



## MEMORANDUM

**TO:** Southwest Washington Regional Transportation Council Board of Directors  
**FROM:** Matt Ransom, Executive Director  
**DATE:** May 30, 2017   
**SUBJECT:** **Bus on Shoulder Feasibility Study – Final Report and Recommendations**

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### INTRODUCTION

The BOS Feasibility Study was initiated as a result of the Access and Operations Study recommendations adopted by the RTC Board in November 2014 which identified bus on shoulder (BOS) as a possible low cost way to improve transit performance, bus service reliability, and ridership.

It examined the technical, operational, geometric, and policy options regarding part-time shoulder running for transit bus operations along I-205 and SR-14 during times of heavy congestion. The study area encompasses the I-205 corridor from the 18<sup>th</sup> Street interchange, south to the I-84 interchange and on SR-14 from I-205 to 164<sup>th</sup> Avenue. The final report is complete and includes draft BOS recommendations.

The last update to the RTC Board was in February 2017. The June update will provide an overview of the recommendations (attached) for review and discussion by Board members. The full report and recommendations can be downloaded at: <http://www.rtc.wa.gov/packets/board/2017/06/201706-08-B-BOSreport.pdf>

### BACKGROUND

Bus on shoulder (BOS) was identified as a transit mobility strategy because of increasing freeway congestion and the amount of commuter bus service on SR-14 and I-205. In addition, as the economy improves, capital investment in new roadway capacity is not keeping pace and congestion in the region continues to worsen. In response, the region is looking at innovative strategies to provide transportation services and improve system performance with low-cost improvements. The BOS Feasibility Study was examined as one of the options that can offer improved mobility and reliability for transit.

The general operating rule for a bus on shoulder system is pretty simple: buses can use the freeway shoulder anytime mainline speed drop below defined threshold. This study assumed that buses can use the freeway shoulder when mainline speeds are less than 35 mph; buses are allowed to go up to 15 mph faster, but still have a maximum speed of 35 mph. Use of the shoulder always maintains its priority for emergency stops, incidents, and breakdowns.

The Bus on Shoulder Workshop, held last December, with participation by a wide range of stakeholders, was one of the key processes used to identify bus on shoulder concepts for analysis and the resulting recommendations.

In addition, there has been extensive stakeholder engagement since the December workshop. A summary of BOS presentations in 2017 is listed below:

January 10	C-TRAN Board
February 7	RTC Board
February 23	C-TRAN Citizens Advisory Committee
March 16	Bi-State Coordination Committee
May 1	American Council of Engineering Consultants

### **NEXT STEPS**

The Washington State Department of Transportation and C-TRAN have been collaborating over the last several months to implement an SR-14 bus on shoulder pilot project. They are currently in the process of signing a letter of understanding for the use of the shoulder and agreements on BOS operating rules and shoulder maintenance. In addition, C-TRAN is working to develop a driver training program which could begin in August as well as an evaluation plan for assessing performance of the project. The current schedule is to implement the SR-14 BOS pilot project in September.

Over the next two weeks, BOS Study recommendations will be presented to the C-TRAN Board and Metro's Joint Policy Advisory Committee on Transportation (JPACT).

RTC staff will collaborate with WSDOT and C-TRAN in assessing the SR-14 BOS pilot project and will propose relevant study recommendations and strategies for inclusion in the Transit System component of the Regional Transportation Plan.

Attached: BOS Study Recommendations

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# BUS ON SHOULDER FEASIBILITY STUDY:

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## Final Report – Recommendations

Prepared for: Southwest Washington Regional Transportation Council

May 2017



DAVID EVANS  
AND ASSOCIATES INC.



PARSONS  
BRINCKERHOFF

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## STUDY RECOMMENDATIONS

This BOS Feasibility Study provides an evaluation on the application of BOS in the study corridors and potentially for a BOS pilot project for implementation. It evaluates potential geometric and operational constraints, and (2) identifies opportunities (locations and time periods) for implementing BOS. BOS operations are recommended on SR-14 from I-205 to 164<sup>th</sup> Avenue and on segments of I-205 from SR-14 to I-84. The recommended segments require relatively little modification of the exiting roadway. These recommendations provide the basis for moving forward with the implementation of BOS segments on SR-14 and I-205.

The legal framework is in place on the Washington side, making SR-14 ideal for a pilot study. BOS in Oregon does not currently have authority to operate buses in the freeway shoulder and would have to be addressed prior to implementation.

In addition, there are several segments in the corridors that have promise in showing additional operational and reliability benefits for transit by completing gaps and expanding the BOS concepts. These additional segments would require a level of investment outside the scope of this study, but should be considered for further evaluation by policy makers.

### RECOMMENDED BOS CONCEPTS

The BOS workshop, held in December 2016, developed a set of BOS concepts framed within the scope of the study that focused on minimal and low cost BOS options for SR-14 and I-205. Minimal cost options, target what can be done with roadway signing and minor striping of the existing roadway. Low cost or low capital options, emphasis signing, more significant striping, merge/diverge adjustments and other minor modifications to complete gaps at key locations. The workshop outcome successfully identified bus on shoulder concepts for SR-14 and I-205 as shown on Figure 17, with implementation of the BOS concepts recommended in the following three categories:

- **Proposed Pilot Project**
  - SR-14 eastbound and westbound between 164<sup>th</sup> Ave. and I-205
- **Recommended**
  - I-205 northbound and southbound between SR-14 and Airport Way
- **Not Recommended at This Time – Subject to Further Review**
  - I-205 southbound from Airport Way exit to eastbound Airport Way entrance
  - I-205 southbound from I-84 eastbound exit to westbound entrance
  - I-205 southbound from I-84 westbound entrance to I-84 westbound exit

**FIGURE 1: BOS CONCEPTS**



While both minimal and low cost options were developed for Westbound SR-14 from I-205 to 164th, the low cost option is recommended. Compared to the minimal cost options, it offers improved bus movement and reliability with minor restriping that:

- Restripes shoulder at the east end of SR-14 to allow buses to stay out of the traffic lane and move directly onto the shoulder from the bus only onramp from 164th Avenue.
- Extends westbound BOS approximately 1,000 feet to the west by restriping collector / distributor road shoulder between the I-205 NB exit and the entrance ramps to westbound SR-14.

## SR-14 EASTBOUND

A minimal cost option from I-205 to 164th is recommended for SR-14 eastbound.

### STUDY TEAM OBSERVATIONS

WSDOT and C-TRAN have cooperated on a thorough examination of SR-14 from I-205 to 164<sup>th</sup> and identified it as an excellent location for a BOS pilot project. The SR-14 concept:

- Has no intermediate interchanges
- Has suitable freeway shoulders
- Has an existing WB bus only on-ramp at 164<sup>th</sup>
- Serves as a queue jump to I-205 SB
- A pilot project evaluation will provide performance measurement and allow proof of concept for consideration of other corridors

The agencies are collaborating on the development of a letter of understanding for operating rules and shoulder maintenance as well as the required design analysis documentation for pilot project approval and implementation. An SR-14 pilot project can also provide insight to how BOS operation could apply to other freeway corridors in the bi-state region.

## I-205 SOUTHBOUND

There are some geometric constraints on segments of I-205 southbound where shoulders are less than 10 feet or dual lane ramps prevent BOS operations. This limits recommended BOS operations to only portions of I-205. The recommended BOS corridor on I-205 southbound is from SR-14 to I-84 and consists of the following segments:

### **RECOMMENDED**

- Segment 1, SR-14 entrance to 1,000 feet before Airport Way

### **NOT RECOMMENDED AT THIS TIME - SUBJECT TO FURTHER REVIEW**

- Segment 2, Airport Way Exit to Airport Way eastbound entrance
- Segment 3, I-84 eastbound exit to I-84 westbound entrance
- Segment 4, I-84- westbound entrance to I-84 westbound exit

## I-205 NORTHBOUND

Geometric constraints also limit opportunities for BOS in the northbound direction primarily due to the programmed construction of northbound auxiliary lanes from I-84 EB and WB to Killingsworth.

- Segment 1, Airport Way Entrance to 1,000 feet before SR-14 Exit

### STUDY TEAM OBSERVATIONS

The northbound and southbound segments that cross the Glenn Jackson Bridge are straightforward sections for the implementation of BOS; there are no intermediate interchanges and there are adequate freeway shoulders for the full length of the bridge. Southbound segments 2, 3 and 4 meet technical criteria established to identify feasible BOS sections. However, they are located in a more complex portion of I-205 with multiple interchanges and several two lane onramps where buses would have to leave and get back on the shoulder. While many regions have successfully operated non-continuous BOS segments with similar characteristics, the three southbound segments may need further examination of operational and safety issues as well as a more detailed policy review on the question of BOS service in the corridor.

There are currently no BOS corridors in the Portland region. The BOS Feasibility Study Report documents operational guidelines, technical criteria, safety factors, and transit benefits to guide the future consideration of other freeway corridors for BOS operations

## **ADDITIONAL ANALYSIS**

### **TRAVEL TIME**

While the recommended segments on I-205 have a benefit to travel time and reliability and show additional promise as congestion in the corridor increases, BOS use is not available on I-84 west of I-205 because of constrained ROW. It should be noted, that commuter buses on I-205 will frequently reroute by using Sandy Boulevard and other parallel facilities into downtown Portland during times of heavy congestion in the I-205/I-84 corridor.

A more detailed examination of bus travel times between Fisher’s Landing and downtown Portland should be conducted to better understand the tradeoffs between transit travel time to downtown via I-205/I-84 or I-205/Sandy, which is one of the alternate routes used by C-TRAN. This analysis would help guide decision-makers on the full range of routing options for commuter transit travel to Portland.

### **I-5 BOS SCAN ASSESSMENT FINDINGS**

A high level assessment of BOS was conducted of I-5 southbound from 99<sup>th</sup> Street to the Interstate Bridge and is documented in Appendix A. The assessment focused on geometric opportunities and constraints and AM peak period travel speeds to determine the adequacy of southbound I-5 for possible BOS operations. The scan assessment found that implementing BOS on southbound I-5 would likely require investment levels beyond simple signing and striping. The following segments were identified for further feasibility evaluation. It should be noted that the corridor could accommodate improvements to either an outside or inside shoulder, but not both.

### OUTSIDE (RIGHT) SHOULDER

- Segment A: 99th St. to 78th St.
- Segment B: Main St. to 39th St.

These segments would require restriping of the existing lanes to widen the outside (right) shoulder to 11.5 feet due to the adjacent barrier and over the longer term strengthening of the shoulder to increase the depth to a minimum of 7 inches.

### INSIDE (LEFT) SHOULDER

- Segment C: 99th St. to SR-14

This segment would require widening and strengthening of the shoulder, along with restriping of the existing lanes to provide an inside (left) shoulder of 11.5 feet due to the adjacent barrier.

## **POLICY FRAMEWORK**

### **WASHINGTON**

The legal framework is already established in the State of Washington for BOS operations and this legal framework covers the SR-14 corridor. This authorization is derived from RCW 47.52.025 (Additional Powers - Controlling use of limited access facilities - High occupancy vehicle lanes - Definition) and RCW 46 61.165 (High Occupancy Vehicles lanes - Definition)

### **OREGON**

Oregon does not have comparable language in the Oregon Revised Statutes (ORS) that expressly permits designation of a shoulder as a BOS lane. However, the legal framework does exist for ODOT to designate exclusive use of lanes for buses. It would first require ODOT support at the region and headquarters levels. If ODOT is interested in pursuing BOS, there are several possible pathways to proceed.

The Oregon Transportation Commission has broad authority to control operations of state highways, including use of shoulders. ODOT and the OTC should examine and make a determination whether a modification to allow use of the shoulder by transit vehicles may occur under Oregon Transportation Commission authority. If ODOT wanted to establish express legal authority for BOS, it could do so through: 1) an Oregon Administrative Rule or by amending the Oregon Revised Statute (ORS), which would require legislative action.

## **POTENTIAL NEAR TERM I-205 BOS EXTENSIONS**

The following segments could accommodate BOS with additional investments beyond the Minimal or Low Cost investments evaluated by the Feasibility Study and were therefore outside the scope of this study. Although they are not recommended, they are included here because they would offer improved reliability and travel time for transit if BOS expansion in the corridor were to be considered.

### **I-205 (18TH STREET TO MILL PLAIN)**

The shoulder is 10 feet wide; however, there is a barrier immediately adjacent to the shoulder for the majority of the segment length and bus on shoulder operations adjacent to a barrier require a minimum 11.5-foot-wide shoulder. As a result, the shoulder will need to be widened to accommodate BOS in this segment. With only one bus route (Route 177) using this segment of the corridor, along with heavy congestion on the 18<sup>th</sup> Street on-ramp limiting the reliability of the bus route, investment in BOS in this segment is not recommended as part of this initial feasibility evaluation.

### **SR-14 LOOP RAMP TO I-205 SOUTH**

The cost of this segment to accommodate BOS was outside the scope of this study, however, the loop ramp from SR-14 Westbound to I-205 Southbound is congested during the AM peak period and buses would benefit from BOS on shoulder operations on the ramp to connect the recommended Westbound SR-14 BOS segment with Segment 1 of the recommended Southbound I-205 BOS across the Glenn Jackson Bridge.

The existing ramp would require widening to provide adequate shoulder width BOS operations. Given the relatively tight horizontal and vertical curvature of the ramp, the shoulder would have to be more than 10 feet to provide adequate site distance and accommodate the wide path of long buses traversing the loop ramp.

**PROGRAMMED SR-14 IMPROVEMENT**

Since the completion of the BOS Study, new funding has become available to expand SR-14 from 2 to 3 travel lanes in each direction between I-205 and 164<sup>th</sup> Avenue. Design of SR-14 improvement is programmed to occur over the next 2 years with construction in 2019 to 2021. SR-14 project design should be considered that accommodates the WB transit on ramp at 164<sup>th</sup>, the future/ongoing operation for transit use of the freeway shoulder on SR-14, the transition of BOS from SR-14 to the SB loop ramp to I-205 and widening of the ramp to accommodate use of ramp shoulder for transit vehicles. This would allow a continuous BOS lane from 164<sup>th</sup> on SR-14 west to the Airport Way Exit on I-205 south.