



Experimental Plan for Analysis of Traffic Queues and Delay

PRIMARY INVESTIGATORS

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GOALS AND OBJECTIVES

The overall goal is to demonstrate utility of remote sensing data to support ITS and traffic operations. Specific objectives include:

1. Evaluate the use of sequential aerial photography and high-resolution satellite data in estimating queues and delay times
2. Provide data for different methods of measuring delay at borders based on the remote sensing observations
3. Examine the utility of fusing the tracking data with remote sensing observation
4. Evaluate the use of Ground Moving Target Indicator (GMTI) RADAR, if available, to estimate traffic queues and delay times and identify the best evacuation routes in an emergency scenario

STUDY SITES

This pilot will include three distinct study sites that focus on (1) queues and delay at an international border crossing (the Blue Water Bridge; see Figures 1 and 2), (2) delays at a freeway construction site (M-14 in western Wayne County; see Figure 3), and delays along one or more other major routes in Oakland County (e.g., I-696, Haggerty Road, Novi Road). If the effort to deploy a UAV near Kalamazoo for traffic monitoring is successful, then we will also include a freeway construction site in southwest Michigan.

DATA SOURCES

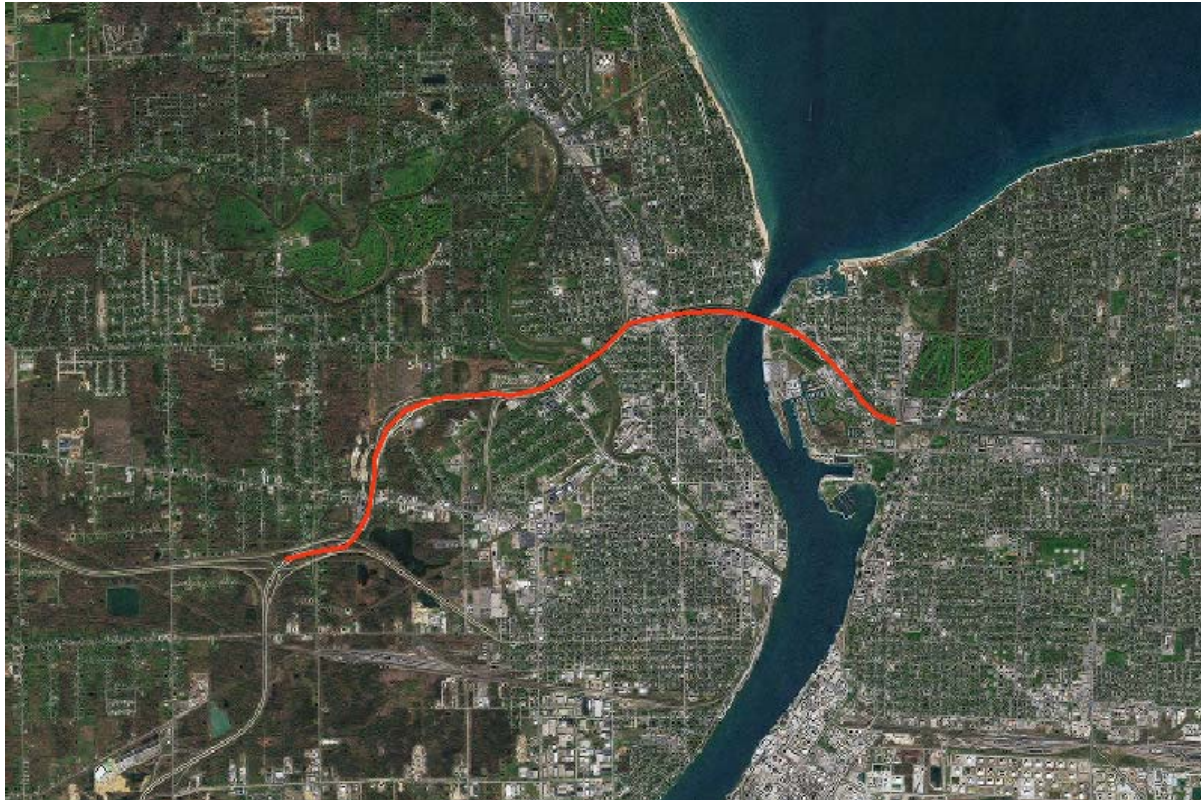
This pilot study will make use of both remotely sensed data and other spatial data and resources integrated within a GIS framework. The remotely sensed data will come from both satellites and airborne imagery. Other data sources will include the Michigan Geographic Framework (version 5a or later, if available) transportation layers, and available border-crossing traffic volume and delay data. The latter will include runs of the GSA-developed Border Wizard software to benchmark estimated delay times, if this software is available to the study team.¹

For validation of the remote sensing results, the MTRI team will employ ground-based observation and measures, as well as *in situ* GPS data collected from vehicles in the construction area queue. This data will be collected for roughly one hour before and after the remote sensing data collection. At the Blue Water Bridge, the ground-truth data will include one year of

¹ MDOT possesses two keys to the Border Wizard software, one of which has been released to a consultant for use on the new Detroit-area border crossing study and the other is retained in Lansing, but effectively is not used. Border Wizard, thus, might be available for use in the TARUT Study.

historical border crossing data (traffic counts and number of customs booths open on an hourly basis), as well as observations and counts for the time of the remote sensing data collection, including roughly one hour before and after the over-flight. These data will be used to obtain independent measurements of travel speeds, lengths of the queues, and estimates of delay times.

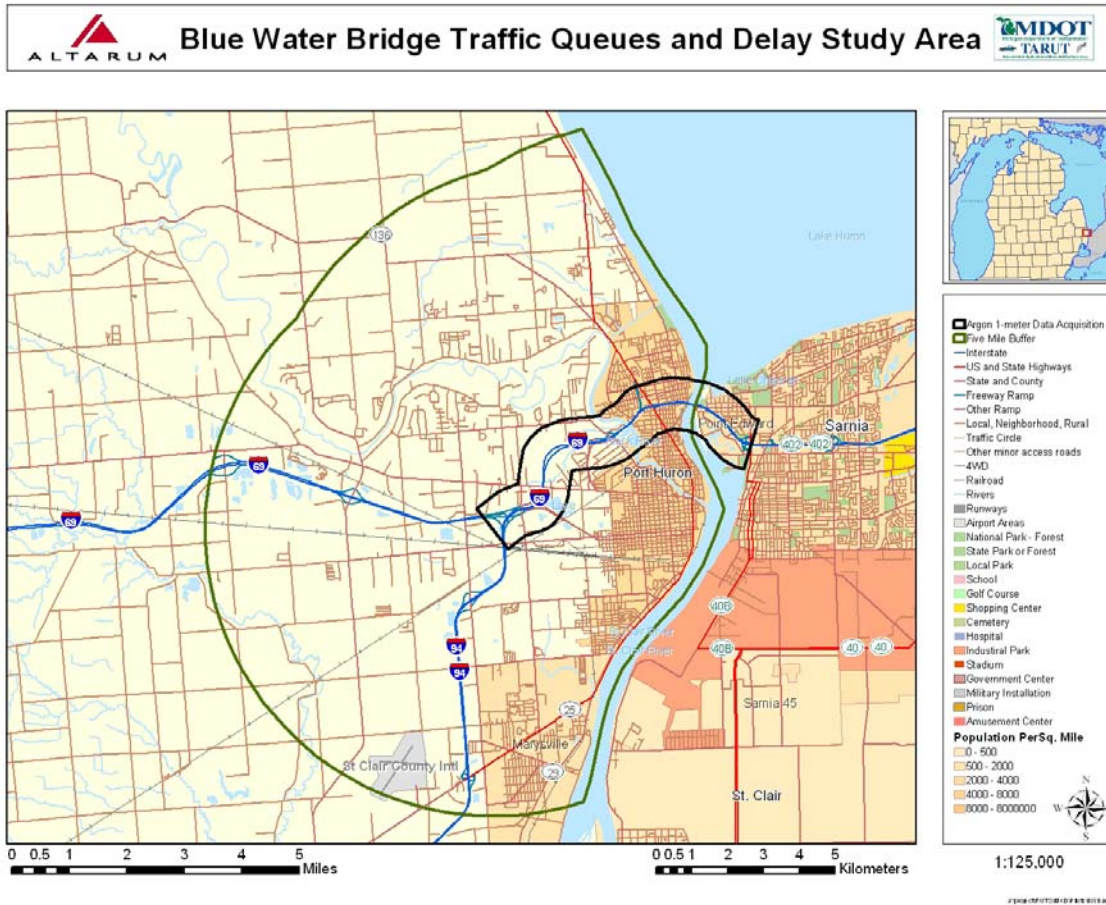
Figure 1: Blue Water Bridge Area near Port Huron and Sarnia



COLLABORATORS

This pilot will involve numerous units within MDOT, including those associated with traffic operations and maintenance, highway safety, maintenance, homeland security, international borders, and others. In addition, this pilot will involve several organizations outside MDOT, including Road Commission for Oakland County (RCOC), US Customs, Ambassador Bridge, Michigan State Police, and perhaps freight haulers. Potentially, this pilot could also involve Canadian officials due to the inclusion of a border-crossing component.

Figure 2: Detail of Blue Bridge Pilot Study Site



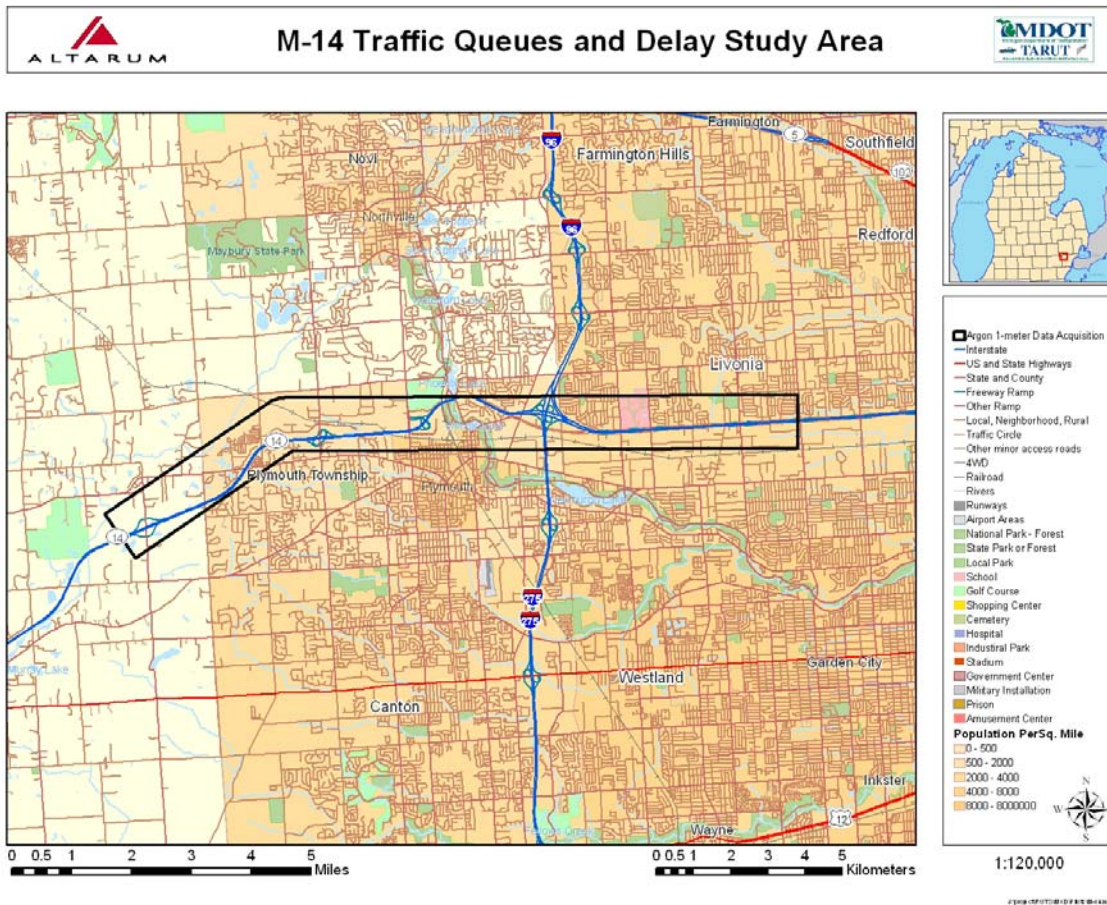
EXPERIMENTAL OVERVIEW

The primary activities for this pilot are briefly summarized below. Because its availability for use during this pilot has not yet been fully determined, GMTI is not included in this plan. If and when GMTI becomes a tool that will be used, these plans will be updated to reflect the role of GMTI.

1. Obtain historical, satellite and/or airborne imagery of the Blue Water Bridge, the M-14 construction zone, and the I-696/I-275 interchange
2. Collect current airborne imagery of traffic on the Blue Water Bridge, the M-14 construction site, and the I-696/I-275 interchange
3. Collect ground-truth traffic data for the Blue Water Bridge, M-14, and the I-696/I-275 interchange during the time of the current airborne data collection
4. Integrate all collected data within a GIS framework that includes the MDOT-CGI Framework
5. Obtain historical border crossing data for the Blue Water Bridge and historical traffic data for the M-14 construction zone (loop data, for example)
6. Obtain access to Border Wizard and/or MDOT's own simulation of Blue Water Bridge operations and other locations (e.g., M-14)

7. Estimate average time for vehicles to travel across the border and to be processed by Customs
8. Estimate travel time through the M-14 construction zone and travel time delay through the zone
9. Build queuing model of Blue Water Bridge crossing that incorporates, at a minimum, traffic volume, number of booths open, and average processing time
10. Benchmark and compare model with Border Wizard and/or MDOT models and ground-truth data

Figure 3: Location of Construction Site along M-14 in Western Wayne County, Michigan



REFERENCES

Paselk, T.A. and F.L. Mannering. 1994. "Use of Duration Models for Predicting Vehicular Delay at a US/Canadian Border Crossing." *Transportation* 21: 249-70.

Vandaele, N., T. Van Woensel, and A. Verbruggen. 2000. "A Queueing Based Traffic Flow Model." *Transportation Research D*: 5: 121-35.