Widening US Route 15 through Frederick: Impacts on Traffic and Emissions

Independent Study under the supervision of Dr. Frederick Ducca

Fall 2014

University of Maryland

Prepared by the National Center for Smart Growth Research and Education

Gerrit Knapp, Executive Director

Uri Avin, PDC Director

Contents

Executive Summary 3

Background 3

Frederick County Case Study 4

Study Area and Demographics 4

Analysis Framework 7

Input and Scenario Description 7

Results Analysis 8

Traffic Impacts 8

Emissions Impacts 13

Concluding Remarks 13

Figures and Tables

Figure 1 Frederick County's Location in the Baltimore-Washington Metropolitan Area 3

Figure 2 The Study Area 5

Figure 3 Frederick County and the Section of US Route 15 in the MSTM Network 6

Figure 4 Change in Vehicle Miles Traveled – County 9

Figure 5 Change in Vehicle Miles Traveled – US Route 15 10

Figure 6 Change in Congested Speed – County 11

Figure 7 Change in Congested Speed – US Route 15 12

Table 1 Scenario Descriptions 7

Table 2 MSTM Demand Input and Projections 7

Table 3 Major Highway Performance Measures With and Without Lane Addition – 2030 8

Table 4 Percent Change in Emissions With Lane Addition Compared to 2030 Network 13

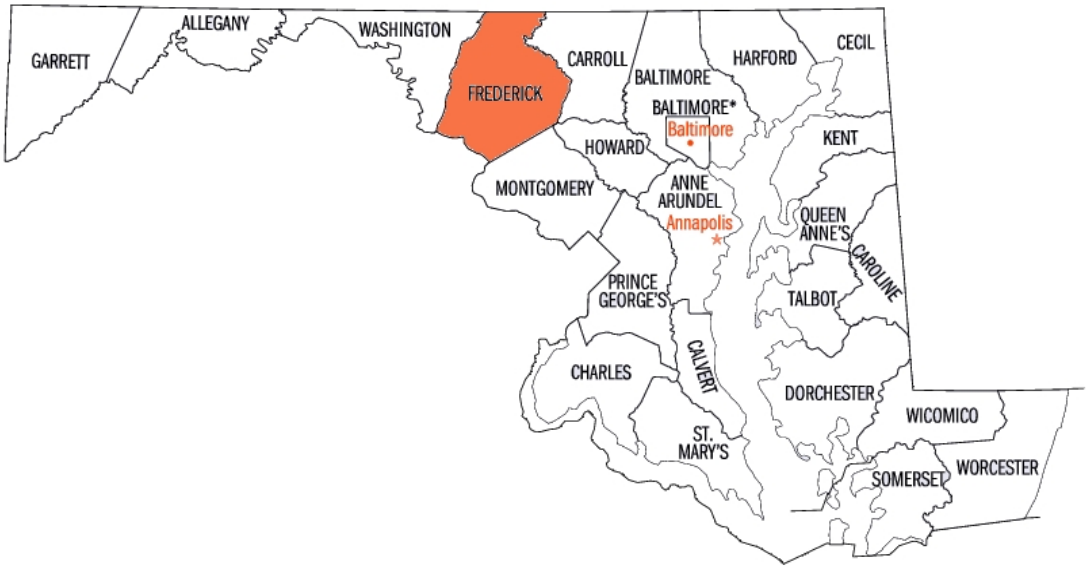
Executive Summary

This case study evaluates the impacts adding a travel lane on US Route 15 would have on traffic, congestion and emissions at the County and corridor level. The specific network improvements studied are the addition of a lane to each direction on Route 15 from South Jefferson Street and US 15/40 (Jefferson Bridge) to I-70 to Monocacy Boulevard. Study shows that for level of service improvement, the lane addition can be beneficial. For congestion reduction, the impact of adding a lane on both directions will be insignificant at the County level, but have substantial benefits at the corridor level. The effect on emissions is minimal. While emissions on Route 15 increase, they are offset by reductions elsewhere in the County.

Background

Located in the northwest of the Baltimore-Washington metropolitan region, Frederick County is rapidly growing and, with its dynamic economy, is becoming an important regional center. The County's population increased 30% from 2000 to 2010 and is projected to increase 16% between 2010 and 2030, reaching approximately 261,000 in 2030. Frederick has also shown significant growth in employment. In the last two decades, civilian labor increased by 45% while non-farm private jobs increased by 60%. Between 2010 and 2030, employment is projected to increase 34% and nearly 50% growth is projected by 2040 (Frederick County Freight and Land Use Plan, 2011).

Figure 1 Frederick County's Location in the Baltimore-Washington Metropolitan Area
(Source: http://commons.wikimedia.org/wiki/File:Frederick_County,_Maryland..PNG)



Population, employment and income growth led to an increase in freight transportation as well as auto travel, resulting in congestion on Frederick's highway system. Demand for travel exceeds the road capacity in the County. Between 1998 and 2007, there was 17% increase in population while VMT (vehicle miles traveled) increased 36%, (State of Maryland Department of Transportation, Blue Ribbon Commission presentation). With highway capacity increasing by only 8% congestion levels increased.

Frederick County Case Study

Study Area and Demographics

Route 15 sees over 5,000 trucks/day, primarily through-travel. The route functions as an Interstate and a major freight corridor between Pennsylvania and Virginia. It plays a key role in the County's economic development by supporting the projected job increases. Thus, Route 15 is one of the corridors that needs improvement, as the County has become a favorite site for businesses to locate for various reasons (Frederick County Freight and Land Use Plan, 2011).

The route's capacity changes significantly as it traverses the County. For example, it is a two-lane roadway with at-grade intersections between the Potomac River and its junction with US 340, while it is a four-lane divided highway from this point north to the Pennsylvania border. Consequently, traffic levels also vary, ranging between 15,000 vehicles/day and 98,000 vehicles/day. The higher traffic levels are observed in the City of Frederick, indicating that Route 15 is a major facility for local traffic.

This case study evaluates the impacts on traffic and congestion of the addition of a lane on a selected section of Route 15 through The City of Frederick. The study also evaluates the impact on emissions at the county and corridor level. The tools used are the Maryland Statewide Transportation Model (MSTM) in conjunction with EPA's MOVES model, a standard framework for calculating GHG and other emissions. The specifics of the lane addition were determined in discussions with the County officials. The specific network improvements studied are the addition of a lane to each direction of Route 15 from South Jefferson Street and US 15/40 (Jefferson Bridge) to I-70 to Monocacy Boulevard (Figures 2 and 3). The length of this section is 4.51 miles.

Figure 2 The Study Area

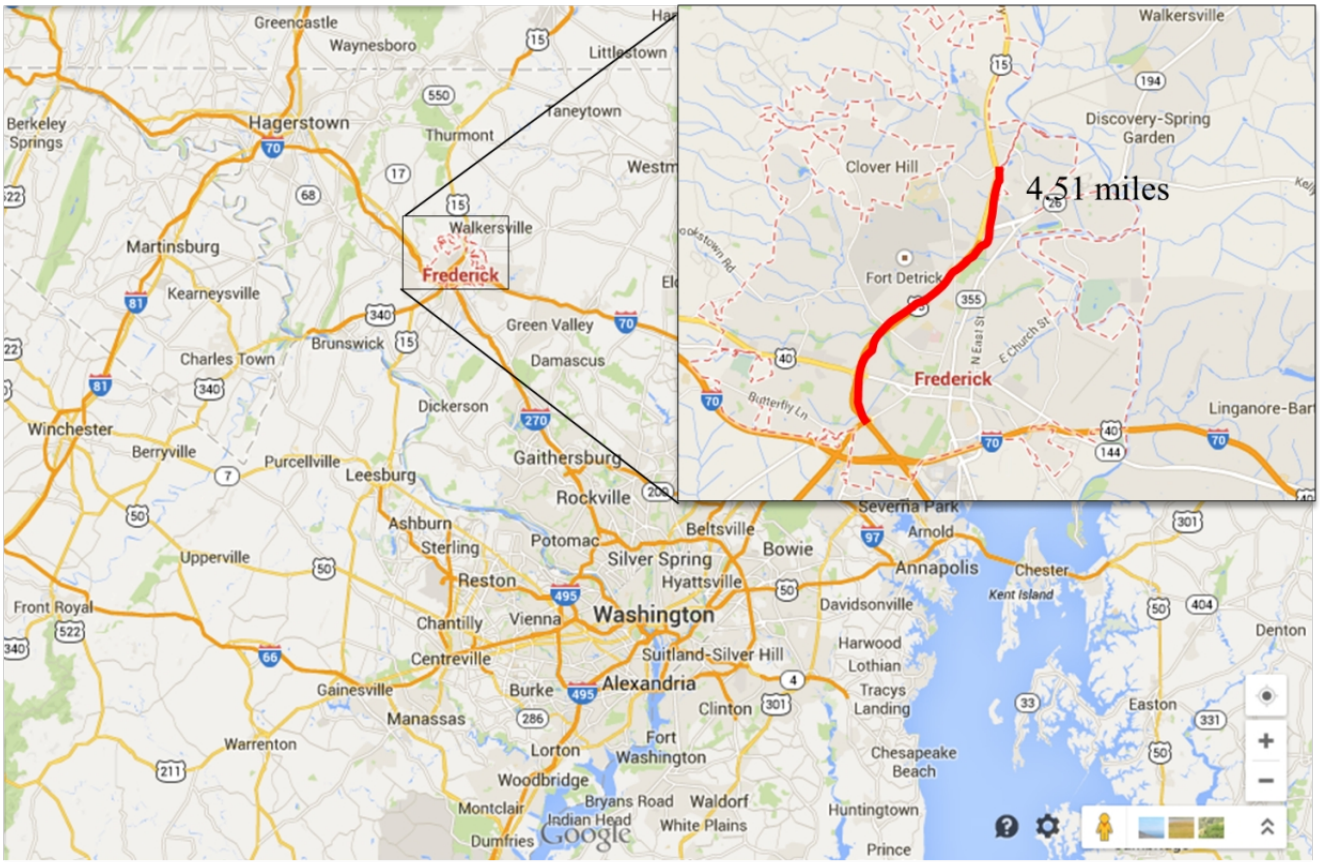


Figure 3 Frederick County and the Section of US Route 15 in the MSTM Network

Analysis Framework

The MSTM network and demand data is used to analyze the impacts of the lane addition. The purpose of the analysis was twofold: (1) looking at the congestion effects in the County and in the City (Impacts on Traffic) and (2) looking at the impact of the project on the County's air quality (Impacts on Emissions). The traffic impacts are reported by the changes in Vehicle Miles Traveled (VMT), Vehicle Hours Traveled (VHT) and graphical congestion analysis using GIS tools. The emissions impacts are reported by the changes in major greenhouse gases (GHG) i.e. CO_2, NOx and VOC, and total emissions.

Input and Scenario Description

For the analysis, the MSTM 2030 network with 2030 fuel efficiency improvements in MOVES is used as the baseline scenario. 2030 fuel efficiency is assumed to be approximately 48 miles per gallon, slightly below the 2030 CAFE standards of 54.5 miles/gallon. This lower MPG compared to the CAFE standards of 54.5miles/gallon account for the delay in higher MPG vehicles penetrating the vehicle fleet (Table 1). The lane addition scenario is built by modifying the Route 15 section in the MSTM network.

Table 1 Scenario Descriptions

Baseline Scenario **2030 – Without lane addition**	**2030 MSTM network with 2030 fuel efficiency improvements in MOVES**
Lane Addition Scenario **2030 – With lane addition**	2030 MSTM network with added lane and 2030 fuel efficiency improvements in MOVES

The MSTM demand input includes two major categories; households and employment. The year 2030 Constrained Long Range Plan (CLRP) data is used for the analysis to reflect the changes in land use patterns at the time the lane addition is complete and functional (Table 2). As shown, the County is expected to attract a large amount of employment, with employment increasing by 97% compared to a 53% increase in households. The higher increase in employment also indicates that the travel into the County from external sources is likely to increase.

Table 2 MSTM Demand Input and Projections

Model Projections	2007	2030	% Change
Households	80,687	123,125	+52.60%
Employment	103,774	204,773	+97.33%

Results Analysis

Traffic Impacts

The impacts of lane additions are reported in Table 3, both at the County level and the corridor level. Increases in VMT and VHT at the County level are minimal. However, the results at the corridor level indicate a significant change with the addition of lanes, particularly in VHT. It is interesting that VMT increases when the lane is added while VHT decreases significantly. This shows that the new lane attracts more traffic to the corridor due to the relieved congestion. Despite the increased travel, the VHT decreases due to the additional capacity.

Table 3 Major Highway Performance Measures With and Without the Lane Addition in 2030

	County		**US Route 15**	
	VMT (thousand miles)	VHT (thousand hours)	VMT (thousand miles)	VHT (thousand hours)
2030 – Without Lane Addition	13,086	730	39	2.21
2030 – With Lane Addition	13,156	735	45	1.11
% Change	+0.54%	+0.74%	+16.84%	-49.80%

The distribution of traffic was examined, focusing on Route 15 and the surrounding areas. Changes in VMT in the County with lane additions are shown in Figure 4 while Figure 5 focuses on the section of the Route 15 with the lane addition. An increase in VMT can be observed on Route 15. In addition, increases in VMT on adjacent local routes can be observed, likely due to the increased number of vehicles accessing Route 15. On the other hand, significant reductions are also observed in the local County network, which can be seen as a positive impact.

Similarly, Figures 6 and 7 demonstrate the change in speed with the lane addition at the County and corridor level respectively. In line with the results in Table 3, the speed increases on Route 15, explaining the decrease in the VHT. Some speed reductions observed on local and access roads are likely due to the increased demand for accessing Route 15.

Figure 4 Change in VMT – County

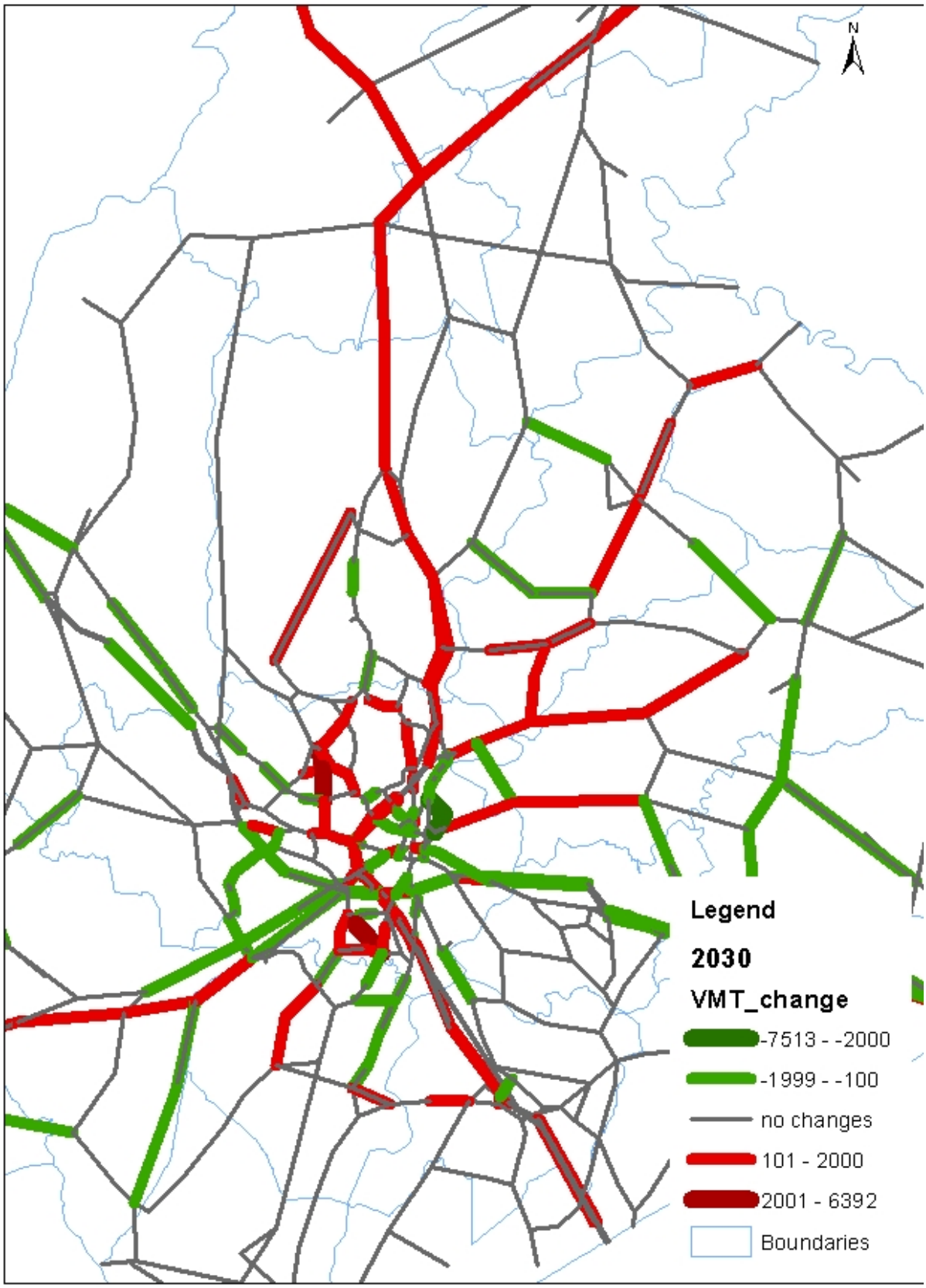


Figure 5 Change in VMT – US Route 15

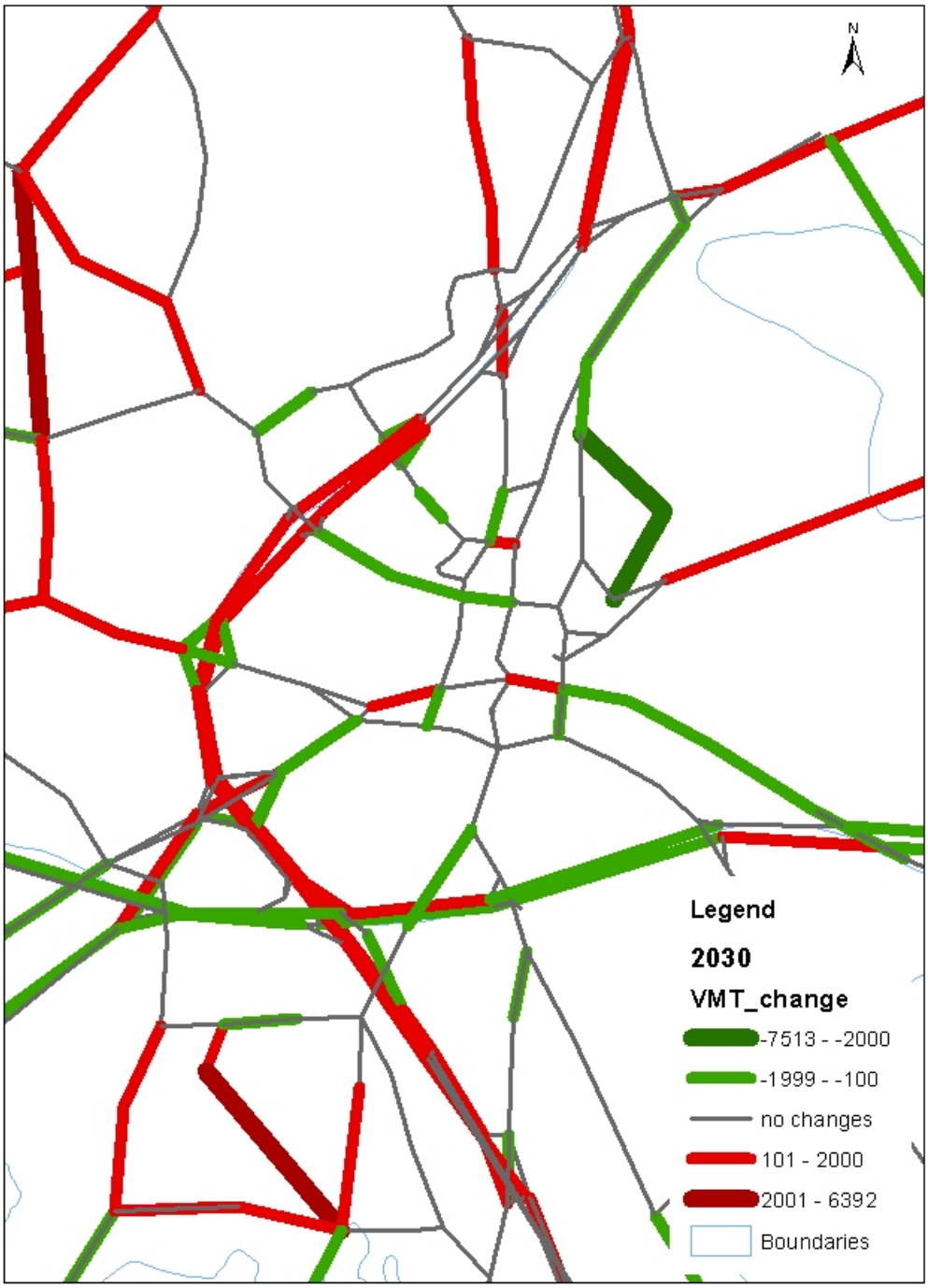


Figure 6 Change in Congested Speed – County

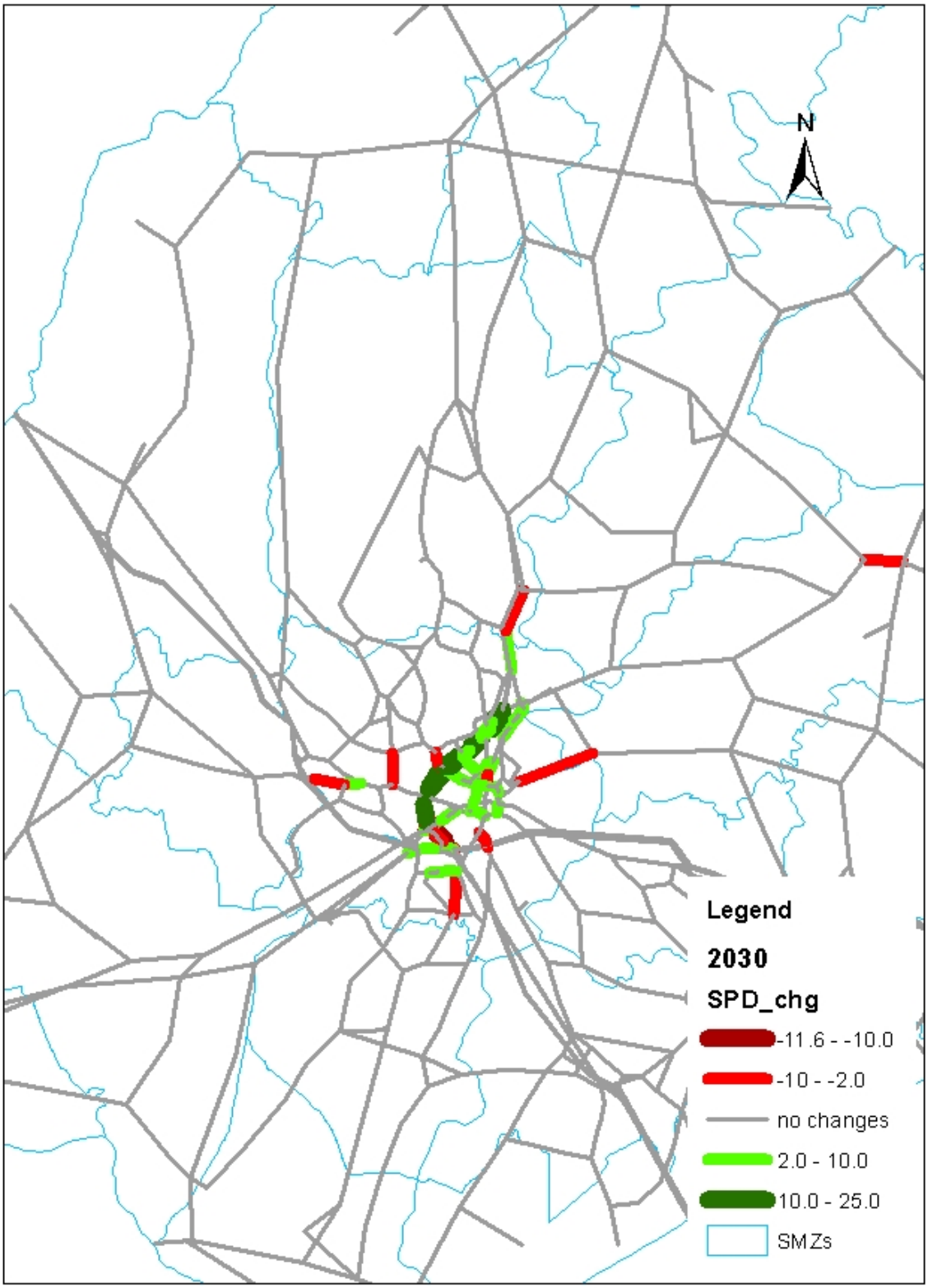
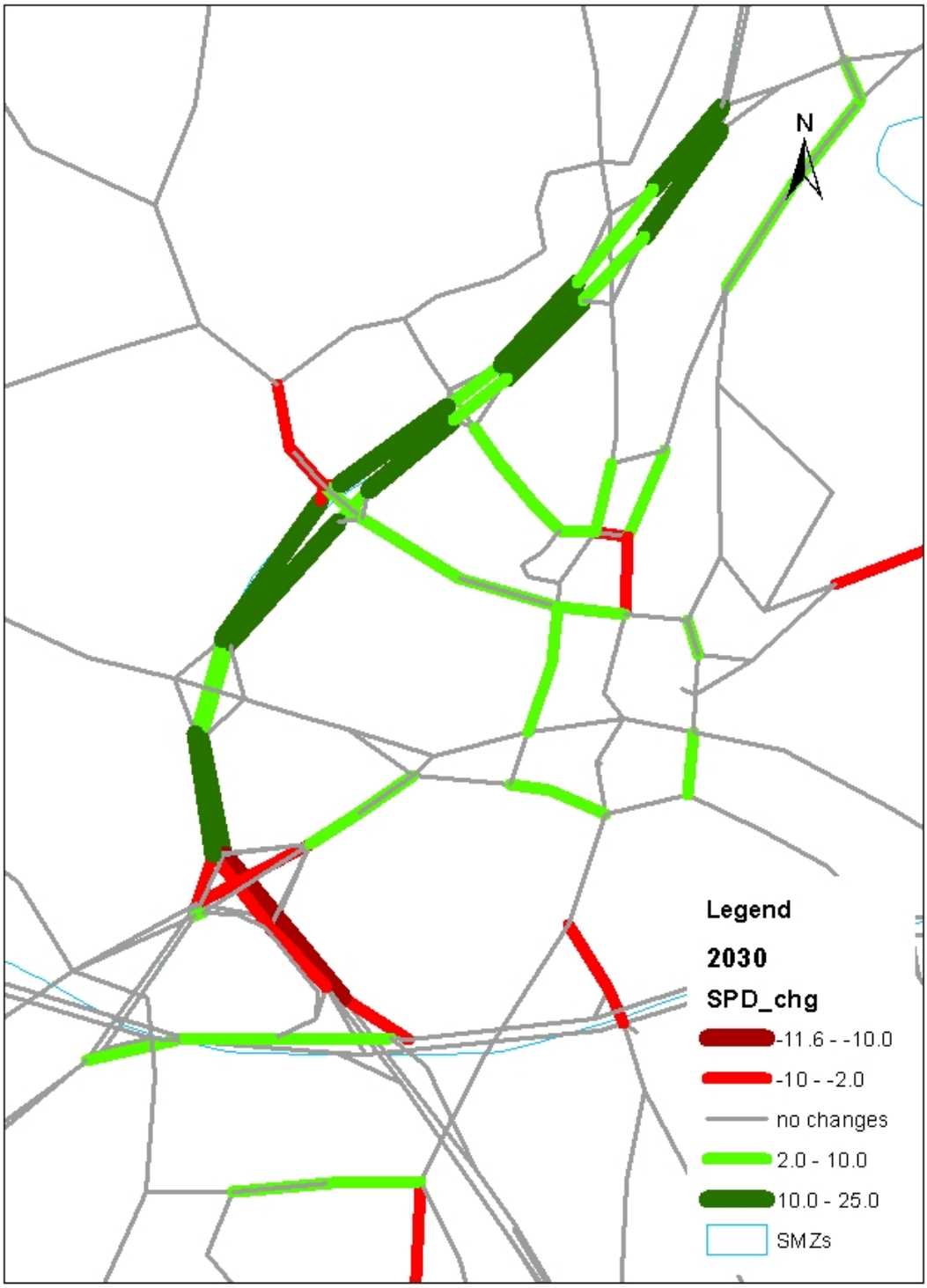


Figure 7 Change in Congested Speed – US Route 15



Emissions Impacts

Emissions impacts of the lane additions are presented in Table 4. Similar to the traffic impacts, emissions impacts are also negligible at the County level, while they are significant at the corridor level. When comparing the baseline and lane addition scenarios, similar amounts of CO_2, NOx and VOC are produced at the County level, however there are significant increases along Route 15 (varying from 16.84% to 17.75%).

Table 4 Percent Change in Emissions with Lane Addition Compared to 2030 Network

	County			
	CO_2	**NOx**	**VOC**	**Total**
% Change	+0.34%	+0.66%	+0.13%	+0.35%
	US Route 15			
	CO_2	**NOx**	**VOC**	**Total**
% Change	+16.84%	+16.84%	+17.75%	+16.84%

Concluding Remarks

For congestion reduction, the impact of adding a lane in both directions will be insignificant at the County level, but substantial benefits are observed at the corridor level. For level of service improvement, the lane addition can be beneficial. The effect on emissions is minimal. While emissions on Route 15 increase; they are offset by reductions elsewhere in the County.