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Border Policy Research Institute

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System Attributes:

- » Based upon wire loops embedded in pavement; the loops detect the presence of a vehicle passing above.
- » Loops are installed at intervals upstream of a POE, allowing computation of the length of a queue.
- » An algorithm converts queue length to wait-time, based upon knowledge of the number and type of open inspection booths.
- » System is deployed for both north- and southbound traffic at all POEs in the Cascade Gateway, with NEXUS traffic measured separately from other traffic.
- » Computed wait-times are disseminated via highway signs installed at strategic locations upstream of POEs. Dissemination also occurs via technologies such as web sites, mobile phone apps, and radio announcements.
- » Posted wait-times are updated every five minutes, and every computed wait-time value is transmitted to a data archive. Several years of archived data are now available, and the data is used for transportation planning.

Introduction. In December 2011 the governments of Canada and the U.S. published the Beyond the Border (BTB) Action Plan, which includes an objective of installing border wait-time (BWT) measurement systems at the 20 busiest land-border crossings by the end of 2014. The BTB plan is not the first instance of federal interest in BWT systems: a BWT Working Group was established in 2008 as a joint initiative of Transport Canada, CBSA, USCBP, and FHWA,¹ and that group investigated the merits of various BWT measurement technologies. Upon creation of the bi-national BTB framework, the task of the working group was absorbed into the larger effort.

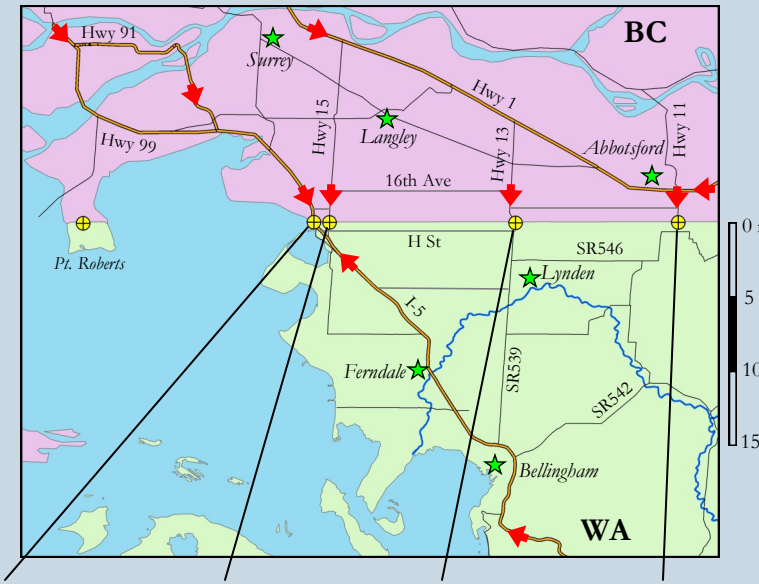
Two years into implementation of the BTB plan, it's clear that rollout of BWT systems to the top 20 crossings will not be accomplished on schedule—progress has been slowed by various technological and organizational obstacles. Meanwhile, a BWT system has been active at the Cascade Gateway for over a decade, and lessons related to that system's success could be of use in other regions.

Goals of a BWT System. Within the toolbox of methods available to improve cross-border mobility, BWT systems are capable of providing specific benefits such as:

- *Route selection.* If alternate ports-of-entry (POEs) are available, a person may choose a POE that offers less delay. This helps balance the workload faced by customs agents at adjacent POEs.
- *Trip schedule.* A person may choose to travel at a different time in order to avoid a queue. This helps smooth the workload faced at a given POE over the course of a day.
- *Trip reduction.* When cognizant of a lengthy border queue, a person may choose to forego a trip.
- *Expectation setting.* A person forewarned about a delay may be more able to cope with the ensuing frustration.
- *Operational metrics.* Accurate knowledge of BWTs can help customs agents make the best decisions about booth staffing and mode of booth use (i.e., whether to temporarily staff a second NEXUS booth in order to whittle down a NEXUS queue).
- *Motivator of agencies.* Widespread public knowledge of BWTs can motivate agencies to take steps to minimize BWTs.

1. A flyer related to the BWT Working Group can be viewed at <http://trd.saic.com/bwt/CBWT%20-%20US-Canada%20Border-%20Flyer.pdf>

Figure 1: Cascade Gateway BWT Signs: Locations and Usage Patterns



▲ Location of sign displaying BWTs, message visible to cars traveling in given direction.

Responses to questions asked of drivers in summer 2013 (sample of 1,100 to 1,500 at each POE):

| Douglas / Peace Arch | Pacific Highway | Aldergrove / Lynden | Abbotsford / Sumas |
|----------------------|-----------------|---------------------|--------------------|
| 73% | 75% | 68% | 64% |
| 33% | 49% | 41% | 50% |

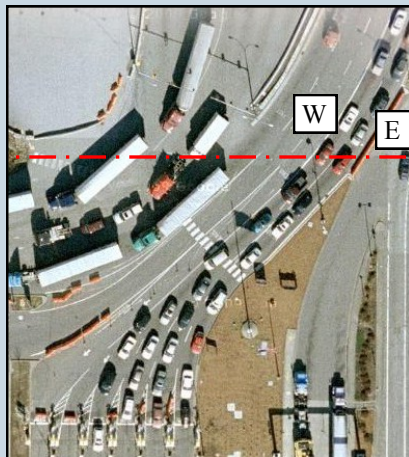
← “I use the BWT system sometimes or all the time.”

← “I feel the posted wait-times are not accurate or are inconsistent.”

The Cascade Gateway BWT System. The left sidebar on page 1 describes components of the Cascade Gateway BWT system, and Figure 1 shows the relevant geography. The gateway consists of four POEs that collectively serve the I-5 corridor that connects the Lower Mainland of B.C. to the western U.S. The Lower Mainland is home to 3 million people dispersed within a group of over 25 municipalities that stretch the breadth of the displayed area. In contrast, the displayed portion of Washington State is home to 200,000, and the major population centers of Washington are 80 miles to the south on I-5. This population pattern leads to a dynamic in which over 80 percent of cross-border travel consists of Canadian residents traveling predominantly to Bellingham or to locations further south. The Canadians reach the four POEs from locations throughout the Lower Mainland, and for this reason there is a dispersed network of eight variable message signs (VMS) displaying BWTs. The VMS network is designed to facilitate choice among the POEs, with each sign placed upstream of a decision point of relevance to a southbound traveler. South of the border there is less need for an extensive VMS network. One sign south of Bellingham provides information to north-bound travelers before they reach the highways (SR539, SR542) that branch off of I-5 to serve the Lynden and Sumas POEs. A second sign is located on I-5 just south of the border, allowing travelers to choose between the Peace Arch and Pacific Highway POEs.

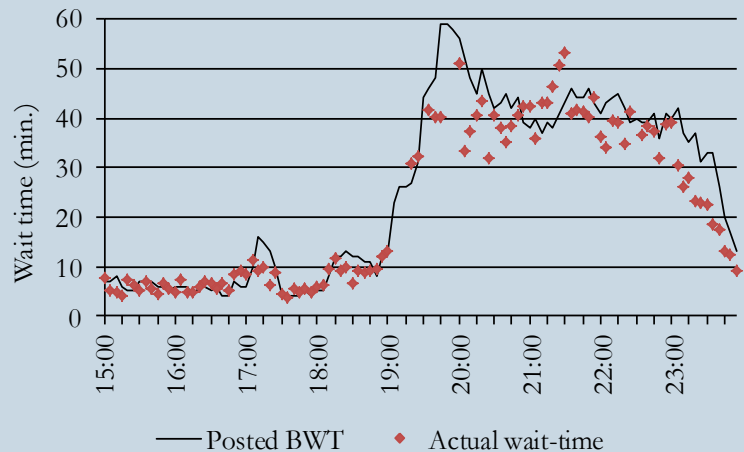
Public Perception of the BWT System. More than a decade of cooperative bi-national effort has been put into the construction of the BWT system, and in summer 2013 regional stakeholders sought to determine the system’s efficacy. As part of a larger traveler-survey project, our institute asked travelers about the BWT system. As seen at the bottom of Figure 1, very high proportions of people make use of the BWT system in their cross-border trips either “sometimes” or “all of the time.” The usage proportion is lowest at the eastern POEs (Sumas, Lynden), which may be attributable to three factors. First, the BWT system was deployed to those POEs relatively recently, so travelers might not have incorporated usage of the system into their habits. Second, the Sumas and Lynden POEs are enough distant from I-5 and from each other that a larger proportion of people using

Figure 2: Queue Dynamics, Southbound, Pacific Hwy.



N 5 4 3 2 1

Figure 3: Post-Calibration Ground-Truth Data, Northbound, Pacific Hwy., May 2013



Source: WSDOT, CBSA, and WCOG

those POEs might be nearby residents undertaking local cross-border trips that really are convenient only through a given POE—e.g., for a person traveling from Abbotsford to Sumas to purchase gas, diversion to the Lynden POE makes no sense, so use of the BWT system might not become a matter of habit for that traveler. Third, there is a possibility that travelers use the system less at the eastern POEs because they have less faith in its accuracy. At the bottom of Figure 1 are responses showing that the greatest faith in system accuracy is found at Peace Arch, followed by Lynden, with Sumas and Pacific Highway the laggards.

Striving for Accuracy. Producing accurate BWTs is not a trivial task, as the system’s accuracy is affected by many things. Upstream of a POE, the efficacy of pavement loops is related to highway conditions. Construction projects might temporarily decommission certain loops; changes in traffic channelization might route traffic in such a way as to make a loop ineffective. At the POE itself, other factors are at play. The average dwell-time of a car at an inspection booth differs depending upon the type of booth (NEXUS, Ready Lane, or standard), and the dwell-time at any one type of booth tends to change over time as the inspection process evolves. A recent complication is the use of dynamic lane management, in which a given booth is converted on the fly to serve a different type of traffic—NEXUS one hour, Ready Lane the next. Figure 2 illustrates another kind of problem. At Pacific Highway during periods of light traffic, USCBP might have just two booths open, booths 1 and 2, fed by the East and West approaching highway lanes. As traffic increases, booths 3, 4, and 5 are opened as necessary, in that order. This can lead to a dynamic in which the East lane receives service at booth 1 alone, while the West lane receives service from booths 2 through 5. The BWT system might accurately display the *average* wait-time of all traffic, but the actual wait-time experienced by someone in the East lane is much higher than the posted value, while in the West lane the wait-time is much lower. Neither outcome is good, because travelers in *both* lanes come away with the impression that the posted BWT was inaccurate. Faith in the system is eroded.

The algorithm that calculates BWTs must be adjusted as necessary to account for the kinds of things described above, and the entire BWT system must be periodically calibrated. Figure 3 shows the final results of a ground-truth project conducted at Pacific Highway. CBSA had heard complaints from northbound travelers about inaccuracies of the posted BWTs, so a mobile license-plate reader was deployed by WSDOT (the WA Dept. of Transportation), and actual wait-times of individual cars were measured. A first round of measurements and observations led WSDOT to make algorithm modifications, and the resulting system operation, as graphed above, was much improved.

Collaborative Management. The success of the Cascade Gateway BWT system depends upon collaborative interagency relationships that have developed over time within the region. Notice the cooperation that was necessary to conduct the ground-truth exercise described earlier. CBSA is the agency that conducts operations that result in a northbound queue. They strive to provide the best service they can, and they use the posted BWTs to assist in booth staffing. To improve the system's accuracy, CBSA must approach WSDOT, which owns and maintains the relevant loops. WSDOT must deploy an upstream license-plate reader and provide the resulting data to CBSA, which must then provide corresponding booth-arrival records derived from its system. All of that data must then be analyzed—in this case by WCOG (the Whatcom Council of Governments) and WSDOT. Similarly, solving the traffic channelization problem illustrated in Figure 2 will require collaboration between USCBP and the B.C. Ministry of Transportation, because the solution is likely to be a channelization scheme that straddles the border.

At the Cascade Gateway, collaboration is achieved via the International Mobility and Trade Corridor ([IMTC](#)) program, which is a monthly forum facilitated by WCOG. IMTC is attended by both nations' inspection agencies, as well as federal, provincial, and state transportation agencies, municipalities, academia, and NGOs.

Conclusion. A variety of factors have influenced the design and success of the Cascade Gateway BWT system, including:

- *Common goal.* Regional entities were able to agree upon the objectives of the system—i.e., aside from smoothing demand at individual POEs, the system is intended to facilitate diversion of traffic between POEs. In other regions the latter goal might not receive support. For instance, a city containing a POE might be unwilling to be at the receiving end of such a diversion, or the owner of a toll bridge might be unwilling to lose traffic to another POE.
- *Appropriate dissemination.* The way that BWTs are made available to travelers is interrelated with the system goals. The goal of diversion has necessitated roadside signs in our region, while web or mobile dissemination might be most appropriate in another setting. The human geography of a region (i.e., population centers, POE locations, highway network) is also inter-related with both the system goals and the dissemination methods.
- *Ongoing effort.* The BWT system requires ongoing attention, because the border environment evolves over time. Resources are needed from various entities at various times—e.g., USCBP has recently agreed to provide an online “booth-status” indicator, so that the system can be made to work with the emerging technology of dynamic lane management.
- *Teamwork.* A large bi-national group of agencies has collaborated to build and maintain the system. While the presence of an ongoing forum such as the IMTC might not be a necessity, it has certainly made the job easier.

Given this list of factors, it seems likely that the goal of deploying BWT systems at the 20 busiest northern-border POEs might ultimately prove unrealistic. The simple fact that a POE has a certain volume of traffic doesn't guarantee that it will be a good candidate for the installation and long-term operation of a BWT system. A mix of geographical, organizational, and technical factors come into play, affecting the viability of a BWT system deployment at a given POE.