Appendix II-C

Summary of Prior *All-Bus* and *Integrated Rail/Bus* Alternatives Analyses

(Analyses conducted prior to 1996 adoption of the Sound Move Plan)

April 5, 2001

Summary Report Requested February 8, 2001, by
Puget Sound Regional Council's
Transportation Policy Board and Growth Management Policy Board

In January 2001, the Regional Council received a formal request to conduct an "all-bus" analysis as an additional alternative in the environmental analysis process for Destination 2030, the update of the region's Metropolitan Transportation Plan. At their February 8 joint meeting, the Policy Boards responded to this request by directing Regional Council staff to work with Sound Transit staff to summarize the previous analyses that led to the currently adopted "rail/bus" plan. Board members felt that an all-bus alternative had already been thoroughly examined as part of earlier legislatively authorized regional transit planning work over the past decade. That prior work was conducted over several years at great expense, and in much greater detail than is possible through a more general regional planning and modeling analysis in a few months.

Drawing upon a review of volumes of reports and information generated over many years of planning, this paper uses a question and answer format to address questions that have come up over the past six or so months regarding the system-level analysis that was previously conducted to compare "all-bus" alternatives with integrated "rail/bus" solutions to address the region's long-term regional transit needs. In addressing these questions, the paper specifically identifies some of the determining factors for selecting light rail in the central I-5 corridor (generally between Northgate and SeaTac) as part of Sound Transit's adopted mixed-mode Sound Move plan. Key documents that were used as a reference are noted at the end of this paper.

1. Over the past several decades, when has the region evaluated the appropriate role for rail and/or bus transit as part of a regional transportation system plan?

There is a long history in the Puget Sound region of decision-makers studying the role that various transit technologies should play in supporting the region's future growth and maintaining long-term regional mobility. In the 1960s a multi-year planning effort resulted in the adoption of the Forward Thrust Public Transportation Plan, a coordinated rail and bus rapid transit system. Ballot-measures to fund the proposed transit investments in this plan failed to receive the required 60 percent super-majority in 1968, and again in 1970. In the 1970s the Puget Sound Council of Governments adopted an all-bus plan in response to the two failed ballot-measures. This plan eventually led to the creation of Metro Transit in King County and subsequent state legislation for

Public Transportation Benefit Areas providing for the formation of Community Transit (Snohomish County), Pierce Transit, and Kitsap Transit.

During the 1980s, a number of multi-year planning efforts were conducted by the Puget Sound Council of Governments that analyzed the feasibility of a rapid transit system that would provide better connections between King, Pierce, and Snohomish counties. The analysis, part of the North Corridor and Multi-Corridor projects, concluded that the combination of bus and rail would provide the best solution to serving long-term regional transit demand. While the studies differed on precisely where, how much, when, and what kind of rail service was appropriate in the region, each of the studies identified the same central I-5 corridor as the common and most critical segment within the region where rail transit would be the best fit and was most justifiable to provide the speed, reliability, and capacity to serve future transit travel demands.

The most recent and comprehensive system-wide analysis that evaluated the relative costs and benefits of a rail/bus alternative and an all-bus alternative was conducted as part of the Regional Transit System Plan (RTSP), completed in 1993. This plan was a combined effort of the public transit operators in King, Pierce, and Snohomish counties under the policy guidance of the Joint Regional Policy Committee (JRPC), which included representatives of the transit operators, cities and counties, and the WSDOT. Technical oversight was provided by a state mandated Expert Review Panel (ERP) composed of experts in various transportation disciplines who were drawn from throughout the U.S. The planning effort included a detailed corridor planning and evaluation of alternatives in the region's primary transit corridors; extensive community involvement including hundreds of public meetings; and the preparation of a programmatic Draft and Final EIS. The system and corridor planning work led to adoption of the Regional Transit System Plan by the JRPC in May 1993. In July 1993 all three counties agreed to the formation of the Regional Transit Authority or RTA (now called Sound Transit) to implement and operate the regional elements of the plan.

2. What elements were included in the Regional Transit System Plan (RTSP) adopted by the JRPC in 1993?

The adopted RTSP determined that an integrated rail/bus alternative was best able to meet the region's long-range transit needs. The regional rail element of the plan was included as an integral part of a larger and more comprehensive set of transit system improvements. Overall, the long-range RTSP, as subsequently modified into Sound Transit's long-range "Vision Plan," proposed the following components for the regional transit system:

- approximately 125 miles of light rail service operating in four corridors (north from Seattle to Everett, south from Seattle to Tacoma, east from Seattle across Lake Washington, and north/south along the I-405 corridor between Lynnwood and SeaTac)
- commuter rail service from Lakewood/DuPont area to Everett
- numerous express freeway bus routes operating in HOV lanes
- direct HOV freeway access improvements
- HOV lane system completion
- local and feeder buses services
- park-and-ride lots, transit centers, and many other operational improvements to increase transit efficiencies

It should be noted that not all of the above facilities and services were assumed to be the responsibility of Sound Transit (nor, under state law, are all such facilities and services eligible for Sound Transit's high capacity transit funding). The analysis that went into this plan recommendation was, consistent with state law, comprehensive and well reviewed. In its final letter, the state's Expert Review Panel remarked:

> "We would like to emphasize that we find the analysis completed to date, first by Metro, then by JRPC, and finally by the RTA, represents possibly the most extensive analysis ever undertaken of an expanded public transit investment prior to presenting the issue to the public for their approval."

The Expert Review Panel letter went on to state:

> "Much of the region's transit needs can continue to be met by buses, and the proposed HOV improvements in this plan will enhance bus speed and reliability in suburban corridors. In the most-traveled and most congested central corridor in the region, however, only rail provides the capacity, speed, and reliability to meet growing demand." *(Expert Review Panel letter submitted to the Governor, state legislative leadership, Secretary of Transportation, and local elected officials, October 14, 1996)*

3. What all-bus alternatives were analyzed leading up to the JRPC's 1993 adoption of the Regional Transit System Plan?

In addition to a rail/bus alternative that was analyzed as part of the RTSP, two "all-bus" alternatives were also fully analyzed. One of the alternatives (known as the Transportation System Management/TSM Alternative) included a significant increase in bus services, completion of the freeway HOV lane network, arterial HOV expansion, priority for transit/HOV vehicles throughout the system, major expansion to park-and-ride lots, new and expanded transit centers, and additional freeway flyer stops. The other all-bus alternative (TSM/Transitway Alternative) included most everything in the TSM Alternative (except where duplication would exist) but added HOV lane system enhancements to provide more speed and reliability in areas where existing or proposed future HOV lanes were not be adequate to handle project levels of transit and HOV demand. These enhancements included a combination of direct freeway HOV access ramps, new busways (physically separated lanes exclusively for buses), and transitways (other physically separated facilities for exclusive use by HOVs and buses).

The all-bus alternatives were designed as a very aggressive system of investments that could provide substantially improved service to destinations throughout the region. The busways and transitways included in one of the all-bus alternatives were an attempt to achieve some of the exclusive operational advantages of a regional rail system using bus rapid transit (BRT) technology. In this more exclusive operational alternative, HOV lanes were separated from general purpose traffic by Jersey barriers to provide better speed and reliability for transit vehicles and other HOVs. In the most congested corridors in the region, bus-only roadways were separated from other HOV traffic to provide an even greater level of transit service.

4. What were the advantages and disadvantages of the integrated all-bus alternatives that were studied?

Short-term (within first 10 years), the all-bus alternatives were found to significantly add to the capacity, speed, and reliability of current transit service levels. Transit service between major regional destinations would be substantially enhanced and operational improvements would greatly improve transit's relative competitiveness with auto travel. Transit service on exclusive transitways would significantly improve transit service levels in a number of very congested corridors serving major activity centers. The initial capital costs of the all-bus alternatives were somewhat less than those of the rail/bus alternative and the all-bus system improvements could generally be implemented more quickly and with somewhat less financial and construction-related risk.

However, beyond about 10 years, the analyses demonstrated that many of these advantages diminish with increasing time. Future population and employment growth results in increasing traffic congestion, resulting in deterioration of the quality and reliability of bus service on the regions freeways and arterials. The all-bus alternative containing exclusive busways and transitways, with a completed regional HOV lane system, could satisfy much of the region's travel needs. However, because of limited right-of-way, even developing these exclusive transit facilities would require converting some general purpose freeway and arterial traffic lanes to exclusive use for buses and/or carpools, which was projected to have an understandably negative effect on traffic. Bus service reliability particularly deteriorates when serving the more densely developed regional activity centers where projections of growing transit demand begin to exceed the capacity of existing city streets to accommodate the growth in buses.

In both the University District and downtown Seattle, the magnitude of buses needed to carry projected ridership at peak-periods would eventually exceed available street capacity unless major changes are made in how those streets are used and managed. In downtown Seattle, the combined capacity of the bus tunnel and north-south surface streets would be inadequate to serve forecasted transit demand beyond 2010. Even if all peak-hour buses were articulated coaches, Seattle would need to convert more existing downtown street lanes and curbside parking to transit-only lanes. The analysis included testing conversion of existing parking lanes along Second and Fourth Avenues into contra-flow (reverse direction) bus lanes to add even more transit capacity; yet even these likely unpopular changes could adequately address longer-range (20 year) transit needs. Somewhat similar capacity constraints were projected to occur in the University District of Seattle and on other north-south arterials paralleling I-5 from downtown Seattle to near the King/Snohomish County line.

Over the long-term, planned improvements for increased HOV lane capacity and operations in the I-5 north corridor were determined to be inadequate to meet the region's projections for transit travel demand for buses, carpools, and vanpools without acquiring new rights-of-way and building new travel lanes in the already highly crowded and fully developed I-5 north corridor.

5. What were some of the determining factors for selecting the integrated rail/bus alternative over an all-bus alternative?

There was no single reason or determining factor cited by policy-makers in selecting a regional rail service component as part of the RTSP. The decision rather hinged on a number of different variables and trade-offs. The integrated rail/bus alternative exhibited better system-wide performance but had substantially higher capital costs to achieve greater exclusive transit operating capacity to more directly serve high density regional centers than the all-bus system alternatives. By 2020, the rail/bus alternative was forecast to attract approximately 20 percent more riders than either of the all-bus alternatives.

A key reason why the rail/bus alternative was able to attract significantly more riders was because of the dramatic service increases that could be achieved in some of the most dense urban travel markets. The all-bus alternatives did perform quite well in the lower-density, more suburban parts of the region, but in more urban markets the bus services were vulnerable to the same congestion and delay experienced by other roadway users. The transitways and busways were shown to greatly improve transit speeds and reliability within congested urban corridors such as I-5 north and south and on I-405 where such facilities could be built. However, the busways and transitways could not gain reliable direct access to the high density residential and employment concentrations of the University District, Capitol Hill, First Hill, downtown Seattle, and the Rainier Valley. The light rail alternative provided the best opportunity to provide reliable, direct congestion-free access to serve these high density markets. Ridership levels for First Hill/Capitol Hill, the University District, and downtown Seattle were dramatically higher under the integrated rail/bus alternative.

Probably one of the most significant factors that tipped the scales toward the rail/bus alternative was the long-term effectiveness and relative efficiencies that rail services would provide over the 20 year planning period. In addition to faster speeds and greater reliability in direct service to high demand transit markets, the rail/bus alternative was found to provide a substantially higher level of long-term future capacity than either of the all-bus alternatives. Whereas the all-bus alternatives were shown to begin experiencing capacity constraints and reduced reliability in service to high density centers sometime around 2010, the rail/bus alternative was shown to provide continuously reliable operational capacity well beyond 2020. Over the longer time frame, this higher level of transit capacity demonstrated cost-effective advantages as future transit needs grow to double and triple today's ridership levels. The greatest share of any transit system's on-going average annual costs are labor, whether the system is bus or rail. Therefore, when an urban area has a high-demand transit corridor (the Federal Transit Administration has used a rule-of-thumb to define such corridors as carrying greater than 15 to 20 thousand daily transit trips) the marginal costs for increasing incremental units of transit service favor rail over bus transit due to a higher passenger to labor ratio (1 bus driver per 100-110 persons seated and standing vs. 1 train driver per 500-600 passengers seated and standing).

In terms of total costs (capital and operating) per rider, the RTSP analysis did demonstrate that the all-bus alternatives would be less expensive in the short-term than the rail/bus alternative (approximately $6 to $6.50 versus $8 per rider in 1990 dollars). However, to expand capacity beyond 2020, the incremental costs per 100,000 additional daily riders was significantly higher for bus than rail ($2.1 billion vs. $170 million). When getting into these much higher levels of

transit ridership in the region's most dense communities and centers, the high incremental cost of expanding the capacity of an all-bus system is, as just noted above, the result of the more favorable incremental labor-to-passenger ratio for additional units of service (1 more bus vs. 1 more train).

As with any transit system expansion, developing a light rail transit system requires a fairly high up front cost to acquire land and build supporting maintenance and storage facilities. The development of the relatively expensive light rail maintenance facility proposed as part of the Sound Move plan allowed for the ability to accommodate a great deal of future capacity expansion with this initial investment. As an all-bus system expands in service, it too must develop these critically important support facilities that are often invisible to the public. For example, for every 300-400 new buses added to a bus fleet, another new maintenance and operating base needs to be sited and constructed. As Metro found out during many years of trying to locate its North Operating Base (now in its home next to the realigned I-5 north freeway), bus bases can be very expensive and finding the essential land for a 10 to 20 acre base, from the community's perspective, can be as contentious as resolving a light rail alignment.

6. What were the determining factors for focusing on and selecting the central I-5 corridor as the initial segment for rail transit investment as part of Sound Move?

Sound Move is a phased approach to implementing the RTSP. The 1996 Sound Move plan calls for a combination of commuter rail, express bus and light rail services to meet the region's high capacity transit needs. Sound Move proposes that a light rail segment between Northgate in Seattle and the city of SeaTac be constructed to serve existing and projected transit demand in the central I-5 corridor. This is the only corridor where the region is currently committed to light rail and the segment between Northgate and the University District remains unfunded at this time. The Sound Transit Long-range Regional Transit Vision acknowledges that before future extensions to rail are made more study is needed to determine the appropriate alignments and transit technology.

The central I-5 corridor (generally between Northgate and SeaTac) contains the region's highest density land use activity, has the most severely congested facilities, and has the most dramatic capacity limitations in the region. The corridor exhibits the highest level of current transit ridership in the region and is projected to have the highest transit demand in the future. In addition, the corridor contains the highest concentration of low-income and minority populations in the region, has the highest per capita transit ridership, the highest number of households without access to a car, and the highest density of seniors and children in the region. In the past three decades, the population density within the corridor has remained high, increasing from 5,400 to about 5,800 residents per square mile. The employment density has significantly increased over the same period from 4,300 to 7,600 jobs per square mile. By 2030 the population density in the corridor is forecast to reach 8,300 residents per square mile with employment density at 10,000 jobs per square mile.

The Seattle central business district, in the heart of the corridor, is by far the most productive transit market in the region followed by the University District and Capitol Hill/First Hill. These areas are characterized by congested streets, limited space to expand parking, slow transit

operating speeds, and limited right-of way for transit expansion. Other transit markets in the corridor include the regionally designated Urban Centers in the cities of SeaTac and Tukwila, and the Rainer Valley in Seattle, which has extremely high daily ridership during both peak and off-peak periods. By 2010, light rail would provide service to 300,000 employees within walking access to stations. Light rail also has a better ability to add capacity to serve future demand in this high travel demand corridor by increasing the number of cars per train or frequency of service without needing additional rights-of-way after initial development.

7. What were found to be some of the distinguishing system performance characteristics of light rail versus bus-only in the central I-5 corridor?

Light rail in the central I-5 corridor provides an attractive travel alternative in the most congested corridor of the region where options to build expanded transit roadways or convert general purpose lanes to transit-only lanes are limited, the geographic constraints are numerous, and the reliability of buses is projected to further decline due to increased congestion. In contrast to additional bus service, the light rail segment would operate on rights-of-way largely independent of congested roadway traffic. Whereas today, bus speeds average about 10 mph on Rainier Avenue South and less than 5 mph on Broadway on Capitol Hill, the light rail trains will travel at an average operating speed of 28 mph throughout the corridor. Light rail will move residents in the Rainier Valley to Capitol Hill to the north and SeaTac Airport to the south in less than 20 minutes – trips that can take twice that long today by bus at rush hour. The comparison of rail with a much improved bus system shows that the speed and reliability improvements provided by light rail could not be duplicated by an all-bus system in the highest density communities and business districts.

As mentioned previously, the bus capacity constraint in downtown Seattle was one of the major reasons for selecting light rail in the central I-5 corridor. Currently about 450 buses per hour go through downtown during the pm peak period – 300 on surface streets and 150 buses (both ways) in the tunnel. The total number of buses that could reasonably be operated through downtown was estimated to be between 650 to 850 buses per hour, assuming full operation of surface streets (450-550 buses) and the downtown tunnel (200-300 buses). The lower end of the range assumes no major operational changes downtown while the higher-end assumes significant operational changes on surface streets and/or in the Downtown Seattle Transit Tunnel (DSTT). The potential modifications to increase transit capacity on downtown streets would include some or all of the following: transit-only contra flow lanes at entry/exit points to downtown, additional bus-only lanes on downtown streets during peak hours, converting whole streets into transit-malls for transit use only, or constructing a second bus tunnel. The higher end of the bus tunnel range would require buses to arrive and depart the tunnel on precise schedules in order to operate in three-bus platoons that would require passengers to queue at additional specific places in the bus tunnel's station platforms.

Under the all-bus alternatives, it was estimated that approximately 875 buses per hour would need to run through downtown Seattle to serve projected transit demand in 2020. Even with major modifications to the downtown street system to accommodate more buses, the transit needs would push beyond the upper-end of the estimated capacity limit on surface streets ***and*** in the tunnel. Analysis of the all-bus alternatives estimated that by 2010 the capacity of buses to carry

commuters to and from downtown Seattle would be reached, resulting in seriously congested downtown streets that would require further conversion of parking lanes and general purpose traffic lanes to transit-only use. Under the rail/bus alternative, it was estimated that a total of 450 buses would be using downtown streets, pushing at the lower-end of the capacity range. Additionally, the estimates demonstrated that rail service in the downtown tunnel would still have significant unused capacity to accommodate future projected transit demand beyond 2020.

Summary

Policy makers in the central Puget Sound region have studied a wide variety of regional transit alternatives over the past 35 years. The studies have analyzed many different transit technologies, evaluated a variety of routes, undergone scrutiny by a state-appointed Expert Review Panel, the USDOT'S Federal Transit Administration and other independent parties, produced a voluminous set of documents, and incorporated thousands of hours of public discussions and review with the region's citizens. Some of the major findings of these analyses include:

- The combination of bus and rail was found to provide the best long-term strategy for tailoring transit services to fit the unique and distinctly different needs of the various part of the three-county Sound Transit service area.

- In the short-term (first 10 years), an all-bus alternative would be capable of offering significantly improved service levels at lower initial capital and operating costs than a rail/bus alternative. Over the long-term (beyond 10 years), an all-bus transit system was shown to experience deteriorating service levels in congested corridors as a result of increasing traffic congestion and operational capacity constraints for transit on city streets and in the downtown transit tunnel.

- The most severe bus operational capacity constraints were projected for downtown Seattle where the ability of the tunnel ***and*** surface streets to handle the growing volume of buses beyond 2010 would still be inadequate to serve long-term transit demand, even when testing the full removal of parking on Second and Fourth Avenues to operate bus contra-flow (reverse direction) lanes. Similar bus operational problems were projected for the University District which would also have to remove much surface parking and convert general purpose traffic lanes to transit-only lanes to marginally maintain short-term service reliability. As with downtown Seattle, even these potentially unpopular measure for business interests failed to adequately address future demand for increased transit service.

- Regional light rail service, as planned for the phase 1 central I-5 corridor (Northgate to Sea Tac), was shown to provide the most optimal continuous future transit capacity, speed, and reliability to serve long-term transit needs where there are few options to build new dedicated transit roadways, extensive geographic constraints, numerous highly sensitive community impacts, and the reliability of buses would be rapidly declining.

- The public ballot in the fall of 1996 that supported financing for the Sound Move plan included the central I-5 light rail segment as just ***one component*** of a much larger set of system-wide regional transit service and highway/HOV facility improvements that were

proposed as part of the Sound Move plan (and are now incorporated into the region's draft Destination 2030 plan).

Selected Bibliography

- *Expert Review Panel Letters* (1990 - 1996)
- *Analysis of Capacity Constraints in Downtown Seattle* (March 1992)
- *Final Environmental Impact Statement, Regional Transit System Plan* (March 1993)
- *Central Corridor Project Justification Report* (November 1993)
- *Sound Move – The Ten-Year Regional Transit System Plan* (May 1996)
- *Documentation of Major Investment Study for Sound Move Plan* (March 1997)
- *Downtown Seattle Transit Tunnel (DSTT) Report* (November 1998)
- *Downtown Seattle Surface Report: Alternatives to Improve Transit Operations* (April 1999)
- *Sound Transit Link Light Rail FY2001 New Starts Report* (September 1999)

These sources are on file at the Puget Sound Regional Council's Information Center for anyone interested in researching this issue further. The Information Center can be contacted at (206) 464-7532 and is located at the Regional Council offices at 1011 Western Avenue Suite 500, Seattle WA.