Mirabeau & North Pines Road Subarea Transportation Impact Fee Rate Study

Prepared for:
City of Spokane Valley, Washington

Updated January, 2022

SE21-0679/ DN21-0719

FEHR PEERS

Table of Contents

Appendices

List of Figures

List of Tables

This page intentionally left blank.

Introduction

This report documents the methods, assumptions, and findings of a transportation impact fee (TIF) rate study for the Mirabeau and North Pines Road subareas in Spokane Valley. The need for a TIF is identified in the *Mirabeau Subarea Traffic Study Update* (Dec 2019), which documented land use growth in the Mirabeau and North Pines Road subareas. That study projected how resulting traffic growth will degrade traffic operations at numerous intersections in and near the two subareas and identified several transportation capacity projects to support growth and ensure adequate level of service through the year 2040. That study identified the needed future transportation capacity improvements in the area, completed project cost estimates, and included a fair share cost analysis to separate project costs between growth in both subareas and growth from other parts of the region. This TIF rate study builds on the *Mirabeau Subarea Traffic Study* and identifies a Growth Management Act (GMA) compliant impact fee rate schedule per development unit in both the Mirabeau Subarea and the North Pines Road Subarea. Using this rate schedule, developers in the TIF area can quickly identify their fair share contribution toward new transportation projects, facilitating development and reducing the cost and complexity of traffic studies associated with project permitting and transportation concurrency requirements.

Except as otherwise identified herein, the *Mirabeau Subarea Traffic Study Update* provides the basis for all TIF rates calculated in this rate study. As part of adoption of any TIF rates, both the *Mirabeau Subarea Traffic Study Update* and this TIF rate study will be adopted as supporting documents.

Study Area

The *Mirabeau Subarea Traffic Study Update* defined the impact fee area for the Mirabeau and North Pines Road Subarea as shown in **Figure 1**. Along with the two subareas, that Study identified seven intersections, as mapped in **Figure 1**, where forecast development in the two subareas would contribute to a degradation of transportation level of service (LOS) by the year 2040. The areas were defined in that study using a select zone analysis from the Spokane Regional Transportation Council (SRTC) regional travel demand model to quantify the impact of the transportation analysis zones (TAZs) to the seven intersections.

- **Mirabeau TIF Area** - **Figure 1** shows the Mirabeau subarea which covers most of the area between Pines Road and Sullivan Road and I-90 and the Spokane River in north central Spokane Valley. This includes the following transportation analysis zones (TAZs) from the SRTC regional travel demand model: 320, 321, and 322. This area will be referred to in this report as the Mirabeau TIF area.
- **North Pines Road TIF Area** - **Figure 1** also shows the North Pines Road subarea, which is around North Pines Road covering most of the area between University Road and Adams Road and East Valleyway Avenue and Trent Avenue excluding the Mirabeau Subarea. The North Pines Road subarea includes the following TAZs: 293, 297, 298, 305, 306, 329, 330, 331, 395, 396, and 397. This area will be referred to in this report as the North Pines Road TIF area.

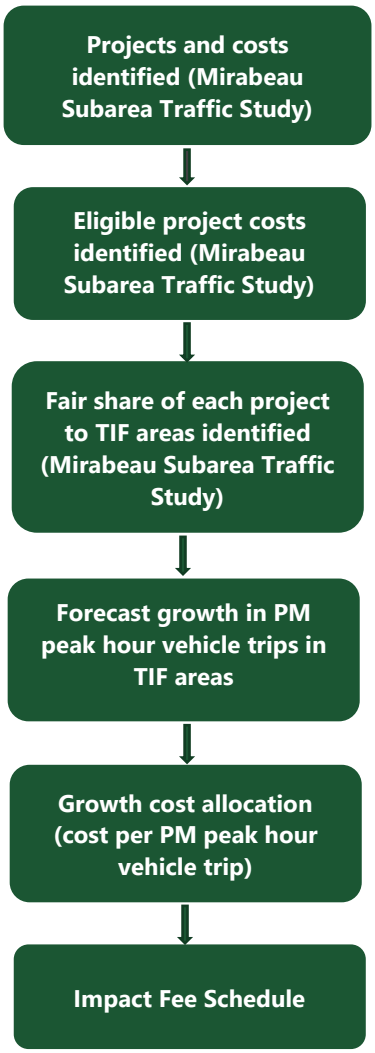
Based on the analysis provided in the *Mirabeau Subarea Traffic Study Update*, future development in the two subareas is expected to contribute between 13% and 66% of future traffic to the seven intersections identified - depending on the intersection.

Figure 1. Mirabeau and North Pines Road Subarea Traffic Study Area

Methodology

The impact fee for the Mirabeau and North Pines Road Subareas was developed to establish the fair share of transportation improvement costs that may be charged to new development in the area. Revised Code of Washington Section 82.02.050 authorizes cities planning under the GMA to impose impact fees for system improvements that are reasonably required to support and mitigate the impacts of new development. Fees may not exceed a proportionate share of the costs of improvements and cannot be used to fund existing deficiencies.

Figure 2. Impact Fee Methodology



The following key points summarize the process for developing the impact fee structure (refer to **Figure 2**):

- The *Mirabeau Subarea Traffic Study Update* identified a list of future projects and estimated costs that will be needed to support future growth through the year 2040.
- The *Mirabeau Subarea Traffic Study Update* also accounted for any existing deficiency (intersections/roadway segments that do not meet current level of service standards) by deducting the costs of those deficiencies from the total project cost.
- The *Mirabeau Subarea Traffic Study Update* next identified the share of traffic growth that is attributed to each of the two TIF areas.
- The forecast growth in PM peak hour vehicle trips in the Mirabeau and North Pines Road TIF area was estimated by converting the forecast land use growth in the SRTC regional travel demand model (and modified based on estimates provided by developers) using the Institute of Transportation Engineers (ITE) Trip Generation Manual, 10th Edition.
- A cost per PM peak hour trip was calculated by dividing the fair share cost of each project by the growth in vehicle trips in each subarea.
- Lastly, a land use-based fee schedule was developed using the cost per PM peak vehicle trip. Trip rates for multiple land use categories were estimated using vehicle trip generation rates from the ITE Trip Generation Manual, 10th Edition. Using the ITE Trip Generation Manual will provide consistency between a project trip generation letter or traffic impact study and the impact fee rate.

The following sections describe in detail these elements that that are integral to the final impact fee schedule.

Project List

The *Mirabeau Subarea Traffic Study*, originally completed in 2016 and updated in December 2019, included an analysis of traffic demand through the year 2040 to identify potential traffic improvement projects at major intersections in and near the subareas. That study identified a total of seven projects that will be needed by 2040 to accommodate future growth and maintain level of service standards. Those projects, and costs in 2021 dollars, are shown in **Table 1**. The seven projects total approximately $7.66 million in 2021 dollars (note: these costs have been updated from the cost estimates in the *Mirabeau Subarea Traffic Study Update* to account for construction cost inflation or more detailed estimates by the City of Spokane Valley - COSV).

Table 1. Mirabeau Traffic Study Project List and Cost Estimates

Project	Description	Program	Cost Estimate (2021 dollars)
Pines Rd/ Indiana Ave	Add westbound left-turn lane; retime traffic signal	N/A	$1,545,000
Pines Rd/ I-90 EB Ramps	Add eastbound left-turn lane and northbound right-turn pocket (extending back to Nora Ave); retime traffic signal	N/A	$1,152,000
Pines Rd/ Mission Ave	Reconfigure lane assignments on Mission Ave to include eastbound dual-left and a through-right lane and westbound left, through, and right turn lane; retime and upgrade traffic signal; add southbound right-turn lane (extending back to the I-90 off-ramp)	2022-2027 TIP (#13)	$2,000,000
Mirabeau Pkwy/ Mansfield Ave	Add traffic signal, add new 180 foot southbound through-right lane	2022-2027 TIP (#41)	$1,252,000
Sullivan Rd/ Mission Ave	Reconfigure eastbound to include a left and through-right lane; retime signal	N/A	$97,000
Pines Rd/ Sprague Ave	Add a southbound right-turn-only lane; convert the existing southbound through-right lane to a through-only lane; add a second eastbound left-turn-only lane.	N/A	$843,000
Argonne Rd/ Trent Ave	Add a second westbound left-turn lane.	N/A	$776,000
		TOTAL	**$7,665,000**

Source: *Mirabeau Subarea Traffic Study Update* (December 2019). Costs were updated based on California Construction Cost Index, which showed a 3.0% inflation rate from December 2019 to March 2021. The exception being the Pines Road/Mission Avenue project, for which cost estimates were more recently updated by COSV.
Note: TIP = City of Spokane Valley Transportation Improvement Plan.

Travel Growth

Determining the growth in travel demand caused by new development is a key requirement for a TIF program. In nearly every TIF program across Washington and the country, the total eligible costs of building new transportation capacity is divided by the total growth in trips to determine a cost per trip. All

developments pay the same cost per trip, but larger developments that generate more trips pay a higher total fee than smaller developments. In this way, the cost to provide the new transportation infrastructure is fairly apportioned to new development. Moreover, in setting the boundary for the TIF, a select zone analysis was performed to validate that all the areas within the two TIF areas contribute a meaningful amount of total traffic to the combined project sites relative to the amount of growth expected. The amount of traffic varies somewhat based on which project location is evaluated and which TAZ the project resides in, but in all cases each of the 11 identified TAZs within the two TIF areas contribute a similar proportion of the total TIF area traffic to the project sites relative to the amount of growth expected in the respective TAZ.

For the Mirabeau TIF area, the future growth in PM peak hour vehicle trips was estimated using the change in land use in the study area from 2015 and 2040 based on the data provided in the original Mirabeau Subarea Traffic Study (2016) as well as trip rates from the ITE Trip Generation Manual, 10th Edition. Forecast land use growth was attained from a combination of sources, including conversations with major developers, a land use audit of development in the pipeline, and the SRTC regional travel demand model.

For the North Pines Road TIF area, which was incorporated by the Mirabeau Subarea Traffic Study Update in 2019, the future growth in PM peak hour vehicle trips was estimated using the change in land use in the study area from the 2015 and 2040 SRTC regional travel demand model as well as trip rates from the ITE Trip Generation Manual, 10th Edition. The SRTC travel demand model includes 11 land use categories: two residential and nine non-residential categories. For each land use in the SRTC model, an associated ITE trip rate was identified.

Table 2 summarizes the calculation for the Mirabeau TIF area and **Table 3** summarizes the calculation for the North Pines Road TIF area.

It should be noted that COSV directs developers to apply the trip calculation methodology based on the process detailed in Section 4.4 of the ITE Trip Generation Handbook, 3rd Edition when estimating trip generation for developments. In some situations the best-fit curve would be used instead of average trip rates. That methodology is applicable at the development scale where developments of various sizes can impact trip rates. However, in this situation given growth forecast in the model will occur among developments of various sizes over a 25-year period, using average trip rates is more appropriate and was applied to forecast growth in trips in the TIF area.

Table 2. Growth in Mirabeau TIF Area PM Peak Hour Vehicle Trips (2015-2040)

Land Use (LU)	2015-2040 LU Growth	Unit of Measure	ITE Code	ITE Description	ITE Average Trip Rate [1] (PM peak hr.)	Growth in Trips (LU growth x trip rate)
Single Family Residential	65	Dwelling Units	210	Single-Family Detached Housing	0.99	65
Multi-Family Residential	979	Dwelling Units	220	Multifamily Housing (Low-Rise)	0.56	549
Hotel/Motel	150	Rooms	310	Hotel	0.60	90
Retail Trade	63.89	Thousand Square Feet	820	Shopping Center	3.81	244
Office	2,561	Employees	710	General Office Building	0.40	1,025
				Total Growth in PM Peak Hour Trips		**1,973**

1. ITE Trip Generation Manual, 10th Edition; average trip rate of adjacent street traffic 4-6 PM was used for all land uses given growth will occur among developments of various sizes.

Table 3. Growth in North Pines Road TIF Area PM Peak Hour Vehicle Trips (2015-2040)

SRTC Land Use (LU)	2015-2040 LU Growth	Unit of Measure	ITE Code	ITE Description	ITE Average Trip Rate [1] (PM peak hr.)	Growth in Trips (LU growth x trip rate)
Single Family Residential	78	Dwelling Units	210	Single-Family Detached Housing	0.99	78
Multi-Family Residential	157	Dwelling Units	220	Multifamily Housing (Low-Rise)	0.56	88
Hotel/Motel	0	Rooms	N/A	N/A	N/A	0
Agriculture, Forestry, Mining, Industrial, Manufacturing, Wholesale	79	Employees	110	General Light Industrial	0.49	39
Retail Trade (Non-Central Business District)	155	Employees	820	Shopping Center	1.62	252
Services and Offices	248	Employees	710	General Office Building	0.40	100
Finance, Insurance, and Real Estate Services (FIRES)	11	Employees	710	General Office Building	0.40	7
Medical	371	Employees	630	Clinic	0.85	316
Retail Trade (CBD)	0	Employees	N/A	N/A	N/A	0
Education Employees	18	Employees	520	Elementary School	1.78	33
University Employees	0	Employees	N/A	N/A	0.40	0
				Total Growth in PM Peak Hour Trips		**911[2]**

1. ITE Trip Generation Manual, 10th Edition; average trip rate of adjacent street traffic 4-6 PM was used for all land uses given growth will occur among developments of various sizes.
2. Estimated growth in trips is slightly higher than the findings in the *Mirabeau Subarea Traffic Study Update (2019)* because the retail trip generation is based on employees instead of square foot and the trip generation from the school land use was updated.

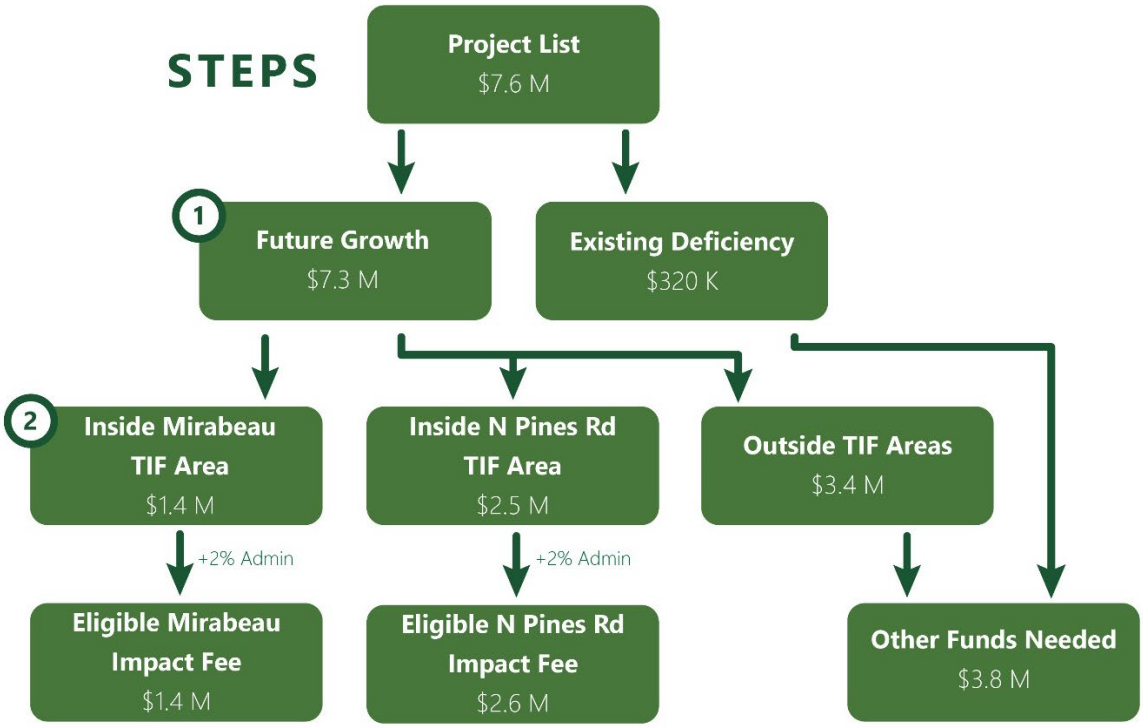
Using this methodology, it is forecast that the Mirabeau TIF area would generate 1,973 new PM peak hour vehicle trips by 2040, and the North Pines TIF area would generate 911 new PM peak hour trips by 2040. The total PM peak hour vehicle trip growth for these two areas will be used in the calculation of the TIF rate.

Cost Allocation

Three steps were used to allocate costs per PM peak hour trip, see **Figure 3**. First, the TIF methodology must separate the share of project costs that address existing deficiencies from the share of project costs

that add transportation capacity and serve new growth. Second, resulting growth-related improvement costs are then further separated to identify the share of growth related to land development in Mirabeau and North Pines Road TIF areas. It should be noted that dedicated funding from external sources (state/regional grants, other mitigation payments, etc.) is considered in the impact fee eligible costs, if the dedicated funding exceeds the share of costs caused by growth outside of the TIF areas. This is currently not the case, thus non-City funding sources were not excluded from the total eligible project cost.

Figure 3. Impact Fee Cost Allocation



Existing Transportation Deficiencies

An existing conditions analysis was conducted for the *Mirabeau Subarea Traffic Study Update*, which identified existing level of service (LOS) deficiencies at two of the seven project locations: Pines Road & Sprague Avenue and Argonne Road & Trent Avenue. A deficiency at an intersection is defined in the Comprehensive Plan as a LOS rating of E or lower at a signalized intersection or LOS F at an unsignalized intersection. The full cost of projects at these two locations cannot be included in the impact fee and a portion must be deducted to account for the existing deficiency. The methodology for accounting for the existing deficiency is explained in *Mirabeau Subarea Traffic Study Update* and provided below.

Pines Road & Sprague Avenue

The full cost of improvements at the Pines Road & Sprague Avenue intersection cannot be applied to the impact fee because there is a LOS deficiency at this intersection under existing conditions. To account for

this, the portion of traffic that if removed from the system today would effectively reduce the LOS at this intersection from an "E" to a "D" was estimated in Synchro. The result was 10% of existing traffic. This means that if traffic volumes were 10% lower at this intersection under existing conditions, the intersection would meet the LOS D threshold. Therefore, to account for the existing deficiency, 10% of the total cost of the improvement project at Pines Road & Sprague Avenue was deducted from the total cost to arrive at the applicable cost as shown in **Table 5** and **Table 6**.

Argonne Road & Trent Avenue

Similarly, the full cost of improvements at the Argonne Road & Trent Avenue intersection cannot be applied to the impact fee because there is an existing LOS deficiency at this intersection. To account for this, the cost of a restriping and signal modification project which would bring the intersection to a LOS D under existing conditions was estimated. The project was recommended as part of the *North Argonne Road/North Mullan Road Corridor Retiming Project*.[1] The estimated cost of this project ($229,200 in 2019 dollars; updated to $236,000 in 2021 dollars) was deducted from cost of the longer term project to arrive at the applicable cost as shown in **Table 5** and **Table 6**.

In total, between the two projects, $320,000 was deducted from the $7.66 million total cost of all seven projects associated with the TIF areas to account for existing deficiencies.

Fair-Share Cost

With deficiencies accounted for, the remaining project costs are related to supporting new growth in trips that will be funded by COSV. However, not all the growth comes from development in the Mirabeau and North Pines Road TIF area – there is a portion of growth that comes from other parts of Spokane Valley and surrounding jurisdictions. To ensure that the costs assessed to development as part of the TIF are fair and proportional to the impact, a fair share percentage was used. The *Mirabeau Subarea Traffic Study Update* identified the percentage of traffic growth through each project intersection that are expected to be attributable to development in the Mirabeau TIF area and North Pines Road TIF area. This was done using a select zone analysis in the 2040 SRTC travel demand model. The percentages range from 4% to 53% depending on the TIF and the project location as shown in **Table 4.**

[1] Fehr & Peers. Technical Memorandum. *N Argonne Road/N Mullan Road Corridor Retiming*. July 25, 2019. Project # SE18-0621.

Table 4. Percent of 2040 Traffic Attributable to each Project Location

Intersection	Mirabeau Subarea Portion of Future Traffic	North Pines Road Subarea Portion of Future Traffic	Combined Portion of Future Traffic from two Subareas
Pines Rd/ Indiana Ave	18%	42%	60%
Pines Rd/ I-90 EB Ramps	18%	48%	66%
Pines Rd/ Mission Ave	4%	53%	57%
Mirabeau Pkwy/ Mansfield Ave	38%	5%	43%
Sullivan Rd/ Mission Ave	4%	9%	13%
Pines Rd/ Sprague Ave	6%	19%	25%
Argonne Rd/ Trent Ave	10%	7%	17%

Source: *Mirabeau Subarea Traffic Study Update* (Dec 2019)

The fair share percentages were multiplied by the eligible cost of each project in the corridor to get the cost of growth-related transportation improvements at the seven project locations that is expected to be attributable to development in the two TIF areas. For the Mirabeau TIF area, this equates to $1,384,640. A two percent administrative fee was added to each Subarea cost to cover the cost of administering the program, including future updates to the TIF rate study. When factored in, the eligible project cost for the Mirabeau TIF area equates to $1,412,330 shown in **Table 5**.

Table 5. Mirabeau TIF Area Eligible Cost Calculations

Project Location	Project Cost	Cost to Address Existing Deficiencies	Eligible Project Cost	TIF Area Fair Share Percent	Cost Attributable to Study Area
Pines Rd/ Indiana Ave	$1,545,000	$0	$1,545,000	18%	$278,100
Pines Rd/ I-90 EB Ramps	$1,152,000	$0	$1,152,000	18%	$207,360
Pines Rd/ Mission Ave	$2,000,000	$0	$2,000,000	16%	$320,000
Mirabeau Pkwy/ Mansfield Ave	$1,252,000	$0	$1,252,000	38%	$475,760
Sullivan Rd/ Mission Ave	$97,000	$0	$97,000	4%	$3,880
Pines Rd/ Sprague Ave	$843,000	$84,000	$759,000	6%	$45,540
Argonne Rd/ Trent Ave	$776,000	$236,000	$540,000	10%	$54,000
SUBTOTAL	**$7,665,000**	**$320,000**	**$7,345,000**	**Varies**	**$1,384,640**
				Administrative Cost (2%)	$27,690
				TOTAL	**$1,412,330**

For the North Pines Road TIF area, the fair share total equates to $2,515,200. When the two percent administrative fee factored in, the eligible project cost for the North Pines Road TIF equates to $2,565,200 as shown in **Table 6**.

Table 6. North Pines Road TIF Area Eligible Cost Calculations

Project Location	Project Cost	Cost to Address Existing Deficiencies	Eligible Project Cost	TIF Area Fair Share Percent	Cost Attributable to Study Area
Pines Rd/ Indiana Ave	$1,545,000	$0	$1,545,000	42%	$648,900
Pines Rd/ I-90 EB Ramps	$1,152,000	$0	$1,152,000	48%	$552,960
Pines Rd/ Mission Ave	$2,000,000	$0	$2,000,000	53%	$1,060,000
Mirabeau Pkwy/ Mansfield Ave	$1,252,000	$0	$1,252,000	5%	$62,600
Sullivan Rd/ Mission Ave	$97,000	$0	$97,000	9%	$8,730
Pines Rd/ Sprague Ave	$843,000	$84,000	$759,000	19%	$144,210
Argonne Rd/ Trent Ave	$776,000	$236,000	$540,000	7%	$37,800
SUBTOTAL	**$7,665,000**	**$320,000**	**$7,345,000**	**Varies**	**$2,515,200**
				Administrative Cost (2%)	$50,300
				TOTAL	**$2,565,500**

Committed External Funding

As identified in **Table 5** and **Table 6**, the two TIF areas are eligible to fund $3.90 million of the $7.66 million total project costs. The City of Spokane Valley is responsible to fund the balance through any non-TIF area funding source. One of the more common sources of funding to pay for this external growth share are grants. To this end, the City has secured a Congestion Mitigation/Air Quality grant of $1.73 million to fund capacity projects in the area and has chosen to advance implementation of the Pines Road and Mission Avenue intersection. Since this grant is less than the total amount the City is liable to cover to fund the share of growth outside of the TIF areas ($3.76 million), there is no change in cost attributable to either of the TIF areas.

Additionally, there are existing "vested" trips from the prior "Pines-Mansfield Development Agreement" that was established by Spokane County. While the transportation improvement projects identified as part of the Pines-Mansfield Development Agreement have largely been constructed, Spokane Valley will count the vested trips as a credit against impact fee documented in this rate study. These trips have a value of $303.36 per PM peak hour trip. Developers can apply the value of their unused vested PM peak hour trips in their current quantity as a credit to the Mirabeau TIF until they have no vested trips remaining.

Cost per PM Peak Hour Trip

Lastly, the cost per PM peak hour trip for each of the two TIF areas was calculated by dividing the total eligible fee for each TIF by the respective growth in PM peak hour trips in each TIF area. This equates to a fee of $716 per PM peak hour trip in the Mirabeau TIF area and $2,816 per PM peak hour trip in the North Pines Road TIF area as shown in **Table 7**.

Table 7. Cost Per PM Peak Hour Trip Calculations

TIF Area	Fair Share Eligible Project Costs	2015-2040 Growth in PM Peak Hour Trips	Cost per PM Peak Hour Trip
Mirabeau TIF	$1,412,330	1,973	**$716**
North Pines Road TIF	$2,565,500	911	**$2,816**

Impact Fee Schedule

The impact fee schedule was developed by adjusting the cost per PM peak hour vehicle trip to reflect differences in trip-making characteristics for the general land use types forecast in the SRTC regional travel demand model within Spokane Valley. The fee schedule is a table where fees are represented as dollars per unit for each land use category which makes it easier for developers to calculate their impact fee rates. **Table 8** and **Table 9** shows the various components of the fee schedule.

Trip Generation

Trip generation rates for each land use type in the PM peak hour were derived from average trip rates for selected land uses of the ITE Trip Generation Manual, 10th Edition to ensure consistent and repeatable calculations across all land uses.

Pass-By Trip Adjustment

The ITE trip generation rates represent total vehicles entering and leaving a development. For certain land uses (e.g., retail, convenience stores, etc.), a substantial amount of the motorized travel is already passing by the property and merely turns into and out of the driveway. These pass-by trips do not add trips to the surrounding street system and therefore are subtracted out prior to calculating the impact fee. The resulting trips are considered "new" trips and are therefore subject to the impact fee calculation. The pass-by trip percentages are taken from the ITE Trip Generation Handbook, 3rd Edition (2017).

Schedule of Rates

The proposed impact fee rates for the Mirabeau TIF are shown in **Table 8** and the proposed impact fee rates for the North Pines Road TIF are shown in **Table 9**. An expanded table of land uses is provided in **Table 10** and **Table 11** in Appendix A. In the fee schedule, fees are shown as dollars per unit of development for various land use categories. The impact fee program is flexible in that if a use does not fit into one of the ITE land use categories listed, an impact fee can be calculated based on the development's projected PM peak hour person trip generation and multiplied by the cost per PM peak hour trip which is $716 for the Mirabeau TIF area as shown in **Table 8** and $2,816 in the North Pines Road TIF area as shown in **Table 9**. Projects with land uses not in **Table 8** - **Table 11** shall prepare a trip generation and distribution letter and will be responsible for a fee based on $716 per PM peak hour trip for the Mirabeau TIF are and $2,816 per PM peak hour trip for the North Pines Road TIF area.

Table 8. Mirabeau Impact Fee Schedule

City of Spokane Valley Mirabeau Transportation Impact Fee Rate Schedule						
ITE Code	ITE Land Use Category	PM Peak Vehicle Trip Rate [1]	Passby % [2]	Adjusted Trips per Unit of Measure [3]	Impact Fee Per Unit [4] @ $716 per PM Peak Vehicle Trip	
210	Single Family & Duplex	0.94	0%	0.94	$673	per dwelling unit
220	Multi-Family (Low-Rise) - Not Close to Rail Transit	0.51	0%	0.51	$365	per dwelling unit
310	Hotel (3 or More Levels)	0.59	0%	0.59	$422	per room
520	Elementary School	0.16	0%	0.16000	$114.53	per student [5]
630	Medical Clinic	0.00369	0%	0.00369	$2.64	per sq ft
710	General Office	0.00144	0%	0.00144	$1.03	per sq ft
820	Shopping Center	0.0034	29%	0.00241	$1.73	per sq ft

[1] ITE Trip Generation Manual (11th Edition): 4-6 PM Peak Hour Vehicle Trip Generation Rates for the Adjacent Street Traffic (weekday 4-6PM); This worksheet represents only the generalized land uses in the SRTC regional travel demand model and is NOT all-inclusive; see Table 10 for a wider variety of uses; Projects with land uses not in Table 8 or 10 shall prepare a trip generation and distribution letter and will be responsible for a fee based on $716 per PM peak hour trip.

[2] Pass by rates were updated based on the Pass-By Data and Rate Tables/2021 Pass-By Tables for ITETripGen Appendices, 11th Edition

[3] PM peak trip rate excluding passby trips

[4] sq ft = square feet, room = available hotel/motel room

[5] ITE also includes an employment-based trip rate which may be used if approved by Spokane Valley

Table 9. North Pines Road Impact Fee Schedule

City of Spokane Valley North Pines Road Transportation Impact Fee Rate Schedule						
ITE Code	ITE Land Use Category	PM Peak Vehicle Trip Rate [1]	Passby % [2]	Adjusted Trips per Unit of Measure [3]	Impact Fee Per Unit [4] @ $2,816 per PM Peak Vehicle Trip	
210	Single Family & Duplex	0.94	0%	0.94	$2,647	per dwelling unit
220	Multi-Family (Low-Rise) - Not Clos	0.51	0%	0.51	$1,436	per dwelling unit
310	Hotel (3 or More Levels)	0.59	0%	0.59	$1,662	per room
520	Elementary School	0.16	0%	0.16000	$450.58	per student [5]
630	Medical Clinic	0.00369	0%	0.00369	$10.39	per sq ft
710	General Office	0.00144	0%	0.00144	$4.06	per sq ft
820	Shopping Center	0.0034	29%	0.00241	$6.80	per sq ft

[1] ITE Trip Generation Manual (11th Edition): 4-6 PM Peak Hour Vehicle Trip Generation Rates for the Adjacent Street Traffic (weekday 4-6PM); This worksheet represents only the generalized land uses in the SRTC regional travel demand model and is NOT all-inclusive; see Table 11 for a wider variety of uses; Projects with land uses not in Table 9 or 11 shall prepare a trip generation and distribution letter and will be responsible for a fee based on $2,816 per PM peak hour trip.

[2] Pass by rates were updated based on the Pass-By Data and Rate Tables/2021 Pass-By Tables for ITETripGen Appendices, 11th Edition

[3] PM peak trip rate excluding passby trips

[4] sq ft = square feet, room = available hotel/motel room

[5] ITE also includes an employment-based trip rate which may be used if approved by Spokane Valley

Appendix A – Expanded Impact Fee Schedule

Table 10. Expanded Mirabeau Impact Fee Schedule

City of Spokane Valley Mirabeau Transportation Impact Fee Rate Schedule							
Land Use Group	*ITE Code*	*ITE Land Use Category*	*PM Peak Vehicle Trip Rate* [1]	*Passby %* [2]	*Adjusted Trips per Unit of Measure* [3]	*Impact Fee Per Unit* [4] *@ $716 per PM Peak Vehicle Trip*	
Residential	210	Single Family & Duplex	0.94	0%	0.94	$673	per dwelling unit
	220	Multi-Family (Low-Rise) - Not Close to Rail Tr	0.51	0%	0.51	$365	per dwelling unit
Services	310	Hotel (3 or More Levels)	0.59	0%	0.59	$422	per room
	492	Health Club	0.00345	0%	0.00345	$2.47	per sq ft
	912	Bank	0.02101	35%	0.01366	$9.78	per sq ft
Institution	520	Elementary School	0.16	0%	0.16000	$114.53	per student [5]
	522	Middle School	0.15	0%	0.15000	$107.37	per student [5]
	525	High School	0.14	0%	0.14000	$100.22	per student [5]
Restaurant	975	Drinking Establishment	0.01136	43%	0.00648	$4.64	per sq ft
	934	Fast Food Restaurant (with drive-thru)	0.03303	55%	0.01486	$10.64	per sq ft
	937	Coffee Shop with Drive-Thru	0.03899	89%	0.00429	$3.07	per sq ft
Retail	820	Shopping Center	0.0034	29%	0.00241	$1.73	per sq ft
	841	Automobile Sales - Used/New	0.00375	0%	0.00375	$2.68	per sq ft
	945	Convenience Store/Gas Station -GFA(4-5.5k)	22.76	66%	7.74	$5,539	per pump
Industrial	110	Light Industry/High Technology	0.00065	0%	0.00065	$0.47	per sq ft
	140	Manufacturing	0.00074	0%	0.00074	$0.53	per sq ft
	150	Warehousing	0.00018	0%	0.00018	$0.13	per sq ft
	151	Mini-Storage	0.00015	0%	0.00015	$0.11	per sq ft
Office	710	General Office	0.00144	0%	0.00144	$1.03	per sq ft
	720	Medical Office / Clinic	0.00393	0%	0.00393	$2.81	per sq ft
	750	Office Park	0.0013	0%	0.00130	$0.93	per sq ft

[1] ITE Trip Generation Manual (11th Edition): 4-6 PM Peak Hour Vehicle Trip Generation Rates for the Adjacent Street Traffic (weekday 4-6PM); This worksheet represents only the most common uses in southeast Spokane Valley and is NOT all-inclusive; Projects with land uses not in Table 8 or 10 shall prepare a trip generation and distribution letter and will be responsible for a fee based on $716 per PM peak hour trip.

[2] Pass by rates were updated based on the Pass-By Data and Rate Tables/2021 Pass-By Tables for ITETripGen Appendices, 11th Edition

[3] PM peak trip rate excluding passby trips

[4] sq ft = square feet, pump = vehicle fueling position(VFA), room = available hotel room

[5] ITE also includes an employment-based trip rate which may be used if approved by Spokane Valley

Table 11. Expanded North Pines Road Impact Fee Schedule

City of Spokane Valley North Pines Road Transportation Impact Fee Rate Schedule							
Land Use Group	*ITE Code*	*ITE Land Use Category*	*PM Peak Vehicle Trip Rate [1]*	*Passby % [2]*	*Adjusted Trips per Unit of Measure [3]*	*Impact Fee Per Unit [4] @ $2,816 per PM Peak Vehicle Trip*	
Residential	210	Single Family & Duplex	0.94	0%	0.94	$2,647	per dwelling unit
	220	Multi-Family (Low-Rise) - Not Close to Rail	0.51	0%	0.51	$1,436	per dwelling unit
Services	310	Hotel (3 or More Levels)	0.59	0%	0.59	$1,662	per room
	492	Health Club	0.00345	0%	0.00345	$9.72	per sq ft
	912	Bank	0.02101	35%	0.01366	$38.46	per sq ft
Institution	520	Elementary School	0.16	0%	0.16000	$450.58	per student [5]
	522	Middle School	0.15	0%	0.15000	$422.42	per student [5]
	525	High School	0.14	0%	0.14000	$394.26	per student [5]
Restaurant	975	Drinking Establishment	0.01136	43%	0.00648	$18.24	per sq ft
	934	Fast Food Restaurant (with drive-thru)	0.03303	55%	0.01486	$41.86	per sq ft
	937	Coffee Shop with Drive-Thru	0.03899	89%	0.00429	$12.08	per sq ft
Retail	820	Shopping Center	0.0034	29%	0.00241	$6.80	per sq ft
	841	Automobile Sales - Used/New	0.00375	0%	0.00375	$10.56	per sq ft
	945	Convenience Store/Gas Station -GFA(4-5.5k	22.76	66%	7.74	$21,792	per pump
Industrial	110	Light Industry/High Technology	0.00065	0%	0.00065	$1.83	per sq ft
	140	Manufacturing	0.00074	0%	0.00074	$2.08	per sq ft
	150	Warehousing	0.00018	0%	0.00018	$0.51	per sq ft
	151	Mini-Storage	0.00015	0%	0.00015	$0.42	per sq ft
Office	710	General Office	0.00144	0%	0.00144	$4.06	per sq ft
	720	Medical Office / Clinic	0.00393	0%	0.00393	$11.07	per sq ft
	750	Office Park	0.0013	0%	0.00130	$3.66	per sq ft

[1] ITE Trip Generation Manual (11th Edition): 4-6 PM Peak Hour Vehicle Trip Generation Rates for the Adjacent Street Traffic (weekday 4-6PM); This worksheet represents only the most common uses in southeast Spokane Valley and is NOT all-inclusive; Projects with land uses not in Table 9 or 11 shall prepare a trip generation and distribution letter and will be responsible for a fee based on $2,816 per PM peak hour trip.

[2] Pass by rates were updated based on the Pass-By Data and Rate Tables/2021 Pass-By Tables for ITETripGen Appendices, 11th Edition

[3] PM peak trip rate excluding passby trips

[4] sq ft = square feet, pump = vehicle fueling position(VFA), room = available hotel room

[5] ITE also includes an employment-based trip rate for ITE Code 520 & 522 which may be used if approved by Spokane Valley

Appendix B – Mirabeau Traffic Study Update (2019)

Mirabeau Subarea Traffic Study Update

Prepared for:
City of Spokane Valley, Washington

December 2019

DN19-0631

FEHR PEERS

Table of Contents

Appendices

List of Figures

List of Tables

This page intentionally left blank.

Introduction

The City of Spokane Valley commissioned the *Mirabeau Subarea Traffic Study* in 2016 that identified existing transportation level of service (LOS) deficiencies and future transportation improvements to support existing and planned growth in the Subarea. Based on the traffic forecasts, future traffic impacts and potential mitigation projects, a fair share analysis was used to estimate a cost per PM peak hour vehicle trip that developers in the Subarea would pay to meet their obligation under SEPA. The City will use these fees to offset the cost of transportation improvement projects directly impacted by development in the Subarea. The Mirabeau Subarea is mapped in **Figure 1** and covers most of the area between Pines Road and Sullivan Road and I-90 and the Spokane River in north central Spokane Valley.

Previous Study Findings

The 2016 Mirabeau Traffic Study identified five intersections in or around the Mirabeau Subarea that are forecast to have LOS deficiencies by 2040. These intersections are shown in **Table 1**, including the 2015 and 2040 PM peak hour LOS and delay. For each intersection, a project was identified to address the future LOS deficiency, including a cost estimate for each project. A fair share percent was also estimated that represents the portion of future traffic that would pass through the location generated by the Mirabeau Subarea. This proportion is based on a select link analysis using the Spokane Regional Transportation Council (SRTC) regional travel demand model. Based on the estimated project costs, fair share analysis, and future traffic generated by development in the Subarea, a cost per PM peak hour vehicle trip of $323.75 was calculated and assessed to developments in the area to pay for the future transportation improvement projects identified in the Study.

Update to Expand Subarea

In 2019, the City commissioned an update to the Mirabeau Traffic Study. This report provides a summary of the update, including an updated cost analysis and findings. The main purpose of this Study is to update the fair share cost per PM peak hour vehicle trip from the original traffic study as well as expand the geographic area by which transportation impact fees will be collected to account for new developments planned for the area south of I-90. Instead of changing the boundaries of the previously established Mirabeau Subarea to accommodate the expanded area, a second Subarea was established directly adjacent to the Mirabeau Subarea. The second Subarea is referred to as the North Pines Road Subarea and is mapped in **Figure 1**. The North Pines Road Subarea is around Pines Road roughly between Sprague Avenue and Trent Avenue and University Road and Adams Road excluding the Mirabeau Subarea.

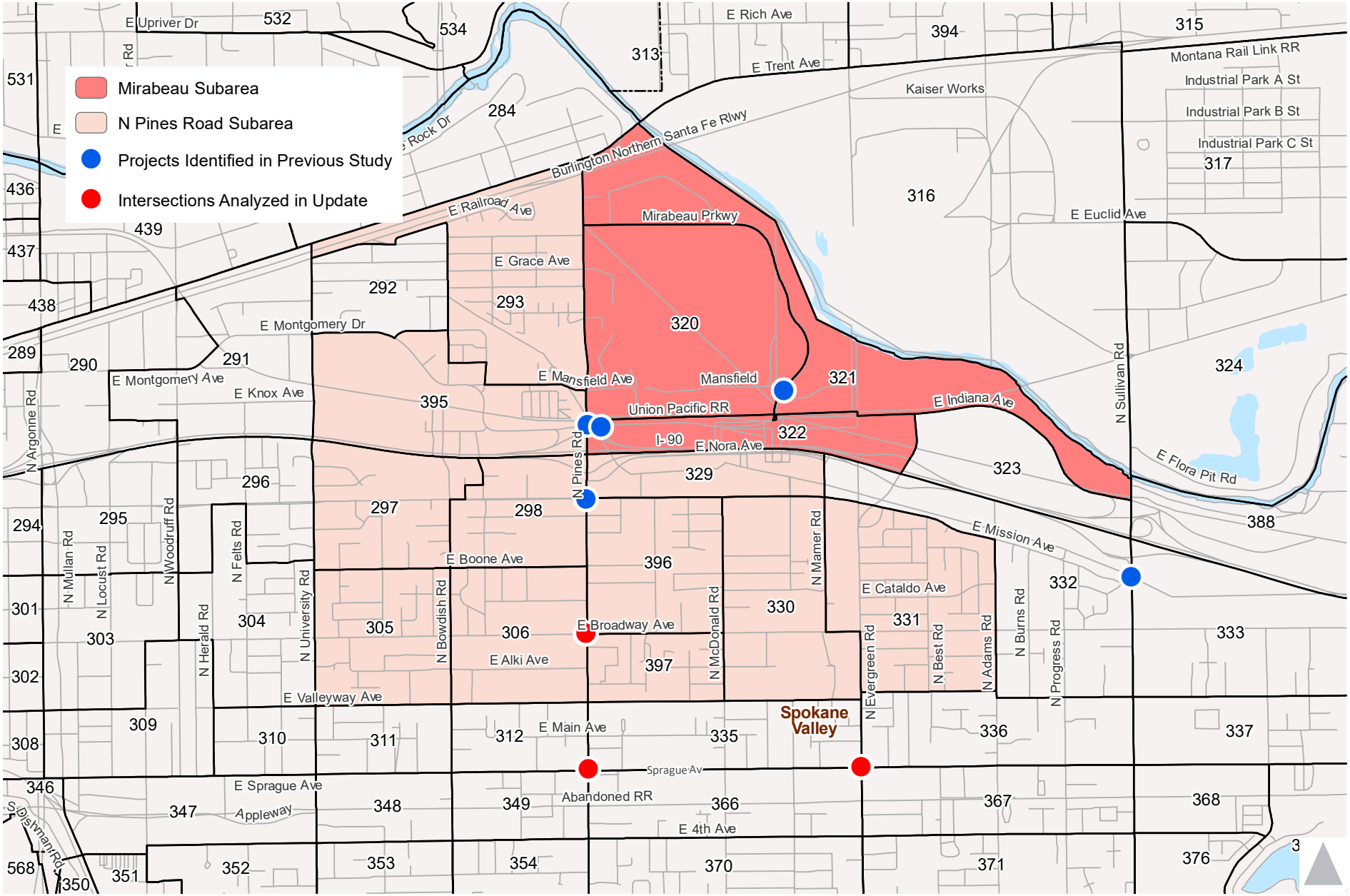


Figure 1

Study Area

Table 1: Projects identified in 2016 Mirabeau Subarea Traffic Study

Project (Intersection)	2015 LOS	2040 LOS	2040 LOS with Improv.	Description of Improvement	Cost Estimate	Mirabeau Subarea Proportion of Future Traffic	Mirabeau Subarea Fair Share Cost
Pines Rd/ Indiana Ave	D	**E**	D	Add westbound left-turn lane; retime traffic signal	$896,000	18%	$161,000
Pines Rd/ I-90 EB Ramps	**E**	**F**	D	Add eastbound left-turn lane and northbound right-turn pocket (extending back to Nora Ave); retime traffic signal	$753,000	18%	$135,000
Pines Rd/ Mission Ave	**E**	**F**	D	Add southbound right-turn lane (extending back to the I-90 off-ramp); reconfigure lane assignments on Mission Ave to include eastbound dual-left and a through-right lane and westbound left, through, and right turn lane; retime traffic signal	$457,000	16%	$73,000
Mirabeau Pkwy/ Mansfield Ave	B	**F**	C	Add traffic signal, add new 180 foot southbound through-right lane	$874,000	38%	$332,000
Sullivan Rd/ Mission Ave	D	**E**	B	Reconfigure eastbound to include a left and through-right lane; retime signal	$61,000	4%	$2,500

Source: Mirabeau Subarea Traffic Study (June 2016).

Traffic Analysis

In the previous study, traffic analysis was performed for 21 intersections in and around the Mirabeau Subarea, with five of those locations identified as having traffic level of service (LOS) deficiencies by Year 2040. No updates to that analysis were performed as part of this study and the COSV still plans to implement those five projects (listed in Table 1) over time as fees are collected. However, as part of expanding the traffic analysis to include the North Pines Road Subarea as part of this study, three additional signalized intersections were identified to evaluate existing (2019) and future (2040) traffic LOS. These include:

1. Pines Road/Broadway
2. Pines Road/Sprague Avenue
3. Evergreen Road/Sprague Avenue

Level of Service Standards

City of Spokane Valley Level of Service Standards

The City of Spokane Valley uses level of service (LOS) to describe and evaluate traffic operations along major arterial corridors and intersections within the City. Levels range from LOS A to LOS F, which encompass a range of congestion types from uninterrupted traffic (LOS A) to highly-congested conditions (LOS F). The description and intersection delay thresholds of each LOS category are described in **Table 2**. These are based on the Highway Capacity Manual, which is the methodology used by Spokane Valley. The LOS for signalized intersections is measured by the average delay per vehicle entering the intersection from all approaches, while the LOS for unsignalized intersections is measured by the average delay per vehicle on the approach with the highest average delay. Spokane Valley also applies Corridor LOS to evaluate major arterial corridors in the City. Average daily traffic (ADT) volume thresholds are used to measure average LOS conditions along the length of the entire corridor. Corridor LOS acknowledges that some intersections may experience greater congestion than the corridor as a whole. Sprague Avenue and Pines Road are both major arterials where corridor-level LOS can be applied.

The LOS standards used by Spokane Valley are defined in the Comprehensive Plan as follows:

- LOS D at the corridor level for major arterial corridors:
    - Argonne/Mullan between the town of Millwood and Appleway Boulevard
    - Pines Road between Trent Avenue and 8th Avenue
    - Evergreen Road between Indiana Avenue and 8th Avenue
    - Sullivan Road between Wellesley Avenue and 8th Avenue
    - Sprague Avenue/Appleway Boulevard between Fancher Road and Sullivan Road
- LOS D for signalized intersections not on major arterial corridors
- LOS E for unsignalized intersections (LOS F acceptable if peak hour traffic signal warrant is unmet)

Table 2: Level of service description and delay thresholds at intersections

Level of Service	Description	Signalized Intersection Delay (seconds)	Unsignalized Intersection Delay (seconds)
A	Free-flowing conditions.	0-10	0-10
B	Stable operating conditions.	10-20	10-15
C	Stable operating conditions, but individual motorists are affected by the interaction with other motorists.	20-35	15-25
D	High density of motorists, but stable flow.	35-55	25-35
E	Near-capacity operations, with speeds reduced to a low but uniform speed.	55-80	35-50
F	Over-capacity conditions with long delays.	> 80	>50

Source: Highway Capacity Manual 2016, Transportation Research Board

WSDOT LOS Standards

WSDOT also uses LOS thresholds for State Highways. The LOS standard for State Highways in Urban Areas (including the Study Area) is LOS D for signalized intersections and LOS E for unsignalized intersections. Within the Study Area WSDOT's LOS standards are also considered for intersections along Pines Road, which is State Route 27.

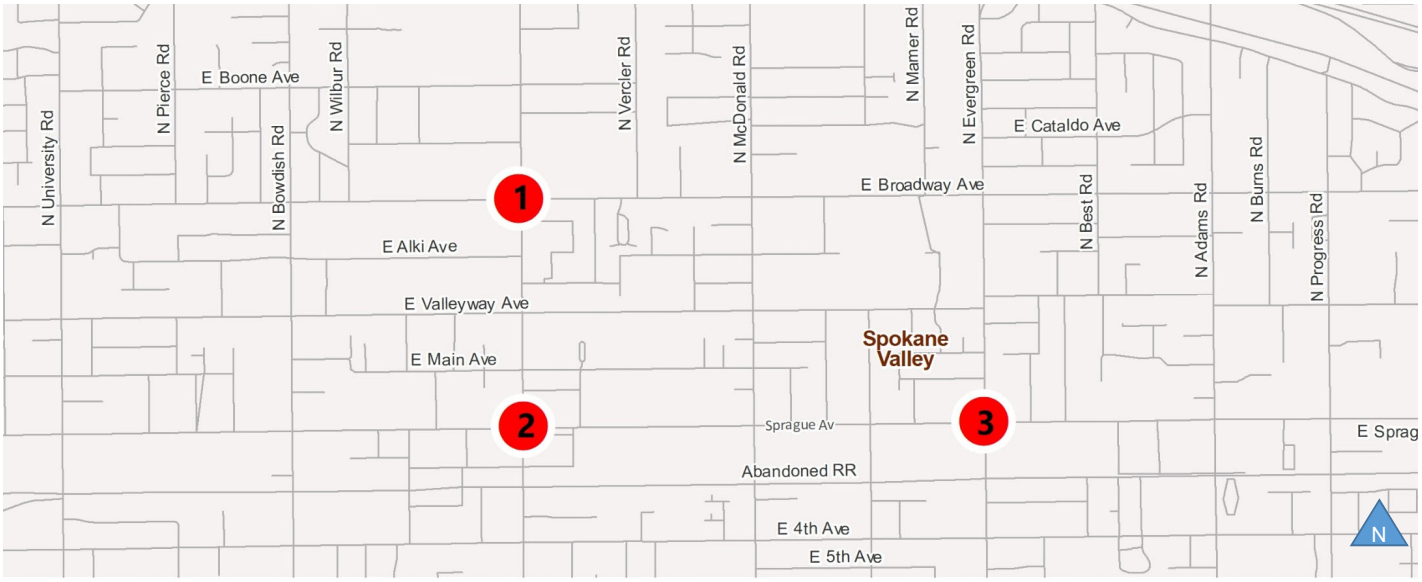
Methodology

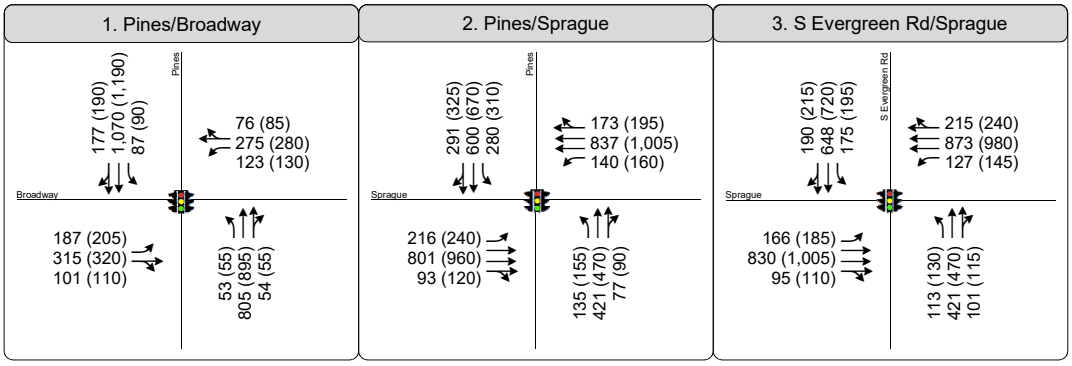
Traffic Analysis

Synchro software (version 9) was used to evaluate PM peak hour LOS at the three signalized intersections included in this Update. Synchro settings were set consistent with WSDOT Synchro & SimTraffic Protocol (Aug 2018) and City of Spokane Valley standards. LOS was measured using the Highway Capacity Manual (HCM) 2010 methodology within Synchro.

Existing (2019) Traffic Volumes

Existing intersection turn movement counts were collected between 4 PM and 6 PM on Thursday, September 19th, 2019. The existing (and future) PM peak hour volumes are shown in **Figure 2**.





Existing PM (2040 PM) Volumes

Figure 2

Existing and 2040 Lane Configurations Traffic Controls, and PM Peak Hour Traffic Volumes

Future Year (2040) Traffic Volumes

Traffic volumes at each of the study intersections were forecast using the current version of the SRTC 2015 and 2040 regional travel demand models, which was last updated in December 2017. After review of the land use forecasts in the model with City staff, no adjustments were made to the existing or future land use assumptions or transportation network in the model. Instead of using the traffic forecasts directly from the 2040 travel demand model, 2040 volumes were estimated using an industry standard approach known as the difference method. Under the difference method, the difference in traffic volumes between the 2015 and 2040 models were added to observed counts at each of the study area intersections to arrive at a 2040 forecast traffic. This method reduces model error by relying as much as possible on observed data rather than model output data. Note: the difference in traffic volumes between the 2015 and 2040 model were multiplied by 0.84 to account for growth in traffic that occurred between 2015 and 2018 (21 years/ 25 years = 0.84). Post processing to account for model anomalies was also applied to arrive at the final 2040 traffic forecasts. Forecast traffic volumes in Year 2040 are also shown in **Figure 2**.

Existing Traffic Level of Service

Table 3 shows the existing PM peak hour LOS using the methodology described above for the three intersections analyzed. Under existing conditions, both the Pines Road/Broadway and Pines Road/Sprague Avenue intersections operate at LOS E, exceeding the COSV and WSDOT intersection LOS D threshold. It should be noted that the Pines Road/Sprague Avenue intersection is just on the cusp of LOS D and LOS E during the PM peak hour. Additionally, both Pines Road and Sprague Avenue are major arterials through these intersections and it should be noted that for these corridors the 2016 Comprehensive Plan directs the LOS threshold to be measured by using corridor-wide LOS. While the Comprehensive Plan acknowledges that individual intersections may exceed the LOS D threshold using this method (as long as the corridor-wide average is at or below LOS D), the corridor-level LOS was not a primary consideration in this case and was not analyzed as part of this study.

Table 3: Existing (2019) PM peak hour level of service

Intersection	Control	Delay (sec)	LOS
Pines Rd/ Broadway	Signal	62	E
Pines Rd/ Sprague Ave	Signal	56	E
Evergreen Rd/ Sprague Ave	Signal	51	D

Source: Fehr & Peers

Improving Existing Level of Service

The most cost-effective way to improve the existing LOS at the Pines Road/ Broadway intersection would be to make signal timing adjustments. **Table 4** shows what the existing PM peak hour LOS would be if the signal timing splits were optimized and cycle length maintained in order to preserve coordination between signals along the corridor. Right-turn-on-red movements were factored into the analysis.

Optimizing the signal splits would improve the Pines Road/Broadway intersection to LOS D, but would have little to no effect at the other two intersections.

Table 4: Existing (2019) PM peak hour LOS with signal timing adjustments

Intersection	Control	Delay (sec)	LOS
Pines Rd/ Broadway	Signal	48	D
Pines Rd/ Sprague Ave	Signal	56	E
Evergreen Rd/ Sprague Ave	Signal	48	D

Source: Fehr & Peers

Year 2040 Traffic Level of Service

Table 5 shows the estimated PM peak hour LOS in 2040 for the three intersections analyzed, based on traffic growth from the SRTC regional travel demand model. The 2040 delay and LOS presented in Table 5 assumes the same cycle length for the signals, but assumes the signal splits would be optimized over time to account for changing traffic patterns. The results show that in 2040 the Pines Road/ Sprague intersection would continue to operate at LOS E, but would degrade by an average of 8 seconds per vehicle from existing conditions, and would exceed WSDOT and COSV intersection LOS threshold. Again, it should be noted that City of Spokane Valley uses corridor-level LOS methodology to measure LOS for both the Pines Road and Sprague Avenue corridors. Corridor-level LOS was not measured in 2040 as part of this analysis, but in consultation with City staff it was determined that addressing congestion at Pines Road and Sprague Avenue in the future was desired to reduce delay, improve corridor-wide LOS for both Sprague Avenue and Pines Road, and to mitigate potential congestion related safety issues.

Table 5: 2040 PM peak hour LOS with signal timing optimized

Intersection	Control	Delay (sec)	LOS
Pines Rd/ Broadway	Signal	49	D
Pines Rd/ Sprague Ave	Signal	64	E
Evergreen Rd/ Sprague Ave	Signal	52	D

Source: Fehr & Peers

Improving 2040 Level of Service

Using an iterative approach and accounting for land use constraints, a project was identified to improve the delay at the Pines Road/ Sprague Avenue intersection in 2040. A description of the project and the improvements to LOS and delay is shown in **Table 6**. This project would reduce the 2040 delay by about 9 seconds and bring the LOS from an E to a D (just on the cusp of a D/E). It should be noted that while this intersection is not specifically required to meet LOS D threshold per Spokane Valley standards (instead the

Pines Road and Sprague Avenue corridors are required to meet corridor-wide average LOS D threshold), improving the average vehicle delay at this intersection will ensure that WSDOT LOS standards are met and would contribute toward ensuring the Pines and Sprague corridors do not exceed LOS D corridor-wide in 2040.

Table 6: Potential project to improve 2040 PM peak hour LOS

Intersection	Description of Improvement	Delay (sec) with Improvement	LOS with Improvement
Pines Rd/ Sprague Ave	• Add a southbound right-turn-only lane; • Convert the existing southbound through-right lane to a through-only lane; • Add a second eastbound left-turn-only lane.	54.6	D

Source: Fehr & Peers

Argonne Road & Trent Avenue Intersection

The intersection of Argonne Road & Trent Avenue is near the North Pines Road Subarea, and while traffic analysis at that intersection was not performed as part of this study, this intersection was identified in the 2016 Spokane Valley Comprehensive Plan as a location that would exceed COSV and WSDOT LOS thresholds. As part of the Comprehensive Plan, a project was identified to address the poor LOS in the future, as described in **Table 7**. Given that development in both the Mirabeau and North Pines Road Subareas would increase traffic at this intersection, this project was also included as part of the fair-share cost analysis for both Subareas. Note that while the improvement at Argonne Road & Trent Avenue would improve the LOS compared to a "do nothing" alternative, this intersection would not meet either WSDOT or COSV LOS thresholds. Land use constraints related to the BNSF railroad overpass and the narrow street cross section in Millwood limit options related to adding roadway capacity to Argonne Road. Because this improvement would add capacity and reduce delay, the cost can be factored into impact fees per the Washington State Environmental Policy Act (SEPA), despite not reducing LOS to within the City or State thresholds.

Table 7: Potential project at Argonne Rd./ Trent Ave. to improve 2040 PM peak hour LOS

Intersection	Description of Improvement	Delay w/o Improvement	LOS w/o Improvement	Delay with Improvement	LOS with Improvement
Argonne Rd/ Trent Ave	• Add a second westbound left-turn lane.	109	F	96	F

Source: Spokane Valley Comprehensive Plan (Dec 2016), Appendix A.

Project Cost Estimates

This section includes updated cost estimates, including methodology, for the five projects identified in previous plans as well as the cost estimates for two projects identified in this study at both the Pines Road & Sprague Avenue and Argonne Road & Trent Avenue intersections.

Updated Project Unit Costs

Unit costs for roadway construction were identified in the 2016 traffic study. In collaboration with City staff, these costs were updated based on construction costs from recently completed transportation projects in Spokane Valley. Where recent costs were not available, unit costs were updated based on inflation from the Federal Highway Administration (FHWA) National Highway Cost Index.[1] Costs to account for drainage and traffic control were also added. **Table 8** summarizes the unit costs that were used to develop project cost estimates.

Table 8: Unit costs

Element	Description	Unit Quantity	Unit Cost (2019 $)
Hard Costs			
Roadway Demolition	Demolition and removal of old roadway	Square Yard	$15
Curb Demolition	Demolition and removal of old curb/gutter	Linear foot	$16
Sidewalk Demolition	Demolition and removal of old sidewalk	Square Yard	$20
Signal Demolition	Demo and removal of old traffic signal eqpt.	Each mast arm	$6,000
Excavation	Excavation, grading, fill, earthwork	Cubic Yard	$35
Road Section	Construction of new roadway surface	Square Yard	$60
Curb	Construction of new curb/gutter	Linear foot	$45
Sidewalk	Construction of new sidewalks	Square Yard	$80
Curb Ramps	Construction of new curb ramps	Each	$4,000
Traffic Signal	Construction of new traffic signal	Each new system	$480,000
Other Costs			
Right-of-way	Cost of acquiring right-of-way	Square Foot	$12
Mobilization	Cost to get a construction crew engaged	10% of "hard" costs above	
Drainage	Cost to provide proper stormwater drainage	20% of applicable "hard" costs above	
Traffic Control	Cost to manage traffic during construction	15% of "hard" costs above	
Contingency	Cost contingency for unexpected drainage/ utility/ earthwork conflicts; WSDOT coordination	30% of "hard" costs above	
Engineering	Cost to design and permit the project	20% of "hard" costs above	

Source: City of Spokane Valley, Fehr & Peers, FHWA National Highway Cost Index.

[1] https://www.fhwa.dot.gov/policy/otps/nhcci/pt1.cfm

Project Cost Estimates

Table 9 shows the cost estimates for seven potential projects in the study area where LOS would degrade to unacceptable levels in the future. This includes updated costs for the five projects identified in the previous (2016) Mirabeau Traffic Study to account for construction cost inflation, plus the additional projects at Pines Road & Sprague Avenue intersection identified in this Update and the potential project at Argonne Road & Trent Avenue identified in the Spokane Valley Comprehensive Plan (2016). Details for how these costs were estimated is provided in Appendix E. All cost estimates are in 2019 dollars.

Table 9: Cost estimate of potential projects to improve future LOS

Project	Description	Cost Estimate	Non-Applicable Costs	Applicable Costs	2016 Cost Estimates (2016 dollars)
Pines Rd/ Indiana Ave	Add westbound left-turn lane; retime traffic signal	$1,500,000	$0	**$1,500,000**	$896,000
Pines Rd/ I-90 EB Ramps	Add eastbound left-turn lane and northbound right-turn pocket (extending back to Nora Ave); retime traffic signal	$1,119,000	$0	**$1,119,000**	$753,000
Pines Rd/ Mission Ave Phase 1	Reconfigure lane assignments on Mission Ave to include eastbound dual-left and a through-right lane and westbound left, through, and right turn lane; retime and upgrade traffic signal	$588,000	$508,620	**$79,380**	$457,000
Pines Rd/ Mission Ave Phase 2	Add southbound right-turn lane (extending back to the I-90 off-ramp);	$ 812,000	$0	**$ 812,000**	
Mirabeau Pkwy/ Mansfield Ave	Add traffic signal, add new 180 foot southbound through-right lane	$1,215,000	$0	**$1,215,000**	$874,000
Sullivan Rd/ Mission Ave	Reconfigure eastbound to include a left and through-right lane; retime signal	$94,000	$0	**$94,000**	$61,000
Pines Rd/ Sprague Ave	Add a southbound right-turn-only lane; convert the existing southbound through-right lane to a through-only lane; add a second eastbound left-turn-only lane.	$818,000	$82,000	**$737,000**	NEW
Argonne Rd/ Trent Ave	Add a second westbound left-turn lane.	$753,600	$229,200	**$524,400**	NEW

Source: Fehr & Peers, City of Spokane Valley.

It should be noted that the improvements at Pines Road & Mission Avenue have been split into two phases as the City is planning to implement a portion of this project (Phase 1) in 2020. Additionally, about 86% of funding for this project is from non-City funds (that portion is funded by a Surface Transportation Block Grant) and thus cannot be included as part of the fair-share cost analysis. All other projects are assumed to be funded entirely by City general funds (which include mitigation fee payments from development).

Secondly, the full cost of improvements at the Pines Road & Sprague Avenue intersection cannot be applied to the impact fee because there is a LOS deficiency at this intersection under existing conditions. To account for this, the portion of traffic that if removed from the system today would effectively reduce the LOS at this intersection from an "E" to a "D" was estimated in Synchro. The result was about 10% of existing traffic. This means that if traffic volumes were 10% lower at this intersection under existing conditions, the intersection would meet the LOS D threshold. Therefore, 10% of the total cost of the potential improvement project at Pines Road & Sprague Avenue was deducted from the total cost to arrive at the applicable cost as shown in Table 9.

Similarly, the full cost of improvements at the Argonne Road & Trent Avenue intersection cannot be applied to the impact fee because there is an existing LOS deficiency at this intersection. To account for this, the cost of a restriping and signal modification project which would bring the intersection to a LOS D under existing conditions was estimated. The project was recommended as part of the North Argonne Road/North Mullan Road Corridor Retiming project.[2] The estimated cost of this project ($229,000) was deducted from cost of the longer term project to arrive at the applicable cost as shown in Table 9.

[2] Fehr & Peers. Technical Memorandum. *N Argonne Road/N Mullan Road Corridor Retiming*. July 25, 2019. Project # SE18-0621.

Fair Share & Cost Per Trip Analysis

Fair Share Analysis

A common way for a development project to mitigate its traffic impact is through a fair-share financial contribution toward a transportation system project that would improve LOS to meet City standards. The Subarea's fair-share financial contribution is determined by how much traffic the Subarea is expected to contribute to each of the deficient intersections under future conditions (see Table 9). In other words, what percentage of 2040 traffic through a deficient intersection is caused by new development within the Mirabeau and North Pines Road Subarea?

The SRTC regional travel model was used to determine the percentage of traffic generated by future development within the two Subareas. The travel model has a tool called a "select zone analysis" that can track the traffic generated by different areas throughout the city. The select zone analysis was set to identify the traffic generated by Mirabeau and North Pines Road Subarea development separate from any other traffic generated by development in the region. The results of the select zone analysis were analyzed for each of the seven deficient intersections identified in **Table 9**. **Table 10** shows the results of the select zone analysis. This reflects the same portion of traffic from the Mirabeau Subarea through the five deficient intersections identified from the previous (2016) study.

Table 10: Subarea share of future PM peak hour traffic at deficient intersections

Intersection	Mirabeau Subarea Portion of Future Traffic	North Pines Road Subarea Portion of Future Traffic	Combined Portion of Future Traffic from two Subareas
Pines Rd/ Indiana Ave	18%	42%	60%
Pines Rd/ I-90 EB Ramps	18%	48%	66%
Pines Rd/ Mission Ave	4%	53%	57%
Mirabeau Pkwy/ Mansfield Ave	38%	5%	43%
Sullivan Rd/ Mission Ave	4%	9%	13%
Pines Rd/ Sprague Ave	6%	19%	25%
Argonne Rd/ Trent Ave	10%	7%	17%

Source: Fehr & Peers, SRTC Regional Travel Demand Model (last updated December, 2017).

The results in Table 10 show that at some intersections, the majority of future traffic is generated by the two Subareas combined, while at other locations, the majority of future traffic is generated by locations outside the two Subareas. For example, at the Pines Road & I-90 Eastbound Ramps, 18% of future traffic will be generated by land uses in the Mirabeau Subarea and 48% will be generated by land uses in the North Pines Road Subarea. Combined, the two Subareas will generate about 66% of the future traffic

passing through the intersection during the PM peak hour. In contrast, about 10% of future traffic at Argonne Road & Trent Avenue intersection will be generated by land uses in the Mirabeau Subarea and 7% will be generated by land uses in the North Pines Road Subarea. Combined the two Subareas will generate about 17% of the future traffic passing through the intersection during the PM peak hour, while land uses outside the Subarea will generate about 83% of future traffic passing through the intersection.

The results in Table 10 were used to determine the two Subareas' financial share of the total project improvements by multiplying the total improvement cost by the proportion of traffic generated by new development in the two Subareas. The result of this calculation is the fair-share cost of each project to the Subarea and is shown in **Table 11**. This shows that the total fair-share cost of all seven projects adds up to $1,079,000 for the Mirabeau Subarea and $1,708,000 for the North Pines Road Subarea. A two percent administrative fee was added to each Subarea cost to cover the cost of administering the program, including future updates to this study. Thus, the total fair share cost of improvements, including the administrative fee, equals $1,101,000 for the Mirabeau Subarea and $1,742,000 for the North Pines Road Subarea.

Table 11: Subareas' share of total improvement costs

Intersection	Applicable Portion of Total Project Cost	Mirabeau Subarea Portion of Future Traffic	Mirabeau Subarea UPDATED Fair-Share Cost	North Pines Road Subarea Portion of Future Traffic	North Pines Road Subarea Fair-Share Cost
Pines Rd/ Indiana Ave	$1,500,000	18%	$270,000	42%	$628,000
Pines Rd/ I-90 EB Ramps	$1,119,000	18%	$201,000	48%	$532,000
Pines Rd/ Mission Ave	$891,000	4%	$143,000	53%	$476,000
Mirabeau Pkwy/ Mansfield Ave	$1,215,000	38%	$462,000	5%	$64,000
Sullivan Rd/ Mission Ave	$94,000	4%	$3,700	9%	$8,200
Pines Rd/ Sprague Ave	$737,000	6%	$48,000	19%	$137,000
Argonne Rd/ Trent Ave	$524,000	10%	$51,000	7%	$38,000
Total Fair-Share Cost	N/A	N/A	$1,079,000	N/A	$1,708,000
Total Fair-Share Cost with 2% Administrative Fee	**N/A**	**N/A**	**$1,101,000**	**N/A**	**$1,742,000**

Cost Per Trip

Given both Subareas' share of the total project costs as identified in Table 11, the cost per PM peak hour trip could be updated for the Mirabeau Subarea and calculated for the North Pines Road Subarea by applying the same methodology as the previous study. The same amount of future land use growth in Mirabeau through Year 2040 assumed in the previous study was applied (but with updated project costs and updated trip rates) as shown in **Table 12**. This calculation might seem counterintuitive because there has been growth in the Mirabeau Subarea between 2016 and today. However, since this study did not re-calculate the proportion of traffic growth associated with the remaining development potential in the Mirabeau Subarea, the original total increase in trip generation was assumed. This is a common assumption used when updating impact/mitigation fees and helps to keep the fees relatively stable and predictable over time.

For the North Pines Road Subarea, the difference between the land use assumed in the 2040 SRTC Regional Travel Demand Model and the 2015 model was used. PM peak hour trip generation was estimated with standard Institute of Transportation Engineers (ITE) trip generation rates. **Table 12** summarizes the land use growth and resulting trip generation rates for both Subareas. This is the same trip generation approach used in the original Mirabeau Subarea Traffic Study, except with updated rates based on the current (2017) ITE Trip Generation Manual.

Table 12: PM peak hour trip generation calculation

Land Use	PM Peak Hour Trip Rate	Mirabeau Subarea Units of Development	Mirabeau Subarea PM Peak Hour Trips	North Pines Road Subarea Units of Development	North Pines Road Subarea PM Peak Hour Trips
Single-Family Residential	0.99	65 dwelling units	65	78 dwelling units	78
Multi-Family Residential	0.56	979 dwelling units	549	157 dwelling units	88
Retail	3.81	63,890 square feet	244	69,750 square feet	266
Office	0.40	2,561 employees	1,025	259 employees	104
Hotel	0.60	150 rooms	90	0 rooms	0
Medical	0.85	0 employees	0	371 employees	316
School	0.17	0 employees	0	18 employees	4
Industrial	0.49	0 employees	0	79 employees	39
Total Fair-Share Cost	**N/A**	**N/A**	**1,973**	**N/A**	**895**

Source: Trip generation: ITE (2017); Mirabeau Subarea land use growth: Mirabeau Subarea Traffic Study (2016); North Pines Subarea land use growth: SRTC Regional Travel Demand Model (last updated December, 2017).

Based on the results from Table 11 and Table 12 the cost per PM peak hour for each Subarea are as follows:

Mirabeau Subarea (UPDATED):

$1,101,000 (Subarea's share of total project costs) / 1,973 (Subarea PM peak hour trip generation from growth) = **$ 558 per PM peak hour trip**.

This compares to $323.75 per PM peak hour trip from the 2016 study. The cost per trip went up because of higher construction costs, the two additional improvement projects (at Pines Road & Sprague Avenue and Argonne Road & Trent Avenue), and slightly lower assumed trip rates based on the updated trip generation manual (which reduced forecast new trips generated by development from 2,176 in the previous study to 1,973).

North Pines Road Subarea:

$1,742,000 (Subarea's share of total project costs) / 895 (Subarea PM peak hour trip generation from growth) = **$ 1,946 per PM peak hour trip**

Vested Trips

There are still existing "vested" trips from the prior "Pines-Mansfield Development Agreement" that was established by Spokane County. While the transportation improvement projects identified as part of the Pines-Mansfield Development Agreement have largely been constructed, Spokane Valley is open to counting the vested trips as a credit against this new transportation improvement program. Based on data supplied by the City of Spokane Valley in October 2019, there were 816 PM peak hour vested trips outstanding amongst the land owners in the Subarea. These trips have a value of $303.36 per trip, which works out to a total value of $247,542. Developers can apply the value of their unused vested PM peak hour trips as a credit to the Mirabeau Subarea Traffic Mitigation Program until they have no vested trips remaining.

Conclusions

This report provided an update to the Mirabeau Subarea Traffic Study previously performed in 2016. The main purpose of this study was to update the projects costs, based primarily on inflation, and to expand the geographic area paying the traffic LOS impact mitigation fee as planned new developments will add a substantial amount of new traffic to the area. Instead of expanding the Mirabeau Subarea, a new Subarea called the North Pines Road Subarea was defined. As part of this analysis, the existing and future traffic LOS conditions at three new intersections in and around the two Subareas was performed. As shown in the previous study and this update, in the future, traffic LOS is expected to degrade within the study area as the Mirabeau Subarea, North Pines Road Subarea, and the rest of Spokane Valley and the region continue to grow. This report identified the necessary traffic mitigation measures to improve congestion and meet Spokane Valley's LOS standards. Most of the congestion relief projects are on the Pines Road corridor with a separate improvement at Argonne Road & Trent Avenue and a minor improvement at the Sullivan Road & Mission Avenue intersection.

A fair-share calculation was developed to identify the Mirabeau Subarea and North Pines Road Subarea landowner's share of future traffic impacts and mitigation costs. If landowners agree to implement future traffic congestion improvement projects through a mitigation contribution up to the amount shown in **Table 13**, then they will meet their SEPA obligations to mitigate traffic congestion impacts. After making this mitigation payment (which is subject to a credit from the existing Pines-Mansfield Development Agreement), the developer will not have to conduct another traffic study, outside of a site access and circulation study, which may be required by Spokane Valley to ensure safe access for all modes into and within the development site.

Table 13: Voluntary Traffic Mitigation Fees for Developers to Meet SEPA Obligation

Subarea	Cost per PM Peak Hour Vehicle Trip
Mirabeau Subarea	$ 558
North Pines Road Subarea	$1,946

Appendix A - Existing Conditions Synchro Reports

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	187	315	101	123	275	76	53	805	54	87	1070	177
Future Volume (veh/h)	187	315	101	123	275	76	53	805	54	87	1070	177
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		1.00	1.00		0.99	1.00		0.98
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1733	1733	1750	1716	1716	1750	1716	1716	1750	1733	1733	1750
Adj Flow Rate, veh/h	195	328	93	128	286	68	55	839	50	91	1115	167
Adj No. of Lanes	1	1	0	1	1	0	1	2	0	1	2	0
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Percent Heavy Veh, %	1	1	1	2	2	2	2	2	2	1	1	1
Cap, veh/h	255	350	99	197	348	83	204	1356	81	112	1080	161
Arrive On Green	0.08	0.27	0.27	0.07	0.26	0.26	0.13	0.43	0.43	0.07	0.38	0.38
Sat Flow, veh/h	1650	1292	366	1634	1339	318	1634	3125	186	1650	2866	428
Grp Volume(v), veh/h	195	0	421	128	0	354	55	438	451	91	639	643
Grp Sat Flow(s),veh/h/ln	1650	0	1659	1634	0	1658	1634	1630	1681	1650	1646	1648
Q Serve(g_s), s	11.0	0.0	32.2	7.4	0.0	26.1	4.0	27.0	27.0	7.1	49.0	49.0
Cycle Q Clear(g_c), s	11.0	0.0	32.2	7.4	0.0	26.1	4.0	27.0	27.0	7.1	49.0	49.0
Prop In Lane	1.00		0.22	1.00		0.19	1.00		0.11	1.00		0.26
Lane Grp Cap(c), veh/h	255	0	450	197	0	430	204	707	730	112	620	621
V/C Ratio(X)	0.76	0.00	0.94	0.65	0.00	0.82	0.27	0.62	0.62	0.81	1.03	1.03
Avail Cap(c_a), veh/h	255	0	472	241	0	497	204	707	730	203	620	621
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	0.91	0.00	0.91	0.62	0.62	0.62	1.00	1.00	1.00
Uniform Delay (d), s/veh	35.7	0.0	46.3	35.5	0.0	45.3	51.5	28.5	28.5	59.7	40.5	40.5
Incr Delay (d2), s/veh	12.8	0.0	25.8	4.0	0.0	8.7	0.4	2.5	2.5	12.8	44.0	45.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	6.1	0.0	18.0	3.5	0.0	13.0	1.8	12.7	13.0	3.6	29.8	30.1
LnGrp Delay(d),s/veh	48.5	0.0	72.1	39.5	0.0	54.0	51.9	31.0	30.9	72.6	84.5	85.9
LnGrp LOS	D		E	D		D	D	C	C	E	F	F
Approach Vol, veh/h		616			482			944			1373	
Approach Delay, s/veh		64.6			50.2			32.2			84.4	
Approach LOS		E			D			C			F	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	21.3	54.0	16.0	38.7	13.8	61.4	14.5	40.2
Change Period (Y+Rc), s	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Max Green Setting (Gmax), s	11.0	49.0	11.0	39.0	16.0	44.0	13.0	37.0
Max Q Clear Time (g_c+I1), s	6.0	51.0	13.0	28.1	9.1	29.0	9.4	34.2
Green Ext Time (p_c), s	0.1	0.0	0.0	2.6	0.1	3.6	0.1	1.0

Intersection Summary	
HCM 2010 Ctrl Delay	61.6
HCM 2010 LOS	E

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	216	801	93	140	837	173	135	421	77	280	600	291
Future Volume (veh/h)	216	801	93	140	837	173	135	421	77	280	600	291
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		0.99	1.00		0.99	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1733	1733	1750	1733	1733	1750	1716	1716	1750	1733	1733	1750
Adj Flow Rate, veh/h	225	834	82	146	872	147	141	439	64	292	625	231
Adj No. of Lanes	1	3	0	1	3	0	1	2	0	1	2	0
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Percent Heavy Veh, %	1	1	1	1	1	1	2	2	2	1	1	1
Cap, veh/h	241	1190	116	171	933	156	292	797	116	317	686	253
Arrive On Green	0.15	0.27	0.27	0.10	0.23	0.23	0.18	0.28	0.28	0.19	0.29	0.29
Sat Flow, veh/h	1650	4381	429	1650	4074	683	1634	2856	414	1650	2345	866
Grp Volume(v), veh/h	225	599	317	146	674	345	141	249	254	292	438	418
Grp Sat Flow(s),veh/h/ln	1650	1577	1656	1650	1577	1604	1634	1630	1640	1650	1646	1565
Q Serve(g_s), s	17.5	22.2	22.4	11.3	27.2	27.5	10.1	16.9	17.1	22.6	33.4	33.5
Cycle Q Clear(g_c), s	17.5	22.2	22.4	11.3	27.2	27.5	10.1	16.9	17.1	22.6	33.4	33.5
Prop In Lane	1.00		0.26	1.00		0.43	1.00		0.25	1.00		0.55
Lane Grp Cap(c), veh/h	241	857	450	171	722	367	292	455	458	317	481	458
V/C Ratio(X)	0.93	0.70	0.70	0.85	0.93	0.94	0.48	0.55	0.55	0.92	0.91	0.91
Avail Cap(c_a), veh/h	241	857	450	241	728	370	292	455	458	355	557	530
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.91	0.91	0.91	0.55	0.55	0.55	1.00	1.00	1.00	0.27	0.27	0.27
Uniform Delay (d), s/veh	54.9	42.6	42.6	57.3	49.1	49.2	48.0	39.9	40.0	51.6	44.4	44.4
Incr Delay (d2), s/veh	37.5	2.3	4.5	11.1	12.1	21.1	1.2	4.7	4.8	10.2	8.6	9.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	10.5	9.9	10.8	5.7	13.1	14.3	4.6	8.2	8.4	11.2	16.4	15.7
LnGrp Delay(d),s/veh	92.4	44.9	47.1	68.4	61.3	70.4	49.2	44.6	44.7	61.8	52.9	53.4
LnGrp LOS	F	D	D	E	E	E	D	D	D	E	D	D
Approach Vol, veh/h		1141			1165			644			1148	
Approach Delay, s/veh		54.9			64.9			45.7			55.4	
Approach LOS		D			E			D			E	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	28.2	43.0	24.0	34.8	30.0	41.3	18.5	40.3
Change Period (Y+Rc), s	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Max Green Setting (Gmax), s	17.0	44.0	19.0	30.0	28.0	33.0	19.0	30.0
Max Q Clear Time (g_c+I1), s	12.1	35.5	19.5	29.5	24.6	19.1	13.3	24.4
Green Ext Time (p_c), s	1.2	2.6	0.0	0.3	0.4	2.2	0.2	2.6

Intersection Summary	
HCM 2010 Ctrl Delay	56.4
HCM 2010 LOS	E

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	166	830	95	127	873	215	113	421	101	175	648	190
Future Volume (veh/h)	166	830	95	127	873	215	113	421	101	175	648	190
Number	1	6	16	5	2	12	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		0.99	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1733	1733	1750	1733	1733	1750	1733	1733	1750	1733	1733	1750
Adj Flow Rate, veh/h	173	865	82	132	909	173	118	439	82	182	675	168
Adj No. of Lanes	1	3	0	1	3	0	1	2	0	1	2	0
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Percent Heavy Veh, %	1	1	1	1	1	1	1	1	1	1	1	1
Cap, veh/h	196	1761	166	157	1506	285	141	661	123	203	721	179
Arrive On Green	0.12	0.40	0.40	0.10	0.38	0.38	0.09	0.24	0.24	0.12	0.28	0.28
Sat Flow, veh/h	1650	4393	415	1650	3993	757	1650	2771	514	1650	2612	650
Grp Volume(v), veh/h	173	620	327	132	717	365	118	260	261	182	425	418
Grp Sat Flow(s),veh/h/ln	1650	1577	1654	1650	1577	1596	1650	1646	1639	1650	1646	1616
Q Serve(g_s), s	13.4	19.1	19.2	10.2	23.8	24.0	9.2	18.5	18.8	14.1	32.8	32.8
Cycle Q Clear(g_c), s	13.4	19.1	19.2	10.2	23.8	24.0	9.2	18.5	18.8	14.1	32.8	32.8
Prop In Lane	1.00		0.25	1.00		0.47	1.00		0.31	1.00		0.40
Lane Grp Cap(c), veh/h	196	1264	663	157	1189	602	141	393	391	203	454	446
V/C Ratio(X)	0.88	0.49	0.49	0.84	0.60	0.61	0.84	0.66	0.67	0.90	0.94	0.94
Avail Cap(c_a), veh/h	203	1264	663	203	1189	602	203	462	460	203	462	454
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.52	0.52	0.52	0.98	0.98	0.98	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	56.4	29.0	29.1	57.9	32.6	32.7	58.5	44.7	44.8	56.2	45.9	46.0
Incr Delay (d2), s/veh	20.1	0.7	1.4	20.9	2.2	4.4	17.8	2.7	2.9	36.1	26.4	26.9
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	7.2	8.4	9.0	5.6	10.7	11.3	4.9	8.7	8.8	8.5	18.2	18.0
LnGrp Delay(d),s/veh	76.5	29.7	30.4	78.7	34.9	37.1	76.4	47.5	47.8	92.3	72.3	72.9
LnGrp LOS	E	C	C	E	C	D	E	D	D	F	E	E
Approach Vol, veh/h		1120			1214			639			1025	
Approach Delay, s/veh		37.2			40.3			52.9			76.1	
Approach LOS		D			D			D			E	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	19.4	54.0	15.1	41.4	16.4	57.1	20.0	36.5
Change Period (Y+Rc), s	4.0	5.0	4.0	5.5	4.0	5.0	4.0	5.5
Max Green Setting (Gmax), s	16.0	43.0	16.0	36.5	16.0	43.0	16.0	36.5
Max Q Clear Time (g_c+I1), s	15.4	26.0	11.2	34.8	12.2	21.2	16.1	20.8
Green Ext Time (p_c), s	0.0	12.1	0.1	1.0	0.1	14.4	0.0	5.4

Intersection Summary	
HCM 2010 Ctrl Delay	50.6
HCM 2010 LOS	D

Appendix B - Existing Conditions Optimized Synchro Reports

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	187	315	101	123	275	76	53	805	54	87	1070	177
Future Volume (veh/h)	187	315	101	123	275	76	53	805	54	87	1070	177
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.99	1.00		0.99	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1733	1733	1750	1716	1716	1750	1716	1716	1750	1733	1733	1750
Adj Flow Rate, veh/h	195	328	93	128	286	69	55	839	50	91	1115	164
Adj No. of Lanes	1	1	0	1	1	0	1	2	0	1	2	0
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Percent Heavy Veh, %	1	1	1	2	2	2	2	2	2	1	1	1
Cap, veh/h	244	350	99	178	310	75	98	1393	83	112	1305	191
Arrive On Green	0.10	0.27	0.27	0.06	0.23	0.23	0.06	0.45	0.45	0.07	0.45	0.45
Sat Flow, veh/h	1650	1292	366	1634	1335	322	1634	3125	186	1650	2875	422
Grp Volume(v), veh/h	195	0	421	128	0	355	55	438	451	91	637	642
Grp Sat Flow(s),veh/h/ln	1650	0	1659	1634	0	1657	1634	1630	1681	1650	1646	1651
Q Serve(g_s), s	11.4	0.0	32.2	7.8	0.0	27.2	4.3	26.4	26.5	7.1	44.8	45.2
Cycle Q Clear(g_c), s	11.4	0.0	32.2	7.8	0.0	27.2	4.3	26.4	26.5	7.1	44.8	45.2
Prop In Lane	1.00		0.22	1.00		0.19	1.00		0.11	1.00		0.26
Lane Grp Cap(c), veh/h	244	0	450	178	0	385	98	726	749	112	747	749
V/C Ratio(X)	0.80	0.00	0.94	0.72	0.00	0.92	0.56	0.60	0.60	0.81	0.85	0.86
Avail Cap(c_a), veh/h	244	0	472	178	0	408	98	726	749	178	747	749
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	0.91	0.00	0.91	0.63	0.63	0.63	1.00	1.00	1.00
Uniform Delay (d), s/veh	35.1	0.0	46.3	38.4	0.0	48.7	59.5	27.3	27.3	59.8	31.6	31.7
Incr Delay (d2), s/veh	16.7	0.0	25.8	11.9	0.0	23.7	4.6	2.3	2.3	14.0	11.8	12.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	6.3	0.0	18.0	4.1	0.0	15.0	2.0	12.4	12.8	3.7	22.8	23.0
LnGrp Delay(d),s/veh	51.9	0.0	72.1	50.3	0.0	72.4	64.1	29.6	29.6	73.8	43.5	43.8
LnGrp LOS	D		E	D		E	E	C	C	E	D	D
Approach Vol, veh/h		616			483			944			1370	
Approach Delay, s/veh		65.7			66.5			31.6			45.6	
Approach LOS		E			E			C			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	12.8	64.0	18.0	35.2	13.8	62.9	13.0	40.2
Change Period (Y+Rc), s	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Max Green Setting (Gmax), s	6.0	59.0	13.0	32.0	14.0	51.0	8.0	37.0
Max Q Clear Time (g_c+I1), s	6.3	47.2	13.4	29.2	9.1	28.5	9.8	34.2
Green Ext Time (p_c), s	0.0	4.8	0.0	1.0	0.1	4.0	0.0	1.0

Intersection Summary	
HCM 2010 Ctrl Delay	48.3
HCM 2010 LOS	D

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	216	801	93	140	837	173	135	421	77	280	600	291
Future Volume (veh/h)	216	801	93	140	837	173	135	421	77	280	600	291
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		0.99	1.00		0.99	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1733	1733	1750	1733	1733	1750	1716	1716	1750	1733	1733	1750
Adj Flow Rate, veh/h	225	834	81	146	872	147	141	439	63	292	625	231
Adj No. of Lanes	1	3	0	1	3	0	1	2	0	1	2	0
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Percent Heavy Veh, %	1	1	1	1	1	1	2	2	2	1	1	1
Cap, veh/h	248	1249	121	170	970	163	269	766	109	315	688	254
Arrive On Green	0.15	0.28	0.28	0.10	0.24	0.24	0.16	0.27	0.27	0.19	0.29	0.29
Sat Flow, veh/h	1650	4387	424	1650	4074	683	1634	2862	408	1650	2345	866
Grp Volume(v), veh/h	225	599	316	146	674	345	141	249	253	292	438	418
Grp Sat Flow(s),veh/h/ln	1650	1577	1657	1650	1577	1604	1634	1630	1641	1650	1646	1565
Q Serve(g_s), s	17.4	21.8	21.9	11.3	26.9	27.2	10.3	17.2	17.4	22.6	33.4	33.4
Cycle Q Clear(g_c), s	17.4	21.8	21.9	11.3	26.9	27.2	10.3	17.2	17.4	22.6	33.4	33.4
Prop In Lane	1.00		0.26	1.00		0.43	1.00		0.25	1.00		0.55
Lane Grp Cap(c), veh/h	248	898	472	170	751	382	269	436	439	315	483	459
V/C Ratio(X)	0.91	0.67	0.67	0.86	0.90	0.90	0.52	0.57	0.58	0.93	0.91	0.91
Avail Cap(c_a), veh/h	254	898	472	228	800	407	269	436	439	330	570	542
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.91	0.91	0.91	0.55	0.55	0.55	1.00	1.00	1.00	0.45	0.45	0.45
Uniform Delay (d), s/veh	54.4	41.0	41.1	57.3	48.0	48.1	49.6	41.2	41.2	51.7	44.2	44.3
Incr Delay (d2), s/veh	30.8	1.7	3.3	12.6	7.5	14.0	1.9	5.3	5.4	17.6	12.6	13.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	10.1	9.7	10.5	5.7	12.5	13.5	4.8	8.4	8.5	11.8	16.8	16.1
LnGrp Delay(d),s/veh	85.2	42.8	44.4	70.0	55.5	62.1	51.5	46.5	46.7	69.3	56.8	57.5
LnGrp LOS	F	D	D	E	E	E	D	D	D	E	E	E
Approach Vol, veh/h		1140			1165			643			1148	
Approach Delay, s/veh		51.6			59.3			47.7			60.3	
Approach LOS		D			E			D			E	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	26.4	43.2	24.5	35.9	29.8	39.8	18.4	42.0
Change Period (Y+Rc), s	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Max Green Setting (Gmax), s	12.0	45.0	20.0	33.0	26.0	31.0	18.0	35.0
Max Q Clear Time (g_c+I1), s	12.3	35.4	19.4	29.2	24.6	19.4	13.3	23.9
Green Ext Time (p_c), s	0.0	2.7	0.1	1.8	0.2	2.1	0.2	4.0

Intersection Summary	
HCM 2010 Ctrl Delay	55.6
HCM 2010 LOS	E

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	166	830	95	127	873	215	113	421	101	175	648	190
Future Volume (veh/h)	166	830	95	127	873	215	113	421	101	175	648	190
Number	1	6	16	5	2	12	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1733	1733	1750	1733	1733	1750	1733	1733	1750	1733	1733	1750
Adj Flow Rate, veh/h	173	865	83	132	909	176	118	439	82	182	675	166
Adj No. of Lanes	1	3	0	1	3	0	1	2	0	1	2	0
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Percent Heavy Veh, %	1	1	1	1	1	1	1	1	1	1	1	1
Cap, veh/h	197	1696	162	158	1443	278	140	695	129	206	761	187
Arrive On Green	0.12	0.39	0.39	0.10	0.36	0.36	0.09	0.25	0.25	0.12	0.29	0.29
Sat Flow, veh/h	1650	4387	419	1650	3980	767	1650	2771	514	1650	2619	644
Grp Volume(v), veh/h	173	621	327	132	719	366	118	260	261	182	424	417
Grp Sat Flow(s),veh/h/ln	1650	1577	1653	1650	1577	1594	1650	1646	1639	1650	1646	1617
Q Serve(g_s), s	13.4	19.5	19.7	10.2	24.5	24.7	9.2	18.2	18.5	14.1	32.0	32.1
Cycle Q Clear(g_c), s	13.4	19.5	19.7	10.2	24.5	24.7	9.2	18.2	18.5	14.1	32.0	32.1
Prop In Lane	1.00		0.25	1.00		0.48	1.00		0.31	1.00		0.40
Lane Grp Cap(c), veh/h	197	1219	639	158	1143	578	140	413	411	206	478	470
V/C Ratio(X)	0.88	0.51	0.51	0.84	0.63	0.63	0.84	0.63	0.64	0.88	0.89	0.89
Avail Cap(c_a), veh/h	228	1219	639	241	1143	578	165	456	454	241	532	522
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.52	0.52	0.52	0.98	0.98	0.98	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	56.3	30.5	30.5	57.8	34.2	34.3	58.6	43.3	43.4	55.9	44.1	44.1
Incr Delay (d2), s/veh	16.3	0.8	1.5	14.0	2.6	5.1	27.1	2.4	2.5	26.8	15.4	15.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	7.0	8.7	9.3	5.3	11.1	11.7	5.3	8.6	8.6	8.0	16.5	16.4
LnGrp Delay(d),s/veh	72.6	31.3	32.0	71.8	36.8	39.4	85.7	45.7	46.0	82.7	59.5	59.9
LnGrp LOS	E	C	C	E	D	D	F	D	D	F	E	E
Approach Vol, veh/h		1121			1217			639			1023	
Approach Delay, s/veh		37.9			41.4			53.2			63.8	
Approach LOS		D			D			D			E	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	19.5	52.1	15.1	43.3	16.4	55.2	20.2	38.1
Change Period (Y+Rc), s	4.0	5.0	4.0	5.5	4.0	5.0	4.0	5.5
Max Green Setting (Gmax), s	18.0	38.5	13.0	42.0	19.0	37.5	19.0	36.0
Max Q Clear Time (g_c+I1), s	15.4	26.7	11.2	34.1	12.2	21.7	16.1	20.5
Green Ext Time (p_c), s	0.1	9.1	0.1	3.7	0.2	11.4	0.2	5.4

Intersection Summary	
HCM 2010 Ctrl Delay	48.0
HCM 2010 LOS	D

Appendix C - Future Conditions Synchro Reports

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	205	320	110	130	280	85	55	895	55	90	1190	190
Future Volume (veh/h)	205	320	110	130	280	85	55	895	55	90	1190	190
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.99	1.00		0.99	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1733	1733	1750	1716	1716	1750	1716	1716	1750	1733	1733	1750
Adj Flow Rate, veh/h	205	320	97	130	280	73	55	895	50	90	1190	174
Adj No. of Lanes	1	1	0	1	1	0	1	2	0	1	2	0
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Percent Heavy Veh, %	1	1	1	2	2	2	2	2	2	1	1	1
Cap, veh/h	239	347	105	171	298	78	68	1417	79	111	1373	200
Arrive On Green	0.10	0.27	0.27	0.05	0.23	0.23	0.04	0.45	0.45	0.07	0.48	0.48
Sat Flow, veh/h	1650	1270	385	1634	1311	342	1634	3138	175	1650	2879	419
Grp Volume(v), veh/h	205	0	417	130	0	353	55	465	480	90	678	686
Grp Sat Flow(s),veh/h/ln	1650	0	1655	1634	0	1653	1634	1630	1683	1650	1646	1652
Q Serve(g_s), s	12.1	0.0	31.8	7.0	0.0	27.3	4.3	28.4	28.4	7.0	47.7	48.3
Cycle Q Clear(g_c), s	12.1	0.0	31.8	7.0	0.0	27.3	4.3	28.4	28.4	7.0	47.7	48.3
Prop In Lane	1.00		0.23	1.00		0.21	1.00		0.10	1.00		0.25
Lane Grp Cap(c), veh/h	239	0	453	171	0	376	68	736	760	111	785	788
V/C Ratio(X)	0.86	0.00	0.92	0.76	0.00	0.94	0.81	0.63	0.63	0.81	0.86	0.87
Avail Cap(c_a), veh/h	239	0	458	171	0	382	68	736	760	165	785	788
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	0.91	0.00	0.91	0.55	0.55	0.55	1.00	1.00	1.00
Uniform Delay (d), s/veh	35.8	0.0	45.9	42.2	0.0	49.3	61.8	27.3	27.3	59.8	30.2	30.4
Incr Delay (d2), s/veh	25.5	0.0	23.8	16.3	0.0	28.8	30.8	2.3	2.2	16.9	12.1	12.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	7.2	0.0	17.5	2.3	0.0	15.5	2.5	13.2	13.7	3.7	24.1	24.7
LnGrp Delay(d),s/veh	61.3	0.0	69.7	58.5	0.0	78.1	92.5	29.6	29.5	76.8	42.4	43.0
LnGrp LOS	E		E	E		E	F	C	C	E	D	D
Approach Vol, veh/h		622			483			1000			1454	
Approach Delay, s/veh		66.9			72.8			33.0			44.8	
Approach LOS		E			E			C			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	10.4	67.0	18.0	34.6	13.7	63.7	12.0	40.6
Change Period (Y+Rc), s	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Max Green Setting (Gmax), s	5.0	62.0	13.0	30.0	13.0	54.0	7.0	36.0
Max Q Clear Time (g_c+I1), s	6.3	50.3	14.1	29.3	9.0	30.4	9.0	33.8
Green Ext Time (p_c), s	0.0	5.2	0.0	0.3	0.1	4.4	0.0	0.8

Intersection Summary	
HCM 2010 Ctrl Delay	49.2
HCM 2010 LOS	D

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	240	960	120	160	1005	195	155	470	90	310	670	325
Future Volume (veh/h)	240	960	120	160	1005	195	155	470	90	310	670	325
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		0.99	1.00		0.99	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1733	1733	1750	1733	1733	1750	1716	1716	1750	1733	1733	1750
Adj Flow Rate, veh/h	240	960	104	160	1005	166	155	470	74	310	670	257
Adj No. of Lanes	1	3	0	1	3	0	1	2	0	1	2	0
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Percent Heavy Veh, %	1	1	1	1	1	1	2	2	2	1	1	1
Cap, veh/h	241	1219	132	183	1006	166	228	760	119	305	729	280
Arrive On Green	0.15	0.28	0.28	0.11	0.25	0.25	0.14	0.27	0.27	0.18	0.31	0.31
Sat Flow, veh/h	1650	4335	468	1650	4086	673	1634	2823	442	1650	2318	889
Grp Volume(v), veh/h	240	698	366	160	775	396	155	270	274	310	476	451
Grp Sat Flow(s),veh/h/ln	1650	1577	1649	1650	1577	1606	1634	1630	1635	1650	1646	1562
Q Serve(g_s), s	18.9	26.5	26.7	12.4	31.9	32.0	11.7	18.9	19.1	24.0	36.2	36.2
Cycle Q Clear(g_c), s	18.9	26.5	26.7	12.4	31.9	32.0	11.7	18.9	19.1	24.0	36.2	36.2
Prop In Lane	1.00		0.28	1.00		0.42	1.00		0.27	1.00		0.57
Lane Grp Cap(c), veh/h	241	887	464	183	776	395	228	439	440	305	518	491
V/C Ratio(X)	1.00	0.79	0.79	0.87	1.00	1.00	0.68	0.62	0.62	1.02	0.92	0.92
Avail Cap(c_a), veh/h	241	887	464	203	776	395	228	439	440	305	582	553
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.91	0.91	0.91	0.55	0.55	0.55	1.00	1.00	1.00	0.34	0.34	0.34
Uniform Delay (d), s/veh	55.5	43.1	43.2	56.9	49.0	49.0	53.2	41.6	41.7	53.0	43.0	43.0
Incr Delay (d2), s/veh	53.8	4.3	8.1	18.7	23.6	33.9	8.0	6.3	6.5	34.7	10.5	11.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
%ile BackOfQ(50%),veh/ln	12.2	12.1	13.2	6.6	16.4	17.9	5.8	9.3	9.4	13.9	18.0	17.2
LnGrp Delay(d),s/veh	109.2	47.5	51.3	75.5	72.6	82.9	61.2	48.0	48.2	87.8	53.5	54.0
LnGrp LOS	F	D	D	E	E	F	E	D	D	F	D	D
Approach Vol, veh/h		1304			1331			699			1237	
Approach Delay, s/veh		59.9			76.0			51.0			62.3	
Approach LOS		E			E			D			E	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	23.1	45.9	24.0	37.0	29.0	40.0	19.4	41.6
Change Period (Y+Rc), s	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Max Green Setting (Gmax), s	13.0	46.0	19.0	32.0	24.0	35.0	16.0	35.0
Max Q Clear Time (g_c+I1), s	13.7	38.2	20.9	34.0	26.0	21.1	14.4	28.7
Green Ext Time (p_c), s	0.0	2.7	0.0	0.0	0.0	2.4	0.1	3.2

Intersection Summary	
HCM 2010 Ctrl Delay	63.9
HCM 2010 LOS	E

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	185	1005	110	145	980	240	130	470	115	195	720	215
Future Volume (veh/h)	185	1005	110	145	980	240	130	470	115	195	720	215
Number	1	6	16	5	2	12	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1733	1733	1750	1733	1733	1750	1733	1733	1750	1733	1733	1750
Adj Flow Rate, veh/h	185	1005	95	145	980	192	130	470	92	195	720	185
Adj No. of Lanes	1	3	0	1	3	0	1	2	0	1	2	0
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Percent Heavy Veh, %	1	1	1	1	1	1	1	1	1	1	1	1
Cap, veh/h	209	1569	148	169	1323	259	152	731	142	218	792	204
Arrive On Green	0.13	0.36	0.36	0.10	0.33	0.33	0.09	0.27	0.27	0.13	0.31	0.31
Sat Flow, veh/h	1650	4393	414	1650	3970	776	1650	2747	534	1650	2593	666
Grp Volume(v), veh/h	185	721	379	145	778	394	130	280	282	195	457	448
Grp Sat Flow(s),veh/h/ln	1650	1577	1654	1650	1577	1592	1650	1646	1636	1650	1646	1613
Q Serve(g_s), s	14.3	24.8	24.9	11.2	28.4	28.5	10.1	19.6	19.8	15.1	34.7	34.7
Cycle Q Clear(g_c), s	14.3	24.8	24.9	11.2	28.4	28.5	10.1	19.6	19.8	15.1	34.7	34.7
Prop In Lane	1.00		0.25	1.00		0.49	1.00		0.33	1.00		0.41
Lane Grp Cap(c), veh/h	209	1126	591	169	1051	531	152	438	435	218	503	493
V/C Ratio(X)	0.89	0.64	0.64	0.86	0.74	0.74	0.85	0.64	0.65	0.89	0.91	0.91
Avail Cap(c_a), veh/h	228	1126	591	198	1051	531	165	470	467	228	533	522
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.52	0.52	0.52	0.98	0.98	0.98	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	55.9	34.8	34.9	57.4	38.4	38.4	58.1	42.2	42.3	55.5	43.4	43.4
Incr Delay (d2), s/veh	18.3	1.5	2.8	25.8	4.6	8.9	31.0	2.7	2.8	32.2	18.9	19.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	7.6	11.0	11.8	6.3	13.0	13.8	5.9	9.2	9.3	8.8	18.4	18.1
LnGrp Delay(d),s/veh	74.1	36.3	37.7	83.2	43.0	47.3	89.2	44.9	45.1	87.8	62.3	62.7
LnGrp LOS	E	D	D	F	D	D	F	D	D	F	E	E
Approach Vol, veh/h		1285			1317			692			1100	
Approach Delay, s/veh		42.2			48.7			53.3			67.0	
Approach LOS		D			D			D			E	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	20.4	48.3	16.0	45.2	17.3	51.4	21.2	40.1
Change Period (Y+Rc), s	4.0	5.0	4.0	5.5	4.0	5.0	4.0	5.5
Max Green Setting (Gmax), s	18.0	38.4	13.0	42.1	15.6	40.8	18.0	37.1
Max Q Clear Time (g_c+I1), s	16.3	30.5	12.1	36.7	13.2	26.9	17.1	21.8
Green Ext Time (p_c), s	0.1	6.8	0.0	3.0	0.1	11.1	0.1	5.8

Intersection Summary	
HCM 2010 Ctrl Delay	52.1
HCM 2010 LOS	D

Appendix D - Future Conditions with Mitigations Synchro Reports

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	240	960	120	160	1005	195	155	470	90	310	670	325
Future Volume (veh/h)	240	960	120	160	1005	195	155	470	90	310	670	325
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		0.99	1.00		0.99	1.00		0.98
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1733	1733	1750	1733	1733	1750	1716	1716	1750	1733	1733	1733
Adj Flow Rate, veh/h	240	960	104	160	1005	166	155	470	74	310	670	257
Adj No. of Lanes	2	3	0	1	3	0	1	2	0	1	2	1
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Percent Heavy Veh, %	1	1	1	1	1	1	2	2	2	1	1	1
Cap, veh/h	292	1120	121	184	1140	188	398	772	121	334	765	336
Arrive On Green	0.09	0.26	0.26	0.11	0.28	0.28	0.24	0.27	0.27	0.20	0.23	0.23
Sat Flow, veh/h	3201	4334	468	1650	4087	674	1634	2823	442	1650	3292	1446
Grp Volume(v), veh/h	240	698	366	160	775	396	155	270	274	310	670	257
Grp Sat Flow(s),veh/h/ln	1601	1577	1649	1650	1577	1607	1634	1630	1635	1650	1646	1446
Q Serve(g_s), s	9.6	27.4	27.5	12.4	30.5	30.7	10.3	18.8	19.0	24.0	25.5	21.6
Cycle Q Clear(g_c), s	9.6	27.4	27.5	12.4	30.5	30.7	10.3	18.8	19.0	24.0	25.5	21.6
Prop In Lane	1.00		0.28	1.00		0.42	1.00		0.27	1.00		1.00
Lane Grp Cap(c), veh/h	292	815	426	184	880	448	398	446	447	334	765	336
V/C Ratio(X)	0.82	0.86	0.86	0.87	0.88	0.88	0.39	0.61	0.61	0.93	0.88	0.76
Avail Cap(c_a), veh/h	296	849	444	228	995	507	398	446	447	368	886	389
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.91	0.91	0.91	0.55	0.55	0.55	1.00	1.00	1.00	0.34	0.34	0.34
Uniform Delay (d), s/veh	58.0	45.9	45.9	56.8	44.8	44.8	41.1	41.1	41.2	50.9	48.1	46.6
Incr Delay (d2), s/veh	15.3	7.7	13.9	15.0	5.0	9.4	0.6	6.0	6.1	12.8	5.2	5.7
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.9	12.8	14.2	6.4	14.0	14.8	4.7	9.2	9.4	12.1	12.2	9.2
LnGrp Delay(d),s/veh	73.3	53.6	59.8	71.8	49.8	54.2	41.7	47.2	47.4	63.7	53.3	52.3
LnGrp LOS	E	D	E	E	D	D	D	D	D	E	D	D
Approach Vol, veh/h		1304			1331			699			1237	
Approach Delay, s/veh		59.0			53.8			46.0			55.7	
Approach LOS		E			D			D			E	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	36.7	35.2	16.9	41.3	31.3	40.5	19.5	38.6
Change Period (Y+Rc), s	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Max Green Setting (Gmax), s	22.0	35.0	12.0	41.0	29.0	28.0	18.0	35.0
Max Q Clear Time (g_c+I1), s	12.3	27.5	11.6	32.7	26.0	21.0	14.4	29.5
Green Ext Time (p_c), s	2.1	2.7	0.3	3.6	0.4	1.7	0.2	2.9

Intersection Summary	
HCM 2010 Ctrl Delay	54.6
HCM 2010 LOS	D

Notes

Appendix E – Project Cost Estimate Spreadsheets

Item	Pines Road & Indiana Ave - 600' EB Lane Addition, Partial SW Corner Island Removal, Full Island Relocation				Pines Road & I-90 EB Ramps - EB 450' Lane Addition and NB 75' Lane Addition			
	Quantity	**Unit**	**Unit Cost**	**Total Cost**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
Roadway Demo	400	Sq Yard	$ 15	$ 6,000	0	Sq Yard	$ 15	$ -
Curb Demo	900	LF	$ 16	$ 14,400	75	LF	$ 16	$ 1,200
Sidewalk Demo	333	Sq Yard	$ 20	$ 6,660	42	Sq Yard	$ 20	$ 840
Signal Demo	2	Each	$ 6,000	$ 12,000	1	Each	$ 6,000	$ 6,000
Excavation	400	Cubic Yard	$ 35	$ 14,000	233	Cubic Yard	$ 35	$ 8,155
Road Section	800	Sq Yard	$ 60	$ 48,000	1,059	Sq Yard	$ 60	$ 63,540
Curb	900	LF	$ 45	$ 40,500	75	LF	$ 45	$ 3,375
Sidewalk	700	Sq Yard	$ 80	$ 56,000	42	Sq Yard	$ 80	$ 3,360
Curb Ramps	6	Each	$ 4,000	$ 24,000	0	Each	$ 4,000	$ -
Traffic Signal	1	Each	$ 480,000	$ 480,000	1	Each	$ 480,000	$ 480,000
ROW	11,000	Sq Foot	$ 12	$ 132,000	1,200	Sq Foot	$ 12	$ 14,400
	Subtotal			$ 701,560	Subtotal			$ 566,470
	10% Mobilization			$ 70,156	10% Mobilization			$ 56,647
	20% Drainage			$ 140,312	20% Drainage			$ 113,294
	15% Traffic Control			$ 105,234	15% Traffic Control			$ 84,971
	30% Contingency			$ 210,468	30% Contingency			$ 169,941
	20% Engineering			$ 140,312	20% Engineering			$ 113,294
	Total			$ 1,500,042	Total			$ 1,119,017
	11000 Sq Ft ROW				1200 Sq Ft ROW			

* About half of the ROW is WSDOT, using standard "over the fence" price for land

Assumes new signal pole and longer mast arm with I-90 off ramp island relocation south. Relocate signal controller. New pole at Pines/Indiana. Reconstruct both right turn islands. Assumes ROW cost for additional lane on south side of road.

Assumes reallignment of intersection to south. Move SE corner ped head. Assumes all ROW for NBR lane would need to be purchased, but no cost to aquire off-ramp widening space. ADA ramps look new. No replacement assumed.

Item	Mirabeau Pkwy and Mansfield Ave -Signalize and SB 175' Lane Addition				Sullivan Road and Mission Ave -Restripe and partially remove curb			
	Quantity	Unit	Unit Cost	Total Cost	Quantity	Unit	Unit Cost	Total Cost
Roadway Demo	0	Sq Yard	$ 15	$ -	20	Sq Yard	$ 15	$ 300
Curb Demo	175	LF	$ 16	$ 2,800	40	LF	$ 16	$ 640
Sidewalk Demo	97	Sq Yard	$ 20	$ 1,940	0	Sq Yard	$ 20	$ -
Signal Demo	0	Each	$ 6,000	$ -	0	Each	$ 6,000	$ -
Excavation	0	Cubic Yard	$ 35	$ -	0	Cubic Yard	$ 35	$ -
Road Section	233	Sq Yard	$ 60	$ 13,980	20	Sq Yard	$ 60	$ 1,200
Curb	300	LF	$ 45	$ 13,500	80	LF	$ 45	$ 3,600
Sidewalk	250	Sq Yard	$ 80	$ 20,000	200	Sq Yard	$ 80	$ 16,000
Curb Ramps	4	Each	$ 4,000	$ 16,000	2	Each	$ 4,000	$ 8,000
Traffic Signal	1.25	Each	$ 480,000	$ 600,000	0.05	Each	$ 480,000	$ 24,000
ROW	2,700	Sq Foot	$ 12	$ 32,400	0	Sq Foot	$ 12	$ -
	Subtotal			$ 668,220	Subtotal			$ 53,740
	10% Mobilization			$ 66,822	10% Mobilization			$ 5,374
	20% Drainage			$ 13,644	20% Drainage			$ -
	15% Traffic Control			$ 100,233	15% Traffic Control			$ 8,061
	30% Contingency			$ 200,466	30% Contingency			$ 16,122
	20% Engineering			$ 133,644	20% Engineering			$ 10,748
	Total			$ 1,215,429	Total			$ 94,045

2700 Sq Ft ROW

Assumes all new ramps to meet current ADA. Assumes new fiber to be installed back to Pines.

3 ramps will need to be made ADA compliant. Risk: Might need to relocate pole and mast arm on NE corner to meet ADA clearance. This is not assumed in the cost.

Item	Pines and Sprague - Add 250' SBR and 325' EBL				Argonne & Trent - 300' WBL turn add			
	Quantity	Unit	Unit Cost	Total Cost	Quantity	Unit	Unit Cost	Total Cost
Roadway Demo	460	Sq Yard	$ 15	$ 6,900	0	Sq Yard	$ 15	$ -
Curb Demo	1,215	LF	$ 16	$ 19,440	850	LF	$ 16	$ 13,600
Sidewalk Demo	433	Sq Yard	$ 20	$ 8,667	100	Sq Yard	$ 20	$ 2,000
Signal Demo	2	Each	$ 6,000	$ 12,000	2	Each	$ 6,000	$ 12,000
Excavation	200	Cubic Yard	$ 35	$ 6,983	208	Cubic Yard	$ 35	$ 7,296
Road Section	566	Sq Yard	$ 60	$ 33,933	933	Sq Yard	$ 60	$ 56,000
Curb	1,215	LF	$ 45	$ 54,675	850	LF	$ 45	$ 38,250
Sidewalk	520	Sq Yard	$ 80	$ 41,600	67	Sq Yard	$ 80	$ 5,333
Curb Ramps	2	Each	$ 4,000	$ 8,000	3	Each	$ 4,000	$ 12,000
Traffic Signal	0.5	Each	$ 480,000	$ 240,000	0.5	Each	$480,000	$ 240,000
ROW	5,175	Sq Foot	$ 12	$ 62,100	0	Sq Foot	$ 12	$ -
	Subtotal			$ 432,198	Subtotal			$ 386,479
	10% Mobilization			$ 43,220	10% Mobilization			$ 38,648
	20% Drainage			$ -	20% Drainage			$ 77,296
	15% Traffic Control			$ 64,830	15% Traffic Control			$ 57,972
	30% Contingency			$ 129,659	30% Contingency			$ 115,944
	20% Engineering			$ 86,440	20% Engineering			$ 77,296
	Total			$ 818,446	Total			$ 753,634

6200 Sq Ft ROW

Assumes northwest curb along Sprague would be moved 4 feet north along with restriping to narrow outside lanes for second EBR. Assumes northwest curb along Pines would be moved west 12 feet to accommodate SBR. Two new signals on northwest and southeast corners.

Assumes south curb along Trent Avenue would be moved 12' south for 300' plus 150' taper on both sides of Argonne to accommodate a second WBL. Both signal poles on the south side would be replaced along with the right turn island on the SW corner.

Pines & Mission Phase 2 - Southbound Right Turn Lane Addition

Engineers Estimate
Project CIP No. TBD
Prepared by - Adam Jackson

Date
3/5/2018

Item No.	Bid Item	Qty	Unit	Unit Price	Est. Cost	Use
100	MOBILIZATION @ 10%	1	L.S.	$ 45,042	$ 45,042	
101	CONSTRUCTION SURVEYING	1	L.S.	$ 15,000	$ 15,000	
102	SPCC PLAN	1	L.S.	$ 5,000	$ 5,000	
103	PROJECT TEMPORARY TRAFFIC CONTROL	1	L.S.	$ 50,000	$ 50,000	
104	PUBLIC LIAISION REPRESENTATIVE	1	L.S.	$ 5,000	$ 5,000	
105	EROSION CONTROL	1	L.S.	$ 5,000	$ 5,000	
106	PORTABLE CHANGEABLE MESSAGE SIGN	1344	HR.	$ 4	$ 5,376	
107	REMOVE CEMENT CONCRETE CURB	350	L.F.	$ 15	$ 5,250	
108	SAWCUT ASPHALT PAVEMENT	750	L.F.-in	$ 5	$ 3,750	
109	ROADWAY EXCAV. INCL. HAUL (assumes 16" depth)	400	C.Y.	$ 30	$ 12,000	
110	CRUSHED SURFACING BASE COURSE, 8 IN. DEPTH	778	S.Y.	$ 25	$ 19,444	
111	JOINT/CRACK SEALANT AT HMA JOINTS	500	L.F.	$ 3	$ 1,500	
112	HMA CL 1/2" PG 70-28 0.50 FT. DEPTH	130	C.Y.	$ 50	$ 6,481	
113	CEMENT CONCRETE TRAFFIC CURB, TYPE B	350	L.F.	$ 45	$ 15,750	
114	CONRETE RETAINING WALL AT BACK OF SIDEWALK	1089	SF	$ 50	$ 54,450	
115	CEMENT CONCRETE CURB RAMP PERPENDICULAR TYPE A	1	EACH	$ 2,500	$ 2,500	
116	CEMENT CONCRETE PEDESTRIAN CURB	20	L.F.	$ 30	$ 600	
117	TRAFFIC SIGNAL SYSTEM MODIFICATIONS	0	L.S.	$ 250,000	$ -	
118	REMOVE EXISTING STRIPING	0	L.F.	$ 3.00	$ -	
119	PLASTIC CROSSWALK LINE	390	S.F.	$ 18	$ 7,020	
120	PLASTIC LINE	300	L.F.	$ 4	$ 1,200	
121	PLASTIC WIDE LINE	300	L.F.	$ 12	$ 3,600	
122	PLASTIC TRAFFIC ARROW	3	EACH	$ 300	$ 900	
123	PLASTIC STOP LINE	20	L.F.	$ 30	$ 600	
124	LANDSCAPE RESTORATION	1	L.S.	$ 30,000	$ 30,000	
125	STORMWATER SWALE AND ROW IN LIMITED ACCESS AREA	1	L.S.	$ 100,000	$ 100,000	
126	UTILITY RELCOATION (POLES AND BOXES)	1	LS	$ 100,000	$ 100,000	
	ITEMS: Total				$ 495,464	
	Contingency			15%	$ 74,320	
	Inflation Adjustment Factor @	2 years		3%	$ 30,174	
	Construction Subtotal				$ 599,958	
	PE Engineering			20%	$ 119,992	
	CN Engineering			10%	$ 59,996	
	ROW (excl. WSDOT)	1	L.S.	$ 32,000.00	$ 32,000	
	Estimated Project Cost				$ 811,945	**$ 812,000**

E Trent Road/N Argonne

Road Proposed Layout Improvements to Address Existing LOS Deficiency

Cost Estimate

		Unit	Unit Cost	Qty	Cost
1	Install of Ground Sign	EA	$ 270.00	4	$ 1,080
2	Remove Striping (Grind)	LF	$ 0.50	800	$ 400
3	Thermoplastic Arrow	EA	$ 475.00	7	$ 3,325
4	Thermoplastic Lane Line	LF	$ 3.50	1100	$ 3,850
5	Thermoplastic Stop Bar	LF	$ 20.00	80	$ 1,600
6	Thermoplastic Traffic Letter	EA	$ 175.00	4	$ 700
7	Traffic Signal Modification	EA	$ 480,000.00	0.25	$ 120,000
				Construction Subtotal	$ 130,955
				Design (20%)	$ 26,190
				Traffic Control (15%)	$ 19,640
				Mobilization (10%)	$ 13,100
				Contingency (30%)	$ 39,290
				Total	**$ 229,200**