imbedded in the track*. These differences will mainly affect the trip time.

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*A detailed comparison of these various propulsion systems is given in the paper entitled "Short Distance Transportation Systems - Recent Development and Future Outlook". The paper has been included in Appendix A.

5.6 OTHER CONSTRAINTS

Other important issues to be resolved include: the location of the maintenance facility, overnight storage of the vehicles, and ability to operate in snow and ice. The following briefly addresses these issues.

5.6.1 Maintenance Facility

To ensure proper maintenance of the system, a facility which is easily accessible from the guideway needs to be provided. Space along the line is rather limited. However, it might be possible to create a multi-use facility near the hospital parking lot. This facility could provide parking for patrons of the Dobson Civic Arena and for hospital patrons and employees at the lower level. The upper level could house the people mover system maintenance facility, control room office, and storage space for vehicles and spare parts. If this space cannot be used, another location that could be considered would be the LionsHead parking structure. This assumes that the building could be modified to accept another level that would be reserved for all the storage and maintenance activities related to the system. If this is not possible, then another location would have to be found.

5.6.2 Overnight Vehicle Storage

Automated vehicles are generally stored in an enclosed facility. In most cases this storage is included within the maintenance facility or in a nearby building. Vehicles can be stored in stations also. This second approach is easily implemented with active guideway systems because the vehicles are "dumb" and require very little maintenance. With respect to cleaning, the vehicle interior can be cleaned at the same time as the station is cleaned. The outside of the vehicle can be cleaned at the maintenance facility according to a predetermined schedule.

5.6.3 Operation in Ice and Snow

In the Vail environment, this issue needs to be examined thoroughly. With few exceptions, systems using self-propelled vehicles require that in addition to sweeping snow from the running surface and from the power collection system, the guideway surface needs to be heated to prevent ice formation. While systems such as UMI has operating at the Minnesota Zoo do not have guideway surface heating, they are operated by drivers on-board and at very slow speeds, lower than 5 mph. When data transmission is performed through a sliding contact, the transmission rail needs to be heated as well to ensure proper data exchange. Self-propelled vehicles in which the traction forces are not transmitted via the wheel or for those that have their running surface protected do not require a guideway heating system.

Active track systems are not subject to these requirements because the propulsion and braking forces are not transmitted via the wheels of the vehicles. However, snow removal will be required to avoid accumulation on the running surface.

6.0 EXAMINATION OF FIXED GUIDEWAY ALTERNATIVES

6.1 AUTOMATED GUIDEWAY TRANSIT TECHNOLOGY

In a fixed guideway system, vehicles operate on an exclusive guideway or track -- a major requirement to ensure safe operation. In most cases, the guideway is either elevated or underground. On some occasions, the guideway is at ground level. Ground level or at-grade guideways are generally less desirable in an urban environment because of the creation of a physical barrier which restricts cross movements by other traffic. Moreover, the cost of tunneling is much higher than the cost of building an elevated structure.

For this study, only two alternative elevated tracks were considered. Tunnels were not considered because of their high cost and because of the relatively low traffic volumes to be encountered.

The major potential advantages of a people mover system over the bus system would be: (1) ability to meet increasing demand; (2) reduced dwell times due to the level boarding, large door openings, and the ability of skiers to bring the ski gear on board the vehicles; and (3) reduced travel time because there will be reduced dwell time and no interference between the pedestrian and people mover vehicle flows. The result is improved service with line capacity which can be adjusted without service degradation.

6.2 ALTERNATIVE ALIGNMENTS

The selection of an alignment is primarily driven by the location of the traffic generator/receptors and the availability of Right of Way (ROW) between these focal points.

In Vail, the two major focal points of the existing system are the bus stops located near the parking structures. These bus stops also serve the two major lift areas of Vail, the Vista Bahn and the LionsHead Gondola.

With respect to ROW availability, a review of the aerial photography of Vail indicated that the area is well built up and that little, if any, real estate is available. The system ROW will have to be "fitted" into the available public space. It is noted that the land along Gore Creek is owned by the Town of Vail, and therefore may provide some financial opportunities in determining the final alignment. However, there are other problems associated with using the creek alignments as follows:

- Stations within the creek alignment will be more complicated and expensive, requiring special pedestrian access.
- Emergency evacuation of passengers from stalled trains on guideways located over the creek will be extremely difficult.

In determining a feasible representative alignment, we assumed that the only public space readily available to the Town of Vail was the space above the road system and possibly some along its edges and some portions of Gore Creek.

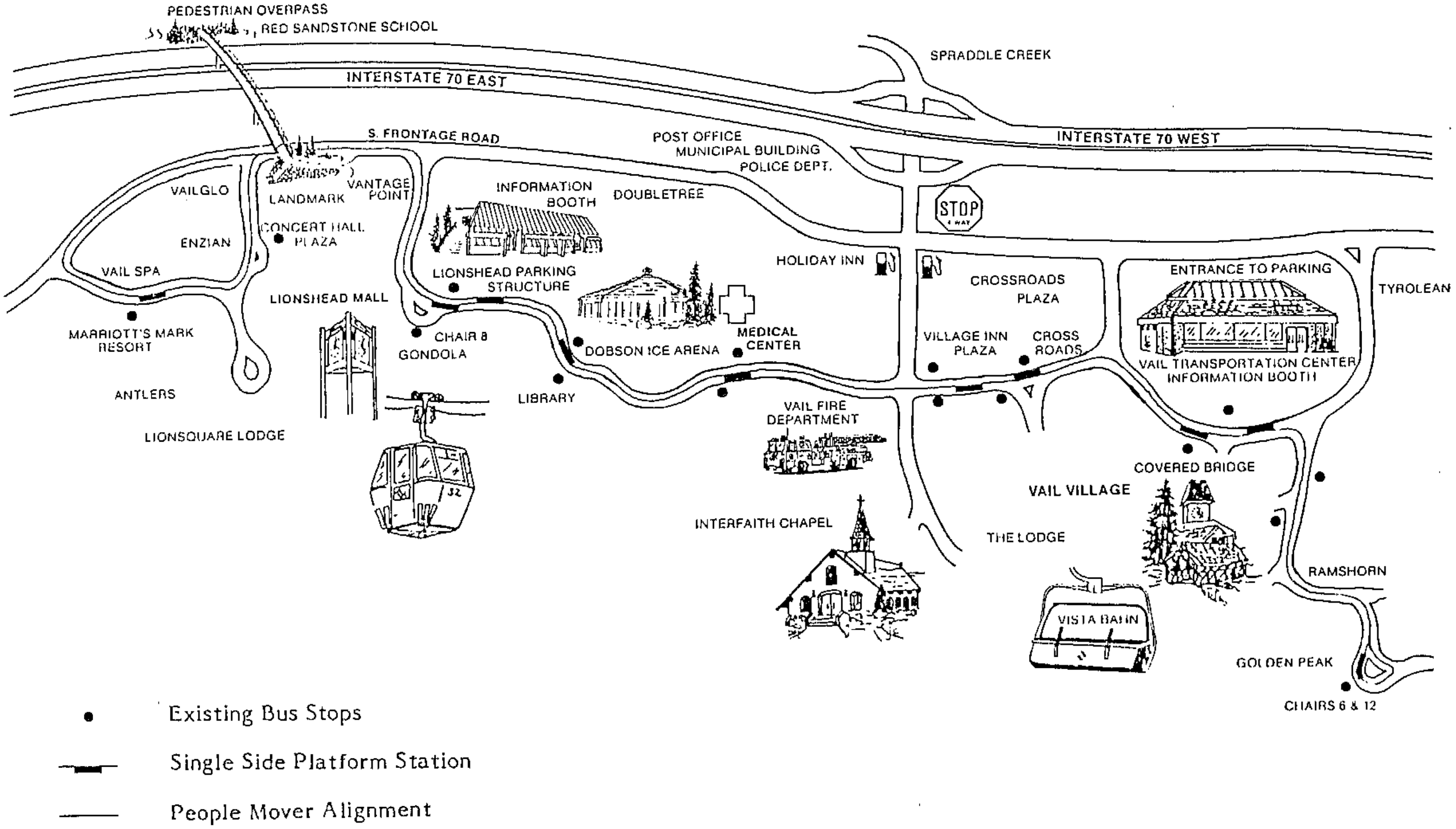
Based on these premises, two possible people mover alignments were identified.

The first one follows the present In-Town Shuttle route (See Exhibit 6-1). The second one, presented in Exhibit 6-2, is basically the same but provides a loop that traverses Vail Village. This loop would start at the intersection of East Meadow, go north on Willow Bridge, east on Gore Creek Drive and south on Gore Creek Road and Vail Valley Drive up to the Golden Peak stop. From Golden Peak, the guideway would then follow Vail Valley Drive and Gore Creek Road north and then proceed west on East Meadow along the same ROW as the first alternative.

This alternative improves the access to the center of Vail Village but decreases access to the public parking. Another severe limitation of this alignment is the extremely tight turn radii that are required to make the various turns. Finally, the alternative alignment may be aesthetically controversial as the majority of the buildings found in this area are low height, chalet-type houses.

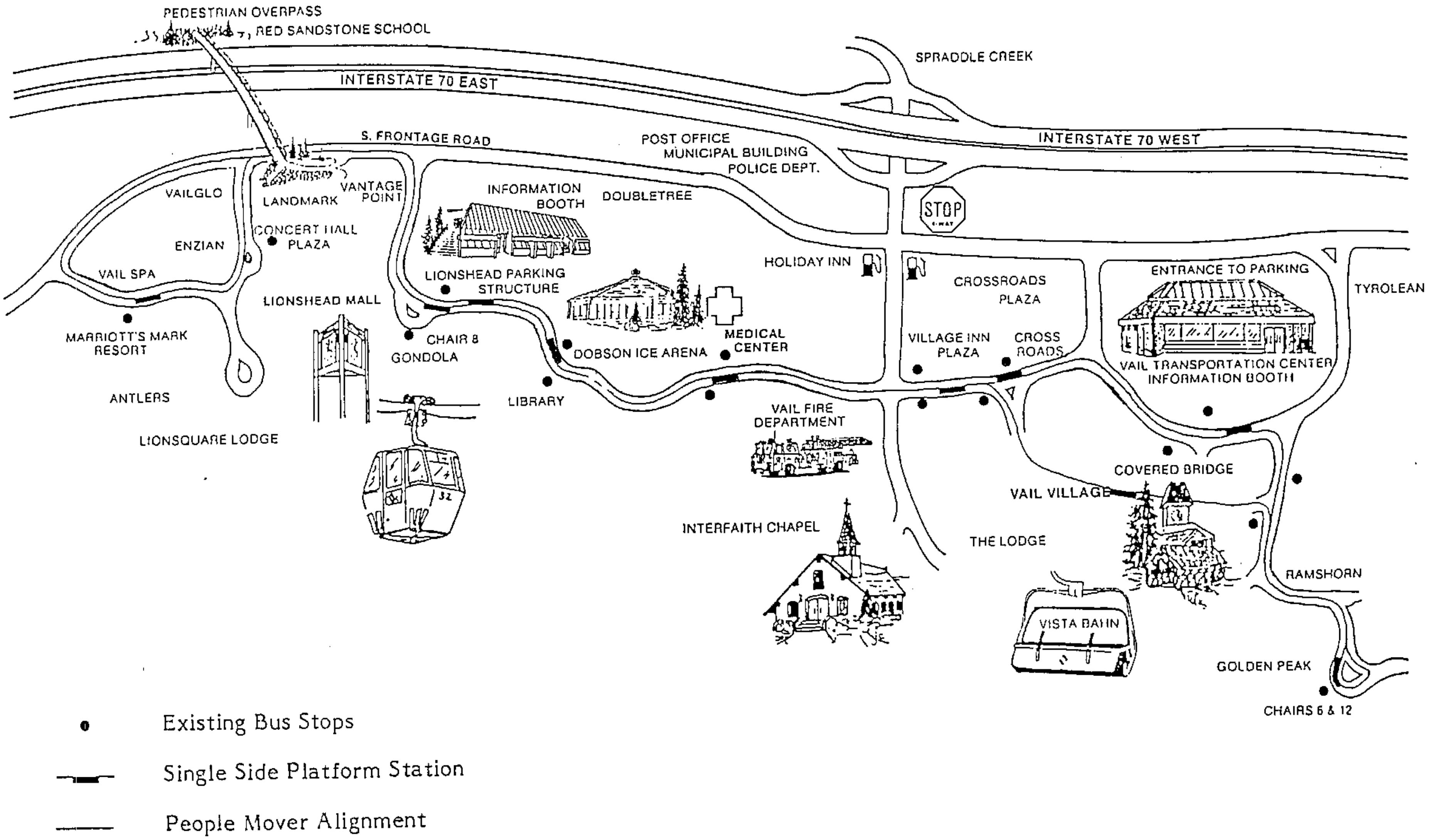
Finally, because of the narrow roads and the general lack of space in the Village, building an aerial station in the Village does not readily appear feasible. One possible location for a station might be the berm area on the south side of the Village if an alignment to it can be found feasible.

EXHIBIT 6-1: IN-TOWN PEOPLE MOVER ALIGNMENT -- OPTION 1 (SELECTED)



- ● Existing Bus Stops
- ▬ Single Side Platform Station
- ── People Mover Alignment

EXHIBIT 6-2: IN-TOWN PEOPLE MOVER ALIGNMENT -- OPTION 2 (REJECTED)



Consequently, the only representative alignment retained for our study for replacing the Shuttle is the one that follows the Shuttle route.

6.3 ALTERNATIVE TECHNOLOGIES

In view of the above, potential candidate people mover technologies were identified and described below. The LEM corporate data base, which includes the most recent developments regarding people mover systems, is the basis for these descriptions and data. A copy of the recently published AGT data base* was given to the Town of Vail. The large number of entries found in the data base were eliminated prior to conducting our cost estimate. A selection of potential (representative) systems which might be operated in the Vail environment was made. The following material reduces the selection process and presents the technologies which appear to be best suited to the Vail environment.

6.3.1 Selection Criteria

The potential systems were screened on the basis of having a turn radius less than or equal to 65 feet and vehicle width not greater than 7 feet. Several systems were identified as potential candidates.

6.3.2 Potential Systems

The potential systems have been classified into four categories: systems in operation, systems under construction, systems which have been demonstrated, and conceptual systems.

A. Systems In Operation

Monorails built by Universal Mobility, Inc. (UMI) and Von Roll Habegger in Switzerland have been included in this group. While none of these systems offer turn radii as low as 50 feet, their actual turn radius is close enough that our requirement could be met with only slight modifications to the alignment and the system technology.

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* International Transit Compendium - Automated Guideway Transit, Volume IV, No. 1.

Systems meeting both the turn radius and width requirement are H-Bahn (small cabin) at Dortmund University, West Germany, the WEDway at Houston International Airport, the Boeing System at Morgantown, and the SK System at Expo '86 in Vancouver and at the Villepinte Fairgrounds in Paris.

B. Systems Under Construction

This group includes the TAU System being built in the City of Liege, Belgium, and the ARAMIS System being built in Paris, France.

C. Systems Which Have Been Demonstrated

This group includes the C-Bahn System which was demonstrated in the late 70's and early 80's at the Demag test facility in Hagen, West Germany. Also included is the C-10 monorail system purchased by Westinghouse from Rohr Industries. Rohr supplied this technology for Pearl Ridge in Honolulu as its P-Series Monorail.

D. Conceptual Systems

These systems, such as the Alpha System which was recently being promoted, were not considered because they have not been developed and are not considered available.

These systems can also be regrouped according to type of propulsion system and guideway(*), as follows:

- o Self-Propelled, Open Guideway
  - All monorails (UMI, Von-Roll Habegger, Westinghouse C-10)
  - Morgantown
  - TAU
  - ARAMIS

(*) Open guideway - the running surface is exposed to the elements (snow, rain). Closed guideway - the running surface is not exposed to the elements (snow, rain).

- Self-Propelled, Enclosed Guideway
  - Traction Force Transmitted by the Wheels
    - H-Bahn
  - Traction Force Not Transmitted by the Wheels
    - C-Bahn
- Track Based Systems
  - SK (cable drawn)
  - WEDway (linear induction motor)

Of the above systems, the Morgantown system and C-Bahn are no longer marketed and were not considered available. A brief description of these various systems is given in Appendix B.

7.0 A REPRESENTATIVE PEOPLE MOVER SYSTEM

This section defines a representative people mover system which may be proposed as a replacement for the In-Town Shuttle bus route. This representative system is based upon proven technology which is available from competitive sources. Also, the system follows the representative alignment discussed in Section 6.2 and shown in Exhibit 6-1. From a physical, geometrical and technological viewpoint the representative system can be said to be feasible.

7.1 DESCRIPTION OF THE REPRESENTATIVE SYSTEM FOR SHUTTLE REPLACEMENT

As discussed in earlier sections, the representative people mover system will closely follow the route of the In-Town Shuttle. The guideway and station structures were all assumed to be elevated. A return loop was assumed feasible at Golden Peak. The system was sized to meet the 1995-96 projected demand and provide a directional line capacity of 1,088 passengers per hour on a design day and 1,343 passengers per hour on a peak day, with service at two minute intervals. By adding three more trains the system can meet the 2003-04 projected demand and provide a single direction line capacity of 1,580 passengers per hour on a peak day. Train operation is automated and requires no on-board personnel. Except during the peak hours of the winter season, stations are unmanned.

The following discusses the technologies that were considered and retained for the Vail application and provides the main physical and operational characteristics of the representative people mover system. These were then used to estimate the cost of the representative system.

Technology

Time and budget constraints did not allow each of the various types of technologies identified in Section 6.0 to be sized for the representative alignment and preparation of detailed cost estimates. The technologies represented by C-Bahn and Morgantown were eliminated because they are not commercially available. The TAU, H-Bahn and WEDway systems, while available commercially, have relatively high costs. Therefore, LEM narrowed its field of investigation to two technologies that have a low cost record as well as a short implementation time. These are the self-propelled monorail (UMI, Von-Roll Habegger and Westinghouse C-10) and the short headway cable driven system (SK). LEM then prepared initial sizing and preliminary cost estimates for both systems. However, as the cable driven system has only been implemented in point to point type of service, it was determined that the large number of stations could have a negative impact on the system reliability to a point where feasible applicability could be suspect. Furthermore, the preliminary cost estimates indicated that the cable driven system cost was slightly higher than the cost of the monorail; therefore, the investigation of the cable-propelled system was not carried further.

Physical Description

The overall characteristics for the monorail system are given in Exhibit 7-1. The system was sized using data extracted from the LEM data base for commercially competitive technologies such as produced by Universal Mobility, Inc., Von Roll-Habegger and Westinghouse (C-10). Stations were assumed to be a very simple, open design with no fare collection equipment. No escalators or elevators were included.

Trains are composed of two permanently coupled cars. While longer trains can be formed, there is an impact on station size, making them hard to fit into already crowded spaces and more expensive. Typical vehicle characteristics are as follows:

Overall length	37 ft.
Overall width	6.5 ft.
Overall height	9 ft.
Height over Guideway Surface	8 ft.
Passenger Capacity, Design	36
Crush	51

Passenger Comfort - Heating & Ventilation, No Air Conditioning
Doors - Double width doors, each side of vehicle
Directional Capability - Unidirectional so long as turnaround loops provided at each end

EXHIBIT 7-1: DESCRIPTION OF REPRESENTATIVE PEOPLE MOVER SYSTEM FOR REPLACING THE IN-TOWN SHUTTLE BUS ROUTE

System Length, Single Lane		5,400 m
Stations, Single-Side Platforms		10
Average Cruise Speed (no accel./decel.)		4.5 m/s
Acceleration/Deceleration, Maximum		1 m/s^2
Acceleration, Average		0.5 m/s^2
Deceleration, Average		1m/s^2
Train Size (2-cars)		10 m
Train Capacity	Design	36 pax
	Crush Load	51 pax
No. of Double Doorways/Train Side		2
Boarding Time per	Non-Skier	1 sec
	Skier with Skis	2.5 sec
Total Dwell Time	Design Day	629 sec
	Peak Day	772 sec
Time Traveling at Cruise Speed		1,089 sec
Time in Acceleration/Deceleration		135 sec
Turnaround Time at Gold Peak		47 sec
Total Round-Trip Time	Design Day	1,900 sec
	Peak Day	2,043 sec
Round Trips per Train per Hour	Design Day	1.895
	Peak Day	1.762
Single Train Capacity per Hour, Each Direction (Passengers/Hr)		
	Design Day	68
	Peak Day	79
Maximum Operating Trains Required to Meet 1995-96 Demand		
	1,039 pax/hr Design Day	16
	1,310 pax/hr Peak Day	17
Headway	Design Day	119 sec
	Peak Day	120 sec
Line Capacity, Single Direction	Design Day	1,088 pax/hr
	Peak Day	1,343 pax/hr
Fleet Requirements for 1995-96:	Operating Trains	17
	Spares	2
	Total	19
Fleet Requirements for 2003-04:	Operating Trains	20
	Spares	3
	Total	23
Headway of Expanded 2003-04 System	Design Day	106 sec
	Peak Day	102 sec

The representative guideway is essentially a steel construction box beam approximately 32 inches wide by 22 inches high. Its guideway can be mounted in a single lane or dual lane configuration, on steel columns with spans up to 65 feet. Longer spans require additional trussing of the guideway beam.

The representative system will be fully automated and driverless, following traditional fail-safe requirements for fixed-guideway transit systems. A control center will be provided within the maintenance facility.

Vehicles will be propelled by electric power picked up from power rails along the guideway. An emergency diesel generator may be required to allow evacuation of the system during a power outage. If so, trains would be sequenced one at a time into stations allowing for a smaller size diesel generator.

Operation

Some of the general operating characteristics of the representative system are given in Exhibit 7-1. Calculations of the dwell times at stations are given in Exhibit 7-2 assuming skis are stored in racks on the side of the cars. Exhibit 7-3 is an operating plan. Section 7.4 recommends that skis can be safely brought on-board by passengers resulting in significant improvement in performance and cost reduction.

7.2 REPRESENTATIVE SYSTEM COST ESTIMATES

7.2.1 Capital Costs

The capital cost was estimated for the Representative People Mover system. This estimate, shown in Exhibit 7-4, was prepared for a system having the characteristics of a low capacity monorail system as sized in Exhibit 7-1. Unit costs from a LEM proprietary cost data base, developed over a period of years utilizing actual costs of a number of system installations, were applied. In cases where an item may be in question, a higher unit cost has been selected to produce a more conservative estimate. Therefore, the estimate provided is considered to be sufficiently accurate to test feasibility. A more detailed estimate will be required during preliminary design for preparing project budgets.

EXHIBIT 7-2: CALCULATION OF DWELL TIME AT STOPS

Time for Person without Skis to Board - 1 Sec
Time for Person with Skis to Board - 2.5 Sec

Percent of Peak Period Riders with Skis - 80%
Time Allocated for Opening/Closing Door and Interlocks - 5 Sec

STATION	DEMAND	PASSENGERS BOARDING				DWELL TIME (SECONDS)	
		DESIGN DAY		PEAK DAY			
	(%)	w/ Skis	w/o Skis	w/ Skis	w/o Skis	Design Day	Peak Day
Gold Peak	8	9	2	12	3	29.5	38
Covered Bridge*	22	25	6	32	8	73.5	93
Cross Roads/Village Inn Plaza*	25	29	7	36	9	84.5	104
Medical Center/Ice Arena*	10	12	3	14	4	38.0	44
LionsHead*	25	29	7	36	9	84.5	104
Marriott/Concert Hall	10	12	3	14	4	38.0	44
TOTAL*						628.5	772

* There are two platforms for each of these four stations; whereas, the others have only one. Total includes doubling dwell time for stations footnoted.

EXHIBIT 7-3: OPERATING PLAN FOR THE REPRESENTATIVE PEOPLE MOVER SYSTEM

OPERATING SCHEDULE	HRS/DAY	FLEET SIZE
WINTER		
Peak Hours	5	16
Off-Peak	8	8
Night Hours	4	4
	17	
OFF SEASON		
Daytime	12	6
Nighttime	4	3
	16	
PEAK SEASON IN DAYS		160
OFF PEAK SEASON		205

EXHIBIT 7-4: CAPITAL COST ESTIMATE FOR REPRESENTATIVE PEOPLE MOVER SYSTEM TO REPLACE IN-TOWN SHUTTLE BUS ROUTE

GUIDEWAY STRUCTURE			
Single Lane	770 m	@ $950/m	$ 731,500
Double Lane	2,315 m	@ $1,400/m	3,241,000
STATIONS	10 sgl. platforms	@ $155,000	1,550,000
SWITCH	1	@ $25,000	25,000
TRANSFER TABLE	1	@ $25,000	25,000
TRAINS (2 cars each)	19	@ $190,000	3,610,000
SERVICE VEHICLE	1	@ $15,000	15,000
POWER DISTRIBUTION			
Substation	4	@ $91,000	364,000
Electric Service	1	@ $8,000	8,000
Feeder Cable	3,085 m	@ $302/m	931,670
Power Rails	5,400 m	@ $164/ m	885,600
COMMAND & CONTROL	1	@ $1,200,000	1,200,000
MAINTENANCE			
Facility	8,100 sq ft	@ $50/sq ft	405,000
Equipment & Parts	1 Lot	@ $500,000	500,000
		Subtotal	$13,491,770
ENGINEERING		15%	$ 2,023,766
TESTING		5%	674,589
CONTINGENCIES		10%	1,349,177
ROW AND UTILITY RELOCATION (Allocation)			2,500,000
		TOTAL	$20,039,302

7.2.2 Operations and Maintenance Costs

A preliminary estimate of annual operations and maintenance (O&M) costs was prepared, based on information regarding actual people mover system O&M cost experiences. The cost estimate was prepared according to the operation plan discussed earlier. This estimate is presented in Exhibit 7-5. Supporting calculations are provided in Appendix C. The costs for liability insurance coverage during system operation have not been included, because of the current unsettled conditions with the insurance industry. Under normal circumstances, insurance costs would be about $100,00 per year.

7.3 ALTERNATIVE STARTER LINE PEOPLE MOVER SYSTEM

It is noted that 78 percent of In-Town Shuttle ridership board the system at stops located at and between LionsHead and Covered Bridge. Therefore, one might consider implementing the first phase of a people mover system to replace only this service. The shuttle bus route could then be reconfigured to two small feed routes that interface with the people mover at LionsHead and Covered Bridge. Since the demand on these two small routes would be light and round trip times short, only a few buses would be required. Also, the feeder route operating to LionsHead could be extended to serve Cascade Village.

Exhibit 7-6 shows a representative alignment for a Starter Line that could partially replace the In-Town Shuttle. It basically follows the street route of the shuttle except that at the western end a single lane loop would start near the Ice Arena departing from West Meadow Drive, pass by LionsHead Structure, proceed down through the LionsHead Area east of Mountaineros and then turn back east following Gore Creek to rejoin the dual-lane guideway on West Meadow Drive. Along both West and East Meadow Drive the guideway would be dual-lane until reaching Bridge Street where it would become a small single-lane loop through Vail Village using Gore Creek as part of the alignment.

The technology would be the same as described in Section 7.1 for replacing the entire In-Town Shuttle. Exhibit 7-7 provides a description of the application, system sizing and fundamental operating performance. Exhibit 7-8 is an estimate of the capital costs which at $15 million are 25 percent less than full replacement of the Shuttle. The O&M costs would also scale back to about $750,000 per year.

EXHIBIT 7-5: SUMMARY OF O&M EXPENSES FOR THE REPRESENTATIVE PEOPLE MOVER SYSTEM

Personnel (Includes All Overhead & G&A)	$560,000	
Temporary Personnel	25,600	
Cleaning Contract	100,000	
Electric Power	163,000	
Subtotal		$848,600
Consumables (2% of Subtotal)		16,975
Contingencies (10% of Subtotal)		84,860
TOTAL		$950,435

EXHIBIT 7-6: ALIGNMENT OF ALTERNATIVE STARTER LINE PEOPLE MOVER SYSTEM

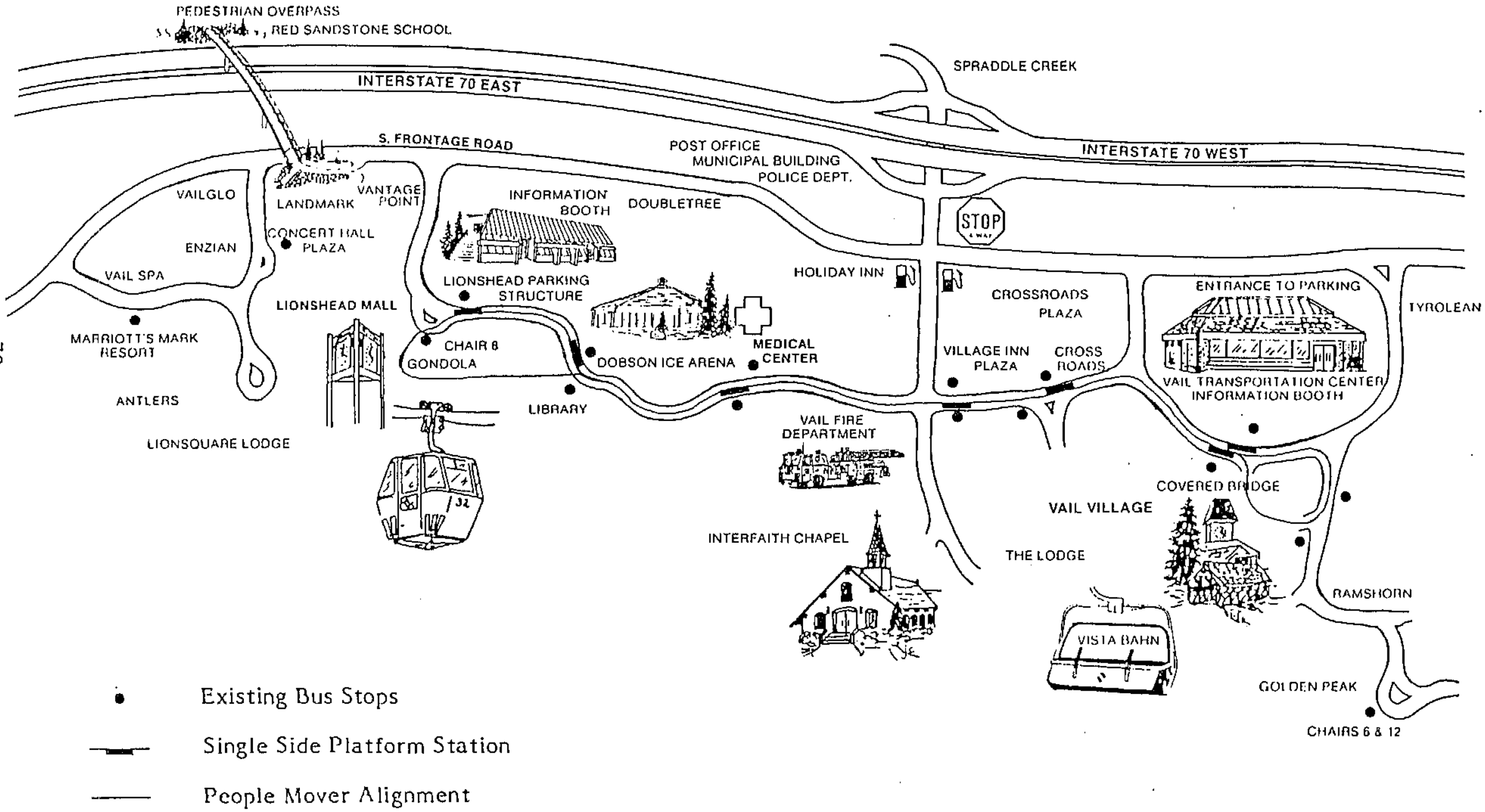

EXHIBIT 7-7: DESCRIPTION OF A STARTER LINE PEOPLE MOVER SYSTEM

System Length	Single Lane	1,900 m	
	Dual lane	790 m	
	Total Single Lane Length		3,480 m
Stations, Single-Side Platforms			7
Average Cruise Speed (no accel./decel.)			4.5 m/s
Acceleration/Deceleration, Maximum			1 m/s^2
Acceleration, Average			0.5 m/s^2
Deceleration, Average			1m/s^2
Train Size (2-cars)			10 m
Train Capacity	Design		36 pax
	Crush Load		51 pax
No. of Double Doorways/Train Side			2
Boarding Time per	Non-Skier		1 sec
	Skier with Skis		2.5 sec
Total Dwell Time	Design Day		523 sec
	Peak Day		646 sec
Time Traveling at Cruise Speed			696 sec
Time in Acceleration/Deceleration			95 sec
Total Round-Trip Time	Design Day		1,314 sec
	Peak Day		1,437 sec
Round Trips per Train per Hour	Design Day		2.740
	Peak Day		2.505
Single Train Capacity per Hour, Each Direction (Passengers/Hr)			
	Design Day		99
	Peak Day		113
Maximum Operating Trains Required to Meet 1995-96 Demand			
	1,039 pax/hr Design Day		11
	1,310 pax/hr Peak Day		112
Headway	Design Day		119 sec
	Peak Day		120 sec
Line Capacity, Single Direction	Design Day		1,089 pax/hr
	Peak Day		1,356 pax/hr
Fleet Requirements for 1995-96:	Operating Trains		12
	Spares		1
	Total		13

EXHIBIT 7-8: CAPITAL COST ESTIMATE FOR STARTER LINE PEOPLE MOVER SYSTEM

GUIDEWAY STRUCTURE			
Single Lane	1,900 m	@ $950/m	$ 1,805,000
Double Lane	790 m	@ $1,400/m	1,106,000
STATIONS	7 sgl. platforms	@ $155,000	1,085,000
SWITCH	1	@ $25,000	25,000
TRANSFER TABLE	1	@ $25,000	25,000
TRAINS (2 cars each)	13	@ $190,000	2,470,000
SERVICE VEHICLE	1	@ $15,000	15,000
POWER DISTRIBUTION			
Substation	3	@ $91,000	273,000
Electric Service	1	@ $8,000	8,000
Feeder Cable	2,690 m	@ $302/m	812,380
Power Rails	3,480 m	@ $164/m	570,720
COMMAND & CONTROL	1	@ $1,000,000	1,000,000
MAINTENANCE			
Facility	8,100 sq ft	@ $50/sq ft	405,000
Equipment & Parts	1 Lot	@ $500,000	500,000
		Subtotal	$10,100,100
ENGINEERING		15%	$ 1,515,015
TESTING		5%	505,005
CONTINGENCIES		10%	1,010,010
ROW AND UTILITY RELOCATION (Allocation)			1,850,000
		TOTAL	$14,980,130

When considering how demand is expected to increase over the next 20 years, the starter line system may be sufficient to alleviate the problems of congestion. However, it would lend itself to extension at both ends by breaking the loops or by addition of switches and building guideway extending towards Golden Peak and towards Cascade Village.

7.4 OPPORTUNITY FOR IMPROVEMENTS

There are opportunities to improve the performance and quality of service of the Representative People Mover and Starter Line People Mover defined in Exhibits 7-1 and 7-7 respectively. Dwell times at stations are excessively long, caused by the requirement that skis not be brought aboard trains and must be stored in racks on the side.

LEM concurs with the concern of Town Officials that carrying skis aboard the buses can be a safety hazard. The bus must be able to and often must emergency brake for other traffic and pedestrians. During such events passengers could be injured by skis. However, the people mover operates on an exclusive grade-separated guideway and encounters no conflicts with other traffic or pedestrians. The only possible collision would be with another train and such events are protected against by the requirements of fail-safe controls and safe braking rates. The system can be designed in accordance with a maximum rate of emergency deceleration of 0.1g, which is also the maximum deceleration for service braking. This would greatly reduce the probability of injury due to skis being brought aboard. It is important to point out that Aerial Passenger Tramways (large cabin systems) throughout the world in ski areas allow skis to be brought aboard the cabin. This is not done on gondolas because there is not enough room inside. Since the People Mover and Aerial Passenger Tramway are parallel situations a safety precedent has been established that should be permissible.

Eliminating ski racks on the sides of the trains permits two improvements as follows:

Reduced Dwell Time - For the systems outlined in Exhibits 7-1 and 7-7, the dwell time in stations is more than cut in half, decreasing the round-trip time for trains. The improvements are as follows:

- Saves three trains in the case of both systems which will reduce costs of the system by $570,000.

- Increases quality of service, average speed, by 25 percent for the full replacement system and 29 percent for the Starter Line.

Improved Station Design - When skis are stored in racks on the side of the train, passsengers must always alight on the same side as boarding to retrieve their skis. Allowing the skis to be brought aboard by the passenger allows the following improvements in station design:

- At heavy demand stations, platforms could be provided on both sides of the train. Doors would be provided on both sides of the train. The train doors for exiting passengers would open first establishing pedestrian flow to the exit platform. The effect is a great reduction in passenger conflicts allowing platform sizes to be reduced. Dwell time in stations may also be further reduced again improving the quality of service.

- Having doors on boths sides of the train allows the flexibility at lower demand stations to place the platform on either side, which may be very important in physically fitting the station within existing real estate. As such, this flexibility may create savings in the cost of civil construction.

- The cost savings provided by reducing the fleet requirements may easily pay for any increased station costs.

8.0 ALTERNATIVE CONFIGURATIONS OF THE TRANSPORTATION SYSTEM

The previous sections of this report were prepared in response to the original LEM proposal. As a reminder, the purpose was to determine whether a people mover system could indeed replace the In-Town Shuttle, provide better service and yet be affordable. This point is the key issue. As indicated in Section 9, private funding of some or all of the fixed facilities will be dependent on the potential return that can be expected from these investments; which, while not estimated in this study, may not be significantly large. Therefore, feasibility may depend upon the ability of the Town of Vail to fund the project.

Adding a people mover guideway to the Vail landscape could be considered as aesthetically disruptive. For example, in the Village, the height of the buildings is rather low. A people mover guideway would, in many cases, tower over those buildings as the track must be as least 15 to 16 feet above the ground to allow circulation of trash removal and emergency vehicles. Such a structure would greatly affect the Vail skyline. In addition to the track structure, station structures would also be required. These elevated structures could be overpowering in the Vail environment as they could rise 37 feet over the landscape. Access would be required from the street requiring stairs to be installed that would use up precious sidewalk space.

Under any circumstance, there is need to improve the current transportation system. Even if feasibility is determined and the Town decides to fund and build a system, there will be an interim period during which demand will continue to increase beyond the capability of the current Shuttle bus route. The earliest that any people mover system might be completed and put into operation would probably be the 1991 ski season. Until this time, demand could increase by another 15 percent (assuming 3.5 percent growth per year). To meet this demand will require that about four additional 35 foot buses be added to the 14 buses operated during peak day peak periods (total fleet of 13 TMC's and five 35 foot buses). Because there is a possibility that adding buses to the fleet could result in a degradation of overall average speed and productivity, it is recommended that the Town study the effect before assuming that the problem can be so simply solved.

The problem appears to be mainly one of overcrowding during peak periods on peak days. Determining the source of this extra demand and a means to carry it, other than on the In-Town Shuttle, could be of value. For example, 23 percent of the peak period peak day demand (965 passengers) has been identified (Exhibit 4-15) as visitors who make cross-movements between Vail Village area and LionsHead each morning and afternoon. Of these, 792 are generated near the Transportation Center (560 are transferring from other Vail bus routes) and 173 are in the LionsHead area having Vail Village or Gold Peak as their destination. There will be a significantly larger number during the afternoon peak period, indicated simply by the fact that 45 percent of Shuttle ridership board the buses at the stops serving LionsHead parking structure and the Vail Transportation Center. Also, nearly one-half of all visitors to the Town Center arrive at one of these two parking structures either by private automobile, bus, taxi or lodge/hotel van.

As the need to improve the transportation system does exist, LEM has examined a set of road based and people mover alternatives that might achieve the primary goal of improving the quality of service of the transportation system. The backbone of these alternatives is a separate express transportation system linking only the two parking structures.

8.1 ROAD BASED SYSTEMS

The two parking structures are accessible from the frontage road and are close to the ski lift areas permitting a dedicated bus system to be implemented between the parking structures. The main components of such a system are related to routing and operations, boarding/egressing (curb space) locations, and vehicles.

The proposed route for the dedicated bus service would link the two parking structures using the frontage road. The service would operate as an express shuttle with no intermediate stops. Vehicle turnaround could be achieved by using the loop at the LionsHead facility, and by using the existing facilities at the Transportation Center.

To reduce confusion at the bus stops which presently serve the two parking structures, the specialized bus service would depart from a different curb side location than the one used by the Shuttle. This would alleviate confusion and pedestrian traffic conflict due to the curb space limitation at these bus stops. The location of the bus stops should facilitate access to the building, facilitate vehicle turnaround, and provide enough curb space to properly handle the demand.

For this type of service, two different types of vehicles could be used: the standard Vail transit bus or a large capacity transit vehicle (either a 35-foot bus, a 40-foot bus or an articulated bus).

Standard Vail Transit Bus

The use of existing Vail transit buses would require reassigning buses from the Shuttle to the new route. This option appears workable because demand on the Shuttle would be reduced and the remaining buses on the Shuttle route would operate more efficiently. On the express link a round trip travel time of 15 minutes would result in a one-way capacity of over 120 passengers per hour per bus, nearly doubling the productivity of a bus. During the peak periods, 3 to 4 buses might be required to handle the peak load. The remaining buses could still be assigned to the In-Town Shuttle. It is anticipated that the net effect of this approach would be to accommodate increased demand for the next few years at a low cost because a supplementary bus purchase would not be required and the attendant increase in O&M cost avoided.

Large Capacity Buses

Large capacity buses could be used along the frontage road since there are very few geometric restrictions. Larger buses could accommodate the peak demand surges, especially if the vehicles are properly designed for the application. For example, one option would be to provide buses with limited or maybe no seating, low level floors, and large doors for easy access. If necessary, level boarding could be provided at the two stations. This would further facilitate passenger access and egress. To be fully effective, the bus/door/platform interface would have to be designed properly.

This approach could require the purchase of special purpose buses that can only be used on the frontage roads. However, from a capacity standpoint, it offers the potential for absorbing peak traffic volumes at a low cost. Also, the In-Town Shuttle service would consequently have a large capacity reserve.

Other Factors

The major drawback of the garage express shuttle approach is that it would increase congestion on the Frontage Road. Also, at present the four-way stop is an impediment to the concept of express buses operating on the Frontage Road. As pointed out in the Vail Traffic Counts (Ref. 5) the four-way stop is presently operating at Level of Service "F"*. Signalization of this intersection has been analyzed and determined to be able to increase the Level of Service to "A" during the morning and "C" during the evening. Therefore, the feasibility of any express bus link hinges on the decision of the Town of Vail to signalize the four-way stop. If so, consideration could be given to allow the express bus to pre-empt the signal allowing a means to alleviate the Level of Service "C" delays in the evening peak.

8.2 DESCRIPTION OF AN ALTERNATE EXPRESS LINK PEOPLE MOVER SYSTEM

An alternate people mover system could link the two parking structures. Two possible alignments are presented in Exhibits 8-1 and 8-2. In each alignment, the stations are adjacent to the parking structures. Access to the station is directly from the roof level of each structure.

To mitigate the issue of right-of-way acquisition, as well as the one related to aesthetics, the proposed alignments would be built on land presently owned by the Colorado Department of Transportation. For the purpose of this study, it was assumed that this land might be made available from Colorado DOT. Should the principle of such a system be retained as a feasible option by the Town of Vail, it will be important to verify that the Colorado DOT is indeed willing to share the ROW. Should this not prove feasible another possible alignment may be running along the south side of the Frontage Road. However, this alignment may be met with objections from property owners and have significant ROW costs.

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* Level of Service "A" - Condition of free flow, no vehicle waits longer than one indication.
Level of Service "C" - Still in zone of stable flow but driver must wait through more than one signal indication.
Level of Service "F" - Indicates a congested condition of forced traffic flow, where queued back ups from locations downstream restrict or prevent movement of vehicles out of the approach, creating a storage area during part or all of the peak hour.

EXHIBIT 8-1: AGT ALIGNMENT BETWEEN PARKING STRUCTURES
OPTION 1

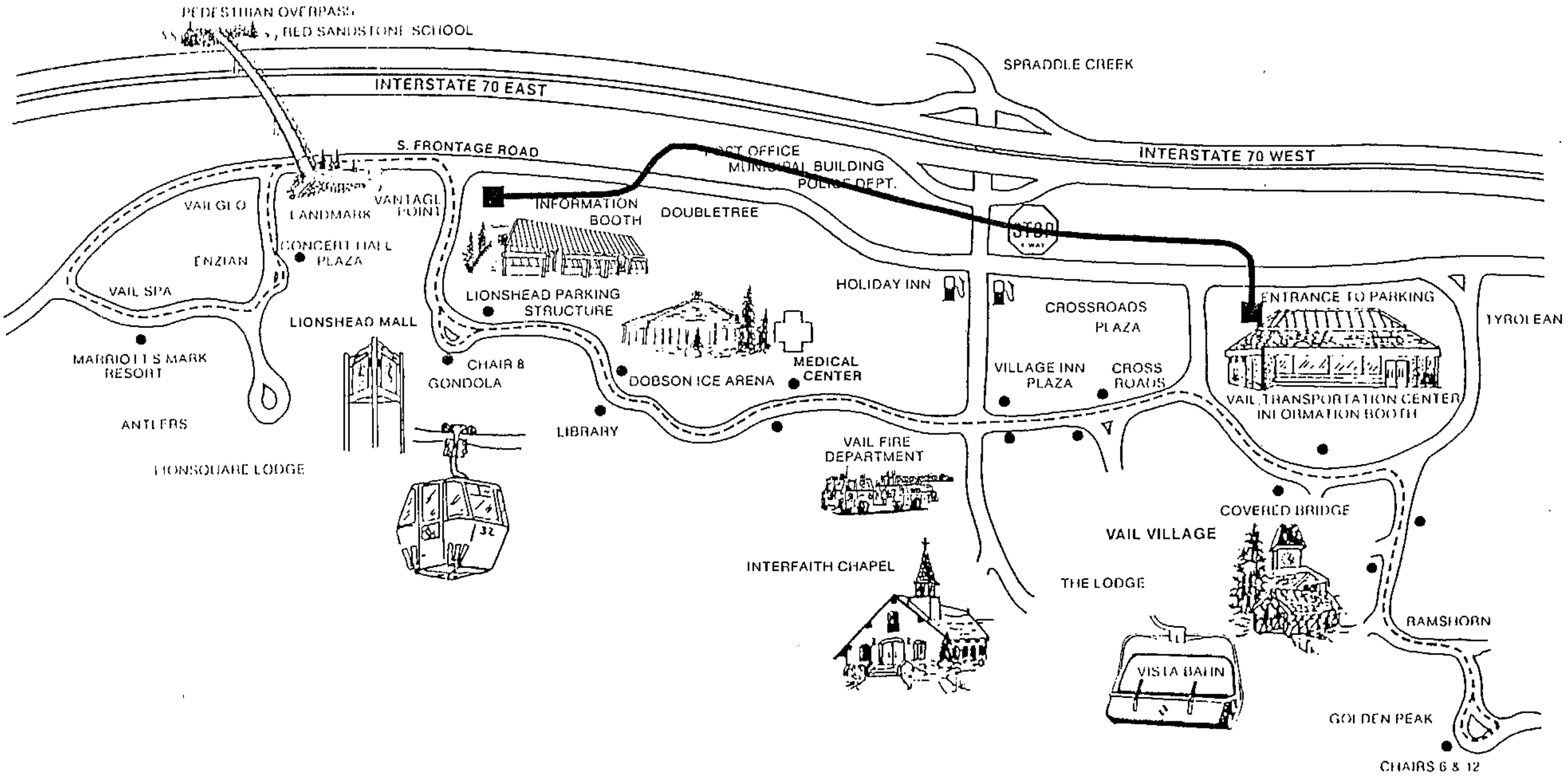
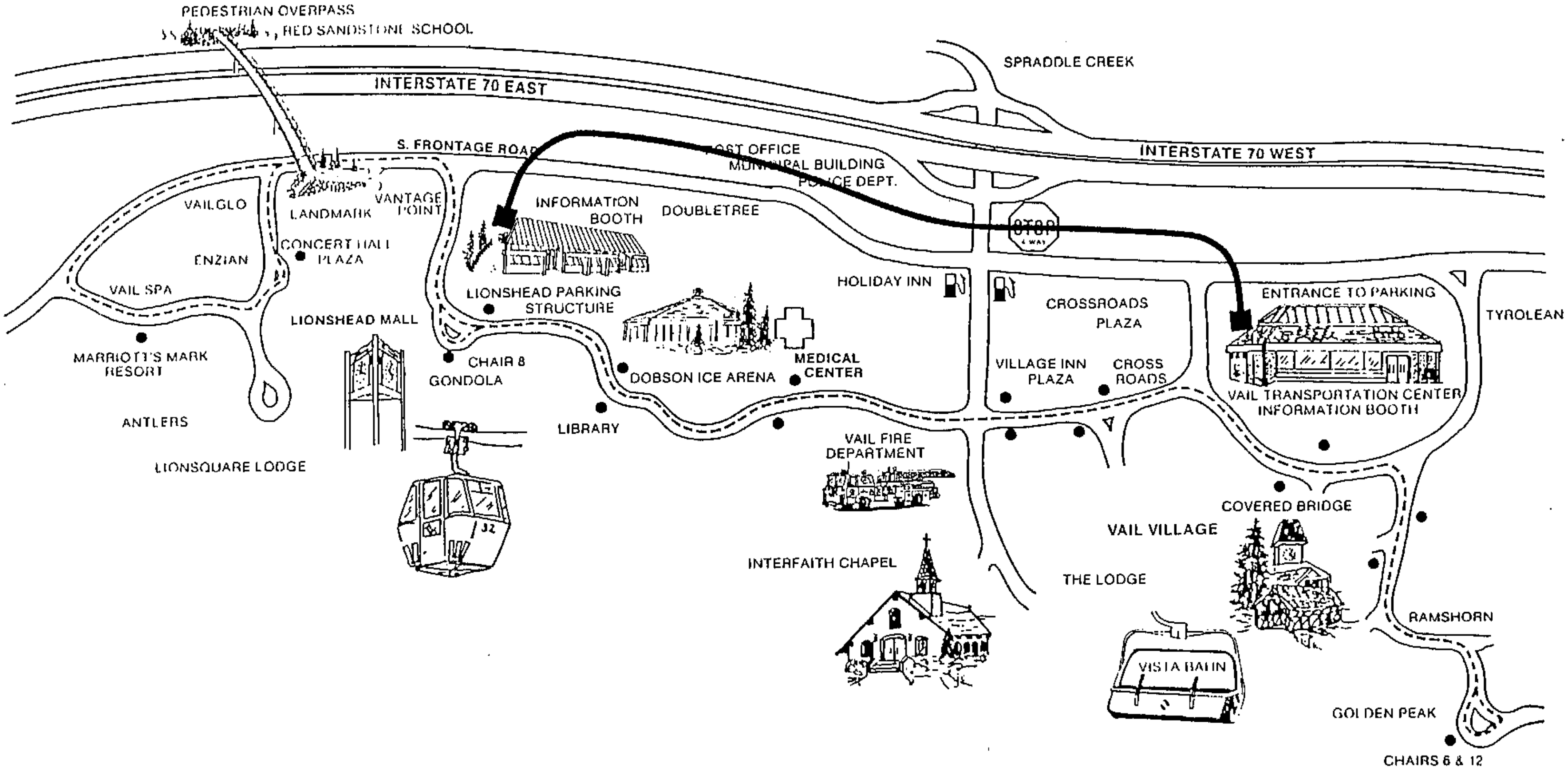


EXHIBIT 8-2: AGT ALIGNMENT BETWEEN PARKING STRUCTURES
OPTION 2



The system's approximate length would be about 3,700 feet. It would be elevated and cross over the frontage road twice and the interstate access road once. Since the system's main role will be to provide quick access between the two parking structures, there would be no intermediate stops.

8.2.1 Potential System Configuration

The proposed system can be classified as a short distance transportation system. Depending on the anticipated traffic volume, different operational configurations can be implemented:

- single track, single vehicle, (See Exhibit 8-3)
- single track, two vehicles, (See Exhibit 8-4)
- double track, two vehicles, (See Exhibit 8-5)
- double track, multiple vehicles, loop operation, (See Exhibit 8-6)

The selection of system type is primarily a function of the capacity and of the level of service. In general, in systems shown in Exhibit 8-3 through 8-5 the capacity is limited by the distance. In order to compensate for these limitations, they utilize large cabins. Such systems are primarily found at airports but there are several non-airport applications in revenue service in the U.S. In these applications, the system links a parking facility to an activity center (e.g., hotel, casino, park). Exhibit 8-7 presents an example of such an application.

While it is not required, a large number of short distance transportation systems in operation to date utilize a track-based propulsion system; in other words, the vehicles are not motorized. In most cases, the vehicles are cable driven. Such modes of propulsion are more applicable for short distances because maximum line speed is limited. Also, cable drawn systems require that the guideway structure be designed so that they can run at constant speed. This is especially true with systems utilizing more than one vehicle driven by the same cable. Because of the lack of sophistication and the absence of complex control systems to perform anti-collision functions, such systems are usually relatively inexpensive.

The type of system presented in Exhibit 8-5 has also been in operation for several years. One of them was demonstrated at Expo '86, linking the French

EXHIBIT 8-3: SINGLE TRACK, SINGLE VEHICLE SHUTTLE

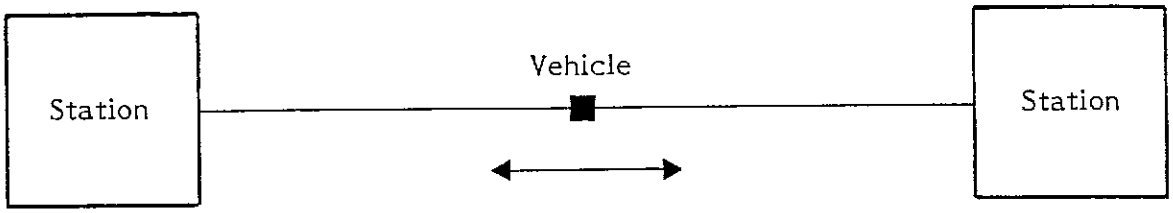


EXHIBIT 8-4: SINGLE TRACK, TWO-VEHICLE SHUTTLE

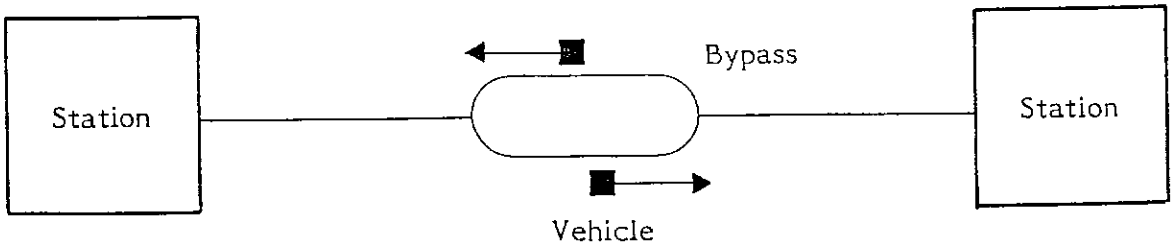


EXHIBIT 8-5: DOUBLE TRACK, TWO-VEHICLE SHUTTLE

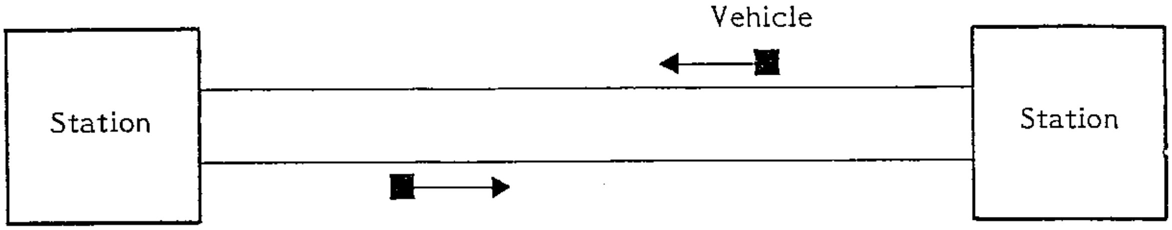


EXHIBIT 8-6: DOUBLE TRACK, MULTIPLE-VEHICLE SHUTTLE

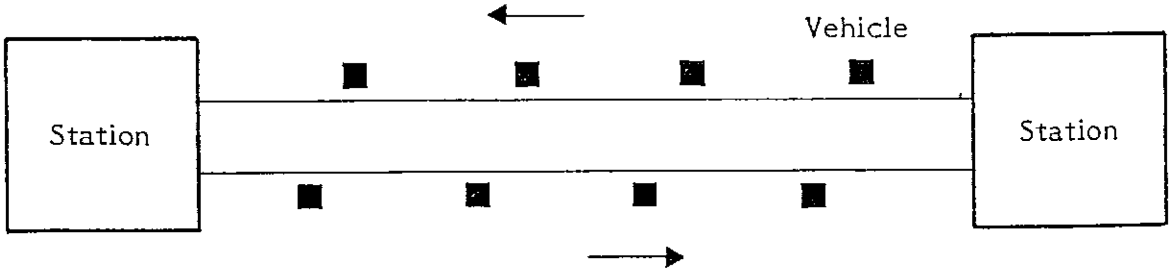
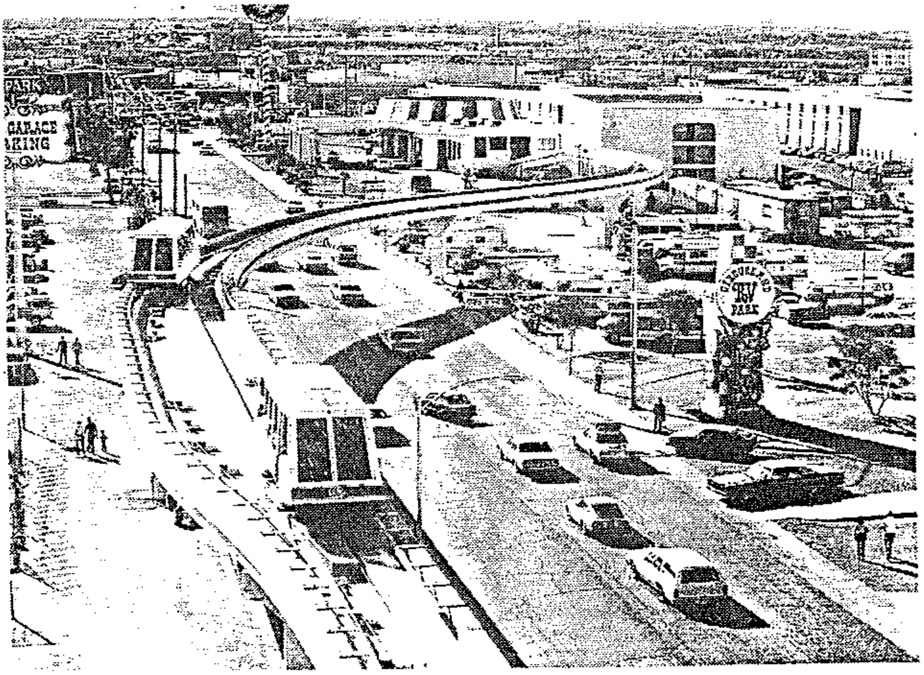


EXHIBIT 8-7: EXAMPLE OF SHUTTLE SYSTEM (CIRCUS CIRCUS CASINO, LAS VEGAS)



Pavilion to the Main Boulevard of the Expo. These systems are characterized by low capacity vehicles operating at small headways (20 seconds and less). The system operates in a fashion similar to the detachable aerial lift found in ski resort areas. In this type of system, the capacity is no longer a function of the length or the speed of the system. It is controlled by the minimum headway achieved in the station. Thus, these systems can deliver capacity in excess of 3,000 passengers per lane per hour. However, as these systems are cable driven, their top speed is limited. As a consequence they become unattractive for distances in excess of a mile.

Another important aspect of these systems is the station access. Systems operating along the principles described in Exhibits 8-3 and 8-4 need only one platform for both boarding and egressing. This makes them more easily integrable into an existing structure, and consequently, they have a positive impact on costs. The other two types of systems require two platforms at each station.

This configuration is more space consuming. However, from a passenger-control point of view, the system presented in Exhibit 8-6 is the simplest because people always board and egress at the same location, and that location is always related to the same function, i.e., either boarding or egressing. This is not the case for the other three types of configurations.

While other propulsion technologies are available, e.g., on-board electric motor, a self-propelled vehicle requires a communication system. The purpose of the communication system is to provide the necessary information to the vehicle control system so that the vehicle operates in a safe manner at all times. When multiple vehicle operation on a single track occurs, a sophisticated control system is required to prevent collision. However, self-propelled vehicles have an important advantage over the track-based system -- they can be designed to operate at the maximum speed permitted by the application. Also, they permit more flexible guideway designs as the vehicle speed can be adjusted to meet local restrictions.

From a reliability point of view, all the systems discussed in Exhibit 8-3 through 8-6 will be equivalent, as the failure of the propulsion system will result in system shutdown (assuming that all utilize a single drive). If independent drives or on-board propulsion systems are used in the double shuttle, failures of one propulsion system will result in a 50 percent capacity loss.

8.2.2 Capital Cost Estimates

Based on the system descriptions given in Exhibit 8-8, two preliminary capital cost estimates were prepared for the two types of technologies considered most appropriate for the in-town people mover. These are presented in Exhibit 8-9 and 8-10. Other technologies, such as the cable-driven reversible shuttle shown in Exhibit 8-7 are also appropriate. However, the time and cost constraints did not permit these investigations.

8.2.3 O&M Cost Estimate

The O&M costs estimates presented in Exhibits 8-11 and 8-12 were prepared for the two types of systems defined in Exhibit 8-8.

EXHIBIT 8-8: SHUTTLE SYSTEM DESCRIPTION

	SELF PROPELLED	TRACK PROPELLED
SYSTEM LENGTH (M)	1150	1150
END OF LINE STATION DOUBLE PLATFORM	2	2
STATION SINGLE PLATFORM	0	0
AVERAGE SPEED M/S (NO DWELL)	6.5	6
ACCELERATION RATE (M/S2)	1	1
VEHICLE/TRAIN CAPACITY - (6 CAR-TRAIN)	114	12
BOARDING TIME PER PASSENGER	1.5	1.5
NUMBER OF DOORS PER CAR/TRAIN	6	1
DWELL TIME	28.5	18
PLATFORM LENGTH (M)	24	6
TURN AROUND TIME AT END STATION	30	40
STATION SPEED (M/S)	0	0.3
TRAVEL TIME (NO DWELL TIME)	190	207
DWELL TIME (TOTAL)	200	175
ROUND TRIP TIME (TOTAL)	390	382
LINE CAPACITY	900	900
CAPACITY PER VEHICLE/TRAINS PER HOUR	1053	113
NUMBER OF VEHICLE/TRAINS IN SERVICE	1	8
SPARES	1	1
TOTAL NUMBER OF VEHICLES/TRAINS	2	10

EXHIBIT 8-9: PRELIMINARY CAPITAL COST ESTIMATE - SHUTTLE MONORAIL

	UNIT COSTS	UNITS	$ AMOUNT
GUIDEWAY			
STRUCTURE			
SINGLE LANE ($/M)	950	1150	1,092,500
DOUBLE LANE ($/M)	1400	0	0
OTHERS	0	0	0
STATIONS			
HALF LINE STATION		0	0
FULL LINE STATION			
FULL END STATION	350000	2	700,000
SWITCH	25000	1	25,000
TRANSFER TABLE	25000	0	0
VEHICLES/TRAINS	450000	2	900,000
SERVICE VEHICLE	15000	0	0
POWER DISTRIBUTION	615,094	1	615,094
C3	252,537	1	252,537
MAINTENANCE			
FACILITY - $ PER SQUARE FOOT	45	3,993	179,674
EQUIPMEMT	125000	1	125,000
SUBTOTAL			3,889,806
ENGINEERING	15%		583,471
TESTING	5%		194,490
CONTINGENCIES	10%		388,981
SUBTOTAL			5,056,747
ROW AND UTILITY RELOCATION COSTS (ALLOCATION)			1,000,000
TOTAL			6,056,747

EXHIBIT 8-10: PRELIMINARY CAPITAL COST ESTIMATE OF SHUTTLE CABLE PROPELLED SYSTEM

	UNIT COSTS	UNITS	$ AMOUNT
GUIDEWAY			
STRUCTURE			
SINGLE LANE ($/M)	950		0
DOUBLE LANE ($/M)	1400	1150	1,610,000
OTHERS (CABLE, RACEWAYS, SHEAVES, ETC)	950	1150	1,092,500
STATIONS			
HALF LINE STATION	128000	0	0
FULL LINE STATION	190000		
FULL END STATION	212000	2	424,000
SWITCH			
TRANSFER TABLE	32000	1	32,000
VEHICLES	76000	10	745,181
SERVICE VEHICLE	15000	0	0
POWER DISTRIBUTION	0		
C3	100000	1	100,000
MAINTENANCE			
FACILITY - $ PER SQUARE FOOT	45	2,451	110,306
EQUIPMEMT	75000	1	75,000
SUBTOTAL			4,188,987
ENGINEERING	15%		628,348
TESTING	5%		209,449
CONTINGENCIES	10%		418,899
SUBTOTAL			5,445,683
ROW AND UTILITY RELOCATION (ALLOCATION)			1,000,000
TOTAL			6,445,683

EXHIBIT 8-11: SUMMARY OF O&M EXPENSES
SELF-PROPELLED SHUTTLE

Personnel (Includes All Overhead & G&A)	$210,000	
Temporary Personnel	6,400	
Cleaning Contract	7,200	
Electric Power	49,252	
Subtotal		$272,852
Consumables (2% of Subtotal)		5,457
Contingencies (10% of Subtotal)		27,285
TOTAL		$305,594

EXHIBIT 8-12: SUMMARY OF O&M EXPENSES
TRACK-PROPELLED SHUTTLE

Personnel (Includes All Overhead & G&A)	$210,000	
Temporary Personnel	6,400	
Cleaning Contract	7,200	
Electric Power	17,899	
Subtotal		$241,499
Consumables (2% of Subtotal)		4,830
Contingencies (10% of Subtotal)		24,150
TOTAL		$270,479

9.0 FINANCIAL CONSIDERATIONS

Funding and financing a people mover system in Vail was briefly examined. Town officials have informed us that no State grants are available. Federal funding, such as through a capital grant from the Urban Mass Transportation Administration (UMTA) is not considered feasible for three reasons. First, the current transit demand for the In-Town Shuttle is less than the average (year around) daily demand of 15,000 trips required by UMTA to even consider funding a fixed-guideway transit system. While current annual demand for the In-Town Shuttle of 3,000,000 trips averages 8,219 trips per day there are an average of 10,146 trips per day during the ski season. On a typical Saturday during the ski season the demand is 14,000 trips. Second, UMTA requires that the system not cost more than $10 per each incremental new rider that it carries. As a replacement for the In-Town Shuttle the people mover system has no current incremental new ridership. In 1995-96 the incremental new ridership is estimated to be about 700,00 per year; therefore, the cost per incremental new rider would be $21 to $29 for the $15 million and $20 million systems respectively. Third, the current administration has a policy not to fund new fixed-guideway systems and has a record of using bureaucratic obstacles as a means to stall even those projects that meet the guidelines. Therefore, funding derived only from the economy of the Town of Vail was considered.

The total annual revenue required to meet both the capital and O&M costs of the three different people mover systems was estimated as follows:

Capital Recovery

15 year period at 10 percent/year interest -- crf = 0.13147

Representative People Mover to Replace In-Town Shuttle

$20,000,000 capital x 0.13147	$2,629,400 /year
O&M cost	950,000 /year
Total	$3,579,400 /year

Starter Line People Mover to Partially Replace In-Town Shuttle

$15,000,000 capital x 0.13147	$1,972,000
O&M cost	750,000
Total	$2,722,000

Alternative People Mover Express Link

$6,000,000 capital x 0.13147	$ 788,820 /year
O&M cost	300,000 /year
Total	$1,088,820 /year

The Town's economy is derived from approximately 1,400,000 annual visitors. Therefore, the above annual costs spread over these visitors would be approximately $2.55 per visitor for the Shuttle Replacement People Mover, $1.94 per visitor for the Starter Line, or 80¢ per visitor for the alternative Express Link. The possibilities of deriving these funds from private and/or public sources were examined.

9.1 PRIVATE FUNDING: CONCESSIONS

A full concession in which a contractor is responsible for providing the entire system and operating it for a fixed amount of time is an attractive idea. This type of approach was investigated for the Orlando people mover by MATRA of France. Unable to obtain all the ROW necessary to build a system that would be economically feasible and lacking support from the major real estate holder, Disney World, MATRA has decided not to pursue the project. Similar investigations have been going on for several years in Atlantic City, Las Vegas, and Boston.

Success greatly depends on whether the capital cost expenditure can be spread between several entrepreneurs and/or businesses who are willing to take the risk of paying for all or a part of the system, anticipating that the additional profits generated by the System's presence will more than offset the capital and O&M expenditure.

Such an approach appears to have two major obstacles. The station locations are not within the two retail areas. Also, the majority of the users, who in the future will be comprised of a higher proportion of day skiers, spend only about $20 per day in Vail versus $120 by destination skiers. To generate $2.55 per visitor totally within the private sector, and not as a direct admission charge, would require additional spending in excess of $25 per day. For the Starter Line People Mover and alternative Express Link such additional spending would have to be more than $20 per day and $8 per day respectively. At this stage, it is doubtful that a people mover system will significantly modify this spending pattern. The predicted increase in the number of skiers will increase the local revenue only marginally; therefore, the implementation of a full concession, whereby a deficit would not be paid by the Town of Vail, appears unlikely.

9.2 PUBLIC FUNDING: NO CONCESSIONS

Under this option the Town of Vail would procure and own the System. Operation could be by public agency or under fixed-price contract. Feasibility is based on the ability of the Town of Vail to:

1. Raise the capital needed for construction of the system.
2. Find a regular source of funding to cover yearly O&M of the System.

Large capital expenditures are traditionally financed through municipal bonds. Whether this approach is feasible in Vail depends on the Town's indebtedness level. The preliminary cost estimates submitted in this report should be an indication of whether such an option can be considered.

Revenue generation for O&M is usually done several ways:

- Fare Collection
- Grants
- Taxes, Fees, or Assessments
- Advertising

In the existing bus system, there is no revenue from fare collection -- an approach which is justified in the Vail environment. Having a fare collection system would increase the confusion and the dwell time. It would also greatly increase station costs because of the need to control paid and unpaid passengers; increased space would have to be provided for passengers buying tickets, etc. It also increases O&M costs since maintenance of fare collection equipment is required and because a special facility and extra personnel are required to handle money.

Grants do not appear likely, especially since the project would not qualify for an UMTA grant as discussed above. The potential for a State grant has been examined by the Town's Planning Department and found unavailable. If aesthetically acceptable, advertising could bring in some revenue, but is estimated to be insignificant with respect to the need.

Therefore, the prime source of funding to retire bonds and meet the O&M costs is expected to be a tax, fee or assessment or combination of each. Some examples for consideration are as follows:

Assessment -- This is usually a tax assessed commensurate with the benefit that is derived by the businesses and property owners whose incomes are enhanced by the System. Formulas can be derived on the basis of assessed property value and/or gross annual income. Since an increase in the economic level is not predicted, the "assessment" approach may be unlikely.

Property Taxes -- This would be an increase in the millage rate, earmarked specifically for the transit system. Exhibit 9-1 provides an analysis of the required increase in millage rate to completely fund the annual cash requirements for the people mover system. It has been assumed that procurement and construction contracts would be let in 1988 and the System opened for operation in 1991. While the estimated millage rates are high, when compared with current rates, they are not proposed or recommended. Exhibit 9-2 shows the revenue generation potential for a 5 point increase in millage rate over the 15 year capital retirement scenario.

Sales Tax -- Increased sales tax revenue requires increased spending, which appears unlikely as discussed above in Section 9.1, or an increase in the sales

EXHIBIT 9-2: POTENTIAL SOURCES OF REVENUE TO FUND THE PEOPLE MOVER

(Constant 1985 $)

PERIOD	YEAR	EXTRA 0.5¢ SALES TAX 1/	INCREASE LIFT/RESORT TAX RATE 25% 2/	EXTRA 5 MILLAGE PTS PROPERTY TAX 3/
1	1991	1,217,000	295,000	768,000
2	1992	1,241,000	301,000	783,000
3	1993	1,266,000	307,000	799,000
4	1994	1,291,000	313,000	815,000
5	1995	1,317,000	320,000	831,000
6	1996	1,343,000	326,000	848,000
7	1997	1,370,000	333,000	864,000
8	1998	1,398,000	339,000	882,000
9	1999	1,425,000	346,000	899,000
10	2000	1,454,000	353,000	917,000
11	2001	1,483,000	360,000	936,000
12	2002	1,513,000	367,000	954,000
13	2003	1,543,000	375,000	973,000
14	2004	1,574,000	382,000	993,000
15	2005	1,605,000	390,000	1,013,000

NOTES:

1/ Sales taxes at 3% in 1985 were $6,482,000 and have been escalated at 2% per year for actual growth of the resort.

2/ 1986 estimated revenue of $1,070,000 escalated 2% per year.

3/ Based on Property valuations given in Exhibit 9-1.

tax rate. A one-cent sales tax earmarked for the transit system would require each visitor to spend $80 just to generate the 80¢ per visitor for the alternative people mover Express Link and $255 to get $2.55 per visitor for the Shuttle Replacement People Mover. The latter clearly exceeds the spending rate for day skiers and probably that of resident skiers. However, if one accounts for the growth of the resort the problem lessens. Exhibit 9-2 shows that with the revenue-generating potential of a 0.5 cent increase in tax rate over the 15-year period, 1991-2005, a system might be financed.

Room or Hotel Tax -- In this case a tax of 80¢, or even as high as $2.55 would be reasonable; however, it would be in addition to any tax presently charged. Also, it would not be paid by day skiers so that it would not generate all of the required revenue. As such, this method should probably be combined with other methods of generating revenue assessed against day skiers.

Visitor Tax or Fees -- There are a number of ways in which a fixed amount could be levied on visitors as follows:

- Additional tax on lift tickets.
- Additional parking fee or tax.
- "Landing Fee" to be paid by bus and limousine operators at the Transportation Center.

If combined with a hotel or room tax, relief for overnighters might be provided by exempting them from any such tax on lift tickets.

Exhibit 9-2 shows the revenue generating potential of a 25 percent increase in the lift/resort tax rate, again for the same 15 year scenario discussed above.

Four scenarios were postulated and assessed for determining the source of revenues to back bonds or other financing of the people mover system. Only the Shuttle Replacement People Mover and Starter Line People Mover were considered in these scenarios. For each case, the design and construction project is assumed to begin early 1988 and the system opened for operation in 1991. The yearly cash requirements are as given at the beginning of Section 9.

Scenario I: Fund Totally by Increased Property Tax Millage Rate, Earmarked for the System

- Shuttle Replacement -- millage rate increase of 19.74.
- Starter Line -- Millage rate increase of 14.15.
- If millage rate kept constant then an excess would build up for buying additional trains and/or extending the system when demand increased beyond 1996.
- Recommendation -- This scenario is not recommended because the extra millage rate is high as compared with that already received by the Town. Great resistance from property owners may be expected.

Scenario II: Fund Totally from Increased Sales Tax Earmarked for the Transit System

- Shuttle Replacement -- Requires increasing sales tax from the present three cents to 4.25 cents
- Starter Line -- Requires increasing sales tax to four cents.
- Holding the incremental increase constant will create excess funds for expanding the system.
- Recommendation -- This scenario may be feasible, particularly for the Starter Line and warrants exploration and consideration by Town officials.

Scenario III: Fund Totally by Increasing the Lift/Resort Tax Rate

- Shuttle Replacement -- Requires increasing tax 3.56 times higher than current rate.
- Starter Line -- Requires increasing tax 2.84 times higher than current rate.
- Recommendation -- Not recommended because it will increase cost to a lift ticket beyond the present $30/day making Vail less competitive against other ski resorts.

Scenario IV: Combination of Tax Increases

- Shuttle Replacement People Mover
  - Increase Sales Tax from three cents to four cents.
  - Increase property tax millage rate by 3.88 points.
- Starter Line
  - Increase Sales Tax from three cents to 3.5 cents.
  - Increase Property Tax millage rate by 6.22 points.
- Holding the increases in tax rate constant will provide excess funds for expansion.
- Recommendation: Combinations of tax increases appear to be reasonable, and therefore should be explored and considered by Town officials.

9.3 CONCLUSIONS

The annual cash requirements to fund the people mover, even as a complete replacement for the In-Town Shuttle, do not appear excessive and may be affordable. Funding the system totally from private sources does not appear likely. However, there may be the opportunity to obtain private participation in obtaining right of way and through some property owners building and owning stations.

Funding the system by grants from the Federal or State government appears even less likely than from private means.

Funding the system by increases in various taxes does appear reasonable. Therefore, is it recommended that in determining feasibility, the Town officials concentrate their efforts on these issues. Technological and physical feasibility has been determined by other work in this report.

REFERENCES

1. Town of Vail Transit Development Plan Update 1987-1991, dated April 1986.

2. Vail Mountain Master Plan, 1985.

3. Potential Impacts of the Vail Master Plan Regarding Circulation, Parking and Population Growth on the Town of Vail, by Rosall, Remmen & Cares, Inc., September 27, 1985.

4. Memorandum to Larry Warren from Nolan Rosall, January 30, 1986, Parking and Bus Utilization, Vail Mountain Master Plan Update.

5. Vail Traffic Counts, Centennial Engineering Inc., March 1986.