LEA HILL ROAD CORRIDOR PLAN

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Project Information

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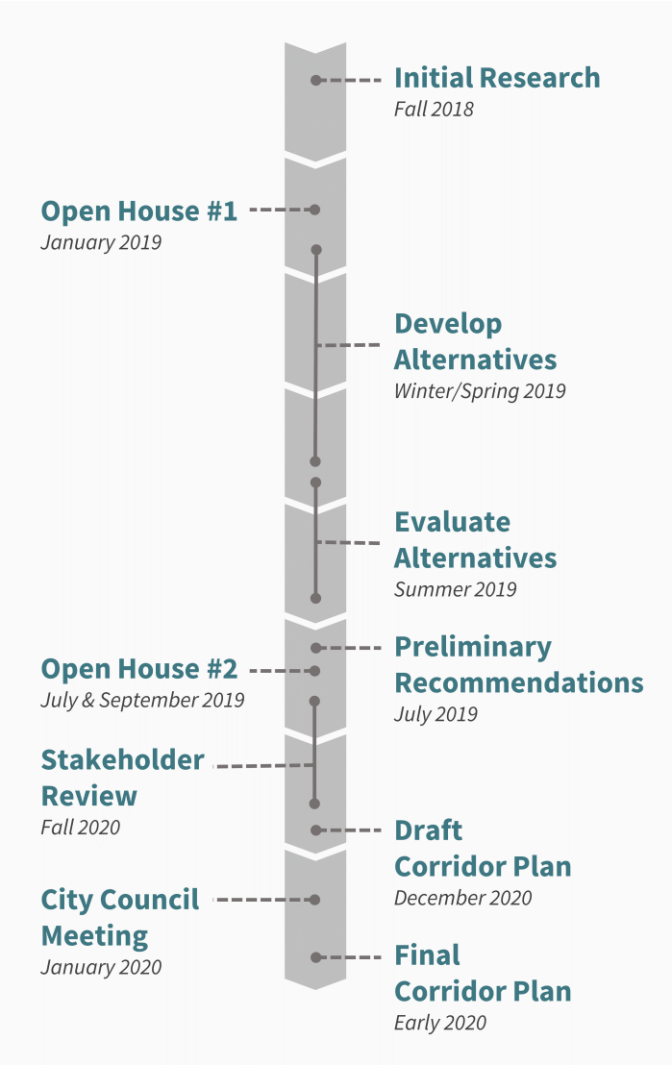
Executive Summary

Project Background

In the Fall of 2018, the City of Auburn initiated a study of the Lea Hill Road Corridor to develop a long-range corridor plan that improves mobility, capacity, and safety along this critical east-west arterial. The study area includes segments of 8th Street NE, Lea Hill Road, and SE 312th Street between Harvey Road/M Street SE and 124th Avenue SE which provides connections to Downtown Auburn, Lea Hill, Green River College, and State Route 18.



Due to development and growth within Auburn and across the Puget Sound region, traffic volumes are expected to increase over the 20-year planning horizon, intensifying existing and emerging congestion issues. However, several physical constraints within the study area make simply widening the Lea Hill Road Corridor difficult, both in terms of construction cost and potential environmental impacts.

Therefore, to effectively consider tradeoffs between the expected benefits and costs, a value-based approach was used to evaluate various alternatives for the future roadway section and intersection design. While developing the plan, continuous engagement with the public and key stakeholders helped to inform, both the evaluation methodology, and our final corridor recommendations.

The following four overarching objectives guided our decision-making process: adequately accommodate growth, improve mobility, enhance safety for all roadway users, and increase access for all modes.

Corridor Design

The recommended corridor design includes the following key elements:

- Closure of Garden Avenue SE/102nd Avenue SE with new street connection to 104th Avenue SE to reduce turning conflicts at this location while maintaining access for all properties
- Multi-lane roundabout intersection at 104th Avenue SE and realignment of Lea Hill Road to improve sight distances and process traffic more efficiently
- Single-lane roundabouts at 112th Avenue SE and 116th Avenue SE to improve traffic operations, remove turning conflicts, and reduce speeding
- Right-in/right-out intersection at 105th Place SE and removal of the existing signal to keep traffic moving on the hill where sight distances are limited
- Left-turn restrictions along 8th Street NE, potentially including the intersection at Pike Street NE, to streamline traffic in this congested segment of corridor
- Wider sidewalks on both sides of the 8th Street Bridge to increase pedestrian safety and calm traffic by narrowing the curb face to curb face width which reduces speeds
- Continuous pedestrian and bicycle facilities and enhanced pedestrian crossings to improve mobility for non-motorized modes
- Improved access to bus stops and upgraded amenities to enhance the transit rider experience and their safety
- Eastbound right-turn lane approaching 124th Avenue SE to improve operations and reduce vehicle queues at the intersection
- Streetlight upgrades to improve visibility and safety for all road users at night

Implementation Strategy

In total, the Lea Hill Road Corridor improvements are expected to cost roughly $25 million dollars. It is not realistic to think a project of this size can happen as one large mega-project. Therefore, to facilitate implementation, the corridor design has been split into the five smaller projects shown below which are more financially feasible and may be more competitive for different local and grant funding sources.

Project	Estimated Cost *(2019$)*	Next Steps
Garden Street/102nd Avenue SE Closure	$620,000	Property Acquisition 2020 *Design 2021 Construction 2022
104th Avenue SE & 8th Street NE	$3,980,000	To be added to Comprehensive Plan
Lea Hill Road	$9,470,000	To be added to Comprehensive Plan
112th Avenue SE & 105th Place SE	$5,090,000	*Design 2024,25 Construction 2026
116th Avenue SE & SE 312th Street	$5,610,000	To be added to Comprehensive Plan
TOTAL	**$24,770,000**	

* Included in proposed 2021-2026 Transportation Improvement Program (TIP)

The two projects included in the TIP were prioritized because they address current safety concerns and near-term LOS/capacity issues. The other projects will be added to the City's Comprehensive Transportation Plan and will be considered for inclusion in future TIP as available funding and priorities align.

When it comes to implementation, the City will need to be both proactive and opportunistic – working to implement projects that address existing operational and safety needs first, using local matching funds to leverage grants for projects that are well suited for a particular program, and working with developers to get pieces of other projects completed.

Project Introduction

The Lea Hill Road Corridor, between Harvey Road/M Street NE and 124th Avenue SE, is a key east-west arterial providing connections to downtown Auburn, the Lea Hill neighborhood, Green River College, Auburn Golf Course, and State Route 18. As Auburn, and specifically the Lea Hill neighborhood, continues to grow and develop, the corridor will carry even more traffic which will create increased congestion and introduce potential safety concerns, beyond those that are already apparent today. Due to a limited network of secondary and side streets to distribute and disperse vehicular traffic, it is especially important to keep traffic moving along this crucial corridor.

Project Objectives

To prepare for anticipated growth, the City of Auburn carried out the Lea Hill Road Corridor Study to identify potential safety, capacity, and mobility improvements along this critical stretch of roadway in the citywide network. The overarching objective of the Lea Hill Road Corridor Study was to develop a future roadway design that:

- Accommodates projected traffic growth
- Meets the City's mobility goals
- Enhances safety for all roadway users
- Increases access for pedestrians, cyclists, and transit riders

Planning Context

Auburn's Comprehensive Plan (2015) identified the need for widening the Lea Hill corridor to two lanes in each direction to accommodate the projected traffic growth. However, there are physical constraints, such as an existing bridge, steep slopes, and wetland areas, that will make widening difficult and costly. Therefore, the challenge of this study was to develop a design that adequately balances the need to keep people moving safely and efficiently with the need to manage project cost as well as environmental risk and impacts.

In addition to taking a look at ways to improve vehicular traffic, this study explored ways to safely accommodate pedestrians and cyclists. The Transportation Element of the Comprehensive Plan identified the Lea Hill Road Corridor as a future bicycle facility, specifically an uphill route. Therefore, another key aspect of this project was providing better access for pedestrians and cyclists in the community. Currently, there are no bike facilities along the corridor and the existing sidewalks are sporadic and disconnected.

King County Metro operates a bus route serving Downtown Auburn and Green River College which travels on the Lea Hill Road Corridor between Harvey Road/M Street NE and 112th Avenue SE. As a result, identifying ways to maintain and improve access to bus stops and the transit rider experience was an important consideration. In addition, King County Metro has identified the Lea Hill Road Corridor as a potential location for a future Rapid Ride route which is an express bus service that could introduce additional design requirements.

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Study Area

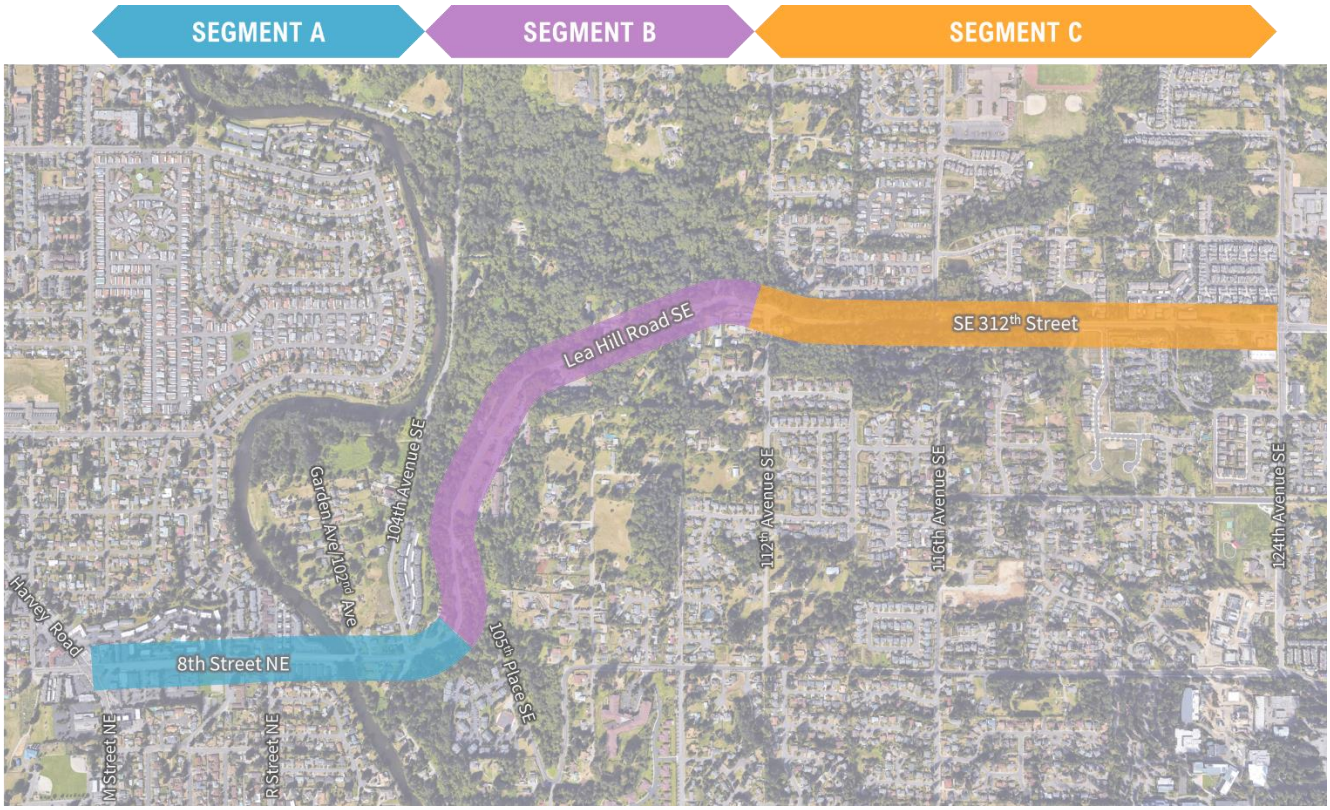
An early task of our study was to clearly define the project limits and evaluate the existing conditions of the study corridor. Our assessment documented the physical conditions and constraints of the project area, considered the existing and forecasted traffic volumes, and reviewed the crash history on this stretch of road. A better understanding of the existing conditions helped to shape our design alternatives, develop our evaluation methodology, and identify our preferred corridor design. In addition, it informed our cost estimates and implementation strategy.

Project Limits & Existing Conditions

The Lea Hill Road Corridor is one of only two Green River crossings within the City limits, providing a connection between Downtown Auburn and SR 18 as well as access to many apartment complexes, single family housing, City parks, and schools in Auburn's Lea Hill area. The study corridor is classified as a minor arterial and is not a designated truck route.

Our study considered improvements on the corridor between Harvey Road/M Street NE and 124th Avenue SE, including segments of 8th Street NE, Lea Hill Road SE, and SE 312th Street. For purposes of evaluation, the study corridor was broken into three sub-segments as shown in **Figure 1**. The characteristics and existing conditions on each of these subsegments is described below.

Figure 1. Project Limits and Study Segments



Segment A: 8th Street NE

Segment A is on the western end of the study corridor closest to Downtown Auburn, between Harvey Road/M Street NE to the west and just past 104th Avenue SE to the east where the hill begins to climb. Segment A also includes the 8th Street Bridge that crosses the Green River.

The majority of this segment consists of two travel lanes in the eastbound direction, one travel lane in the westbound direction, and a center, two-way left turn lane. There are three existing traffic signals in this segment at Harvey Road/M Street NE, the tee-intersection at R Street NE, and 104th Avenue SE. There are continuous sidewalks on both sides of 8th Street NE between Harvey Road/M Street NE and the bridge and pedestrian crossings at each of the signal intersections. There are bus stops in this segment however, there are no sidewalks east of the 8th Street Bridge to serve the bus stops located at 104th Avenue SE. Additionally, there is no on-street parking in this segment.

WHAT WE HEARD...

from community members during our Issues & Ideas Open House

- The 104th Avenue SE intersection has poor sightlines, sharp turns, and experiences traffic congestion and collisions
- Sightlines are limited around the curve, just east of 104th Avenue SE
- Frequent driveway access between Pike Street NE and 8th Street Bridge causes turning conflicts and congestion
- Unsafe, poorly illuminated pedestrian crossings at Pike Street NE and R Street NE
- Aggressive weaving behavior over 8th Street Bridge approaching 104th Avenue SE
- Poor bicycle and pedestrian facilities on 8th Street Bridge
- Safety concerns at Garden Avenue SE/102nd Avenue SE located just east of the bridge

Segment B: Lea Hill Road SE

Segment B starts between 104th Avenue SE and 105th Place SE and ends just west of 112th Avenue SE. This segment of the study corridor runs roughly north-south, unlike 8th Street NE and SE 312th Street which run east-west.

Segment B is characterized by steep roadway grades. In addition, there is a steep hillside running across the road with the uphill side located to the east. Due to topography as well as adjacent streams and wetlands, there are few intersecting roadways or driveways along this segment. The tee-intersection at 105th Place SE is the only signalized intersection in this segment. There are two driveways at 106th Place SE and 107th Place SE that serve the Lea Hill Condominiums as well as several private driveways.

WHAT WE HEARD...

from community members during our Issues & Ideas Open House

- Speeding vehicles with poor sightlines cannot see traffic congestion ahead
- Difficulty making left-turns at 105th Place SE and vehicles drive in shoulder to get around turning vehicles
- Busy bus stops with poor pedestrian access at 106th Place SE and 112th Avenue SE
- Lack of pedestrian and bicycle facilities and poor lighting throughout
- Difficulty entering and exiting from driveways between 106th Place SE and 112th Avenue SE

This segment consists of one travel lane in each direction and a shoulder of varying width of either side of the road. There are no sidewalks or dedicated bicycle facilities on this section of the corridor. There are bus stops located at 106th Place SE and 107th Place SE but there are no pedestrian facilities provided at these stops. Additionally, there is no on-street parking in this segment.

Steep slopes adjacent to Lea Hill Road near 106th Place SE (left) and 112th Avenue SE (left).

Segment C: SE 312th Street

Segment C runs along SE 312th Street between 112th Avenue SE and 124th Avenue SE. Both 112th Avenue SE and 116th Avenue SE are tee-intersections with stop control on the minor leg. The only signalized intersection in this segment is located at 124th Avenue SE.

Most of this segment consists of one travel lane in each direction with left and right turn pockets provided at 120th Place SE, 121st Place SE, and 124th Avenue SE. Rainier Middle School, Hazelwood Elementary, and Lea Hill Elementary are located on the north side of SE 312th Street between 116th Avenue SE and 124th Avenue SE.

There are no sidewalks between 112th Avenue SE and 120th Place SE. Between 120th Place SE and 124th Avenue SE, sidewalks have been constructed in some sections but they are not continuous on both sides of the road. In some locations, there is a shoulder or a bike lane provided but it is not a consistent treatment throughout. There are bus stops located at the intersection of 112th Avenue SE where the bus route turns to serve Green River College. Additionally, there is no on-street parking in this segment.

WHAT WE HEARD...

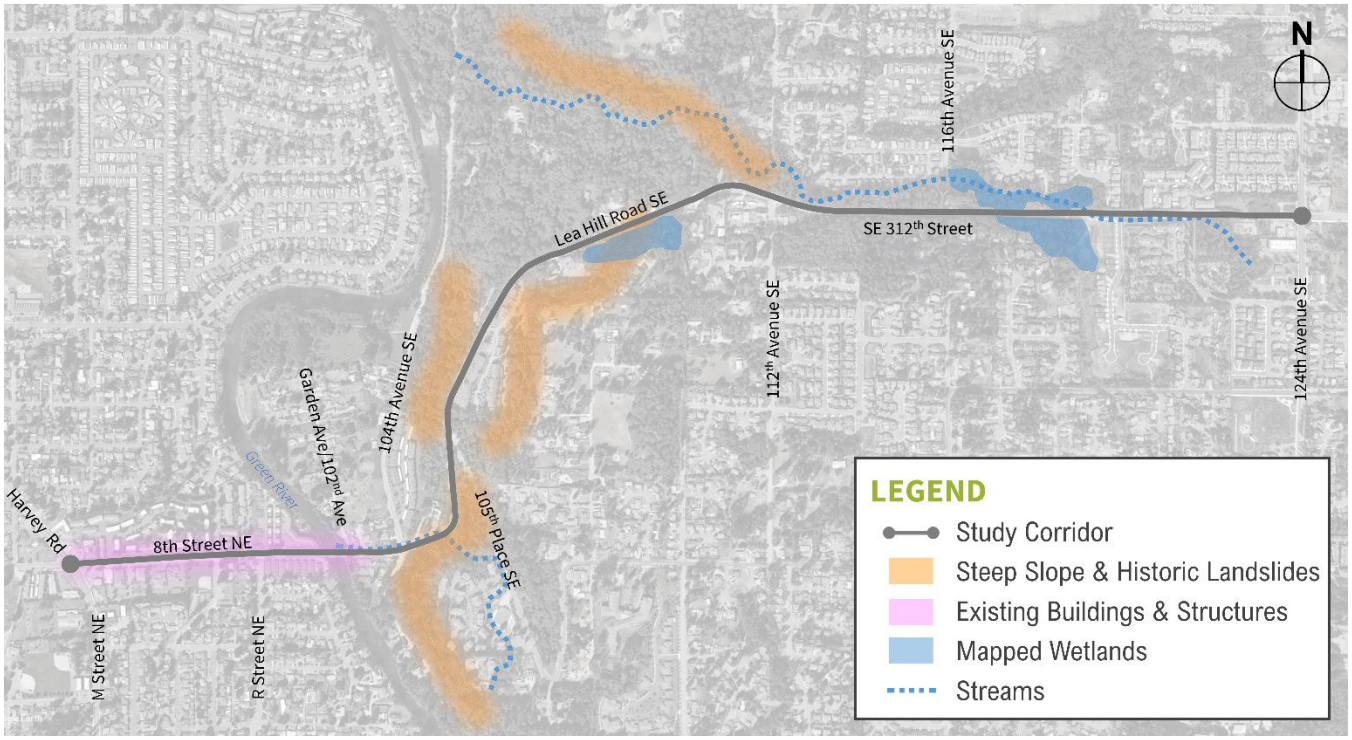
from community members during our Issues & Ideas Open House

- Difficulty turning from 112th Avenue SE due to limited visibility, speeding cars, bus stop proximity, and traffic conditions
- Difficult turning from 116th Avenue SE due to traffic conditions
- Vehicles drive in shoulder to get around turning vehicles at 112th and 116th Avenues
- Unsafe pedestrian activity crossing at 116th Avenue SE, including school children, without sidewalk or crosswalks
- Sidewalks are not continuous along SE 312th Street
- Lack of transit service at the top of Lea Hill
- Pedestrians crossing without crosswalks at 121st Place SE
- Vehicles speeding
- Traffic congestion at 124th Avenue SE due to Green River College traffic, mornings especially

Design Constraints

There are several physical features that make widening along the Lea Hill Road Corridor a challenge, potentially escalating costs and introducing potential additional environmental risks. Each segment of the corridor has a unique set of constraints which are illustrated in **Figure 2** and discussed in more detail below.

Figure 2. Diagram of Design Constraints



Existing Buildings & Structures

The majority of frontage improvements along the 8th Street NE segment of the study corridor, between Harvey Road/M Street and the 8th Street Bridge, has been constructed. In addition, many buildings built close to the right-of-way and the proximity of cultural resource properties, such as Scootie Brown Park, would make widening this segment of roadway particularly challenging. In addition, the 8th Street Bridge itself would be extremely costly to widen and/or replace and would potentially require permitting and environmental mitigation related impacts to the Green River and associated buffers.

Steep Slopes & Historic Landslides

Segment B, or Lea Hill Road between 104th Avenue SE and 112th Avenue SE, is characterized by very steep slopes running east-west with the uphill side on the east side of Lea Hill Road. A review of the King County topographic and sensitive areas data indicates historic slides in close proximity to Lea Hill Road and the entire roadway segment is within a landslide hazard area.

The slope west of Lea Hill Road, north of 105th Place SE, has experienced movement since the roadway was constructed in 1964 with the most recent episode of significant settlement occurring in March of

2014. At that time, the City installed monitoring points to evaluate the movement of the shoulder and hired Shannon & Wilson, Inc. to perform a geotechnical evaluation. The final report recommended a soldier pile retaining wall design to mitigate the existing hazards. Any widening of this section of roadway would require further geotechnical analysis and design considerations.

Mapped Wetlands & Streams

At the top of the hill, running along SE 312th Street, there is an unclassified stream that runs east-west. Between 112th Avenue SE to 120th Place SE, the stream runs on the north side of the road. In the proximity of 120th Place SE, the stream crosses SE 312th Street to the south and terminates before reaching 124th Avenue SE. There is also a mapped wetland complex that straddles SE 312th Street located between 116th Ave SE and 120th Place SE.

Traffic Volumes & Operations

Another aspect of this study was to evaluate traffic operations along the corridor, today as well as in the future, to better understand the transportation needs and inform the future corridor design.

Level of service (LOS) is an indicator of how well an intersection or corridor operates from the driver's perspective. LOS is defined using a grade-scale, where LOS A represents free flow traffic and LOS F represents gridlock. The City of Auburn, as established in the Transportation Element of the 2015 Comprehensive Plan, has set a minimum LOS standard for the Lea Hill Road Corridor of LOS E.

The City of Auburn maintains a travel demand model of the entire roadway network. The existing year model uses current traffic volumes, collected during a city-wide count program in October 2018, and distributes traffic throughout the network based on the underlying zoning designations and land uses. The horizon year model includes planned transportation improvements and anticipated growth based on current zoning and developable land to produce forecasted traffic distribution and volumes.

LOS DESCRIPTION

A	Free flow with little to no delay. No driver frustration.
B	Reasonably free flow with minimal delay. No driver frustration
C	Stable flow with some delay. Minimal driver frustration.
D	Approaching unstable flow with moderate delay. Some driver frustration.
E	Unstable flow with high delay. High driver frustration.
F	Severe congestion with excessive delay. Extreme driver frustration.

However, the traffic forecasting process revealed that there is substantial latent demand for the Lea Hill Road Corridor. Meaning, if the Lea Hill Road Corridor were to be widened to two lanes in each direction, as included in the City's Transportation Improvement Plan, the traffic demand model predicts that a substantial number of vehicles would move from other routes in the network to the Lea Hill Road Corridor. In other words, the act of increasing capacity on the corridor causes an increase in demand which translates into an extremely high growth rate for traffic on the corridor. Therefore, to get a purer growth rate for the purposes of our effort, an additional model scenario was prepared which assumes that the Lea Hill Road Corridor remains one lane in each direction.

The City's current horizon year model forecasts for 2035, however the standard planning horizon is 20 years. Therefore, we grew the 2035 volumes an additional five years to create a 2040 horizon year forecast. While the growth estimate was done on an individual intersection and movement basis to account for location-specific land use development potential, generally speaking, we found that the study corridor is expected to experience a roughly 2% annual growth rate in traffic volumes over the 20-year planning horizon.

The existing (2018) and horizon year (2040) forecasted volumes were used to perform operational analysis at key study intersections to understand how our roadway network is expected to operate in the future and what improvements are needed to solve any existing or emerging transportation issues. The forecasted volumes were also used during the alternatives analysis to compare intersection operations and informed the future intersection design. **Table 1** summarizes how the key study intersections operate today and are expected to operate in the future without any improvements to the transportation network.

Table 1. Intersection Operations – Existing (2018) and Horizon Year (2040) Without Improvements

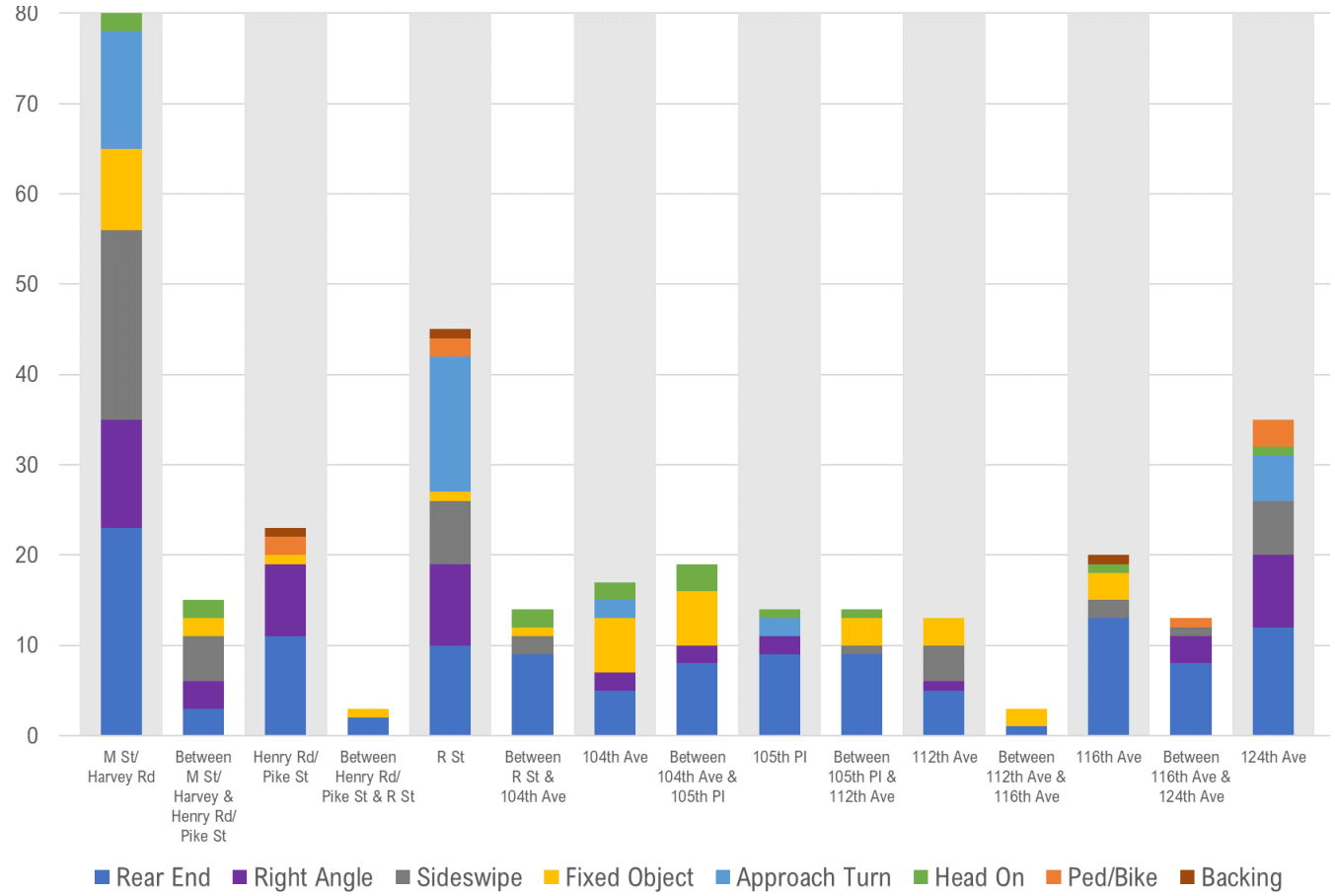
Intersection	Level of Service (LOS)	
	Existing (2018)	Horizon Year (2040)
8th Street NE & Harvey Road/M Street NE	D	D
8th Street NE & Pike Street NE	C	F
8th Street NE & R Street NE	B	C
Lea Hill Road SE & 104th Avenue SE	B	C
Lea Hill Road SE & 105th Place SE	A	D
Lea Hill Road SE & 112th Avenue SE	C	F
SE 312th Street & 116th Avenue SE	C	F
SE 312th Street & 124th Avenue SE	C	D

Intersection operations in the forecast year indicate that the minor-leg stop control intersections of Pike Street NE, 112th Avenue SE, and 1116th Avenue SE are anticipated to be failing by the 2040 horizon year. The results of this analysis provide insights into the prioritization of improvements based on operational need and capacity constraints. Detailed outputs of the operational analysis are included as **Appendix A**.

Crash History

Crash data along the corridor was analyzed to identify any existing safety concerns and/or collision patterns. Similar to the operational analysis, the safety analysis results were also used to make sure the project addresses existing safety issues and helps to prioritize improvements. The City of Auburn maintains a crash database which was used to gather reported crashes within the study limits that occurred over a five-year period (2014-2018). **Figure 3** is a summary of the number and type of crashes reported by intersection or midblock segment along the study corridor.

Figure 3. Crash Frequency and Type by Location (2014-2018)



In total, there were 328 crashes reported along the study corridor over the five-year analysis period (2014-2018). In general, more crashes occurred at intersections compared to midblock segments. M Street NE and R Street NE, both located on 8th Street NE, experienced the highest number of crashes with 80 and 45 respectively. The midblock segment with the highest number of crashes was Lea Hill Road between 104th Avenue and 105th Place, mostly consisting of rear ends or collisions with fixed objects. There were eight total collisions involving pedestrians and cyclists that occurred during the analysis period. **Table 2** summarized the type and location of each.

Table 2. Pedestrian and Bicycle Crashes by Location (2014-2018)

Location	Pedestrian	Bicycle
8th Street NE & Pike street NE	2	0
8th Street NE & R Street NE	1	1
SE 312th Street, between 116th Avenue SE and 124th Street SE	1	0
SE 312th Street & 124th Avenue SE	3	0
TOTALS	**7**	**1**

Table 3 summarizes the crash severity by study intersection and midblock segment. Of the study intersections, R Street NE, 104th Avenue SE, and 112th Avenue SE had the highest percentage of injury crashes relative to the total number of crashes reported. In addition, the intersection of R Street NE and 8th Street NE is the location of the only fatality that occurred on the study corridor during the analysis period. The midblock segment between 112th Avenue SE and 116th Avenue SE had the highest percentage of injury crashes, but the total number of crashes was very low compared to other locations.

Table 3. Crash Severity by Location (2014-2018)

Location	Fatality	Severe Injury	Evident Injury	Possible Injury	Property Damage	Unknown	Total	% Injury Crashes*
At 8th Street NE & M Street NE/Harvey Road NE	0	1	2	18	59	0	**80**	26.3%
Between Harvey Rd/M St & Henry Rd/Pike St	0	0	0	4	11	0	**15**	26.7%
At 8th Street NE & Henry Road/Pike Street NE	0	0	2	5	15	1	**23**	30.4%
Between Henry Rd/Pike St & R St	0	0	0	0	3	0	**3**	0.0%
At 8th Street NE & R Street NE	1	1	6	11	26	0	**45**	42.2%
Between R St & 104th Avenue SE	0	0	1	2	11	0	**14**	21.4%
At Lea Hill Road SE & 104th Avenue SE	0	0	3	4	10	0	**17**	41.2%
Between 104th Ave & 105th Place SE	0	0	3	2	14	0	**19**	26.3%
At Lea Hill Road SE & 105th Place SE	0	0	0	1	12	1	**14**	7.1%
Between 105th Place SE & 112th Avenue SE	0	0	0	3	10	1	**14**	21.4%
At SE 312th Street & 112th Avenue SE	0	1	0	4	7	1	**13**	38.5%
Between 112th Avenue SE & 116th Avenue SE	0	0	0	2	0	1	**3**	66.7%
At SE 312th Street & 116th Avenue SE	0	0	3	3	14	0	**20**	30.0%
Between 116th Avenue SE & 124th Avenue SE	0	1	1	3	8	0	**13**	38.5%
At SE 312th Street & 124th Avenue SE	0	0	2	4	29	0	**35**	17.1%
TOTALS	**1**	**4**	**23**	**66**	**229**	**5**	**328**	28.7%

*Injury Crashes includes all crashes within the Fatality, Severe Injury, Evident Injury, and Possible Injury categories.

Public Involvement

Public involvement is a critical component of any planning process – facilitating the exchange of information between the project team and community. An effective plan must be informed by the people who will be most affected by its implementation and aim to accurately reflect their needs, priorities, and vision. Throughout the study, a variety of methods were used to share information with and gather feedback from area residents, key stakeholders, City partners, and local decision makers.

Transportation Advisory Board Briefings

The City of Auburn's Transportation Advisory Board (TAB) is a broad-based group of stakeholders that serves a critical role in providing the Mayor, City Council, and staff with an invaluable community perspective that helps to shape policy and financial decisions affecting transportation in the community. The TAB meets on a quarterly basis to discuss current transportation topics in the community. Throughout the project, project information was shared with the TAB for their review and input. Briefing topics included a project introduction, our project evaluation criteria, and the preliminary recommendations. Members of the TAB were also asked to share the project information with the entities or groups they represented to expand the reach of our engagement effort.

Stakeholder Coordination

Throughout the project, we shared information about the project and upcoming engagement opportunities with key stakeholders. In addition, meetings were held with King County Metro, Green River College, Auburn School District, Valley Regional Fire Authority, and Auburn Police Department to discuss the preliminary recommendations. Their review and comments were used to advance the corridor plan and highlight further design considerations specific to their operations. As projects move from conceptual design into preliminary and final design, additional engagement with these and other key stakeholders is recommended to further refine corridor design details.

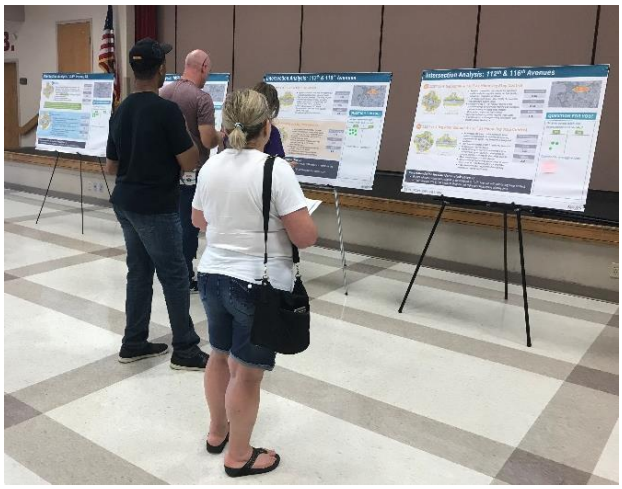
Project Webpage

A project-specific webpage, located on the City of Auburn webpage, was developed and maintained over the course of the project to provide background information, share public meeting materials and summaries, advertise upcoming engagement events, link to online surveys, and provide project contact information. Once finalized, a link to this study will be posted on the City's transportation web page.

Public Open Houses and Surveys

Over the course of the project, the City held two public open house events to share project information and gather valuable feedback from area residents who are most familiar with the corridor. Both of the open houses included in-person events held at Rainier Middle School as well as an online version of the open

house for those community members who were unable to attend the physical open house. The online open house was available for two weeks following each of the in-person events.



Public open house events; Issues & Ideas (left) and Preliminary Recommendations (right)

To get the word out about the open houses, the City sent postcards to area residents, posted the event on the project webpage, notified stakeholders groups, advertised in the Auburn Reporter, emailed notification to our project distribution list, and shared it on the City of Auburn Facebook page and other social media sites as appropriate.

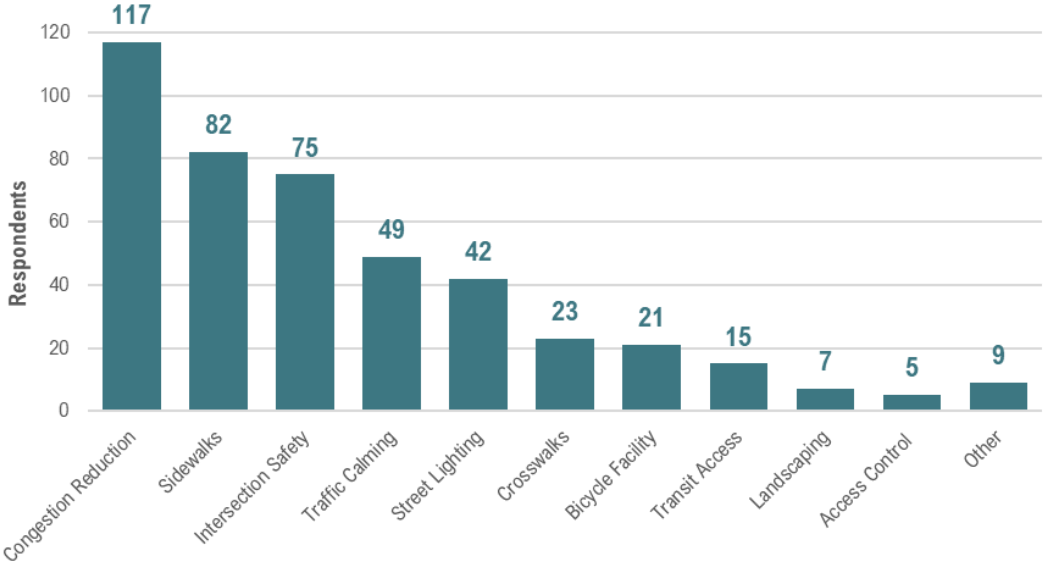
Issues & Ideas Open House

The first open house was held on January 16th, 2019 with the online version available until February 1st. The purpose of the event was to introduce the public to our project and gather input centered around existing issues and ideas. The information shared was used to develop and evaluate the various design alternatives.

In total, the City heard from over 160 members of the community. The large majority of participants (70%) reported using the Lea Hill Road Corridor everyday which indicates that the comments shared were from people who are very familiar with the study area and were speaking from first-hand experience.

When asked what type of improvements were most important, the highest priority among survey participants was implementing traffic congestion reduction measures. Constructing and connecting sidewalks and increased intersection safety were the second and third most important improvements. Many respondents also wanted to see some form of traffic calming and improved street lighting. The need for pedestrian safety improvements ranked higher than either bicycle facilities and transit access improvements. Landscaping, a median, and public spaces were the lowest priorities among respondents which tells us having a corridor that accommodates all modes safely and efficiently is more important than how it looks and feels. These survey results are summarized in **Figure 4** below.

Figure 4. Survey Respondent's Priority Corridor Improvements



Participants were also asked to provide map-based comments both in-person and online. In total, we received 308 map-based comments. In the graphic below, the circles indicate the number of intersection-related comments received which highlight some of the 'hot spots', most notably the 112th Avenue SE intersection. **Figure 5** illustrates what types of comments were submitted, including both intersection-related and segment-related comments.

Figure 5. Overview of Map-Based Comments Received

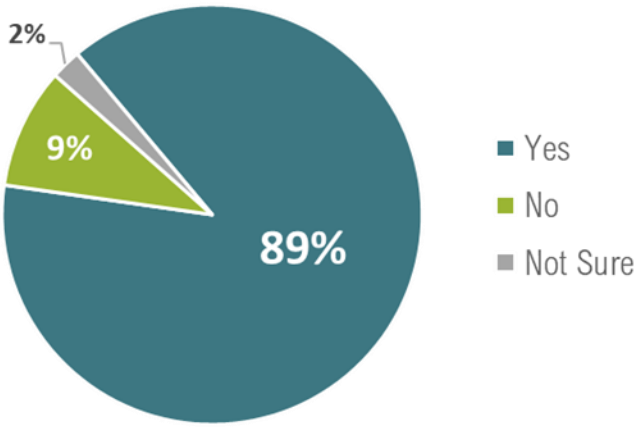
Preliminary Recommendations Open House

A second round of public open houses were held to share the results of the alternatives analysis process and gather feedback on our preliminary recommendations. The open house consisted of a two in-person events held on July 25th, 2019 and September 5th, 2019. An online version of the open house was also available between July 25th and September 20th, 2019 for those who were unable to attend in-person. In total, over 95 members of the community participated in the open house.

Our survey found that performance metrics that were used in the alternatives analysis spoke to most of the community's concerns and project objectives. In addition, the City's weighting assigned to these performance metrics was determined to be very similar to the priorities that the public shared which further validated the results of our analysis.

We also learned that the majority of respondents are supportive of roundabouts in Auburn, as demonstrated in **Figure 6**. Some community members expressed the need for an educational campaign and want to make sure pedestrian and bicycle crossings are safely designed.

Figure 6. Community Support for Roundabouts



In general, the majority of respondents were supportive of the preliminary recommendations that were presented. However, some participants did not fully support the proposed access limitations at 105th Place SE while others suggested a full closure at this location. As a result, further discussions with stakeholders were required to better understand the full impacts of restricting access more fully at 105th Place SE.

Council Study Session

The draft corridor plan was presented to Auburn City Council during a Council Study Session on June 8, 2020. In general, the City Council was agreeable to the corridor recommendations that were presented and look forward to seeing these proposed projects come to realization.

Alternatives Analysis

To determine the recommended corridor design, our analysis considered different intersection and roadway cross section alternatives and evaluated them using a value-based evaluation method. This section describes the analysis methodology and results.

Evaluation Method

The evaluation of alternatives used value-based approach to find the most cost-effective solution that best meet our project objectives.

The performance score represents how well each alternative satisfied a series of project-specific performance metrics. Details about the performance metrics used and the scoring methodology are provided below.

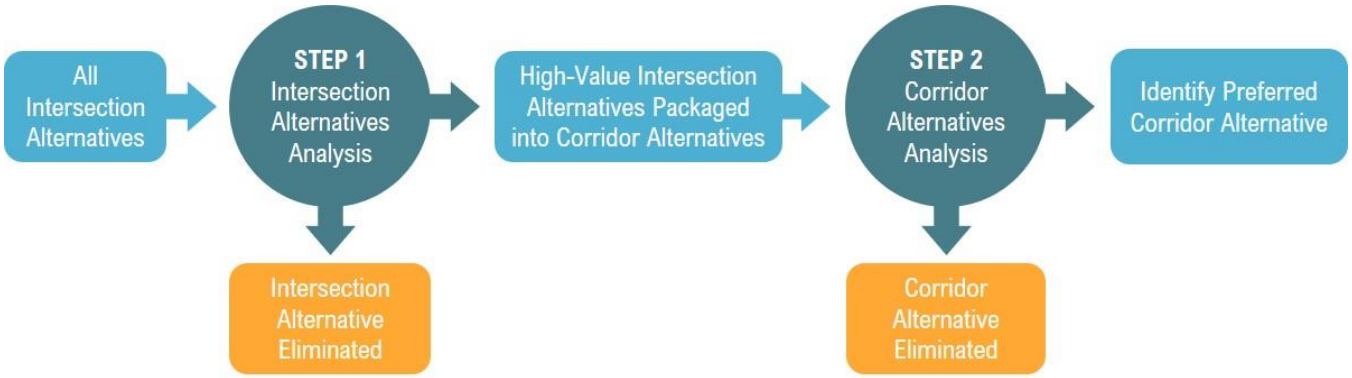
The relative cost score was determined by comparing high-level, construction cost estimates of each alternative. The cost estimates used during our evaluation were not all inclusive and were used to better understand the relative cost between options. A full cost estimate was prepared for the preferred corridor design which is discussed in the final chapter of this report.

The performance score of each alternative was divided by its cost score to produce the value score for that alternative. The alterative value scores were compared to determine which solution provides the most 'bang for the buck' and should either be advanced to the next round of analysis or chosen as the preferred corridor design alternative.

Two-Step Evaluation Process

The evaluation of alternatives was carried out using a two-step process as illustrated in **Figure 7**.

Figure 7. Alternatives Analysis Process Diagram



Step 1 of the process, the Intersection Alternatives Analysis, was to evaluate alternatives at the intersection level to determine which alternatives offer the highest value and should be advanced to the following step in the evaluation. In some instances, lower value alternatives were advanced to fully understand the corridor-wide impacts of an alternative. There were three groups of alternatives that were considered at each of the following intersecting streets:

- 104th Avenue SE
- 105th Place SE
- 112th Avenue SE & 116th Avenue SE

Step 2 of the process, the Corridor Alternatives Analysis, packaged the advanced intersection alternatives into corridor alternatives which were then evaluated to determine the preferred corridor alternative. In total, four corridor alternatives were evaluated.

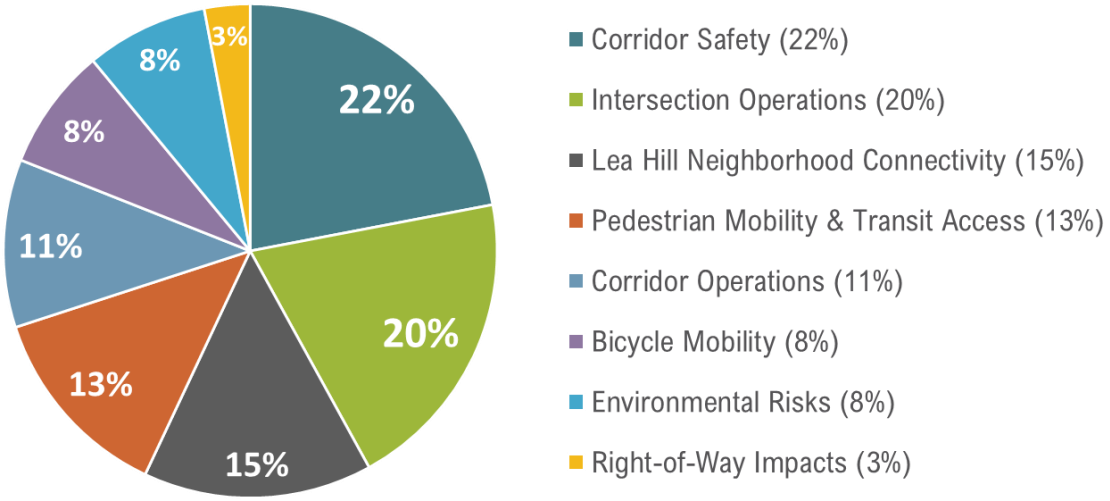
Evaluation Criteria & Scoring

To measure the expected performance of the alternatives, the project team developed a series of project-specific criteria which speak directly to our project objectives. Below is a list of each of these criteria, how they were defined, and what metric was used to evaluate each.

- **Corridor Safety** – Minimize the number of conflict points and predicted crashes
- **Intersection Operations** – Minimize vehicle delay and congestion at key intersections
- **Corridor Operations** – Minimize vehicle travel times and maximize vehicle throughput
- **Lea Hill Neighborhood Connectivity** – Increase street connectivity and route options in the neighborhood
- **Pedestrian Mobility & Transit Access** – Improve the walking environment and access to bus stops
- **Bicycle Mobility** – Improve access and safety for cyclists on the corridor
- **Environmental Risks** – Limit impacts to steep slopes, streams, wetlands, and other environmental hazards and cultural resources
- **Right-of-Way Impacts** – Minimize property acquisition and the number of property relocations

Through discussions among the City of Auburn and the consultant project team and using a pair-wise comparison technique, each of the eight performance criteria was assigned a weight, as a percentage, to reflect how important each criteria is to the decision-making process. During the outreach process, the community was asked what their priorities were to help validate and refine the assigned weighting. **Figure 8** illustrates the assigned weights of each performance criteria.

Figure 8. Performance Criteria and Weighting



Scoring of the alternatives was done in a relative manner, comparing the alternatives against each other. For each of the project-specific criteria, a scoring scale was developed to represent the range of values observed or measured. Using this scale, a score between 0 (worst score) and 10 (best score), was assigned to each of the alternatives. These scores were then combined, according to the previously defined weighting, to produce an overall performance score. When the performance score is divided by the cost score, it results in the alternative's value score. The overall value scores were used to determine which of the intersection alternatives should be advanced to the corridor analysis and which corridor alternative was determined to be the preferred corridor design.

Intersection Alternatives & Analysis Results

On the following pages, each alternative considered during the Intersection Alternatives Analysis (Step 1) is presented for each of the three study corridor segments. A summary of the analysis results, including the relative performance, cost, and value scores is provided as well as the recommendations for which alternatives should be considered in the Corridor Alternatives Analysis (Step 2). For more detail on the scoring and analysis results, see **Appendix B**.

104th Avenue SE

Two intersection alternatives were considered at the intersection of 104th Avenue SE and Lea Hill Road SE. These included a signalized intersection and a multi-lane roundabout. Both intersection options were designed and analyzed using the forecasted 2040 traffic volumes. A summary of the analysis results is provided in **Figure 9**.

Figure 9. 104th Avenue SE Intersection Alternatives Analysis Results

A1 Signal

- Signalized intersection has more conflict points with more potential for crashes, particularly crashes resulting in injury
- One eastbound receiving lane does not resolve merging and jockeying behavior over bridge
- Operates at level of service (LOS) C during PM peak hour with queue and capacity issues
- No major environmental impacts
- Minimal right-of-way acquisition required

Performance		Cost		Value
0.51	÷	0.50	=	**1.0**

A2 Roundabout

- Roundabout is safer intersection control with fewer conflict points and slower vehicle speeds
- Carrying two eastbound lanes through the roundabout reduces merging and jockeying behavior over bridge
- Operates at LOS B during PM peak hour with no significant queues
- Roundabout allows for U-turns and provides an alternative to making eastbound left-turns on 8th Street
- No major environmental impacts
- Minimal right-of-way acquisition required

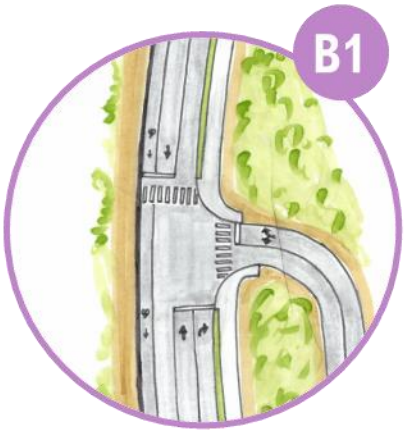
Performance		Cost		Value
0.85	÷	0.50	=	**1.7**

Based on the results of our analysis, only the roundabout alternative (A2) was advanced to Step 2 (Corridor Alternatives Analysis) because it represented the highest-value alternative. The signal alternative (A1) was removed from further consideration.

105th Place SE

Four intersection alternatives were considered at the intersection of 105th Place SE and Lea Hill Road SE. The options included: 1) remaining as full-access signalized intersection, 2) limiting access at 105th Place SE to right-in/right-out and removing the signal, 3) converting 105th Place SE to one-way in the downhill direction with a signalized intersection, and 4) removing the signal and implementing a full closure of 105th Place SE between Lea Hill Road SE and the Amberview Apartment access road. All intersection options were designed and analyzed using the forecasted 2040 traffic volumes. A summary of the analysis and results is provided in **Figure 10**.

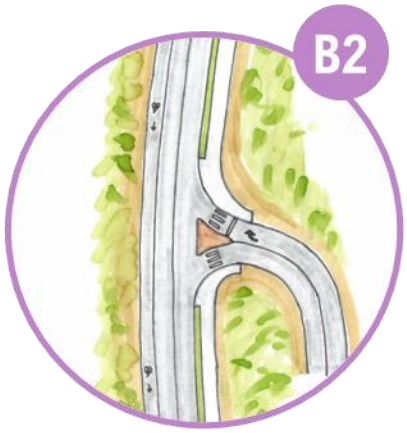
Figure 10. 105th Place SE Intersection Alternatives Analysis Results



B1 Southbound Left-turn Ban (Signalized)

- Southbound left-turn restriction reduces friction on the corridor
- Signalized intersection has potential for high-speed crashes
- Operates at LOS B during PM peak hour with manageable queues
- Widening required results in need for retaining wall (approximately 725-feet), introducing more environmental risk than B2 or B3

Performance		Cost		Value
0.67	÷	0.44	=	**1.5**



B2 Right-in/Right-out (Unsignalized)

- Free flow of Lea Hill traffic with minor delay for low-volume westbound right-turn
- Widening required results in need for retaining wall (approximately 135-feet), introducing less environmental risk than B1
- Redirects westbound lefts (105th Place to Lea Hill Road) to 112th Avenue & 124th Avenue
- No controlled pedestrian crossing provided across Lea Hill Road which is not needed unless a new southbound bus stop is proposed here

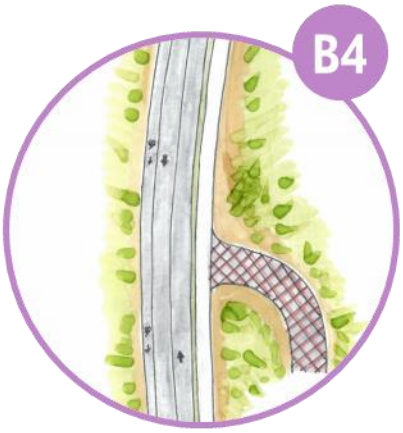
Performance		Cost		Value
0.71	÷	0.18	=	**3.9**

Figure 10. 105th Place SE Intersection Alternatives Analysis Results (continued)

B3 One-way Downhill (Signalized)

- Signalized intersection has potential for high-speed crashes
- Operates at level of service C during PM peak hour with significant queues, especially northbound
- Widening required results in need for retaining wall (approximately 135-feet), introducing less environmental risk than B1
- Redirects northbound rights (Lea Hill Road to 105th Place) to 112th Avenue & 124th Avenue

Performance		Cost		Value
0.57	÷	0.21	=	**2.7**



B4 Full Closure (Unsignalized)

- Free flow of Lea Hill traffic with minor delay for low-volume westbound right-turn
- Widening required results in need for retaining wall (approximately 135-feet), introducing less environmental risk than B1
- Redirects all 105th Place traffic to alternative routes (112th Avenue & 124th Avenue)
- Increased travel times for all travelers including emergency response
- Continuous pedestrian and bicycle facility without interaction with turning vehicles

Performance		Cost		Value
0.63	÷	0.17	=	**3.7**

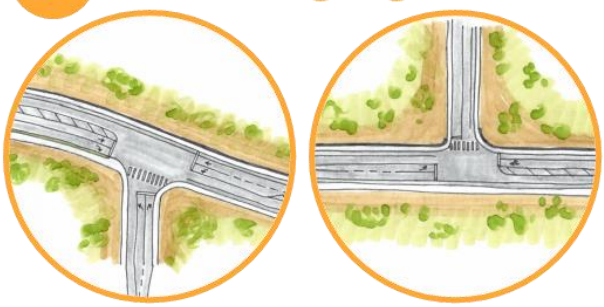
Based on the results of our analysis, the right-in/right-out access, unsignalized alternative (B2) was advanced to Step 2 (Corridor Alternatives Analysis) because it represented the highest-value alternative. However, the right-in/right-out alternative involves a significant diversion of turning traffic from 105th Place SE to other network intersections. To better understand the corridor-wide effects of this access change, we also advanced the full access, signalized intersection (B1) even though it was not found to be a high-value alternative.

112th Avenue & 116th Avenue

For evaluation purposes, 112th Avenue SE and 116th Avenue SE were developed and analyzed together. There was a total of eight intersection options that were considered which included combinations of minor-leg stop control, signals, and roundabouts. We also considered four-leg intersections at both locations. All intersection options were designed and analyzed using the forecasted 2040 traffic volumes. A summary of the analysis and results in provided in **Figure 11**.

Figure 11. 112th Avenue SE & 116th Avenue SE Intersection Alternatives Analysis Results

C1 Both 3-leg Signals



112th Ave SE 116th Ave SE

- Signalized intersections have more conflict points than roundabouts and potential for high-speed crashes
- Each intersection operates at LOS D during PM peak hour with queuing issues on minor leg
- Retaining walls required to mitigate steep slope impacts on north side at 112th Avenue
- Minor wetland impacts at 116th Avenue
- No relocations but some right-of-way acquisition required (strip takes)
- No additional neighborhood connectivity

Performance		Cost		Value
0.49	÷	0.13	=	**3.9**

C2 Both 3-leg Roundabouts

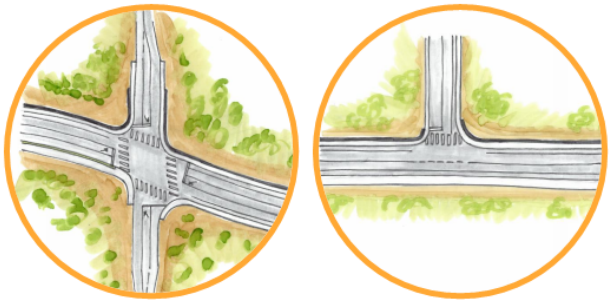
112th Ave SE 116th Ave SE

- 3-leg roundabout intersections have the fewest possible conflict points and slower vehicle speeds
- 112th Avenue operates at LOS B and 116th Avenue operates at LOS A during PM peak hour with no capacity or queueing issues
- Retaining walls required to mitigate steep slope impacts on north side at 112th Avenue
- Minor wetland impacts
- Requires one full right-of-way take of parcel on southwest corner of 112th Avenue
- No additional neighborhood connectivity but roundabouts make intersections more efficient

Performance		Cost		Value
0.78	÷	0.12	=	**6.6**

Figure 11. 112th Avenue SE & 116th Avenue SE Intersection Alternatives Analysis Results (continued)

C3 112th as 4-leg Signal & 116th as Minor-leg Stop Control

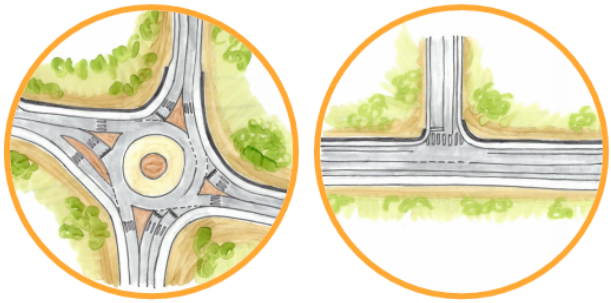


112th Ave SE 116th Ave SE

- Signalized intersection has potential for high-speed crashes and minor-leg stop control can lead to risky behaviors in congested conditions
- 112th Avenue operates at LOS D during PM peak hour with significant queuing issues
- Adding north leg to 112th Avenue requires a cost-prohibitive bridge structure and retaining wall to mitigate a stream crossing and steep slope impacts
- Minor wetland impacts at 116th Avenue
- Some right-of-way acquisition required (strip takes)
- 4-leg intersection adds neighborhood connectivity with greater regional significance

Performance		Cost		Value
0.48	÷	0.43	=	**1.1**

C4 112th as 4-leg Roundabout & 116th as Minor-leg Stop Control



112th Ave SE 116th Ave SE

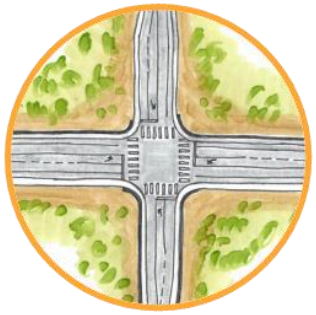
- Roundabout has fewer conflict points and slower speeds than signalized intersections but minor-leg stop control can lead to risky behaviors in congested conditions
- 112th Avenue operates at LOS B during PM peak hour no queuing or capacity issues
- Adding north leg to 112th Avenue requires a cost-prohibitive bridge structure and retaining wall to mitigate a stream crossing and steep slope impacts
- Minor wetland impacts at 116th Avenue
- Requires one full right-of-way take of parcel on south-west corner of 112th Avenue and some strip takes
- 4-leg intersection adds neighborhood connectivity with greater regional significance

Performance		Cost		Value
0.70	÷	0.32	=	**2.2**

Figure 11. 112th Avenue SE & 116th Avenue SE Intersection Alternatives Analysis Results (continued)

C5 112th as Minor-leg Stop Control & 116th as 4-leg Signal

112th Ave SE



116th Ave SE

- Signalized intersection has potential for high-speed crashes and does not resolve sight issues related to minor-leg stop control at 112th Avenue
- 116th Avenue operates at LOS C during PM peak hour with manageable queues
- Adding south leg to 116th Avenue requires tall retaining wall to maintain adequate roadway grades
- One full right-of-way take on southwest corner of 116th Avenue with significant slope easements
- Minor wetland impacts at 116th Avenue
- 4-leg intersection adds neighborhood connectivity with lesser regional significance

Performance		Cost		Value
0.48	÷	0.22	=	**2.2**

C6 112th as Minor-leg Stop Control & 116th as 4-leg Roundabout

112th Ave SE

116th Ave SE

- Roundabout has fewer conflict points and slower speeds than signalized intersections but does not resolve sight issues related to minor-leg stop control at 112th Avenue
- 116th Avenue operates at LOS B during PM peak hour no queuing or capacity issues
- Adding south leg to 116th Avenue requires tall retaining wall to maintain adequate roadway grades
- One full right-of-way take on southwest corner of 116th Avenue with significant slope easements
- Minor wetland impacts at 116th Avenue
- 4-leg intersection adds neighborhood connectivity with lesser regional significance

Performance		Cost		Value
0.57	÷	0.19	=	**3.0**

Figure 11. 112th Avenue SE & 116th Avenue SE Intersection Alternatives Analysis Results (continued)

C7 Both as 4-leg Signals

112th Ave SE

116th Ave SE

- Signalized intersections have more conflict points than roundabouts and potential for high-speed crashes
- Both intersections operate at LOS C during PM peak hour with some queueing issues
- Adding north leg to 112th Avenue requires a cost-prohibitive bridge structure and retaining wall to mitigate a stream crossing and steep slope impacts
- Minor wetland impacts at 116th Avenue
- Adding south leg to 116th Avenue requires tall retaining wall to maintain adequate roadway grades
- Requires one full right-of-way take at 116th Avenue, some strip takes, and significant slope easements

Performance		Cost		Value
0.47	÷	0.56	=	**0.8**

C8 Both as 4-leg Roundabouts

112th Ave SE

116th Ave SE

- Roundabouts have fewer conflict points and slower speeds than signalized intersections
- 112th Avenue operates at LOS B and 116th Avenue operates at LOS A during PM peak hour no queuing or capacity issues
- Adding north leg to 112th Avenue requires a cost-prohibitive bridge structure and retaining wall to mitigate a stream crossing and steep slope impacts
- Minor wetland impacts at 116th Avenue
- Adding south leg to 116th Avenue requires tall retaining wall to maintain adequate roadway grades
- Requires two full right-of-way takes, some strip takes, and significant slope easements

Performance		Cost		Value
0.75	÷	0.43	=	**1.7**

Based on the results of our analysis, the three-leg roundabouts at each intersection alternative (C2) and the four-leg roundabout at 116th Avenue SE alternative (C6) were advanced because they represented the two highest value alternatives. All other alternatives were removed from further consideration.

Corridor Alternatives & Analysis Results

Combining each of the intersection alternatives that was advanced to the Corridor Intersection Analysis (Step 2), we have a total of four corridor alternatives that were evaluated using the same methodology only now considering interactions on a corridor level. A summary of the alternatives and evaluation results is provided in **Figure 12**. For more detail on the scoring and analysis results, see **Appendix C**.

Figure 12. Corridor Alternatives Analysis Results

Corridor Alternative 1

Performance		Cost		Value
0.64	÷	0.24	=	**2.7**

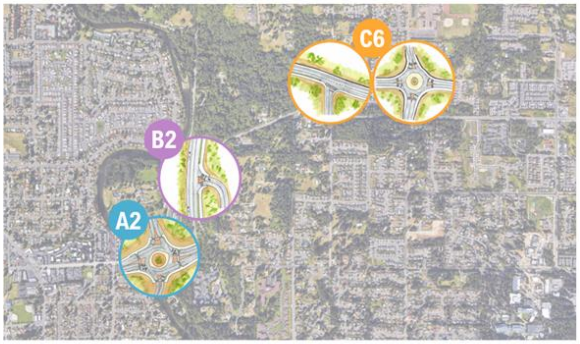
Corridor Alternative 2

Performance		Cost		Value
0.53	÷	0.30	=	**1.8**

Corridor Alternative 3

Performance		Cost		Value
0.62	÷	0.20	=	**3.2**

Corridor Alternative 4



Performance		Cost		Value
0.53	÷	0.26	=	**2.0**

Based on these results, the preferred combination of intersection control for the Lea Hill Road Corridor was Corridor Alternative 3 which includes a multi-lane roundabout at 104th Avenue SE (A2), unsignalized intersection with right-in/right-out access at 105th Place SE (B2), and two 3-leg single-lane roundabouts at both 112th Avenue SE and 116th Avenue SE (C2).

Cross Section Alternatives

The frontage improvements and adjacent parcels on 8th Street NE (Segment A) have been built out. Widening through this section would have significant right-of-way impacts including residential displacements. In addition, the segment is constricted at the 8th Street Bridge. Widening the corridor to include five lanes, bike lanes, and 10-foot sidewalks per City Standard without widening or replacing the bridge would provide little operational benefits to the corridor.

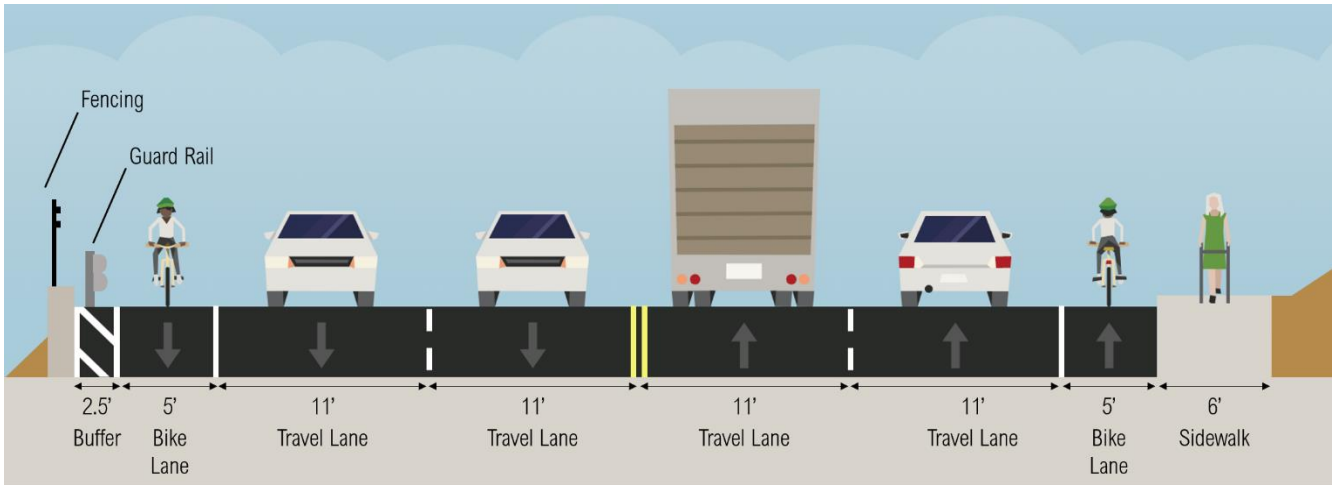
Existing and forecasted volumes on SE 312th Street (Segment C) do not warrant the need for an additional travel lane in each direction. However, the more frequent driveways and intersections between 116th Avenue SE and 124th Avenue SE create the need for dedicated turn lanes which are largely existing and will remain.

Lea Hill Road (Segment B), was the only study segment that warranted a review of cross section alternatives. On Lea Hill Road (Segment B), the limited number of adjacent properties requiring access between 104th and 116th, due to both topography and environmentally sensitive areas, indicates that there is no need for a continuous two-way, left-turn lane in this study segment. The alternatives considered are described below.

Two Travel Lanes in Each Direction

Volumes on the Lea Hill Road Corridor suggest that a second lane, especially in the eastbound, or uphill, direction may be warranted. Therefore, a standard section with two travel lanes and bicycle lanes in each direction was considered as shown in **Figure 13**.

Figure 13. Lea Hill Road Alternative – Two Travel Lanes in Each Direction



However, as discussed in the Study Area section, the traffic demand model indicates there is latent demand for the study corridor. Meaning if a second lane is constructed, vehicles in the network will shift from other routes and increasing traffic volumes on the corridor. Therefore, minimizing the operational benefits of provided a second travel lane.

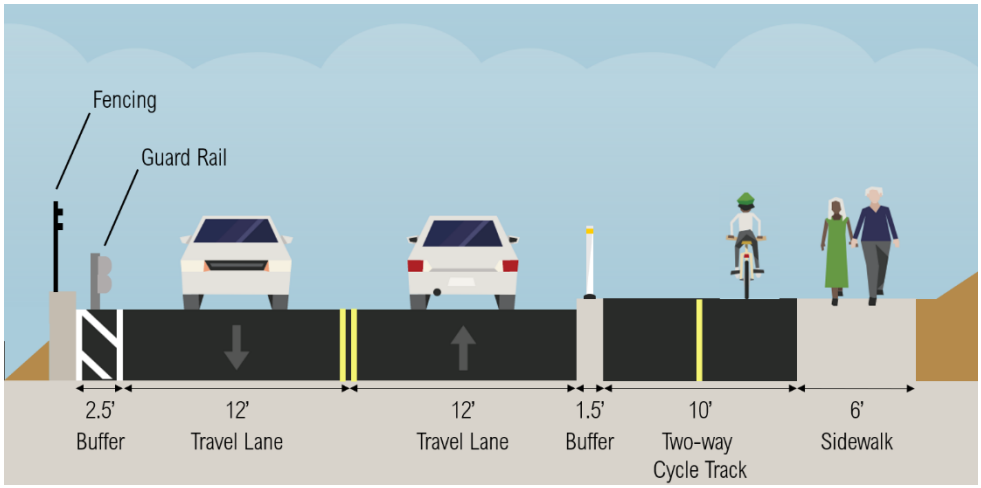
Most importantly, adding a second travel lane in either direction on Lea Hill Road requires significant retaining walls on the uphill and downhill side of the corridor. Construction of these walls would be expensive and hazardous. The hillside has moved during past construction activities.

Due to the expense and environmental risks and minimal operation gains, we determined the two-lane section to be fatally flawed and did not move it forward in the alternative analysis. To mitigate the landslide hazard, we reviewed two single lane cross sections for the Lea Hill Road segment.

One Travel Lane in Each Direction with Two-Way Cycle Track

The first section placed all the non-motorized users on the uphill side, or east side, of Lea Hill Road as there are few pedestrian generators on the downhill, or west, side of the road. The non-motorized facilities included a raised 10-foot wide two-way asphalt cycle track, buffered from traffic by 1.5-feet of concrete, adjacent to a 6-foot wide concrete sidewalk as shown in **Figure 14**.

Figure 14. Lea Hill Road Alternative – One Travel Lane in Each Direction with Two-Way Cycle Track



In this option, no on-road bicycle lanes were included. Therefore, the cycle track does not provide a continuous westbound bike facility and requires cyclists to cross the road at the 104th Street and 112th Street roundabouts to access the cycle track which could be considered an inconvenience for more experience cyclists.

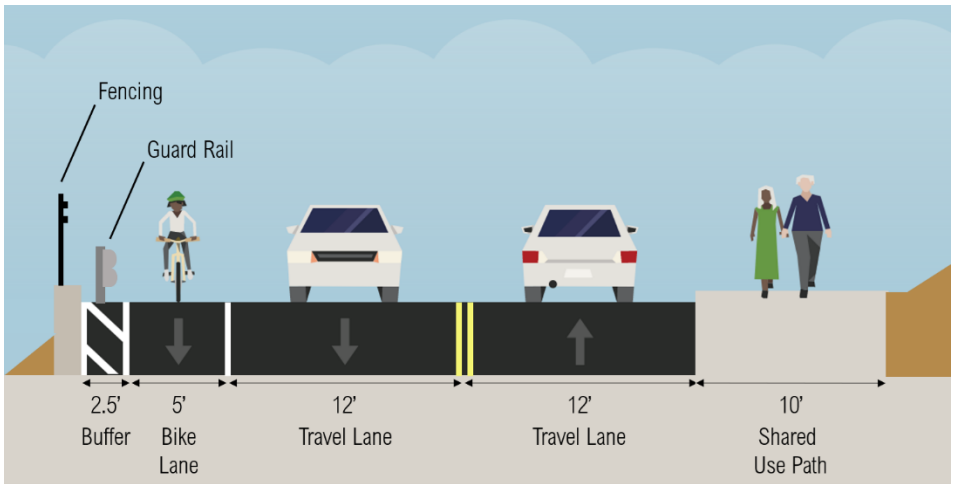
In addition, the proximity of downhill cyclists, who have the potential to be traveling at high speeds, to uphill bicyclists, who will be traveling at much slower speeds, introduces a safety concern. Likewise, the cycle track would travel through two bus loading areas, introducing conflicts between downhill bicyclists and transit riders that would be difficult to mitigate.

Also, the minimal buffer between downhill cyclists, with the potential to be going very quickly, and the uphill vehicle traffic traveling at the speed limit, presents the opportunity for severe injury in the event a cyclists or vehicle were to lose control. For these reasons, this option was found to unacceptable.

One Travel Lane in Each Direction with Downhill Bike Lane and Uphill Shared Use Path

The second single lane section analyzed includes a 5-foot downhill (westbound) bike lane and a ten-foot uphill (eastbound) shared use path as shown in **Figure 15**.

Figure 15. Lea Hill Road Alternative – One Travel Lanes in Each Direction with Downhill Bike Lane and Uphill Shared Use Path



This option provides a continuous bike facility in both directions. The shared use path provides a safe route for pedestrians and cyclists who will be traveling at slow speeds uphill. Due to the limited environmental impact and decreased conflicts between modes, this option was determined to be the preferred solution.

Corridor Design

The results of the alternatives analysis were used as the basis for our preliminary recommendations which were shared with the public and key stakeholders for review and input. Based on their feedback, the recommendations were further refined to create the final Lea Hill Road Corridor recommendations presented below. The end of this section highlights several key design considerations that will need to be revisited as elements of the project move into implementation.

Corridor Recommendations

The recommended conceptual corridor design is illustrated in **Figures 16**, **17**, and **18**. Each figure highlights a different aspect of the design: intersection treatments, roadway cross sections, and non-motorized facilities. Further design considerations, beyond what is included in these exhibits, are discussed in more detail in the section that follows. Additionally, a roll plot of the conceptual corridor design is included as **Appendix D**.

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Figure 16. Conceptual Corridor Design – Intersection Treatments

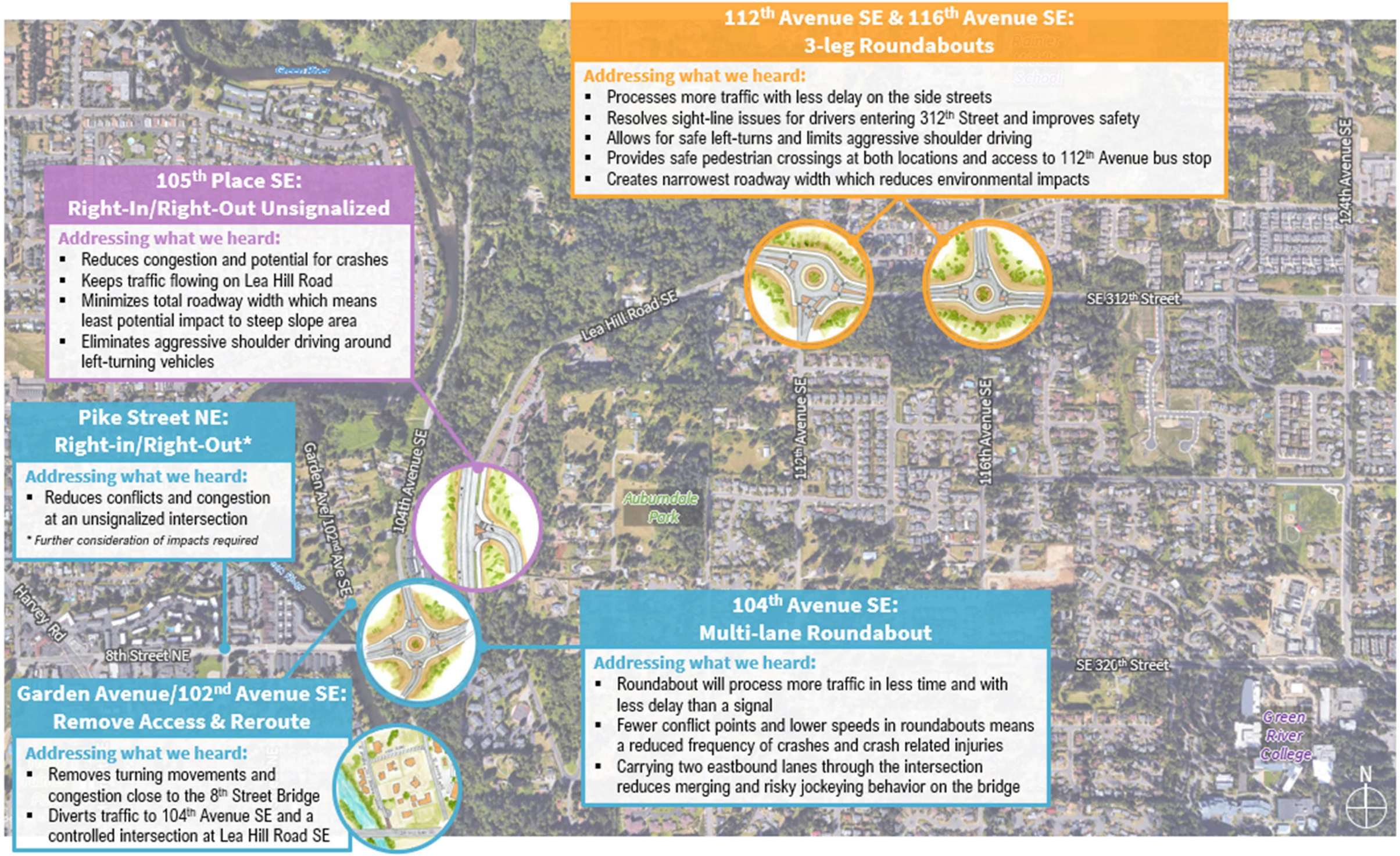

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Figure 17. Conceptual Corridor Design – Roadway Cross Sections

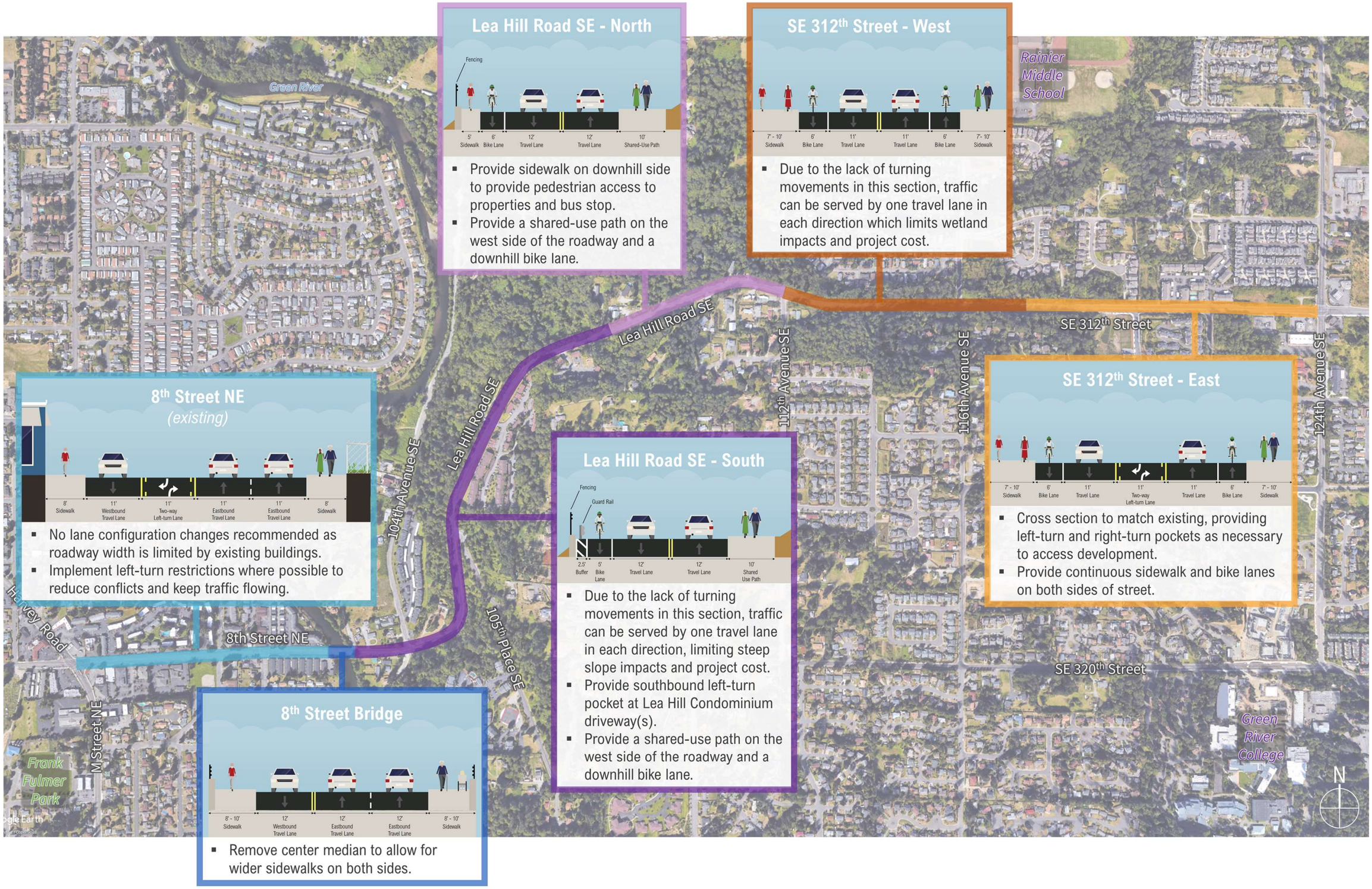

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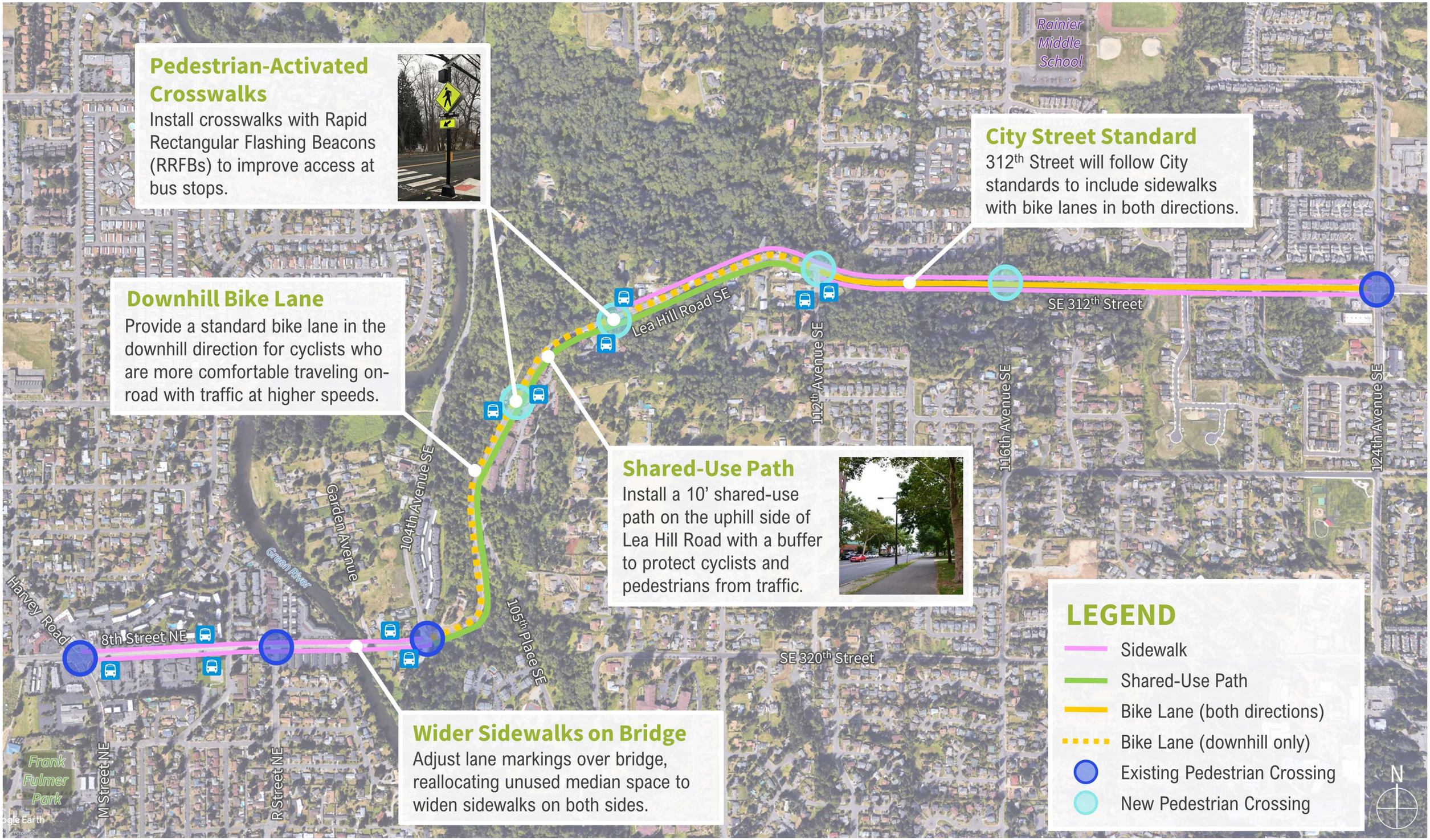
Figure 18. Conceptual Corridor Design – Non-Motorized Facilities



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Design Considerations

The conceptual design for the Lea Hill Road Corridor presented in this plan provides a solid foundation for future design phases. However, as project elements move into preliminary and final design, there are a number of details that will need to be figured out. The following section discusses some of these important design considerations and provides guidance which was informed by coordination with key stakeholders.

Pedestrian Facilities

The recommended corridor solution provides sidewalk the entire length of the Lea Hill Road Corridor. In most locations, sidewalks are proposed on both sides of the roadway. However, between 104th Avenue SE and 107th Place SE, a shared-use path located on the east side of Lea Hill Road is recommended due to the limited number of pedestrian generators in this segment as well as the physical constraints of widening. On the east side of Lea Hill Road at 106th Place SE, a bus boarding island (roughly 8-feet wide and 10-feet in length) will be constructed to provide access to the southbound bus stop which serves the Lea Hill Condominiums. In the following design phases, consideration will have to be given to the treatment at 'back-of-walk' to determine whether there is a need for retaining walls, fencing, or a slope easement. All sidewalks and ramps at crosswalks must be ADA compliant to safely accommodate users with vision-impairments and limited mobility.

RRFB Example

New crosswalks will be installed as a part of the roundabouts at both 112th Avenue SE and 116th Avenue SE. In addition, crosswalks are recommended on Lea Hill Road at both 106th Place SE and 107th Place SE to provide access to the bus stops. At these uncontrolled locations, rapid rectangular flashing beacons (RRFBs) are recommended to improve visibility, safety, and accessibility for pedestrians and transit users. The need for RRFBs should also be considered at the multi-lane crossings of the 104th Avenue SE roundabout.

The corridor plan also includes the restriping of the 8th Street bridge to remove an unused painted median and expand the sidewalks to 9' on both sides of the bridge. During design, a structural engineer will need to verify that bridge structure can support the additional concrete without requiring further structural modifications to the bridge.

Roundabout Design

Whenever possible, single-lane roundabouts are preferred over multi-lane roundabouts. Single-lane roundabouts have fewer conflict points, use up less right-of-way, and are easier to navigate for vehicles, pedestrians, and bicycles alike. Both roundabouts at 112th Avenue SE and 116th Avenue SE are designed to be single-lane roundabouts although the northbound approach to 112th Avenue SE will require a right-turn slip lane to accommodate the diverted traffic from 105th Place SE.

The multi-lane roundabout located at 104th Avenue SE has been designed to encourage a 'zipper merge' when exiting the roundabout traveling east or west. When driving through multi-lane roundabouts, vehicles tend to stagger themselves because they do not like to travel directly next to another vehicle while turning.

As a result, they exit the roundabout staggered and ready to merge. To improve safety, the merge point is purposely located after the pedestrian crossing but early enough that vehicles will not be back up to full speed. In addition, no indication is provided that one lane has right-of-way over the other (i.e. no 'merge left' or 'right lane ends' signs). Taking this design approach limits aggressive driving behaviors and encourages better 'zippering' upon exiting the roundabout.

During the design phase, the roundabout should be designed to accommodate turning movements for all types of vehicles that expected to regularly use the intersection. King County Metro (Metro) recommends using the 40' bus and 60' articulated bus templates in AutoTURN to ensure their vehicles can navigate the roundabout. In addition, Metro has informed the City that their buses cannot drive over the mountable truck apron because it causes maintenance issues with the articulation mechanism and disrupts riders. In multi-lane roundabouts, Metro would prefer their drivers straddle, or split, the lanes if absolutely necessary and an alternative to mounting the truck apron.

Transit

Incorporating transit operations was an important element of the corridor design. Metro currently operates Route 181 on the Lea Hill Road Corridor between the western project limit and 112th Avenue SE. The Lea Hill Road Corridor has also been identified as potential future Rapid Ride route which may require additional sidewalk width and/or space for rider amenities, to be determined based on ridership. However, there is not currently a timeline for Rapid Ride along this corridor.

In general, pullout bus stop treatments are undesirable because drivers have difficulty re-entering the flow of traffic, especially on higher volume corridors, which causes service delays and can increase the risk of collisions. For this reason, the Lea Hill Road Corridor plan assumes that all bus stops will happen in lane, blocking the flow of traffic in that lane while the bus is boarding and deboarding customers.

Metro is open to looking at the relocation of bus stops, in particular at 104th Avenue SE and 112th Avenue SE, to optimize both roadway conditions as well as bus operations. For instance, the current westbound bus stop at 104th Avenue SE is located on the far side of the intersection. Once the roundabout is constructed at this location, it is recommended that the bus stop be moved to the near-side of the roundabout. During design, Metro will be engaged to determine the best bus top locations and review the proposed designs.

Bus Stops in Roundabouts

Federal Highway Administration's (FHWA) guidance on roundabout design[1] states that bus stops should be located sufficiently far from the roundabout entries and exits and should never be located in the circulating lane. Bus stops can be located on either on the approach (near-side) or the exit (far-side) and the report provides the following guidance for both treatments:

[1] Transportation Research Board of the National Academies. *NCHRP Report 672: Roundabouts: An information Guide (Second Edition)*. Washington, D.C., 2010.

Near-side stops: If a bus stop is to be provided on the near side of a round-about, it should typically be located far enough away from the splitter island so that a vehicle overtaking a stationary bus is in no danger of being forced into the splitter island, especially if the bus starts to pull away from the stop. If an approach has only one lane and capacity is not an issue on that entry, the bus stop could be located at the pedestrian crossing in the lane of traffic. This is not recommended for entries with more than one lane because vehicles in the lane next to the bus may not see pedestrians. At multilane roundabouts, a nearside bus stop can be included in the travel lane (a bus bulb-out design), as long as it is set back at least 50 ft (15 m) from the crosswalk. Nearside stops provide the advantage of having a potentially slower speed environment where vehicles are slowing down, compared to a far-side location where vehicles may be accelerating upon exiting the roundabout.

Far-side stops: Bus stops on the far side of a roundabout should be located beyond the pedestrian crossing to improve visibility of pedestrians to other exiting vehicles. Far-side stops result in the crosswalk being behind the bus, which provides for better sight lines for vehicles exiting the roundabout to pedestrians and keeps bus patrons from blocking the progress of the bus when they cross the street. The use of bus pullouts has some trade-offs to consider. A positive feature of a bus pullout is that it reduces the likelihood of queuing behind the bus into the roundabout. A possible negative feature is that a bus pullout may create sight line challenges for the bus driver to see vehicles approaching from behind when attempting to merge into traffic. It may also be possible at multilane roundabouts in slow-speed urban environments to include a bus stop without a bus pullout immediately after the crosswalk, as exiting traffic has an opportunity to pass the waiting bus.

Considering the guidance from both King County Metro and FHWA, it is recommended that bus stops at roundabout intersections should be located on the near-side of the roundabout in the approach lane to reduce the occurrence of cars blocking the roundabout as they wait for the bus to load and unload passengers.

At 104th Avenue SE, which is recommended as a multi-lane roundabout, vehicles can use the left lane to get around a stopped bus. The bus stop should be located at least 50-feet away from the pedestrian crossing to keep sight lines of crossing pedestrians clear. In addition, locating the bus stop further from the circulating lanes will reduce conflicts between buses traveling through the intersection and vehicles making right-turns.

Example of near-side bus stop at a multi-lane roundabout

Bicycle Facilities

The National Association of City Transportation Officials (NACTO) states conventional bike lanes are appropriate for streets with greater than 3,000 daily vehicles and speeds between 25mph and 35mph which describes the conditions on the Lea Hill Road Corridor. Bike lanes, which are included on SE 312th Street in both directions and on Lea Hill Road in the downhill direction, are designed to be 6-feet wide between the curb and the travel lane.

The downhill bike lane provided between 112th Avenue SE and 104th Avenue SE will be adjacent to a guardrail. Fencing, a minimum of 54-inches in height, will be installed behind the guardrail to ensure that cyclists do not fall into down the steep embankment if they are somehow thrown from their bicycle.

In the uphill direction, between 104th Avenue SE and 112th Avenue SE, bicycles will be traveling at much lower speeds and expected to use the shared-use path which is recommended to be a minimum of 10-feet wide to safely accommodate both pedestrians and cyclists. Signage may be used at transition points to clarify that cyclists are allowed to use the sidewalk but are expected to yield to pedestrians.

Example of sign used at University of Colorado Boulder

Bicycles in Roundabouts

At roundabouts, ramps are provided upon entering and exiting to transition cyclists between the roadway and a wide sidewalk. Cyclists are given the option to navigate the roundabout the same way a pedestrian would, using the crosswalks to make their way through the intersection, and reentering the on-street bike lane after the roundabout. However, more experienced cyclists may choose to merge into the traffic lane and use the circulating lane of the roundabout.

Bicycles at Bus Stops

Bicycle lanes will continue through bus stop locations. The majority of the time, a bus will not be present at the bus stop. However, when the bus is stopped, it will block the bicycle lane and cyclists will have to either use the travel lane to travel around the stopped bus or wait until the bus is done loading and unloading passengers. This design is common on arterials that serve bus routes and have bicycle lanes. King County Transit did request that the bike lane strip be marked as skip lines for a total of 110-feet (25-feet in advance of the stop, 60-feet at the stop itself, and 25-feet after the stop).

Access Management

Frequent driveways and intersections on 8th Street NE approaching the 8th Street Bridge is recognized to cause conflicts and congestion. In particular, the intersection of Pike Street NE has emerging operational issues that may need to be addressed with in the 20-year planning horizon. However, 2040 forecasted volumes at this intersection are not expected to warrant signalization. In addition, the close proximity to the currently signalized intersection of R Street NE would require close signal timing coordination which presents additional challenges.

As an alternative, the intersection could be converted to right-in/right-out access, eliminating all left-turns onto or off of 8th Street NE. While the roadway network to the south provides a number of alternate routes for accessing 8th Street NE, drivers coming from or going to the north would be required to make a much more significant diversion using 12th Street NE and Harvey Road. During the design phase of the 104th Avenue SE intersection, additional analysis and community outreach should be conducted to determine the need for improvements at Pike Street NE and better understand the impacts and acceptance of limiting access at this location.

When the roundabout at 104th Avenue SE is constructed, opportunities to harden the centerline on 8th Street NE between R Street and the 8th Street Bridge should be explored to restrict left-turns into driveways. The roundabout will allow U-turn movements at the intersection which opens the door for additional access revisions. Instead of making an eastbound left-turn, drivers can continue through the roundabout to make the U-turn and make a westbound right-turn into the driveway or intersection instead. This access management change will help keep traffic moving and reduce weaving and merging behavior approaching the bridge.

Emergency Response

During the planning process, the project team consulted with Auburn Police and Valley Regional Fire Authority (VRFA) to ensure that the conceptual design did not inhibit their emergency response operations or negatively impact response times.

The access restriction at 105th Place SE, which diverts traffic to 112th Avenue SE, was the largest concern for emergency responders. To limit the potential impacts, the 'porkchop' island recommended at the 105th Place SE intersection, to reinforce the right-in/right-out restriction, will be designed to allow emergency vehicles to turn left from 105th Place SE onto Lea Hill Road traveling toward Downtown Auburn. The design may require that the island be installed in paint with flexible delineators to discourage passenger vehicles from making the prohibited left-turn movement.

In addition, if access restrictions are proposed on 8th Street NE as a part of the 104th Avenue SE intersection improvements, impacts to emergency response will need to be considered and taken into account during the design phase.

Lighting

Illumination is an important feature for every street and is critical to providing safe conditions for all road users. Streetlights will be installed along the entire length of the Lea Hill Road Corridor according to City of Auburn standards and adequate illumination will be provided at every marked crosswalk.

Speed Limit

The current speed limit on the Lea Hill Road Corridor is 35 miles per hour. However, some of the improvements included in this plan, such as roundabouts and sidewalks, may help to calm traffic along the corridor. Therefore, as projects are implemented, speed studies may be conducted to make sure that the posted speed limit is appropriate for the observed speed of traffic on the corridor.

Right-of-Way

The recommended roadway alignment, cross sections, and intersection improvements provide increased safety and improved multi-modal transportation routes throughout the corridor. As is common with transportation improvement projects, the recommended improvements will impact adjacent properties. Right-of-way impacts include one full parcel acquisitions at the 112th Avenue roundabout and multiple strip takes ranging from five to ten feet between 112th Avenue and 124th Avenue. As projects move forward into design, our goal will be to minimize these impacts as much as possible.

Stormwater Management

A preliminary stormwater evaluation was performed to get a sense for what infrastructure upgrades would be required to deal with the additional run-off created by the project. The analysis utilized the Department of Ecology's Stormwater Management Manual for Western Washington along with the City of Auburn's supplement to the manual (SMMWW).

The Lea Hill Road Corridor consists of four drainage basins which discharge at different points either into wetlands, streams, or the Green River. None of the existing runoff on the Lea Hill Road Corridor is treated prior to discharge.

The construction associated with the corridor plan, with the exception of one basin serving 8th Street NE, will add over 5,000 square feet in impervious surface which triggers all the minimum requirements for upgrades to the conveyance, detention, and treatment of stormwater. However, the minimum requirements only apply to the additional area of impervious surface being added, not the existing or replaced impervious surfaces.

During the design phase, further consideration will need to be given to the type of stormwater facility and treatment that is most appropriate. In some locations, the City's preferred engineering treatment of Oldcastle BioPod System may be the best solution. Retention ponds, which are not typically well-suited for urban roadway projects, may be the most cost-effective, lowest-maintenance solution in some locations. For instance, the three City-owned parcels in the proximity of 104th Avenue SE are potential candidates for a new retention pond.

More detail on the stormwater analysis, flow rate increase, and treatment needs can be found in the technical memo provided as **Appendix E**.

Implementation

Taken together, the work described in this plan totals nearly $25 million dollars. We know that a project of this size is not going to happen all at once or quickly. Therefore, we have developed an implementation strategy that will direct Lea Hill Road Corridor investments over the next decade or more. The following section provides guidance on how to parse the entire corridor into smaller, more financially manageable, pieces of work. Information about potential funding sources is also provided.

Project Strategy

We have broken down the Lea Hill Road Corridor improvements into five functionally independent projects, including the Garden Avenue Closure which is the only project that is currently funded and expected to be under construction in 2020.

When it comes to implementation of the other projects, the City will need to be both proactive and opportunistic – working to implement projects that address existing operational and safety needs first, using local matching funds to leverage grants for projects that are well suited for a particular program, and working with developers to get pieces of other projects completed.

The first project to progress will be the Garden Avenue/102nd Avenue SE Closure which is planned for design in 2020 and construction in 2021. Based on the existing conditions analysis included in the Study Area section of this report, the highest priority project in terms of operational and safety needs is the intersection of 112th Avenue SE. The project is included in the proposed 2021-2026 Transportation Improvement Program (TIP) with design scheduled for 2024-2025 and construction scheduled for 2026.

The City has made some progress toward implementing the 104th Avenue SE roundabout project by acquiring the necessary right-of-way. This project along with the projects at 116th Avenue/312th Street and the Lea Hill Road improvements will be added to the City's Comprehensive Transportation Plan and will be considered for inclusion in future TIP as available funding and priorities align.

While each of the projects can operate independently, there are a couple of phasing elements which should be noted for implementation. Firstly, the roundabout at 104th Avenue SE should be in place before any additional access restrictions on 8th Street NE are implemented. Secondly, the roundabout at 112th Avenue SE should be constructed in advance of implementing the recommended access limitation at 105th Place SE to ensure the diverted traffic can be accommodated.

Figure 19 illustrates the five recommended projects, followed by brief descriptions.

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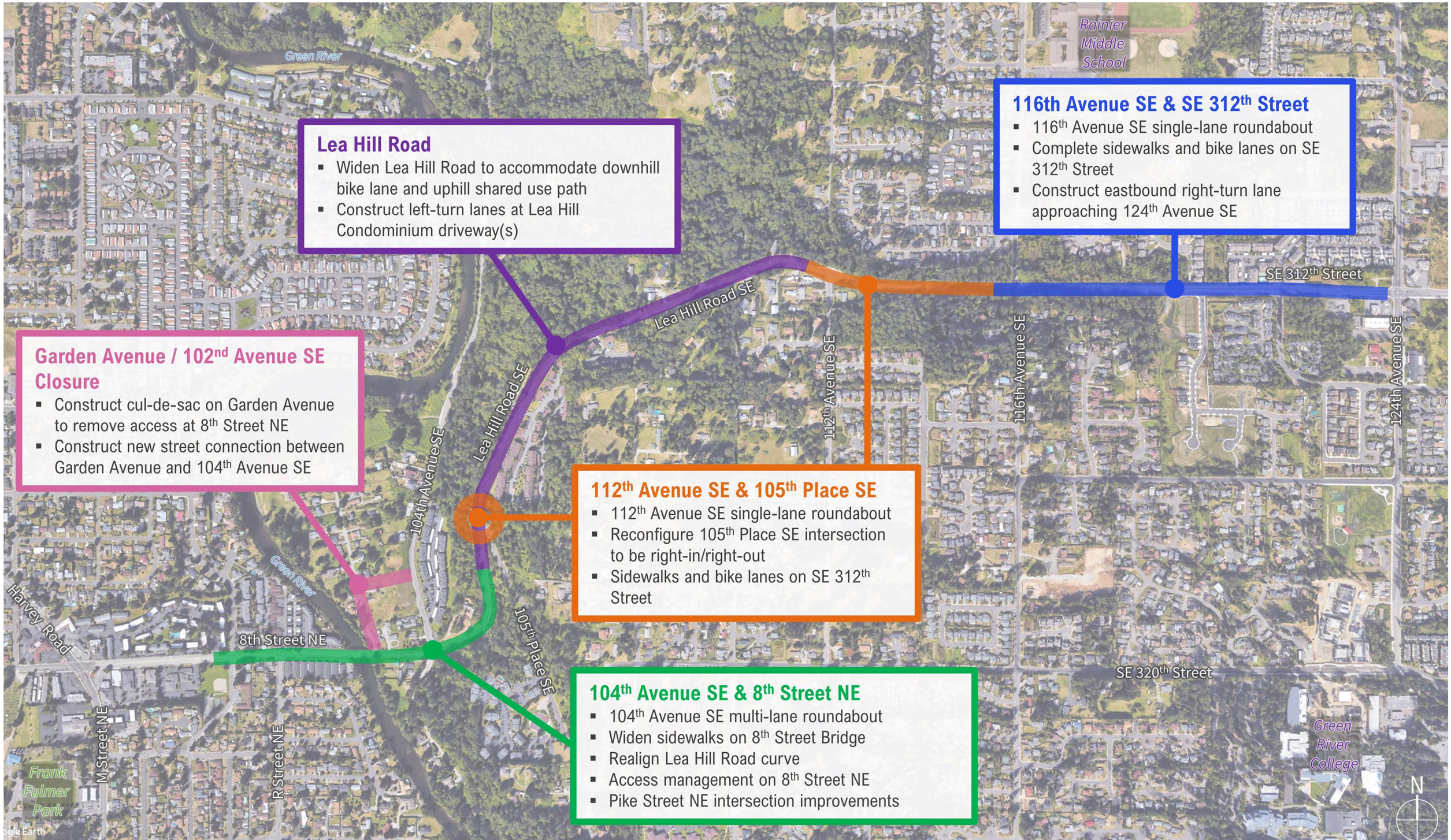
Figure 19. Lea Hill Road Corridor Phasing Strategy



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Project Descriptions

A brief description for each of the recommended projects and their associated construction elements is provided below.

Garden Avenue/102nd Avenue SE Closure

This project consists of the closure of Garden Avenue/102nd Avenue SE as it approaches 8th Avenue NE. A cul-de-sac will be constructed at the dead-end location and a new roadway connection will be built between Garden Avenue/102nd Avenue SE and 104th Avenue SE to maintain access for all properties. The City of Auburn is currently in the process of finalizing the alignment of the new connection and acquiring the necessary right-of-way. Construction of this project is expected to occur in the next one to two years.

104th Street SE & 8th Street NE

This project consists of constructing a multi-lane, four-leg roundabout at the intersection of 104th Avenue SE and a realignment of Lea Hill Road between 104th Avenue SE and 105th Place SE to flatten the curve and improve sight distances. In addition, 8th Street NE over the bridge will be restriped to remove the center median and construct wider sidewalks on either side. This project will also implement bus stop improvements approaching the roundabout, including the relocation of the westbound bus stop to the near side of the intersection. During design, further consideration to be given to access revisions on 8th Street NE, limiting left-turn movements between Pike Street SE and the bridge to improve traffic flow and safety.

112th Avenue SE & 105th Place SE

This project consists of the construction of a single-lane, three-leg roundabout at 112th Avenue SE and Lea Hill Road/312th Street SE. The installation of flashing beacons at pedestrian crossings should be considered. This project also includes the conversion of 105th Place SE to right-in/right-out intersection and removal of the existing signal and the existing pedestrian crossing across Lea Hill Road at this location.

To accommodate diverted traffic due to the access restriction, the 112th Avenue SE conceptual roundabout design includes a northbound right-turn slip lane to increase the efficiency of this approach and reduce queues. However, the need for the right-turn slip lane is based on forecasted 2040 traffic volumes which may not be realized by the time of construction. Therefore, as the project moves into final design, the City should evaluate the operational need for the right-turn slip lane. If the opening year volumes do not indicate the need for the right-turn slip lane, the roundabout could be constructed without it, understanding that it may need to be added to resolve operational issues in the future.

During design, the specific location and treatment of bus stops will need to be evaluated to determine the best possible configuration. Lastly, sidewalks and bike lanes will be constructed on both sides of SE 312th Street between 112th Avenue SE and 116th Avenue SE. A soldier-pile retaining wall will be constructed on the north side of street as needed to accommodate roadway widening and stabilize the hillside.

116th Avenue SE & SE 312th Street

This project consists of the construction of a single-lane, three-leg roundabout at the intersection of 116th Avenue SE. The installation of flashing beacons at pedestrian crossings should be considered, especially given the proximity to local schools. Retaining wall will be constructed as required to accommodate the roundabout. This project will also complete sidewalk and bike lanes between 116th Avenue SE and 124th Avenue SE. The project will maintain the existing left- and right-turn pockets and add a right-turn lane in the eastbound direction approaching 124th Avenue SE. Some elements of this project may be required as frontage improvements for developers.

Lea Hill Road

This project consists of completing the corridor improvements along Lea Hill Road between 104th Avenue SE and 112th Avenue SE including a downhill sidewalk between 112th Avenue SE and 106th Place SE, a shared use path uphill, and a downhill bike lane. Left-turn pockets will be constructed to access the Lea Hill Condominiums and transit stop improvements, included pedestrian crossings with flashing beacons, will be implemented at the bus stops that serve the condominium. In addition, a soldier-pile retaining wall will be constructed on the downhill side of Lea Hill Road as needed to accommodate roadway widening and stabilize the hillside.

Cost Estimates

Planning-level cost estimates were also developed for each of the identified projects. The estimates reflect 2019 dollars and include construction, preliminary engineering, construction engineering, right-of-way acquisition, and high-level stormwater costs. **Table 4** provides a summary of the costs by project. More detail on the estimates, including the assumptions, can be found in **Appendix F**.

Table 4. Preliminary Cost Estimates by Project

Project	Estimated Cost *(2019$)*
Garden Street/102nd Avenue SE Closure	$620,000
104th Avenue SE & 8th Street NE	$3,980,000
Lea Hill Road	$9,470,000
112th Avenue SE & 105th Place SE	$5,090,000
116th Avenue SE & SE 312th Street	$5,610,000
TOTAL	**$24,770,000**

Funding Sources

We anticipate that the projects identified in this plan will be funded through a combination of City, State, Federal, and development-driven funding sources. A few of the potential funding mechanisms are described below.

Local Funding Mechanisms

The City of Auburn has established a Transportation Impact Fee (TIF) system for collecting impact fees from developers for projects that create a need for transportation capacity improvements. The collected impact fees can be applied to projects included in our regularly updated Transportation Improvement Program (TIP) list that address existing or emerging vehicle capacity issues, such as the Lea Hill Road Corridor projects. In addition, local funds raised through the TIF program can be leveraged as matching funds to make our transportation improvement projects more competitive for state or federal grant programs.

Currently, there is no local mechanism to generate funding for the construction of pedestrian and bicycle facilities. However, the City's Comprehensive Transportation Plan (2015) the City's acknowledges the need for developing a multimodal level of service standard. If adopted, this would create a way to collect impact fees for non-motorized projects, in addition to vehicle capacity projects. Until that time, the City will rely on grant funding to implement the projects included in this plan. In some cases, especially on the SE 3112th Street segment, some elements of the project may be implemented through frontage improvements as required by private development.

Grant Opportunities

There are a number of grant opportunities which would be applicable to the Lea Hill Road Corridor project. Depending on the grant program, they can be administrated on the federal, state, or regional level. Brief descriptions of potential grant opportunities are included below followed by a matrix of potential applications specific to the projects identified in this plan.

Puget Sound Reginal Council (PSRC) Regional Funding

PSRC oversees the allocation of Federal Highways Administration (FHWA) grant funding (STP and CMAQ) to local jurisdictions. PSRC administers two grant funding processes, Countywide and Regional, which are applicable to some of the Lea Hill Corridor projects. Through the King County Countywide Process, the Lea Hill Corridor projects would be eligible for both the Larger Jurisdiction Program and the Non-Motorized Set-Aside Program. PSRC puts out a call for projects every two years under a consolidated application process which is overseen by the King County Project Evaluation Committee (KCPEC).

More information: www.psrc.org/our-work/funding/project-selection/fhwa-and-fta-regional-funding

Highway Safety Improvement Program (HSIP)

The HSIP is a federal program that allows local governments to target safety funds to their most critical safety needs. The goal of the program is to reduce serious traffic injuries and deaths, consistent with local road safety plans. Under HSIP, WSDOT administers the City Safety Program and makes a call for projects every two years. HSIP funding can be applied to design, right-of-way acquisition, and construction phases of eligible projects. Eligible projects include corridor or intersection improvements that use engineering countermeasures in locations that have experienced fatal and serious injury crashes in the last five years, such as R Street SE, 112th Avenue SE, and 116th Avenue SE. To be eligible to apply, the City must submit a local road safety plan that addresses fatal and serious injury crashes and systemic safety needs.

More information: www.wsdot.wa.gov/LocalPrograms/Traffic/FedSafety.htm

Pedestrian and Bicycle Program

WSDOT administers the Pedestrian and Bicycle Program which provides grants for projects that reduce collisions with pedestrians and bicyclists and increase walking and biking activity. Funding can be used for construction as well as for design-only projects that lead to construction-ready pedestrian and bicycle improvement projects. The segment of Leah Hill Road between 104th Avenue and 116th Avenue may be a good candidate for this grant program as it helps complete the bicycle and pedestrian network on this major arterial and transit route, improving multimodal connectivity between Lea Hill and Downtown Auburn.

More information: www.wsdot.wa.gov/LocalPrograms/ATP/funding.htm

Safe Routes to School (SRTS)

WSDOT also oversees a competitive grant program to fund projects that increase the number of students walking and biking to school safely. SRTS funds can be used for infrastructure improvements located within two miles of a school and all public agencies responsible for administering local transportation safety programs are eligible to apply. The segment of 312th Street between 112th Avenue and 124th Avenue may be a good candidate for this grant program due to its proximity to Rainier Middle School and Hazelwood Elementary School. In addition, the scope of work is focused toward non-motorized users, including adding bike lanes, sidewalks, crosswalks, and intersection control improvements designed with pedestrian safety in mind.

More information: www.wsdot.wa.gov/LocalPrograms/SafeRoutes/default.htm

Transportation Improvement Board (TIB) Grants

There are two annual TIB grant pools available to cities like Auburn with populations of 5,000 or greater. The Sidewalk Program (SP) supports transportation projects (not recreation) on a federally classified roadway to improve pedestrian safety, access, connectivity, and address system continuity. The Lea Hill Road Corridor is federally classified as a minor arterial and is therefore eligible. Funds can only be applied to sidewalk construction tasks but can be combined with other funding sources to create a more complete funding package.

The Urban Arterial Program (UAP) supports roadway construction projects that score well in one of four bands: safety, growth and development, physical condition, or mobility. The projects identified in this plan may be competitive in the safety or mobility categories. All projects must also rate well in sustainability and constructability categories to be competitive.

The City of Auburn is also eligible to be nominated for TIB's Complete Street Award because the City has an adopted complete streets ordinance. The Complete Streets Award is flexible money given to any city or county that demonstrates an ethic of planning and building streets that use context sensitive solutions to accommodate all users, including pedestrians, transit users, cyclists, and motorists. A number of approved state agency partners and non-profit organizations may nominate eligible agencies. The City will reach out to the established nominating partners to promote projects that are a good fit for the funding source and

seek nomination during the next round of nominations. Award amounts range between $100,000 and $1,000,000 and are awarded every two years.

More information: www.tib.wa.gov/grants/grants.cfm

Each of the projects identified in this plan will require some combination of local and grant funding sources. **Table 5** provides an overview of all the potential grant funding sources and their applicability to each of the projects.

Table 5. Potential Grant Funding Sources by Project

	PSRC	WSDOT		TIB		Local	
Project	Countywide	HSIP	Pedestrian & Bicycle	SP	UAP	TIF Funds	Developer Funded
Garden St/102nd Ave SE Closure*							
104th Avenue SE & 8th Street NE	X	X			X	X	
Lea Hill Road			X	X	X		
112th Avenue SE & 105th Place SE	X	X	X		X	X	
116th Avenue SE & SE 312th Street	X		X	X	X	X	X

* This project is already funded using local sources

Most grant opportunities are available on a biannual basis which means, if you miss an opportunity, it is going to be awhile until the next one comes along. Being well-positioned when the call for applications opens can help to avoid significant project delays. The City can begin talking with grant coordinators about potential projects to determine which projects are best suited for each pool and then identify ways to leverage local investments to make grant applications more competitive.

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Appendix A

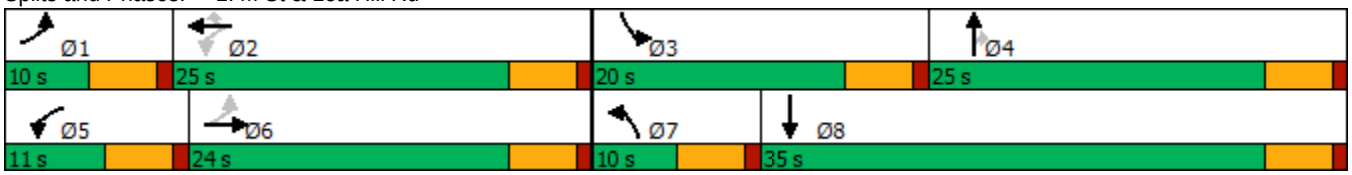
2018 and 2040 Operational Analysis

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	36	319	118	340	233	391	102	297	209	529	552	16
Future Volume (vph)	36	319	118	340	233	391	102	297	209	529	552	16
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	11	11	11	11	11	11	11	11	11	11
Storage Length (ft)	50		200	200		200	150		150	200		150
Storage Lanes	1		1	1		1	1		1	1		0
Taper Length (ft)	90			90			90			90		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		35			35			35			35	
Link Distance (ft)		1099			1148			1511			2105	
Travel Time (s)		21.4			22.4			29.4			41.0	
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Prot	NA	Perm	Prot	NA	
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases	6			2		2			4			
Detector Phase	1	6		5	2	2	7	4	4	3	8	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Minimum Split (s)	10.0	23.0		10.0	22.0	22.0	10.0	25.0	25.0	10.0	19.0	
Total Split (s)	10.0	24.0		11.0	25.0	25.0	10.0	25.0	25.0	20.0	35.0	
Total Split (%)	12.5%	30.0%		13.8%	31.3%	31.3%	12.5%	31.3%	31.3%	25.0%	43.8%	
Maximum Green (s)	5.0	19.0		6.0	20.0	20.0	5.0	20.0	20.0	15.0	30.0	
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	Min		None	Min	Min	None	Min	Min	None	Min	
Walk Time (s)		7.0			7.0	7.0		7.0	7.0		7.0	
Flash Dont Walk (s)		11.0			10.0	10.0		13.0	13.0		7.0	
Pedestrian Calls (#/hr)		9			9	9		9	9		9	

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 71.9
Natural Cycle: 90
Control Type: Actuated-Uncoordinated

Splits and Phases: 1: M St & Lea Hill Rd



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	36	319	118	340	233	391	102	297	209	529	552	16
Future Volume (veh/h)	36	319	118	340	233	391	102	297	209	529	552	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.97	0.99		0.98	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
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1885	1885	1885
Adj Flow Rate, veh/h	36	322	119	343	235	395	103	300	0	534	558	0
Peak Hour Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	1	1	1
Cap, veh/h	302	577	208	357	517	430	125	796		639	636	
Arrive On Green	0.04	0.23	0.23	0.08	0.28	0.28	0.07	0.22	0.00	0.18	0.34	0.00
Sat Flow, veh/h	1781	2530	914	1781	1870	1555	1781	3554	1585	3483	1885	0
Grp Volume(v), veh/h	36	224	217	343	235	395	103	300	0	534	558	0
Grp Sat Flow(s),veh/h/ln	1781	1777	1667	1781	1870	1555	1781	1777	1585	1742	1885	0
Q Serve(g_s), s	1.1	7.9	8.2	6.0	7.4	17.6	4.1	5.1	0.0	10.5	19.9	0.0
Cycle Q Clear(g_c), s	1.1	7.9	8.2	6.0	7.4	17.6	4.1	5.1	0.0	10.5	19.9	0.0
Prop In Lane	1.00		0.55	1.00		1.00	1.00		1.00	1.00		0.00
Lane Grp Cap(c), veh/h	302	405	380	357	517	430	125	796		639	636	
V/C Ratio(X)	0.12	0.55	0.57	0.96	0.45	0.92	0.83	0.38		0.84	0.88	
Avail Cap(c_a), veh/h	363	473	444	357	524	436	125	996		732	793	
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	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	19.8	24.3	24.4	25.8	21.4	25.0	32.7	23.5	0.0	28.1	22.2	0.0
Incr Delay (d2), s/veh	0.2	1.2	1.4	37.3	0.6	24.3	34.4	0.3	0.0	7.5	9.3	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	3.3	3.2	6.5	3.1	8.8	2.9	2.0	0.0	4.8	9.6	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	20.0	25.5	25.8	63.1	22.0	49.3	67.1	23.8	0.0	35.5	31.5	0.0
LnGrp LOS	C	C	C	E	C	D	E	C		D	C	
Approach Vol, veh/h		477			973			403	A		1092	A
Approach Delay, s/veh		25.2			47.6			34.8			33.5	
Approach LOS		C			D			C			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	7.6	24.7	18.1	21.0	11.0	21.3	10.0	29.1
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	20.0	15.0	20.0	6.0	19.0	5.0	30.0
Max Q Clear Time (g_c+I1), s	3.1	19.6	12.5	7.1	8.0	10.2	6.1	21.9
Green Ext Time (p_c), s	0.0	0.1	0.5	1.4	0.0	1.7	0.0	2.2

Intersection Summary	
HCM 6th Ctrl Delay	37.0
HCM 6th LOS	D

Notes

Unsignalized Delay for [NBR, SBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	0.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	19	1118	40	14	832	28	0	0	4	4	1	19
Future Vol, veh/h	19	1118	40	14	832	28	0	0	4	4	1	19
Conflicting Peds, #/hr	4	0	9	9	0	4	0	0	3	3	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	150	-	150	90	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	1	1	1	2	2	2	0	0	0	0	0	0
Mvmt Flow	20	1177	42	15	876	29	0	0	4	4	1	20

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	909	0	0	1228	0	0	2157	2165	601	1557	2193	895
Stage 1	-	-	-	-	-	-	1226	1226	-	925	925	-
Stage 2	-	-	-	-	-	-	931	939	-	632	1268	-
Critical Hdwy	4.115	-	-	4.13	-	-	7.3	6.5	6.9	7.3	6.5	6.2
Critical Hdwy Stg 1	-	-	-	-	-	-	6.5	5.5	-	6.1	5.5	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.1	5.5	-	6.5	5.5	-
Follow-up Hdwy	2.2095	-	-	2.219	-	-	3.5	4	3.3	3.5	4	3.3
Pot Cap-1 Maneuver	752	-	-	565	-	-	31	48	448	85	46	342
Stage 1	-	-	-	-	-	-	192	253	-	325	351	-
Stage 2	-	-	-	-	-	-	323	345	-	440	242	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	749	-	-	561	-	-	27	45	443	80	43	341
Mov Cap-2 Maneuver	-	-	-	-	-	-	27	45	-	80	43	-
Stage 1	-	-	-	-	-	-	185	244	-	315	340	-
Stage 2	-	-	-	-	-	-	295	335	-	423	234	-

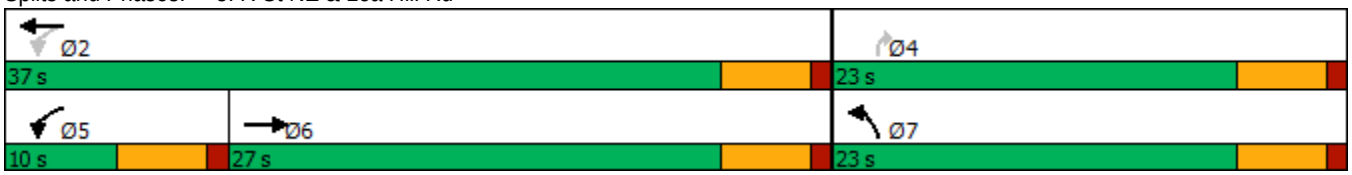
Approach	EB	WB	NB	SB
HCM Control Delay, s	0.2	0.2	13.2	20.5
HCM LOS			B	C

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	443	749	-	-	561	-	-	253
HCM Lane V/C Ratio	0.01	0.027	-	-	0.026	-	-	0.083
HCM Control Delay (s)	13.2	9.9	-	-	11.6	-	-	20.5
HCM Lane LOS	B	A	-	-	B	-	-	C
HCM 95th %tile Q(veh)	0	0.1	-	-	0.1	-	-	0.3

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	933	193	212	787	72	182
Future Volume (vph)	933	193	212	787	72	182
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	90		100	0
Storage Lanes		0	1		1	1
Taper Length (ft)			90		90	
Right Turn on Red		Yes				Yes
Link Speed (mph)	35			35	30	
Link Distance (ft)	327			768	2637	
Travel Time (s)	6.4			15.0	59.9	
Turn Type	NA		pm+pt	NA	Prot	Perm
Protected Phases	6		5	2	7	
Permitted Phases			2			4
Detector Phase	6		5	2	7	4
Switch Phase						
Minimum Initial (s)	5.0		5.0	5.0	4.0	4.0
Minimum Split (s)	23.0		10.0	10.0	9.0	9.0
Total Split (s)	27.0		10.0	37.0	23.0	23.0
Total Split (%)	45.0%		16.7%	61.7%	38.3%	38.3%
Maximum Green (s)	22.0		5.0	32.0	18.0	18.0
Yellow Time (s)	4.0		4.0	4.0	4.0	4.0
All-Red Time (s)	1.0		1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0		0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0		5.0	5.0	5.0	5.0
Lead/Lag	Lag		Lead			
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Recall Mode	Min		None	Min	None	None
Walk Time (s)	7.0					
Flash Dont Walk (s)	11.0					
Pedestrian Calls (#/hr)	1					

Intersection Summary	
Area Type:	Other
Cycle Length: 60	
Actuated Cycle Length: 47.5	
Natural Cycle: 45	
Control Type: Actuated-Uncoordinated	

Splits and Phases: 3: R St NE & Lea Hill Rd



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	933	193	212	787	72	182
Future Volume (veh/h)	933	193	212	787	72	182
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)		1.00	1.00		1.00	1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No	No	
Adj Sat Flow, veh/h/ln	1885	1885	1885	1885	1885	1885
Adj Flow Rate, veh/h	972	201	221	820	75	190
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Percent Heavy Veh, %	1	1	1	1	1	1
Cap, veh/h	1222	252	396	1173	294	261
Arrive On Green	0.41	0.41	0.10	0.62	0.16	0.16
Sat Flow, veh/h	3048	610	1795	1885	1795	1598
Grp Volume(v), veh/h	589	584	221	820	75	190
Grp Sat Flow(s),veh/h/ln	1791	1773	1795	1885	1795	1598
Q Serve(g_s), s	13.4	13.4	2.9	13.6	1.7	5.3
Cycle Q Clear(g_c), s	13.4	13.4	2.9	13.6	1.7	5.3
Prop In Lane		0.34	1.00		1.00	1.00
Lane Grp Cap(c), veh/h	741	733	396	1173	294	261
V/C Ratio(X)	0.79	0.80	0.56	0.70	0.26	0.73
Avail Cap(c_a), veh/h	845	837	407	1294	693	617
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	11.9	12.0	9.3	5.9	17.0	18.5
Incr Delay (d2), s/veh	4.7	4.8	1.6	1.5	0.5	3.9
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.9	4.9	0.8	3.1	0.7	0.3
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	16.6	16.8	10.9	7.4	17.5	22.4
LnGrp LOS	B	B	B	A	B	C
Approach Vol, veh/h	1173			1041	265	
Approach Delay, s/veh	16.7			8.1	21.0	
Approach LOS	B			A	C	

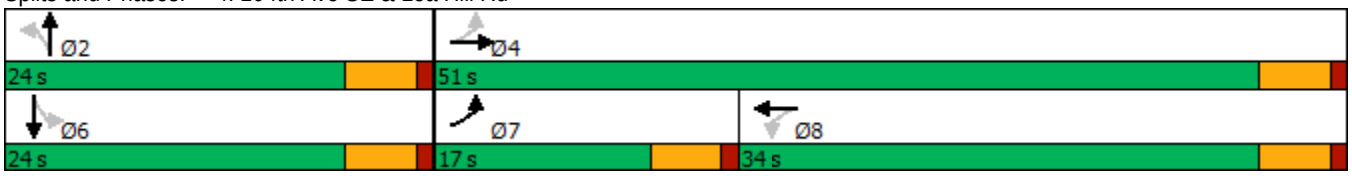
Timer - Assigned Phs		2		4	5	6
Phs Duration (G+Y+Rc), s		34.0		12.6	9.7	24.3
Change Period (Y+Rc), s		5.0		5.0	5.0	5.0
Max Green Setting (Gmax), s		32.0		18.0	5.0	22.0
Max Q Clear Time (g_c+I1), s		15.6		7.3	4.9	15.4
Green Ext Time (p_c), s		5.4		0.6	0.0	3.8

Intersection Summary	
HCM 6th Ctrl Delay	13.6
HCM 6th LOS	B

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	287	819	3	0	580	16	2	1	0	61	2	433
Future Volume (vph)	287	819	3	0	580	16	2	1	0	61	2	433
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	11	11	11	11	11	11	11	11	11	11
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		35			35			30			30	
Link Distance (ft)		333			1135			952			1476	
Travel Time (s)		6.5			22.1			21.6			33.5	
Turn Type	pm+pt	NA			NA		Perm	NA		Perm	NA	
Protected Phases	7	4			8			2			6	
Permitted Phases	4			8			2			6		
Detector Phase	7	4		8	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Minimum Split (s)	10.0	23.0		23.0	23.0		23.0	23.0		23.0	23.0	
Total Split (s)	17.0	51.0		34.0	34.0		24.0	24.0		24.0	24.0	
Total Split (%)	22.7%	68.0%		45.3%	45.3%		32.0%	32.0%		32.0%	32.0%	
Maximum Green (s)	12.0	46.0		29.0	29.0		19.0	19.0		19.0	19.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0	0.0			0.0			0.0			0.0	
Total Lost Time (s)	5.0	5.0			5.0			5.0			5.0	
Lead/Lag	Lead			Lag	Lag							
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		Min	Min		Min	Min	
Walk Time (s)		7.0		7.0	7.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)		11.0		11.0	11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0		3	3		1	1		0	0	

Intersection Summary	
Area Type:	Other
Cycle Length: 75	
Actuated Cycle Length: 65.9	
Natural Cycle: 70	
Control Type: Actuated-Uncoordinated	

Splits and Phases: 4: 104th Ave SE & Lea Hill Rd



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	287	819	3	0	580	16	2	1	0	61	2	433
Future Volume (veh/h)	287	819	3	0	580	16	2	1	0	61	2	433
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		1.00	1.00		1.00	1.00		0.97
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
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1856	1856	1856	1900	1900	1900	1885	1885	1885
Adj Flow Rate, veh/h	302	862	3	0	611	17	2	1	0	64	2	114
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	2	2	2	3	3	3	0	0	0	1	1	1
Cap, veh/h	458	1188	4	0	731	20	273	114	0	166	23	162
Arrive On Green	0.13	0.64	0.64	0.00	0.41	0.41	0.17	0.17	0.00	0.17	0.17	0.17
Sat Flow, veh/h	1781	1863	6	0	1797	50	933	690	0	424	140	975
Grp Volume(v), veh/h	302	0	865	0	0	628	3	0	0	180	0	0
Grp Sat Flow(s),veh/h/ln	1781	0	1869	0	0	1847	1624	0	0	1540	0	0
Q Serve(g_s), s	4.4	0.0	15.9	0.0	0.0	15.5	0.0	0.0	0.0	3.8	0.0	0.0
Cycle Q Clear(g_c), s	4.4	0.0	15.9	0.0	0.0	15.5	0.1	0.0	0.0	5.5	0.0	0.0
Prop In Lane	1.00		0.00	0.00		0.03	0.67		0.00	0.36		0.63
Lane Grp Cap(c), veh/h	458	0	1192	0	0	752	387	0	0	351	0	0
V/C Ratio(X)	0.66	0.00	0.73	0.00	0.00	0.84	0.01	0.00	0.00	0.51	0.00	0.00
Avail Cap(c_a), veh/h	643	0	1691	0	0	1053	688	0	0	665	0	0
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	0.00	0.00	1.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	9.8	0.0	6.2	0.0	0.0	13.5	17.7	0.0	0.0	20.0	0.0	0.0
Incr Delay (d2), s/veh	1.6	0.0	0.9	0.0	0.0	4.2	0.0	0.0	0.0	1.2	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.2	0.0	3.6	0.0	0.0	5.9	0.0	0.0	0.0	1.9	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	11.4	0.0	7.1	0.0	0.0	17.8	17.7	0.0	0.0	21.1	0.0	0.0
LnGrp LOS	B	A	A	A	A	B	B	A	A	C	A	A
Approach Vol, veh/h		1167			628			3			180	
Approach Delay, s/veh		8.3			17.8			17.7			21.1	
Approach LOS		A			B			B			C	

Timer - Assigned Phs		2		4		6	7	8
Phs Duration (G+Y+Rc), s		13.4		37.4		13.4	11.7	25.7
Change Period (Y+Rc), s		5.0		5.0		5.0	5.0	5.0
Max Green Setting (Gmax), s		19.0		46.0		19.0	12.0	29.0
Max Q Clear Time (g_c+I1), s		2.1		17.9		7.5	6.4	17.5
Green Ext Time (p_c), s		0.0		7.2		0.7	0.5	3.2

Intersection Summary	
HCM 6th Ctrl Delay	12.5
HCM 6th LOS	B

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	237	8	560	294	10	386
Future Volume (vph)	237	8	560	294	10	386
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12
Storage Length (ft)	0	50		0	0	
Storage Lanes	1	1		0	0	
Taper Length (ft)	90				90	
Right Turn on Red		Yes		Yes		
Link Speed (mph)	25		35			35
Link Distance (ft)	240		1135			897
Travel Time (s)	6.5		22.1			17.5
Turn Type	Prot	Perm	NA		Perm	NA
Protected Phases	2		8			4
Permitted Phases		2			4	
Detector Phase	2	2	8		4	4
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0		5.0	5.0
Minimum Split (s)	21.0	21.0	18.5		18.5	18.5
Total Split (s)	21.0	21.0	49.0		49.0	49.0
Total Split (%)	30.0%	30.0%	70.0%		70.0%	70.0%
Maximum Green (s)	16.0	16.0	44.5		44.5	44.5
Yellow Time (s)	4.0	4.0	3.5		3.5	3.5
All-Red Time (s)	1.0	1.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0			0.0
Total Lost Time (s)	5.0	5.0	4.5			4.5
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Recall Mode	None	None	Min		Min	Min
Walk Time (s)	7.0	7.0	7.0		7.0	7.0
Flash Dont Walk (s)	9.0	9.0	7.0		7.0	7.0
Pedestrian Calls (#/hr)	0	0	0		0	0

Intersection Summary

Area Type: Other
Cycle Length: 70
Actuated Cycle Length: 57.7
Natural Cycle: 60
Control Type: Actuated-Uncoordinated

Splits and Phases: 5: Lea Hill Rd & SE 320th St

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	237	8	560	294	10	386
Future Volume (veh/h)	237	8	560	294	10	386
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No		No			No
Adj Sat Flow, veh/h/ln	1885	1885	1885	1885	1856	1856
Adj Flow Rate, veh/h	247	8	583	306	10	402
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Percent Heavy Veh, %	1	1	1	1	3	3
Cap, veh/h	321	285	708	372	90	1108
Arrive On Green	0.18	0.18	0.61	0.61	0.61	0.61
Sat Flow, veh/h	1795	1598	1163	611	12	1820
Grp Volume(v), veh/h	247	8	0	889	412	0
Grp Sat Flow(s),veh/h/ln	1795	1598	0	1774	1832	0
Q Serve(g_s), s	5.9	0.2	0.0	17.6	0.0	0.0
Cycle Q Clear(g_c), s	5.9	0.2	0.0	17.6	5.0	0.0
Prop In Lane	1.00	1.00		0.34	0.02	
Lane Grp Cap(c), veh/h	321	285	0	1080	1197	0
V/C Ratio(X)	0.77	0.03	0.00	0.82	0.34	0.00
Avail Cap(c_a), veh/h	643	572	0	1768	1883	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	0.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	17.5	15.1	0.0	6.9	4.4	0.0
Incr Delay (d2), s/veh	3.9	0.0	0.0	1.7	0.2	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.5	0.1	0.0	3.6	1.0	0.0
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	21.4	15.2	0.0	8.5	4.6	0.0
LnGrp LOS	C	B	A	A	A	A
Approach Vol, veh/h	255		889			412
Approach Delay, s/veh	21.2		8.5			4.6
Approach LOS	C		A			A

Timer - Assigned Phs	2	4	8
Phs Duration (G+Y+Rc), s	13.0	31.7	31.7
Change Period (Y+Rc), s	5.0	4.5	4.5
Max Green Setting (Gmax), s	16.0	44.5	44.5
Max Q Clear Time (g_c+I1), s	7.9	7.0	19.6
Green Ext Time (p_c), s	0.5	2.8	7.6

Intersection Summary	
HCM 6th Ctrl Delay	9.6
HCM 6th LOS	A

Intersection	
Int Delay, s/veh	2.3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	449	95	53	333	55	24
Future Vol, veh/h	449	95	53	333	55	24
Conflicting Peds, #/hr	0	0	0	0	0	1
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	89	89	89	89	89	89
Heavy Vehicles, %	1	1	1	1	1	1
Mvmt Flow	504	107	60	374	62	27

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	611	0	1052	559
Stage 1	-	-	-	-	558	-
Stage 2	-	-	-	-	494	-
Critical Hdwy	-	-	4.11	-	6.41	6.21
Critical Hdwy Stg 1	-	-	-	-	5.41	-
Critical Hdwy Stg 2	-	-	-	-	5.41	-
Follow-up Hdwy	-	-	2.209	-	3.509	3.309
Pot Cap-1 Maneuver	-	-	973	-	252	530
Stage 1	-	-	-	-	575	-
Stage 2	-	-	-	-	615	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	973	-	232	529
Mov Cap-2 Maneuver	-	-	-	-	232	-
Stage 1	-	-	-	-	575	-
Stage 2	-	-	-	-	567	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.2	23.7
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	280	-	-	973	-
HCM Lane V/C Ratio	0.317	-	-	0.061	-
HCM Control Delay (s)	23.7	-	-	8.9	0
HCM Lane LOS	C	-	-	A	A
HCM 95th %tile Q(veh)	1.3	-	-	0.2	-

Intersection	
Int Delay, s/veh	2.8

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	87	387	317	31	37	84
Future Vol, veh/h	87	387	317	31	37	84
Conflicting Peds, #/hr	2	0	0	2	1	1
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	96	96	96	96	96	96
Heavy Vehicles, %	1	1	2	2	1	1
Mvmt Flow	91	403	330	32	39	88

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	364	0	-	0	934	349
Stage 1	-	-	-	-	348	-
Stage 2	-	-	-	-	586	-
Critical Hdwy	4.11	-	-	-	6.41	6.21
Critical Hdwy Stg 1	-	-	-	-	5.41	-
Critical Hdwy Stg 2	-	-	-	-	5.41	-
Follow-up Hdwy	2.209	-	-	-	3.509	3.309
Pot Cap-1 Maneuver	1200	-	-	-	296	697
Stage 1	-	-	-	-	717	-
Stage 2	-	-	-	-	558	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1198	-	-	-	266	695
Mov Cap-2 Maneuver	-	-	-	-	266	-
Stage 1	-	-	-	-	645	-
Stage 2	-	-	-	-	557	-

Approach	EB	WB	SB
HCM Control Delay, s	1.5	0	15.6
HCM LOS			C

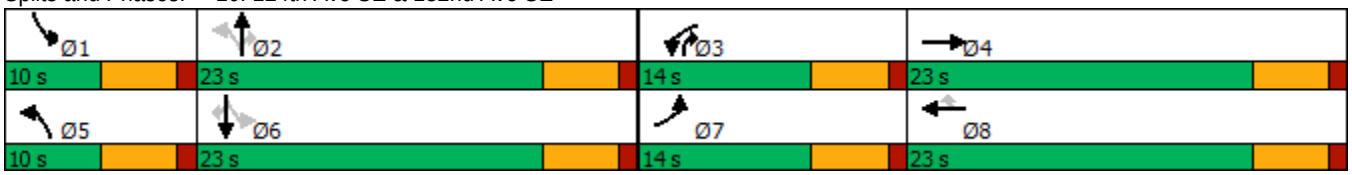
Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1198	-	-	-	465
HCM Lane V/C Ratio	0.076	-	-	-	0.271
HCM Control Delay (s)	8.3	0	-	-	15.6
HCM Lane LOS	A	A	-	-	C
HCM 95th %tile Q(veh)	0.2	-	-	-	1.1

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	79	246	76	229	195	55	76	160	303	99	163	82
Future Volume (vph)	79	246	76	229	195	55	76	160	303	99	163	82
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	12	12	12
Storage Length (ft)	100		0	100		120	150		300	200		60
Storage Lanes	1		0	1		1	1		1	1		1
Taper Length (ft)	90			90			90			90		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		35			35			30			30	
Link Distance (ft)		825			926			659			836	
Travel Time (s)		16.1			18.0			15.0			19.0	
Turn Type	Prot	NA		Prot	NA	Perm	pm+pt	NA	pm+ov	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2	3	1	6	
Permitted Phases						8	2		2	6		6
Detector Phase	7	4		3	8	8	5	2	3	1	6	6
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	10.0	23.0		10.0	23.0	23.0	10.0	23.0	10.0	10.0	23.0	23.0
Total Split (s)	14.0	23.0		14.0	23.0	23.0	10.0	23.0	14.0	10.0	23.0	23.0
Total Split (%)	20.0%	32.9%		20.0%	32.9%	32.9%	14.3%	32.9%	20.0%	14.3%	32.9%	32.9%
Maximum Green (s)	9.0	18.0		9.0	18.0	18.0	5.0	18.0	9.0	5.0	18.0	18.0
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag	Lead	Lead	Lag	Lag
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None		None	None	None	None	Min	None	None	Min	Min
Walk Time (s)		7.0			7.0	7.0		7.0			7.0	7.0
Flash Dont Walk (s)		11.0			11.0	11.0		11.0			11.0	11.0
Pedestrian Calls (#/hr)		2			2	2		3			9	9

Intersection Summary

Area Type: Other
Cycle Length: 70
Actuated Cycle Length: 58.1
Natural Cycle: 70
Control Type: Actuated-Uncoordinated

Splits and Phases: 10: 124th Ave SE & 132nd Ave SE



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	79	246	76	229	195	55	76	160	303	99	163	82
Future Volume (veh/h)	79	246	76	229	195	55	76	160	303	99	163	82
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.95	1.00		0.96	0.97		0.95	0.98		0.95
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
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1885	1885	1885	1900	1900	1900	1885	1885	1885	1885	1885	1885
Adj Flow Rate, veh/h	82	256	79	239	203	57	79	167	316	103	170	85
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	0	0	0	1	1	1	1	1	1
Cap, veh/h	109	321	99	259	606	491	406	445	588	380	458	371
Arrive On Green	0.06	0.24	0.24	0.14	0.32	0.32	0.06	0.24	0.24	0.07	0.24	0.24
Sat Flow, veh/h	1795	1361	420	1810	1900	1540	1795	1885	1523	1795	1885	1525
Grp Volume(v), veh/h	82	0	335	239	203	57	79	167	316	103	170	85
Grp Sat Flow(s),veh/h/ln	1795	0	1781	1810	1900	1540	1795	1885	1523	1795	1885	1525
Q Serve(g_s), s	2.8	0.0	11.1	8.2	5.1	1.6	2.0	4.7	10.2	2.7	4.7	2.8
Cycle Q Clear(g_c), s	2.8	0.0	11.1	8.2	5.1	1.6	2.0	4.7	10.2	2.7	4.7	2.8
Prop In Lane	1.00		0.24	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	109	0	421	259	606	491	406	445	588	380	458	371
V/C Ratio(X)	0.75	0.00	0.80	0.92	0.34	0.12	0.19	0.38	0.54	0.27	0.37	0.23
Avail Cap(c_a), veh/h	257	0	510	259	606	491	442	540	665	403	540	437
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	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	29.1	0.0	22.6	26.6	16.3	15.1	16.5	20.1	15.3	16.4	19.8	19.1
Incr Delay (d2), s/veh	10.1	0.0	7.2	35.8	0.3	0.1	0.2	0.5	0.8	0.4	0.5	0.3
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	1.4	0.0	5.1	5.8	2.1	0.5	0.8	2.0	3.2	1.1	2.0	0.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	39.1	0.0	29.8	62.4	16.7	15.3	16.7	20.6	16.0	16.8	20.3	19.4
LnGrp LOS	D	A	C	E	B	B	B	C	B	B	C	B
Approach Vol, veh/h		417			499			562			358	
Approach Delay, s/veh		31.6			38.4			17.5			19.1	
Approach LOS		C			D			B			B	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	9.2	19.8	14.0	19.8	8.7	20.3	8.8	25.0
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	5.0	18.0	9.0	18.0	5.0	18.0	9.0	18.0
Max Q Clear Time (g_c+I1), s	4.7	12.2	10.2	13.1	4.0	6.7	4.8	7.1
Green Ext Time (p_c), s	0.0	1.1	0.0	0.8	0.0	0.9	0.1	0.9

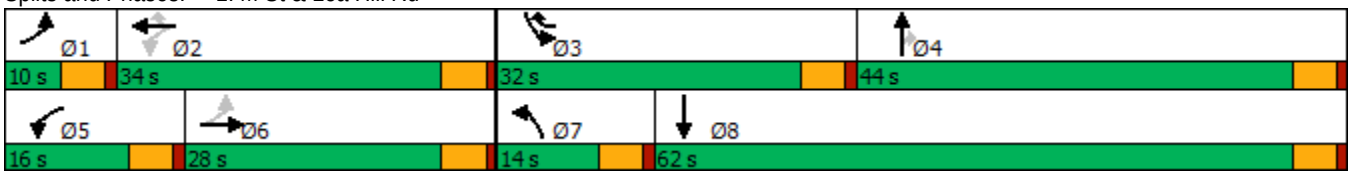
Intersection Summary	
HCM 6th Ctrl Delay	26.7
HCM 6th LOS	C

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	65	310	185	235	315	430	115	665	405	610	780	5
Future Volume (vph)	65	310	185	235	315	430	115	665	405	610	780	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	11	11	11	11	11	11	11	11	11	11
Storage Length (ft)	50		200	200		0	150		150	200		150
Storage Lanes	1		1	1		1	1		1	1		0
Taper Length (ft)	90			90			90			90		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		35			35			35			35	
Link Distance (ft)		999			1094			1937			2040	
Travel Time (s)		19.5			21.3			37.7			39.7	
Turn Type	pm+pt	NA		pm+pt	NA	pm+ov	Prot	NA	Perm	Prot	NA	
Protected Phases	1	6		5	2	3	7	4		3	8	
Permitted Phases	6			2		2			4			
Detector Phase	1	6		5	2	3	7	4	4	3	8	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Minimum Split (s)	10.0	26.0		10.0	30.0	10.0	10.0	32.0	32.0	10.0	25.0	
Total Split (s)	10.0	28.0		16.0	34.0	32.0	14.0	44.0	44.0	32.0	62.0	
Total Split (%)	8.3%	23.3%		13.3%	28.3%	26.7%	11.7%	36.7%	36.7%	26.7%	51.7%	
Maximum Green (s)	5.0	23.0		11.0	29.0	27.0	9.0	39.0	39.0	27.0	57.0	
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Lead/Lag	Lead	Lag		Lead	Lag	Lead	Lead	Lag	Lag	Lead	Lag	
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Recall Mode	None	None		None	None	None	None	Min	Min	None	Min	
Walk Time (s)		5.0			5.0			5.0	5.0		5.0	
Flash Dont Walk (s)		16.0			20.0			22.0	22.0		15.0	
Pedestrian Calls (#/hr)		9			9			9	9		9	

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 114.8
Natural Cycle: 95
Control Type: Actuated-Uncoordinated

Splits and Phases: 1: M St & Lea Hill Rd



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	65	310	185	235	315	430	115	665	405	610	780	5
Future Volume (veh/h)	65	310	185	235	315	430	115	665	405	610	780	5
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.96	1.00		0.98	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
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1900	1900	1900	1885	1885	1885	1885	1885	1885	1885	1885	1885
Adj Flow Rate, veh/h	68	326	195	247	332	453	121	700	0	642	821	0
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	0	0	0	1	1	1	1	1	1	1	1	1
Cap, veh/h	197	415	241	272	463	713	140	1192		718	869	
Arrive On Green	0.04	0.19	0.19	0.10	0.25	0.25	0.08	0.33	0.00	0.21	0.46	0.00
Sat Flow, veh/h	1810	2156	1254	1795	1885	1560	1795	3582	1598	3483	1885	0
Grp Volume(v), veh/h	68	271	250	247	332	453	121	700	0	642	821	0
Grp Sat Flow(s),veh/h/ln	1810	1805	1605	1795	1885	1560	1795	1791	1598	1742	1885	0
Q Serve(g_s), s	3.4	16.5	17.2	11.0	18.6	25.9	7.7	18.7	0.0	20.7	48.0	0.0
Cycle Q Clear(g_c), s	3.4	16.5	17.2	11.0	18.6	25.9	7.7	18.7	0.0	20.7	48.0	0.0
Prop In Lane	1.00		0.78	1.00		1.00	1.00		1.00	1.00		0.00
Lane Grp Cap(c), veh/h	197	347	309	272	463	713	140	1192		718	869	
V/C Ratio(X)	0.34	0.78	0.81	0.91	0.72	0.64	0.86	0.59		0.89	0.94	
Avail Cap(c_a), veh/h	200	360	320	272	474	721	140	1211		815	932	
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	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	35.9	44.3	44.5	36.7	39.8	24.4	52.6	31.9	0.0	44.6	29.7	0.0
Incr Delay (d2), s/veh	1.0	10.3	13.9	31.5	5.0	1.8	39.1	0.7	0.0	11.4	17.1	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.6	8.3	7.9	4.0	9.1	9.6	5.0	8.1	0.0	9.9	24.7	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	36.9	54.6	58.4	68.2	44.8	26.2	91.7	32.6	0.0	56.0	46.8	0.0
LnGrp LOS	D	D	E	E	D	C	F	C		E	D	
Approach Vol, veh/h		589			1032			821	A		1463	A
Approach Delay, s/veh		54.2			42.3			41.3			50.8	
Approach LOS		D			D			D			D	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	9.8	33.4	28.8	43.4	16.0	27.2	14.0	58.2
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	5.0	29.0	27.0	39.0	11.0	23.0	9.0	57.0
Max Q Clear Time (g_c+I1), s	5.4	27.9	22.7	20.7	13.0	19.2	9.7	50.0
Green Ext Time (p_c), s	0.0	0.5	1.1	4.5	0.0	1.1	0.0	3.2

Intersection Summary	
HCM 6th Ctrl Delay	47.1
HCM 6th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [NBR, SBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	19.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	40	1375	35	15	935	30	5	5	10	45	5	40
Future Vol, veh/h	40	1375	35	15	935	30	5	5	10	45	5	40
Conflicting Peds, #/hr	4	0	9	9	0	4	0	0	1	1	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	150	-	150	100	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	1	1	1	1	1	1	0	0	0	0	0	0
Mvmt Flow	42	1447	37	16	984	32	5	5	11	47	5	42

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	1020	0	0	1493	0	0	2596	2592	734	1847	2613	1004
Stage 1	-	-	-	-	-	-	1540	1540	-	1036	1036	-
Stage 2	-	-	-	-	-	-	1056	1052	-	811	1577	-
Critical Hdwy	4.115	-	-	4.115	-	-	7.3	6.5	6.9	7.3	6.5	6.2
Critical Hdwy Stg 1	-	-	-	-	-	-	6.5	5.5	-	6.1	5.5	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.1	5.5	-	6.5	5.5	-
Follow-up Hdwy	2.2095	-	-	2.2095	-	-	3.5	4	3.3	3.5	4	3.3
Pot Cap-1 Maneuver	683	-	-	452	-	-	15	25	367	52	25	296
Stage 1	-	-	-	-	-	-	123	179	-	282	311	-
Stage 2	-	-	-	-	-	-	275	306	-	344	171	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	681	-	-	448	-	-	10	22	364	~ 38	22	295
Mov Cap-2 Maneuver	-	-	-	-	-	-	10	22	-	~ 38	22	-
Stage 1	-	-	-	-	-	-	115	166	-	264	299	-
Stage 2	-	-	-	-	-	-	223	294	-	303	159	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.3	0.2	$ 329.3	$ 466.4
HCM LOS			F	F

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	26	681	-	-	448	-	-	58
HCM Lane V/C Ratio	0.81	0.062	-	-	0.035	-	-	1.633
HCM Control Delay (s)	$ 329.3	10.6	-	-	13.3	-	-	$ 466.4
HCM Lane LOS	F	B	-	-	B	-	-	F
HCM 95th %tile Q(veh)	2.5	0.2	-	-	0.1	-	-	8.7

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	1215	200	225	875	110	385
Future Volume (vph)	1215	200	225	875	110	385
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	100		250	0
Storage Lanes		0	1		1	1
Taper Length (ft)			90		90	
Right Turn on Red		Yes				Yes
Link Speed (mph)	35			35	30	
Link Distance (ft)	339			547	1453	
Travel Time (s)	6.6			10.7	33.0	
Turn Type	NA		pm+pt	NA	Prot	Perm
Protected Phases	6		5	2	7	
Permitted Phases			2			4
Detector Phase	6		5	2	7	4
Switch Phase						
Minimum Initial (s)	5.0		5.0	5.0	4.0	4.0
Minimum Split (s)	23.0		10.0	10.0	9.0	23.0
Total Split (s)	36.0		11.0	47.0	23.0	23.0
Total Split (%)	51.4%		15.7%	67.1%	32.9%	32.9%
Maximum Green (s)	31.0		6.0	42.0	18.0	18.0
Yellow Time (s)	4.0		4.0	4.0	4.0	4.0
All-Red Time (s)	1.0		1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0		0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0		5.0	5.0	5.0	5.0
Lead/Lag	Lag		Lead			
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Recall Mode	Min		None	Min	None	None
Walk Time (s)	7.0					7.0
Flash Dont Walk (s)	11.0					11.0
Pedestrian Calls (#/hr)	1					0

Intersection Summary	
Area Type:	Other
Cycle Length: 70	
Actuated Cycle Length: 66.3	
Natural Cycle: 80	
Control Type: Actuated-Uncoordinated	

Splits and Phases: 3: R St NE & Lea Hill Rd

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	1215	200	225	875	110	385
Future Volume (veh/h)	1215	200	225	875	110	385
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)		0.99	1.00		1.00	1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No	No	
Adj Sat Flow, veh/h/ln	1885	1885	1900	1900	1900	1900
Adj Flow Rate, veh/h	1279	211	237	921	116	405
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	1	1	0	0	0	0
Cap, veh/h	1358	222	272	1138	466	415
Arrive On Green	0.44	0.44	0.09	0.60	0.26	0.26
Sat Flow, veh/h	3170	503	1810	1900	1810	1610
Grp Volume(v), veh/h	740	750	237	921	116	405
Grp Sat Flow(s),veh/h/ln	1791	1788	1810	1900	1810	1610
Q Serve(g_s), s	27.5	28.2	4.7	26.3	3.6	17.4
Cycle Q Clear(g_c), s	27.5	28.2	4.7	26.3	3.6	17.4
Prop In Lane		0.28	1.00		1.00	1.00
Lane Grp Cap(c), veh/h	791	790	272	1138	466	415
V/C Ratio(X)	0.94	0.95	0.87	0.81	0.25	0.98
Avail Cap(c_a), veh/h	795	793	272	1142	466	415
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	18.6	18.8	15.6	10.9	20.6	25.7
Incr Delay (d2), s/veh	18.2	20.6	24.8	4.4	0.3	37.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	13.7	14.5	3.4	9.7	1.5	18.0
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	36.7	39.3	40.4	15.3	20.8	63.5
LnGrp LOS	D	D	D	B	C	E
Approach Vol, veh/h	1490			1158	521	
Approach Delay, s/veh	38.0			20.5	54.0	
Approach LOS	D			C	D	

Timer - Assigned Phs		2		4	5	6
Phs Duration (G+Y+Rc), s		46.9		23.0	11.0	35.9
Change Period (Y+Rc), s		5.0		5.0	5.0	5.0
Max Green Setting (Gmax), s		42.0		18.0	6.0	31.0
Max Q Clear Time (g_c+I1), s		28.3		19.4	6.7	30.2
Green Ext Time (p_c), s		5.8		0.0	0.0	0.7

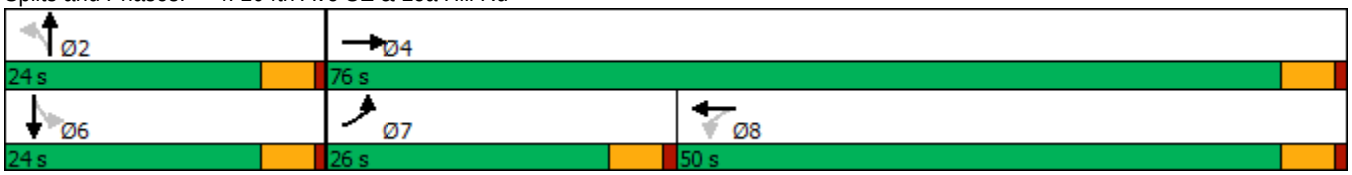
Intersection Summary	
HCM 6th Ctrl Delay	34.2
HCM 6th LOS	C

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	375	1135	10	1	795	15	10	1	1	35	5	295
Future Volume (vph)	375	1135	10	1	795	15	10	1	1	35	5	295
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	11	11	11	11	11	11	11	11	11	11
Storage Length (ft)	0		0	100		0	0		0	0		100
Storage Lanes	1		0	0		0	0		0	0		0
Taper Length (ft)	0			90			90			90		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		35			35			30			30	
Link Distance (ft)		551			1144			287			694	
Travel Time (s)		10.7			22.3			6.5			15.8	
Turn Type	Prot	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases	7	4			8			2			6	
Permitted Phases				8			2			6		
Detector Phase	7	4		8	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Minimum Split (s)	10.0	23.0		23.0	23.0		23.0	23.0		23.0	23.0	
Total Split (s)	26.0	76.0		50.0	50.0		24.0	24.0		24.0	24.0	
Total Split (%)	26.0%	76.0%		50.0%	50.0%		24.0%	24.0%		24.0%	24.0%	
Maximum Green (s)	21.0	71.0		45.0	45.0		19.0	19.0		19.0	19.0	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0	0.0			0.0			0.0			0.0	
Total Lost Time (s)	5.0	5.0			5.0			5.0			5.0	
Lead/Lag	Lead			Lag	Lag							
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	Min	Min		Min	Min		None	None		None	None	
Walk Time (s)		7.0		7.0	7.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)		11.0		11.0	11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0		3	3		1	1		0	0	

Intersection Summary

Area Type: Other
Cycle Length: 100
Actuated Cycle Length: 91.3
Natural Cycle: 100
Control Type: Actuated-Uncoordinated

Splits and Phases: 4: 104th Ave SE & Lea Hill Rd



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	375	1135	10	1	795	15	10	1	1	35	5	295
Future Volume (veh/h)	375	1135	10	1	795	15	10	1	1	35	5	295
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		1.00	1.00		1.00	1.00		0.97
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
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1885	1885	1885	1885	1885	1885	1900	1900	1900	1885	1885	1885
Adj Flow Rate, veh/h	395	1195	11	1	837	16	11	1	1	37	5	48
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	1	1	1	1	1	1	0	0	0	1	1	1
Cap, veh/h	434	1490	14	45	913	17	183	17	10	104	14	63
Arrive On Green	0.24	0.80	0.80	0.50	0.50	0.50	0.08	0.08	0.08	0.08	0.08	0.08
Sat Flow, veh/h	1795	1865	17	0	1842	35	1301	219	127	532	185	820
Grp Volume(v), veh/h	395	0	1206	854	0	0	13	0	0	90	0	0
Grp Sat Flow(s),veh/h/ln	1795	0	1882	1878	0	0	1646	0	0	1537	0	0
Q Serve(g_s), s	17.3	0.0	28.9	0.0	0.0	0.0	0.0	0.0	0.0	3.7	0.0	0.0
Cycle Q Clear(g_c), s	17.3	0.0	28.9	33.9	0.0	0.0	0.5	0.0	0.0	4.6	0.0	0.0
Prop In Lane	1.00		0.01	0.00		0.02	0.85		0.08	0.41		0.53
Lane Grp Cap(c), veh/h	434	0	1504	975	0	0	209	0	0	181	0	0
V/C Ratio(X)	0.91	0.00	0.80	0.88	0.00	0.00	0.06	0.00	0.00	0.50	0.00	0.00
Avail Cap(c_a), veh/h	467	0	1656	1092	0	0	434	0	0	421	0	0
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	1.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	29.7	0.0	4.5	18.8	0.0	0.0	34.6	0.0	0.0	36.4	0.0	0.0
Incr Delay (d2), s/veh	20.9	0.0	2.7	7.6	0.0	0.0	0.1	0.0	0.0	2.1	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	9.6	0.0	5.9	14.9	0.0	0.0	0.2	0.0	0.0	1.8	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	50.7	0.0	7.2	26.4	0.0	0.0	34.7	0.0	0.0	38.5	0.0	0.0
LnGrp LOS	D	A	A	C	A	A	C	A	A	D	A	A
Approach Vol, veh/h		1601			854			13			90	
Approach Delay, s/veh		17.9			26.4			34.7			38.5	
Approach LOS		B			C			C			D	

Timer - Assigned Phs		2		4		6	7	8
Phs Duration (G+Y+Rc), s		11.2		69.5		11.2	24.5	45.0
Change Period (Y+Rc), s		5.0		5.0		5.0	5.0	5.0
Max Green Setting (Gmax), s		19.0		71.0		19.0	21.0	45.0
Max Q Clear Time (g_c+I1), s		2.5		30.9		6.6	19.3	35.9
Green Ext Time (p_c), s		0.0		15.5		0.3	0.3	4.0

Intersection Summary			
HCM 6th Ctrl Delay			21.6
HCM 6th LOS			C

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	300	5	850	380	5	470
Future Volume (vph)	300	5	850	380	5	470
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12
Storage Length (ft)	0	50		100	100	
Storage Lanes	1	0		0	0	
Taper Length (ft)	90				90	
Right Turn on Red		Yes		Yes		
Link Speed (mph)	25		35			35
Link Distance (ft)	281		1144			893
Travel Time (s)	7.7		22.3			17.4
Turn Type	Prot		NA		Perm	NA
Protected Phases	1		8			4
Permitted Phases					4	
Detector Phase	1		8		4	4
Switch Phase						
Minimum Initial (s)	5.0		5.0		5.0	5.0
Minimum Split (s)	21.0		18.5		18.5	18.5
Total Split (s)	21.0		69.0		69.0	69.0
Total Split (%)	23.3%		76.7%		76.7%	76.7%
Maximum Green (s)	16.0		64.5		64.5	64.5
Yellow Time (s)	4.0		3.5		3.5	3.5
All-Red Time (s)	1.0		1.0		1.0	1.0
Lost Time Adjust (s)	0.0		0.0			0.0
Total Lost Time (s)	5.0		4.5			4.5
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0		3.0		3.0	3.0
Recall Mode	None		Min		Min	Min
Walk Time (s)	7.0		7.0		7.0	7.0
Flash Dont Walk (s)	9.0		7.0		7.0	7.0
Pedestrian Calls (#/hr)	0		0		0	0

Intersection Summary	
Area Type:	Other
Cycle Length: 90	
Actuated Cycle Length: 90.7	
Natural Cycle: 90	
Control Type: Actuated-Uncoordinated	

Splits and Phases: 5: Lea Hill Rd & SE 320th St

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	300	5	850	380	5	470
Future Volume (veh/h)	300	5	850	380	5	470
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No		No			No
Adj Sat Flow, veh/h/ln	1900	1900	1885	1885	1885	1885
Adj Flow Rate, veh/h	316	5	895	400	5	495
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	0	0	1	1	1	1
Cap, veh/h	315	5	885	395	40	1029
Arrive On Green	0.18	0.18	0.72	0.72	0.72	0.72
Sat Flow, veh/h	1773	28	1234	552	0	1436
Grp Volume(v), veh/h	322	0	0	1295	500	0
Grp Sat Flow(s),veh/h/ln	1806	0	0	1786	1436	0
Q Serve(g_s), s	16.0	0.0	0.0	64.5	0.0	0.0
Cycle Q Clear(g_c), s	16.0	0.0	0.0	64.5	64.5	0.0
Prop In Lane	0.98	0.02		0.31	0.01	
Lane Grp Cap(c), veh/h	321	0	0	1280	1069	0
V/C Ratio(X)	1.00	0.00	0.00	1.01	0.47	0.00
Avail Cap(c_a), veh/h	321	0	0	1280	1069	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	37.0	0.0	0.0	12.8	9.5	0.0
Incr Delay (d2), s/veh	50.9	0.0	0.0	28.1	0.3	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	11.5	0.0	0.0	27.9	4.3	0.0
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	87.9	0.0	0.0	40.9	9.8	0.0
LnGrp LOS	F	A	A	F	A	A
Approach Vol, veh/h	322		1295			500
Approach Delay, s/veh	87.9		40.9			9.8
Approach LOS	F		D			A

Timer - Assigned Phs			4		6		8
Phs Duration (G+Y+Rc), s			69.0		21.0		69.0
Change Period (Y+Rc), s			4.5		5.0		4.5
Max Green Setting (Gmax), s			64.5		16.0		64.5
Max Q Clear Time (g_c+I1), s			66.5		18.0		66.5
Green Ext Time (p_c), s			0.0		0.0		0.0

Intersection Summary	
HCM 6th Ctrl Delay	40.7
HCM 6th LOS	D

Intersection	
Int Delay, s/veh	689.8

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	515	250	350	410	185	360
Future Vol, veh/h	515	250	350	410	185	360
Conflicting Peds, #/hr	0	1	1	0	0	1
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	-	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	1	1	5	5	0	0
Mvmt Flow	542	263	368	432	195	379

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	806	0	1843	676
Stage 1	-	-	-	-	675	-
Stage 2	-	-	-	-	1168	-
Critical Hdwy	-	-	4.15	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.245	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	806	-	~ 84	457
Stage 1	-	-	-	-	510	-
Stage 2	-	-	-	-	298	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	805	-	~ 34	456
Mov Cap-2 Maneuver	-	-	-	-	~ 34	-
Stage 1	-	-	-	-	509	-
Stage 2	-	-	-	-	~ 119	-

Approach	EB	WB	NB
HCM Control Delay, s	0	6.1	$ 2611.6
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	87	-	-	805	-
HCM Lane V/C Ratio	6.594	-	-	0.458	-
HCM Control Delay (s)	$ 2611.6	-	-	13.2	0
HCM Lane LOS	F	-	-	B	A
HCM 95th %tile Q(veh)	64.2	-	-	2.4	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection	
Int Delay, s/veh	269.9

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	300	580	340	30	165	410
Future Vol, veh/h	300	580	340	30	165	410
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	100	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	5	5	3	3	6	6
Mvmt Flow	316	611	358	32	174	432

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	390	0	-	0	1617	374
Stage 1	-	-	-	-	374	-
Stage 2	-	-	-	-	1243	-
Critical Hdwy	4.15	-	-	-	6.46	6.26
Critical Hdwy Stg 1	-	-	-	-	5.46	-
Critical Hdwy Stg 2	-	-	-	-	5.46	-
Follow-up Hdwy	2.245	-	-	-	3.554	3.354
Pot Cap-1 Maneuver	1152	-	-	-	~ 111	663
Stage 1	-	-	-	-	687	-
Stage 2	-	-	-	-	267	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1152	-	-	-	~ 81	663
Mov Cap-2 Maneuver	-	-	-	-	~ 81	-
Stage 1	-	-	-	-	499	-
Stage 2	-	-	-	-	267	-

Approach	EB	WB	SB
HCM Control Delay, s	3.2	0	$ 851.8
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1152	-	-	-	217
HCM Lane V/C Ratio	0.274	-	-	-	2.789
HCM Control Delay (s)	9.3	-	-	-	$ 851.8
HCM Lane LOS	A	-	-	-	F
HCM 95th %tile Q(veh)	1.1	-	-	-	52.8

Notes

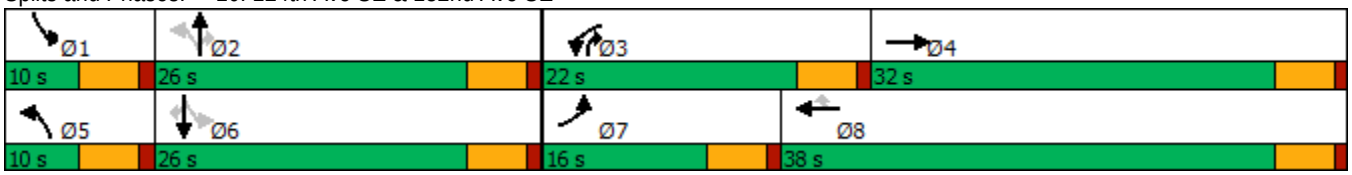
~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	100	265	215	295	200	80	90	185	395	115	320	95
Future Volume (vph)	100	265	215	295	200	80	90	185	395	115	320	95
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	12	12	12
Storage Length (ft)	100		250	100		120	150		300	200		60
Storage Lanes	1		0	1		1	1		1	1		1
Taper Length (ft)	90			90			90			90		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		35			35			30			30	
Link Distance (ft)		821			3057			1495			4493	
Travel Time (s)		16.0			59.6			34.0			102.1	
Turn Type	Prot	NA		Prot	NA	Perm	pm+pt	NA	pm+ov	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2	3	1	6	
Permitted Phases						8	2		2	6		6
Detector Phase	7	4		3	8	8	5	2	3	1	6	6
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	10.0	23.0		10.0	23.0	23.0	10.0	23.0	10.0	10.0	23.0	23.0
Total Split (s)	16.0	32.0		22.0	38.0	38.0	10.0	26.0	22.0	10.0	26.0	26.0
Total Split (%)	17.8%	35.6%		24.4%	42.2%	42.2%	11.1%	28.9%	24.4%	11.1%	28.9%	28.9%
Maximum Green (s)	11.0	27.0		17.0	33.0	33.0	5.0	21.0	17.0	5.0	21.0	21.0
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag	Lead	Lead	Lag	Lag
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None		None	None	None	None	Min	None	None	Min	Min
Walk Time (s)		7.0			7.0	7.0		7.0			7.0	7.0
Flash Dont Walk (s)		11.0			11.0	11.0		11.0			11.0	11.0
Pedestrian Calls (#/hr)		2			2	2		3			9	9

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 84.3
Natural Cycle: 90
Control Type: Actuated-Uncoordinated

Splits and Phases: 10: 124th Ave SE & 132nd Ave SE



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	100	265	215	295	200	80	90	185	395	115	320	95
Future Volume (veh/h)	100	265	215	295	200	80	90	185	395	115	320	95
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.93	1.00		0.97	0.99		0.96	0.99		0.96
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
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1885	1885	1885	1900	1900	1900	1885	1885	1885	1870	1870	1870
Adj Flow Rate, veh/h	105	279	226	311	211	84	95	195	416	121	337	100
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	1	1	1	0	0	0	1	1	1	2	2	2
Cap, veh/h	134	280	226	342	787	648	242	440	661	295	436	356
Arrive On Green	0.07	0.30	0.30	0.19	0.41	0.41	0.06	0.23	0.23	0.06	0.23	0.23
Sat Flow, veh/h	1795	932	755	1810	1900	1564	1795	1885	1539	1781	1870	1527
Grp Volume(v), veh/h	105	0	505	311	211	84	95	195	416	121	337	100
Grp Sat Flow(s),veh/h/ln	1795	0	1686	1810	1900	1564	1795	1885	1539	1781	1870	1527
Q Serve(g_s), s	5.2	0.0	26.9	15.2	6.6	3.0	3.6	8.0	19.3	4.7	15.2	4.8
Cycle Q Clear(g_c), s	5.2	0.0	26.9	15.2	6.6	3.0	3.6	8.0	19.3	4.7	15.2	4.8
Prop In Lane	1.00		0.45	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	134	0	506	342	787	648	242	440	661	295	436	356
V/C Ratio(X)	0.78	0.00	1.00	0.91	0.27	0.13	0.39	0.44	0.63	0.41	0.77	0.28
Avail Cap(c_a), veh/h	219	0	506	342	787	648	242	440	661	295	436	356
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	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	40.9	0.0	31.5	35.7	17.4	16.3	25.4	29.5	20.6	24.8	32.3	28.3
Incr Delay (d2), s/veh	9.6	0.0	39.5	27.3	0.2	0.1	1.0	0.7	1.9	0.9	8.3	0.4
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	2.6	0.0	15.9	9.0	2.8	1.0	1.6	3.6	6.8	2.0	7.7	1.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	50.5	0.0	71.0	63.0	17.6	16.4	26.5	30.2	22.5	25.7	40.6	28.7
LnGrp LOS	D	A	E	E	B	B	C	C	C	C	D	C
Approach Vol, veh/h		610			606			706			558	
Approach Delay, s/veh		67.5			40.7			25.2			35.2	
Approach LOS		E			D			C			D	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	10.0	26.0	22.0	32.0	10.0	26.0	11.7	42.3
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	5.0	21.0	17.0	27.0	5.0	21.0	11.0	33.0
Max Q Clear Time (g_c+I1), s	6.7	21.3	17.2	28.9	5.6	17.2	7.2	8.6
Green Ext Time (p_c), s	0.0	0.0	0.0	0.0	0.0	0.9	0.1	1.4

Intersection Summary	
HCM 6th Ctrl Delay	41.6
HCM 6th LOS	D

Appendix B

Intersection Analysis Scores and Results

PERFORMANCE SCORING: 104th Avenue Alternatives *Lea Hill Corridor*		
Alternative A1	**104th Avenue Signal**	
Performance Criteria	**Rationale**	**Rating**
Environmental Risks	Steep slopes in the SE corner, no retaining walls, no impacts to wetlands.	9
Lea Hill Neighborhood Connectivity	Connectivity remains the same.	5
Intersection Operations	Operates at LOS C, with a WB approach v/c ratio of 0.94 suggesting occasional queue problems and vulnerability to volume spikes or stoppage events.	5
Safety	Signalized intersections have more conflict points and potential for high-speed crashes with left-turns present.	3
Right-of-Way Impacts	No Relocations Required. Approximatly 10 SF of the parcel in the SE corner will need to be acquired and a slope easement.	8

Alternative A2	**104th Avenue Roundabout**	
Performance Criteria	**Rationale**	**Rating**
Environmental Risks	Steep slopes in the SE corner, no retaining walls however the SE corner may need a wall, no impacts to Wetlands.	8
Lea Hill Neighborhood Connectivity	Connectivity remains the same but roundabout adds some U-turn capabilities to serve as an alternative to left-turn movements in the EB direction on 8th Street.	7
Intersection Operations	Operates at LOS B with v/c ratios under 0.8 for all approaches.	10
Safety	intersection but has more potential for collisions than a single-lane RAB.	8
Right-of-Way Impacts	No Relocation Required. The impacted property on the NW corner is the City of Auburn's property.	10

Comparison of 104th Avenue Alternatives Value
Performance / Cost / Time Scores
Value Index
1.000
0.900
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
1.800
1.600
1.400
1.200
1.000
0.800
0.600
0.400
0.200
0.000
Alternative A1
Alternative A2
Performance
Cost / Time
Value Index

PERFORMANCE SCORING: 105th Place Alternatives

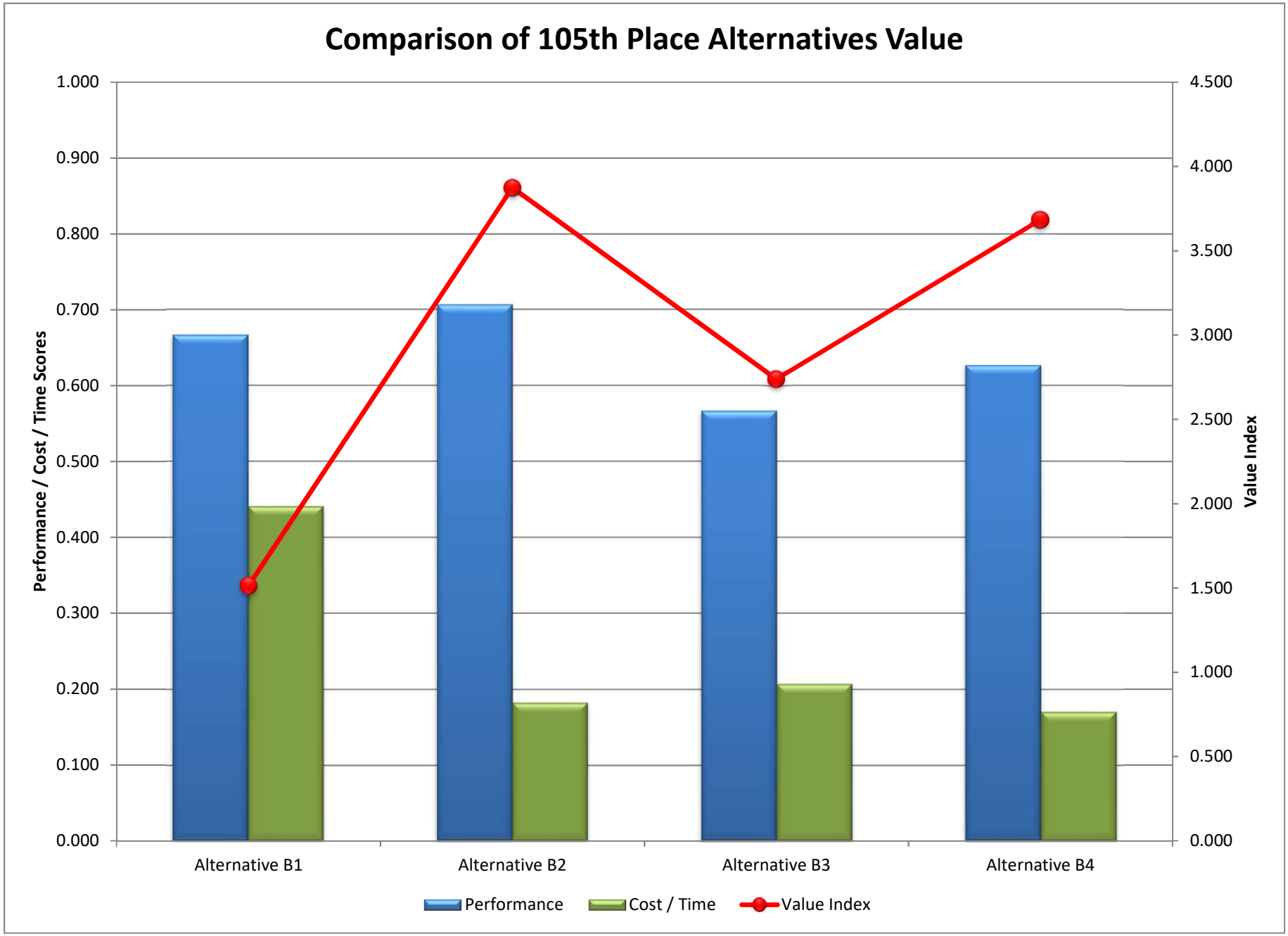
Lea Hill Corridor

Alternative B1	**105th Place Signal w SB Left-turn Ban**	
Performance Criteria	**Rationale**	**Rating**
Environmental Risks	Impacts to steep slopes requires a 725 LF retaining wall. No Wetlands impacted.	4
Lea Hill Neighborhood Connectivity	Connectivity remains the same.	10
Intersection Operations	Operates at LOS B, with NB v/c ratio of 0.83.	7
Safety	High-speed potential for conflicts with left-turns. Two signalized crosswalk with turning vehicle conflicts.	5
Right-of-Way Impacts	Requires no relocations. Parcel in the SE corner will need a slope easement.	9

Alternative B2	**105th Place RI/RO with Minor-leg Stop Control**	
Performance Criteria	**Rationale**	**Rating**
Environmental Risks	Impacts to steep slopes requires a 135 LF retaining wall. No Wetlands impacted.	7
Lea Hill Neighborhood Connectivity	Reduces neighborhood connectivity by restricting WB lefts from 105th to Lea Hill, rerouting them to 112th Avenue.	4
Intersection Operations	Operates at LOS C for the minor street movement, which has a minimal volume (5). No delay for volume on Lea Hill	9
Safety	Potential for conflicts low-severity (no left-turn movements) without right-turn lane. Two yield crosswalks and no crossing across Lea Hill Road.	7
Right-of-Way Impacts	Requires no relocations. Parcel in the SE corner will need a slope easement.	9

Alternative B3	**105th Place Signal with One-Way Downhill**	
Performance Criteria	**Rationale**	**Rating**
Environmental Risks	Requires 135 LF retaining wall, Steep Slopes, No Wetlands affected	7
Lea Hill Neighborhood Connectivity	Reduces neighborhood connectivity by restricting NB rights from Lea Hill to 105th Place, rerouting them to 112th Avenue.	4
Intersection Operations	Operates at LOS C, with a NB v/c ratio of 0.98 as a result of the NB right-turn vehicles being shifted into the through lane. This v/c ratio indicates lengthy queues and vulnerability to events and volume spikes.	5
Safety	High-speed potential for conflicts with left-turns. One signalized crosswalk with vehicle turning conflict and another signalized crosswalk with no conflicts.	6
Right-of-Way Impacts	Requires no relocations. Parcel in the SE corner will need a slope easement.	9

Alternative B4	**105th Place Closure**	
Performance Criteria	**Rationale**	**Rating**
Environmental Risks	Minimal change to current configuration to accommodate non-motorized facilities	7
Lea Hill Neighborhood Connectivity	Highest potential impact. Reduces connectivity by removing access at 105th Place and rerouting all traffic to 112th and 124th Streets	0
Intersection Operations	No intersection, no delay.	10
Safety	No pedestrian crossing across Lea Hill but no crosswalk at 105th Place and free movement of cyclists and pedestrians up and down Lea Hill Road. Slower emergency response times.	6
Right-of-Way Impacts	Requires no relocations. Least potential impact of all options.	10


Comparison of 105th Place Alternatives Value
Performance / Cost / Time Scores
Value Index
1.000
0.900
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
4.500
4.000
3.500
3.000
2.500
2.000
1.500
1.000
0.500
0.000
Alternative B1
Alternative B2
Alternative B3
Alternative B4
Performance
Cost / Time
Value Index

PERFORMANCE SCORING: 112th & 116th Avenues Alternatives

Lea Hill Corridor

Alternative C1	Both 3-leg Signals	
Performance Criteria	**Rationale**	**Rating**
Environmental Risks	Steep slope impacts require some retaining wall on north side of Lea Hill Road at 112th. Minor wetland impacts at 116th.	7
Lea Hill Neighborhood Connectivity	Connectivity remains the same.	3
Intersection Operations	Each operates at LOS D, with minor street v/c ratios in excess of 1.0 which indicates significant, building queues.	4
Safety	3-leg signal intersection have more conflicts (9) than single lane RAB and potential for high-speed collisions with left-turning vehicles.	5
Right-of-Way Impacts	No full takes required. North side of Lea Hill Road at 112th Avenue will need 7550 SF of ROW acquisition (strip take).	9

Alternative C2	Both 3-leg Roundabouts	
Performance Criteria	**Rationale**	**Rating**
Environmental Risks	Steep slope impacts require some retaining wall on north side of Lea Hill Road at 112th. Minor wetland impacts at 116th.	7
Lea Hill Neighborhood Connectivity	Connectivity remains the same but control makes intersections more efficient.	4
Intersection Operations	112th operates at LOS B and 116th at LOS A. Both v/c ratios for the Lea Hill approaches are below 0.80 which indicates manageable queues.	9
Safety	Two 3-leg single-lane RABs at both intersections means the fewest possible conflict points (6 each) and lower-speed, less-severe crashes.	10
Right-of-Way Impacts	One full take required. Total parcel take required at 112th Avenue in the SW corner. 116th right-of-way acquisition required on NW corner 1,060 SF and SE corner 160 SF (strip takes).	5

Alternative C3	112th as 4-way Signal & 116th as 3-way Minor-leg Stop Control	
Performance Criteria	**Rationale**	**Rating**
Environmental Risks	Bridge required to go over stream and steep ravine to construct north leg of 112th Avenue. Bridge structure is longer for a signal than required for a roundabout due to roadway alignment. Steep slope impacts require retaining wall at 112th. No wetland impacts.	4
Lea Hill Neighborhood Connectivity	Additional connection to the north of 112th which provides more regional connectivity compared to 116th.	8
Intersection Operations	112th operates at LOS D, with the EB approach v/c ratio at 1.02 which indicates significant, building queues. 116th operates at LOS C with very low v/c ratio which indicates minimal queuing.	4
Safety	potential for high-speed, high-severity collisions with left-turns present. Minor-leg stop control can lead to risky behaviors in congested conditions.	3
Right-of-Way Impacts	No full takes required. Right-of-way acquisition required in the NW corner of 112th of 1225 SF (strip take).	9

PERFORMANCE SCORING: 112th & 116th Avenues Alternatives

Lea Hill Corridor

Alternative C4	**112th as 4-way Roundabout & 116th as 3-way Minor-leg Stop Control**	
Performance Criteria	**Rationale**	**Rating**
Environmental Risks	Bridge required to go over stream and steep ravine to construct north leg of 112th Avenue. Bridge structure is shorter for a roundabout than required for a signal due to roadway alignment. Steep slope impacts require retaining wall at 112th. No wetland impacts.	5
Lea Hill Neighborhood Connectivity	Additional connection to the north of 112th which provides more regional connectivity compared to 116th.	8
Intersection Operations	112th operates at LOS B with v/c ratios under 0.8 which indicates manageable queues. 116th operates at LOS C with very low v/c ratio which indicates minimal queuing.	8
Safety	4-leg RABs have fewer possible conflict points (8) with potential for lower-speed, less-server collisions. Minor-leg stop control can lead to risky behaviors in congested conditions.	7
Right-of-Way Impacts	One full take required. Total parcel take required at 112th Avenue in the SW corner. A total of 15320 SF of right-of-way acquisition will be needed at the 112th intersection beyond the full parcel take.	4

Alternative C5	**116th as 4-way Signal & 112th as 3-way Minor-leg Stop Control**	
Performance Criteria	**Rationale**	**Rating**
Environmental Risks	Steep slope impacts require some retaining wall required at 112th. Minor impact to wetlands at 116th. Retaining wall of significant height is required on south leg of 116th but not in a high risk location.	5
Lea Hill Neighborhood Connectivity	Additional connection to the south of 116th which provides less regional connectivity compared to 112th	7
Intersection Operations	116th operates at LOS C with Lea Hill v/c ratios at or under 0.86. 112th operates at LOS D for minor street, with v/c of 0.40	6
Safety	4-way signal has the highest number of possible conflict points (32) with potential for high-speed, high-severity collisions with left-turns present. Existing 112th as minor-leg stop control has sight distance issues that would be unresolved.	3
Right-of-Way Impacts	At least one full take required. Total parcel take required at 116th Avenue in the SW corner. A total of 6200 SF of additional right-of-way acquisition required at 116th Avenue which does not include easements for connecting existing driveways to proposed grade of road which could potentially mean additional full takes if grade is infeasible.	2

PERFORMANCE SCORING: 112th & 116th Avenues Alternatives

Lea Hill Corridor

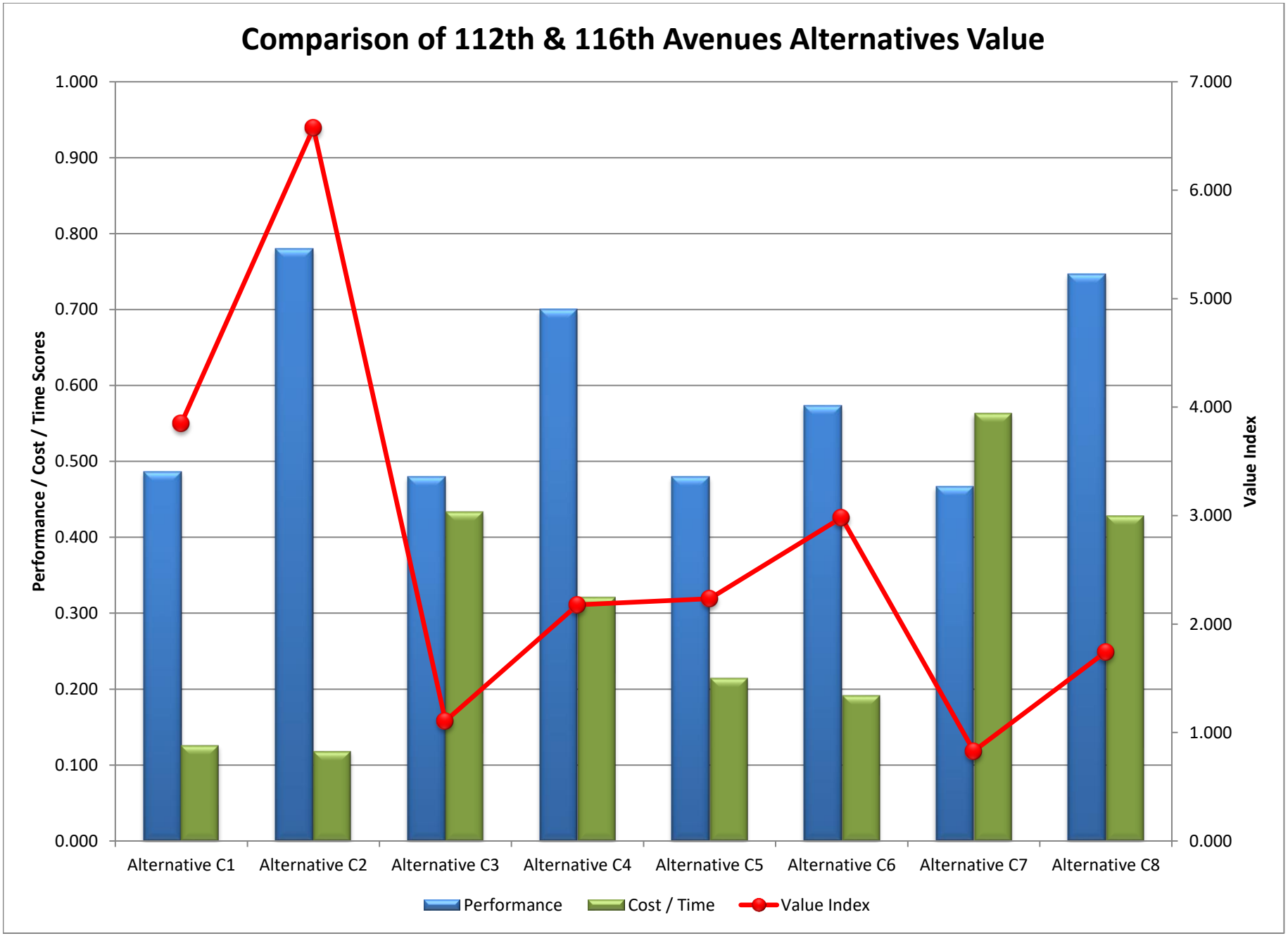
Alternative C6	**116th as 4-way Roundabout & 112th as 3-way Minor-leg Stop Control**	
Performance Criteria	**Rationale**	**Rating**
Environmental Risks	Steep slope impacts require some retaining wall required at 112th. Minor impact to wetlands at 116th. Retaining wall of significant height is required on south leg of 116th but not in a high risk location.	5
Lea Hill Neighborhood Connectivity	Additional connection to the south of 116th which provides less regional connectivity compared to 112th	7
Intersection Operations	116th operates at LOS B with v/c ratios at/under 0.81. 112th operates at LOS D for minor street, with v/c of 0.40	7
Safety	4-leg RABs have fewer possible conflict points (8) with potential for lower-speed, less-server collisions. Existing 112th as minor-leg stop control has sight distance issues that would be unresolved.	5
Right-of-Way Impacts	At least one full take required. Total parcel take required at 116th Avenue in the SW corner. A total of 6200 SF of additional right-of-way acquisition required at 116th Avenue which does not include easements for connecting existing driveways to proposed grade of road which could potentially mean additional full takes if grade is infeasible.	2

Alternative C7	**112th as 4-way Signal & 116th as 4-way Signal**	
Performance Criteria	**Rationale**	**Rating**
Environmental Risks	Bridge required to go over stream and steep ravine to construct north leg of 112th Avenue. Bridge structure is longer for a signal than required for a roundabout due to roadway alignment. Steep slope impacts require retaining wall at 112th. Minor impact to wetlands at 116th. Retaining wall of significant height is required on south leg of 116th but not in a high risk location.	2
Lea Hill Neighborhood Connectivity	Additional connectivity at both 112th and 116th.	10
Intersection Operations	Both signals operate at LOS C with v/c ratios above 0.90 for the EB approach of Lea Hill which indicate some queuing issues.	5
Safety	each) with potential for high-speed, high-severity collisions with left-turns present.	3
Right-of-Way Impacts	At least one full take required. Right-of-way acquisition required in the NW corner of 112th of 1225 SF (strip take). Total parcel take required at 116th Avenue in the SW corner. A total of 6200 SF of additional right-of-way acquisition required at 116th Avenue which does not include easements for connecting existing driveways to proposed grade of road which could potentially mean additional full takes if grade is infeasible.	1

PERFORMANCE SCORING: 112th & 116th Avenues Alternatives

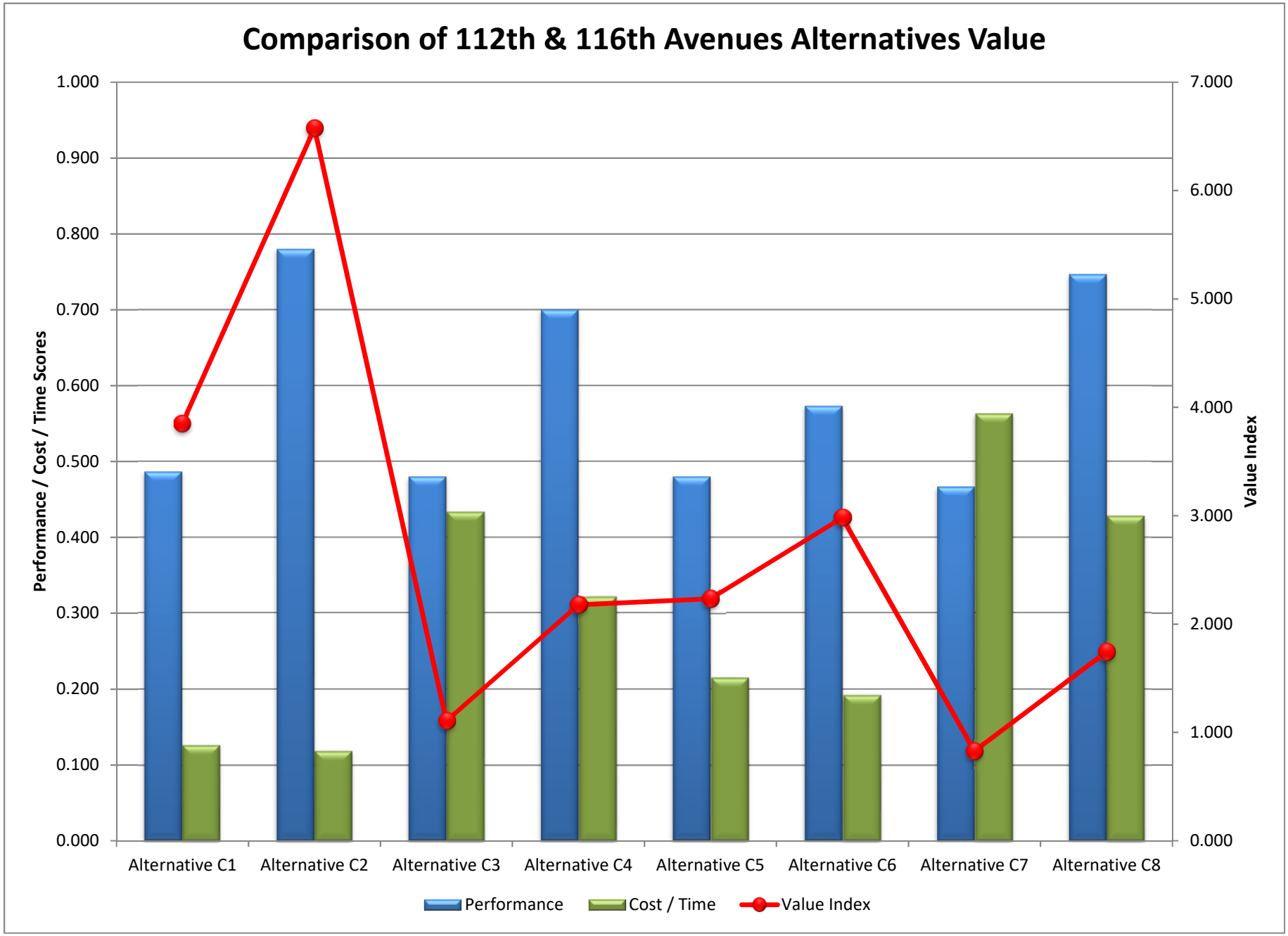
Lea Hill Corridor

Alternative C8	**112th as 4-way Roundabout & 116th as 4-way Roundabout**	
Performance Criteria	**Rationale**	**Rating**
Environmental Risks	Bridge required to go over stream and steep ravine to construct north leg of 112th Avenue. Bridge structure is shorter for a roundabout than required for a signal due to roadway alignment. Steep slope impacts require retaining wall at 112th. Minor impact to wetlands at 116th. Retaining wall of significant height is required on south leg of 116th but not in a high risk location.	3
Lea Hill Neighborhood Connectivity	Additional connectivity at both 112th and 116th	10
Intersection Operations	112th operates at LOS B and 116th at LOS A. Both v/c ratios for the Lea Hill approaches are at/below 0.80	9
Safety	Two 4-leg RABs have fewer possible conflict points (8 each) with potential for lower-speed, less-server collisions.	8
Right-of-Way Impacts	At least two full takes required. Total parcel take required at 112th Avenue in the SW corner. A total of 15320 SF of right-of-way acquisition will be needed at the 112th intersection beyond the full parcel take. Total parcel take required at 116th Avenue in the SW corner. A total of 6200 SF of additional right-of-way acquisition required at 116th Avenue which does not include easements for connecting existing driveways to proposed grade of road which could potentially mean additional full takes if grade is infeasible.	0


Comparison of 112th & 116th Avenues Alternatives Value
Performance / Cost / Time Scores
Value Index
1.000
0.900
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
7.000
6.000
5.000
4.000
3.000
2.000
1.000
0.000
Alternative C1
Alternative C2
Alternative C3
Alternative C4
Alternative C5
Alternative C6
Alternative C7
Alternative C8
Performance
Cost / Time
Value Index

Appendix C

Corridor Analysis Score and Results


Comparison of 112th & 116th Avenues Alternatives Value
Performance / Cost / Time Scores
Value Index
1.000
0.900
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
7.000
6.000
5.000
4.000
3.000
2.000
1.000
0.000
Alternative C1
Alternative C2
Alternative C3
Alternative C4
Alternative C5
Alternative C6
Alternative C7
Alternative C8
Performance
Cost / Time
Value Index

PERFORMANCE SCORING - Corridor Analysis *Lea Hill Corridor*		
Alternative #1	**A2 & B1 & C2**	
Performance Criteria	**Rationale**	**Rating**
Environmental Risks	Minimal environmental risk at 104th Avenue, same for all alternatives. More retaining wall and impact to steep slopes at 105th Place compared to B2 alternatives. Steep slope impacts at 112th and 116th Avenues require 1630-LF of retaining wall. Minor impacts to wetlands. C2 presents the least environmental risk compared to either C4 or C6 alternatives.	5
Lea Hill Neighborhood Connectivity	Minimal increase in connectivity due to RAB at 104th Ave provides potential for U-turns as an alternative to EB left-turns. Minimal decrease in connectivity at 105th Place related to restricting very small volume of SB left-turns. No net change.	4
Corridor Operations	Traffic signal at 105th and control at both 112th and 116th create increased delay along Lea Hill corridor	5
Intersection Operations	Roundabouts at 104th, 112th and 116th all operate at LOS B or better. Traffic signal at 105th operates at LOS B. Traffic signals at Harvey and 124th operate at LOS D.	8
Pedestrian Mobility & Transit Access	Smallest possible RABs at 104, 112, 116. Signalized pedestrian crossings at 105th Place across both streets (only needed if a bus stop were to be located here). Most crossings available across the study corridor, including at 112th Ave bus stop location.	8
Bicycle Mobility	No discernable difference in bicycle mobility among alternatives. Does not provide bicycle facility on 8th Ave.	7
Corridor Safety	Multi-lane RAB at 104 has fewer conflict points than a signalized intersection but has more potential for collisions than a single-lane RAB. Signal at 105th has potential for high-speed conflicts with left-turns. Two 3-leg single-lane RABs at both 112th and 116th means the fewest possible conflict points (6 each) and lower-speed, less-severe crashes types.	7
Right-of-Way Impacts	One full take required. Total parcel take required at 112th Avenue in the SW corner. 116th right-of-way acquisition required on NW corner 1,060 SF and SE corner 160 SF (strip takes).	6

PERFORMANCE SCORING - Corridor Analysis *Lea Hill Corridor*		
Alternative #2	**A2 & B1 & C6**	
Performance Criteria	**Rationale**	**Rating**
Environmental Risks	Minimal environmental risk at 104th Avenue, same for all alternatives. More retaining wall and impact to steep slopes at 105th Place compared to B2 alternatives. 112th requires 630-LF retaining wall on the north side of Lea Hill Road. 4-leg intersections at 116th Avenues requires 2820-LF retaining wall between 15-27ft in height. Minor wetland impacts overall.	4
Lea Hill Neighborhood Connectivity	Minimal increase in connectivity due to RAB at 104th Ave provides potential for U-turns as an alternative to EB left-turns. Minimal decrease in connectivity at 105th Place related to restricting very small volume of SB left-turns. Significant increase due to new connection south of 116th improves neighborhood connectivity, with smaller regional benefit compared to 112th. Net increase in connectivity.	6
Corridor Operations	Traffic signal at 105th and RAB at 112th but not at 116th limits the increase of delay on Lea Hill Corridor. The EB delay at 116th is greater than the 112th RAB.	7
Intersection Operations	Roundabouts at 104th and 116th operate at LOS B or better. Stop-control at 112th operates at LOS D for minor street. Traffic signal at 105th operates at LOS B. Traffic signals at Harvey and 124th operate at LOS D.	5
Pedestrian Mobility & Transit Access	RAB at 116th has more multi-lane approaches which are less safe for pedestrians. Signalized pedestrian crossings at 105th Place across both streets (only needed if a bus stop were to be located here). No crossing of 312th Street provided at 112th Ave where bus stop is located.	6
Bicycle Mobility	No discernable difference in bicycle mobility among alternatives. Does not provide bicycle facility on 8th Ave.	7
Corridor Safety	Multi-lane RAB at 104 has fewer conflict points than a signalized intersection but has more potential for collisions than a single-lane RAB. Signal at 105th has potential for high-speed conflicts with left-turns. Two 3-leg single-lane RABs at both 112th and 116th means the fewest possible conflict points (6 each) and lower-speed, less-severe crashes types with one additional multilane approach to 112th RAB compared to C2.	4
Right-of-Way Impacts	At least one full take required. Total parcel take required at 116th Avenue in the SW corner. A total of 6200 SF of additional right-of-way acquisition required at 116th Avenue which does not include easements for connecting existing driveways to proposed grade of road which could potentially mean additional full takes if grade is infeasible.	4

PERFORMANCE SCORING - Corridor Analysis *Lea Hill Corridor*		
Alternative #3	**A2 & B2 & C2-ALT**	
Performance Criteria	**Rationale**	**Rating**
Environmental Risks	Minimal environmental risk at 104th Avenue, same for all alternatives. Less retaining wall and impact to steep slopes at 105th Place compared to B1 alternatives. Steep slope impacts at 112th and 116th Avenues require 1630-LF of retaining wall. Minor impacts to wetlands. C2 presents the least environmental risk compared to either C4 or C6 alternatives.	7
Lea Hill Neighborhood Connectivity	Minimal increase in connectivity due to RAB at 104th Ave provides potential for U-turns as an alternative to EB left-turns. Significant decrease in connectivity at 105th Place related RI/RO restriction which diverts NB lefts to 112th Avenue. No additional connectivity at 112th or 116th Avenues but RABs process traffic more efficiently. Net slight decrease in connectivity.	3
Corridor Operations	RIRO control at 105th reduces delay on Lea Hill corridor. Control at both 112th and 116th adds delay, and 112th with the reassigned traffic from 105th increases delay at that location.	7
Intersection Operations	Roundabouts at 104th, 112th and 116th all operate at LOS B or better. RIRO at 105th operates at LOS C for small, minor street volume. Traffic signals at Harvey and 124th operate at LOS D.	6
Pedestrian Mobility & Transit Access	RABs at 112th and 116th provide safest crossing options, although 112th RAB has more multilane approaches than in Alt 1. No crossing of Lea Hill provided at 105th Place (not needed unless a bus stop were to be located here).	6
Bicycle Mobility	No discernable difference in bicycle mobility among alternatives. Does not provide bicycle facility on 8th Ave.	7
Corridor Safety	Multi-lane RAB at 104 has fewer conflict points than a signalized intersection but has more potential for collisions than a single-lane RAB. RI/RO at 105th means potential for conflicts low-severity (no left-turn movements) without right-turn lane. 4-leg RAB at 116 has two more possible conflict points (8 total) compared to 3-leg RABs but with potential for lower-speed, less-server crash types. Existing 112th as minor-leg stop control has sight distance issues that would be unresolved.	8
Right-of-Way Impacts	One full take required. Total parcel take required at 112th Avenue in the SW corner. 116th right-of-way acquisition required on NW corner 1,060 SF and SE corner 160 SF (strip takes). Small amount of additional right-of-way needed to accommodate NB right-turn slip lane.	5

PERFORMANCE SCORING - Corridor Analysis *Lea Hill Corridor*		
Alternative #4	**A2 & B2 & C6-ALT**	
Performance Criteria	**Rationale**	**Rating**
Environmental Risks	Minimal environmental risk at 104th Avenue, same for all alternatives. Less retaining wall and impact to steep slopes at 105th Place compared to B1 alternatives. 112th requires 630-LF retaining wall on the north side of Lea Hill Road. 4-leg intersections at 116th Avenues requires 2820-LF retaining wall between 15-27ft in height. Minor wetland impacts overall.	6
Lea Hill Neighborhood Connectivity	Minimal increase in connectivity due to RAB at 104th Ave provides potential for U-turns as an alternative to EB left-turns. Significant decrease in connectivity at 105th Place related RI/RO restriction which diverts NB lefts to 112th Avenue. Significant increase due to new connection south of 116th improves neighborhood connectivity, with smaller regional benefit compared to 112th. Net slight increase in connectivity.	5
Corridor Operations	RIRO control at 105th reduces delay on Lea Hill corridor. Control at 116th but not 112th limits delay further, but the 116th intersection is projected to experience more delay than 112th.	9
Intersection Operations	Roundabouts at 104th and 116th operate at LOS B or better. Stop-control at 112th operates at LOS F for minor street given additional WB volume from RIRO at 105th. Traffic signal at 105th operates at LOS B. Traffic signals at Harvey and 124th operate at LOS D.	4
Pedestrian Mobility & Transit Access	RAB at 116th provides crossing but has more multilane approaches that RAB in Alt 3. No crossing of Lea Hill provided at 105th Place (not needed unless a bus stop were to be located here). No crossing of 312th Street provided at 112th Ave where bus stop is located.	4
Bicycle Mobility	No discernable difference in bicycle mobility among alternatives. Does not provide bicycle facility on 8th Ave.	7
Corridor Safety	Multi-lane RAB at 104 has fewer conflict points than a signalized intersection but has more potential for collisions than a single-lane RAB. RI/RO at 105th means potential for conflicts low-severity (no left-turn movements) without right-turn lane. 4-leg RAB at 116 has two more possible conflict points (8 total) compared to 3-leg RABs but with potential for lower-speed, less-server crash types. with one additional multilane approach to 116th RAB compared to C6. Existing 112th as minor-leg stop control has sight distance issues that would be unresolved.	5
Right-of-Way Impacts	At least one full take required. Total parcel take required at 116th Avenue in the SW corner. A total of 6200 SF of additional right-of-way acquisition required at 116th Avenue which does not include easements for connecting existing driveways to proposed grade of road which could potentially mean additional full takes if grade is infeasible. Additional NB right-turn lane (compared to C6) may exaggerate these impacts.	3

Appendix D

Corridor Roll Plot

0 100 200
SCALE IN FEET

LEGEND

- STRUCTURAL EARTH WALL
- CEMENT CONCRETE SIDEWALK
- CEMENT CONCRETE SPLITTER ISLAND/TRUCK APRON/HARDSCAPE
- ASPHALT

LEA HILL CORRIDOR STUDY
CORRIDOR CONCEPT LAYOUT

Appendix E

Stormwater Analysis Technical Memo

SCJ ALLIANCE
CONSULTING SERVICES

Technical Memo

To Kim Truong, PE, City of Auburn

From: Josh Brannin, PE, SCJ Alliance

Date: January 23, 2020

Project: Lea Hill Corridor Study

Subject Stormwater Management Evaluation

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1. Project Description

The Lea Hill Corridor Study evaluated alternatives for improving the Lea Hill Corridor between Harvey Street and 124th Avenue. This memo documents the stormwater evaluation for the selected alternatives.

Evaluation is based on the Department of Ecology's Stormwater Management Manual for Western Washington (SMMWW) and the City of Auburn's supplement to the SMMWW.

2. Existing Conditions

There are four drainage basins along the Lea Hill Corridor. The general basin limits are as follows:

- Basin 1 – Harvey Road to 102nd Avenue
  Basin 1 consists of a five-lane road and six to eight-foot sidewalks. Stormwater in Basin 1 flows into an underground collection and conveyance system and discharges into the west bank of the Green River via a 48-inch corrugated metal pipe (CMP) on the northside of the bridge. Runoff in Basin 1 is not treated prior to discharging into the Green River.

- Basin 2 – 102nd Avenue to 106th Place
  Basin 2 consists of a two-lane road with five-foot shoulders. Stormwater in Basin 2 flows into an underground collection and conveyance system and discharges into the east bank of the Green River via a 24-inch CMP on the southside of the bridge. Runoff in Basin 2 is not treated prior to discharging into the Green River.

- Basin 3 – 106th Place to 112th Avenue
  Basin 3 consists of a two-lane road with five-foot shoulders. Stormwater in Basin 3 flows into an underground collection and conveyance system. Runoff is conveyed outside the Lea Hill Corridor via 18-

inch CMP pipe installed along the hillside at 106th Place SE. The pipe connects Lea Hill Road to 104th Avenue SE. Runoff is then conveyed through a series of ditches and culverts before discharging into the Green River approximately 0.5 mile north of the 104th Avenue/Lea Hill Road intersection. Runoff in Basin 3 is not treated prior to discharging into the Green River.

- Basin 4 – 112th Avenue to 124th Avenue
  Basin 4 consists of a two-lane road with five-foot shoulders on the western section and a four-lane road with six and ten-foot sidewalks on the eastern section. Stormwater in Basin 4 flows into a combination of underground collection and conveyance systems, roadside ditches, wetlands, and natural drainages. The runoff leaves the Lea Hill Basin via an unnamed stream on the northside of Lea Hill Road at 112th Avenue. The unnamed stream is a Green River tributary which discharges into the Green River approximately 0.75 mile north of the 104th Avenue/Lea Hill Road intersection. There is evidence of erosion and slope instability where runoff from Basin 4 and the additional tributary area north of Lea Hill Road discharges into the unnamed stream at 112th Avenue. Runoff in Basin 4 is not treated prior to entering the wetlands and unnamed stream or discharging into the Green River.

3. Preliminary Basin Analysis

Basins were analyzed using the Western Washington Hydrology Model using forested Type C soils as the existing condition. Per conversations with Tim Carlaw, Storm Drainage Engineer at the City, infiltration is not feasible within the corridor.

3.1. Basin 1

The proposed alternatives in Basin 1 do not increase the impervious area and require minimal roadway reconstruction. In addition, the tributary basin appears to be close to if not fully developed. Subsequently, we do not anticipate needing to upsize the existing pipe for capacity.

While improvements in Basin 1 do not cross thresholds requiring treatment, we recommend evaluating the cost/benefit of installing treatment in the Basin during final design to help improve the water quality and limit pollutants in the Green River.

3.2. Basin 2

The proposed alternatives in Basin 2 will add approximately 0.5 acres of pollution generating hard surface requiring both flow control and treatment BMPs for the new hard surfaces and converted vegetation areas. The existing conveyance system should be replaced with a new conveyance system as the proposed flowlines are offset from the existing flowlines by five feet or more. In addition, the existing CMP is in poor condition.

The additional area will increase runoff flow rates by approximately 1.05 cfs and 1.50 cfs for the 25-year and 100-year events respectively. The final design phase will need to evaluate the tributary basin for the existing 24-inch outfall along with the pipe condition, erosion protection at the outfall, and permitting allowances and

requirements to determine the required flow control BMPs for Basin 2. Required flow control will need to be provided via above ground or underground storage. The City owns three parcels at the 104th Avenue/Lea Hill Road intersection that could be utilized for detention.

Table 1. Basin 2 - Increased Flow Rates for New Hard Surface

Event	Pre-developed	Post-developed
2-yr	0.0224	0.2353
5-yr	0.0356	0.2994
10-yr	0.0443	0.3432
25-yr	0.0547	0.4003
50-yr	0.0620	0.4410
100-yr	0.0690	0.4892

The additional hard surface is pollution generating and will require treatment BMPs for the new pollution generating hard surface (PGHS). Table 2 summarizes the required volume and flow rates. Retention ponds are cost effective and require the least amount of maintenance. However, they are not typically suited for urban roadway projects as they use up valuable resources. Additional treatment BMPs include proprietary engineered treatment structures. The City's preferred engineered treatment is the Oldcastle BioPod System. The three City owned parcels are also suitable for retention ponds as well.

Table 2. Basin 2 – Water Quality Sizing

BMP Type	Minimum Treatment
24 Hr Volume (ac-ft)	0.0598
On-line Flow Rate (cfs)	0.0942
Off-line Flow Rate (cfs)	0.0531

3.3. Basin 3

The proposed alternatives in Basin 3 will add approximately 0.6 acre of pollution generating hard surface requiring both flow control and treatment BMPs for the new hard surfaces and converted vegetation areas. The existing conveyance system should be replaced with a new conveyance system as the proposed flowlines are offset from the existing flowlines by five feet or more.

Table 3 summarizes the increased flow resulting from the additional hard surface. The final design phase will need to evaluate the tributary basin for the existing outfall into the Green River along with the pipe condition, erosion protection at the outfalls, and permitting allowances and requirements to determine the required flow control BMPs for Basin 3. Required flow control will need to be provided via above ground or underground storage. There is limited area within the existing right-of-way within the Lea Hill Road corridor for above ground storage.

Table 3. Basin 3 - Increased Flow Rates for New Hard Surface

Event	Pre-developed	Post-developed
2-yr	0.0268	0.2823
5-yr	0.0428	0.3593
10-yr	0.0531	0.4118
25-yr	0.0656	0.4803
50-yr	0.0744	0.5329
100-yr	0.0828	0.5870

The additional hard surface is pollution generating and will require treatment BMPs for the new pollution generating hard surface (PGHS). Table 4 summarizes the required volume and flow rates. Retention ponds are cost effective and require the least amount of maintenance. However, they are not typically suited for urban roadway projects as they use up valuable resources. Additional treatment BMPs include proprietary engineered treatment structures. The City's preferred engineered treatment is the Oldcastle BioPod System.

Table 4. Basin 2 – Water Quality Sizing

BMP Type	Minimum Treatment
24 Hr Volume (ac-ft)	0.0718
On-line Flow Rate (cfs)	0.1130
Off-line Flow Rate (cfs)	0.0637

3.4. Basin 4

The proposed alternatives in Basin 3 will add approximately 1 acre of pollution generating hard surface requiring both flow control and treatment BMPs for the new hard surfaces and converted vegetation areas. The existing conveyance system should be replaced with a new conveyance system as the proposed flowlines are offset from the existing flowlines by five feet or more.

Table 5 summarizes the increased flow resulting from the additional hard surface. The final design phase will need to evaluate the tributary basin for the existing outfalls into the unnamed creek and the Green River along with the pipe condition, erosion protection at the outfalls, and permitting allowances and requirements to determine the required flow control BMPs for Basin 3. There is limited area within the existing right-of-way within the Lea Hill Road corridor for above ground storage and adjacent undeveloped parcels are mostly wetland areas unsuitable for detention ponds.

Table 5. Basin 4 - Increased Flow Rates for New Hard Surface

Event	Pre-developed	Post-developed
2-yr	0.0447	0.4705
5-yr	0.0713	0.5988
10-yr	0.0885	0.6864
25-yr	0.1096	0.8005
50-yr	0.1241	0.8882
100-yr	0.1380	0.9784

The additional hard surface is pollution generating and will require treatment BMPs for the new pollution generating hard surface (PGHS). Table 2 summarizes the required volume and flow rates. Retention ponds are cost effective and require the least amount of maintenance. However, they are not typically suited for urban roadway projects as they use up valuable resources. Additional treatment BMPs include proprietary engineered treatment structures. The City's preferred engineered treatment is the Oldcastle BioPod System.

Table 2. Basin 2 – Water Quality Sizing

BMP Type	Minimum Treatment
24 Hr Volume (ac-ft)	0.1196
On-line Flow Rate (cfs)	0.1884
Off-line Flow Rate (cfs)	0.1062

Appendix F

Detailed Cost Estimates

May 12, 2020

SCJ ALLIANCE
CONSULTING SERVICES

ENGINEER'S ESTIMATE OF PROBABLE COSTS
PROJECT 1 - GARDEN AVENUE
AUBURN, WA

PREPARED BY: CITY OF AUBURN
REVIEWED BY: JOSH BRANNIN, PE (UNIT PRICE ONLY)

ITEM NO.	ITEM	UNIT	UNIT PRICE	QTY	SUBTOTAL
	PREPARATION				
1	MOBILIZATION (8%)	L.S.	$43,600	1	$43,600
2	CLEARING AND GRUBBING	L.S.	$5,000	1	$5,000
3	ROADWAY EXCAVATION INCL. HAUL	L.S.	$1,000	1	$1,000
4	REMOVAL OF CONCRETE OR ASPHALT PAVEMENT	S.Y.	$15	180	$2,700
	GRADING				
5	ROADWAY EXCAVATION INCL. HAUL	C.Y.	$60	153	$9,180
6	UNSUITABLE FOUNDATION EXCAVATION, INCL. HAUL	C.Y.	$100	77	$7,700
7	SUBGRADE PREPARATION	S.Y.	$15	1,128	$16,920
	STORM SEWER				
8	CATCH BASIN TYPE 1L	EACH	$1,500	3	$4,500
9	SOLID WALL PVC STORM PIPE, SDR-35, 12 INCH DIAM.	L.F.	$100	199	$19,900
10	STORM SEWER TELEVISION INSPECTION	L.F.	$10	199	$1,990
11	PIPE FOUNDATION MATERIAL	TON	$50	60	$3,000
12	PIPE ZONE BEDDING	TON	$50	105	$5,250
13	IMPORTED PIPE TRENCH BACKFILL	TON	$40	232	$9,280
	SURFACING				
14	CSTC	TON	$60	22	$1,320
15	CSBC	TON	$50	500	$25,000
	HOT MIX ASPHALT				
16	HMA CL. 1/2 IN. PG 58-22	TON	$140	238	$33,320
17	HMA CL. 1 IN. PG 58-22	TON	$100	475	$47,500
18	ASPHALT COLD PATCH	TON	$150	7	$1,050
19	COMMERCIAL HMA	TON	$280	36	$10,080
	EROSION CONTROL AND ROADSIDE PLANTING				
20	TEMPORARY WATER POLLUTION/EROSION CONTROL	EST	$1	5,000	$5,000
21	ESC LEAD	DAY	$35	120	$4,200
22	TESC PLAN	L.S.	$1	500	$500
23	INLET PROTECTION	EACH	$100	2	$200
24	TOPSOIL TYPE A	C.Y.	$100	19	$1,900
25	TOPSOIL TYPE C	C.Y.	$100	9	$900
26	SOD INSTALLATION	S.Y.	$30	122	$3,660
27	ROOT CONTROL BARRIER	L.F.	$20	200	$4,000
28	ROADSIDE RESTORATION	EST	$1	15,000	$15,000
29	PSIPE_PYRAMIDAL EUROPEAN HORNBEAM	EACH	$100	20	$2,000
	TRAFFIC				
30	CEMENT CONC. TRAFFIC CURB AND GUTTER	L.F.	$50	199	$9,950
31	PERMANENT SIGNING	L.S.	$1,000	1	$1,000
32	PLATSIC CROSSWALK LINE	S.F.	$10	144	$1,440
33	PLATSIC STOP LINE	L.F.	$20	10	$200
34	CONSTRUCTION SITE SIGN(S)	EACH	$500	1	$500
35	TRAFFIC CONTROL SUPERVISOR	L.S.	$2,000	1	$2,000
36	TRAFFIC CONTROL LABOR (MIN. BID $42.22 PER HOUR)	HR	$60	840	$50,400
37	SEQUENTIAL ARROW SIGN	DAY	$100	8	$800
38	PORTABLE CHANGEABLE MESSAGE SIGN	DAY	$100	5	$500
	OTHER ITEMS				
39	RESIDENTIAL DRIVEWAY APRON	S.Y.	$75	29	$2,175
40	CEMENT CONC. SIDEWALK	S.Y.	$65	327	$21,255
41	CEMENT CONC. CURB RAMP TYPE SINGLE DIRECTION A	EACH	$1,500	6	$9,000
42	ILLUMINATION SYSTEM, COMPLETE	L.S.	$70,000	1	$70,000
43	MINOR CHANGES	EST	$1	20,000	$20,000
44	RECORD DRAWINGS (MINIMUM BID $500)	L.S.	$500	1	$500
45	SPCC PLAN	L.S.	$500	1	$500
46	ROADSIDE CLEANUP	EST	$1	3,000	$3,000
	CONSTRUCTION SUBTOTAL				**$478,870**
	Contingency (5%)				$23,944
	CONSTRUCTION TOTAL				**$502,814**
	Construction Inspection & Engineering (10%)				$50,281
	Preliminary Engineering (12%)				$60,338
	TOTAL (Rounded to 10,000)				***$620,000***

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May 12, 2020

SCJ ALLIANCE
CONSULTING SERVICES

ENGINEER'S ESTIMATE OF PROBABLE COSTS
Project 2 - 104th Avenue / Lea Hill Road Roundabout
AUBURN, WA

PREPARED BY: SARAH HOWSDEN, EIT
REVIEWED BY: JOSH BRANNIN, PE

ITEM NO.	ITEM	UNIT	UNIT PRICE	QTY	SUBTOTAL
	PREPARATION				
1	MOBILIZATION (8%)	L.S.	$183,400	1	$183,400
2	REMOVAL OF STRUCTURE AND OBSTRUCTION	L.S.	$25,000	1	$25,000
	GRADING				
3	ROADWAY EXCAVATION INCL. HAUL	C.Y.	$35	1,800	$63,000
4	SELECT BORROW INCL. HAUL	TON	$25	5,905	$147,625
	STORM SEWER				
5	CATCH BASIN TYPE 1	EACH	$1,500	8	$12,000
6	CATCH BASIN TYPE 2 - 48" DIAM.	EACH	$3,800	10	$38,000
7	SCH. A STORM SEWER PIPE 12 IN. DIAM.	L.F.	$50	1,600	$80,000
8	SCH. A STORM SEWER PIPE 18 IN. DIAM.	L.F.	$60	320	$19,200
9	WATER QUALITY	L.S.	$80,000	1	$80,000
10	FLOW CONTROL	L.S.	$80,000	1	$80,000
	SURFACING				
11	CSTC	TON	$35	2,505	$87,675
12	CSBC	TON	$35	4,780	$167,300
	HOT MIX ASPHALT				
13	HMA CL. 1/2 IN. PG 58-22	TON	$110	3,210	$353,100
	EROSION CONTROL AND ROADSIDE PLANTING				
14	TEMPORARY EROSION AND SEDIMENT CONTROL	L.S.	$50,000	1	$50,000
	TRAFFIC				
15	CEMENT CONC TRAFFIC CURB AND GUTTER	L.F.	$85	2,285	$194,225
16	CEMENT CONC PAVEMENT	C.Y.	$160	125	$20,000
17	ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER	L.F.	$35	1,260	$44,100
18	ROUNDABOUT TRUCK APRON CEM. CONC. CURB AND GUTTER	L.F.	$55	240	$13,200
19	BEAM GUARDRAIL TYPE 3 - 8 FT. LONG POST	L.F.	$30	400	$12,000
20	PAVEMENT MARKINGS AND PERMANENT SIGNS	L.S.	$10,000	1	$10,000
21	PROJECT TEMPORARY TRAFFIC CONTROL (10%)	L.S.	$250,000	1	$250,000
	OTHER ITEMS				
22	CEMENT CONC. SIDEWALK	S.Y.	$65	3,195	$207,675
23	CEMENT CONC. CURB RAMP TYPE	EACH	$4,500	12	$54,000
24	LAND/HARDSCAPE (5%)	L.S.	$88,000	1	$88,000
25	LUMINAIRES	EACH	$14,500	8	$116,000
26	CONSTRUCTION SURVEYING	L.S.	$80,000	1	$80,000
	CONSTRUCTION SUBTOTAL				**$2,475,500**
	Contingency (30%)				$742,650
	CONSTRUCTION TOTAL				**$3,218,150**
	Construction Inspection & Engineering (10%)				$321,815
	Preliminary Engineering (12%)				$386,178
	Right of Way Purchase				$50,000
	TOTAL (Rounded to 10,000)				***$3,980,000***

May 12, 2020

SCJ ALLIANCE
CONSULTING SERVICES

ENGINEER'S ESTIMATE OF PROBABLE COSTS
PROJECT 3 - LEA HILL ROAD OVERLAY, SIDEWALK, AND BIKE LANE
AUBURN, WA

PREPARED BY: SARAH HOWSDEN, EIT
REVIEWED BY: JOSH BRANNIN, PE

ITEM NO.	ITEM	UNIT	UNIT PRICE	QTY	SUBTOTAL
	PREPARATION				
1	MOBILIZATION (8%)	L.S.	$442,100	1	$442,100
2	REMOVAL OF STRUCTURE AND OBSTRUCTION	L.S.	$25,000	1	$25,000
	GRADING				
3	ROADWAY EXCAVATION INCL. HAUL	C.Y.	$35	11,000	$385,000
4	SELECT BORROW INCL. HAUL	TON	$25	8,755	$218,875
	STORM SEWER				
5	CATCH BASIN TYPE 1	EACH	$1,500	9	$13,500
6	CATCH BASIN TYPE 2 - 48" DIAM.	EACH	$3,800	2	$7,600
7	SCH. A STORM SEWER PIPE 12 IN. DIAM.	L.F.	$50	4,000	$200,000
8	SCH. A STORM SEWER PIPE 18 IN. DIAM.	L.F.	$60	1,200	$72,000
9	WATER QUALITY	L.S.	$64,000	1	$64,000
10	FLOW CONTROL	L.S.	$46,000	1	$46,000
	STRUCTURAL				
11	SOLDIER PILE WALL	S.F.	$185	6,700.00	$1,239,500
12	STRUCTURAL EARTH WALL	S.F.	$75	2,900.00	$217,500
	SURFACING				
13	CSTC	TON	$35	2,115	$74,025
14	CSBC	TON	$35	3,715	$130,025
	HOT MIX ASPHALT				
15	HMA CL. 1/2 IN. PG 58-22	TON	$110	3,940	$433,400
	EROSION CONTROL AND ROADSIDE PLANTING				
16	TEMPORARY EROSION AND SEDIMENT CONTROL	L.S.	$100,000	1	$100,000
	TRAFFIC				
17	CEMENT CONC TRAFFIC CURB AND GUTTER	L.F.	$85	7,575	$643,875
18	BEAM GUARDRAIL TYPE 3 - 8 FT. LONG POST	L.F.	$30	3,650	$109,500
19	PAVEMENT MARKINGS AND PERMANENT SIGNS	L.S.	$10,000	1	$10,000
20	PROJECT TEMPORARY TRAFFIC CONTROL (10%)	L.S.	$250,000	1	$250,000
	OTHER ITEMS				
21	CEMENT CONC. SIDEWALK	S.Y.	$95	4,780	$454,100
22	CEMENT CONC. CURB RAMP TYPE	EACH	$4,500	10	$45,000
23	LAND/HARDSCAPE (5%)	L.S.	$251,300	1	$251,300
24	COATED CHAIN LINK FENCE TYPE 4	L.S.	$25	3,500	$87,500
25	LUMINAIRES	EACH	$14,500	24	$348,000
26	CONSTRUCTION SURVEYING	L.S.	$100,000	1	$100,000
	CONSTRUCTION SUBTOTAL				**$5,967,800**
	Contingency (30%)				$1,790,340
	CONSTRUCTION TOTAL				**$7,758,140**
	Construction Inspection & Engineering (10%)				$775,814
	Preliminary Engineering (12%)				$930,977
	Right of Way Purchase				$0
	TOTAL (Rounded to 10,000)				***$9,470,000***

May 12, 2020

SCJ ALLIANCE
CONSULTING SERVICES

ENGINEER'S ESTIMATE OF PROBABLE COSTS
PROJECT 4 - 112TH AVENUE / 312TH STREET ROUNDABOUT
AUBURN, WA

PREPARED BY: SARAH HOWSDEN, EIT
REVIEWED BY: JOSH BRANNIN, PE

ITEM NO.	ITEM	UNIT	UNIT PRICE	QTY	SUBTOTAL
	PREPARATION				
1	MOBILIZATION (8%)	L.S.	$218,600	1	$218,600
2	REMOVAL OF STRUCTURE AND OBSTRUCTION	L.S.	$25,000	1	$25,000
	GRADING				
3	ROADWAY EXCAVATION INCL. HAUL	C.Y.	$35	2,900	$101,500
4	SELECT BORROW INCL. HAUL	TON	$25	2,445	$61,125
	STORM SEWER				
5	CATCH BASIN TYPE 1	EACH	$1,500	10	$15,000
6	CATCH BASIN TYPE 2 - 48" DIAM.	EACH	$3,800	4	$15,200
7	SCH. A STORM SEWER PIPE 12 IN. DIAM.	L.F.	$50	1,600	$80,000
8	SCH. A STORM SEWER PIPE 18 IN. DIAM.	L.F.	$60	320	$19,200
9	WATER QUALITY	L.S.	$80,000	1	$80,000
10	FLOW CONTROL	L.S.	$80,000	1	$80,000
	STRUCTURAL				
11	STRUCTURAL EARTH WALL	S.F.	$75	10,225.00	$766,875
	SURFACING				
12	CSTC	TON	$35	1,315	$46,025
13	CSBC	TON	$35	2,045	$71,575
	HOT MIX ASPHALT				
14	HMA CL. 1/2 IN. PG 58-22	TON	$110	1,645	$180,950
	EROSION CONTROL AND ROADSIDE PLANTING				
15	TEMPORARY EROSION AND SEDIMENT CONTROL	L.S.	$50,000	1	$50,000
	TRAFFIC				
16	CEMENT CONC TRAFFIC CURB AND GUTTER	L.F.	$85	800	$68,000
17	CEMENT CONC PAVEMENT	C.Y.	$160	105	$16,800
18	ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER	L.F.	$35	2,100	$73,500
19	ROUNDABOUT TRUCK APRON CEM. CONC. CURB AND GUTTER	L.F.	$55	380	$20,900
20	BEAM GUARDRAIL TYPE 3 - 8 FT. LONG POST	L.F.	$30	500	$15,000
21	PAVEMENT MARKINGS AND PERMANENT SIGNS	L.S.	$10,000	1	$10,000
22	PROJECT TEMPORARY TRAFFIC CONTROL (10%)	L.S.	$200,000	1	$200,000
	OTHER ITEMS				
23	CEMENT CONC. SIDEWALK	S.Y.	$95	2,860	$271,700
24	CEMENT CONC. CURB RAMP TYPE	EACH	$4,500	11	$49,500
25	LAND/HARDSCAPE (5%)	L.S.	$120,600	1	$120,600
26	LUMINAIRES	EACH	$14,500	12	$174,000
27	CONSTRUCTION SURVEYING	L.S.	$120,000	1	$120,000
	CONSTRUCTION SUBTOTAL				**$2,951,050**
	Contingency (30%)				$885,315
	CONSTRUCTION TOTAL				**$3,836,365**
	Construction Inspection & Engineering (10%)				$383,637
	Preliminary Engineering (12%)				$460,364
	Right of Way Purchase				$400,000
	GRAND TOTAL (Rounded to 10,000)				***$5,090,000***

May 12, 2020

SCJ ALLIANCE
CONSULTING SERVICES

ENGINEER'S ESTIMATE OF PROBABLE COSTS
PROJECT 5 - 116TH AVENUE / 312TH STREET ROUNDABOUT & 312TH STREET SIDEWALKS AND OVERLAY
AUBURN, WA

PREPARED BY: SARAH HOWSDEN, EIT
REVIEWED BY: JOSH BRANNIN, PE

ITEM NO.	ITEM	UNIT	UNIT PRICE	QTY	SUBTOTAL
	PREPARATION				
1	MOBILIZATION (8%)	L.S.	$259,500	1	$259,500
2	REMOVAL OF STRUCTURE AND OBSTRUCTION	L.S.	$25,000	1	$25,000
	GRADING				
3	ROADWAY EXCAVATION INCL. HAUL	C.Y.	$35	4,000	$140,000
4	SELECT BORROW INCL. HAUL	TON	$25	2,035	$50,875
	STORM SEWER				
5	CATCH BASIN TYPE 1	EACH	$1,500	10	$15,000
6	CATCH BASIN TYPE 2 - 48" DIAM.	EACH	$3,800	4	$15,200
7	SCH. A STORM SEWER PIPE 12 IN. DIAM.	L.F.	$50	2,000	$100,000
8	SCH. A STORM SEWER PIPE 18 IN. DIAM.	L.F.	$60	400	$24,000
9	BOX CULVERT	L.S.	$20,000	1	$20,000
10	WATER QUALITY	L.S.	$80,000	1	$80,000
11	FLOW CONTROL	L.S.	$80,000	1	$80,000
	STRUCTURAL				
12	STRUCTURAL EARTH WALL	S.F.	$75	6,560	$492,000
	SURFACING				
13	CSTC	TON	$35	2,145	$75,075
14	CSBC	TON	$35	3,180	$111,300
	HOT MIX ASPHALT				
15	HMA CL. 1/2 IN. PG 58-22	TON	$110	3,380	$371,800
	EROSION CONTROL AND ROADSIDE PLANTING				
16	TEMPORARY EROSION AND SEDIMENT CONTROL	L.S.	$50,000	1	$50,000
	TRAFFIC				
17	CEMENT CONC TRAFFIC CURB AND GUTTER	L.F.	$85	800	$68,000
18	CEMENT CONC PAVEMENT	C.Y.	$160	90	$14,400
19	ROUNDABOUT CEMENT CONCRETE CURB AND GUTTER	L.F.	$35	1,355	$47,425
20	ROUNDABOUT TRUCK APRON CEM. CONC. CURB AND GUTTER	L.F.	$55	380	$20,900
21	BEAM GUARDRAIL TYPE 3 - 8 FT. LONG POST	L.F.	$30	500	$15,000
22	PAVEMENT MARKINGS AND PERMANENT SIGNS	L.S.	$10,000	1	$10,000
23	PROJECT TEMPORARY TRAFFIC CONTROL (10%)	L.S.	$200,000	1	$200,000
	OTHER ITEMS				
24	CEMENT CONC. SIDEWALK	S.Y.	$95	5,170	$491,150
25	CEMENT CONC. CURB RAMP TYPE	EACH	$4,500	9	$40,500
26	LAND/HARDSCAPE (5%)	L.S.	$133,100	1	$133,100
27	SIGNAL RETROFIT	L.S.	$250,000	1	$250,000
28	LUMINAIRES	EACH	$14,500	14	$203,000
29	CONSTRUCTION SURVEYING	L.S.	$100,000	1	$100,000
	CONSTRUCTION SUBTOTAL				**$3,503,225**
	Contingency (30%)				$1,050,968
	CONSTRUCTION TOTAL				**$4,554,193**
	Construction Inspection & Engineering (10%)				$455,419
	Preliminary Engineering (12%)				$546,503
	Right of Way Purchase				$50,000
	GRAND TOTAL (Rounded to 10,000)				***$5,610,000***