BORED TUNNEL CONCEPT FOR AWVSRP

1. Introduction

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A number of interested parties have suggested that a bored bypass tunnel be considered in the collaborative process examining alternatives for the central waterfront section of the Alaskan Way Viaduct and Seawall Replacement Program. This concept would route SR 99 in twin two-lane tunnels running for approximately two miles under downtown from the vicinity of the stadiums to the vicinity of the north portal of the Battery Street Tunnel. While the concept presents some alignment and traffic performance challenges, it takes advantage of current technology and has the potential to reduce cost and construction impacts compared to other alternatives.

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2. **Previously Considered Tunnel Alternatives** (and why they were not carried forward)

Several tunnel alternatives have been considered for the AWVSRP:

- In 2002 a concept that featured twin three-lane bored tunnels was set aside because the required diameter of 55' pushed the achievable threshold of boring-machine technology.
- In 2004 a two-lane bypass cut-and-cover tunnel along the waterfront was judged inferior to other alternatives in terms of traffic operations and capacity.

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- In 2007 the preferred three-lane cut-and-cover tunnel along the waterfront encountered objections to the construction cost, risks and impacts.

3. Bored Tunnel Technology

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Improvements in modern tunnel boring machines have greatly reduced previous risks associated with ground surface settlement and made bored tunnels cost competitive with cut-and-cover tunnels, with substantially less construction impacts. The use of bored tunnels for highways is common and widespread in Europe and Asia with the following examples:

- The largest soft ground tunnel in the world was constructed through Mount Baker Ridge in Seattle using multiple passes of a small diameter tunnel boring machine.

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- The Lefortovo Tunnel in Moscow is twin 47 foot diameter bores that carry 3 lanes of traffic each.

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- The Calle 30 ring road in Madrid uses twin 49 foot diameter bores to carry 3 lanes each.

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- A highway tunnel in Shanghai was recently completed that used twin 42 foot diameter bores to carry 2 lanes of traffic in each direction.

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- These tunnels were constructed successfully in a wide range of soil conditions and settings with diameters ranging up to 50 feet.

The AWVSRP Bypass Tunnel concept would be similar to the tunnels recently completed in Shanghai. Each roughly 40 foot diameter bore would carry two lanes of one-way traffic. Tunnel excavation could be started in the south allowing excavated soil to be either trucked off site or placed in railroad cars for disposal. Except for a construction site on the WOSCA property, construction would not be visible to the public until the tunnels came back to the surface in South Lake Union. Traffic could remain on the viaduct for nearly the duration of construction. The tunnels would have a precast-segmental concrete lining and if two tunnel boring machines were used, the excavation and lining of the tunnels could take approximately one year. Emergency egress would be provided by constructing cross passages between the two tunnels to provide refuge area in the event of fire. The tunnels would have a ventilation system requiring fan buildings that would most likely be located at or near the portals. Alignment of these tunnels would place them horizontally in public right of way as much as possible and vertically deep enough to minimize settlement. They would be expected to behave extremely well in the event of a major earthquake.

4. Opportunities

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Portal Location & Configuration – In the south, the tunnel portals can be located on recently purchased property and the roadway can connect with minor modification to the interchange already under design. The north presents options, either to connect into the existing Battery Street Tunnel or to proceed further north and surface in SR 99.

Standard Practice Construction –Tunnel boring has advanced in recent years to become standard practice, as illustrated by the success of the Downtown Seattle Transit Tunnel built in the mid-1990's and Sound Transit Beacon Hill Tunnel nearing completion.

Environmental & Archeological Disturbance – Not excavating for a tunnel or for bridge foundations along the waterfront reduces potential environmental and archeological impacts.

Cost in a dense urban setting – While detailed estimates will require more design information, several considerations lead to expecting a bored tunnel to be cost efficient. Much of the construction takes place underground, away from the traffic, utilities and neighboring structures found at, near or above the surface. Expensive challenges of the contaminated and unstable soils of the waterfront are avoided. Experience on other projects and preliminary calculations indicate twin 40' bored tunnel costs to be 30-40% less than for a waterfront cut-and-cover tunnel.

Less Surface Disruption – Going underground also reduces the noise, dust and disruption of access for urban residents, customers, employees and services associated with surface construction.

Less Impact to Waterfront – The cultural and economic resources of the central waterfront would receive less impact. Once it is no longer needed, Viaduct demolition can be accomplished in several months, outside the tourist season. In the absence of a tunnel or elevated structure along the waterfront, seawall rehabilitation is less difficult and can proceed at a pace determined to be acceptable.

Better Traffic Maintenance – Much of the work for a bored bypass tunnel can be accomplished while the current Viaduct is still in operation, limiting closures of SR 99 to months rather than years.

Inclusion of Utilities – The round cross-section of a bored tunnel provides space for routing utilities that are displaced from the Viaduct and for future new utilities.

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5. Risks

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Soils and Groundwater – Underground challenges around Seattle include water, saturated sands and boulders, but previous tunnel projects have met and overcome them.

Downtown Buildings – Routing even deep bored tunnels under tall building foundations presents legal and technical challenges, which are best avoided by aligning the tunnels as much as possible under streets.

Utilities – At the ends where the tunnels connect to the surface in retained cuts, conflicts with existing utilities will require relocations.

6. Transportation System Performance

The bored bypass tunnel, like earlier bypass concepts, would serve SR 99 through traffic and traffic approaching downtown from the north and south. Anticipated capacities for these trips approach or exceed those of the existing facility. However, it would not preserve the connection to and from SR 99 at Elliott and Western Avenues. Traffic to and from the Interbay area would reach SR 99 after traversing downtown by way of Alaskan Way or surface arterials. Travel times from Interbay to the 1st Avenue South Bridge would increase, including economically important freight traffic. Furthermore, hazardous cargoes would not be allowed in the tunnel. Reconfiguring Alaskan Way and downtown streets offer ways to mitigate these impacts.

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7. The bored bypass tunnel concept employs current construction techniques to reduce construction cost and disruption while advancing waterfront urban planning goals. It can meet transportation needs as part of a comprehensive regional solution. It should be considered as a viable alternative by the AWV collaborative process team.

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Figures

1. broad brush corridor plan of bored tunnel alignment
2. bored tunnel south portal shot
3. cross section of bored tunnel