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MEMORANDUM

To: Paul Benning, Urban/MPO Engineer-Local Government, NDDOT

From: Shawn Birst, Associate Research Fellow, UGPTI-ATAC

Date: August 16, 2002

Re: **US 2/52 Bypass Improvements (Minot, ND)**

INTRODUCTION

Your letter dated July, 19, 2002, requested the Advanced Traffic Analysis Center (ATAC) to perform a simulation analysis of Minot's US 2/52 Bypass. The analysis will compare user cost of the existing traffic control to an alternative that was provided by a previous study.

BACKGROUND

The US 2/52 Bypass is a four-lane divided highway, which is classified as a principal arterial. The bypass is a major corridor serving east/west traffic along Highway 2 between Williston and Grand Forks, northwest/southeast along Highway 52 between Portal and Jamestown, and intercity traffic within Minot. The corridor accommodates significant truck traffic traveling across the state and accesses various ports of entry.

The US 2/52 Bypass has been evaluated a couple times over the past few years. A "Minot Transportation Plan Update" was completed in May 2000 by Kadrmas Lee & Jackson and HDR Engineering. The plan primarily focused on the US 2/52 Bypass and proposed two options: 1) Option A (Urban Arterial) and 2) Option B (Freeway). Option A was recommended for the short-range plan, while Option B was recommended for the long-range plan.

A second study entitled "City of Minot Land Use and Transportation Plan" is being conducted by Olsson Associates and is currently in draft form. The plan analyzed the current land use and transportation conditions in addition to performing a traffic analysis using a traffic forecast model and a population projection of 50,000. The plan also focused on the operation of the US 2/52 Bypass. Using the 2000 study as a starting point, some modifications were made to Option A and Option B. The study pointed out that based on discussions between the City of Minot and the NDDOT, the US 2/52 Bypass has been established as a freeway. Therefore, the Option A (Urban Arterial) was modified to an expressway option and was recommended to be implemented in the next 10 years. The plan also recommended that the freeway option should be implemented within 10-25 years depending on the growth rate of Minot.

OBJECTIVE

The objective of this study is to compare the existing conditions to the expressway option, which incorporates several access modifications and traffic signals. Using the available data from the NDDOT and City of Minot, ATAC replicated the two scenarios as accurately as possible. Since forecasted traffic volumes were not available for all of the intersections along the bypass, some of the intersections were

excluded from the study. Overall, the study will provide user cost information related to the affects of modifying the corridor to an expressway facility compared to a freeway facility.

METHODOLOGY

The analysis will primarily focus on the delay impacts and associated user costs by installing traffic signals along US 2/52 Bypass. There is a basic understanding that disrupting traffic flow on an uninterrupted facility will adversely affect the facility; however, it is difficult to determine to what extent the effect is to the freeway and the total network (including the freeway and side-streets). The methodology of this analysis is described in the following sections.

Analysis Tools

The TSIS 5.0 (Traffic Software Integrated Shell) software package, which was initially developed in the 1970's for the Federal Highway Administration (FHWA), was used for this study. TSIS includes several models, including TRAFED (graphical user interface), CORSIM (microscopic simulation model), and TRAFVU (animation viewer). CORSIM consists of two main components: NETSIM and FRESIM. NETSIM is used to simulate surface streets, while FRESIM is used to simulate freeways and incorporates different driving behavior, such as car following and lane changing logic.

CORSIM provides useful visual and numerical output. The visual output (animation) is useful for troubleshooting and calibrating the model, while the numerical output is used for comparison purposes and includes travel time, delay time, speed, etc.

The Synchro traffic signal optimization program was used to update the current signalized intersections in the analysis area and provide timing plans for the proposed signalized intersections. Several input parameters were needed for the simulation and signal timing analysis, which include the following:

- Road Geometry - intersection location, street length, lane geometry, speed limit
- Traffic Control - phases, green and intergreen time, actuated settings
- Traffic Volume - turning movement counts and/or average daily traffic (ADT)

Data Collection

The NDDOT and City of Minot provided the necessary data for the analysis. Aerial photos were provided by the NDDOT and were scanned into a digital format (.bmp). The .bmp file was then used by TRAFED to construct the corridor network. Traffic volumes in the form of ADT were provided along US 2/ 52 by the NDDOT. In addition, turning movement counts were provided from the 2000 Minot Transportation Plan Update. The current traffic signal plans were provided by the NDDOT and City of Minot.

Analysis Corridor Limits

The study area for the project spans over 8 miles having east and west boundaries of 55th St. SE and US 83 West Bypass, respectively. The analysis included three interchanges and nine intersections along the bypass. The driveway accesses along the corridor were not analyzed since traffic data were not available. (note Figure 1).

Model Construction

Two scenarios were compared for the analysis: 1) existing condition and 2) expressway option. The existing condition consisted of the current geometry and traffic control, while the expressway option includes five additional signalized intersections along the corridor.

The traffic volumes used for the analysis were based on the 1998 ADT along the corridor. The NDDOT requested a 20 projection from the current year with a growth rate of 2.5% per year. The resulting traffic volume for the analysis year of 2022 had a growth factor of 1.81 compared to 1998 ADT. The side-street traffic volumes were primarily used to balance the US 2/52 Bypass volumes having the remaining approach volume to travel through the intersection or across the corridor.

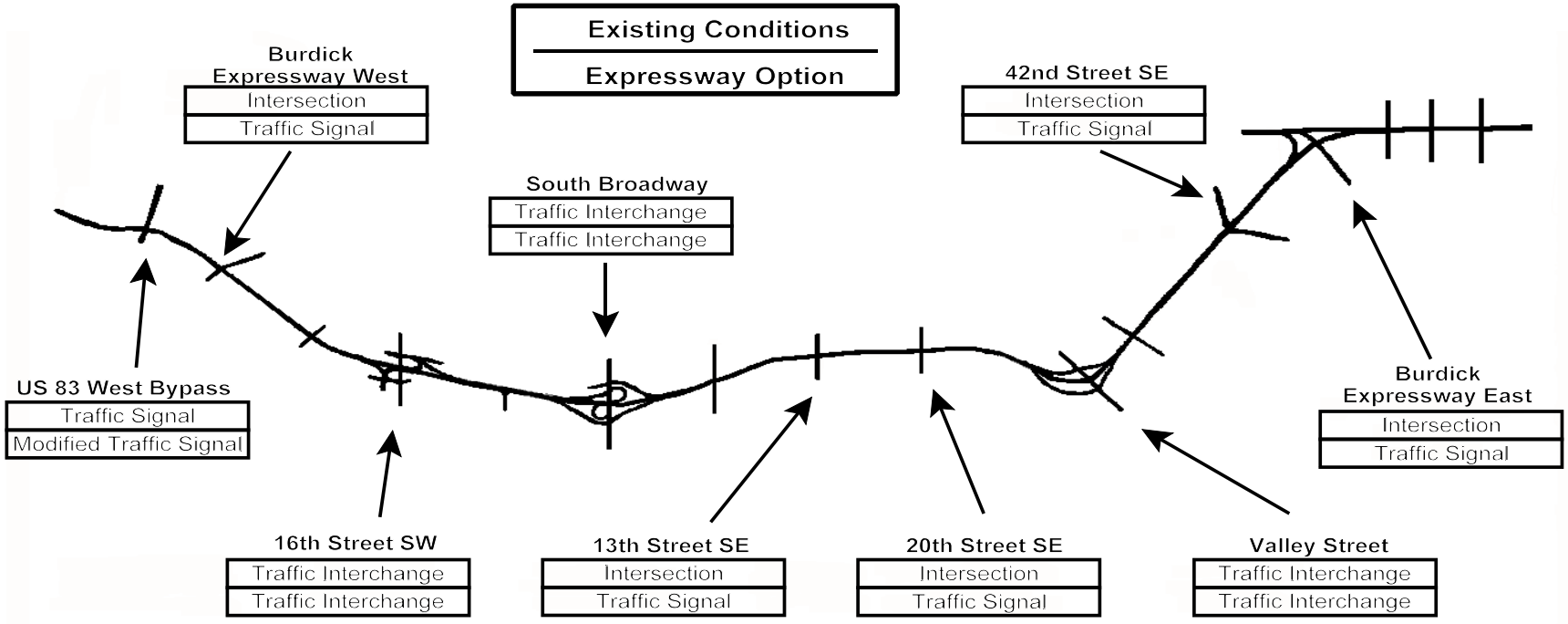

Figure 1. US 2/52 Analysis Network.

The existing and proposed signalized intersections were optimized using Synchro. Since some of the intersection volumes were not available, the existing signalized intersections operated as pretimed in both scenarios. However, the proposed signals operated as actuated signals. Since the intersections of 13th St. and 20th St. are in relatively close proximity, the two signals were coordinated. The geometry of the side-street approaches of the additional signalized intersections was modified to achieve a LOS C and typically consisted of a left-turn lane and a shared through/right-turn lane.

Each scenario was simulated to replicate five hours of traffic having one hour of peak-hour traffic and four hours of off-peak traffic. Typical peak periods range from 8-12% of the ADT. To account for most of the daily traffic in the corridor, the peak-hour and off-peak conditions were 9.0% and 5.5% of the ADT, respectively. To compare the impacts between the two scenarios, the values of the simulation output were multiplied times three to simulate the AM, Mid-day, and PM peaks and accounted for 93% of the total ADT. To reduce the variance between the two scenarios due to the random processes of the simulation model, each scenario was simulated 30 times and the link delay times were averaged for all of the runs.

STUDY RESULTS

The delay time increased 84.5% along the US 2/52 east/west approaches while the total network delay increased 21.3% as a result of installing the five signals. The daily increase in user cost for the US 2/52 east and west bound links and the total analysis network were $2,584 and $2,831, respectively (shown in Table 1). Annual user cost for the year 2022 in today's dollars equate to $943,160 for US 2/52 and $1,033,315 for the total network.

Table 1. Daily User Cost for 2022.

		Delay Time (veh-hr)	% Increase	Auto Cost ($/hr)	% of Auto	Truck Cost ($/hr)	% of Trucks	Total Cost ($)	Increase Cost ($)
Existing Conditions	US 2/52	235	--	11.50	89	25.00	11	3,051	--
	Total Network	1,023	--	11.50	89	25.00	11	13,284	--
Expressway Option	US 2/52	434	84.5	11.50	89	25.00	11	5,635	2,584
	Total Network	1,241	21.3	11.50	89	25.00	11	16,114	2,831

Note: 11% HV was obtained from averaging the three classification stations along US 2/52
Auto and Truck costs were used in previous NDDOT studies and represent operating/opportunity costs

As was expected, the impact of adding signals along a facility adversely affects the performance of the major movements, especially a freeway facility. Since the side-streets did not incur significant delay during this study, the US 2/52 approaches received a large portion of the available green time. However, as the side-street traffic increases, so does the green time allocation resulting in more delay for the US 2/52 approaches. A point may be reached when the network benefits from the signal installation due to the high delay values for the side-streets. It should also be noted that if the side-street volumes projected from the "Minot Transportation Plan Update" are reached along the corridor, the differences between the two scenarios will be very different than those of this study. This is due to the significant increases in side-street volumes that were projected for the east portion of the corridor.

If you have any questions regarding this memo, please contact me at (701)231-1063.