November 20, 2008

Alaskan Way Viaduct Stakeholders Advisory Committee
c/o Alaskan Way Viaduct and Seawall Replacement Program
999 Third Ave., Suite 2424
Seattle, WA 98104

Dear Committee:

Cascadia Center of Discovery Institute wants to express its continued support for the Committee's work to find new alternatives for replacing the Alaskan Way Viaduct. As the Committee enters the final stages of its deliberations, we wanted to also make sure that the advances in and practicalities of tunneling technology are fully and fairly appreciated.

In March, you received from us a letter explaining our view that a deep-bored bypass option deserves serious consideration as a workable, effective option for replacing the aging Viaduct. That letter and its attachments articulated the reasons that this option could be the best solution. We also shared examples of tunnel projects around the world. Since then, and with the assistance of ARUP, a leading global engineering and consulting firm, we have more closely analyzed worldwide tunnel projects. Those findings are summarized in the charts and comprehensive study attached to this letter and titled, "Large Diameter Soft Ground Bored Tunnel Review."

Cascadia Center is a strong supporter of surface transit options, and we have worked on issues such as bus rapid transit, streetcars and passenger ferries. Surface transit options appear to be a feasible first step, but the deep-bored bypass tunnel option should continue to be studied and considered as a solution for the 70 percent of vehicles now using the Viaduct for freight and bypass purposes. For the sake of Western Washington's economic viability, and to realistically plan for a growing population and capacity issues, the tunnel should be further vetted. A deep-bored tunnel stands the best long term chance of helping the region fully utilize Highway 99 and the Interstate 5 corridor. <u>Further, a key advantage of the deep-bored tunnel is that it can be constructed without disrupting the waterfront and its businesses</u>.

As indicated in the attached material, advances in tunnel technology—especially with regard to diameter increases—continue at a steady pace. As noted in the report, "the completion of two highway tunnels beneath the Yangtze River in Shanghai, China in September this year represents another milestone…." Those tunnels have a 51ft. diameter and "will carry three lanes of vehicular traffic and a transit line in each direction." That region's soil consists of sand and clay. We strongly encourage your review of the most recent Cascadia-ARUP report, which offers these key conclusions about tunnel boring technology:

- Capable of increasingly large diameters—up to 51ft.—and increasingly common in use and proposal for worldwide and U.S. highway traffic;
- Becoming more commonly used and of larger diameter (Moscow, Russia-based ZOA Infrastruktura has penned a deal to acquire a 62.3ft. diameter tunnel boring machine);
- Able to successfully and safely navigate weak ground and in significant groundwater pressures

The Cascadia-ARUP report also addresses cost comparisons for several projects around the globe. Although there are multiple and variable considerations to weigh when estimating costs for large infrastructure projects, Table 2 and Figure 4 of the report "suggest a typical cost range per mile of a twin bore project of approximately $200M to $700M" indicating "that construction costs for tunnel projects larger than a two mile Alaskan Way by-pass tunnel are somewhat less than previously published estimates." Importantly, the report emphasizes that whole-life costs of a tunnel make more sense than other options. From the report: "The life span of tunnels have historically been longer than that of viaducts, with the BNSF tunnels in Seattle being over 100 years old against the existing Alaskan Way Viaduct and SR-520, which are reaching the end of their life span after approximately 50 years."

Based on our research and analysis, there seems to be no reason not to give full consideration to the deep-bored bypass tunnel option. As a means of lowering cost, addressing capacity, offering the least amount of disruption to the city and its inhabitants, controlling storm-water runoff into the Bay, and reducing emissions, a tunnel option makes most sense. A deep bored tunnel also has the benefit of increasing Seattle's natural asthetic by allowing views (from neighborhoods such as Magnolia and Fremont) and allowing South Lake Union and South Queen Anne to be "knit" back together. The issue of capacity is a vitally important consideration, and it is important to remember that studies show that the majority of vehicles using the Viaduct are passing through, not trying to get to, the city.

Our letter from March addressed a variety of legitimate issues—Seattle's substantive history with tunnels, capacity and freight concerns, and environmental matters—that are part of the debate. As reference to those issues, we've also included the entirety of our March submission to the Committee.

Finally, in 2007, we held an international tunneling symposium that brought international experts in to discuss advances in tunneling technology and possibilities. We would look forward to hosting another session in early 2009. Such a session would be important because there are other projects in the area with a strong interest in how deep-bored tunnels can be used. Most importantly, a session in early 2009 could be designed to answer these specific questions: specific costs for a Seattle tunnel; possible construction duration schedules based on whether one or two moling machines were used; budget scenarios, including mitigation; and, the impact on the city under this scenario.

Thank you again for your important work. As the Committee enters the close of its deliberations, we urge strong, fair consideration of the inland deep-bored bypass tunnel. We look forward to answering any questions you may have and stand ready to help in any way we can.

Sincerely,

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Attachments

Comparison Charts Extracted from "Large Diameter Soft Ground Bored Tunnel Review," November 2008
Commissioned by Cascadia Center

COMPLETED LARGE BORE TUNNELS – TABLE 1

Completed large diameter highway tunnels						
Name	**Length**	**Dia.**	**Bores**	**Reported cost per *mile* of tunnel ($)**	**Soils**	**Function**
Shanghai River Crossing, China	4.6 mi	50.6 ft	twin	$27m	sand, clay, rubble	Road
Madrid M-30 - north tunnel of the south bypass, Spain	3.65 mi	50 ft	twin	$131m	marly clays of the Madrid Tertiary penuela and gypsum	Road
Serebryany Bor Tunnel	1.5 mi	46.6 ft	twin	*no data*	*no data*	Road/Metro
Lefortovo, Moscow	1.3 mi	46.6 ft	twin	$439m	fine to coarse sand, clay, limestone (medium strength, partially very fissured)	Road
4th Tube of the Elbe Tunnel, Germany	1.6 mi	46.5 ft	single	$303m	sand and mud, rock and pebbles, marly till and mica schist	Road
SMART Tunnel, Kuala Lumpur, Malaysia	1.86 mi	43.3 ft	single	$85m	*no data*	Water/ Road
Wesertunnel, Kleinensiel, Germany	1 mi	38.3 ft	twin	$180m	clay, sand, turf, till, silt	Road
Westerschelde, Terneuzen, Netherlands	4.1 mi	37 ft	twin	$60m	soft, permeable ground	Road
A-86W East Tunnel, Paris France	6.2 mi	34 ft	single	$242m	limestone, sand, clay, marl, chalk	Road

SURVEY OF TUNNEL COSTS – TABLE 2

Tunnel	Year completed	Diameter (ft)	Bores	Alignment length (miles)	Total length of tunnels (miles)	Reported cost ($ million)	Cost per mile of tunnel (million $/mile)
Port of Miami Tunnel	proposed	36	twin	0.7	1.5	1,000	$677
Lefortovo	2005	47	single	1.4	1.4	600	$439
Airport Link Brisbane	2012	41	twin	3.3	6.5	2,206	$338
Groene Hart Tunnel	2006	48	single	1.4	1.4	450	$332
4th Tube of the Elbe	2002	47	single	2.6	2.6	775	$303
I-710 (A3)	proposed	50[1]	triple	4.1	12.4	3,585	$290
I-710 (C3)	proposed	42[1]	triple	4.0	12.0	3,195	$266
A86W	2010	37.9[1]	single	10.9	10.9	2,641	$242
Wesertunnel	2001	38	twin	1.0	2.0	358	$180
Beacon Hill Tunnel	2009	21	twin	0.8	1.6	280	$172
M-30	2008	50	twin	2.2	4.3	570	$131
Dublin Port Tunnel	2006	38	twin	2.8	5.6	530	$94
Pannerdenschkanaal	2003	32	twin	1.0	2.0	173	$86
SMART	2007	43	single	6.0	6.0	515	$85
Wuhan	2008	37	twin	1.7	3.4	288	$85
Nanjing	2013	49	twin	1.9	3.7	245	$66
Westerschelde	2002	37	twin	4.1	8.2	490	$60
Shanghai River Crossing	2008	51	twin	4.6	9.3	245	$27

[1] This scheme contains multiple tunnel diameters. This number presented is the average tunnel diameter.