Steese Expressway/Johansen Expressway Interchange

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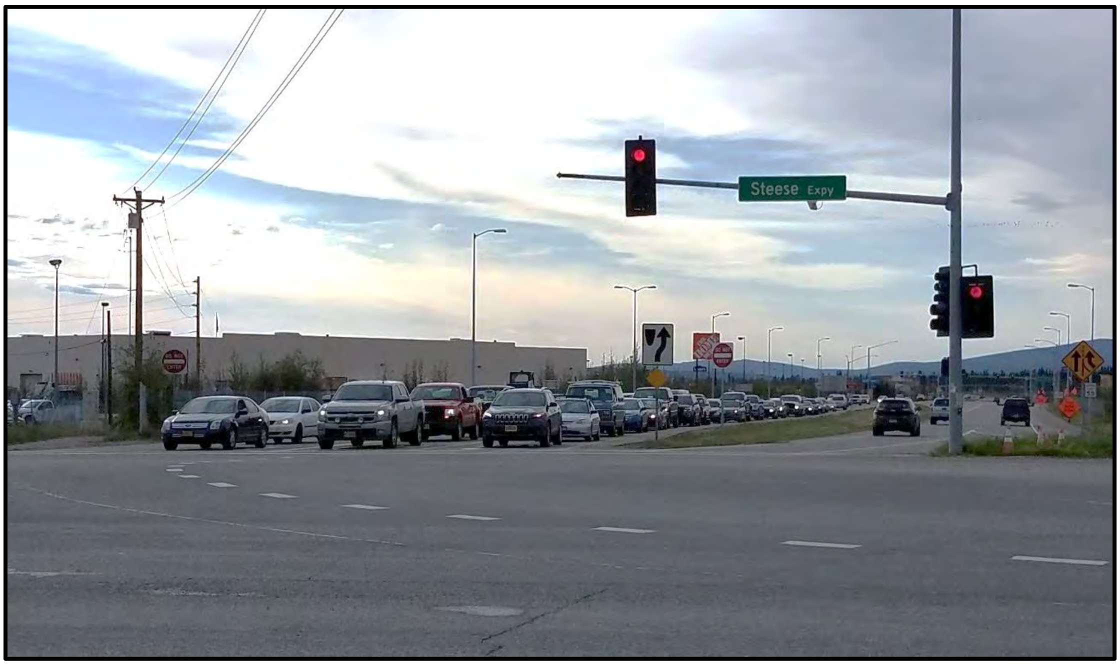
DRAFT Alternatives Analysis Report

November 2018



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Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
CJC	Church of Jesus Christ of Latter-day Saints
DOT&PF	Alaska Department of Transportation and Public Facilities
ETT	Experienced Travel Time
FHWA	Federal Highway Administration
FMATS	Fairbanks Metropolitan Area Transportation System
GIS	Geographic Information System
HCM	Highway Capacity Manual
ICAP	Indirect Cost Allocation Plan
LOS	Level of Service
M&O	Maintenance and Operations
PAC	Project Advisory Committee
PGDHS	*A Policy on Geometric Design of Highways and Streets*
KE	Kinney Engineering
ROW	Right of Way
Steese-Jo	Steese Expressway and Johansen Expressway Intersection
TRB	Transportation Research Board
USDOT	United States Department of Transportation

Definition of Terms

Controlled Access Freeway: Divided multi-lane highway without direct access to adjacent land uses. Users must utilize ramps to reach adjacent highway facilities with access to the adjacent land uses.

Interchange: Set of ramps and intersections used to allow traffic to travel to and from a controlled access freeway facility.

Level of Service (LOS): Performance measure concept used to quantify the operational performance of a facility and present the information to users and operating agencies. The actual performance measure used varies by the type of facility; however, all use a scale of A (best conditions for individual users) to F (worst conditions). Often, LOS C or D in the most congested hours of the day will provide the optimal societal benefits for the required construction and maintenance costs.

Experienced Travel Time (ETT): Measure of delay at junctions associated with interchanges or at alternative junction types where vehicles travel through multiple intersections or out of their way in order to traverse the entire junction. This measure combines the delay for all intersections and all out of direction travel and reports it by origin-destination pair through the junction, so that the operations of multiple junction types can be evaluated fairly.

Executive Summary

Alternative concepts for improving the intersection of Steese Expressway at Johansen Expressway (the Steese-Jo intersection) were analyzed to determine whether or not they meet the purpose and need established in the previous phase of this project. Each alternative was scored using screening criteria developed through a collaborative effort with the Project Advisory Committee and public comments received. In general, interchange alternatives scored higher than intersection alternatives. The twelve concepts that were considered and the extent to which they meet purpose and need (four of the seventeen screening criteria) are shown below.

	Screening Criteria Score	Cost Estimate ($ million)	Improves Pedestrian and Bicycle Safety	Decreases Pedestrian Delay	Reduces Weaving	Reduces Vehicular Delay
A, No Build	0.0	0.0				
B, Conventional Intersection	14.6	16.4		✓	✔	✓
C, Synchronous Split-Phased Intersection	13.9	25.7		✓	✔	✓
D, Diverted Left Turn Intersection	11.1	26.5			✔	✓
E, Conventional Intersection with Old Steese Connection to Farmers Loop	14.5	19.5		✓	✔	✓
F, Eastbound Flyover	21.6	42.5	✓	✔	✔	✔
G1, Tight Diamond Interchange	18.0	29.4	✓	✓	✔	✔
G2, Diamond interchange with Cloverleaf	15.4	37.2		✔	✔	✔
G3, Diverging Diamond Interchange	18.0	32.6	✓	✓	✔	✔
H1, Full Echelon	22.6	31.0	✔	✔	✔	✔
H2, Partial Echelon	23.9	30.6	✔	✓	✔	✔
I, Pedestrian Overpass	9.5	4.6	✔	✔		

✔ = Meets goal much better than No Build ✓ = Meets goal better than No Build

1 Purpose and Need

The Alaska Department of Transportation and Public Facilities (DOT&PF) is in the early stages of upgrading the Steese Expressway and Johansen Expressway Intersection (Steese-Jo), located in northeast Fairbanks, Alaska. The proposed project is intended to reduce vehicular and pedestrian delay and improve safety. Improvements at the intersection investigated to date include grade separated interchanges, at-grade intersection options, a pedestrian overpass, and modifications to adjacent access roads.

The Existing Conditions Report (January 2018) describes the existing traffic and safety elements of the Steese-Jo intersection and summarizes relevant project area planning documents and land uses. Purpose and need for the project were developed through a combination of engineering analysis (found in the Existing Conditions Report), collaboration with the Project Advisory Committee (PAC), and public comments collected using an online survey, the Department website, and a public Open House. The Project Advisory Committee consists of representatives of the following agencies:

- Fairbanks Metropolitan Area Transportation System (FMATS)
- City of Fairbanks, engineering and public safety
- Fairbanks North Star Borough, planning and emergency management
- Alaska State Troopers
- DOT&PF, planning, utilities, materials, bridge design, traffic and safety, design, and Maintenance and Operations (M&O)
- US Army Fort Wainwright
- US Army Corps of Engineers

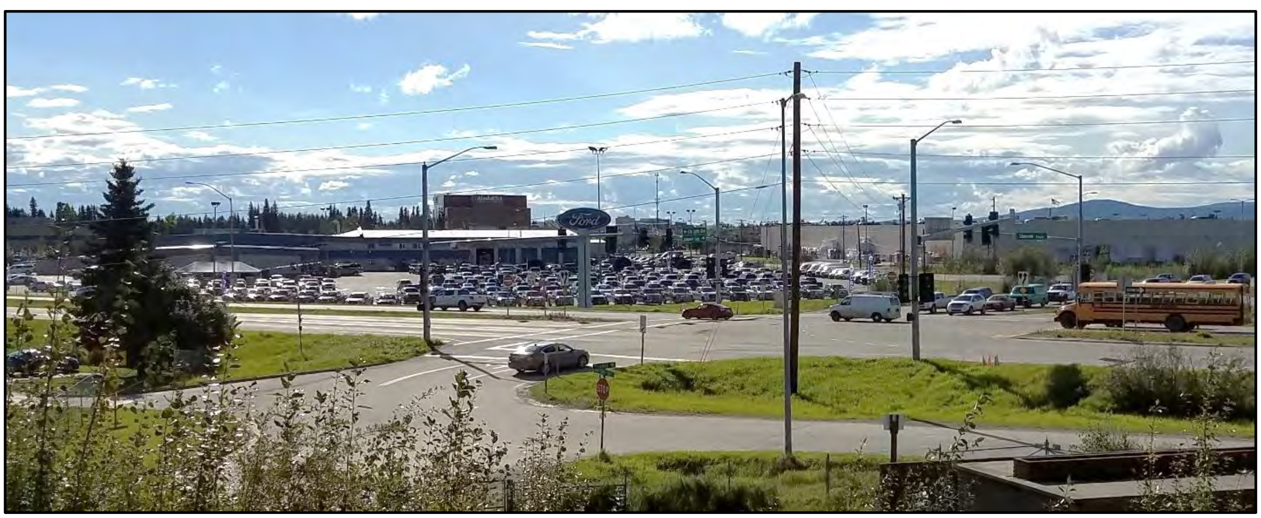


Figure 1: View of Steese-Jo Intersection from the Birch Hill Cemetery

Purpose: The purpose of the Steese Expressway/Johansen Expressway Interchange project is to enhance motorized and non-motorized mobility and user safety at the Steese Expressway and Johansen Expressway intersection and within the influence area of the intersection.

Need: The traffic volumes within the Steese Expressway/Johansen Expressway area are among the highest in the City of Fairbanks. The Johansen Expressway serves as a major thoroughfare for traffic moving east and west and provides a prominent link to developable lands, both north and south of the expressway. Historic data for the Johansen Expressway shows rapid growth within the last 20 years. Large tracts of property within and adjacent to Bentley Trust commercial property have experienced a rapid increase in commercial and residential development. Multiple large and small retail stores, as well as service-oriented businesses and a residential neighborhood have developed in this area, dramatically increasing traffic volumes. Future development plans will likely consist of business and residential land uses like those currently in the area. As development continues in the area, traffic volumes will continue to increase. The Steese Expressway in the project area serves as a principal arterial for traffic moving north and south between residential and commercial developments. It is also the only route to access the Dalton Highway and continue to the North Slope; therefore, it serves the trucking industry.

An analysis of the intersection identified the following operational and safety concerns:

- **Pedestrian and Bicycle Safety**: Two pedestrian crashes occurred, between 2005 and 2014, crossing Steese Expressway, with one resulting in a pedestrian fatality and the other resulting in a major injury. Residences on the east side of Steese Expressway and the commercial district on the west side create a high crossing demand.
- **Pedestrian Delay**: Pedestrians crossing the southbound right-turn lane in the morning may currently wait up to 45 seconds to find a gap to cross. Pedestrian delay for crossing at the signal is an average of 42 seconds or more (LOS E). The Highway Capacity Manual (HCM) 2010 states that "In general, pedestrians become impatient when they experience delays in excess of 30 seconds/pedestrian, and there is a high likelihood of their not complying with the signal indication".[1] Thus, pedestrians are likely to feel impatient as they wait at the signal and may cross against the walk signal if they feel there is a gap sufficient in the oncoming traffic to do so.
- **Proximity of Farmers Loop Road**: The proximity of the Farmers Loop Road intersection creates southbound weaving conflicts during the AM peak on Steese Expressway between merging Farmers Loop Road traffic and Steese Expressway traffic desiring to exit at the Johansen Expressway. In addition, eastbound left turn vehicles at the Johansen Expressway stack up in the left-most turn lane, because many desire to turn left at Farmers Loop Road, resulting in uneven use of the left turn lanes and reduced signal capacity.
- **Vehicular Delay**: Eastbound left-turn vehicles currently may wait through one signal cycle at the intersection with an average delay of over 1 minute per vehicle in the PM peak. The intersection LOS is expected to fall to LOS E by 2024.

[1] HCM 2010, page 18-69.

Figure 2: Eastbound Vehicles Queued on Johansen Expressway at 5PM

Most of the freight traffic traveling through the intersection make either eastbound left-turn or northbound through movements. The average vehicle delays for freight traffic are the highest during the evening peak with 76 seconds per vehicle for eastbound left turns (LOS E) and 34 seconds per vehicle for northbound throughs (LOS C). Delay for the freight movements will increase by at least 200 seconds of additional delay in 2045.

Transit vehicles make either eastbound left-turn or southbound right-turn movements at the intersection. As the southbound right-turn movement is free from any control, it experiences minor delay (less than 10 seconds – LOS A) throughout the day. The eastbound left-turn movement experiences similar delays as freight traffic, with an average delay of 76 seconds per vehicle in the evening peak. During the 2045 evening peak, the eastbound left-turn movement will have about 300 seconds of delay per vehicle (LOS F).

2 Introduction of Screening Criteria

After the development of the Purpose and Need statement, the PAC worked together to create and prioritize a list of goals, issues, and constraints that could be used as screening criteria for the various alternatives, to facilitate the comparison of alternatives that meet the purpose and need. After identifying the list of goals, issues, and constraints, the PAC weighted the elements based on importance. Table 1 shows the identified goals, issues, and constraints.

Alternatives are first evaluated for how well they meet the project goals (50% of the overall score). Then the alternative is screened against its ability to manage the issues identified from public outreach and PAC discussions (35% of the overall score). Finally, the alternative is evaluated for how well it addresses project constraints (15% of the overall score).

Table 1: Screening Criteria

GOALS (50%)	**Weight**	**How to Measure:**
Reduce congestion.	5.00	Annual cost of congestion (delay, air quality)
Improve non-motorized user safety.	3.50	Qualitative comparison of options, using research if available
Improve freight mobility.	3.25	Annual delay for movements made by freight
Improve multi-modal connectivity.	2.00	Ped travel time between neighborhood and commercial area
Improve drainage.	1.25	Qualitative
Goals Score (Alternative Rating x Goal Weight):		
IDENTIFIED ISSUES (35%)	**Weight**	**How to Measure:**
Vehicular delay.	5.00	Change in PM peak delay
Proximity of Farmers Loop Road.	5.00	Number of weaving vehicles or change in lane utilization
Non-motorized safety.	4.00	Qualitative comparison of options, using research if available
Proximity of Old Steese Highway.	3.00	Number of weaving vehicles
Proximity of City Lights Boulevard.	2.00	Number of conflict points within functional area of Steese/Jo intersection
Identified Issues Score (Alternative Rating x Issue Weight):		
CONSTRAINTS (15%)	**Weight**	**How to Measure:**
Maintain Lazelle Rd access, including accommodating Ft Wainwright gate relocation and considering EMS response times.	5.00	Difference in peak hour delay (AM or PM) with and without Ft Wainwright traffic (smaller difference gets more points)
Accommodate overheight/overweight vehicles	5.00	Qualitative, including considering out of distance travel required/ traffic impact during movement
Maintain access to commercial areas (Northside, Bentley).	4.00	Travel time to businesses
Avoid physical impact to cemetery	4.00	Qualitative
Avoid physical impact to conservation area	3.50	Qualitative (acres of impact and type of impact)
Snow storage and snow removal techniques.	3.00	Ask M&O to rank
Minimize ROW acquisition.	2.00	Acres of impact, type of impact
Constraints Score (Alternative Rating x Constraint Weight):		

The remainder of this section describes each of the criteria and how they were measured. Specific results in relation to the various alternatives are presented in Section 5 on page 133.

2.1 Goals

The goals support the purpose of the project.

2.1.1 Reduce Congestion

Traffic congestion is measured using vehicular delay. Drivers that experience long delays are more likely to become impatient and make poor decisions (e.g. running red lights). Long delays also increase vehicle emissions, degrading local air quality, particularly in the winter.

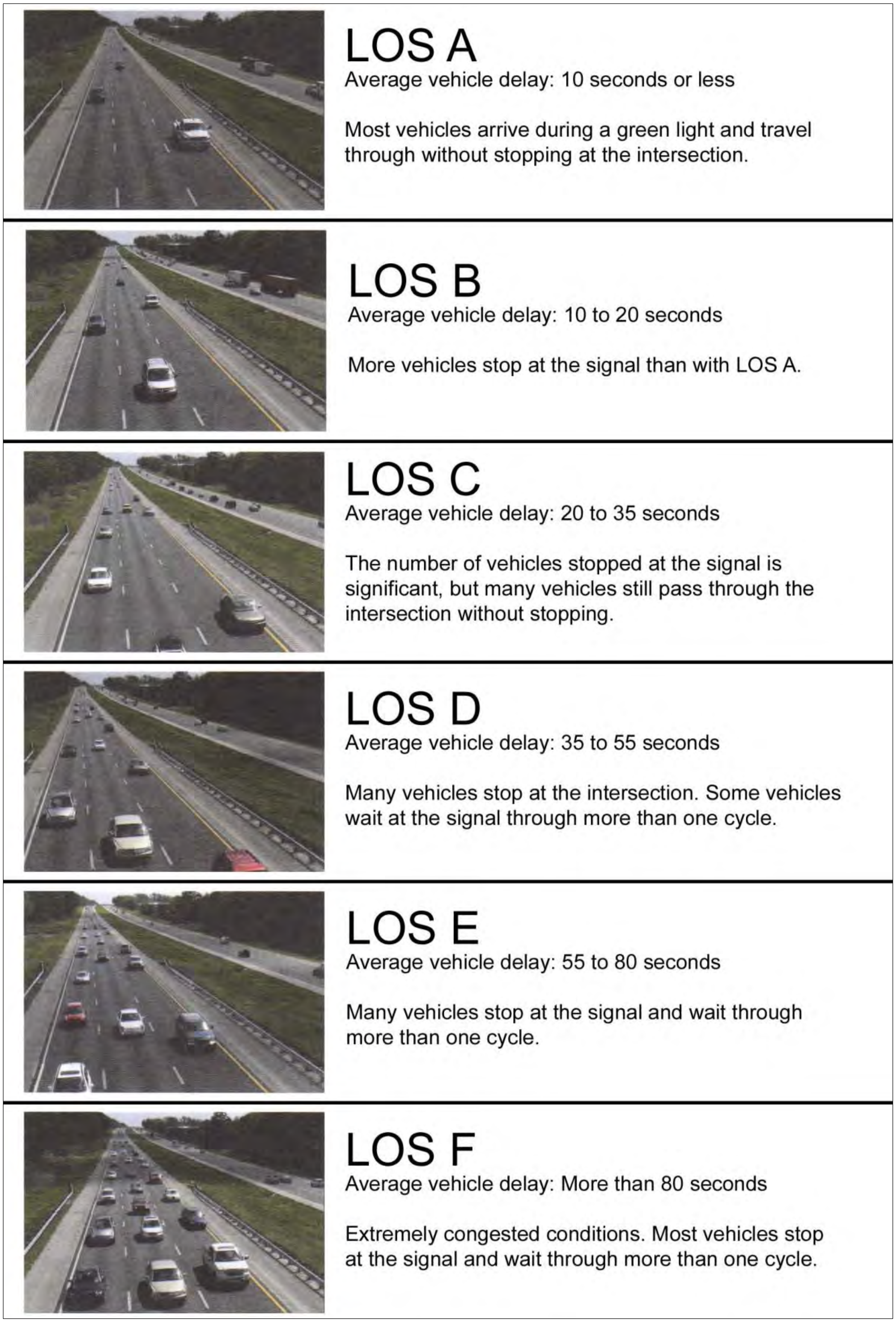
The Existing Conditions Report found that the eastbound left turn movement experiences an average of over 1 minute of delay per vehicle during the PM peak period, with many vehicles waiting through more than one signal cycle to make the turn. As traffic volumes increase, the overall intersection level of service (LOS) is expected to drop to LOS E (estimated by 2024, with a traffic volume increase of about 15%).

Based on the design LOS guidelines found in the American Association of State Highway and Transportation Officials (AASHTO) *A Policy on the Geometric Design of Highways and Streets* (the Green Book), the design LOS for the Steese-Jo intersection is LOS C or D. As a result, all of the alternative concepts were designed to ensure a minimum LOS of D during both the AM and PM peak hours. Figure 4 presents the definition of each LOS letter at a signalized intersection.

Functional Class	Appropriate Level of Service for Specified Combinations of Area and Terrain Type			
	Rural Level	Rural Rolling	Rural Mountainous	Urban and Suburban
Freeway	B	B	C	C or D
Arterial	B	B	C	C or D
Collector	C	C	D	D
Local	D	D	D	D

SOURCE: AASHTO Green Book, Table 2-5

Figure 3: Guidelines for Selection of Design Levels of Service



MODIFIED FROM: HCM 2010, Exhibit 12-14

Figure 4: Signalized LOS Definitions

To compare the extent to which the alternatives reduced congestion, the change in the cost of vehicle delay over the life cycle of the project under each alternative was calculated, compared to the cost of vehicle delay under the no build condition. Additionally, the change in vehicle emissions in 2045 (the design year) was also calculated.

Section 3.2 on page 16 describes the methods used to calculate the change in delay over the life of the project.

Pollution emissions are directly correlated with vehicle delay and fuel use. Fuel use for each alternative was determined using the methodology found in the AASHTO publication *User Benefit Analysis for Highways* (2003). Pollution emissions were calculated using default values in Synchro of 69.9 g of Carbon Monoxide (CO), 13.6 g of Nitrogen Oxides (NO_x), and 16.2 g of Volatile Oxygen Compounds (VOC) per gallon of fuel used.

2.1.2 Improve Non-Motorized User Safety

While overall the Steese-Jo intersection does not have a crash rate that is higher than expected for similar intersections, public outreach and discussions with the PAC identified non-motorized safety as a concern. Two pedestrian crashes occurred in the 5-year study period (2010 to 2014), resulting in two major injuries and one fatality. The long crossing lengths (four-plus lanes of traffic) and high speed traffic (55 mph posted speed) result in a high risk crossing for pedestrians.

Figure 5: South Leg Crossing at the Steese-Jo Intersection (Looking South)

Strategies identified in the Existing Conditions report to improve non-motorized safety that apply to the alternative concepts analyzed in this report include:

- **Reduce exposure of pedestrian/bicycle traffic to oncoming vehicles.** This strategy limits the amount of time pedestrians are in the crosswalk, exposed to traffic, by either narrowing the crossing distance (by decreasing corner radii or building right-turn islands, for example) or by physically separating pedestrian and bicycle traffic from vehicular traffic (for example, with an overpass).

- **Separate pedestrian and bicycle walk signal from vehicle traffic green signal**. This could range from a completely independent walk phase for pedestrians, allowing pedestrians to cross all approaches while all vehicle traffic is stopped, to simply starting the pedestrian walk signal in advance of the vehicular green light. Both methods would likely increase delay to vehicular traffic.

Source: https://www.flickr.com/photos/dolske/8009866817/

Figure 6: Pedestrian Overpass Separating Pedestrians and Vehicles

One strategy for unsignalized crossings where pedestrians cross the right turn lanes is to signalize the crossing. This would require vehicles to stop and allow pedestrians to cross.

2.1.3 Improve Freight Mobility

The Steese and Johansen Expressways are high-mobility corridors carrying long-distance traffic through Fairbanks to and from the North Slope, Valdez, the Port of Anchorage, and many communities in between. This intersection is the primary portal for freight traveling to the northern interior of Alaska and on to Prudhoe Bay. Figure 7 presents the key freight routes in the Fairbanks area. In the Existing Conditions report, four movements through the Steese-Jo intersection were identified as carrying the highest volume of freight traffic: eastbound left, northbound through, southbound through, and southbound right (see Figure 8).

Freight mobility was measured by calculating the change in the cost of vehicle delay over the life cycle of the project for the four freight critical movements under each alternative.

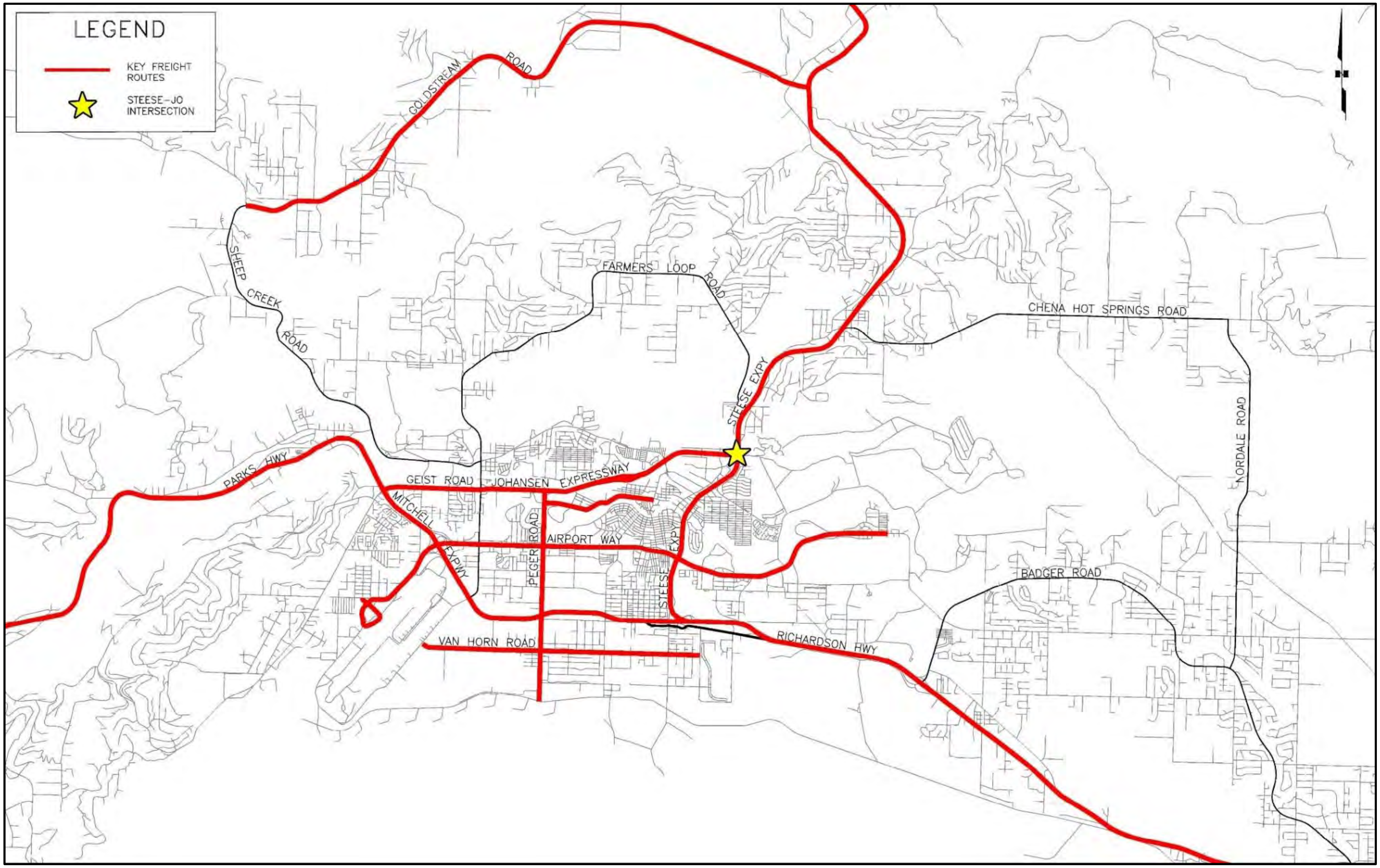


Figure 7: Key Freight Routes in the Fairbanks Area

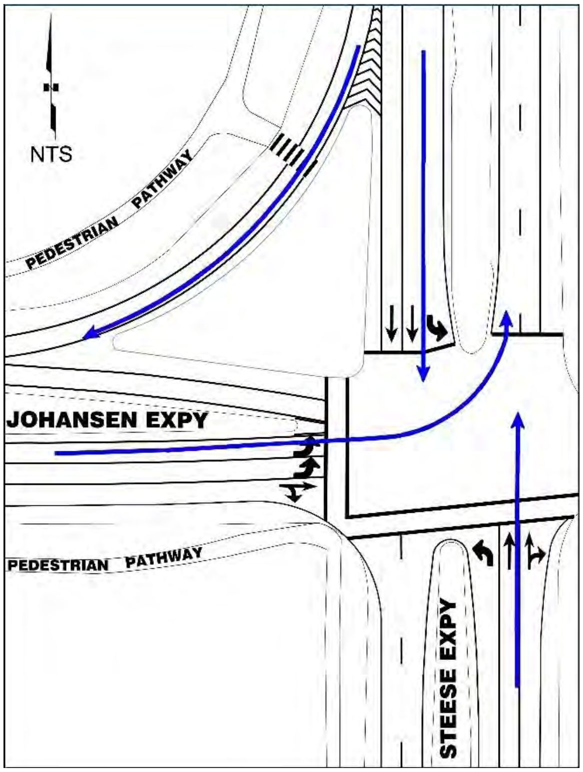


Figure 8: High Volume Freight Movements at Steese-Jo

2.1.4 Improve Multi-Modal Connectivity

The Steese-Jo intersection connects the residential neighborhoods on one side of the Steese Expressway to the commercial area on the other side of the road. It also connects the pedestrian pathway that runs along the west side of the Steese Expressway. This measure was analyzed by considering the average delay a pedestrian experiences traveling from each quadrant of the intersection to the adjacent quadrants. For example, Figure 9 presents the pedestrian travel paths from one quadrant to another under existing conditions. Average delay for a pedestrian arriving at an unsignalized crossing was calculated using the HCM 2010 analysis for unsignalized intersections, which considers crossing distance and vehicle volume. Average delay for a pedestrian arriving at a signalized crossing was calculated using the HCM 2010 analysis for signalized intersections, which uses characteristics of the signal such as vehicle green time and pedestrian walk and clearance time. Where pedestrians cross multiple roadways to travel from one quadrant to another, it was assumed the calculated pedestrian delay was incurred at every unsignalized crossing and at the first signalized crossing. Delay for subsequent signalized crossings was calculated using vehicle green time and pedestrian clearance time. To arrive at the final delay value for crossing between two quadrants, the calculated delay for each crossing was added together.

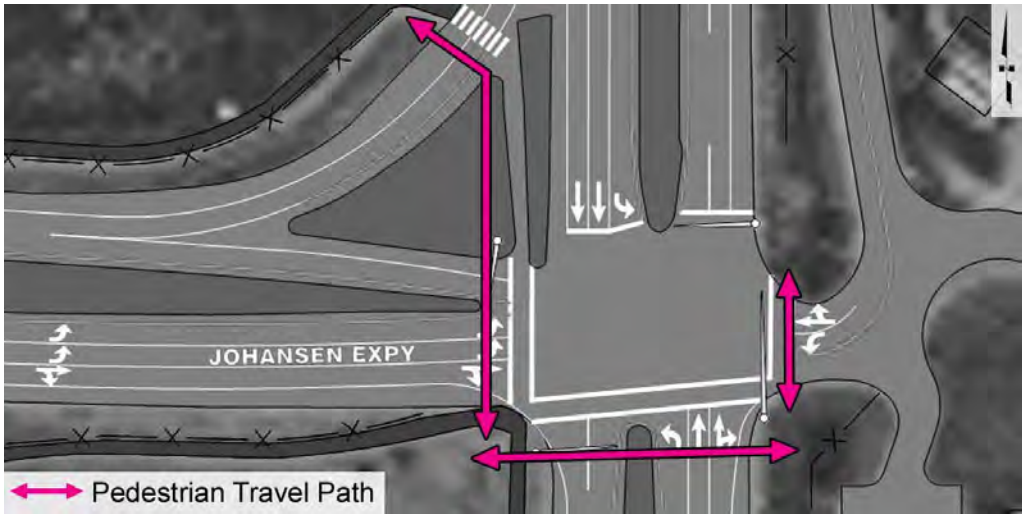


Figure 9: Pedestrian Travel Paths between Intersection Quadrants

2.1.5 Improve Drainage

All of the alternatives give opportunities to improve the drainage by making roadway profile improvements, resizing drainage structures, and providing vegetated ditches to filter runoff before it enters the storm drain inlets.

Drainage was identified as a concern early on due to the built environment blocking and altering natural drainage patterns in the area over several decades of development. This has led to ponding adjacent to the highway, and some private property owners discharging their drainage in the spring to the adjacent highway right-of-way.

2.2 Identified Issues

A variety of concerns were identified by the PAC and through public outreach. These are concerns that the group felt should be considered in the analysis of each alternative.

2.2.1 Vehicular Delay in Evening Peak

The evening peak period was identified in the Existing Conditions report as being the period with the most delay. This measure compares the per-vehicle PM peak hour delay for each of the alternatives in the design year of 2045.

2.2.2 Weaving and Lane Utilization Due to Proximity of Farmers Loop Road

The Existing Conditions report identified a weaving concern for southbound traffic between the Farmers Loop Road intersection and the Johansen Expressway. The most critical time period is during the AM peak, when southbound volumes are high. This measure looked at how weaving changes between the two roadways during the AM peak period in the design year of 2045.

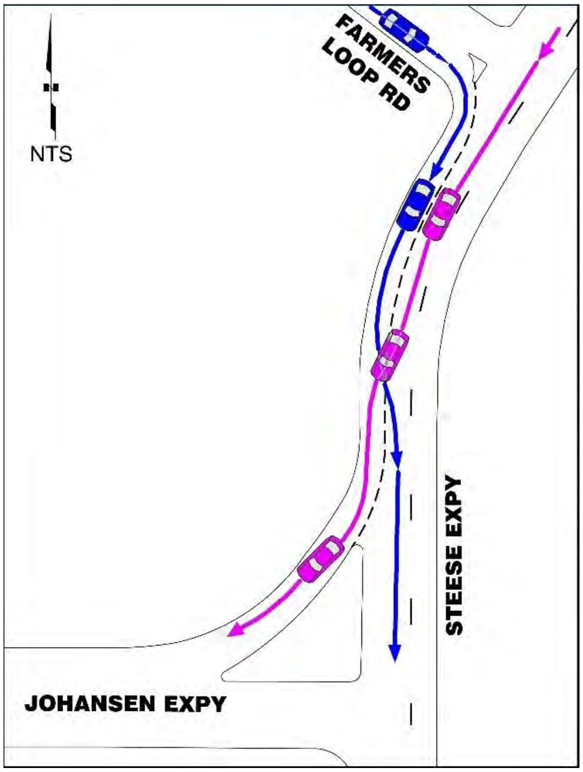


Figure 10: Southbound Weaving Concern on Steese Expressway

2.2.3 Non-Motorized User Safety

This topic was identified both as a goal and as an issue to be considered. The same considerations were used for ranking the alternatives according to this measure in both categories.

2.2.4 Weaving Due to Proximity of Old Steese Highway

Southbound vehicles turning right from the Steese Expressway to the Johansen Expressway and then desiring to turn left at the Old Steese Highway have only about 450 feet to change lanes so that they can enter the left turn lane at the Old Steese Highway. The highest left turn volumes at Old Steese Highway occur during the PM peak hour. As such, this measure looked at how weaving changes between the Steese Expressway and Old Steese Highway during the PM peak period in the design year of 2045.

2.2.5 Driveway Conflict Points on East Leg of Steese-Jo Intersection

The east leg of the Steese-Jo intersection is currently very low volume; however, there are multiple conflict points very close to the Steese Expressway due to driveways and side streets, including City Lights Boulevard, as well as driveways into the church parking lots. After discussions with the PAC, City Lights Boulevard was closed for all alternatives due to its close proximity to the Steese Expressway. This measure looks at the impact of the church driveways and D Street on the different alternatives. Figure 11 presents the close proximity between the Steese Expressway on the left side of figure and City Lights Boulevard on the right side.

Figure 11: Proximity of Steese Expressway and City Lights Boulevard

2.3 Constraints

The PAC identified constraints for the project; that is, factors that need to be accommodated in any design.

2.3.1 Access to Lazelle Road

The 2016 *Fort Wainwright Chena North District Area Development Plan* indicates the need for a new access control point (gate) that meets Army standards. The plan proposes to build a new facility on Canol Road (accessed through Lazelle Road). This would act as the main gate and would increase the traffic volume on Lazelle Road, redistributing traffic traveling through the Steese-Jo intersection significantly.

Two sets of volumes were considered for each alternative: intersection volumes with and without traffic associated with Fort Wainwright. If needed to achieve the design LOS D, the design of the alternative concept was altered for the Fort Wainwright traffic. For all alternatives, this measure compares the delay during the AM and PM peak hours in the design year of 2045 for the alternative with and without the Fort Wainwright traffic.

2.3.2 Overheight/Overweight Vehicles

The Steese-Jo intersection is on the approved route for overheight/overweight vehicles. As such, the design of the alternative concepts included features intended to allow passage of the majority of oversized vehicles. Final design details will be evaluated to ensure extremely oversized vehicles can be accommodated occasionally.

2.3.3 Access to Bentley Trust and Northside Commercial Areas

This constraint was included to ensure access was not reduced to the commercial areas north and south of the Johansen through impacts to the Old Steese Highway intersection. None of the alternatives ended up significantly impacting this intersection.

2.3.4 Impacts to Birch Hill Cemetery

The Birch Hill Cemetery is located in the northeast corner of the intersection. It has been used as a cemetery since the late 1930s. While some impacts to the cemetery may be unavoidable, the PAC identified reducing impacts to the cemetery as desirable. The impacts are measured as approximate acreage of the cemetery impacted by each alternative.

2.3.5 Impacts to Wetland Conservation Area

A portion of the Northside Business Park tract has been set aside as a wetlands conservation area (Tract A). It is desirable to avoid impacts to this area in order to preserve it. Preliminary discussions with the regulatory agency responsible for permitting impacts to the conservation area have indicated permitting will be challenging at best if this area is impacted.

2.3.6 Snow Removal and Storage

DOT&PF M&O identified that all designs should consider snow removal and storage needs. This is especially important for elevated structures, where minimum design widths might make it difficult to store snow until it can be picked up and removed. These considerations were included in the concept designs. This constraint is not scored in this draft report; however, it will be scored after comments are received by DOT&PF M&O.

2.3.7 Right of Way Acquisition

The PAC identified the desire to limit right of way (ROW) acquisition as much as possible, to avoid impacts to residents and businesses. As such, this constraint measures the approximate amount and type of right of way acquisitions associated with each alternative.

3 Analysis Methods

3.1 Alternative Intersection Delay Calculation

When driving through one of the alternative intersections or interchanges discussed in this report, a driver may pass through several different intersections to make the same movement that only requires traveling through one intersection with a conventional design. Thus, a driver may stop multiple times as they traverse the entire intersection or interchange. Figure 12 presents how a northbound through vehicle would travel through a conventional intersection and through a synchronized split-phased intersection. The northbound vehicle will need to travel through one intersection under the conventional intersection. However, under the synchronized split-phased intersection, the vehicle is required to travel through three intersections to make the same movement.

Figure 12: Northbound Vehicle Movement, Conventional Intersection Versus Synchronized Split-Phased Intersection

Chapter 23 of the most recent *Highway Capacity Manual* describes a methodology for providing a fair comparison of the delay and LOS at all of these different types of intersections/interchanges. The methodology computes the experienced travel time, which consists of the time to travel any extra distance due to the intersection type, plus the sum of the delay experienced at each of the intersections. This calculation is made for each origin-destination pair separately. For all of the alternatives presented in this report, it was assumed that there is not any extra distance traveled due to the intersection type.

3.2 Life Cycle Cost of Change in Delay Calculation

The value of time for a vehicle user was calculated with the methodology presented in the United States Department of Transportation (USDOT) publication *The Value of Travel Time Savings: Departmental Guidance for Conducting Economic Evaluations, Revision 2*. This report describes how to calculate the value of time for personal and business travel. The value of time is found by dividing the median household income by 2,080 work hours a year (52 weeks/year at 40 hours/week) and then multiplying by the average vehicle occupancy rate. The value is then multiplied by 50% to estimate the value of personal travel and by 100% to estimate the value of business travel.

The median 2016 household income for Fairbanks is $73,831, given in 2016 dollars.[2] As vehicle occupancy rates could not be found for Fairbanks, the average vehicle occupancy rate of 1.1 was taken from the Municipality of Anchorage *Congestion Management Process Update & Status of the System* report (2016). Using these values, the value of time in Fairbanks is $19.52 per vehicle hour for personal travel and $39.05 per vehicle hour for business travel. Per USDOT guidance, these values are weighted at 95.4% personal travel and 4.6% business travel. The weighted average value of time of $20.42 per vehicle hour was used to calculate the value of delay.

To find the total value of change in delay for each alternative concept as compared to the no-build alternative concept, 24-hour weekday delays were calculated for the Steese-Jo intersection for the 2022 construction year through the 2045 design year. These were brought to yearly delays by multiplying by 260 (the number of weekdays per year). The yearly cost of change in delay was calculated by multiplying the yearly delay by the value of time. The total value of change in delay over the design life for each alternative concept was calculated by summing the present value of the change in delay over the 24-year period using a 3% discount rate (per DOT&PF).

The amount of emissions (in grams per day) produced for each alternative was calculated per the AASHTO reference, *User Benefit Analysis for Highways*.[3] First, fuel consumption was calculated taking into account vehicle types, the free flow speed that vehicles are expected to reach after stopping, and stopped delay. Once fuel consumption had been calculated, the emissions were calculated per the values: 69.9 grams of carbon monoxide per gallon of fuel, 13.6 grams of nitrogen oxide per gallon of fuel, and 16.2 grams of volatile oxygen compounds per gallon of fuel.[4] Note that the amount of fuel consumed is more dependent on the number of times a vehicle stops and the expected speed between stops than on the amounted of time between stops. Therefore, the life cycle congestion costs and the amount of emissions for each alternative are not necessarily directly related.

3.3 Weaving Analysis

For the westbound weaving on the Johansen Expressway from the Steese-Jo intersection to the Old Steese Highway intersection, the weaving analysis was performed using a microsimulation

[2] United States Census Bureau, QuickFacts, www.census.gov
[3] User Benefit Analysis for Highways (2003), AASHTO, page 5-14
[4] Synchro User Manual, page 3-10

program known as Vissim. Each alternative was modeled using 2045 design volumes and the differences in the number of vehicles changing lanes during the appropriate peak hour period was compared for each alternative.

Although the Vissim analysis was also prepared for the southbound weaving on Steese Expressway from the Farmers Loop intersection to the Johansen Expressway, this analysis was made complicated by the design, which reduces the number of southbound lanes available from three under the existing condition to two under the proposed condition. Under the proposed condition, the number of southbound lanes widens back out into three prior to entering the turn lanes at the Johansen Expressway. Because of this design, there are as many lane changes with the free eastbound right turn at Farmers Loop as there are with the signalized dual right turns at Farmers Loop. However, the signalization should organize these lane changes so that there are fewer weaving conflicts. Since the design for this movement is the same for all alternatives except for the pedestrian overpass, each alternative received the same score for the Farmers Loop weaving criteria.

3.4 Pedestrian Delay

Pedestrian delay was calculated similar to intersection delay. The delay for each individual crossing was calculated, and then the delay for a pedestrian to travel from one quadrant to another was calculated by summing the delay experienced at each crossing, taking into account the signal phasing.

3.5 Intersection Functional Area

The functional area of an intersection represents the area upstream and downstream of the physical intersection where the traffic control of the intersection adds to the cognitive load of drivers, increasing the number of things drivers have to think about and actions the driver has to take or be ready to take. The mixture of these maneuvers within the traffic flow creates conflicts which may increase crash potential and decrease operational efficiency. It is desirable to limit access (driveways or side streets) within the functional area of the intersection so that drivers can focus on safely maneuvering through the intersection before new conflicts are encountered.

Per the Transportation Research Board (TRB) *Access Management Manual*, the functional area of the intersection is defined in parts. The upstream functional area encompasses the turn-lane queue and storage lengths, the distance vehicles need to make decisions and movements before reaching the physical intersection (such as changing lanes and decelerating), and perception and reaction distance (the time it takes a driver to see and then respond to a visual cue such as a red light). The 95th percentile queue lengths were used as the queue and storage distance. The deceleration and maneuvering distance is the distance required to decelerate from the free flow travel speed to a full stop. A perception-reaction time of 1.5 seconds was used to calculate the perception-reaction distance.

The downstream functional area includes the distance it takes to recover from the conditions of the intersection. Three distances were considered in calculating the downstream functional area: stopping sight distance, acceleration distance, and corner clearance distance. The stopping sight distance is the distance it would take for vehicles to come to a full stop from travel speeds. The acceleration distance is the distance needed to accelerate back to travel speed. The corner clearance is the minimum allowable distance from the nearest face of curb of a public roadway intersection to the nearest edge of the driveway. Corner clearance distances were taken from the *Alaska Highway Preconstruction Manual* based on speed and hourly traffic volumes.

Both the Steese Expressway and the Johansen Expressway are access controlled highways, meaning that there are no driveways or side street connections in between the signalized intersections. However, the Lazelle Road approach is not access controlled; therefore, an analysis of the intersection functional area on Lazelle Road will give an idea of the effect of the driveways and side street connections on safety and operations of that leg. For each alternative, the upstream and downstream functional area for the Lazelle Road leg was calculated, and it was determined how many driveways and side streets are within the functional area of the intersection.

3.6 Cost Estimates

Construction cost estimates were developed using planning-level designs with current construction cost data (i.e., not adjusted for future construction years). The construction costs include contingency (20%), construction engineering (15%), and ICAP (3.70%). (ICAP refers to the Indirect Cost Allocation Plan, which takes into account the indirect costs associated with DOT&PF effort for the project.) Design costs are estimated at 15% of the total construction costs.

The right of way impacts are also based on planning-level designs and right of way data from the Fairbanks North Star Borough Geographic Information System (GIS). The right of way impacts do not include temporary construction permits/easements that may be required.

4 Alternatives

A No Build alternative and eight build alternative concepts were considered:

A. No Build
B. Conventional Intersection
C. Synchronized Split-Phased Intersection
D. Partial Displaced Left-Turn Intersection
E. Old Steese to Farmers Loop Connection
F. Eastbound Left-Turn Flyover
G. Tight Diamond/ Diverging Diamond Interchange
H. Echelon Interchange
I. Pedestrian Overpass

Some build alternatives included sub-alternatives. For example, for Alternative H a full and partial echelon interchange were evaluated.

4.1 Design Elements Common to Multiple Alternative Concepts

4.1.1 Modifications to Free Right Turn

There are free right turn lanes both at Farmers Loop Road (eastbound right turn) and at the Steese-Jo intersection (southbound right turn). This type of design is high capacity, allowing right turn vehicles to enter the new roadway at relatively high speed and with no delay. However, the Existing Conditions report noted weaving problems associated with both of these movements. Additionally, both free right turn lanes encounter a signalized intersection relatively close to the merge location. In both cases, the weaving can be alleviated by converting the free right turn lane to signalized dual right turn lanes. This also improves pedestrian safety by providing a signalized crossing to access the bike path.

Figure 13 describes the weaving concern for the southbound traffic from the Farmers Loop intersection, caused by the free eastbound right turn at Farmers Loop. Under this design, vehicles exiting the right lane to go through on Steese Expressway and vehicles entering the right lane to turn right onto Johansen Expressway conflict with each other. With signalized dual right turn lanes for eastbound Farmers Loop, the right turn and through vehicles are staggered, and they can choose the lane they need ahead of time.

Figure 14 describes the weaving concern for the westbound traffic from the Steese-Jo intersection, caused by the free southbound right turn at Steese-Jo. When the northbound left turn traffic is released from the signal, these vehicles fill the westbound left lane on Johansen Expressway, making it difficult for southbound right turn vehicles from Steese Expressway to change lanes and turn left at the Old Steese intersection, if desired. With signalized dual right turn lanes for southbound Steese Expressway, the right turn and left turn vehicles are staggered, and they can choose the lane they need ahead of time.

The proposed design for Farmers Loop Road used in every build alternative is shown in Figure 15.

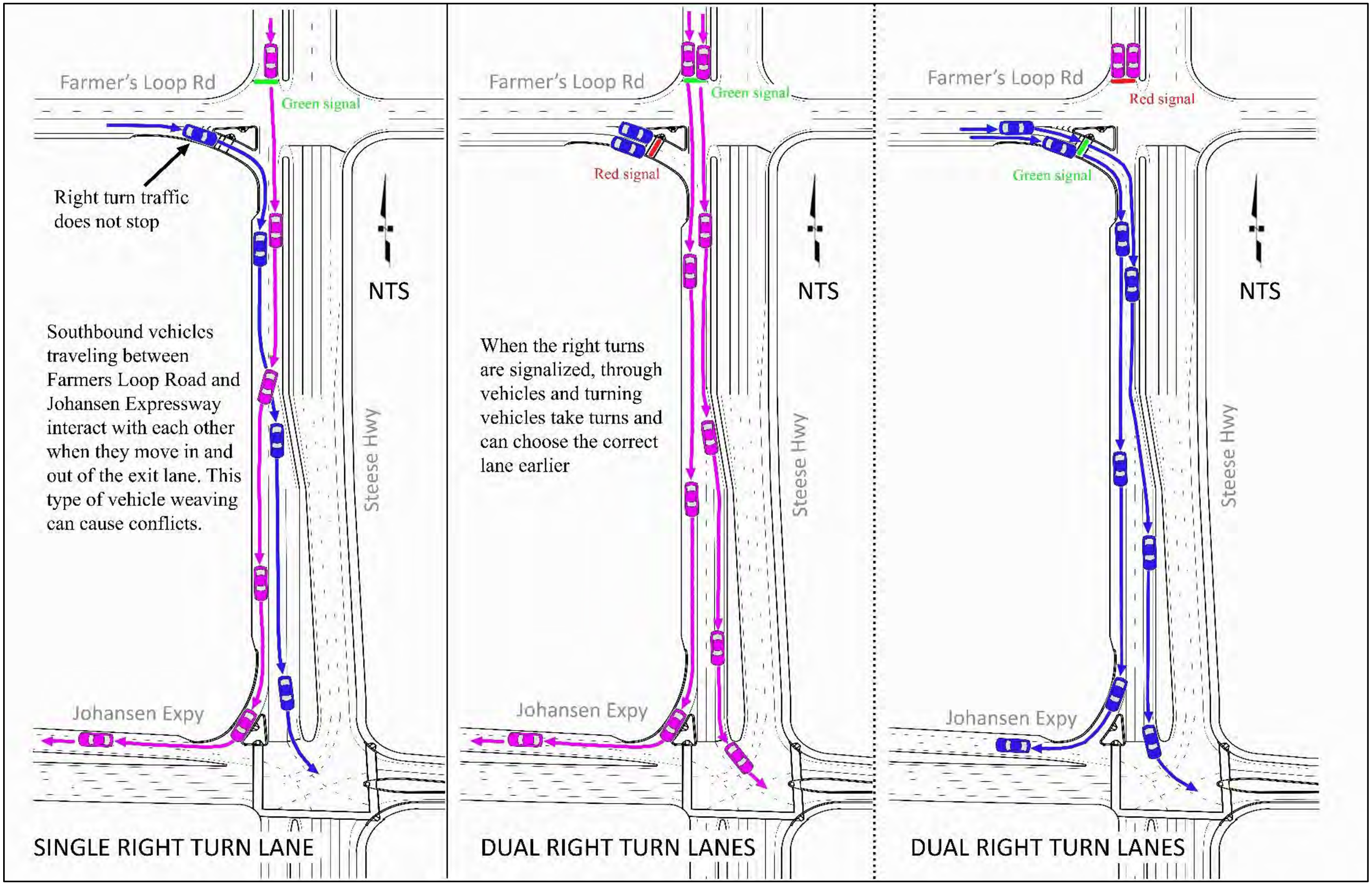


Figure 13: Farmers Loop Conversion of Free Right Turn Lane to Signalized Dual Lanes

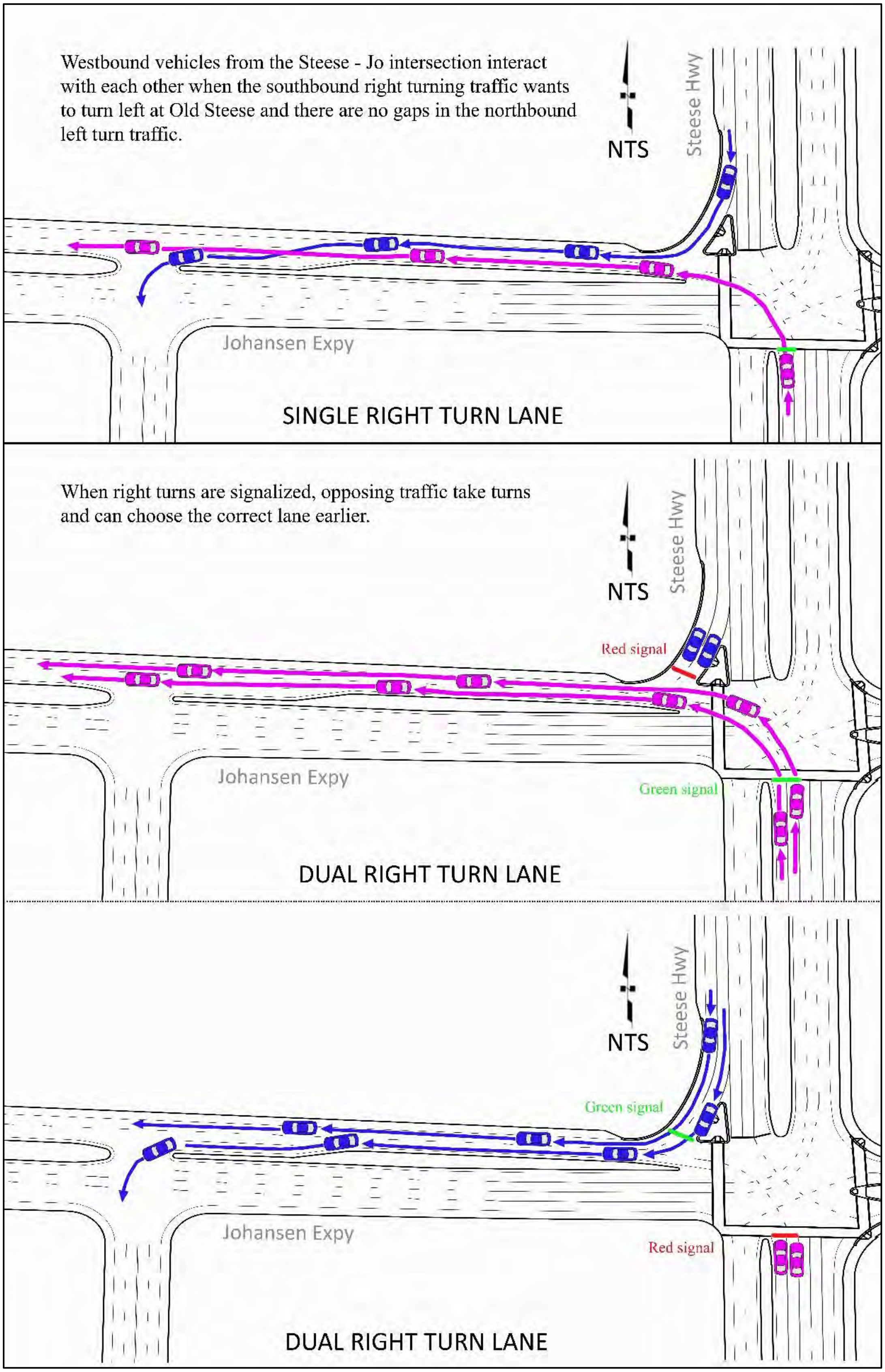


Figure 14: Steese-Jo Conversion of Free Right Turn Lane to Signalized Dual Lanes

4.1.2 Pedestrian Crossing of North Leg

As described in the Existing Conditions report, there is a multi-use bike path along the west side of Steese Expressway and along either side of the Johansen Expressway. There is no path or sidewalk on the east side of the Steese Expressway, or along Lazelle Road. Pedestrians and bicyclists east of the Steese Expressway either travel on the shoulder, or on parallel roadways (such as City Lights Boulevard and D Street).

At the Steese-Jo intersection, pedestrians are allowed to cross the east, west, and south legs of the intersection, but are not allowed to cross the north leg of the intersection. The main reason for this is due to the heavy eastbound left turn movement in the evening. It is difficult to accommodate both pedestrian crossing time and enough time for the eastbound left turn movement without reducing vehicle LOS to an undesirable level. The lack of a crossing for the north leg is a minor inconvenience, due to the available pedestrian infrastructure and the existing land uses in the northeast quadrant of the intersection.

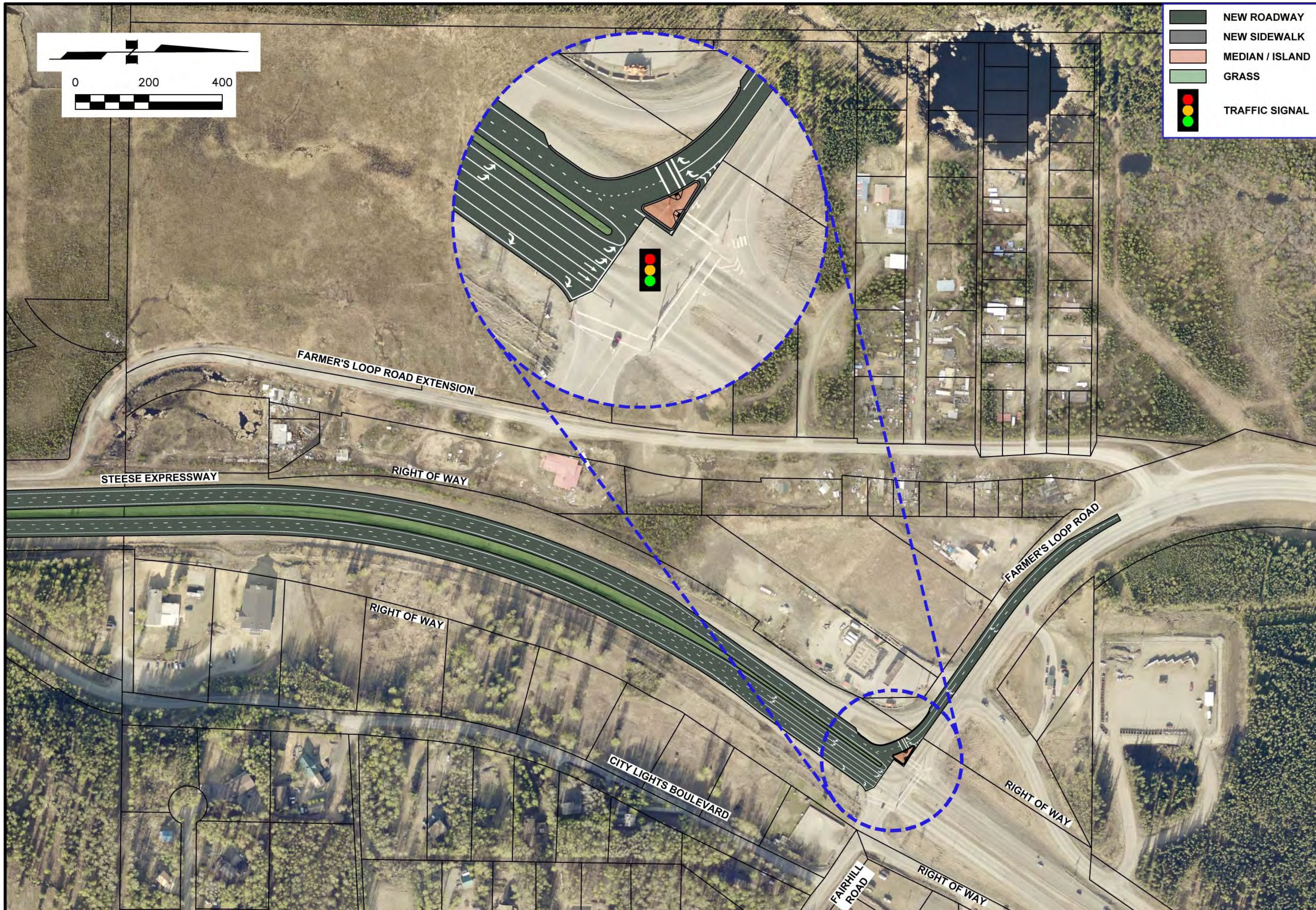
Nevertheless, it was considered desirable to include a crossing for the north leg, if possible. Thus, the feasibility of including a pedestrian crossing for the north leg was considered for each alternative. If the desired vehicle LOS (LOS D or better) could be achieved given the necessary timing for a pedestrian to cross the north leg, then the crossing was included.

For the screening criteria, if a pedestrian crossing of the north leg was not included in the alternative, that movement was given a high pedestrian delay, so that alternatives without the crossing on the north leg did not fare as well as alternatives with the north leg crossing under the multimodal connectivity goal.

4.1.3 Northbound Approach to Farmers Loop Intersection

Under the existing condition, there are two northbound lanes from the Steese-Jo intersection north to Farmers Loop. At the Farmers Loop intersection, two left turn lanes are added to the left of the through lanes and one right turn lane is added to the right of the through lanes. The Existing Conditions report found that almost one-third of the northbound traffic turns left at the Farmers Loop intersection. This means that one-third of the traffic has to be in the left-most through lane in order to turn left at Farmers Loop. This contributes to an uneven distribution of traffic for the eastbound left turn from Johansen Expressway and subsequent reduced level of service.

The 2045 Fairbanks Metropolitan Area Transportation System (FMATS) travel demand model indicates that traffic growth will occur predominantly north of the Farmers Loop intersection, rather than on Farmers Loop itself. Thus, this condition is expected to improve somewhat with time. In addition, many of the alternatives found it necessary to introduce three northbound lanes on the Steese Expressway in order to accommodate future traffic volumes. Since there are only two through lanes north of Farmers Loop currently, all of the design concepts utilized the additional northbound lane by converting the left-most lane into a left turn lane at Farmers Loop. This design is shown in Figure 15.



- Eastbound right turn vehicles can position themselves in two right turn lanes to reduce weaving in southbound traffic.
- Third northbound lane becomes left turn lane at Farmers Loop.
- The eastbound right turn pedestrian crossing is signalized.

Figure 15: Proposed Changes to Farmer's Loop Intersection

4.1.4 Triple Left Turn Lanes

Some of the proposed alternatives have difficulty handling the heavy eastbound left turn volumes without using three turning lanes. While there are locations in the United States with triple left turn lanes, there are none in Alaska. The Texas Transportation Institute published guidelines for triple left turn lanes in 2011. The study indicates:

> Skip lines, preferably comprised of raised pavement markers (RPMs), should be used through the intersection with appropriate spacing to control the multiple turning paths and keep each vehicle within its lane.

Thus, maintaining the visibility of the lane striping through the intersection is critical. Since snow and ice frequently obliterate striping in the wintertime, consideration will have to be given to how to keep the skip lines visible through the winter if any of the alternatives with triple left turns are chosen.

4.1.5 Signal Timing

Under the existing timing plan, the intersection operates split phased, so that the eastbound and westbound movements never enter the intersection at the same time. While this type of operation generally works well now because there is significantly more eastbound traffic then westbound traffic, split phasing is less flexible to meet changes in volume over time and throughout the day. As such, none of the concepts used split phasing in their analysis.

4.1.6 Drainage

Design of all the alternatives will consider improvements that benefit area drainage. Roadway profile improvements will be considered to promote drainage to and through existing and proposed culverts and inlets. Resizing drainage structures will be considered to reduce ponding and debris management issues. Vegetated ditches in the project area will be reconstructed to filter runoff before entering storm drain inlets.

4.1.7 Accommodation of Overheight/Overweight Vehicles

For each alternative, the road structural section will be designed to accommodate design loads in accordance with the *Alaska Flexible Pavement Design Manual*. Traffic signals will be mounted at least 18 feet above the road surface.

For the alternatives with bridges, the concept provides 18’-6” of clearance over the roadway underneath to accommodate overheight vehicles travelling to and from the North Slope.

4.2 Alternative A – No Build

4.2.1 Alternative Concept

The No Build alternative was analyzed to determine the costs and impacts of doing nothing and then compared to all of the Build alternatives. The No Build Alternative assumes that no improvements are made, other than adjustments to the signal timing to accommodate changes in the traffic volumes.

4.2.2 Pedestrian Safety

One of the challenges of pedestrian safety with the current design of the intersection is that pedestrians must cross a high-speed, high-volume traffic stream (the channelized southbound right turn lane). Additionally, the signalized crossings of the west leg and of the south leg of the intersection are long (crossing 4 to 5 lanes) and there is no crossing allowed for the north leg of the intersection.

4.2.3 Design Turning Movement Volumes

Two sets of design turning movement volumes were developed for the Steese-Jo intersection: under normal growth conditions (see Figure 16) and with the relocation of the main Fort Wainwright gate to Canol Road (connecting to Lazelle Road) (see Figure 17). Both design volumes were developed using the FMATS travel demand model, as described in the Existing Conditions report.

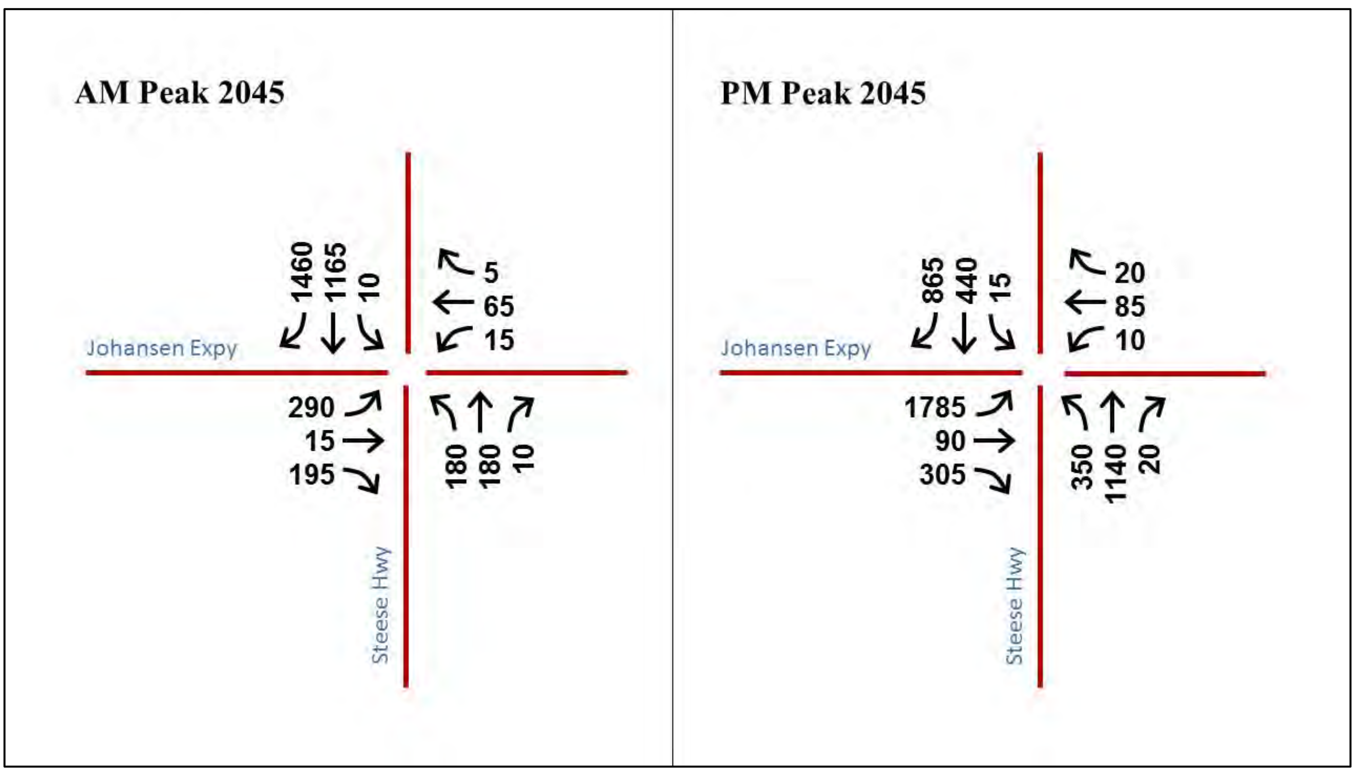


Figure 16: Design Turning Movement Volumes under Normal Growth

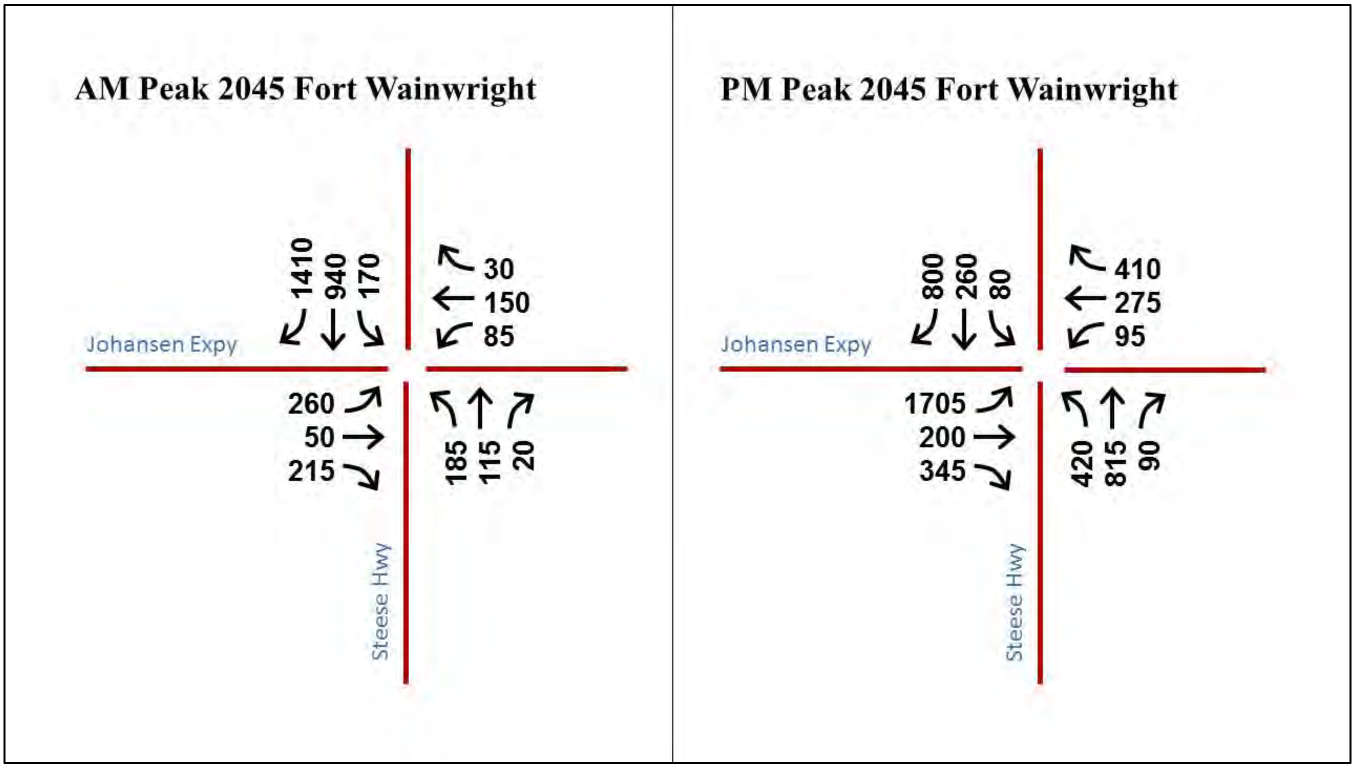


Figure 17: Design Turning Movement Volumes with Relocation of Fort Wainwright Main Gate

4.2.4 Daily Operations in 2045

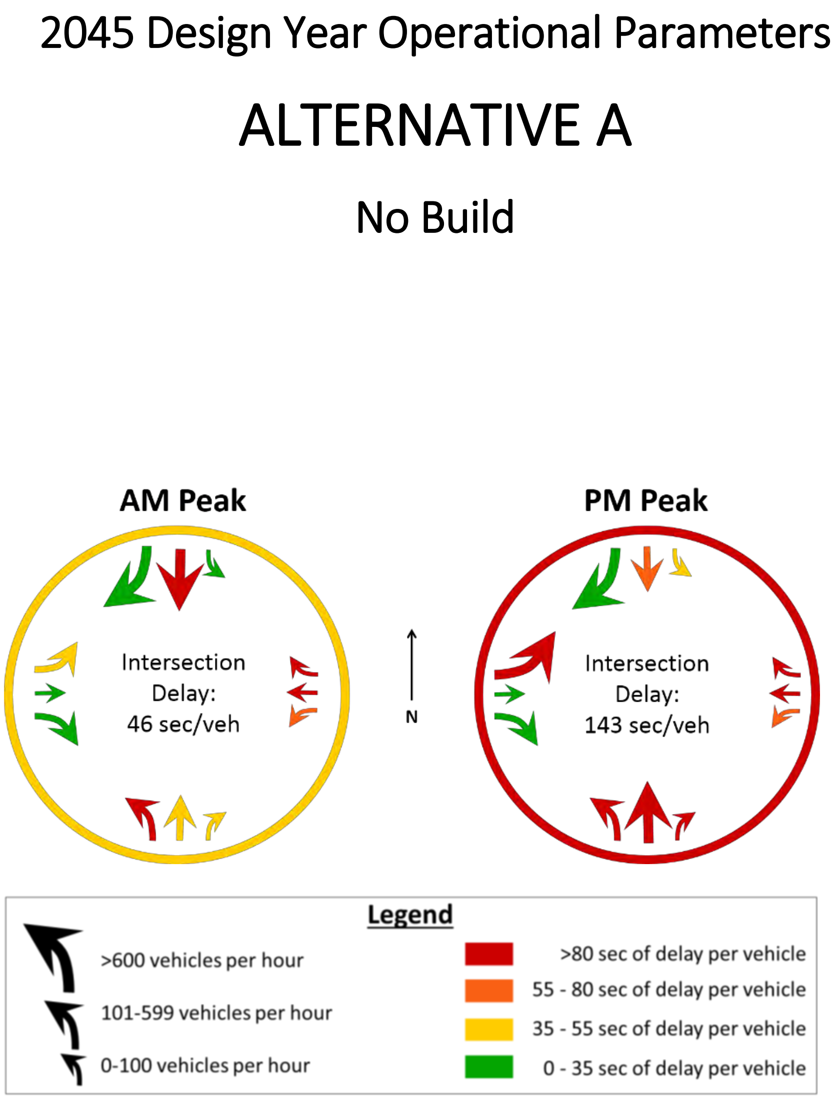
Figure 18 presents the operational status of the Steese-Jo intersection in 2045 under the No Build condition. Except for the southbound right turn, which operates free of the intersection with no delay, all the heaviest movements experience LOS F during the morning and evening peak.

On average, pedestrians experience greater than 30 seconds of delay. The HCM 2010 states that at signals, "In general, pedestrians become impatient when they experience delays in excess of 30 seconds/pedestrian, and there is a high likelihood of their not complying with the signal indication.[5] In contrast, pedestrians are very likely to comply with the signal indication if their expected delay is less than 10 seconds/pedestrian."

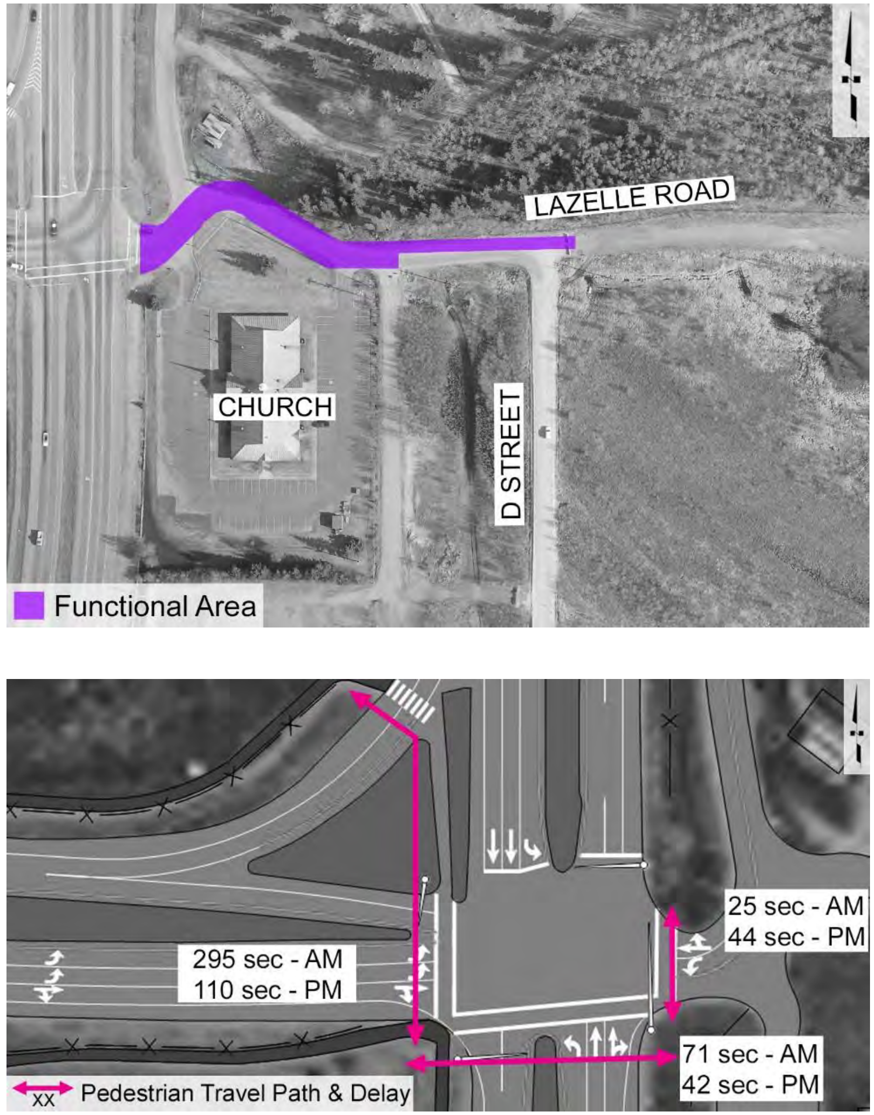
In spite of the relatively low volumes on Lazelle Road, the functional area for the east leg of the intersection extends past D Street, in part due to the significant delay for the westbound movements. This indicates that traffic turning into and out of the driveways and side streets on Lazelle Road conflicts with traffic queuing at the Steese-Jo intersection.

Figure 19 presents the operational status of the Steese-Jo intersection in 2045 if the main gate at Fort Wainwright is relocated to Canol Road (connecting to Lazelle Road). In general, delay is increased for vehicles and pedestrians and the functional area is expanded.

[5] HVM 2010, page 18-69

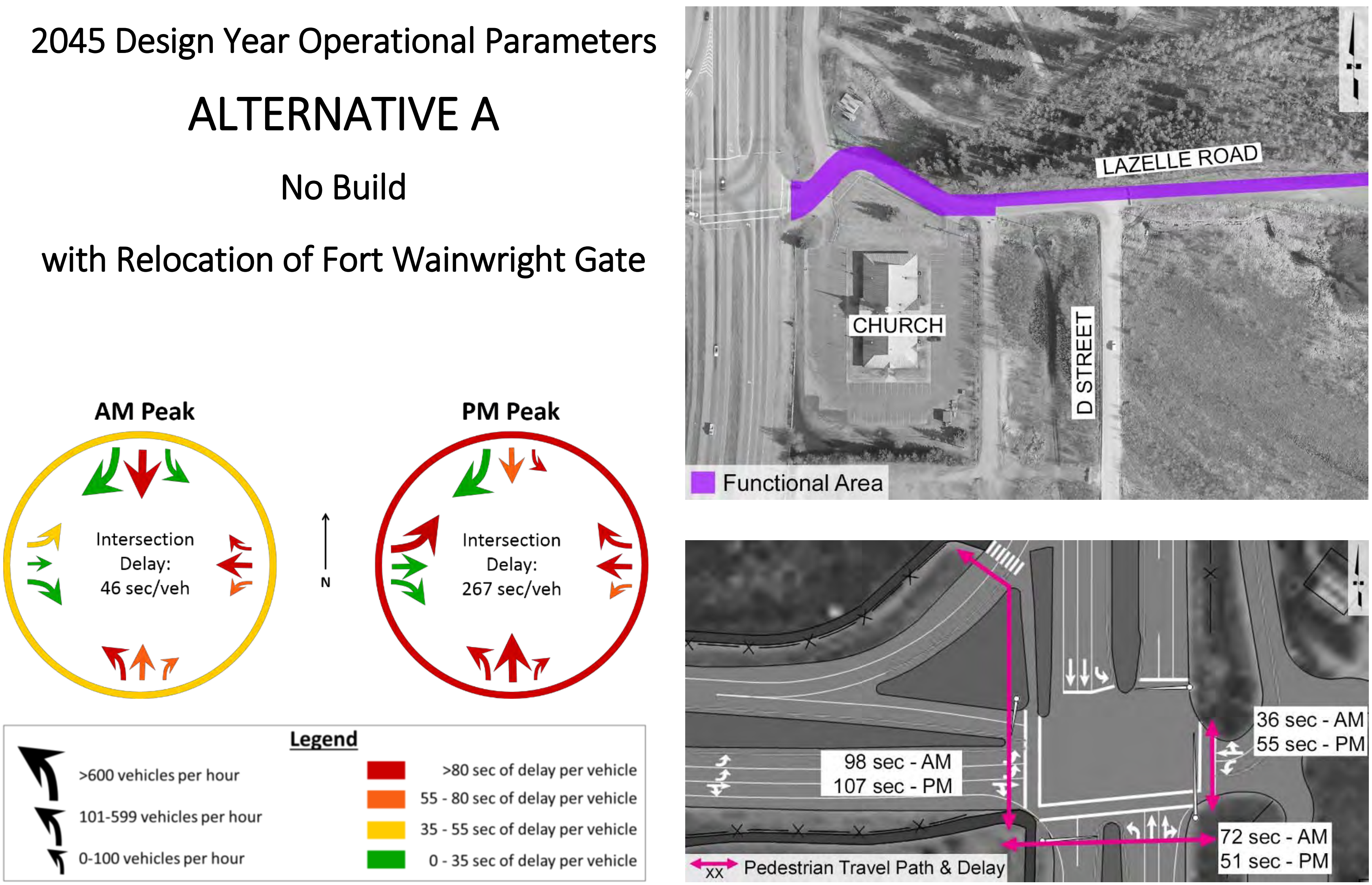


Vehicle Delay



Pedestrian Delay

Figure 18: Operational Parameters for Alternative A, No Build



Vehicle Delay **Pedestrian Delay**

Figure 19: Operational Parameters for Alternative A, No Build with Relocation of Fort Wainwright Gate

4.2.5 Annual Cost of Congestion

This measure takes into account the total life cycle delay, including during peak hours, as well as at other times of the day. Table 2 shows the life cycle costs for the No Build condition from 2022 (the year the project would be built) to 2045 (the design life of the project) under both the normal growth condition and under the condition that the Fort Wainwright main gate is moved to Canol Road.

Table 2: Present Value of Cost due to Delay (2022 to 2045) for No Build Alternative

	Present Value of Cost due to Delay (2022 to 2045)
Normal Growth Volumes	$54,634,000
Relocation of Fort Wainwright Main Gate	$85,686,000

Table 3 presents the cost of delay to freight traffic, which was estimated using the same methodology. The Existing Conditions report identified four movements carrying the majority of the freight traffic: eastbound left, northbound through, southbound through, and southbound right.

Table 3: Present Value of Cost due to Freight Delay (2022 to 2045) for No Build Alternative

	Present Value of Cost due to Delay for Freight Traffic (2022 to 2045)
Normal Growth Volumes	$6,938,000
Relocation of Fort Wainwright Main Gate	$7,216,000

4.2.6 Design Impacts

There are no impacts to drainage, accommodation of oversize vehicles, or snow storage and removal. No ROW acquisition is needed.

4.2.7 Cost Estimate

There are no costs associated with the No Build alternative other than normal maintenance costs.

4.2.8 Summary

The No Build alternative does not meet the project purpose and need:

Improves Pedestrian and Bicycle Safety	
Decreases Pedestrian Delay	
Reduces Weaving	
Reduces Vehicular Delay	

✔ = Meets goal much better than No Build ✓ = Meets goal better than No Build

4.3 Alternative B – Conventional Intersection

4.3.1 Alternative Concept

This alternative explores the effect of adding additional lanes to the intersection in order to meet the operational LOS goal of D or better under the design volumes.

In the morning peak, the heaviest movement is the southbound right turn movement, and there is also a significant southbound through movement, which competes with the northbound left turn for green time at the signal. To better accommodate these heavy volumes in the morning, both Alternative B concepts propose dual northbound left turn lanes, as shown in Figure 20 and Figure 21. Under the concepts, the free southbound right turn is turned into dual signalized southbound right turn lanes, as described in Section 4.1.1 on page 19.

In the evening peak, the heaviest movement is the eastbound left turn. The northbound through volume is also heavy in the evening. To accommodate the expected combined volume of this traffic, three eastbound left turn lanes and three northbound through lanes are needed. (See Appendix A for the intersection LOS with only two left turn lanes.)

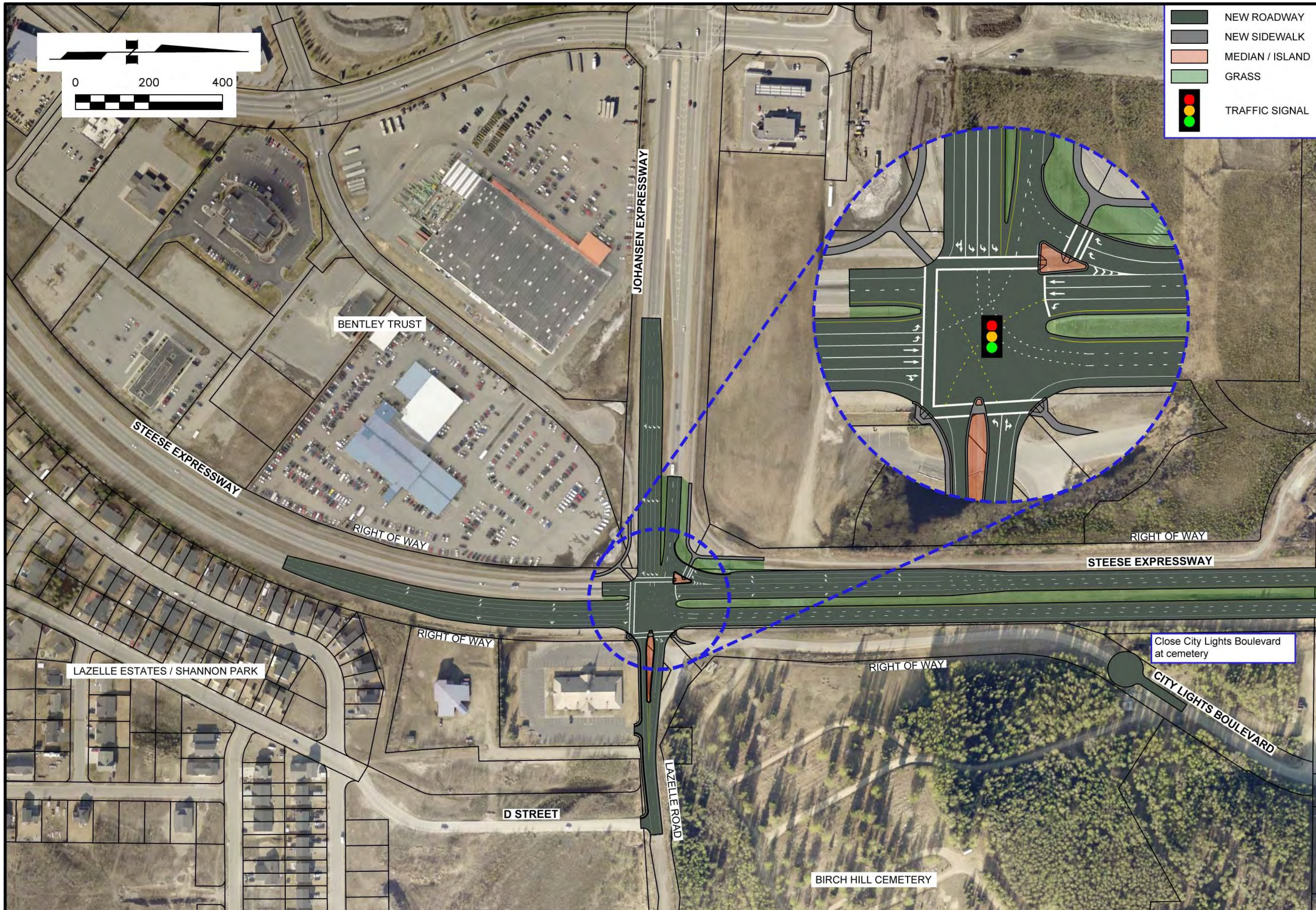
When traffic traveling to and from Fort Wainwright is added to the east leg of the intersection, the westbound approach requires a left turn lane, two through lanes, and a channelized right turn. All of the other right turns are also channelized, as this reduces the crossing distance for pedestrians, allowing more flexibility to the signal timing to achieve the LOS goal of D or better.

Many intersections of this type have been built in the United States.

4.3.2 Pedestrian Safety

Two aspects of this design improve pedestrian safety: the southbound right turn is signalized and the southbound and northbound left turns are protected, reducing the conflicts for pedestrians crossing these traffic streams. However, the pedestrian crossings are lengthened for both the west and south legs, meaning that pedestrians are exposed to traffic for a longer distance.

For the design that accommodates additional Fort Wainwright traffic, additional lanes are added to the west, south, and east legs of the intersection; however, the added right turn lanes are channelized, so that pedestrian exposure to traffic is similar to the design that does not accommodate additional Fort Wainwright traffic.



Morning Peak:

- Southbound right turn vehicles stop at signal in two right turn lanes, reducing weaving for those accessing Bentley Trust.
- Two northbound left turn lanes provide additional capacity.

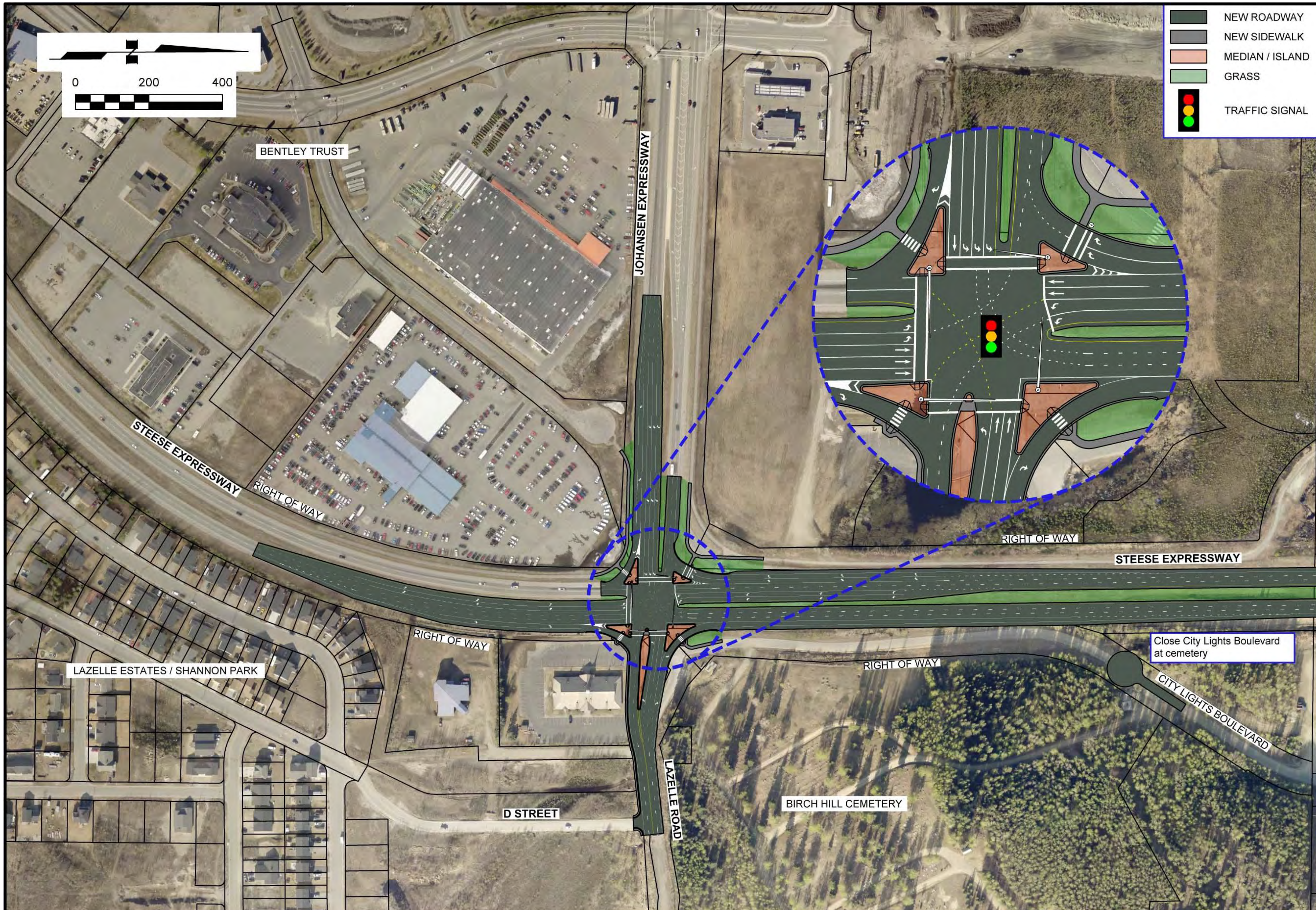
Evening Peak:

- Three eastbound left turn lanes accommodate highest volume movement.
- Three northbound through lanes provide additional capacity.

Pedestrians:

- All allowed pedestrian movements are signalized, including the crossing for the southbound right turn lanes.
- Similar to existing intersection, pedestrians are not allowed to cross the north leg of the intersection.

Figure 20: Alternative B – Conventional Intersection



Morning Peak:

- Southbound right turn vehicles stop at signal in two right turn lanes, reducing weaving for those accessing Bentley Trust.
- Two northbound left turn lanes and two southbound left turn lanes provide additional capacity.

Evening Peak:

- Three eastbound left turn lanes accommodate nearly 1800 vehicles per hour.
- Three northbound through lanes provide additional capacity.
- Additional lanes on Lazelle Road accommodate traffic traveling to and from Fort Wainwright.

Pedestrians:

- All allowed pedestrian movements are signalized, including the crossing for the southbound right turn lanes.
- Similar to existing intersection, pedestrians are not allowed to cross the north leg of the intersection.

Figure 21: Alternative B – Conventional Intersection with Relocation of Fort Wainwright Gate

4.3.3 Design Volumes

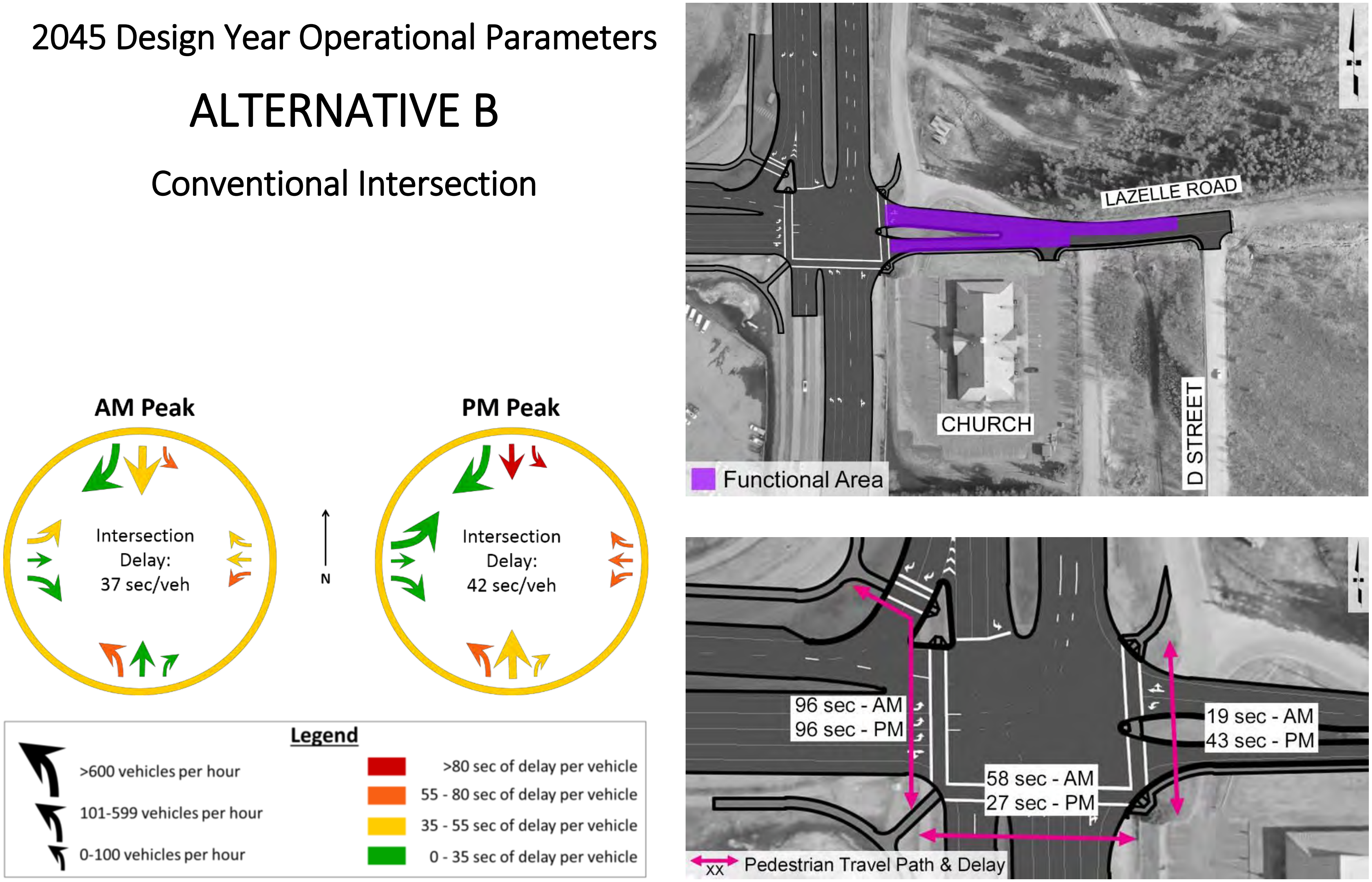
The design volumes for this alternative are the same as for the No Build alternative, presented in Section 4.2.3 on page 26.

4.3.4 Daily Operations in 2045 and Annual Cost of Congestion

Figure 22 presents the average vehicle delay, average pedestrian delay, and functional area of the intersection under Alternative B (Conventional Intersection).

Figure 23 presents the impacts of delay on vehicle emissions, as well as the value of the savings in delay for Alternative B (Conventional Intersection) as compared to Alternative A (No Build).

Figure 24 and Figure 25 present the same information for Alternative B (Conventional Intersection) with the relocation of the Fort Wainwright main gate.



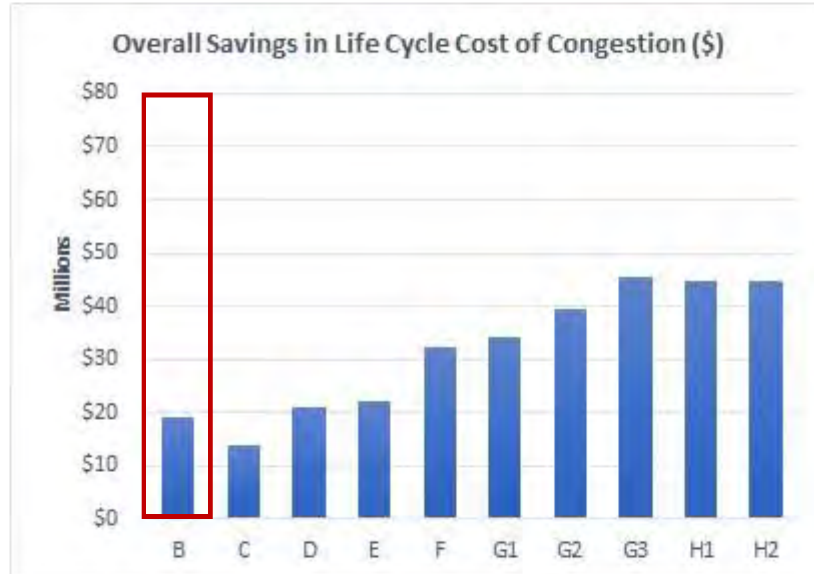
Vehicle Delay **Pedestrian Delay**

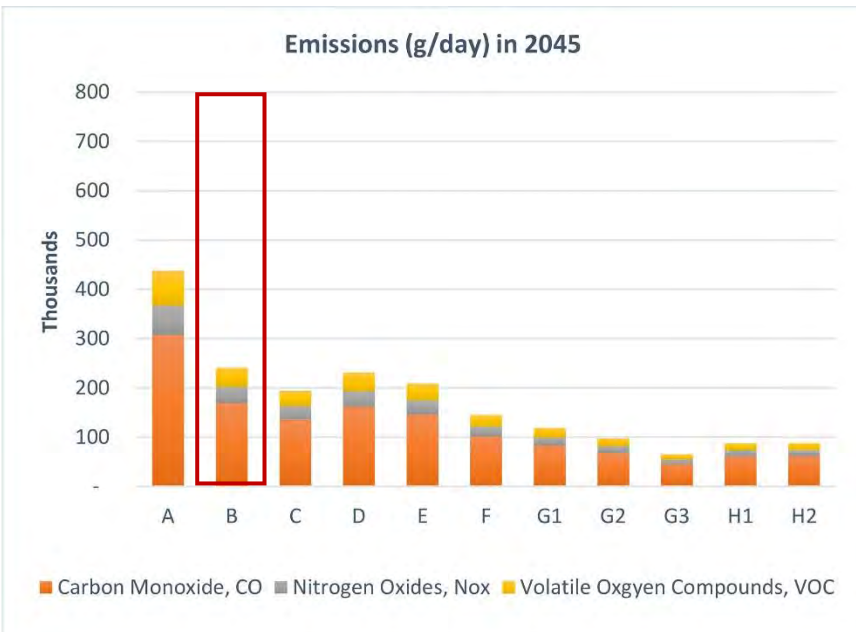
Figure 22: Operational Parameters for Alternative B, Conventional Intersection

Impacts of Delay

ALTERNATIVE B

Conventional Intersection





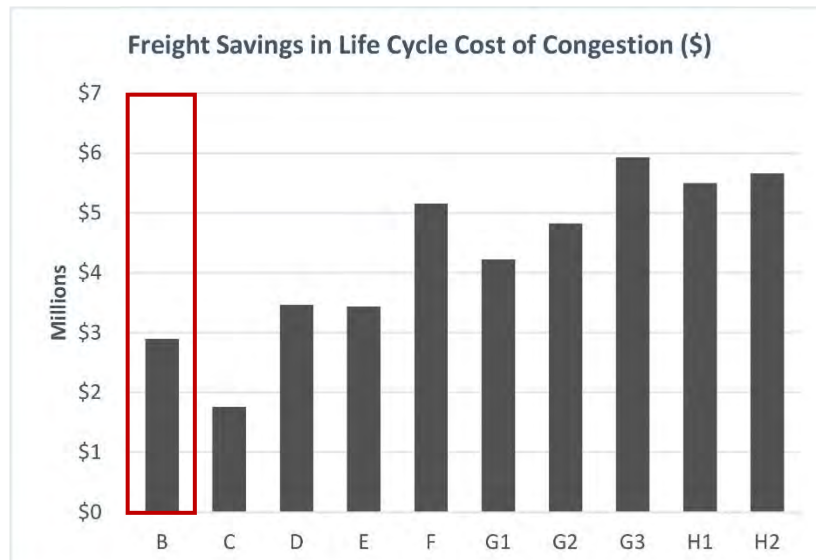
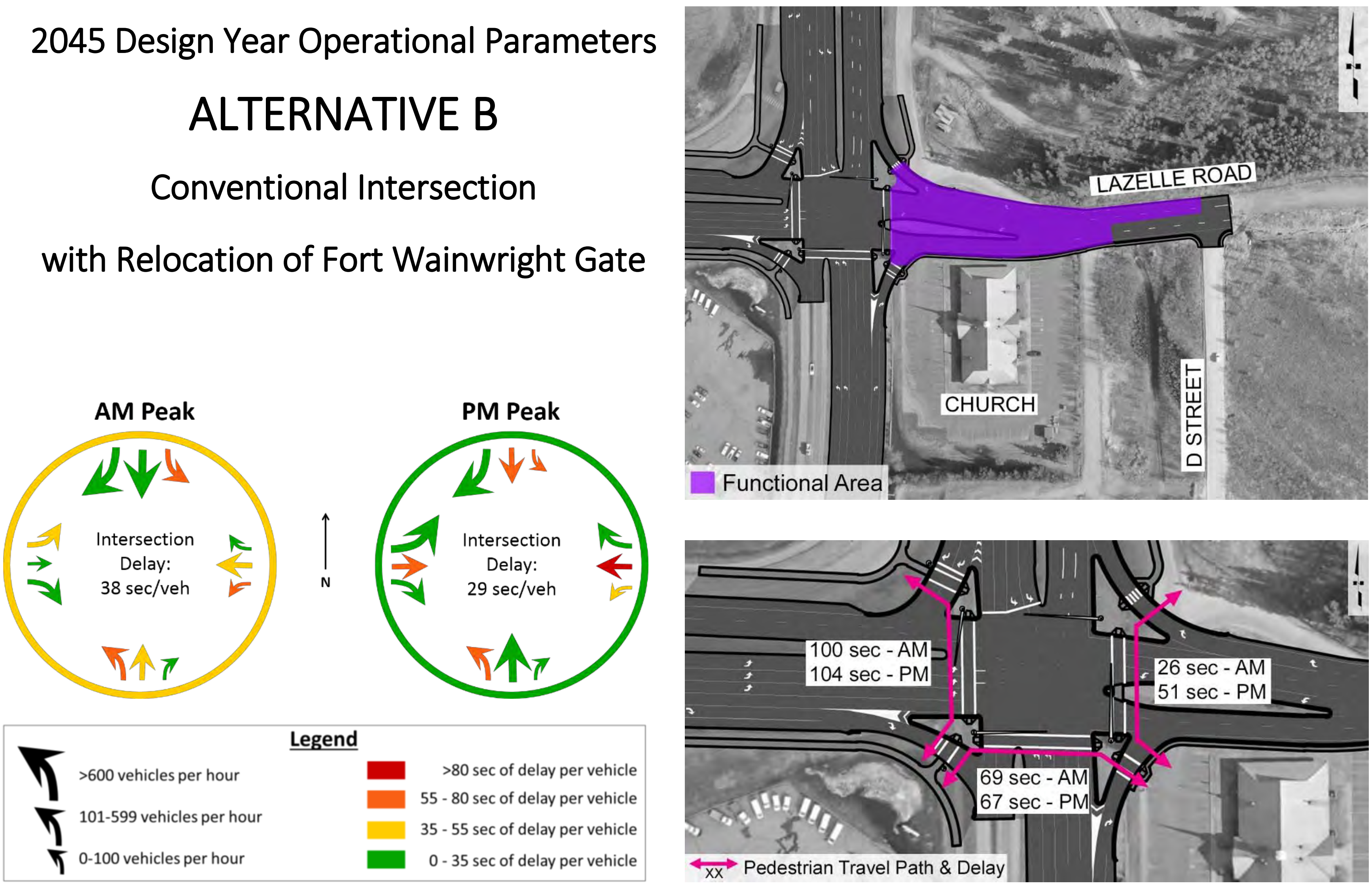


Figure 23: Impacts of Delay for Alternative B, Conventional Intersection



Vehicle Delay **Pedestrian Delay**

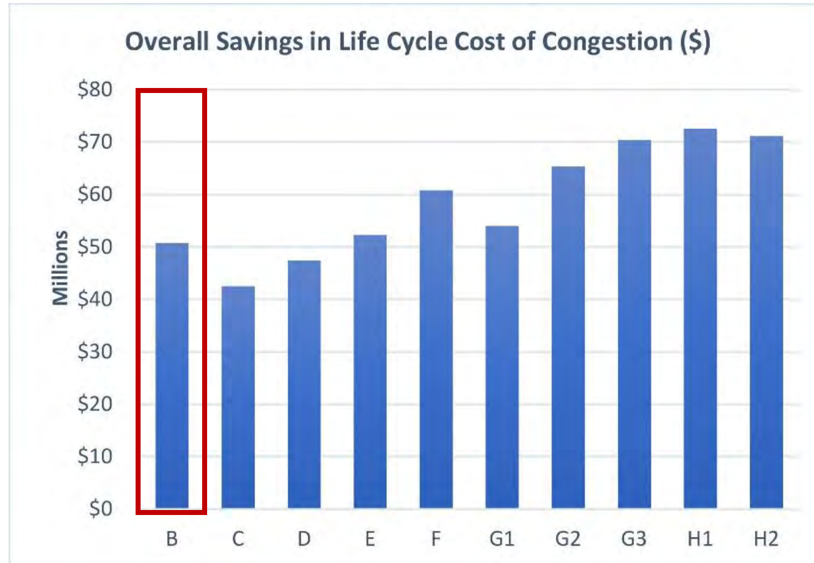
Figure 24: Operational Parameters for Alternative B, Conventional Intersection with Relocation of Fort Wainwright Gate

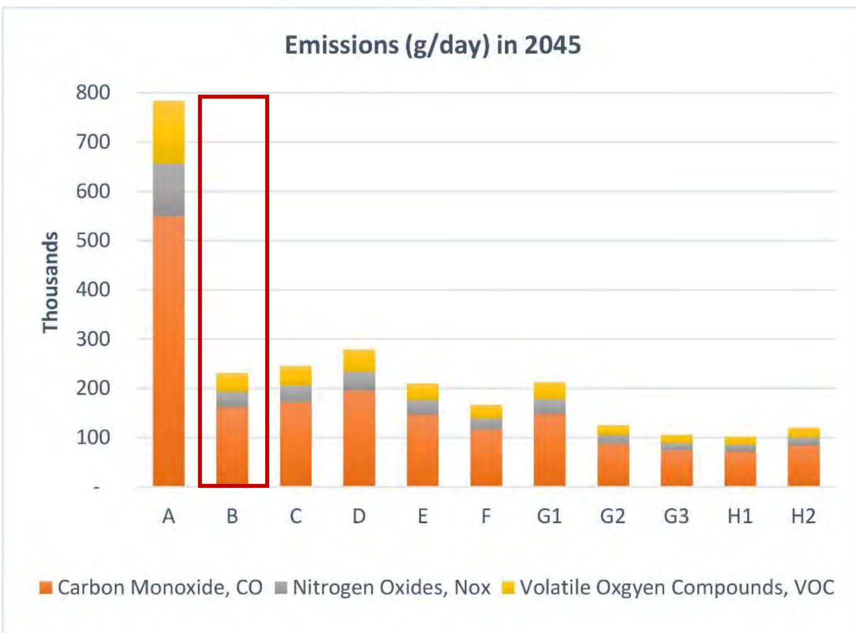
Impacts of Delay

ALTERNATIVE B

Conventional Intersection

with Relocation of Fort Wainwright Gate





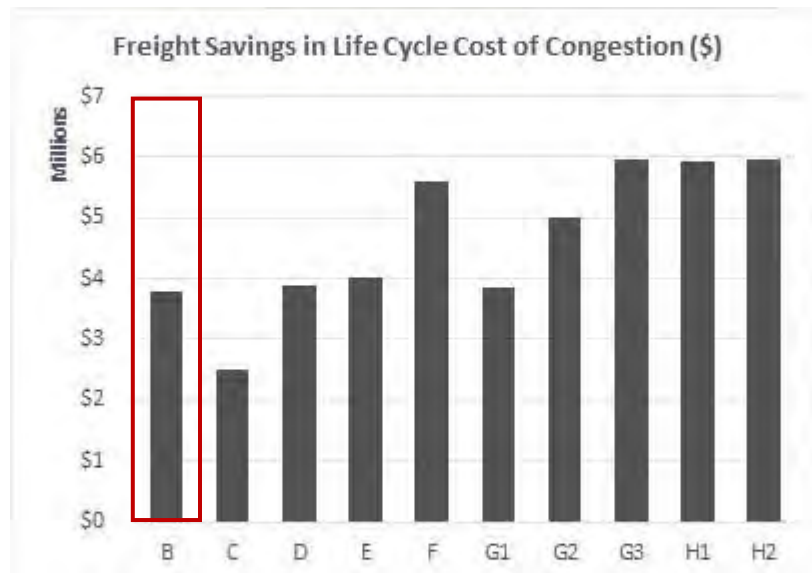


Figure 25: Impacts of Delay for Alternative B, Conventional Intersection with Relocation of Fort Wainwright Gate

4.3.5 Design Impacts

4.3.5.1 Physical (ROW) impacts and acquisition needs

Figure 26 presents the ROW impacts under Alternative B (Conventional Intersection). Figure 27 presents the impacts with the relocation of the Fort Wainwright main gate.

4.3.5.2 *Snow storage and snow removal*

DOT&PF M&O considers Alternative B harder to maintain and operate compared to the No Build condition.

4.3.6 Cost Estimate

Table 4: Cost Estimate for Alternative B, Conventional Intersection

Category	Cost	
Project Development	$	2,070,000
Right of Way	$	180,000
Utilities	$	300,000
Construction Total	$	13,800,000
Total Projected Estimated Cost	**$**	**16,350,000**

Table 5: Cost Estimate for Alternative B, Conventional Intersection Accommodating Fort Wainwright Connection

Category	Cost	
Project Development	$	2,310,000
Right of Way	$	240,000
Utilities	$	300,000
Construction Total	$	15,400,000
Total Projected Estimated Cost	**$**	**18,250,000**

The above Order-of-Magnitude Estimate is in 2018 dollars based on conceptual design. Final costs of the project will depend on labor and material costs, site conditions, productivity, market conditions, scope, and other variable factors.

4.3.7 Summary

Alternative B addresses three concerns identified under the project purpose and need:

Improves Pedestrian and Bicycle Safety	
Decreases Pedestrian Delay	✓
Reduces Weaving	✔
Reduces Vehicular Delay	✓

✔ = Meets goal much better than No Build ✓ = Meets goal better than No Build

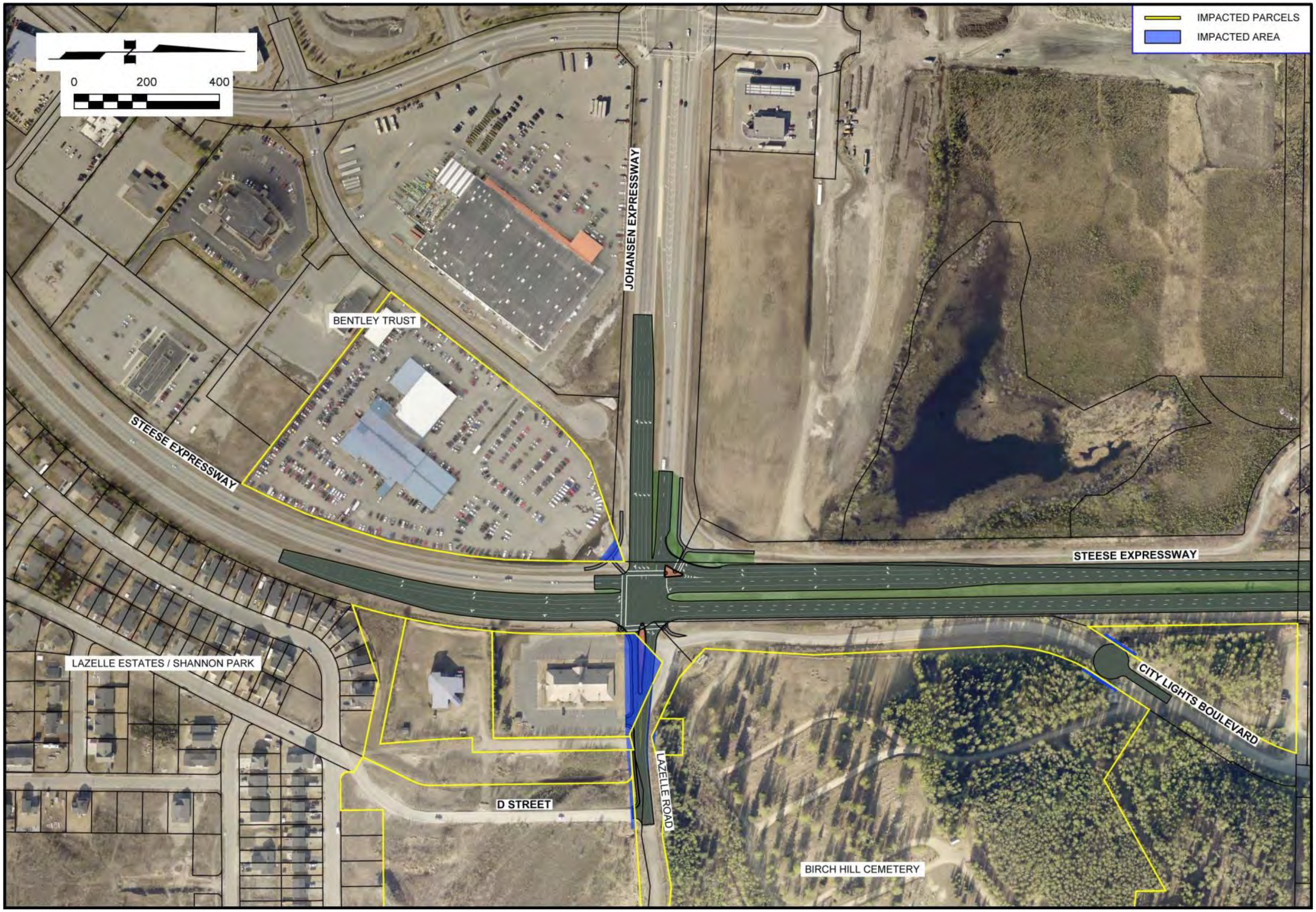


Figure 26: ROW Impacts for Alternative B, Conventional Intersection

Figure 27: ROW Impacts for Alternative B, Conventional Intersection with Relocation of Fort Wainwright Gate

4.4 Alternative C – Synchronized Split-Phased Intersection

4.4.1 Alternative Concept

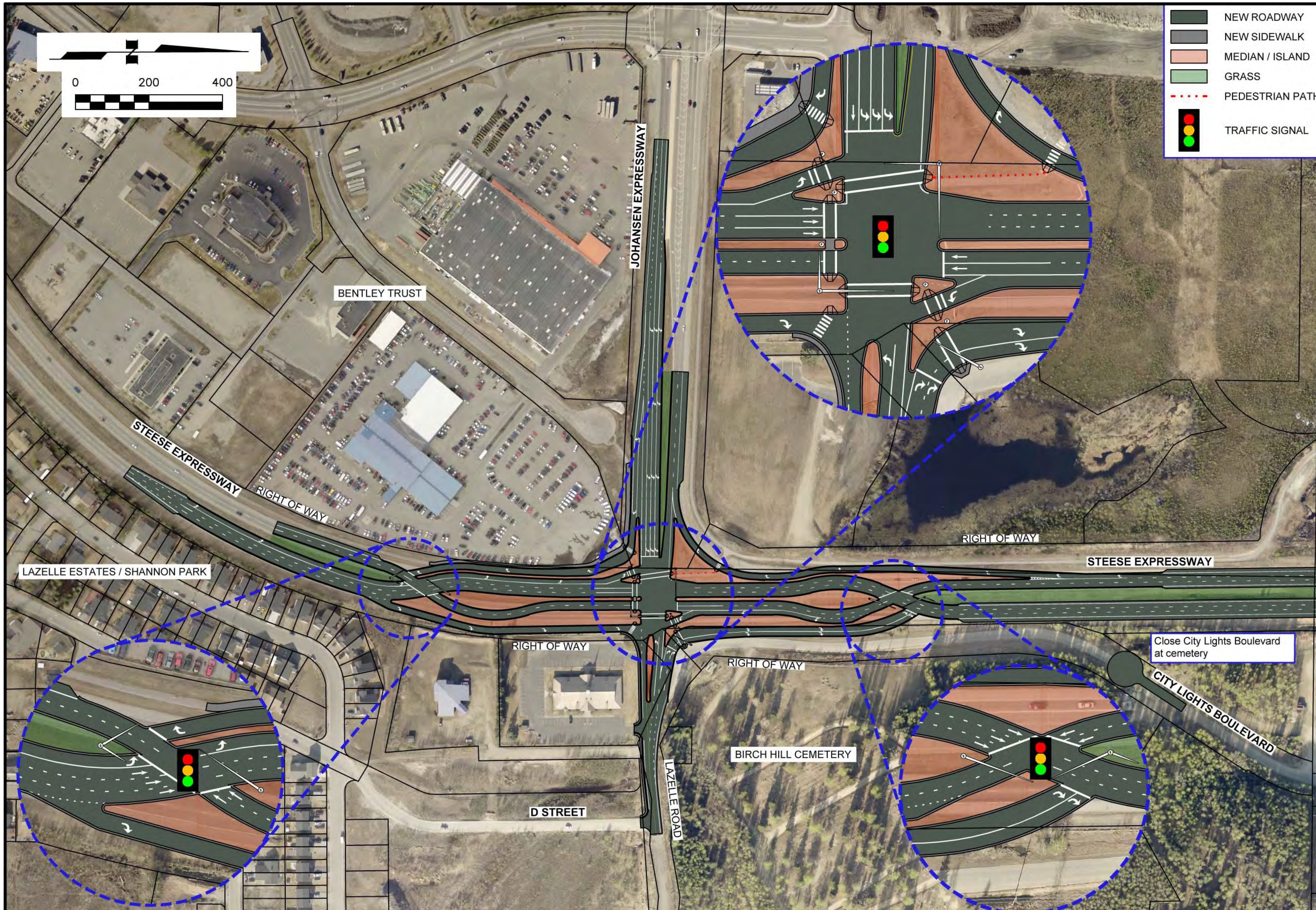
Alternative C would construct an intersection where the northbound and southbound left turn and through movements cross to the left side of the opposing traffic upstream as they approach the intersection. All right turns are taken out of the main intersection into channelized turns as shown in Figure 28. The westbound right turn lane is shown in the figure as dual lanes; however, two lanes are only needed for the traffic associated with the relocation of the Fort Wainwright main gate. Without this relocation, only one lane is needed for the westbound right turn. In this design, traffic signals are present at the main intersection and at the crossover location. Figure 29 shows how vehicles move through the intersection.

The main advantage of this design is that all northbound and southbound through and left turn traffic can enter the main intersection at the same time. Ideally, the timing would be set so that north- and southbound vehicles could travel through the three intersections (the two crossover signals and the main intersection) without stopping. The analysis showed that the combined heavy eastbound left and northbound through volumes in the PM peak make it difficult to time the signals for the southbound movements, so that southbound traffic would be stopping at all three intersections. As with Alternative B, three eastbound left turn lanes and three northbound through lanes are needed. (See Appendix A for the intersection LOS with only two left turn lanes.)

The design of this intersection is similar to the Diverging Diamond Interchange (see Section 4.10 on page 103). However, while many Diverging Diamond Interchanges have been built in the United States (including one in Anchorage), no Synchronized Split-Phased Intersections have been built.

4.4.2 Pedestrian Safety

In developing the design concept shown in Figure 28, guidelines from the Federal Highway Administration (FHWA) *Displaced Left Turn Informational Guide* was used to help determine how to help pedestrians navigate the unfamiliar crossing scenario for this intersection type. The Guide indicates that medians that provide pedestrian refuges help pedestrians navigate the crossings. While the overall crossing distances are comparable to other large intersections (such as Alternative B), one of the benefits of this type of intersection is that pedestrians are separated from a permissive left turn movement and there are no unsignalized crossings of high-speed roadways. At the unsignalized crossings where pedestrians cross the right turn lanes, the crossings should be designed so that vehicles are traveling at low speed at the crossing point.



Morning Peak:

- Southbound right turn vehicles operate the same as existing, with no stopping except to allow pedestrians to cross.
- Southbound and northbound traffic cross opposing traffic prior to the intersection, allowing south- and northbound left turn vehicles to enter the intersection at the same time as north- and southbound through vehicles.

Evening Peak:

- Three eastbound left turn lanes accommodate nearly 1800 vehicles per hour.
- Three northbound through lanes provide additional capacity.

Right Turns:

- All right turns occur outside of the main intersection.
- A second westbound right turn lane is needed to accommodate traffic traveling to and from Fort Wainwright

Pedestrians:

- All pedestrian crossings are signalized, except for where pedestrians cross one right turn lane. Where there are two right turn lanes, the pedestrian crossing is signalized.
- Similar to existing intersection, pedestrians are not allowed to cross the north leg of the intersection.

At north crossover, when northbound vehicles are stopped by the signal, southbound vehicles cross to the left side and advance to Johansen Expressway while westbound right turn vehicles enter northbound lanes.

At south crossover, when southbound vehicles are stopped by the signal, northbound vehicles cross to the left side and advance to Johansen Expressway while eastbound right turn vehicles enter southbound lanes.

Figure 28: Alternative C – Synchronized Split-Phased Intersection

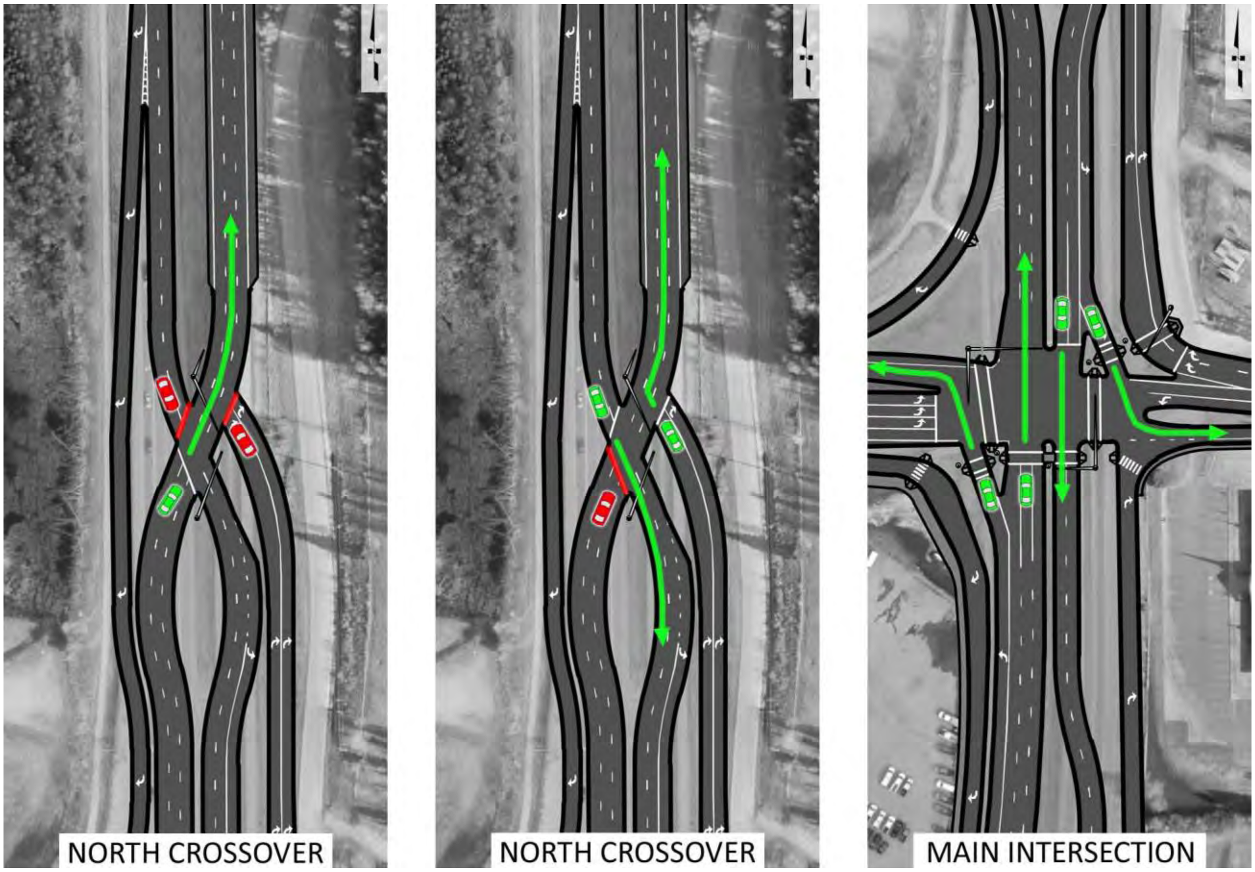


Figure 29: Alternative C – Vehicular Movements

4.4.3 Design Volumes

The design volumes for this alternative are the same as for the No Build alternative, presented in Section 4.2.3 on page 26.

4.4.4 Daily Operations in 2045 and Annual Cost of Congestion

Figure 30 presents the average vehicle delay, average pedestrian delay, and functional area of the intersection under Alternative C (Synchronized Split-Phased Intersection).

Figure 31 presents the impacts of delay on vehicle emissions, as well as the value of the savings in delay for Alternative C (Synchronized Split-Phased Intersection) as compared to Alternative A (No Build).

Figure 32 and Figure 33 present the same information for Alternative C (Synchronized Split-Phased Intersection) with the relocation of the Fort Wainwright main gate.

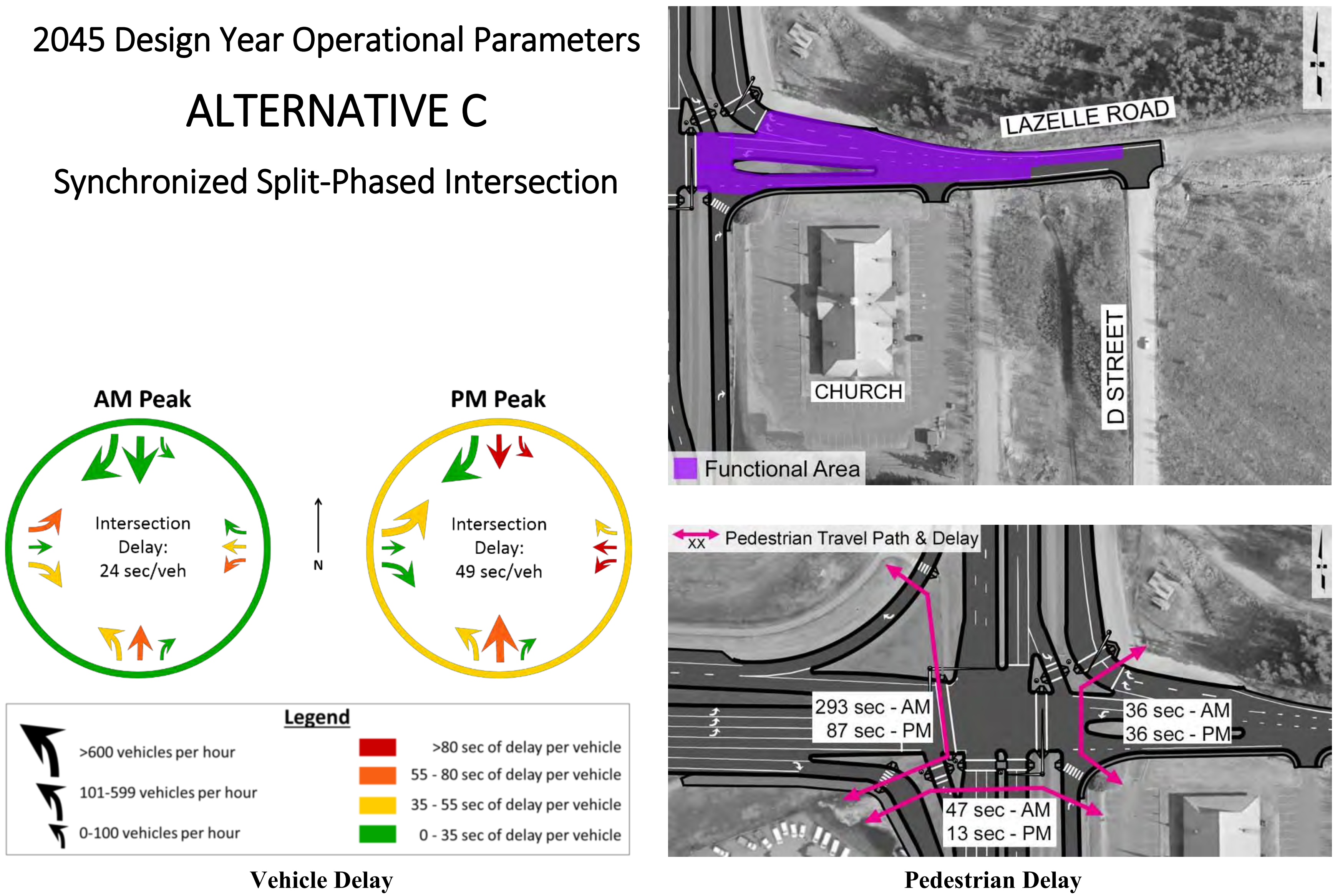


Figure 30: Operational Parameters for Alternative C, Synchronized Split-Phased Intersection

Impacts of Delay

ALTERNATIVE C

Synchronized Split-Phased Intersection

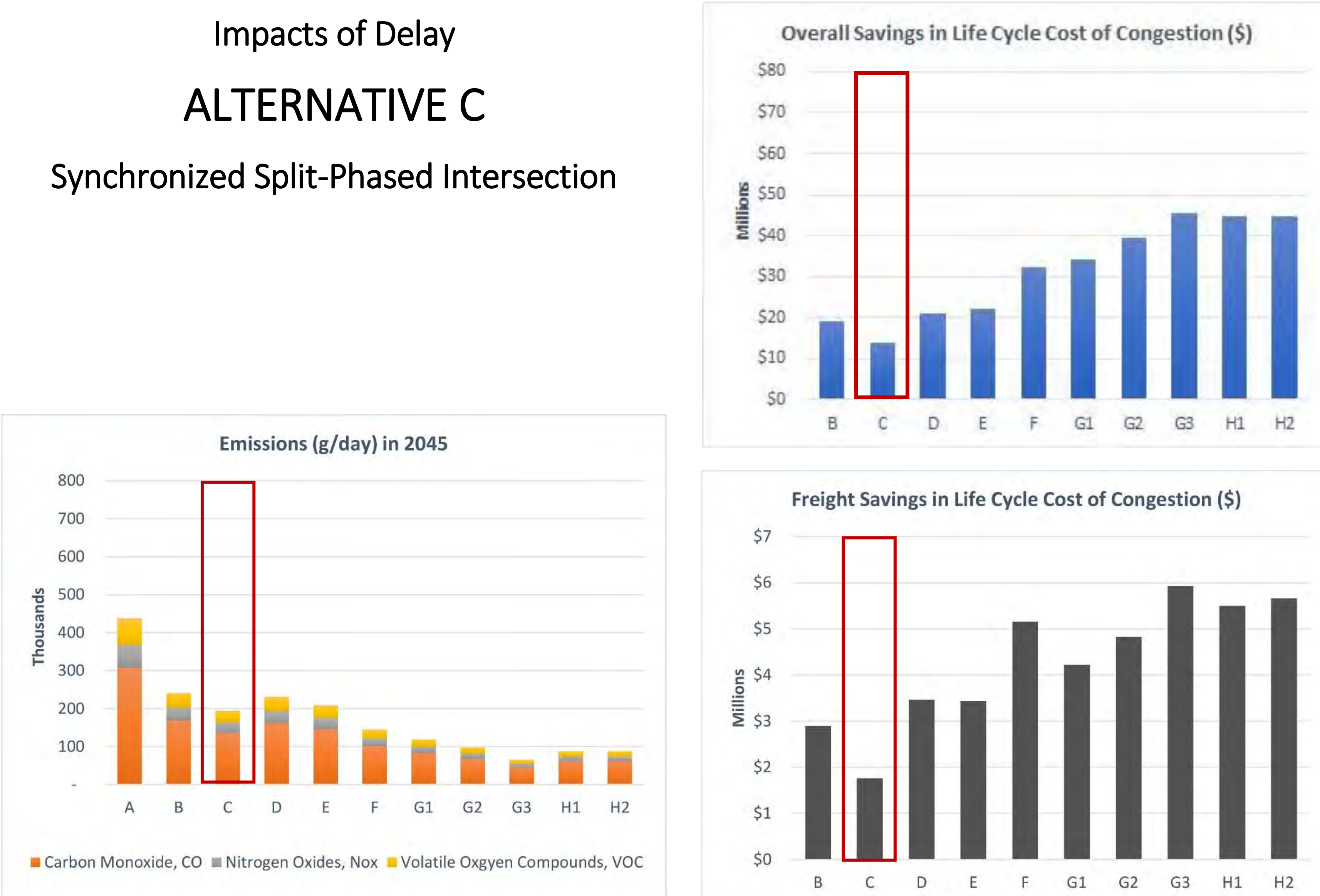
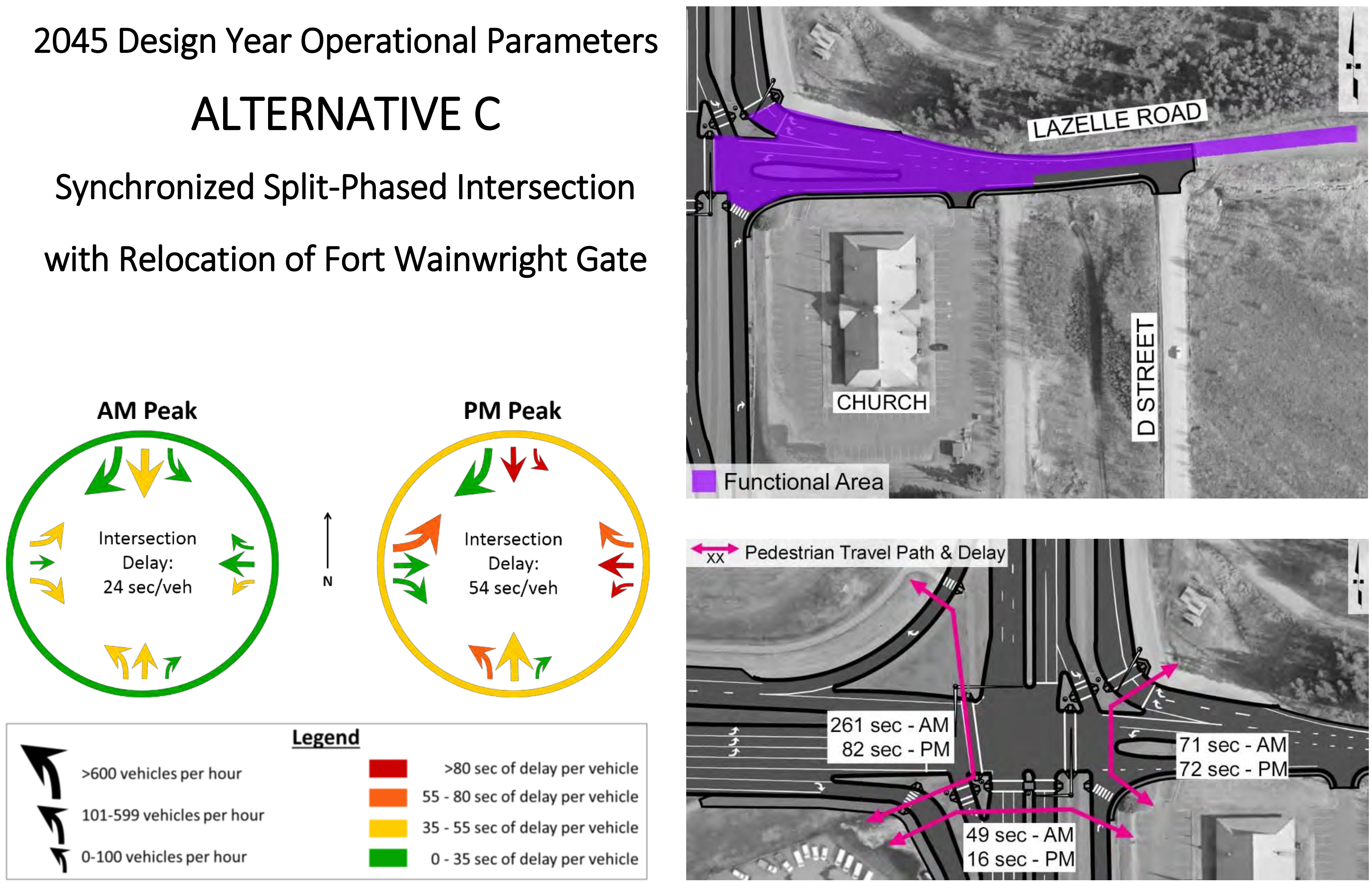


Figure 31: Impacts of Delay for Alternative C, Synchronized Split-Phased Intersection



Vehicle Delay

Pedestrian Delay

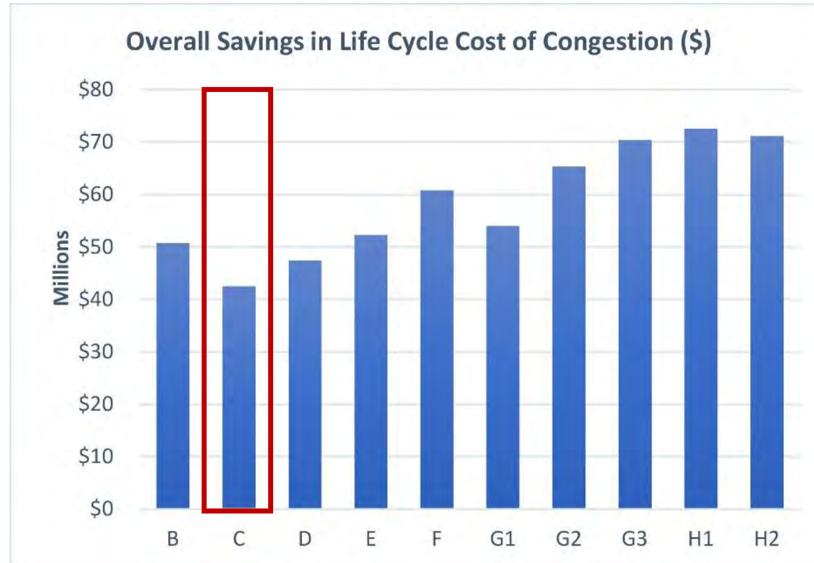
Figure 32: Operational Parameters for Alternative C, Synchronized Split-Phased Intersection with Relocation of Fort Wainwright Gate

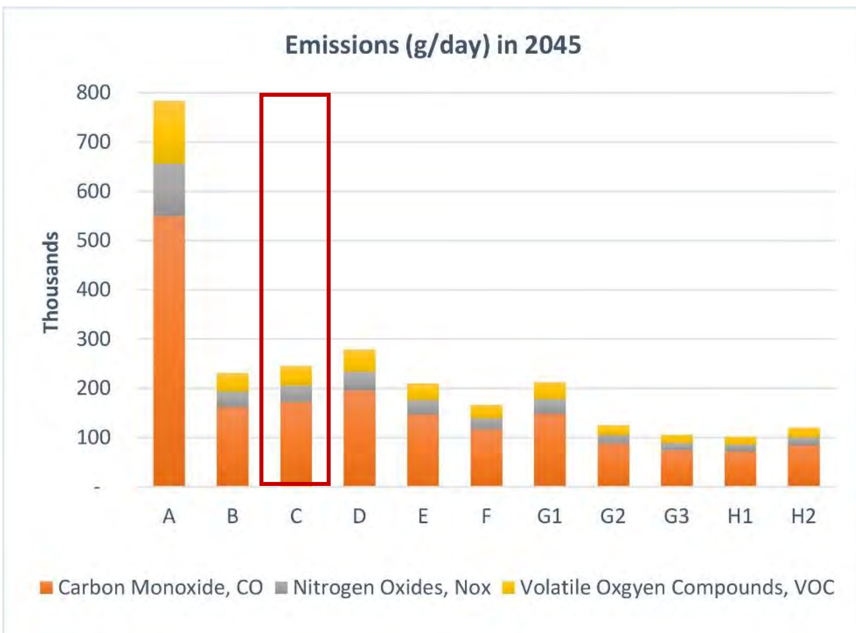
Impacts of Delay

ALTERNATIVE C

Synchronized Split-Phased Intersection

with Relocation of Fort Wainwright Gate





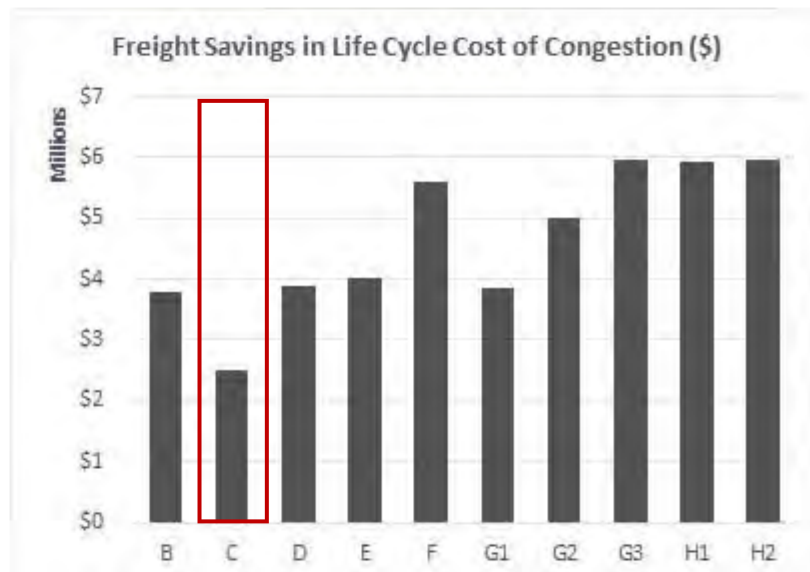


Figure 33: Impacts of Delay for Alternative C, Synchronized Split-Phased Intersection with Relocation of Fort Wainwright Gate

4.4.5 Design Impacts

4.4.5.1 Physical (ROW) impacts and acquisition needs

Figure 34 presents the ROW impacts under Alternative C (Synchronized Split-Phased Intersection).

***4.4.5.2** Snow storage and snow removal*

DOT&PF M&O considers Alternative C much harder to maintain and operate compared to the No Build condition.

4.4.6 Cost Estimate

Table 6: Cost Estimate for Alternative C, Synchronized Split-Phased Intersection

Category	Cost	
Project Development	$	3,240,000
Right of Way	$	390,000
Utilities	$	500,000
Construction Total	$	21,600,000
Total Projected Estimated Cost	**$**	**25,730,000**

The above Order-of-Magnitude Estimate is in 2018 dollars based on conceptual design. Final costs of the project will depend on labor and material costs, site conditions, productivity, market conditions, scope, and other variable factors.

4.4.7 Summary

Alternative C fulfills three criteria under the project purpose and need:

Improves Pedestrian and Bicycle Safety	
Decreases Pedestrian Delay	✓
Reduces Weaving	✔
Reduces Vehicular Delay	✓

✔ = Meets goal much better than No Build ✓ = Meets goal better than No Build

Figure 34: ROW Impacts for Alternative C, Synchronized Split-Phased Intersection

4.5 Alternative D – Partial Displaced Left Turn Intersection

4.5.1 Alternative Concept

Alternative D would construct an intersection with partial displaced left turns. In this design northbound and southbound left turn movements cross to the left side of the opposing roadway upstream of the main intersection, as shown in Figure 35. North- and southbound left-turning vehicles travel on a roadway parallel to the opposing lanes and then complete the left turn movement simultaneously with the through traffic at the main intersection. In this design, traffic signals are present at the main intersection and at the crossover locations. Figure 36 shows how vehicles move through the intersection.[6]

As with Alternative B, three eastbound left turn lanes and three northbound through lanes are needed. (See Appendix A for the intersection LOS with only two left turn lanes.)

Unlike the synchronized split-phased intersection (Alternative C), northbound and southbound traffic only stop at one of the two crossover intersections. Thus, there is less likelihood of vehicles having to stop at multiple intersections.

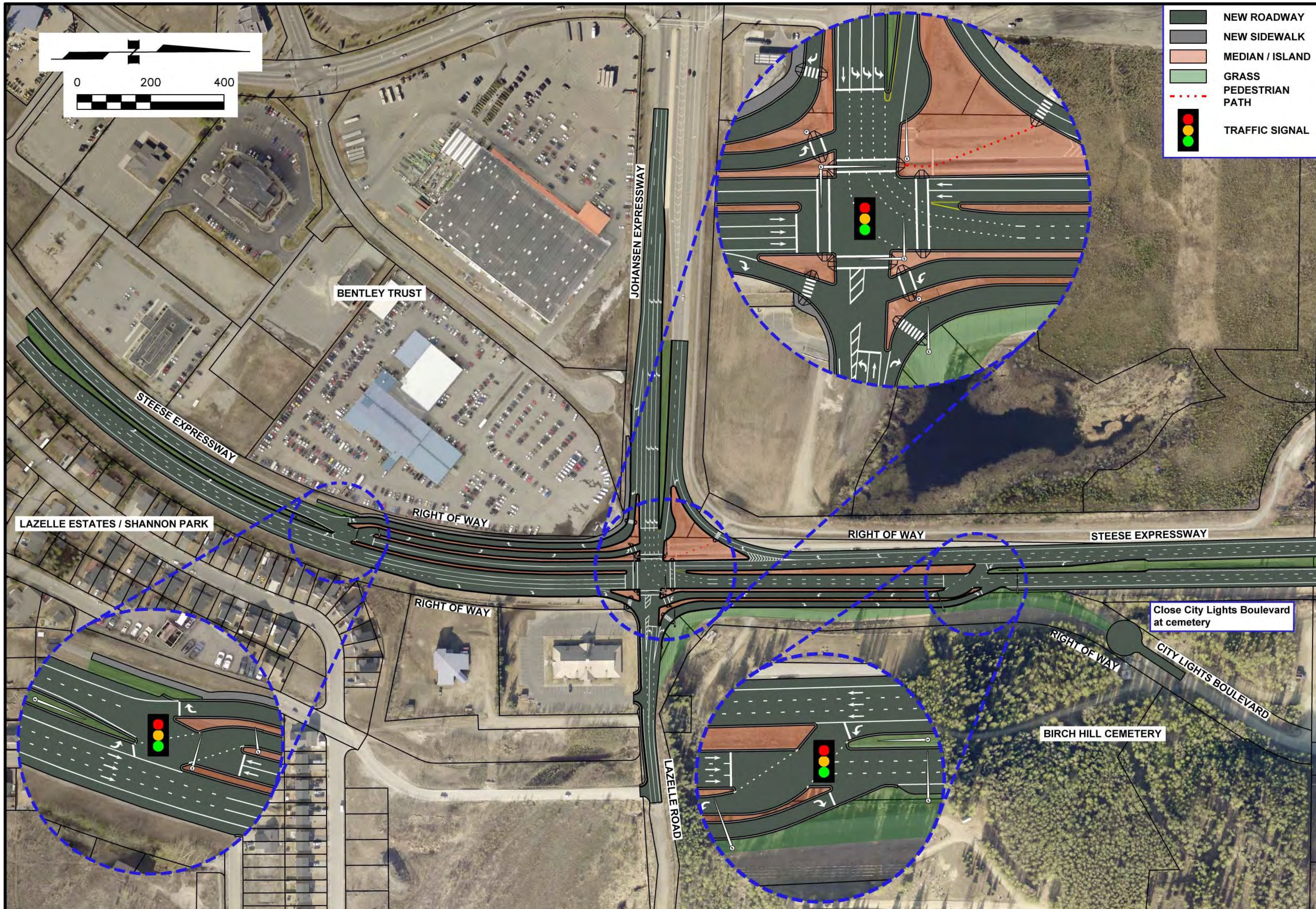
Many intersections of this type have been built in the United States.

4.5.2 Pedestrian Safety

The FHWA *Displaced Left Turn Informational Guide* indicates that medians should be built to provide pedestrian refuges and help pedestrians navigate the unfamiliar crossing scenario with this type of intersection. The concept design shown in Figure 35 incorporates these medians. One of the benefits of this type of intersection is that pedestrians are separated from a permissive left turn movement.

This design allows pedestrians to cross the north leg of the intersection.

[6] See https://www.youtube.com/watch?v=3wIv0a9fuB0 for an FHWA video showing how the Displaced Left Turn works.



Morning Peak:

- Southbound right turn vehicles operate the same as existing, with no stopping except to allow pedestrians to cross.
- Southbound and northbound left turn traffic cross to the left of oncoming through traffic prior to the intersection, allowing south- and northbound left turn vehicles to enter the intersection at the same time as north- and southbound through vehicles.

Evening Peak:

- Three eastbound left turn lanes accommodate nearly 1800 vehicles per hour.
- Three northbound through lanes provide additional capacity.

Right Turns:

- All right turns occur outside of the main intersection.

Pedestrians:

- All pedestrian crossings are signalized, except for where pedestrians cross the right turn lanes.
- Pedestrians are allowed to cross all legs of the intersection.

At north crossover, when northbound vehicles are stopped by the signal, southbound vehicles cross to the left side and advance to Johansen Expressway while westbound right turn vehicles enter northbound lanes.

At south crossover, when southbound vehicles are stopped by the signal, northbound left turn vehicles cross to the left and advance to Johansen Expressway while eastbound right turn vehicles enter southbound lanes.

No changes to the design are needed to accommodate traffic traveling to and from Fort Wainwright.

Figure 35: Alternative D – Partial Displaced Left Turn

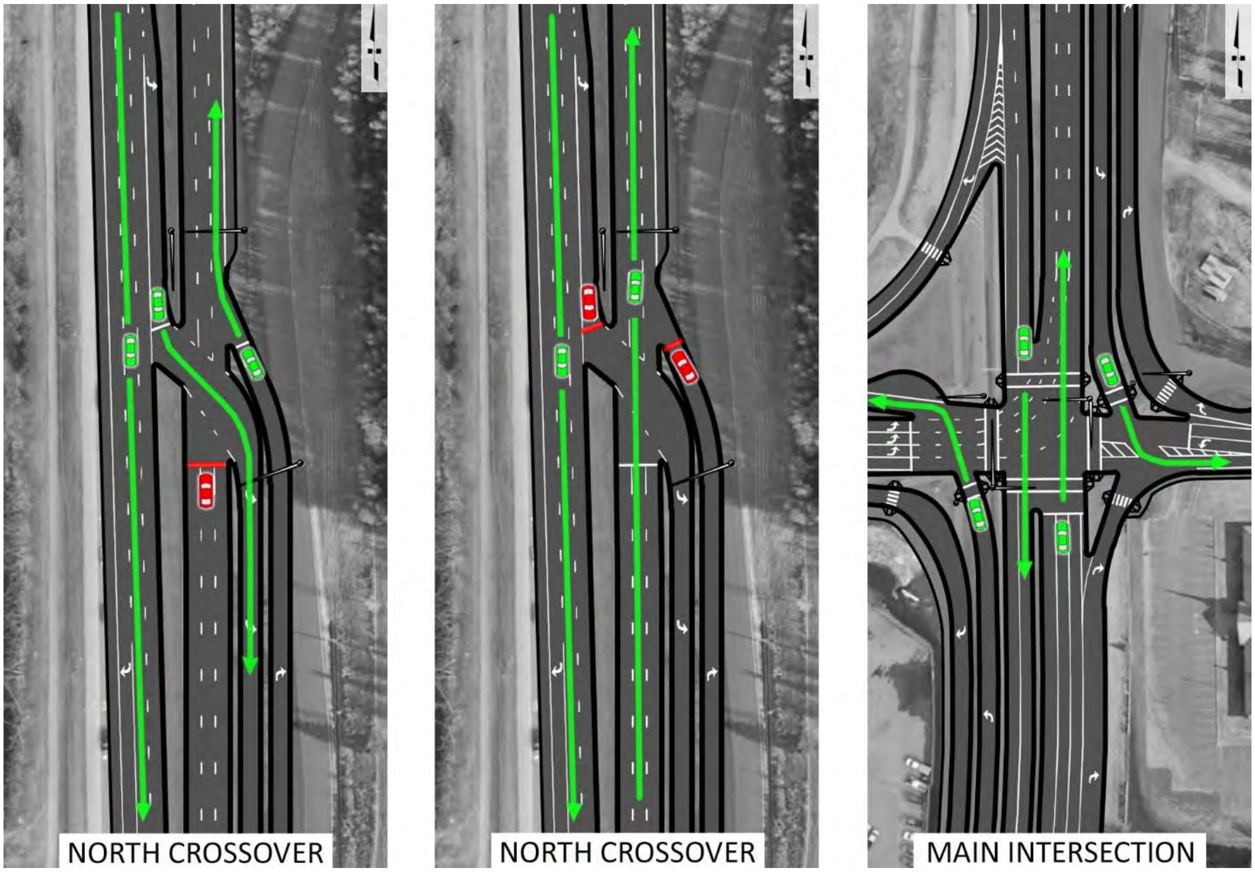


Figure 36: Alternative D – Vehicular Movements

4.5.3 Design Volumes

The design volumes for this alternative are the same as for the No Build alternative, presented in Section 4.2.3 on page 26.

4.5.4 Daily Operations in 2045 and Annual Cost of Congestion

Figure 37 presents the average vehicle delay, average pedestrian delay, and functional area of the intersection under Alternative D (Partial Displaced Left Turn).

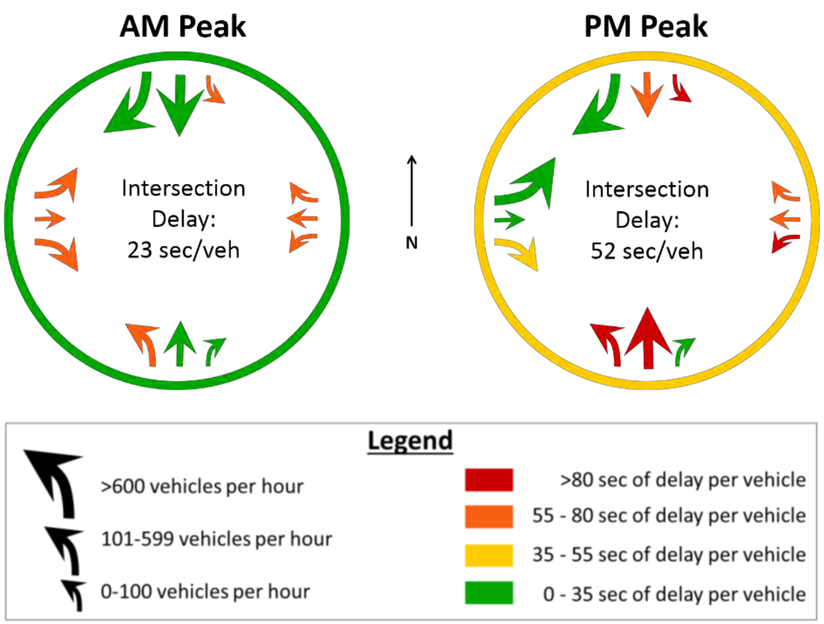
Figure 38 presents the impacts of delay on vehicle emissions, as well as the value of the savings in delay for Alternative D (Partial Displaced Left Turn) as compared to Alternative A (No Build).

Figure 39 and Figure 40 present the same information for Alternative D (Partial Displaced Left Turn) with the relocation of the Fort Wainwright main gate.

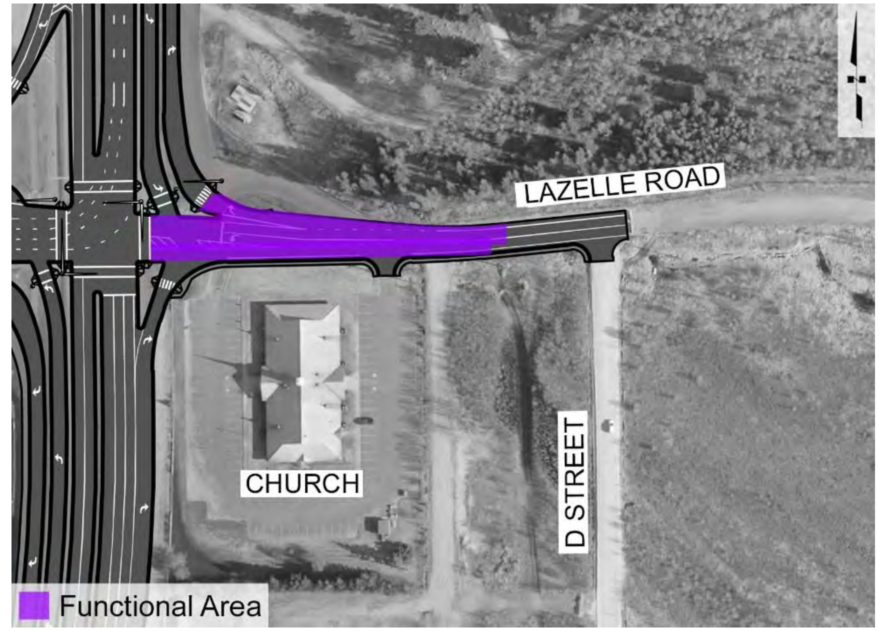
2045 Design Year Operational Parameters

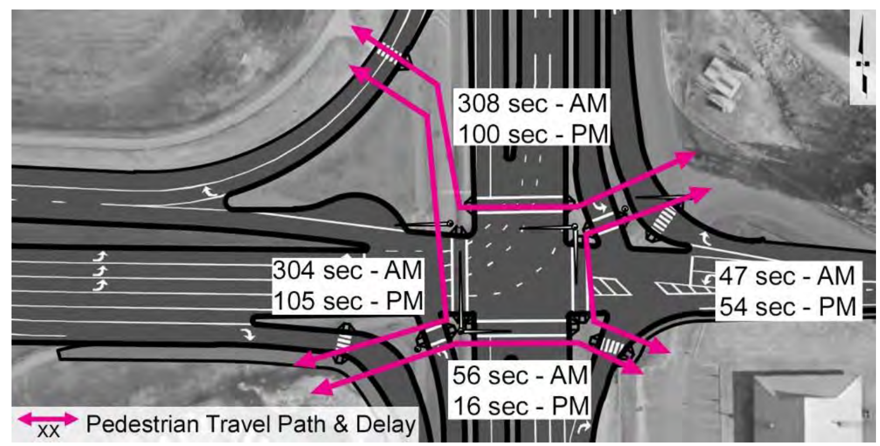
ALTERNATIVE D

Partial Displaced Left Turn Intersection



Vehicle Delay





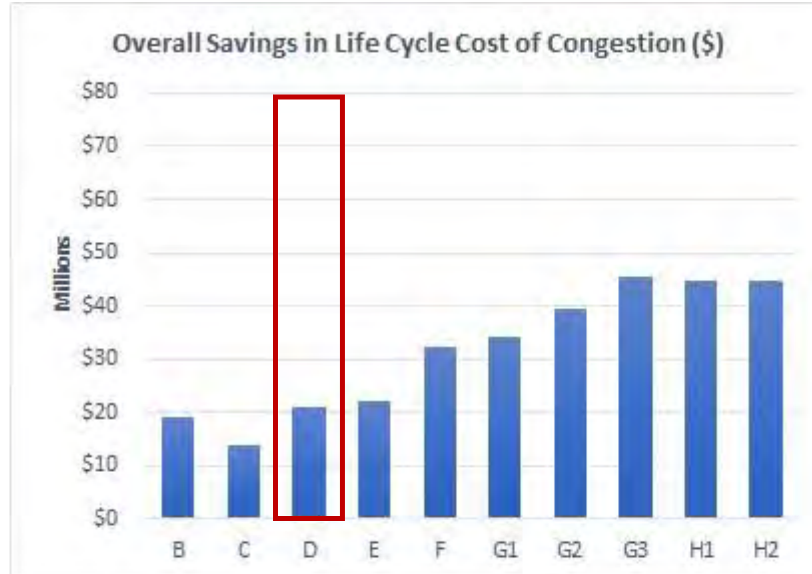
Pedestrian Delay

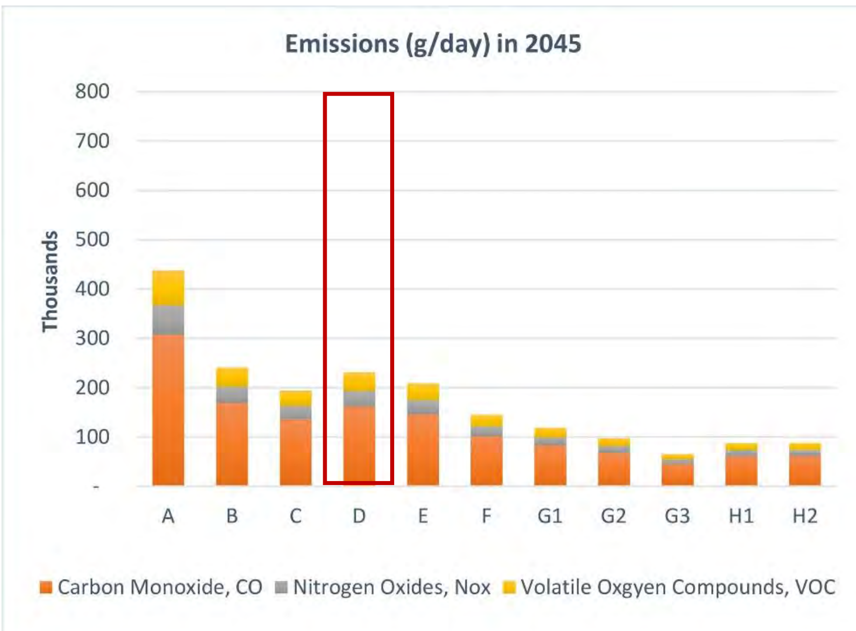
Figure 37: Operational Parameters for Alternative D, Partial Displaced Left Turn Intersection

Impacts of Delay

ALTERNATIVE D

Partial Displaced Left Turn Intersection





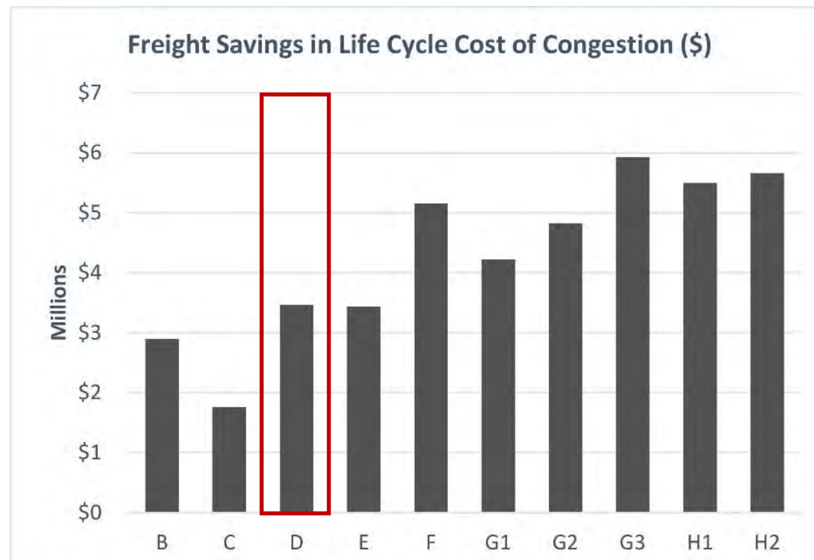


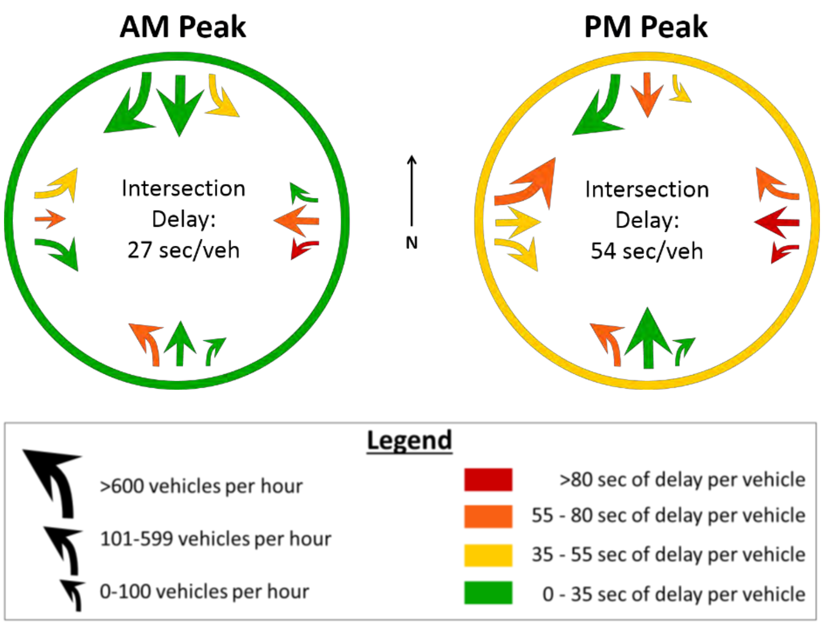
Figure 38: Impacts of Delay for Alternative D, Partial Displaced Left Turn Intersection

2045 Design Year Operational Parameters

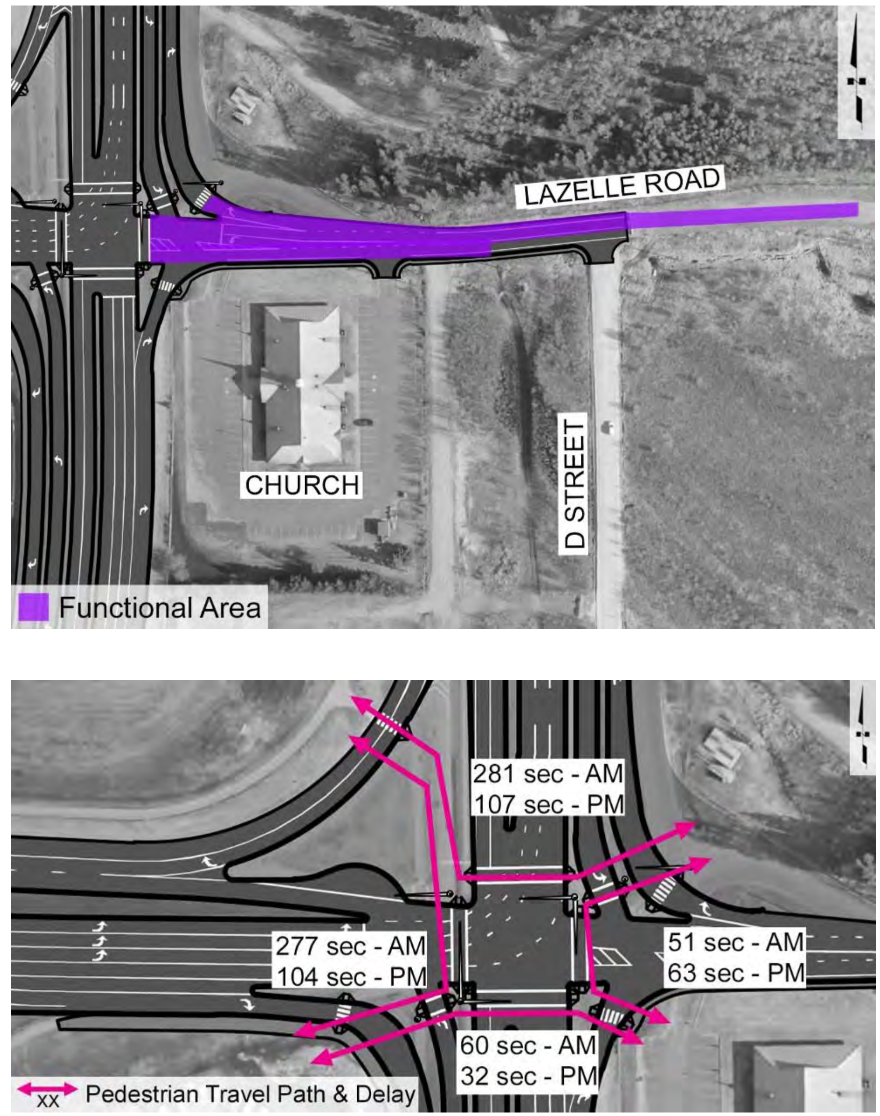
ALTERNATIVE D

Partial Displaced Left Turn Intersection

with Relocation of Fort Wainwright Gate



Vehicle Delay



Pedestrian Delay

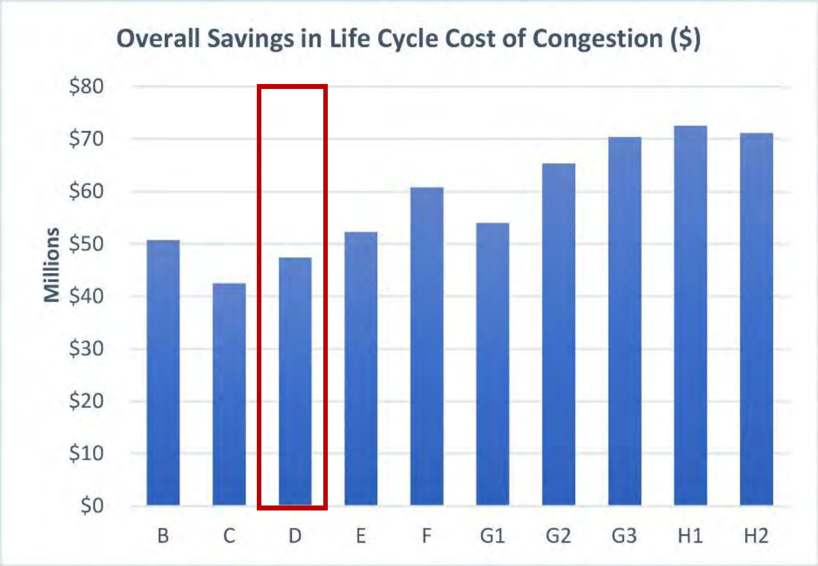
Figure 39: Operational Parameters for Alternative D, Partial Displaced Left Turn Intersection with Relocation of Fort Wainwright Gate

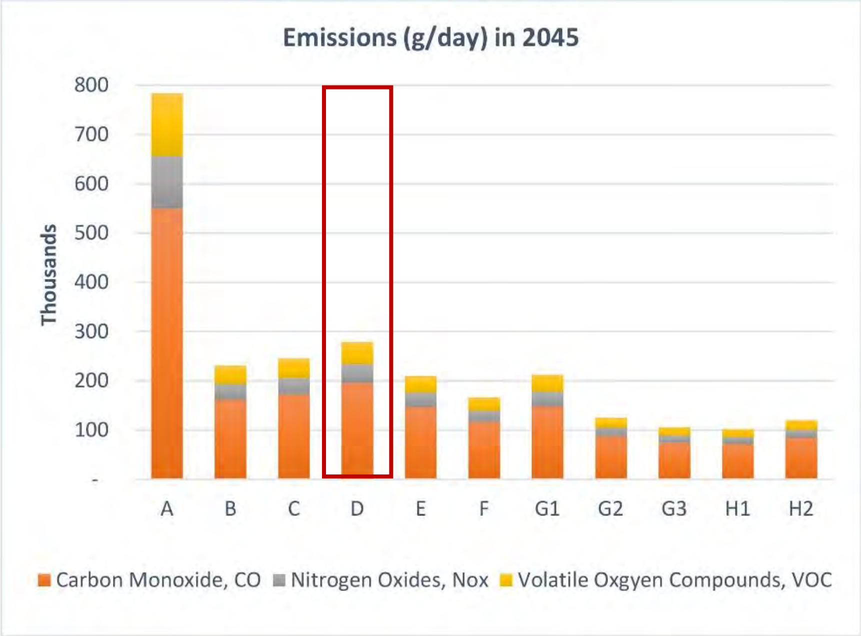
Impacts of Delay

ALTERNATIVE D

Partial Displaced Left Turn Intersection

with Relocation of Fort Wainwright Gate





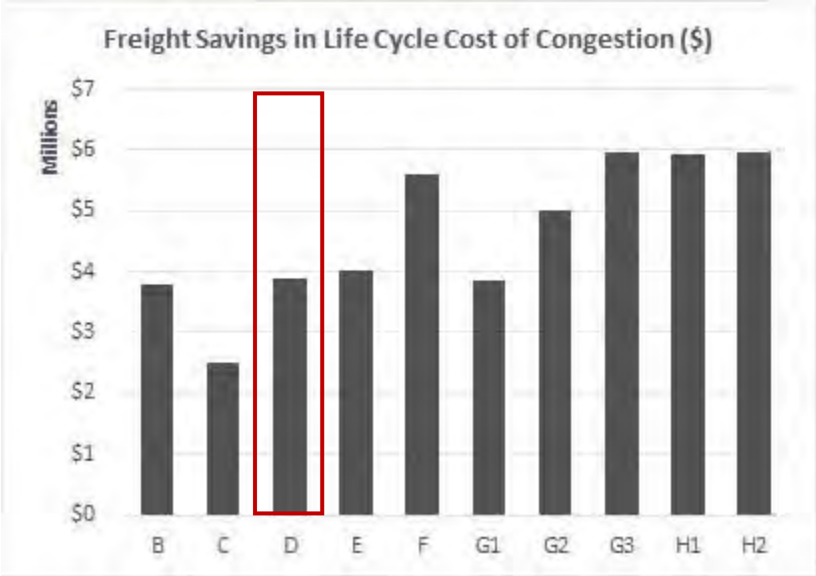


Figure 40: Impacts of Delay for Alternative D, Partial Displaced Left Turn Intersection with Relocation of Fort Wainwright Gate

4.5.5 Design Impacts

4.5.5.1 Physical (ROW) impacts and acquisition needs

Figure 41 presents the ROW impacts under Alternative D (Partial Displaced Left Turn).

4.5.5.2 *Snow storage and snow removal*

DOT&PF M&O considers Alternative D harder to maintain and operate compared to the No Build condition.

4.5.6 Cost Estimate

Table 7: Cost Estimate for Alternative D, Partial Displaced Left Turn Intersection

Category	Cost	
Project Development	$	3,360,000
Right of Way	$	240,000
Utilities	$	500,000
Construction Total	$	22,400,000
Total Projected Estimated Cost	**$**	**26,500,000**

The above Order-of-Magnitude Estimate is in 2018 dollars based on conceptual design. Final costs of the project will depend on labor and material costs, site conditions, productivity, market conditions, scope, and other variable factors.

4.5.7 Summary

Alternative D meets two out of four concerns identified in the project purpose and need:

Improves Pedestrian and Bicycle Safety	
Decreases Pedestrian Delay	
Reduces Weaving	✔
Reduces Vehicular Delay	✓

✔ = Meets goal much better than No Build ✓ = Meets goal better than No Build

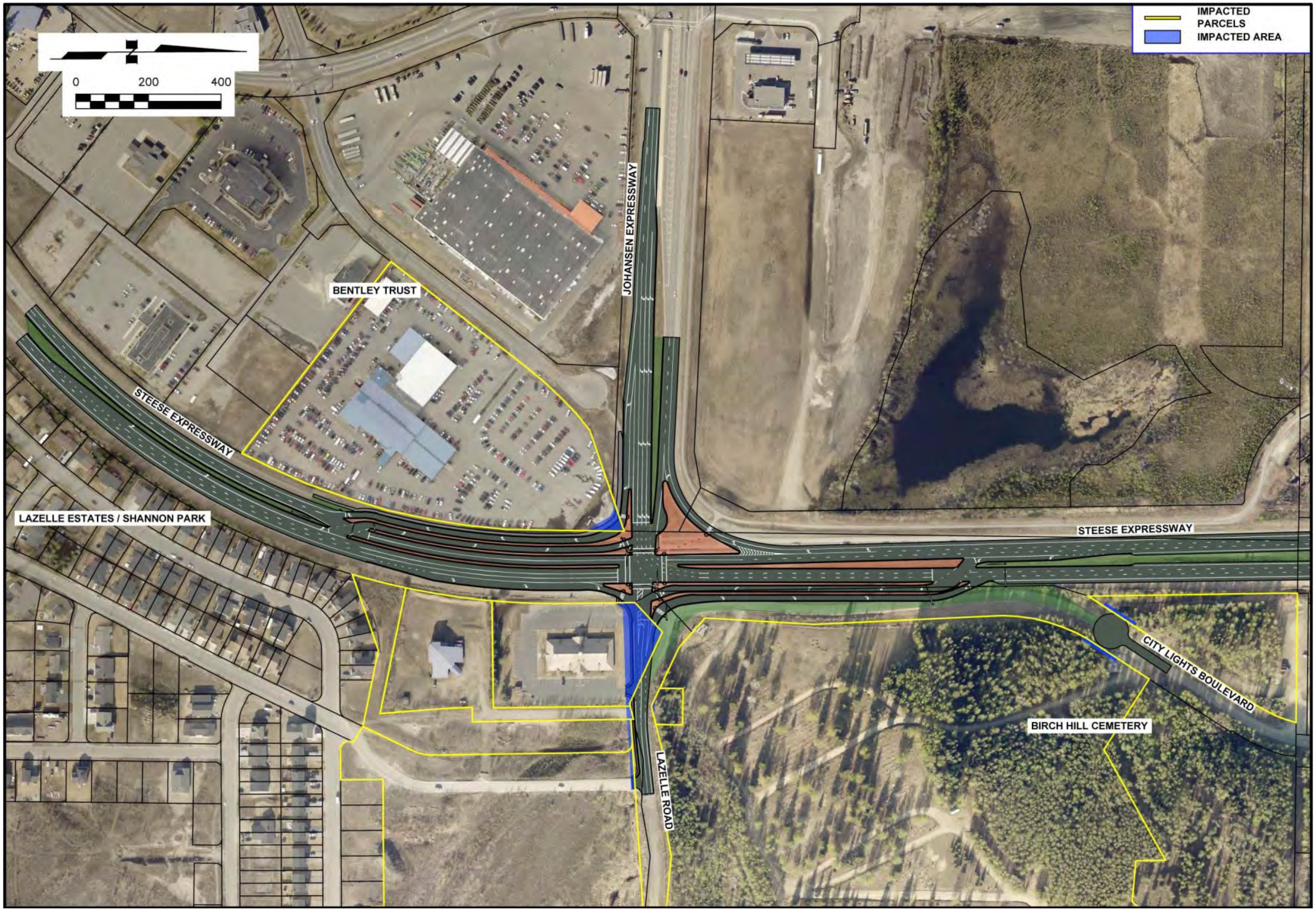


Figure 41: ROW Impacts for Alternative D, Partial Displaced Left Turn Intersection

4.6 Alternative E – Old Steese to Farmers Loop Connection

The Alternative E concepts build off of the Alternative B concepts. In addition to increasing the number of lanes at the main intersection to accommodate the design traffic volumes, Alternative E (both with and without the relocation of the Fort Wainwright gate) would build a direct connection from Old Steese Highway to the Farmers Loop Road Extension, as shown in Figure 42 and Figure 43. The volume of traffic that would divert to the new roadway was estimated using the FMATS travel demand model and is presented Section 4.6.3. Since the diverted traffic is a relatively small volume, the analysis found that the main Steese-Jo intersection design remained the same as for the Alternative B concepts.

While adding the alternative route is not forecast to take significant volume from the Steese-Jo intersection, it does add some redundancy to the system, providing an alternate route in case of a crash or other event that closes the Steese Expressway between Farmers Loop and Johansen Expressway. It also provides opportunity for enhancing the existing multi-use path through the area by improving visibility and potentially reducing connection time from Farmers Loop to the retail area if a raised sidewalk or detached path were added to the roadway improvements.

4.6.1 Alternative Concept

Many intersections of this type have been built in the United States.

4.6.2 Pedestrian Safety

Pedestrian safety for this alternative is similar to pedestrian safety for Alternative B.

Morning Peak:

- Southbound right turn vehicles stop at signal in two right turn lanes, reducing weaving for those accessing Bentley Trust.
- Two northbound left turn lanes provide additional capacity.
- Farmers Loop Road Extension provides a secondary route with added capacity.

Evening Peak:

- Three eastbound left turn lanes accommodate highest volume movement.
- Three northbound through lanes provide additional capacity.
- Farmers Loop Road Extension provides a secondary route with added capacity.

Pedestrians:

- All allowed pedestrian movements are signalized, including the crossing for the southbound right turn lanes.
- Similar to existing intersection, pedestrians are not allowed to cross the north leg of the intersection.

Figure 42: Alternative E – Old Steese to Famers Loop Connection

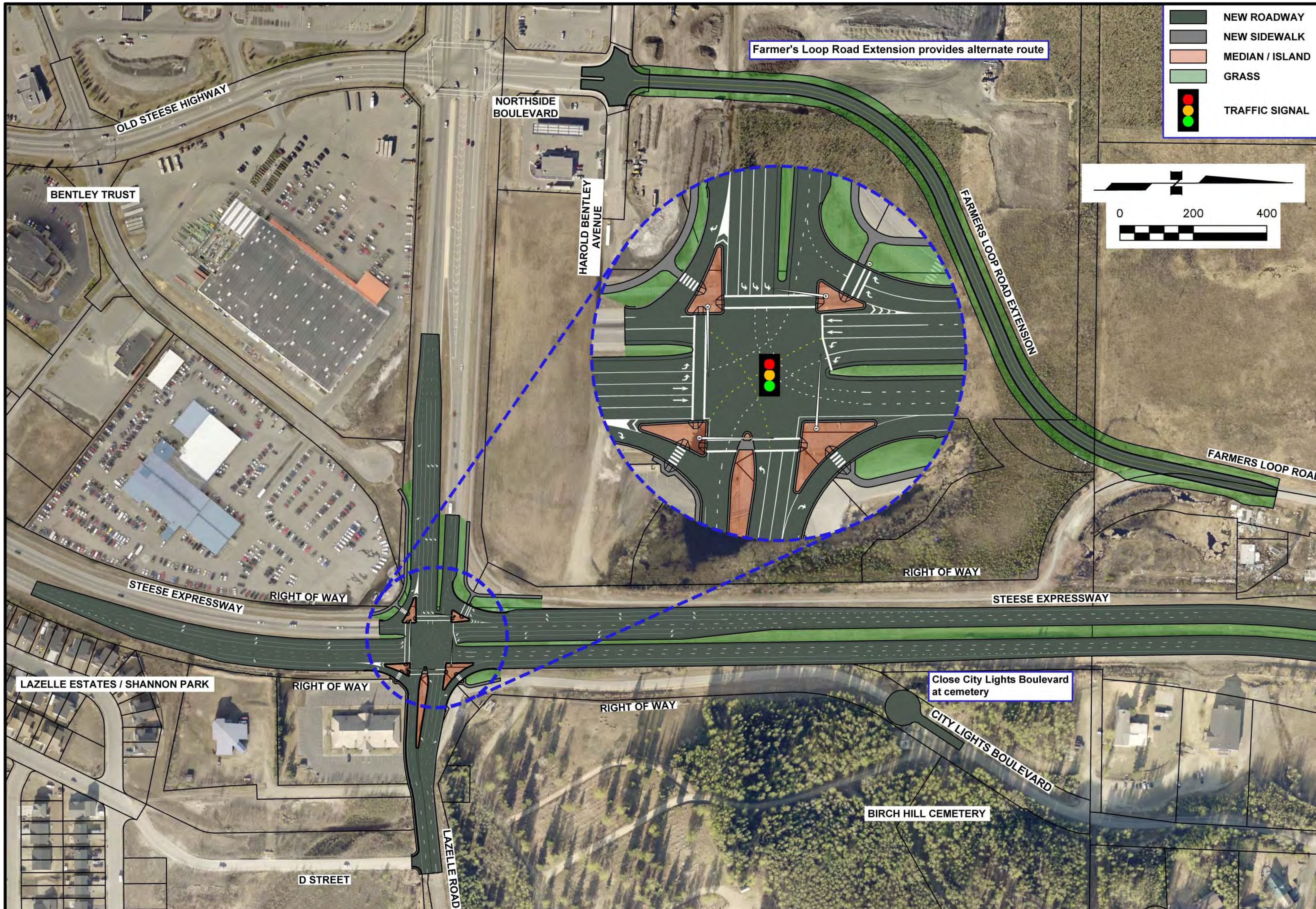


Figure 43: Alternative E – Old Steese to Farmers Loop Connection with Relocation of Fort Wainwright Gate

Morning Peak:

- Southbound right turn vehicles stop at signal in two right turn lanes, reducing weaving for those accessing Bentley Trust.
- Two northbound left turn lanes provide additional capacity.

Evening Peak:

- Three eastbound left turn lanes accommodate highest volume movement.
- Three northbound through lanes provide additional capacity.
- Farmers Loop Road Extension provides a secondary route with added capacity.
- Additional lanes on Lazelle Road accommodate traffic traveling to and from Fort Wainwright.

Pedestrians:

- All allowed pedestrian movements are signalized, including the crossing for the southbound right turn lanes.
- Similar to existing intersection, pedestrians are not allowed to cross the north leg of the intersection.

Farmers Loop Road Extension provides a secondary route with added capacity.

4.6.3 Design Volumes

Using the FMATs travel demand model, two sets of design turning movement volumes were developed for the Steese-Jo intersection: under normal growth conditions and with the relocation of the main Fort Wainwright gate to Canol Road (connecting to Lazelle Road). Under both Alternative E concepts, some traffic would divert to the new connection from Old Steese Highway to the Farmers Loop Road Extension. The volume of traffic that would divert to the new roadway was also estimated using the FMATS travel demand model, and is shown in red in Figure 44 and Figure 45.

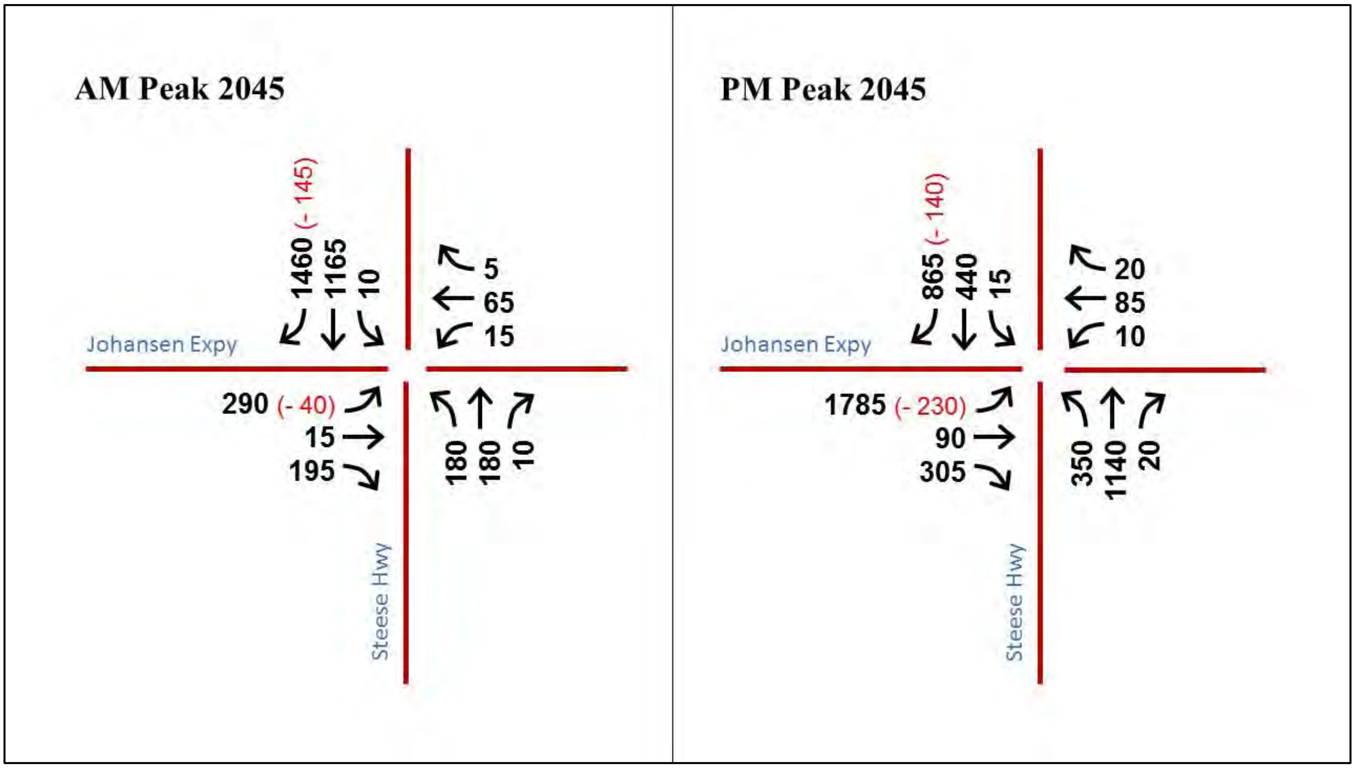


Figure 44: Design Turning Movement Volumes for Alternative E under Normal Growth

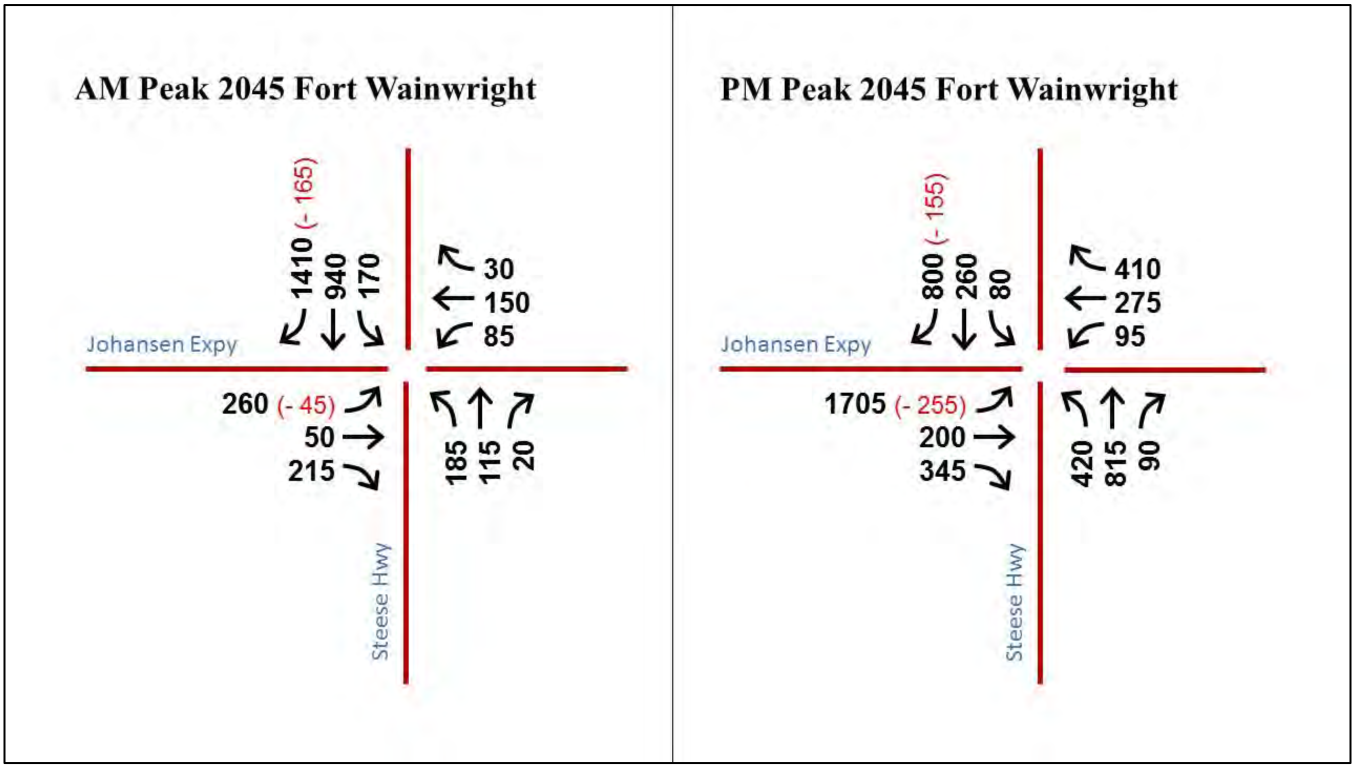


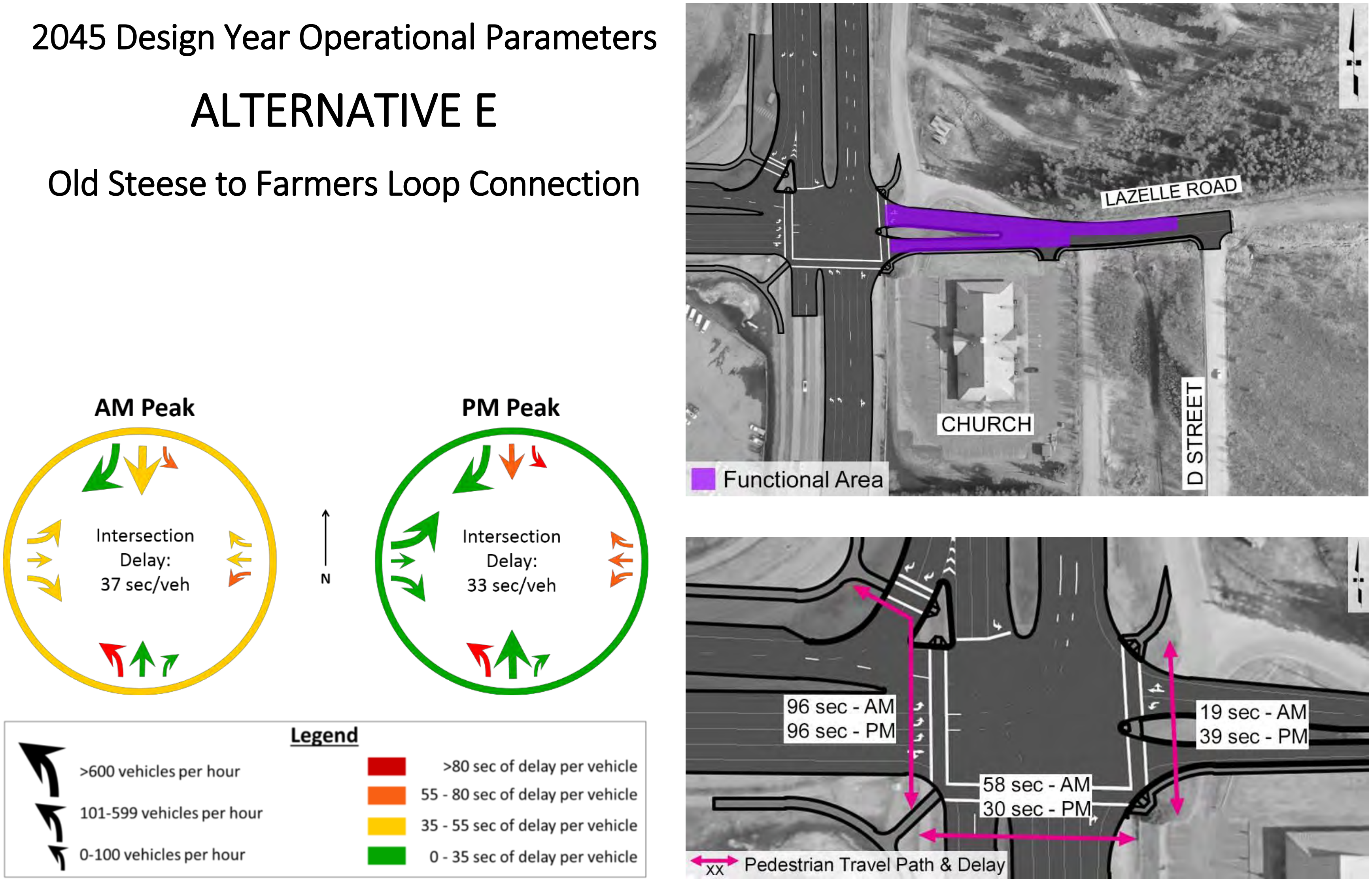
Figure 45: Design Turning Movement Volumes for Alternative E with Relocation of Fort Wainwright Connection

4.6.4 Daily Operations in 2045 and Annual Cost of Congestion

Figure 46 presents the average vehicle delay, average pedestrian delay, and functional area of the intersection under Alternative E (Old Steese to Farmers Loop Connection).

Figure 47 presents the impacts of delay on vehicle emissions, as well as the value of the savings in delay for Alternative E (Old Steese to Farmers Loop Connection) as compared to Alternative A (No Build).

Figure 48 and Figure 49 present the same information for Alternative E (Old Steese to Farmers Loop Connection) with the relocation of the Fort Wainwright main gate.



Vehicle Delay **Pedestrian Delay**

Figure 46: Operational Parameters for Alternative E, Old Steese to Farmers Loop Connection

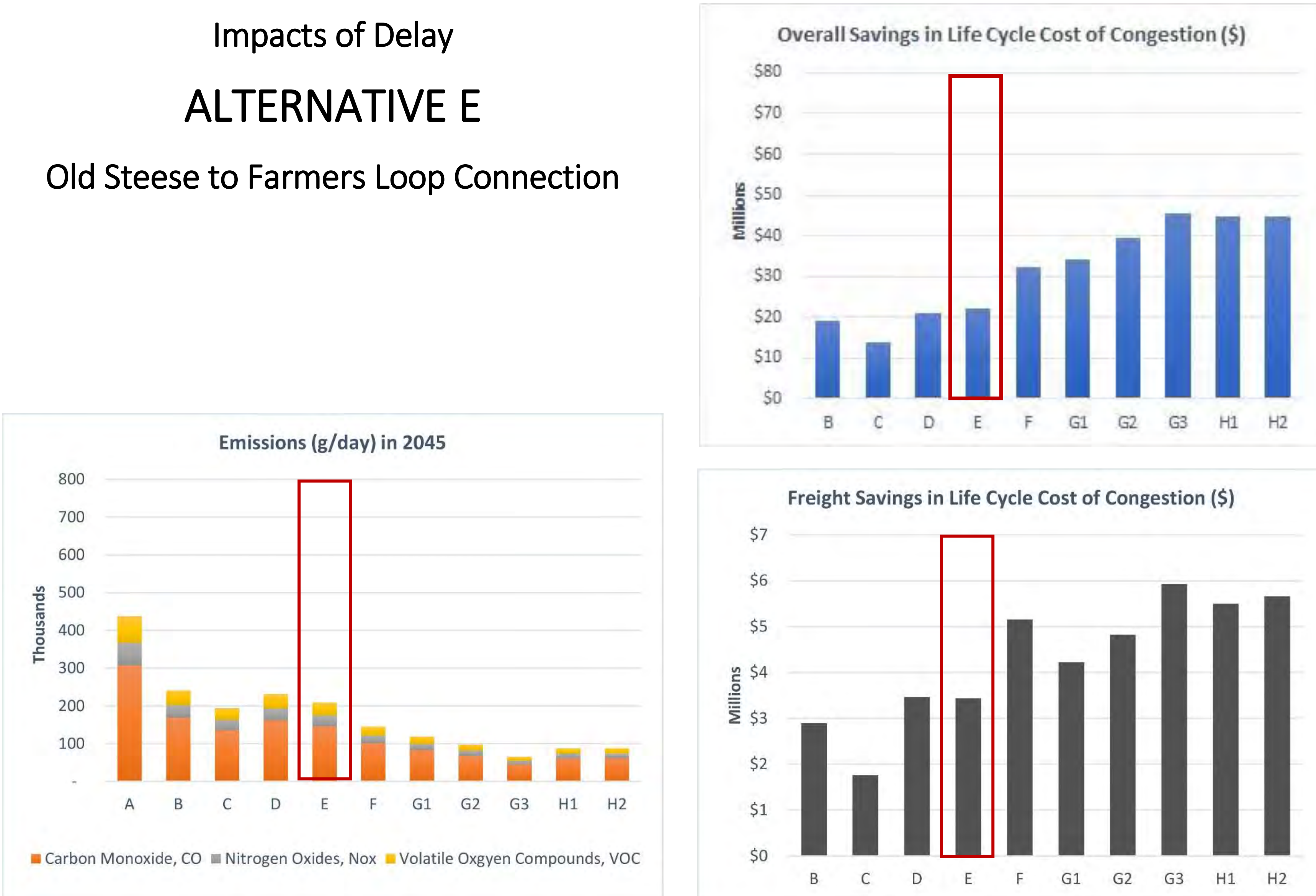


Figure 47: Impacts of Delay for Alternative E, Old Steese to Farmers Loop Connection

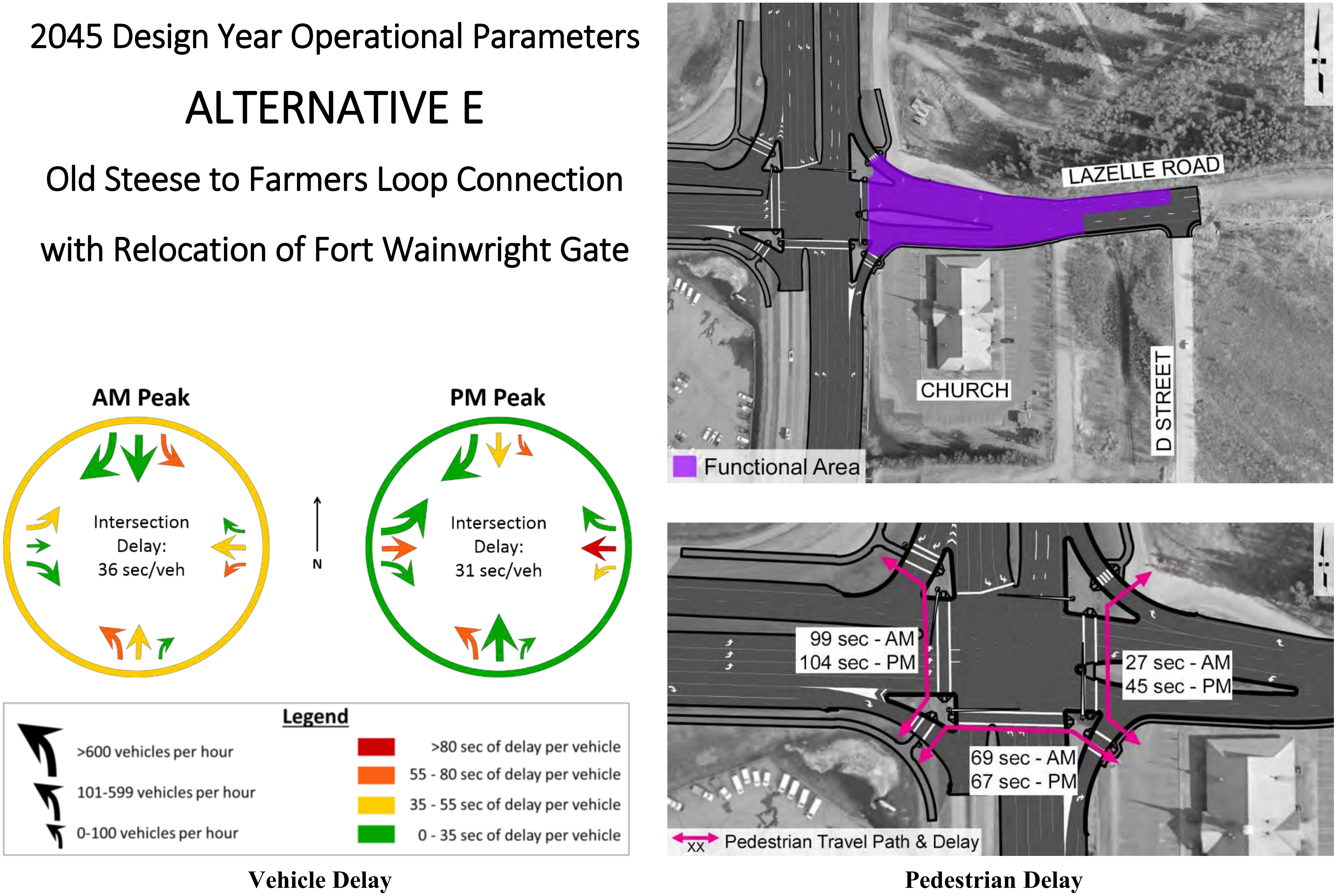


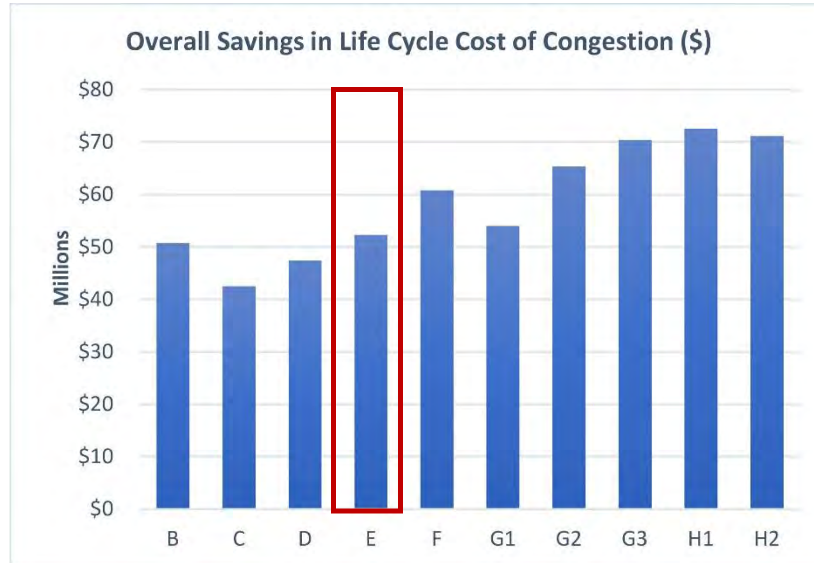
Figure 48: Operational Parameters for Alternative E, Old Steese to Farmers Loop Connection with Relocation of Fort Wainwright Gate

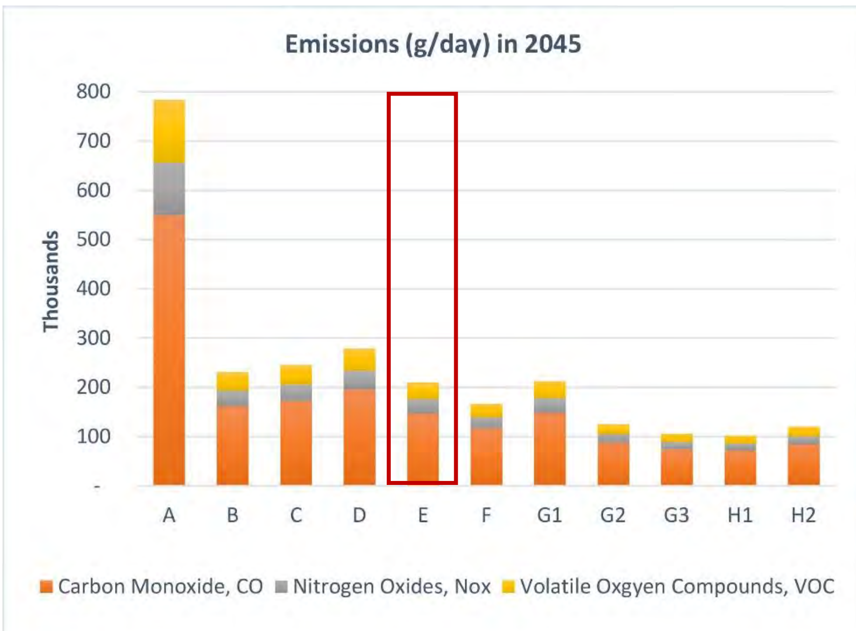
Impacts of Delay

ALTERNATIVE E

Old Steese to Farmers Loop Connection

with Relocation of Fort Wainwright Gate





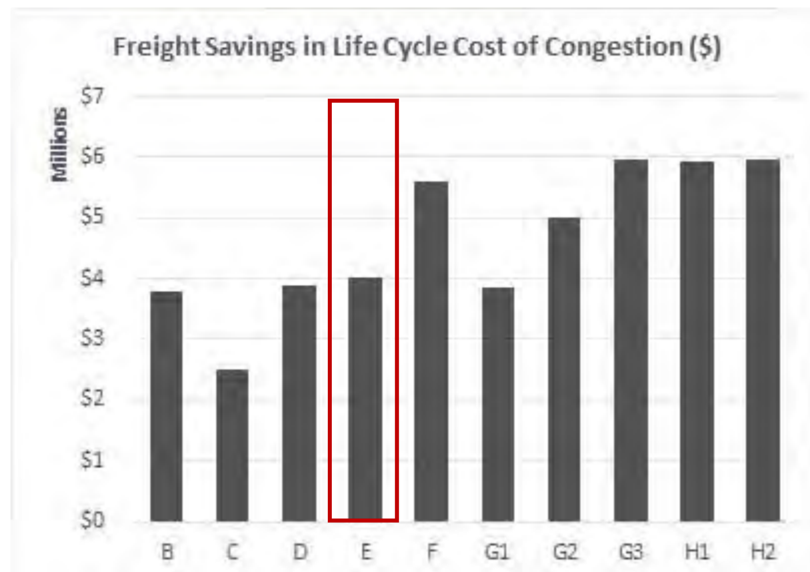


Figure 49: Impacts of Delay for Alternative E, Old Steese to Farmers Loop Connection with Relocation of Fort Wainwright Gate

4.6.5 Design Impacts

4.6.5.1 Physical (ROW) impacts and acquisition needs

Figure 50 presents the ROW impacts under Alternative E (Old Steese to Farmers Loop Connection). Figure 51 presents the ROW impacts with the relocation of the Fort Wainwright main gate.

4.6.5.2 Snow storage and snow removal

DOT&PF M&O considers it much harder to maintain and operate Alternative E compared to the No Build condition.

4.6.6 Cost Estimate

Table 8: Cost Estimate for Alternative E, Farmers Loop Connection

Category	Cost
Project Development	$ 510,000
Right of Way	$ 150,000
Utilities	$ -
Construction Total	$ 3,400,000
Total Projected Estimated Cost	**$ 4,060,000**

To get the full costs of the E alternatives, the costs from Table 8 are added to the costs of the B alternatives in Table 4 and Table 5.

Table 9: Cost Estimate for Alternative E, Farmers Loop Connection and Intersection Improvements

Category	Cost
Project Development	$ 2,580,000
Right of Way	$ 330,000
Utilities	$ 300,000
Construction Total	$ 17,200,000
Total Projected Estimated Cost	**$ 20,410,000**

Table 10: Cost Estimate for Alternative E, Farmers Loop Connection and Intersection Improvements with Fort Wainwright Connection

Category	Cost
Project Development	$ 2,820,000
Right of Way	$ 390,000
Utilities	$ 300,000
Construction Total	$ 18,800,000
Total Projected Estimated Cost	**$ 22,310,000**

The above Order-of-Magnitude Estimate is in 2018 dollars based on conceptual design. Final costs of the project will depend on labor and material costs, site conditions, productivity, market conditions, scope, and other variable factors.

Figure 50: ROW Impacts for Alternative E, Old Steese to Farmers Loop Connection

Figure 51: ROW Impacts for Alternative E, Old Steese to Farmers Loop Connection with Relocation of Fort Wainwright Gate

4.6.7 Summary

Alternative E improves three concerns identified in the project purpose and need:

Improves Pedestrian and Bicycle Safety	
Decreases Pedestrian Delay	✓
Reduces Weaving	✔
Reduces Vehicular Delay	✓

✔ = Meets goal much better than No Build ✓ = Meets goal better than No Build

4.7 Alternative F – Eastbound Left Turn Flyover

4.7.1 Alternative Concept

Alternative F would construct a two-lane flyover bridge for the eastbound left turn movement at the Steese-Jo intersection, depicted in Figure 52. In this design, the eastbound left turn traffic is able to flow freely without stopping while traveling from the Johansen Expressway to the Steese Expressway. At the Steese-Jo intersection itself, the other movements would operate better, as they no longer have to compete with the eastbound left turn movement for signal time.

Improvements as a result of the eastbound left turn flyover would mostly occur in the PM peak period. In the AM peak period, the southbound through and northbound left turn movements will still compete for signal time, so that two northbound left turn lanes are needed.

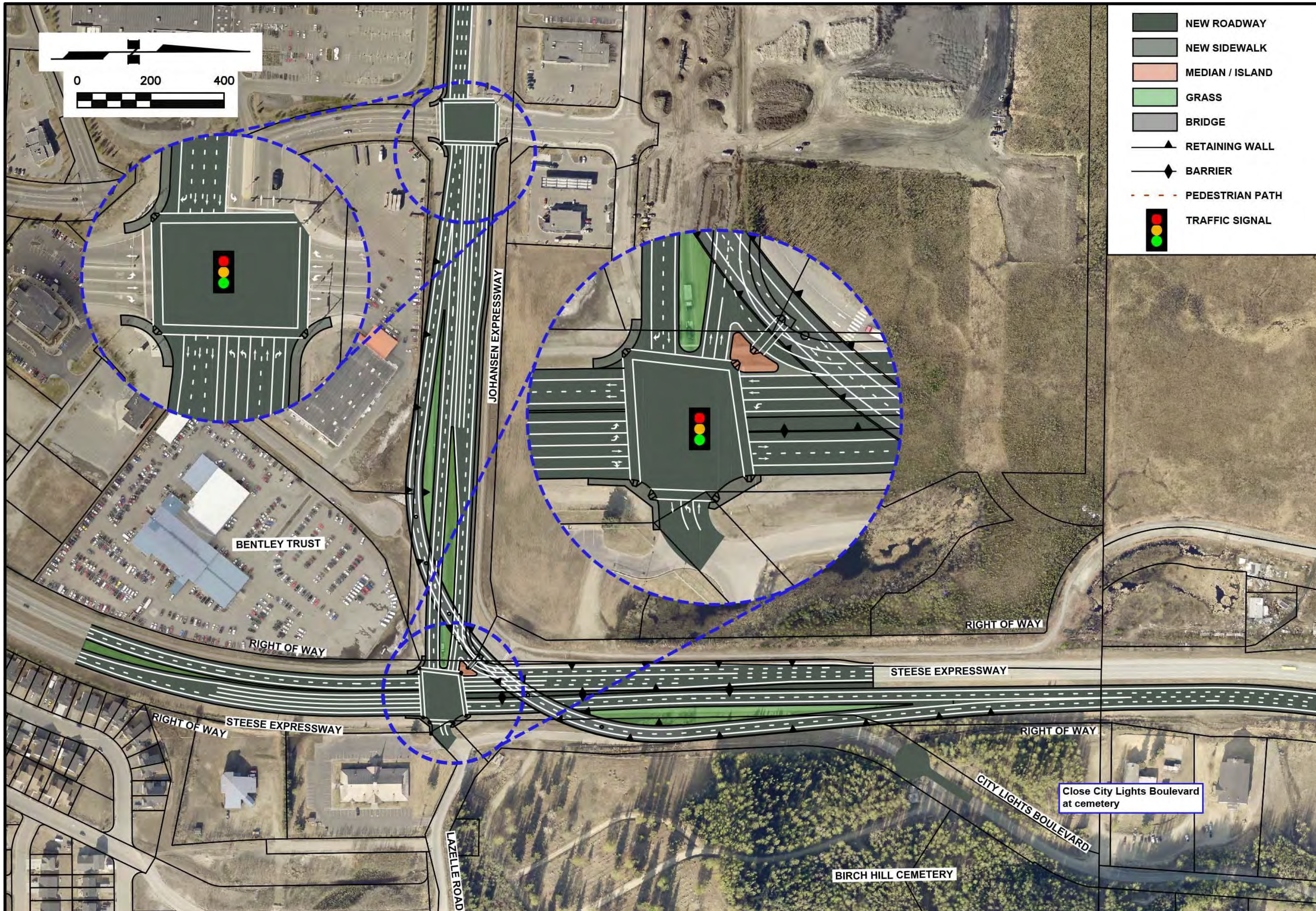
When traffic traveling to and from Fort Wainwright is added to the east leg of the intersection, the westbound approach requires a left turn lane, a through lane, and a right turn lane, as shown in Figure 53.

This alternative is a partial interchange. This type of design has been used before in the United States.

4.7.2 Pedestrian Safety

Pedestrians will be prohibited from using the eastbound flyover ramp. At the at-grade intersection, several improvements benefit pedestrian safety: the southbound right turn is signalized, and the northbound and southbound left turns are protected, separating pedestrians from conflicts with turning traffic. The crossing distances are generally similar to the existing no build condition, except for the east leg under the Fort Wainwright traffic, which is expanded from a 3-lane crossing to a 4-lane crossing.

This design allows pedestrians to cross the north leg of the intersection.



Morning Peak:

- Southbound right turn vehicles stop at signal in two right turn lanes, reducing weaving for those accessing Bentley Trust.
- Two northbound left turn lanes provide additional capacity.

Evening Peak:

- Eastbound left turn volume of nearly 1800 vehicles per hour is carried on a flyover ramp over the intersection so that it does not stop.
- Because the signal timing does not have to accommodate the heavy eastbound left turn movement, only two northbound through lanes are needed.

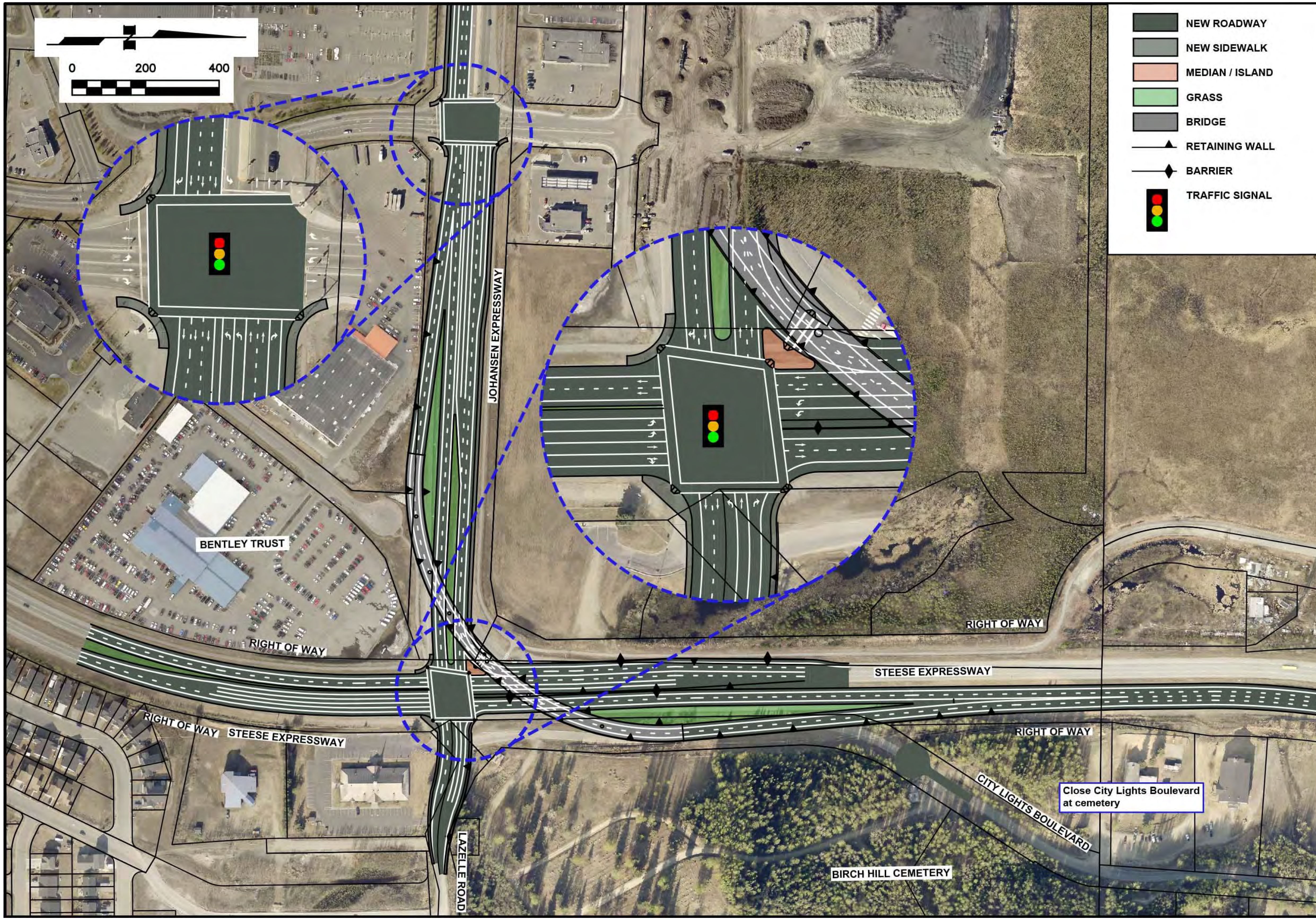
Pedestrians:

- All pedestrian crossings are signalized.
- Pedestrians are allowed to cross all legs of the intersection.

Old Steese Intersection:

- An additional eastbound through lane is needed to accommodate two-lane exit for eastbound left turn traffic entering the flyover.

Figure 52: Alternative F – Eastbound Left Turn Flyover



Morning Peak:

- Southbound right turn vehicles stop at signal in two right turn lanes, reducing weaving for those accessing Bentley Trust.
- Two northbound left turn lanes provide additional capacity.

Evening Peak:

- Eastbound left turn volume of nearly 1800 vehicles per hour is carried on a flyover ramp over the intersection so that it does not stop.
- Because the signal timing does not have to accommodate the heavy eastbound left turn movement, only two northbound through lanes are needed.
- Additional lanes on Lazelle Road accommodate traffic traveling to and from Fort Wainwright.

Pedestrians:

- All pedestrian crossings are signalized.
- Pedestrians are allowed to cross all legs of the intersection.

Old Steese Intersection:

- An additional eastbound through lane is needed to accommodate two-lane exit for eastbound left turn traffic entering the flyover.

Figure 53: Alternative F – Eastbound Left Turn Flyover with Relocation of Fort Wainwright Gate

4.7.3 Design Volumes

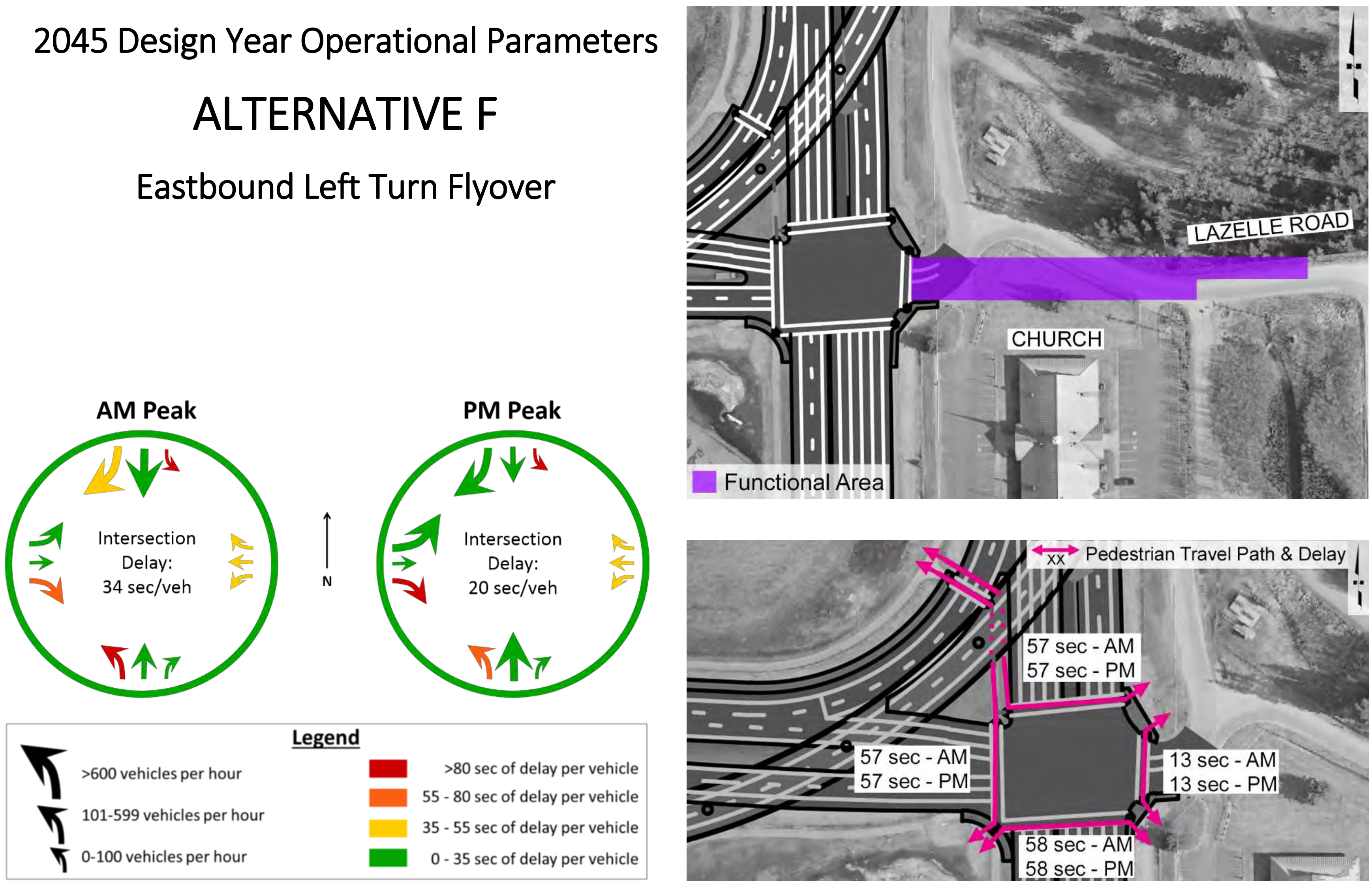
The design volumes for this alternative are the same as for the No Build alternative, presented in Section 4.2.3 on page 26.

4.7.4 Daily Operations in 2045 and Annual Cost of Congestion

Figure 54 presents the average vehicle delay, average pedestrian delay, and functional area of the intersection under Alternative F (Eastbound Left Turn Flyover).

Figure 55 presents the impacts of delay on vehicle emissions, as well as the value of the savings in delay for Alternative F (Eastbound Left Turn Flyover) as compared to Alternative A (No Build).

Figure 56 and Figure 57 present the same information for Alternative F (Eastbound Left Turn Flyover) with the relocation of the Fort Wainwright main gate.



Vehicle Delay

Pedestrian Delay

Figure 54: Operational Parameters for Alternative F, Eastbound Left Turn Flyover

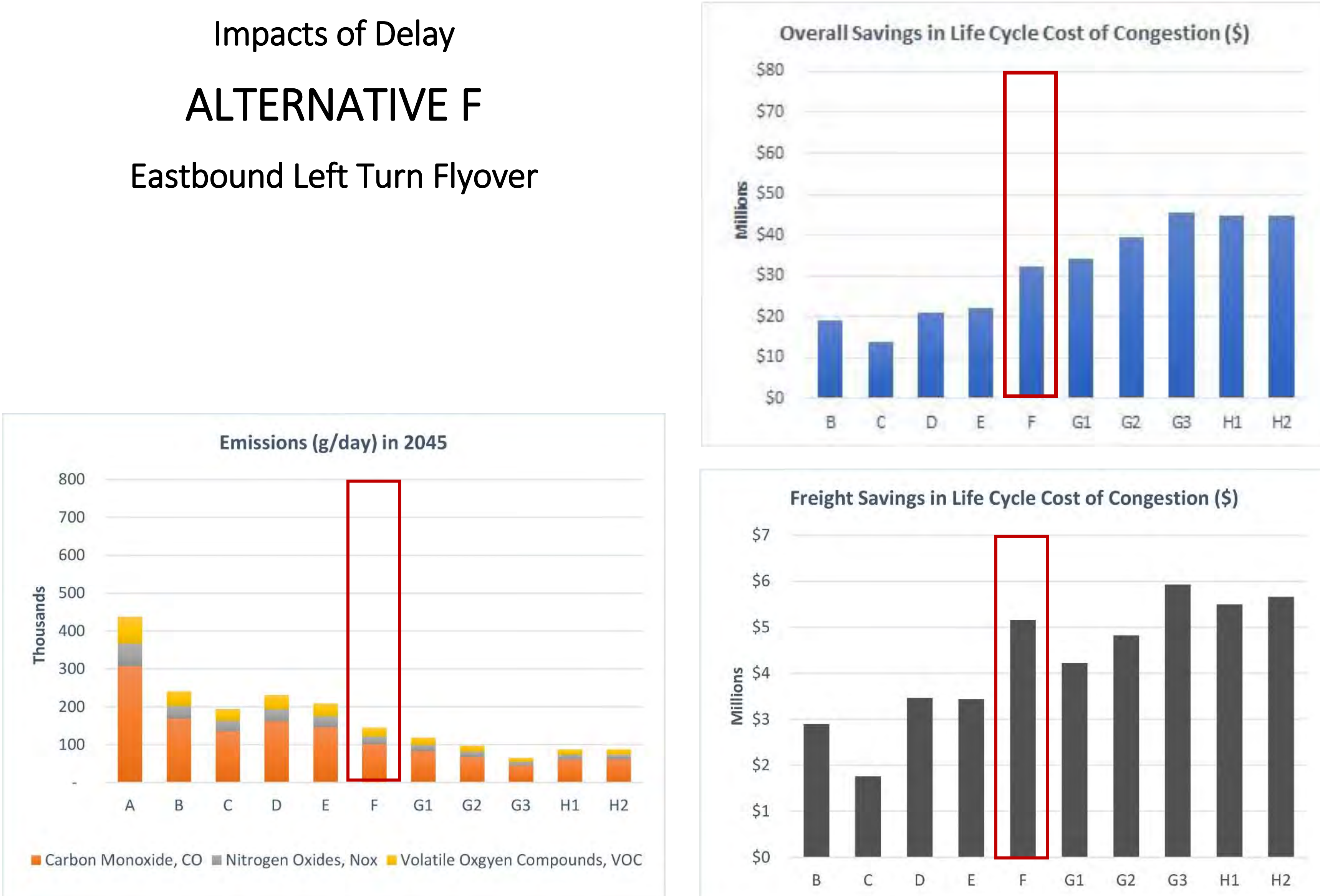
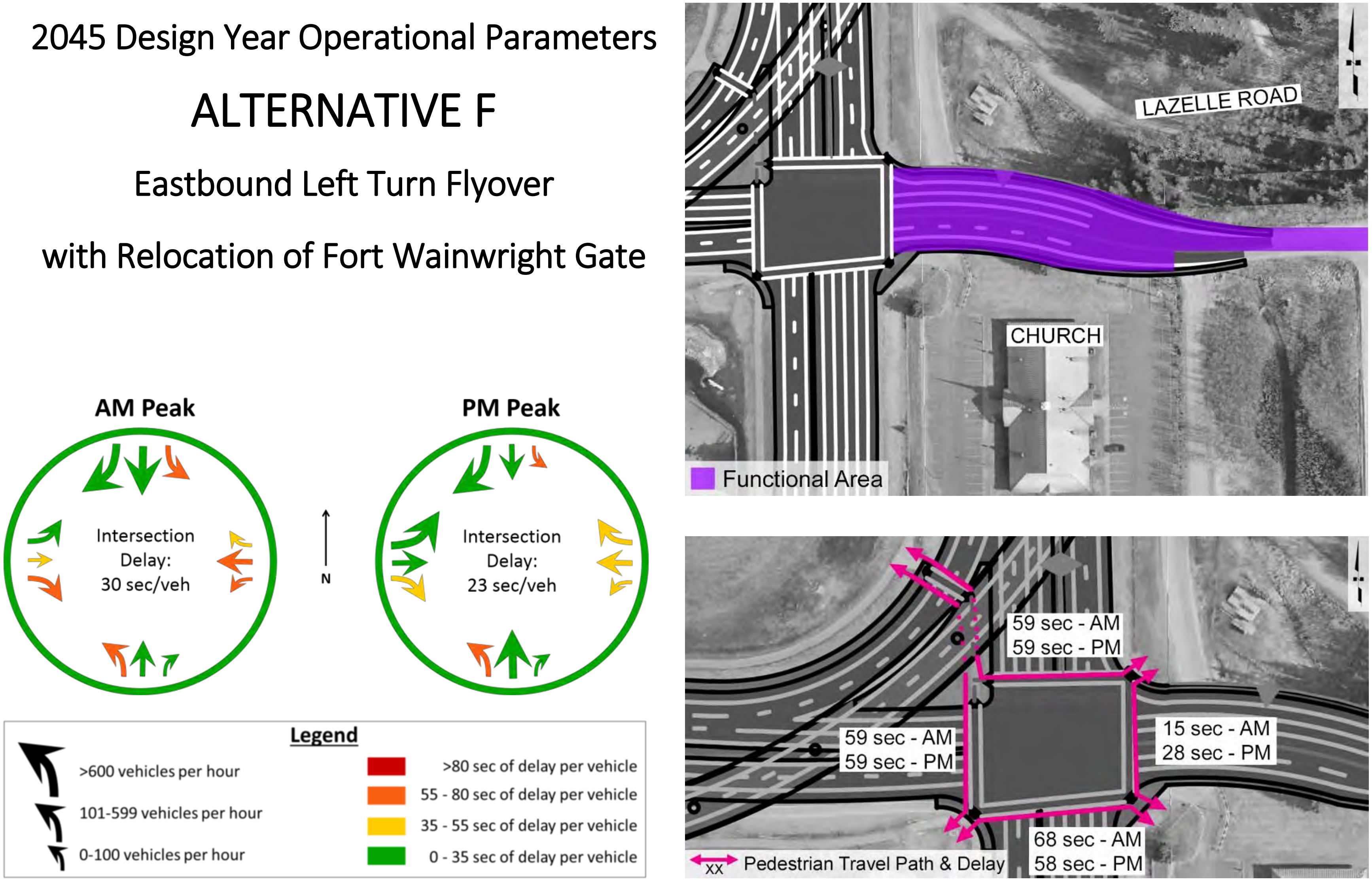


Figure 55: Impacts of Delay for Alternative F, Eastbound Left Turn Flyover



Vehicle Delay **Pedestrian Delay**

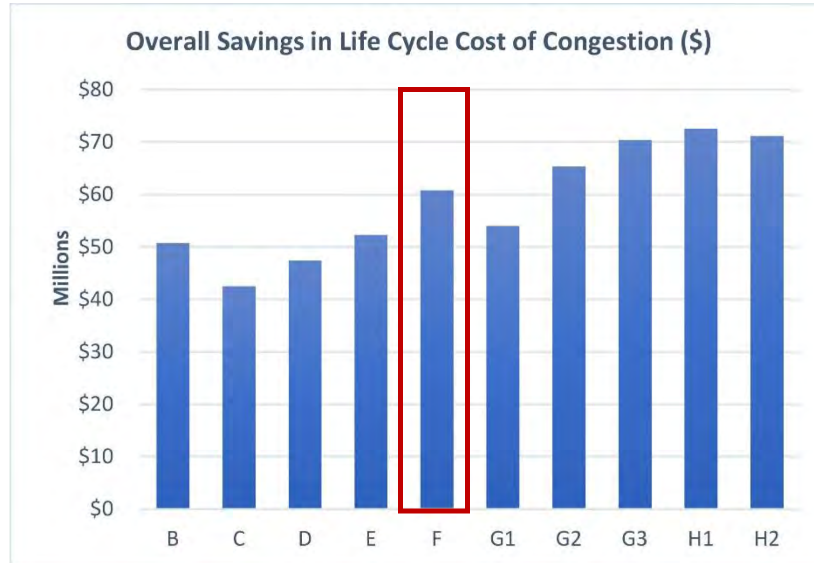
Figure 56: Operational Parameters for Alternative F, Eastbound Left Turn Flyover with Relocation of Fort Wainwright Gate

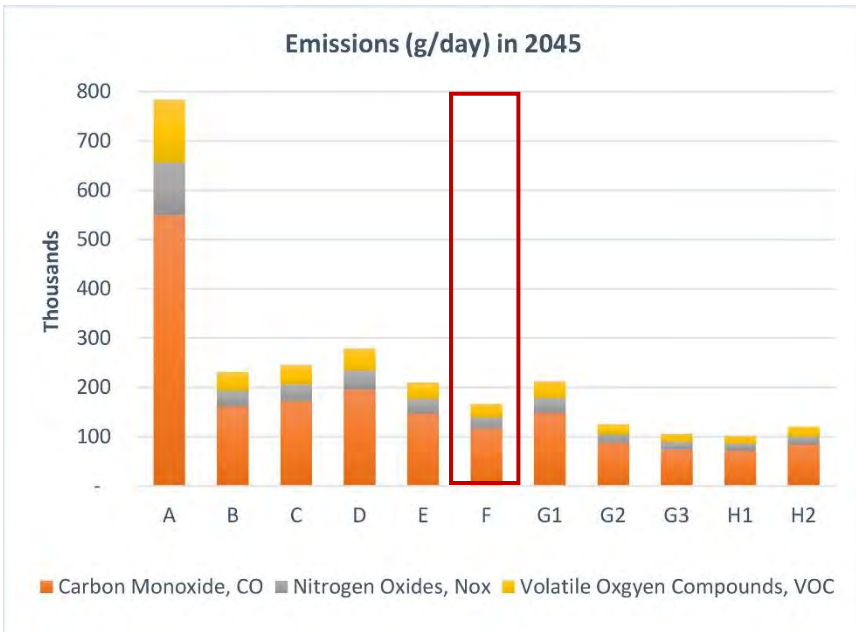
Impacts of Delay

ALTERNATIVE F

Eastbound Left Turn Flyover

with Relocation of Fort Wainwright Gate





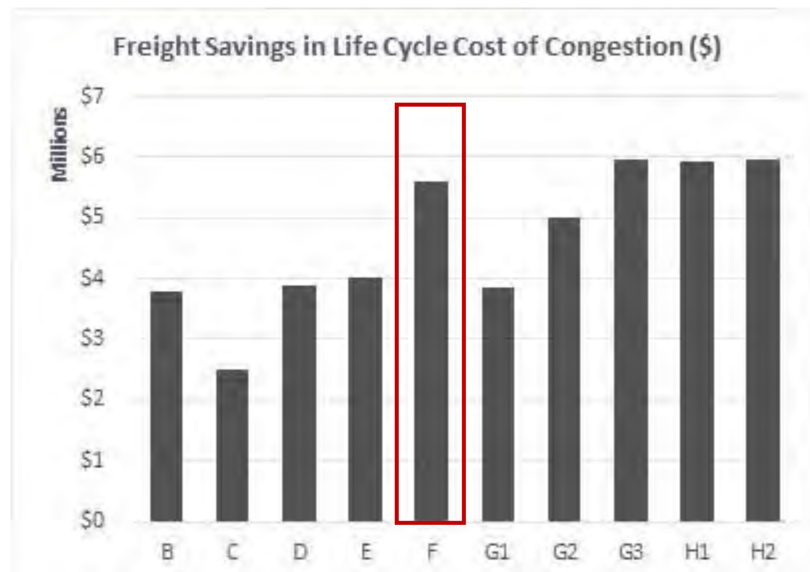


Figure 57: Impacts of Delay for Alternative F, Eastbound Left Turn Flyover with Relocation of Fort Wainwright Gate

4.7.5 Design Impacts

4.7.5.1 Physical (ROW) impacts and acquisition needs

Figure 58 presents the ROW impacts under Alternative F (Eastbound Left Turn Flyover). Figure 59 presents the impacts with the relocation of the Fort Wainwright main gate.

4.7.5.2 Snow storage and snow removal

DOT&PF M&O considers Alternative F harder to maintain and operate compared to the No Build condition.

4.7.6 Cost Estimate

Table 11: Cost Estimate for Alternative F, Eastbound Left Turn Flyover

Category	Cost
Project Development	$ 5,300,000
Right of Way	$ 700,000
Utilities	$ 1,900,000
Construction Total	$ 35,000,000
Total Projected Estimated Cost	**$ 42,900,000**

Table 12: Cost Estimate for Alternative F, Eastbound Left Turn Flyover with Fort Wainwright Connection

Category	Cost
Project Development	$ 5,300,000
Right of Way	$ 700,000
Utilities	$ 2,000,000
Construction Total	$ 35,300,000
Total Projected Estimated Cost	**$ 43,300,000**

The above Order-of-Magnitude Estimate is in 2018 dollars based on conceptual design. Final costs of the project will depend on labor and material costs, site conditions, productivity, market conditions, scope, and other variable factors.

Figure 58: ROW Impacts for Alternative F, Eastbound Left Turn Flyover

Figure 59: ROW Impacts for Alternative F, Eastbound Left Turn Flyover with Relocation of Fort Wainwright Gate

4.7.7 Summary

Alternative F improves all four concerns identified in the project purpose and need:

Improves Pedestrian and Bicycle Safety	✓ (outline)
Decreases Pedestrian Delay	✓ (solid)
Reduces Weaving	✓ (solid)
Reduces Vehicular Delay	✓ (solid)

✓ (solid) = Meets goal much better than No Build   ✓ (outline) = Meets goal better than No Build

4.8 Alternative G1 – Tight Diamond Interchange

4.8.1 Alternative Concept

Alternative G1 would construct a tight diamond interchange, shown in Figure 60. Northbound and southbound traffic on the Steese Expressway would be carried up and over the intersections without stopping. The remaining movements would interact at two ramp intersections. This type of diamond interchange is used where right of way is a constraint, so the two ramp intersections are placed close together. There is limited space for queuing between the intersections and queues from one intersection may block traffic from turning at the other intersection with this type of alternative. Based on our analysis of queues at the two intersections, the interchange was designed with 150 feet of queue storage between the intersections.

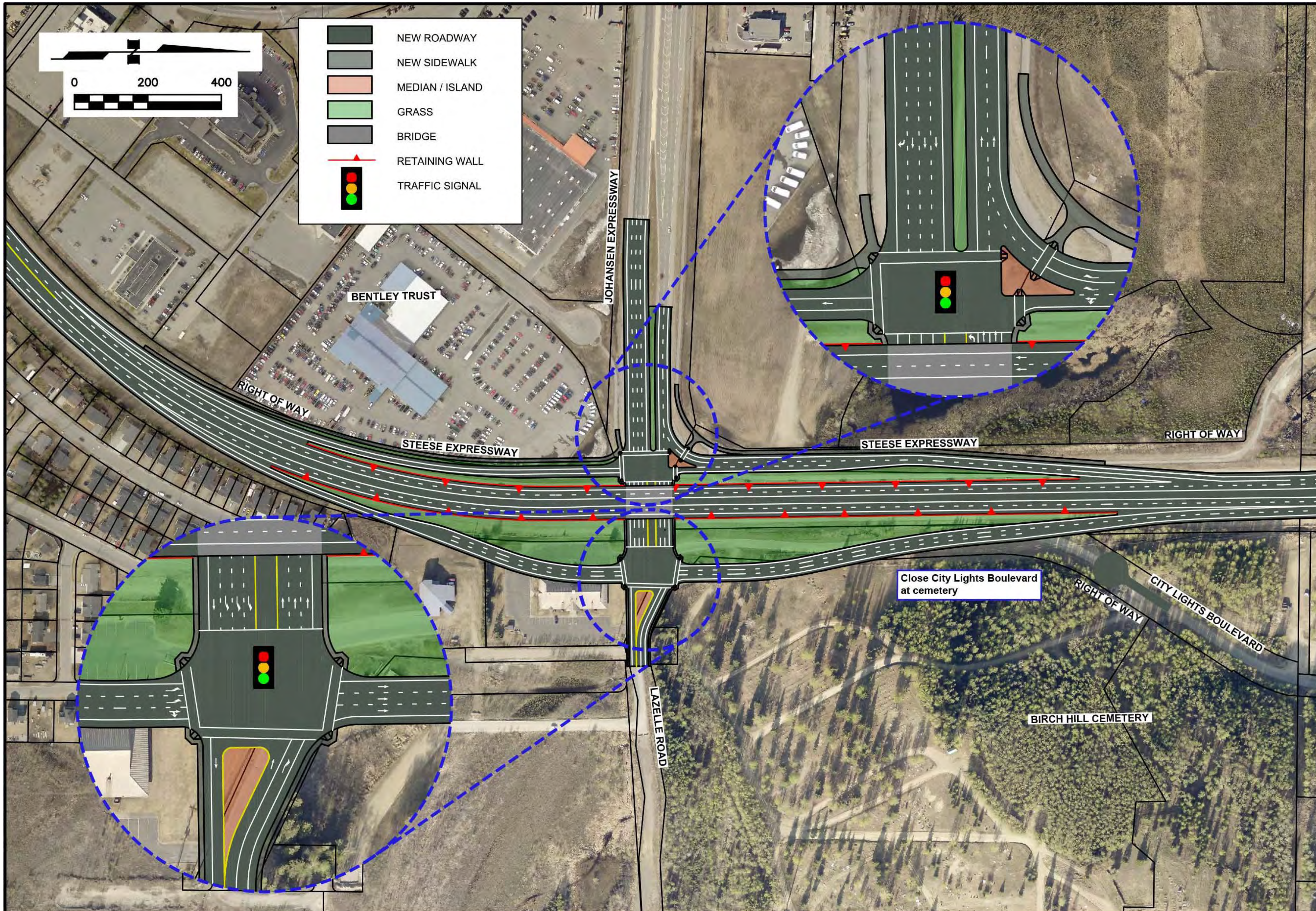
While this design eliminates all conflicts with southbound and northbound through traffic, the signalized intersections still have to accommodate the heavy eastbound left turn movement. As a result, three eastbound left turn lanes and two northbound left turn lanes are needed at the east ramp intersection. (See Appendix A for the intersection LOS with only two left turn lanes.)

This alternative is a full interchange. This type of design is common in the United States and in Alaska. The Parks Highway interchange at Geist Road is an example of this type of design.

4.8.2 Pedestrian Safety

As a full interchange, one of the benefits of this design is that pedestrians no longer cross northbound and southbound through traffic, since that traffic is grade-separated from the other movements. Advantages of this design for pedestrian safety include: the southbound right turn is signalized and pedestrians do not cross at the same intersection as the northbound and southbound left turns, separating pedestrians from conflicts with turning traffic. While pedestrians must pass through two intersections to cross the north or south legs of the interchange, the crossing distances are short for each intersection. The crossing for the east approach is wider than the existing intersection.

This design allows pedestrians to cross along the north side of the interchange.



Morning Peak:

- Southbound right turn vehicles stop at signal in two right turn lanes, reducing weaving for those accessing Bentley Trust.
- Two northbound left turn lanes provide additional capacity.

Evening Peak:

- Three eastbound left turn lanes accommodate nearly 1800 vehicles per hour through the signals, then merge into two lanes before entering the Steese Expressway.

Pedestrians:

- All pedestrian crossings are signalized.
- Pedestrians are allowed to cross all outside legs of the intersection.

Through traffic on Steese Expressway is brought up and over the intersection without stopping.

Figure 60: Alternative G1 – Tight Diamond Interchange

4.8.3 Design Volumes

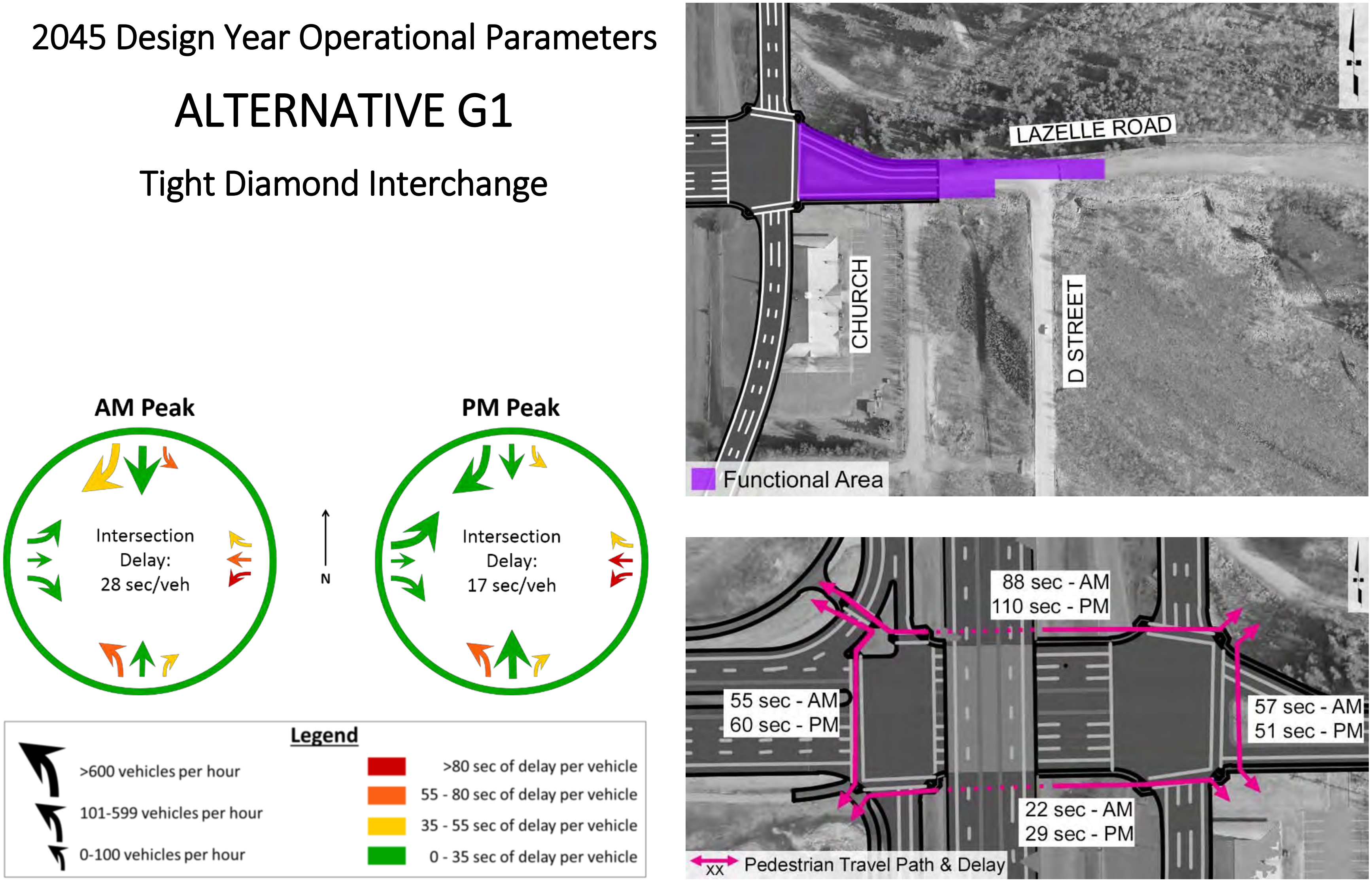
The design volumes for this alternative are the same as for the No Build alternative, presented in Section 4.2.3 on page 26.

4.8.4 Daily Operations in 2045 and Annual Cost of Congestion

Figure 61 presents the average vehicle delay, average pedestrian delay, and functional area of the intersection under Alternative G1 (Tight Diamond Interchange).

Figure 62 presents the impacts of delay on vehicle emissions, as well as the value of the savings in delay for Alternative G1 (Tight Diamond Interchange) as compared to Alternative A (No Build).

Figure 63 and Figure 64 present the same information for Alternative G1 (Tight Diamond Interchange) with the relocation of the Fort Wainwright main gate.



Vehicle Delay

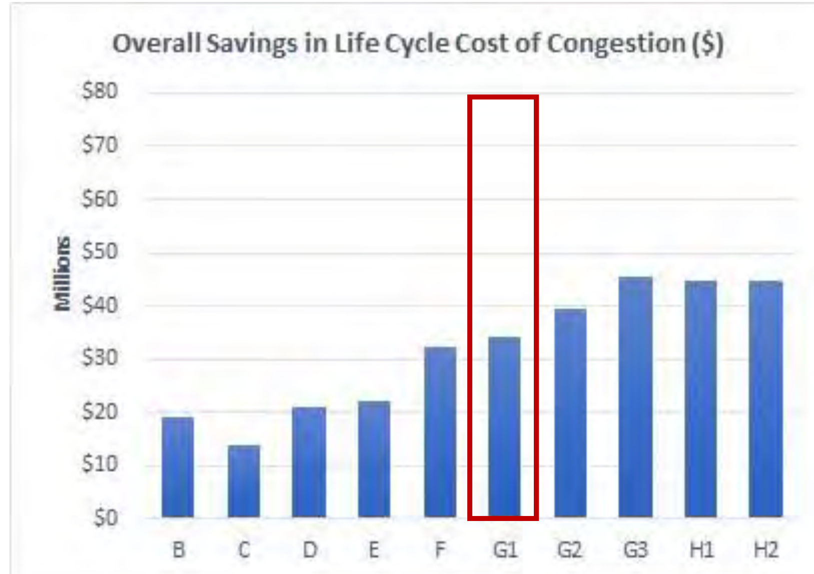
Pedestrian Delay

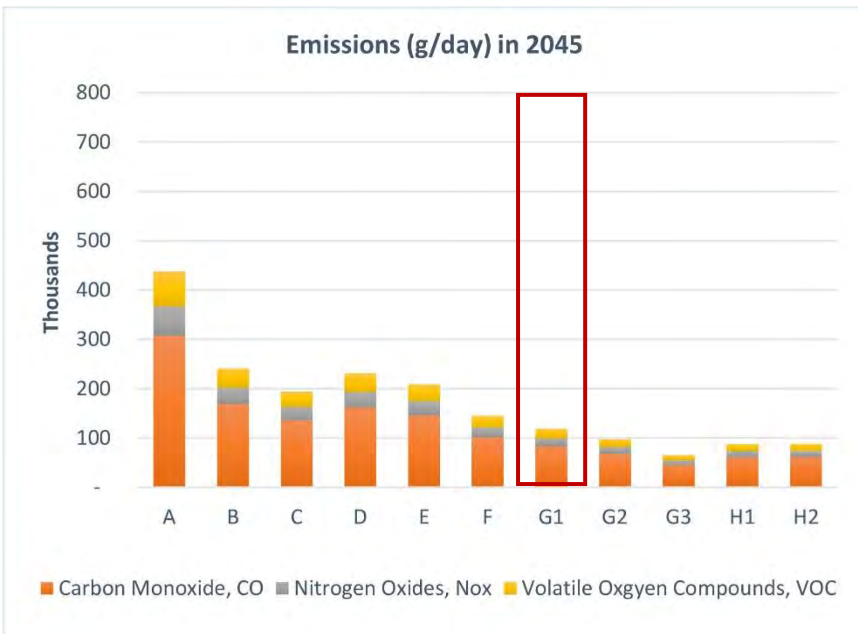
Figure 61: Operational Parameters for Alternative G1, Tight Diamond Interchange

Impacts of Delay

ALTERNATIVE G1

Tight Diamond Interchange





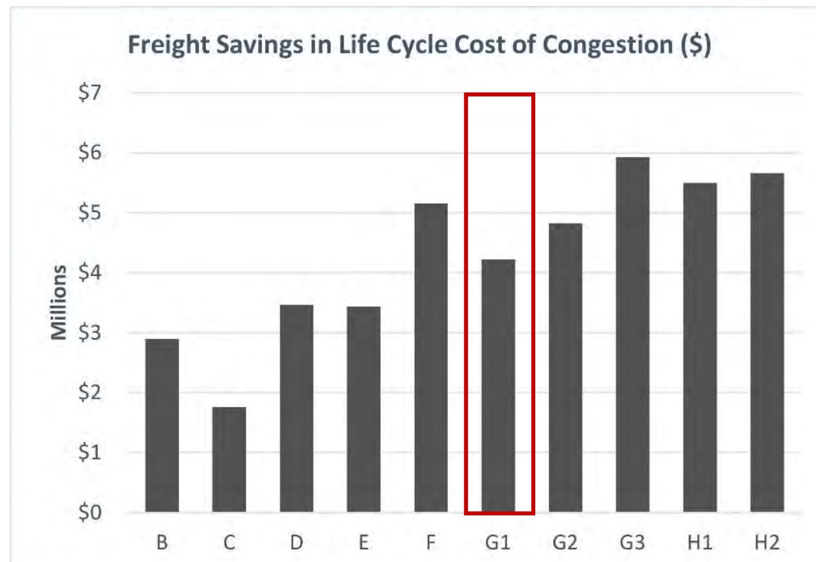
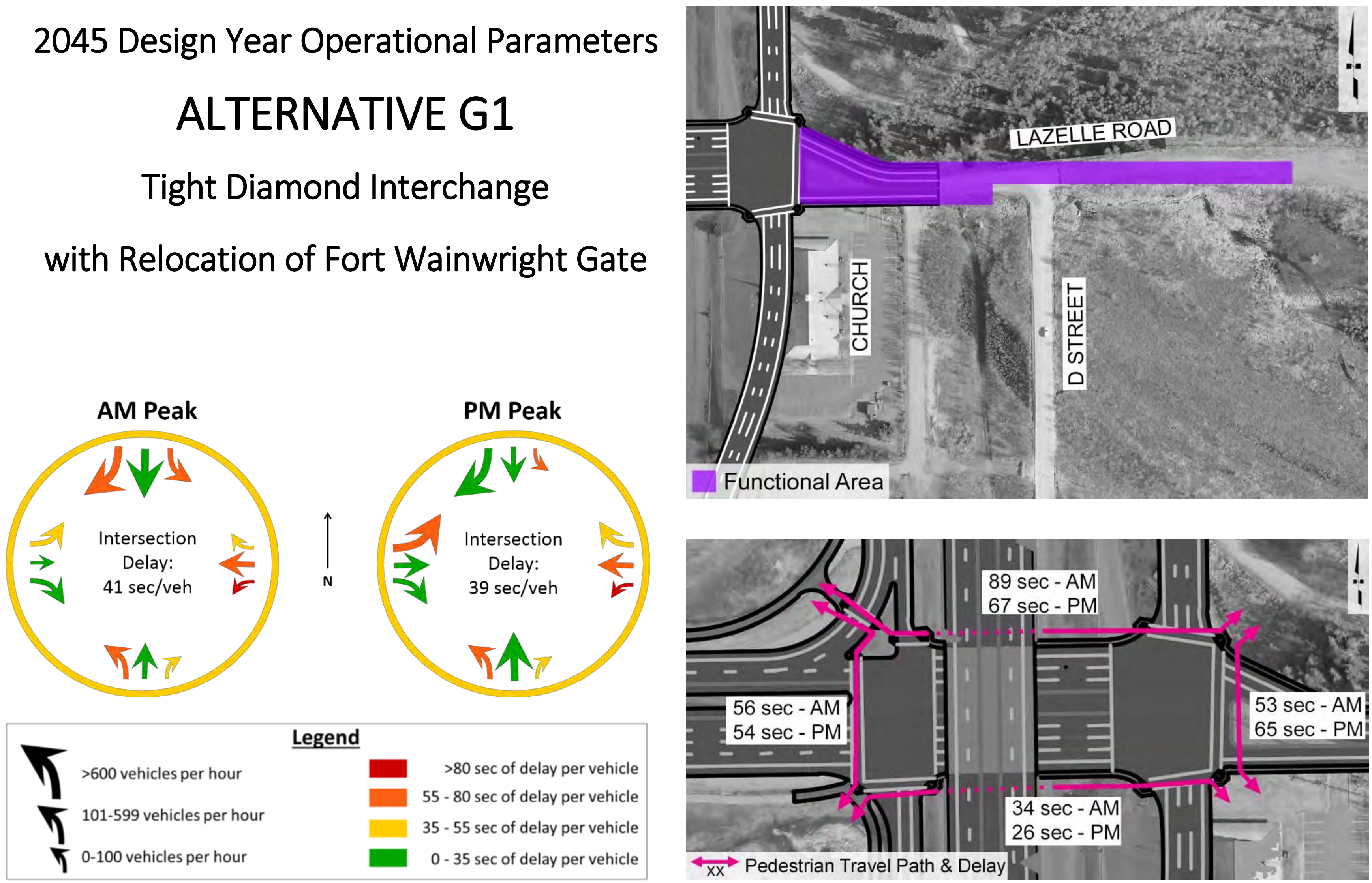


Figure 62: Impacts of Delay for Alternative G1, Tight Diamond Interchange



Vehicle Delay

Pedestrian Delay

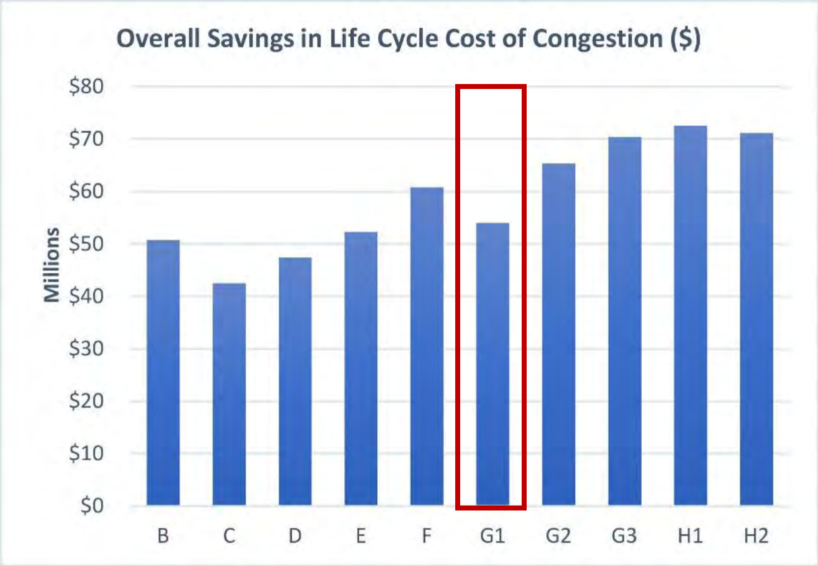
Figure 63: Operational Parameters for Alternative G1, Tight Diamond Interchange with Relocation of Fort Wainwright Gate

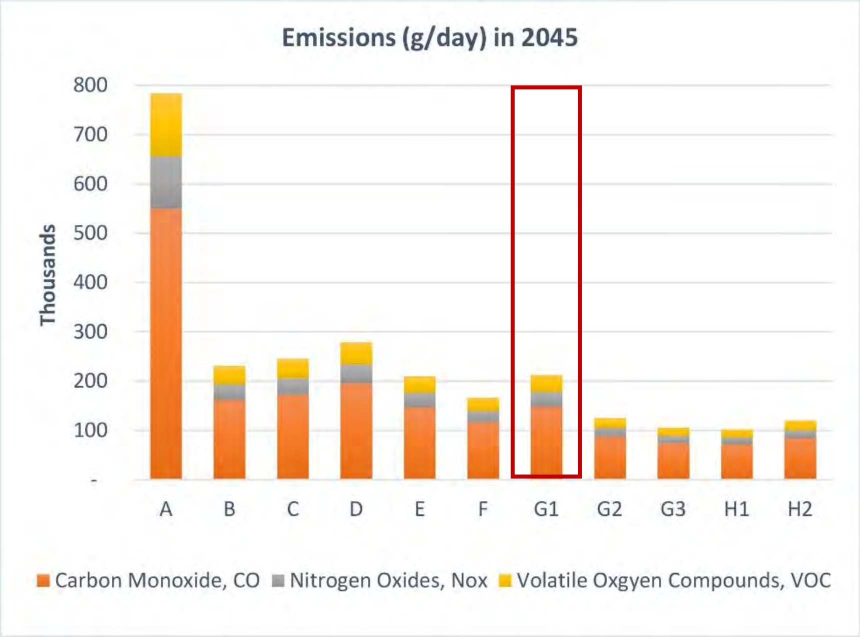
Impacts of Delay

ALTERNATIVE G1

Tight Diamond Interchange

with Relocation of Fort Wainwright Gate





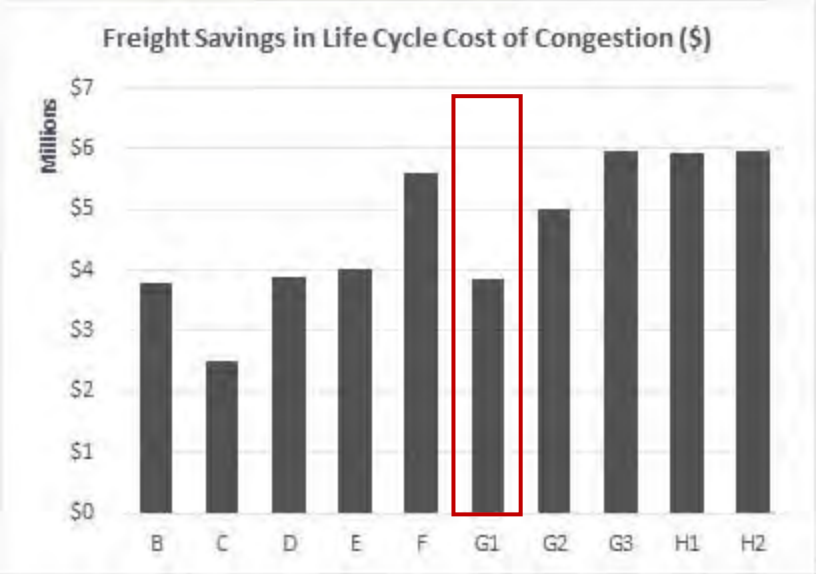


Figure 64: Impacts of Delay for Alternative G1, Tight Diamond Interchange with Relocation of Fort Wainwright Gate

4.8.5 Design Impacts

4.8.5.1 Physical (ROW) impacts and acquisition needs

Figure 65 presents the ROW impacts under Alternative G1 (Tight Diamond Interchange).

***4.8.5.2** Snow storage and snow removal*

DOT&PF M&O considers Alternative G1 to have the same operational and maintenance needs as the No Build condition.

4.8.6 Cost Estimate

Table 13: Cost Estimate for Alternative G1, Tight Diamond Interchange

Category	Cost
Project Development	$ 3,300,000
Right of Way	$ 7,500,000
Utilities	$ 3,900,000
Construction Total	$ 21,700,000
Total Projected Estimated Cost	**$ 36,400,000**

The above Order-of-Magnitude Estimate is in 2018 dollars based on conceptual design. Final costs of the project will depend on labor and material costs, site conditions, productivity, market conditions, scope, and other variable factors.

4.8.7 Summary

Alternative G1 improves all four concerns identified in the project purpose and need:

Improves Pedestrian and Bicycle Safety	✓
Decreases Pedestrian Delay	✓
Reduces Weaving	✔
Reduces Vehicular Delay	✔

✔ = Meets goal much better than No Build ✓ = Meets goal better than No Build

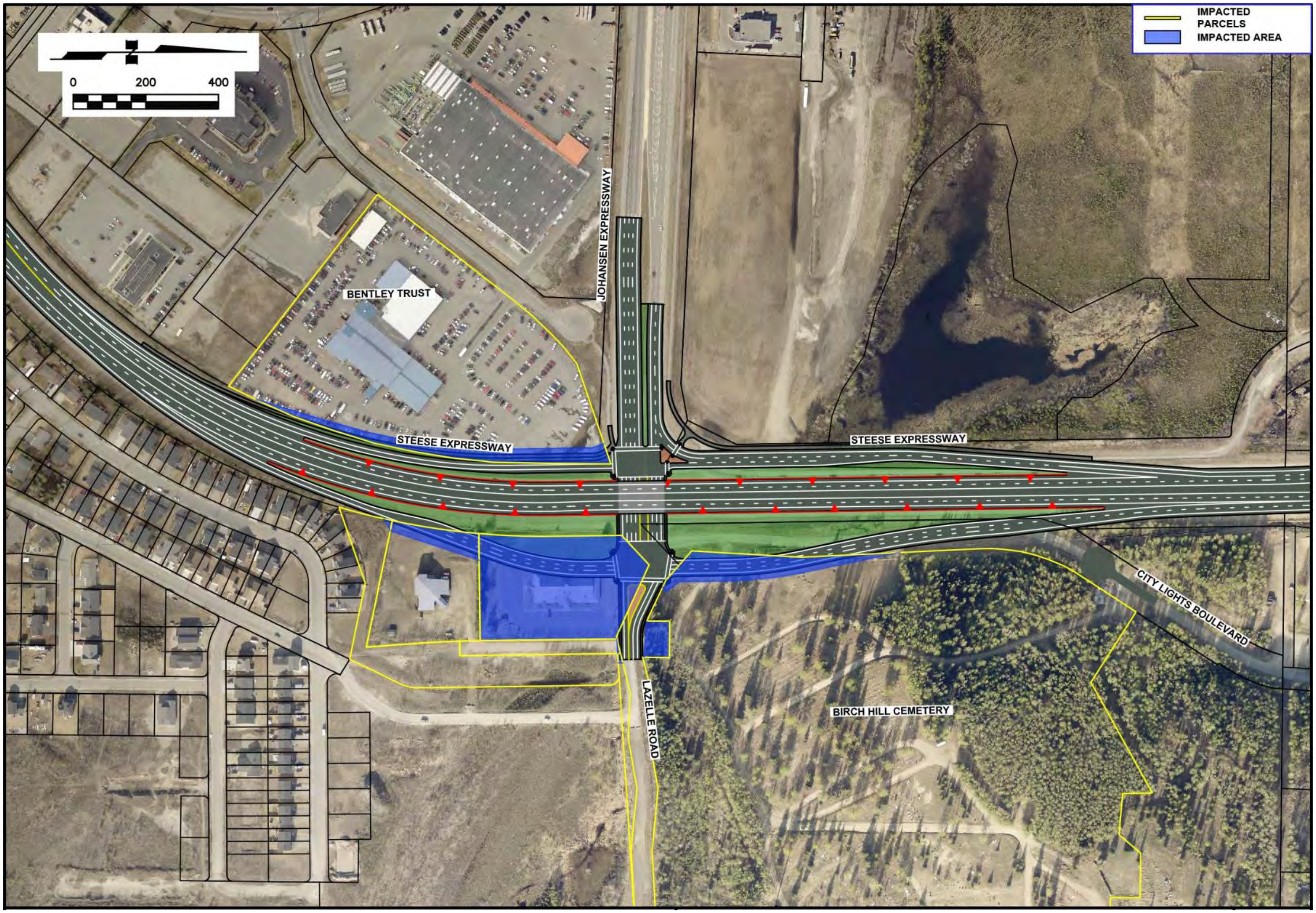


Figure 65: ROW Impacts for Alternative G1, Tight Diamond Interchange

4.9 Alternative G2 – Diamond Interchange with Cloverleaf Ramp

4.9.1 Alternative Concept

Alternative G2 improves on the concept for the Alternative G1 design by adding a cloverleaf ramp that allows eastbound left turn vehicles to bypass the east intersection and merge directly onto the Steese Expressway, as shown in Figure 66. This allows more time at the signal for the northbound and westbound movements, which decreases overall delay, especially under the forecasted volumes with traffic traveling to and from Fort Wainwright.

This alternative is a full interchange. This type of design is common in the United States and in Alaska.

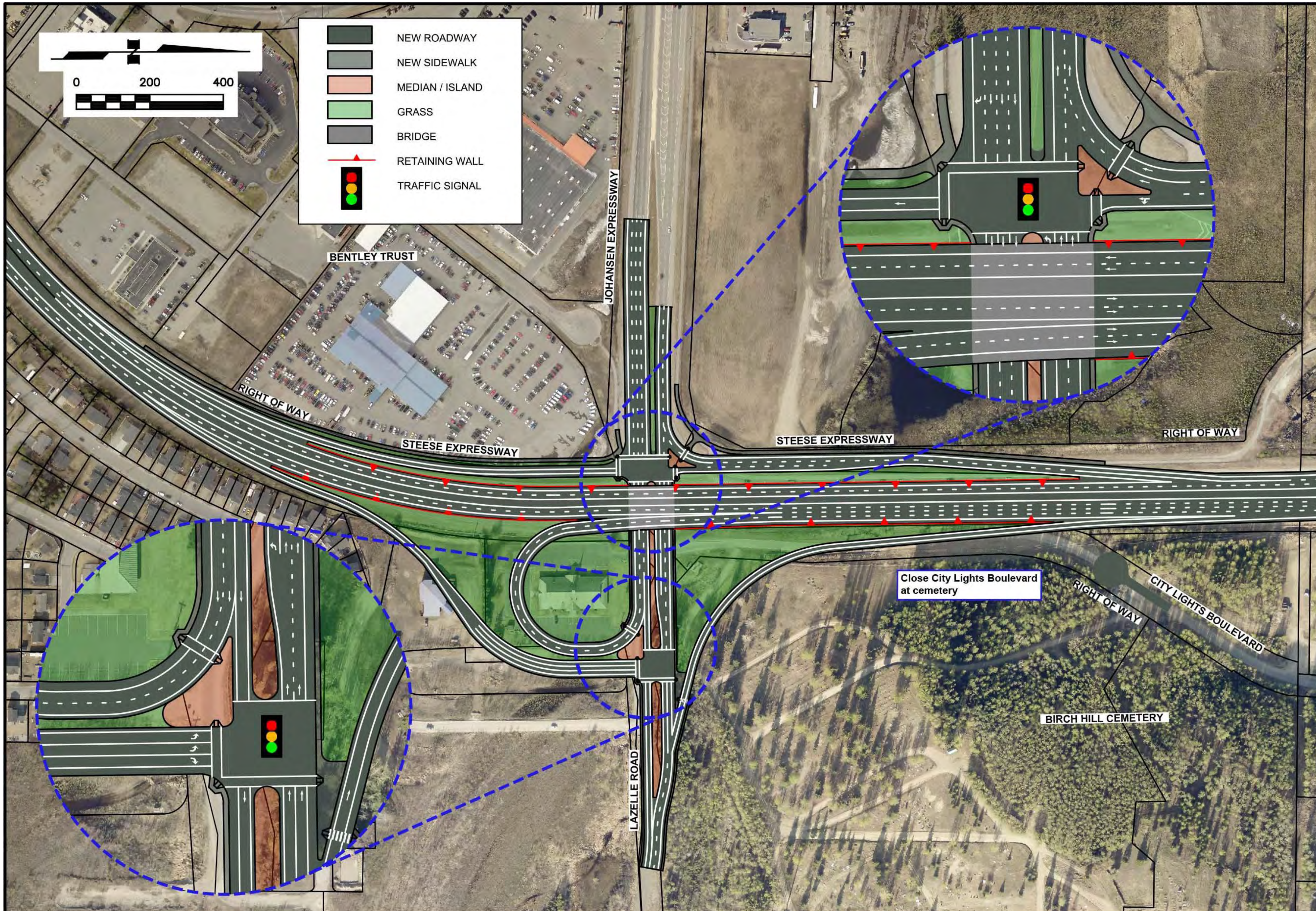
4.9.2 Pedestrian Safety

As a full interchange, one of the benefits of this design is that pedestrians no longer cross northbound and southbound through traffic, as that traffic is grade-separated from the other movements. Advantages of this design for pedestrian safety include: the southbound right turn is signalized and pedestrians do not cross at the same intersection as the northbound and southbound left turns, separating pedestrians from conflicts with turning traffic. While pedestrians must pass through two intersections to cross the north or south legs of the interchange, the crossing distances are short for each intersection.

This design includes a new crossing of the dual lane on-ramp taking eastbound left turn vehicles onto the Steese Highway. Because two lanes of traffic are being crossed, the crossing is signalized. This signalized crossing would not need to be coordinated with the other movements of this intersection. Along the north side of the interchange, pedestrians cross the westbound right turn movement, which is a free right turn onto the on-ramp. Care should be taken to ensure that this crossing is designed so that vehicle speeds are controlled at the crossing and vehicles and pedestrians can see each other well.

The crossing for the east approach is wider than the existing intersection.

This design allows pedestrians to cross along the north side of the interchange.



Morning Peak:

- Southbound right turn vehicles stop at signal in two right turn lanes, reducing weaving for those accessing Bentley Trust.
- Two northbound left turn lanes provide additional capacity.

Evening Peak:

- A two-lane loop ramp accommodates the eastbound left turn volume of nearly 1800 vehicles per hour without having to stop at the east intersection, except to yield to pedestrians.

Pedestrians:

- All pedestrian crossings are signalized, except for crossing the westbound right turn ramp.
- Pedestrians are allowed to cross all outside legs of the intersection.

Through traffic on Steese Expressway is brought up and over the intersection without stopping.

Figure 66: Alternative G2 – Tight Diamond Interchange with Cloverleaf Ramp

4.9.3 Design Volumes

The design volumes for this alternative are the same as for the No Build alternative, presented in Section 4.2.3 on page 26.

4.9.4 Daily Operations in 2045 and Annual Cost of Congestion

Figure 67 presents the average vehicle delay, average pedestrian delay, and functional area of the intersection under Alternative G2 (Tight Diamond Interchange with Cloverleaf Ramp).

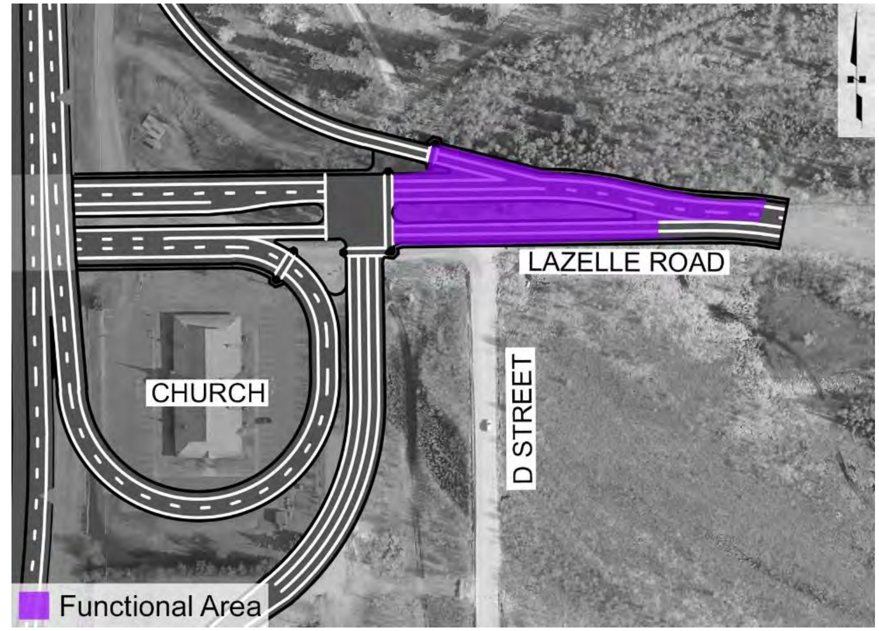
Figure 68 presents the impacts of delay on vehicle emissions, as well as the value of the savings in delay for Alternative G2 (Tight Diamond Interchange with Cloverleaf Ramp) as compared to Alternative A (No Build).

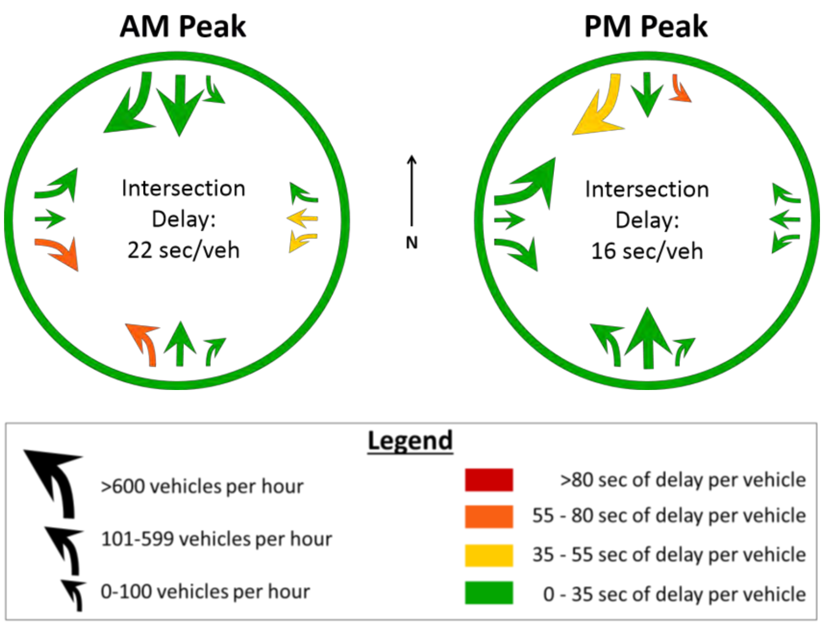
Figure 69 and Figure 70 present the same information for Alternative G2 (Tight Diamond Interchange with Cloverleaf Ramp) with the relocation of the Fort Wainwright main gate.

2045 Design Year Operational Parameters

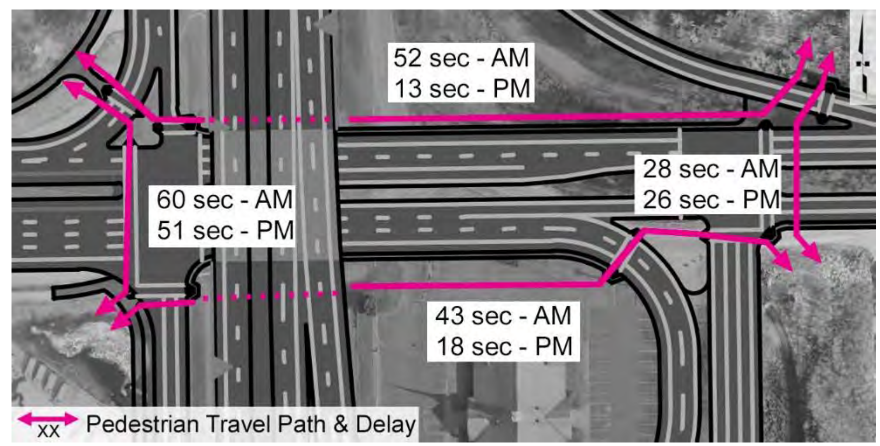
ALTERNATIVE G2

Tight Diamond Interchange with Cloverleaf Ramp





Vehicle Delay



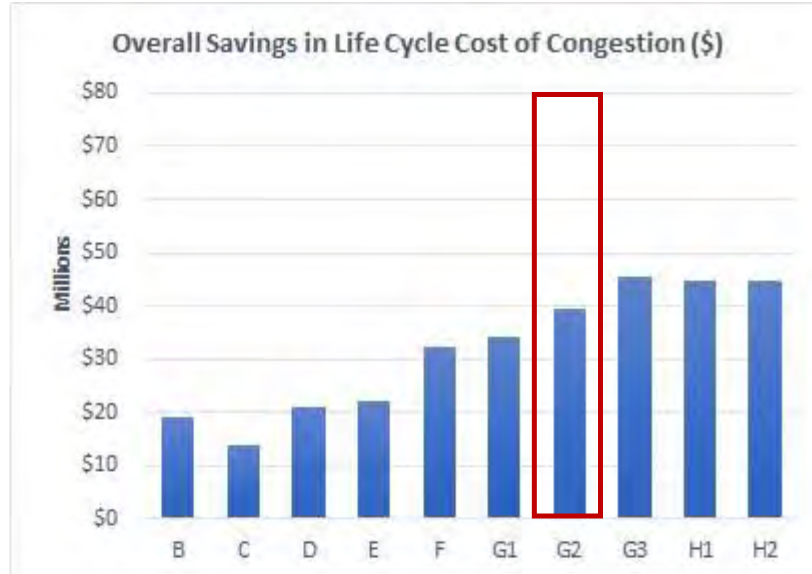
Pedestrian Delay

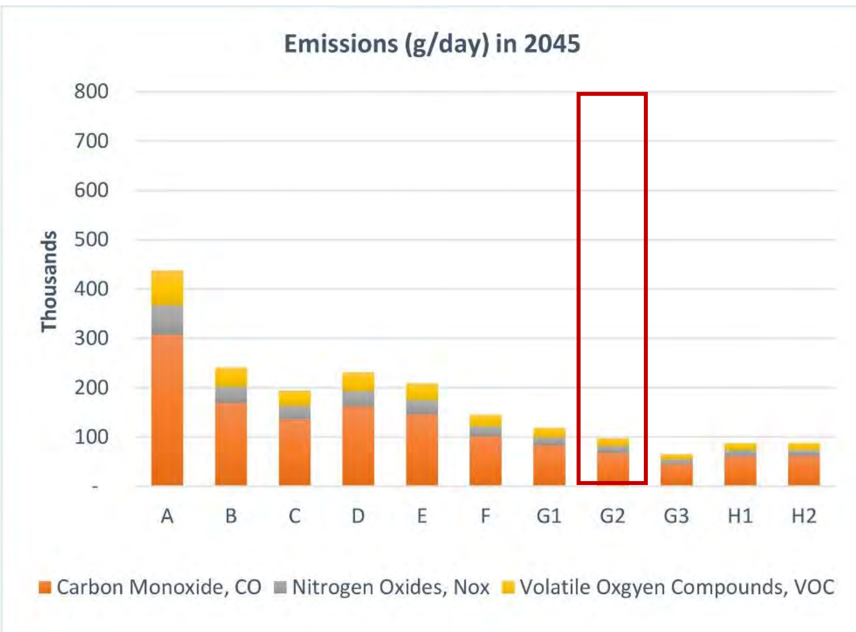
Figure 67: Operational Parameters for Alternative G2, Tight Diamond Interchange with Cloverleaf Ramp

Impacts of Delay

ALTERNATIVE G2

Tight Diamond Interchange with Cloverleaf Ramp





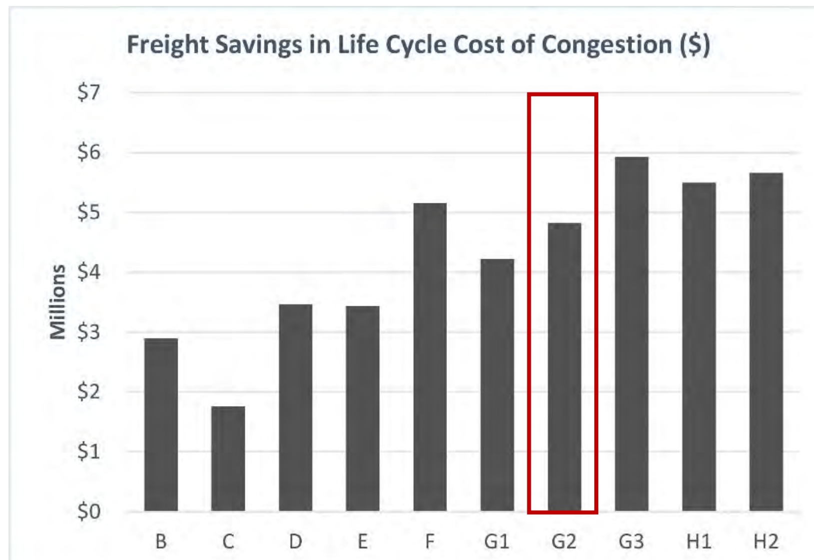
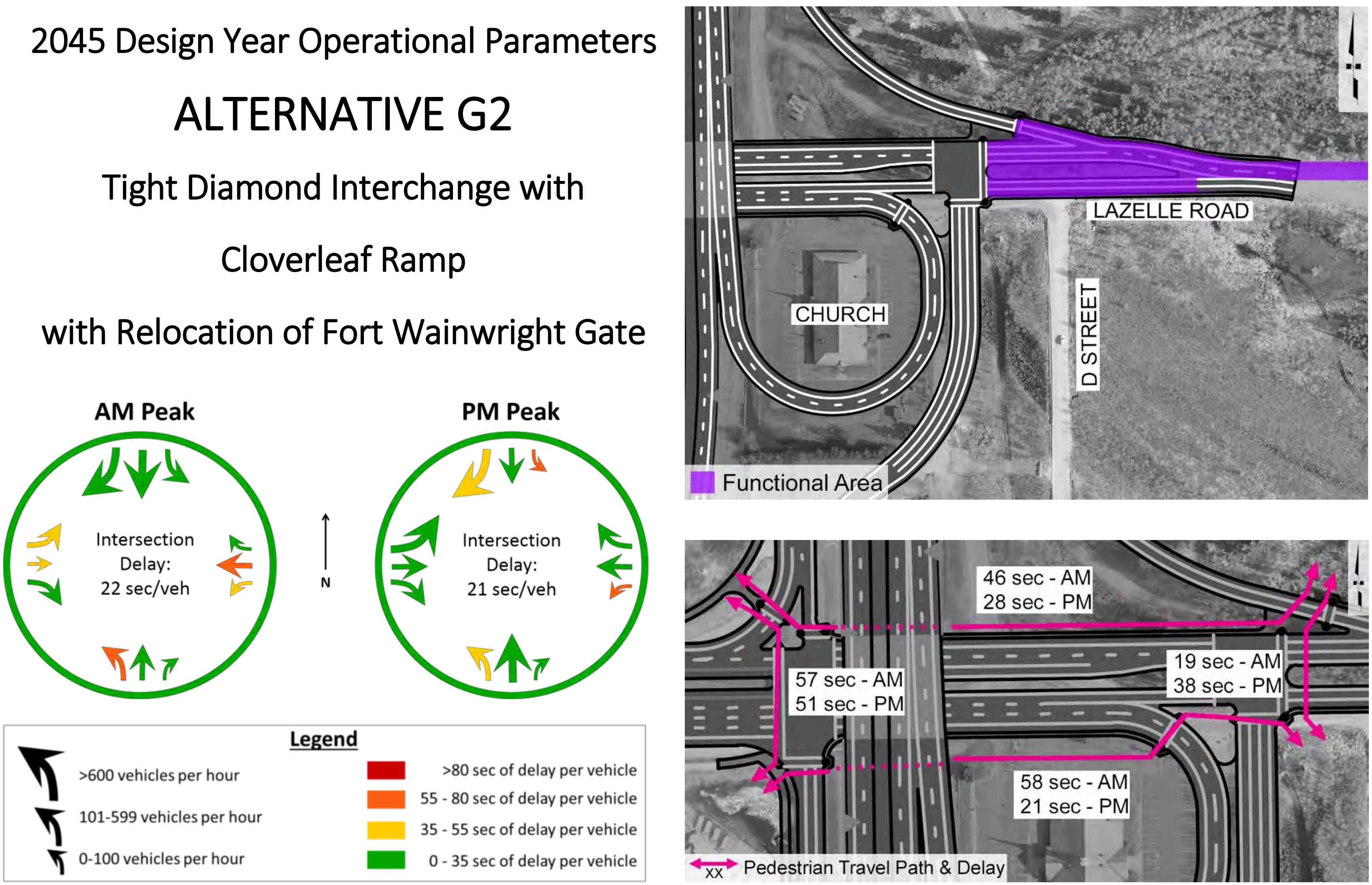


Figure 68: Impacts of Delay for Alternative G2, Tight Diamond Interchange with Cloverleaf Ramp



Vehicle Delay **Pedestrian Delay**

Figure 69: Operational Parameters for Alternative G2, Tight Diamond Interchange with Cloverleaf Ramp with Relocation of Fort Wainwright Gate

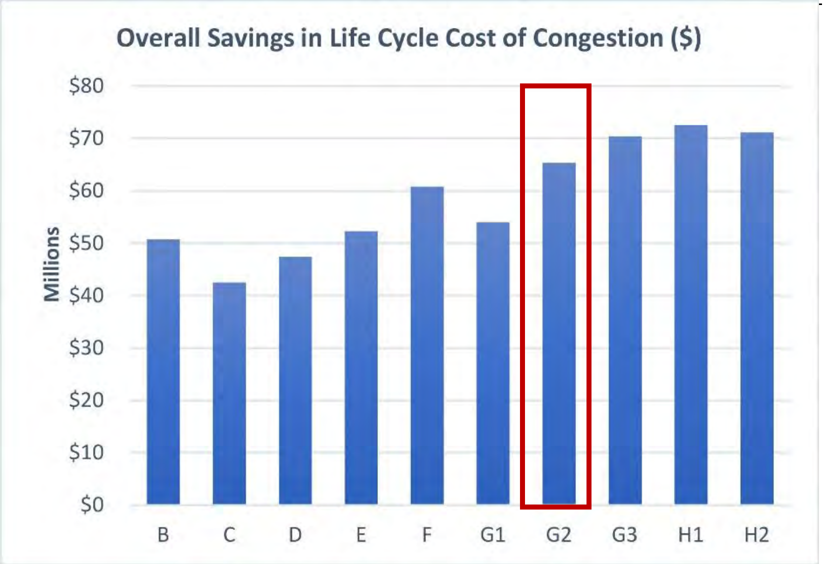
Impacts of Delay

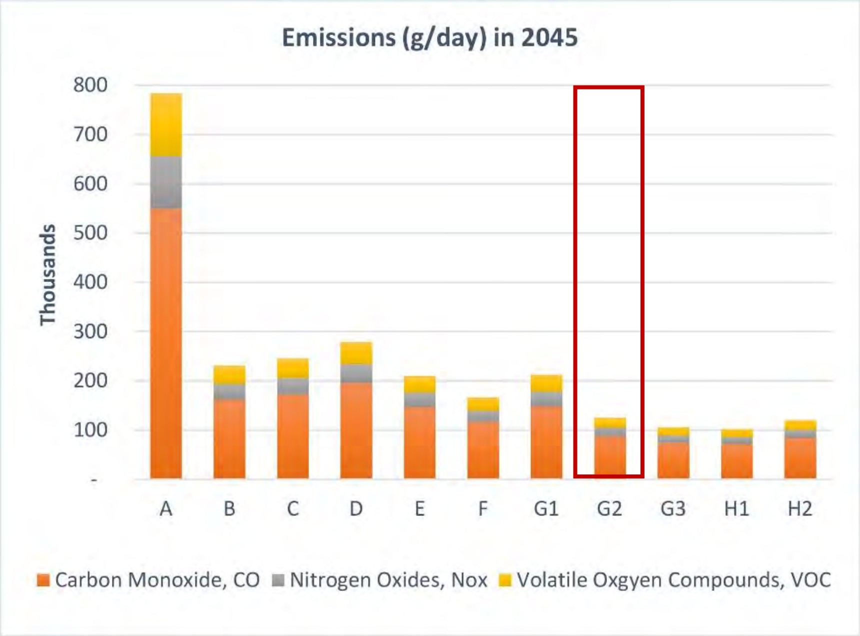
ALTERNATIVE G2

Tight Diamond Interchange with

Cloverleaf Ramp

with Relocation of Fort Wainwright Gate





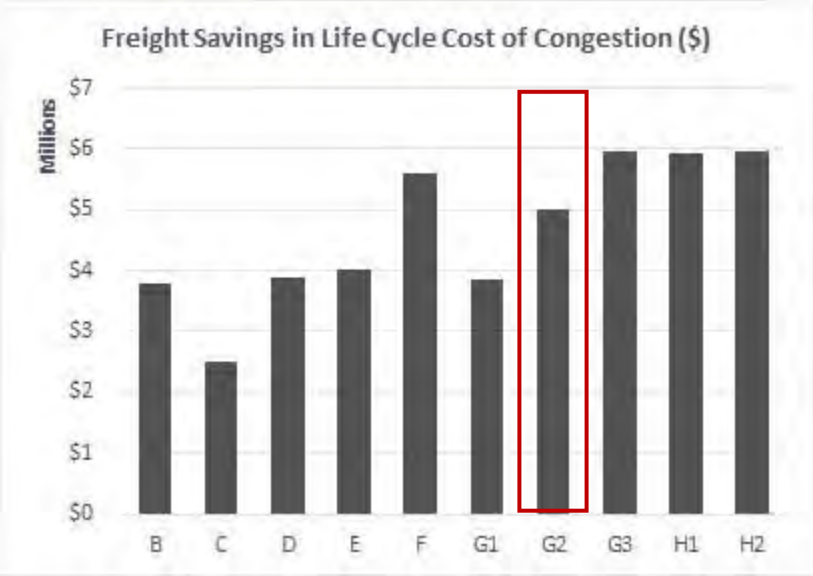


Figure 70: Impacts of Delay for Alternative G2, Tight Diamond Interchange with Cloverleaf Ramp with Relocation of Fort Wainwright Gate

4.9.5 Design Impacts

4.9.5.1 Physical (ROW) impacts and acquisition needs

Figure 71 presents the ROW impacts under Alternative G2 (Diamond Interchange with Cloverleaf Ramp).

***4.9.5.2** Snow storage and snow removal*

DOT&PF M&O considers it harder to maintain and operate Alternative G2 compared to the No Build condition.

4.9.6 Cost Estimate

Table 14: Cost Estimate for Alternative G2, Diamond Interchange with Cloverleaf Ramp

Category	Cost
Project Development	$ 3,500,000
Right of Way	$ 11,700,000
Utilities	$ 4,000,000
Construction Total	$ 23,600,000
Total Projected Estimated Cost	**$ 42,800,000**

The above Order-of-Magnitude Estimate is in 2018 dollars based on conceptual design. Final costs of the project will depend on labor and material costs, site conditions, productivity, market conditions, scope, and other variable factors.

4.9.7 Summary

Alternative G2 addresses three concerns identified in the project purpose and need:

Improves Pedestrian and Bicycle Safety	
Decreases Pedestrian Delay	✔
Reduces Weaving	✔
Reduces Vehicular Delay	✔

✔ = Meets goal much better than No Build ✓ = Meets goal better than No Build

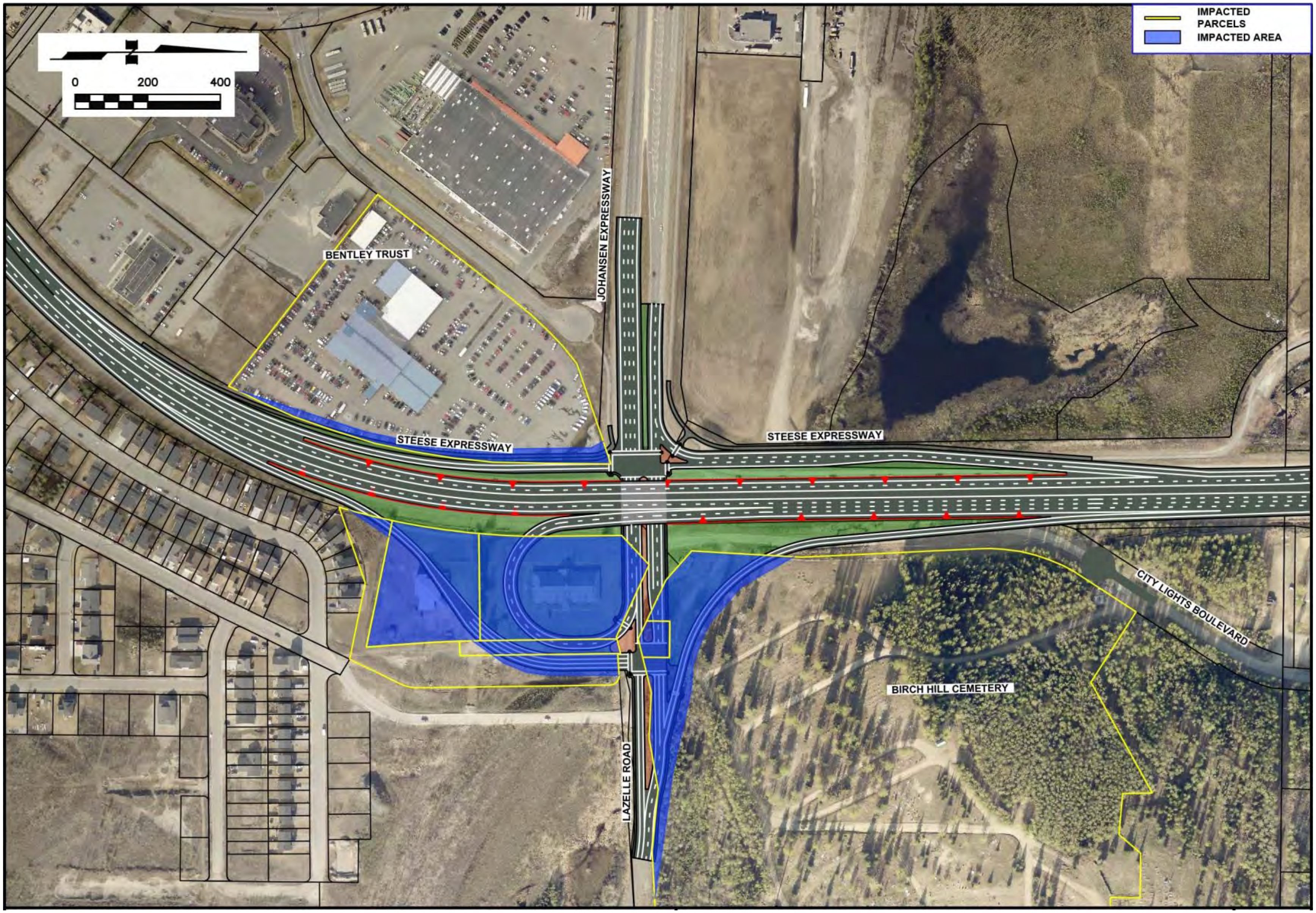


Figure 71: ROW Impacts for Alternative G2, Diamond Interchange with Cloverleaf Ramp

4.10 Alternative G3 – Diverging Diamond Interchange

4.10.1 Alternative Concept

Alternative G3 would construct a diverging diamond interchange, depicted in Figure 72. This is a relatively new type of interchange that has been gaining popularity throughout the United States. The first diverging diamond interchange built in Alaska is at the Muldoon Road interchange with the Glenn Highway and has been under operation for about one year. Figure 73 shows how vehicles move through the interchange.[7]

As with the G1 and G2 alternative concepts, the northbound and southbound through traffic on the Steese Expressway would be carried up and over the intersection without stopping. East- and westbound traffic will cross to the left as they approach the bridge, and then cross back to the right after the bridge. With this configuration, right turn movements are made onto a ramp before the crossover. The left turn movements are made onto a ramp after the crossover, so that the left turn movement enters the ramp freely, similar to a right turn movement. The crossover intersections and the off ramp merge intersections are signalized.

The diverging diamond interchange has less conflict points than a conventional diamond interchange. This configuration works well when there are either heavy left or right turn movements on or off of the ramps. Thus, it accommodates the heavy eastbound left turn movement in the PM peak.

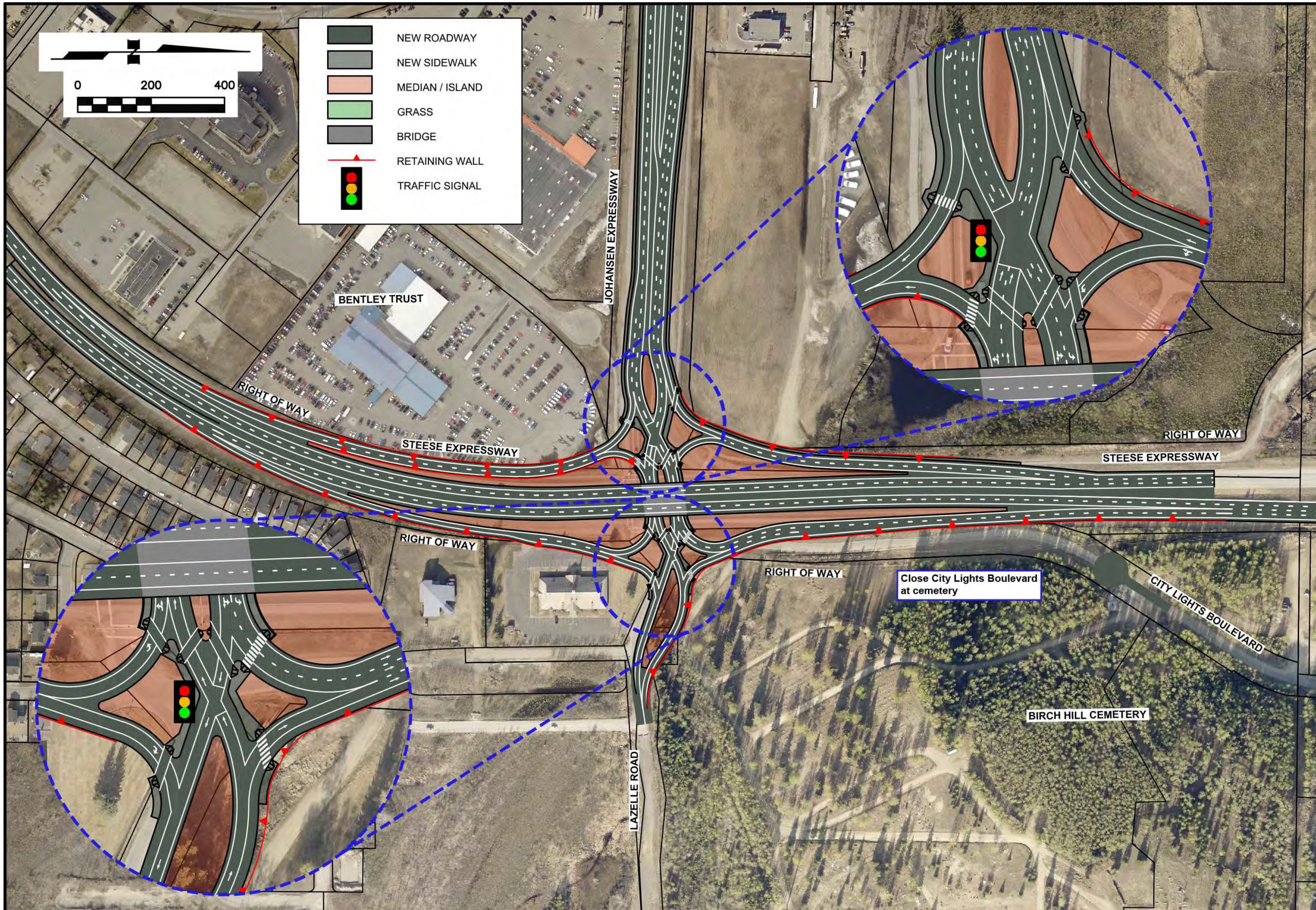
This alternative is a full interchange. Many interchanges of this type have been built in the United States, including the one recently constructed in Anchorage, Alaska.

4.10.2 Pedestrian Safety

As a full interchange, one of the benefits of this design is that pedestrians no longer cross northbound and southbound through traffic, as that traffic is grade-separated from the other movements. If this alternative concept is chosen for further consideration, care should be taken to define a reasonable pedestrian pathway that reduces the number and width of the crossings, allows pedestrians to travel between all quadrants of the interchange, and signalizes all crossings that are wider than a single lane.

This design allows pedestrians to cross the north leg of the interchange.

[7] See https://vimeo.com/143181922 to see how vehicles move through this type of interchange (Glenn Highway at Muldoon Road in Anchorage).



Morning Peak:

- Southbound right turn vehicles stop at signal in two right turn lanes, reducing weaving for those accessing Bentley Trust.
- Eastbound and westbound traffic cross to the left as they approach the overpass and then cross back to the right after passing under it. This allows northbound left turn traffic to enter the intersection without crossing opposing traffic, similar to a right turn.

Evening Peak:

- Eastbound and westbound traffic cross to the left as they approach the overpass and then cross back to the right after passing under it. This allows eastbound left turn traffic to exit the intersection without crossing opposing traffic, similar to a right turn.

Pedestrians:

- All pedestrian crossings are signalized.
- Pedestrians are allowed to cross all outside legs of the intersection.

Through traffic on Steese Expressway is brought up and over the intersection without stopping.

Figure 72: Alternative G3 – Diverging Diamond Interchange

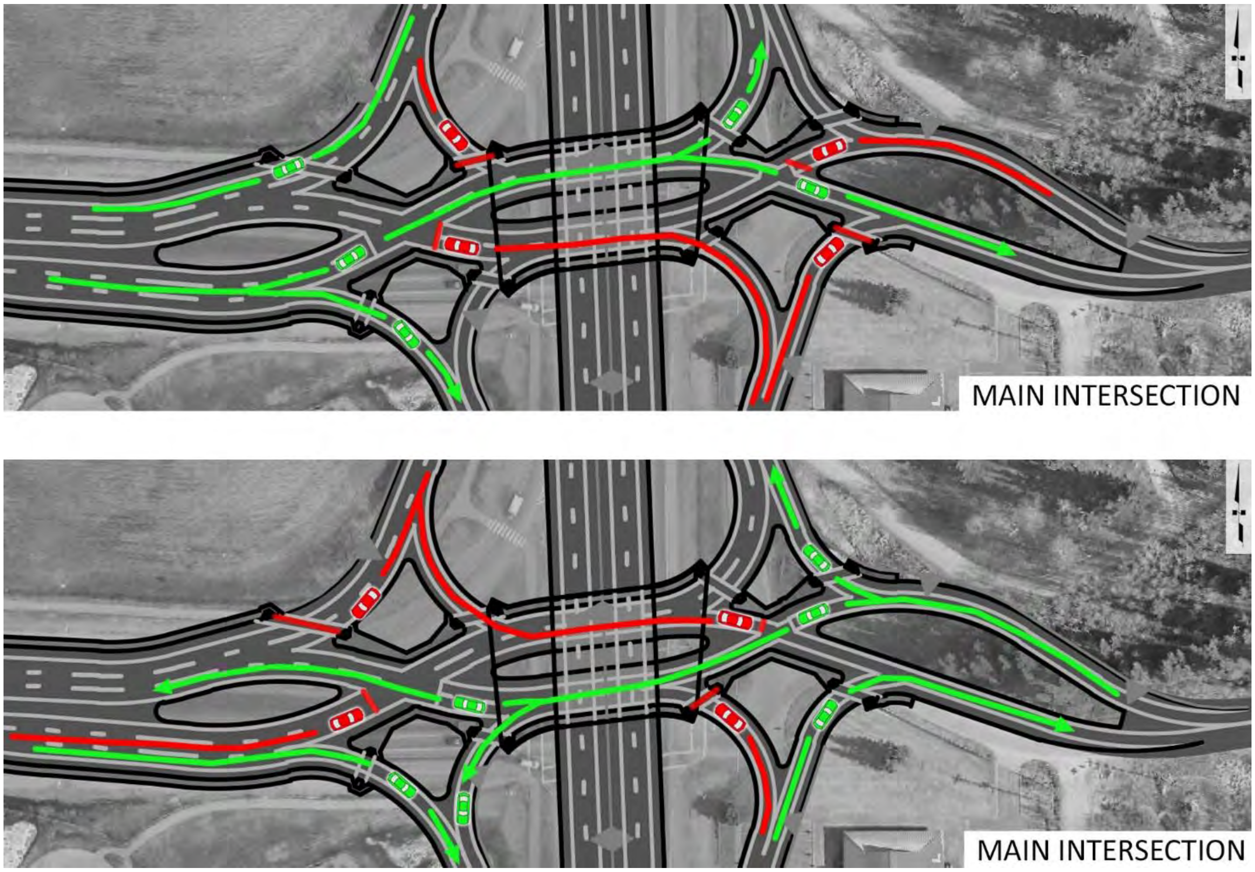


Figure 73: Alternative G3 – Vehicular Movements

4.10.3 Design Volumes

The design volumes for this alternative are the same as for the No Build alternative, presented in Section 4.2.3 on page 26.

4.10.4 Daily Operations in 2045 and Annual Cost of Congestion

Figure 74 presents the average vehicle delay, average pedestrian delay, and functional area of the intersection under Alternative G3 (Diverging Diamond Interchange).

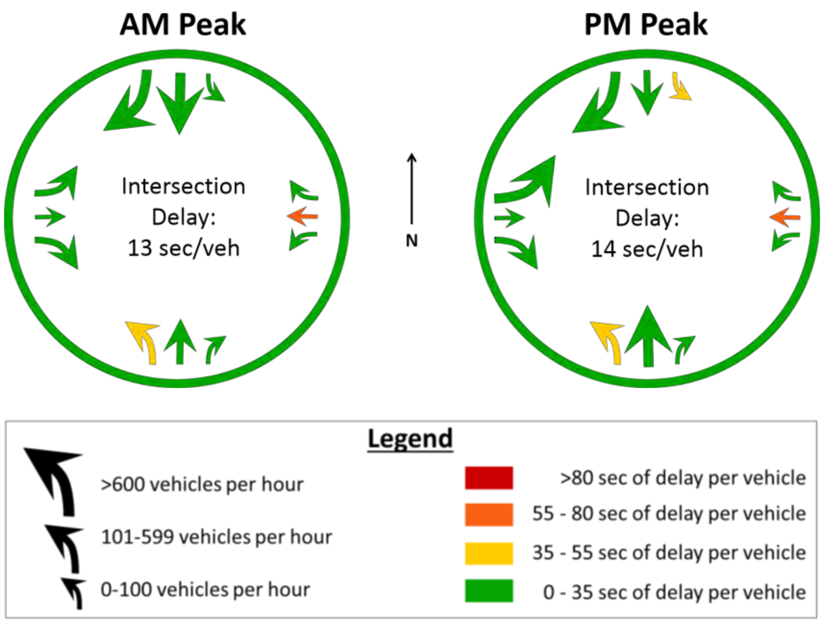
Figure 75 presents the impacts of delay on vehicle emissions, as well as the value of the savings in delay for Alternative G3 (Diverging Diamond Interchange) as compared to Alternative A (No Build).

Figure 76 and Figure 77 present the same information for Alternative G3 (Diverging Diamond Interchange) with the relocation of the Fort Wainwright main gate.

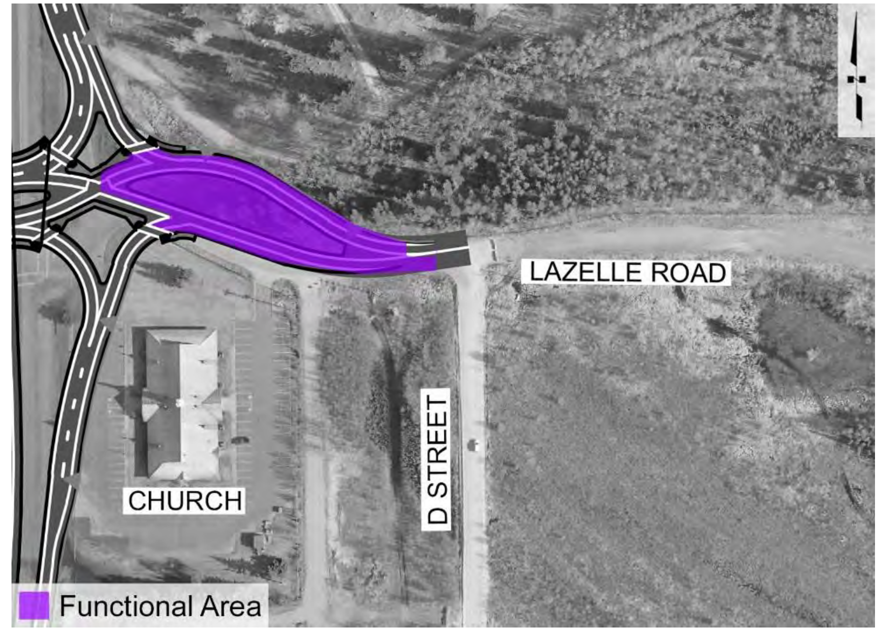
2045 Design Year Operational Parameters

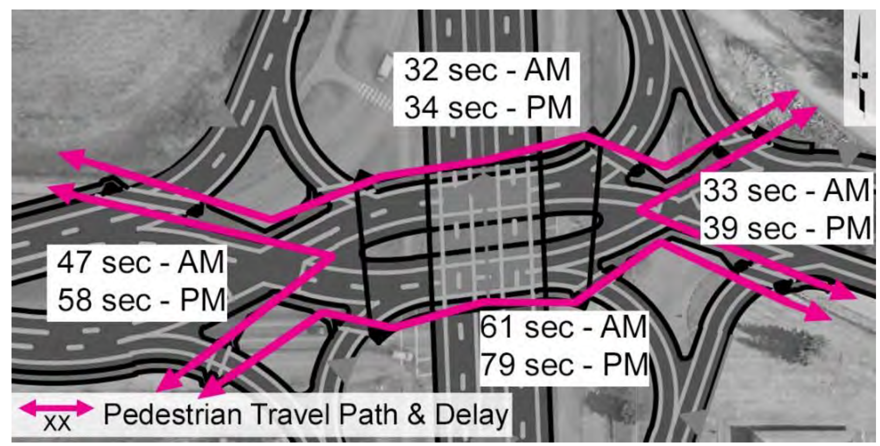
ALTERNATIVE G3

Diverging Diamond Interchange



Vehicle Delay





Pedestrian Delay

Figure 74: Operational Parameters for Alternative G3, Diverging Diamond Interchange

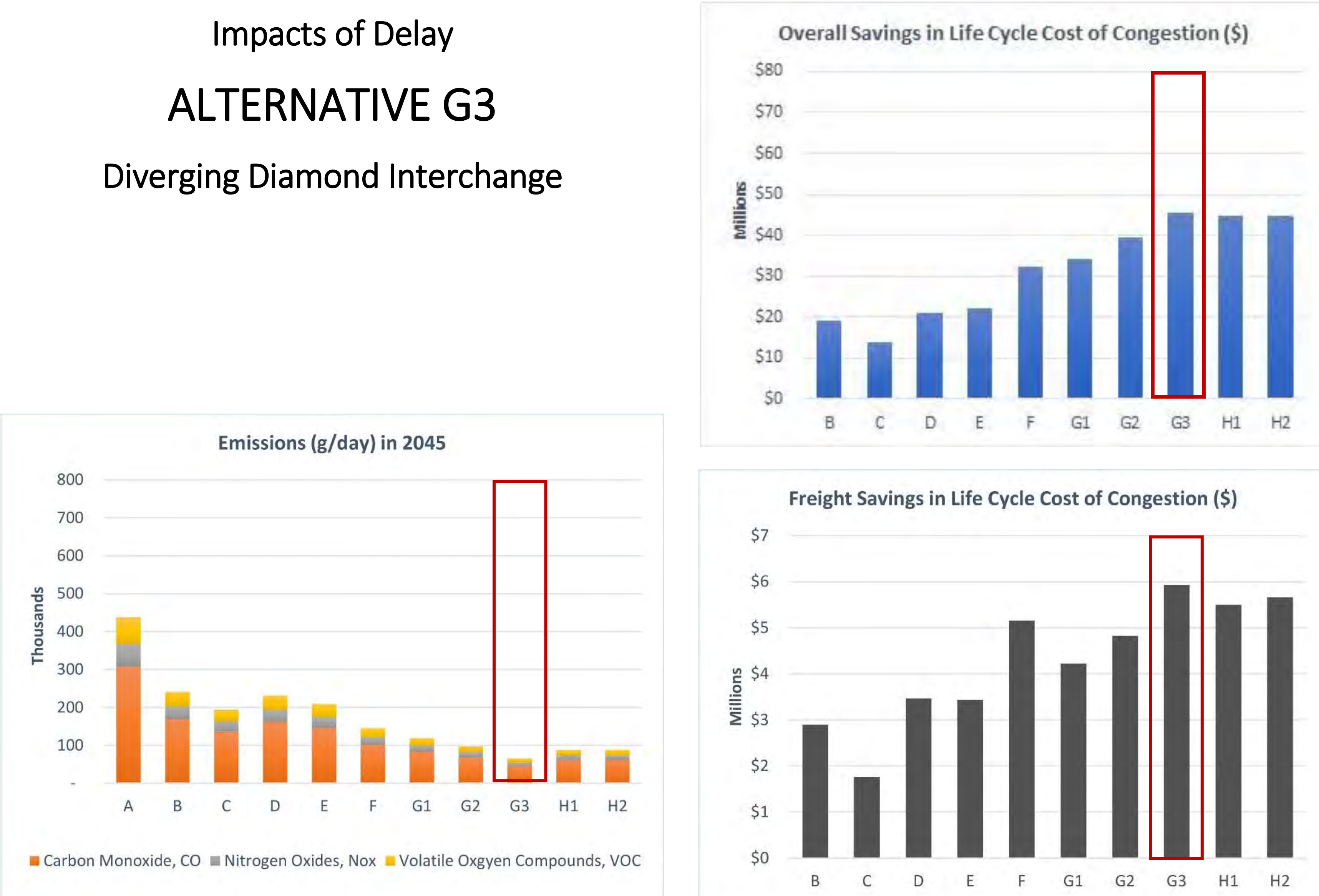


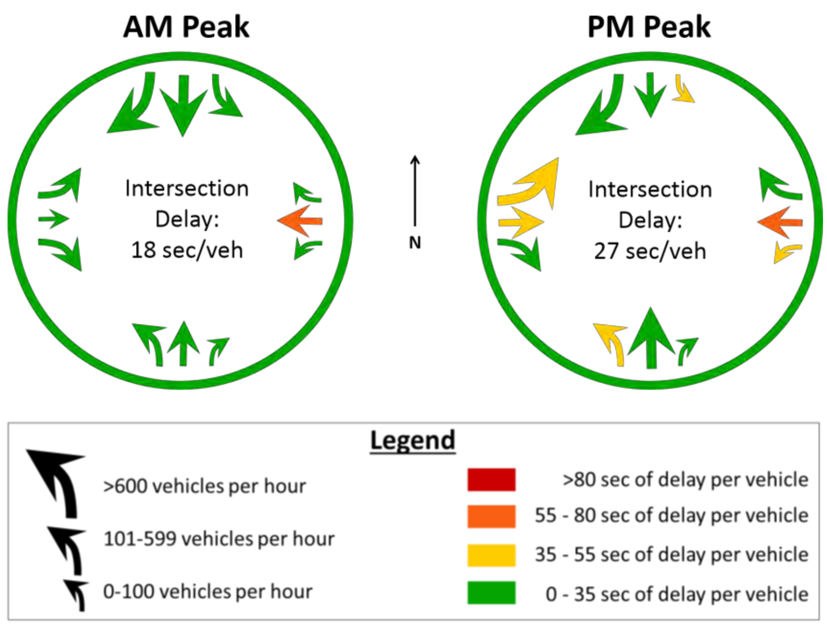
Figure 75: Impacts of Delay for Alternative G3, Diverging Diamond Interchange

2045 Design Year Operational Parameters

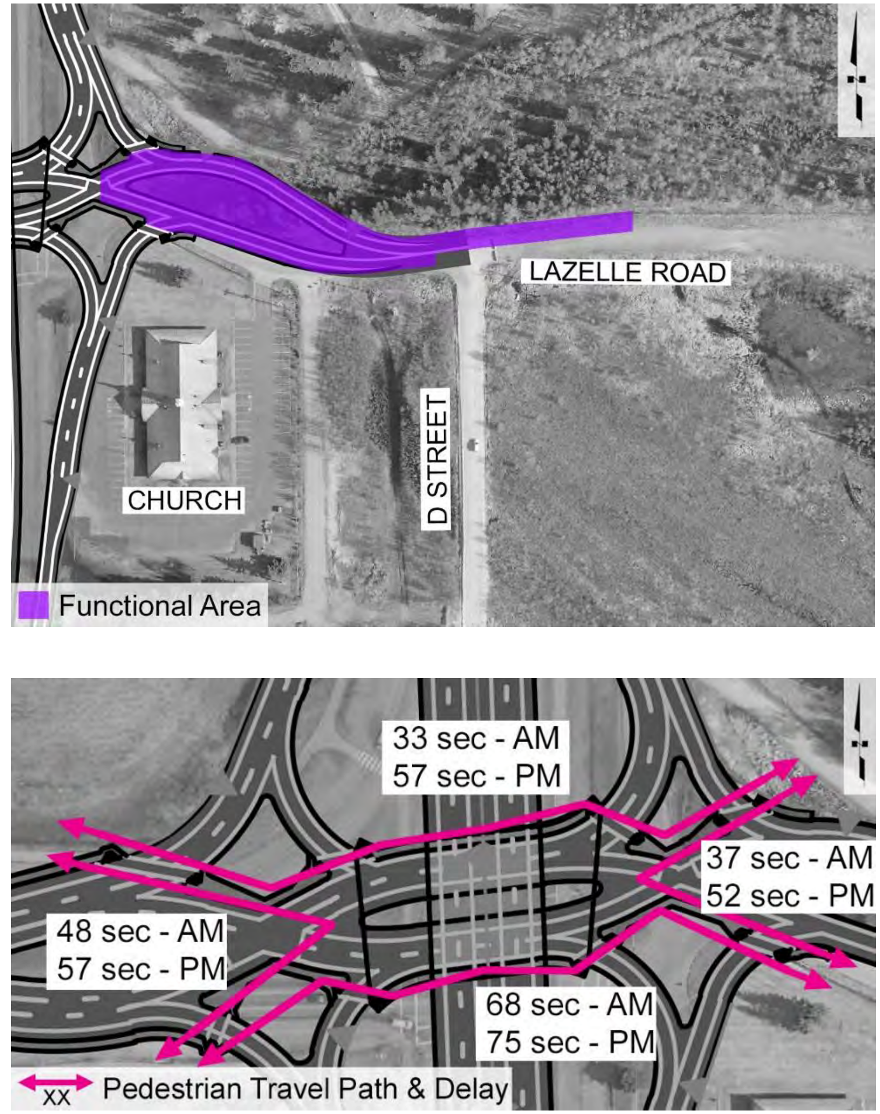
ALTERNATIVE G3

Diverging Diamond Interchange

with Relocation of Fort Wainwright Gate



Vehicle Delay



Pedestrian Delay

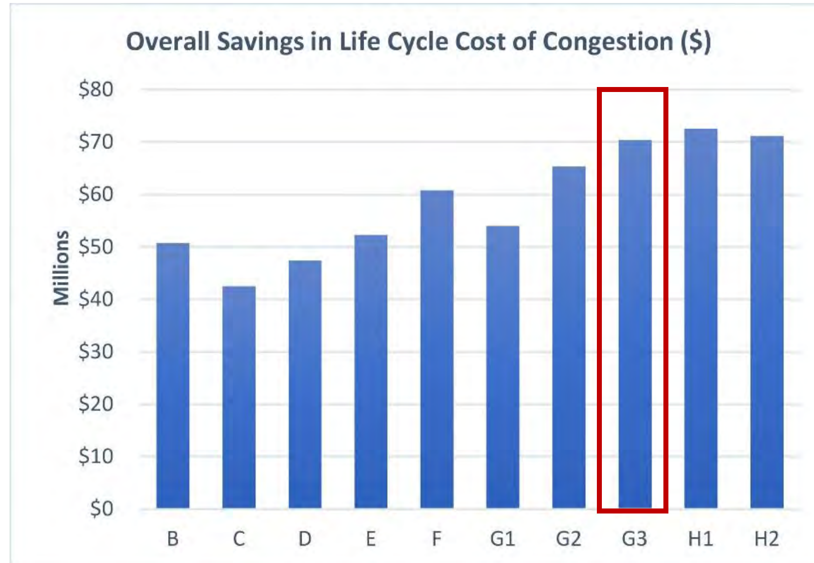
Figure 76: Operational Parameters for Alternative G3, Diverging Diamond Interchange with Relocation of Fort Wainwright Gate

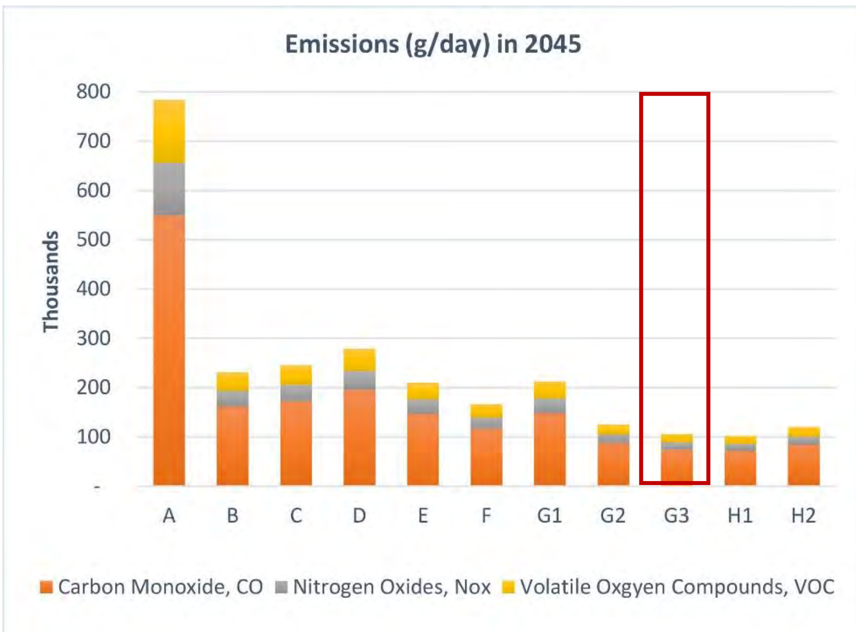
Impacts of Delay

ALTERNATIVE G3

Diverging Diamond Interchange

with Relocation of Fort Wainwright Gate





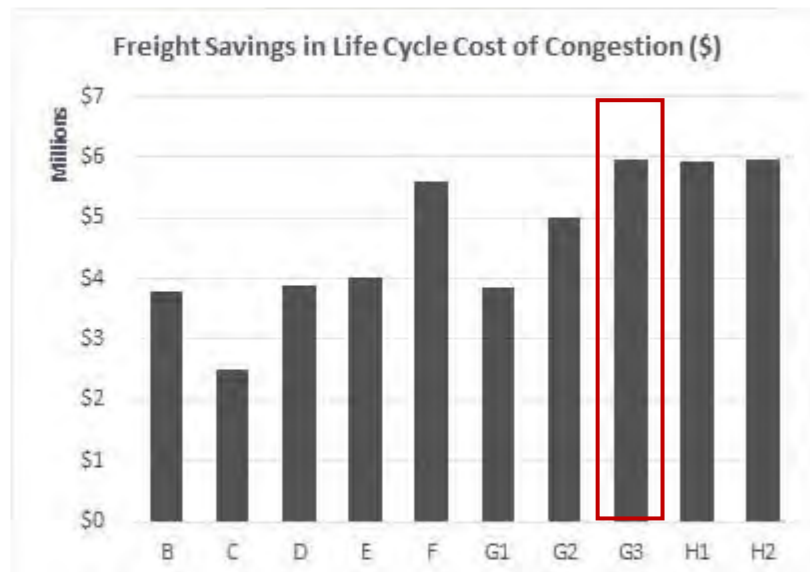


Figure 77: Impacts of Delay for Alternative G3, Diverging Diamond Interchange with Relocation of Fort Wainwright Gate

4.10.5 Design Impacts

4.10.5.1 Physical (ROW) impacts and acquisition needs

Figure 78 presents the ROW impacts under Alternative G3 (Diverging Diamond Interchange).

4.10.5.2 *Snow storage and snow removal*

DOT&PF M&O considers Alternative G3 much harder to maintain and operate compared to the No Build condition.

4.10.6 Cost Estimate

Table 15: Cost Estimate for Alternative G3, Diverging Diamond Interchange

Category	Cost
Project Development	$ 3,200,000
Right of Way	$ 5,700,000
Utilities	$ 3,100,000
Construction Total	$ 21,000,000
Total Projected Estimated Cost	**$ 33,000,000**

The above Order-of-Magnitude Estimate is in 2018 dollars based on conceptual design. Final costs of the project will depend on labor and material costs, site conditions, productivity, market conditions, scope, and other variable factors.

4.10.7 Summary

Alternative G3 improves all four concerns identified in the project purpose and need:

Improves Pedestrian and Bicycle Safety	✓
Decreases Pedestrian Delay	✓
Reduces Weaving	✔
Reduces Vehicular Delay	✔

✔ = Meets goal much better than No Build ✓ = Meets goal better than No Build

Figure 78: ROW Impacts for Alternative G3, Diverging Diamond Interchange

4.11 Alternative H1 – Echelon Interchange

4.11.1 Alternative Concept

Alternative H1 would construct an echelon interchange, as shown in Figure 79.[8] This design creates two intersections, one at grade and the other elevated. The southbound and eastbound approaches would be elevated, while the northbound and westbound approaches intersect on the ground. The southbound right turn movement will stay free flowing and enter into its own lane on westbound Johansen Expressway (similar to existing). Pedestrians will pass under this lane.

The advantage of this design is that high volume conflicting movements can be separated. In the morning, the heavy southbound through volume is accommodated at the elevated intersection while the heavy northbound left volume is accommodated at the ground level intersection. In the evening, the heavy eastbound left turn volume is accommodated at the elevated intersection while the heavy northbound through and left volume is accommodated at the ground level intersection.

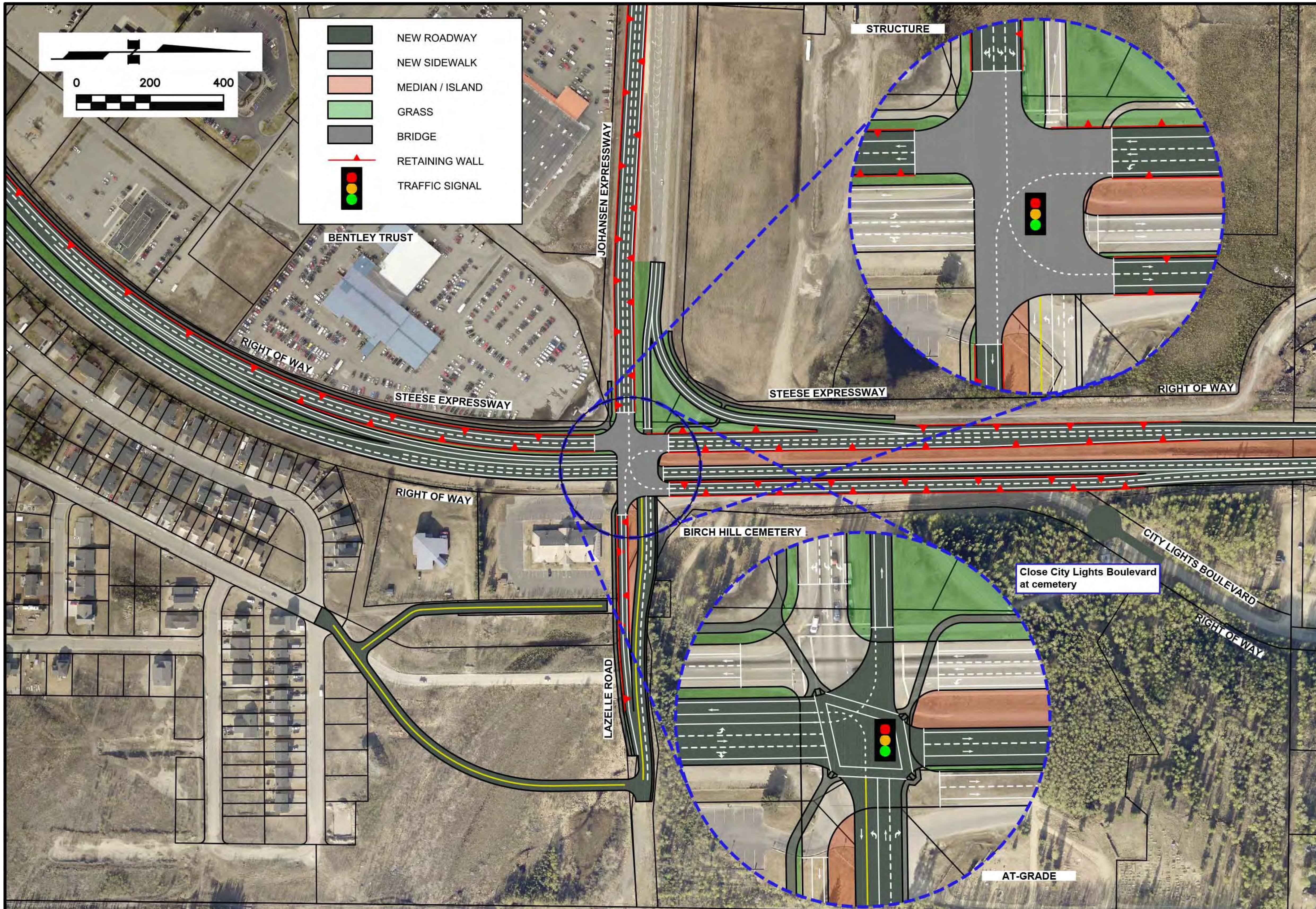
This alternative is a partial interchange. Only one echelon interchange has been built in the United States to date – in Aventura, Florida.

4.11.2 Pedestrian Safety

As a partial interchange, one of the benefits of this design is that pedestrians no longer cross some of the traffic movements, as that traffic is grade-separated. Additionally, the pedestrian crossings are relatively short.

This design allows pedestrians to cross the north leg of the interchange.

[8] See http://attap.umd.edu/uids-knowlege-base/Echelon.php to see how vehicles move through this type of interchange.



Morning Peak:

- Southbound right turn vehicles operate the same as existing, with no stopping except to allow pedestrians to cross.
- Southbound through and left turn traffic is brought up to an elevated intersection, while northbound traffic is brought to an intersection at-grade. This provides sufficient capacity for northbound left turn traffic without the need for dual lanes.

Evening Peak:

- Eastbound traffic is bought up to an elevated intersection, while northbound traffic is brought to an intersection at-grade. This provides sufficient capacity that only two eastbound left turn lanes and only two northbound through lanes are needed.

Pedestrians:

- Pedestrians will pass under the southbound right turn lane.
- Pedestrians pass through the intersection at-grade and all crossings are signalized.
- Pedestrians are allowed to cross all legs of the intersection.

Figure 79: Alternative H1 – Echelon Interchange

4.11.3 Design Volumes

The design volumes for this alternative are the same as for the No Build alternative, presented in Section 4.2.3 on page 26.

4.11.4 Daily Operations in 2045 and Annual Cost of Congestion

Figure 80 presents the average vehicle delay, average pedestrian delay, and functional area of the intersection under Alternative H1 (Echelon Interchange).

Figure 81 presents the impacts of delay on vehicle emissions, as well as the value of the savings in delay for Alternative H1 (Echelon Interchange) as compared to Alternative A (No Build).

Figure 82 and Figure 83 present the same information for Alternative H1 (Echelon Interchange) with the relocation of the Fort Wainwright main gate.

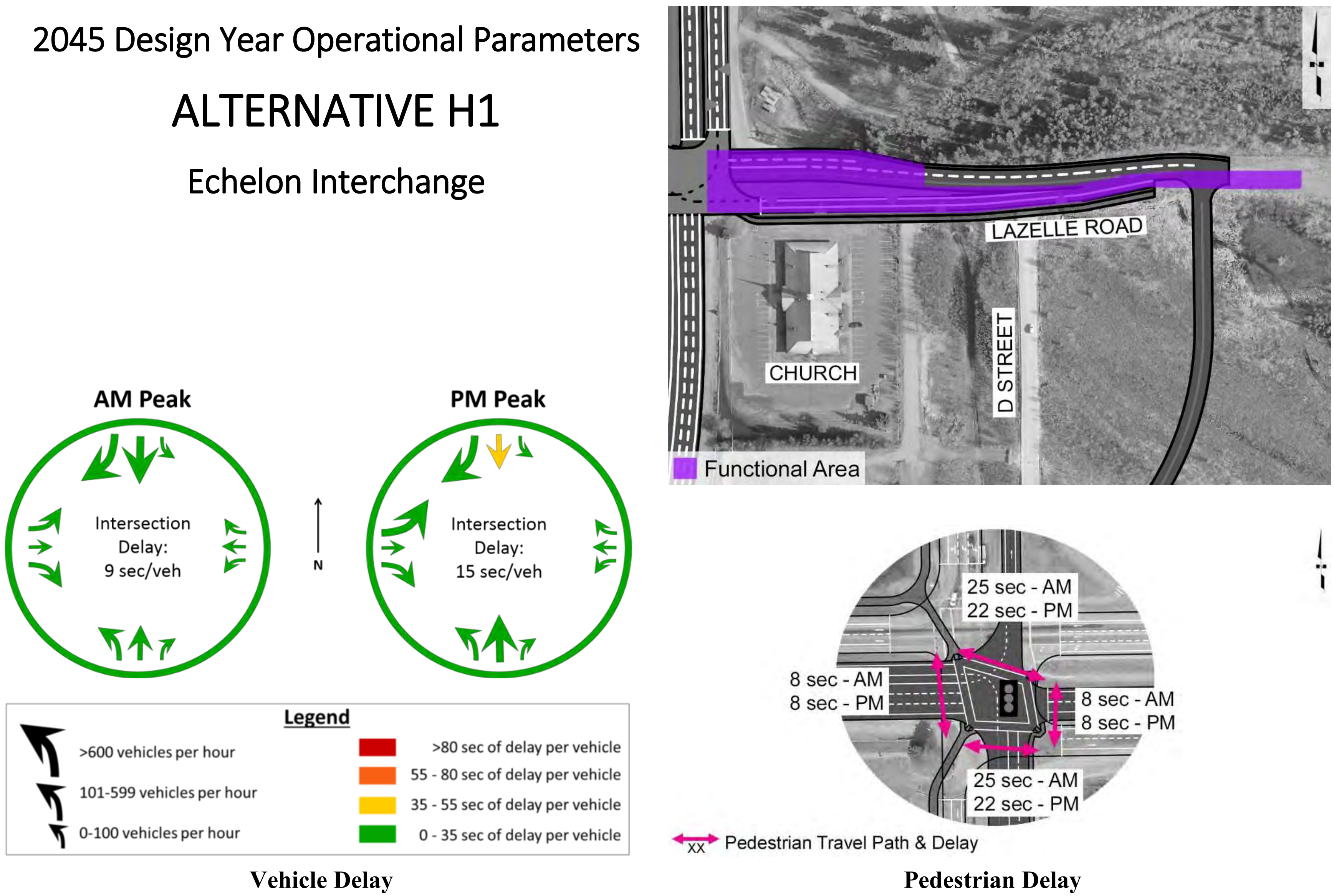
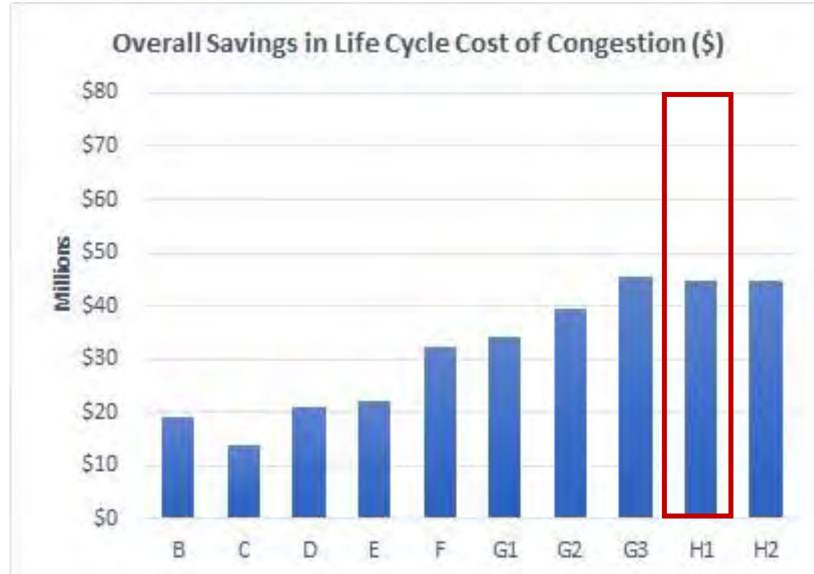


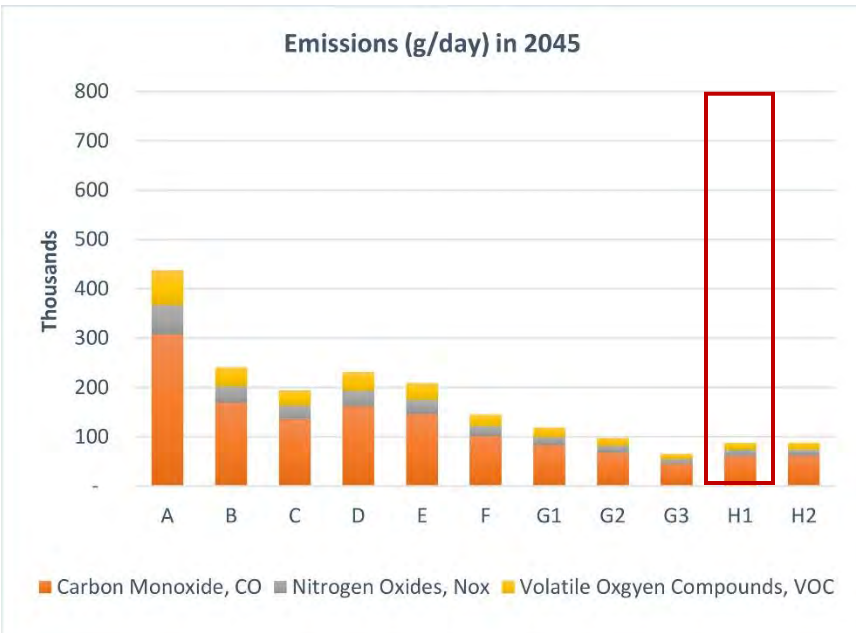
Figure 80: Operational Parameters for Alternative H1, Echelon Interchange

Impacts of Delay

ALTERNATIVE H1

Echelon Interchange





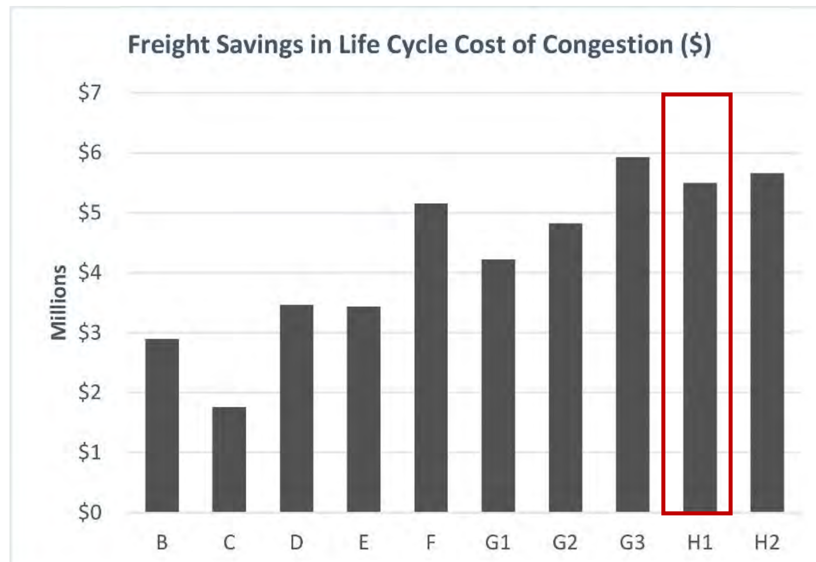
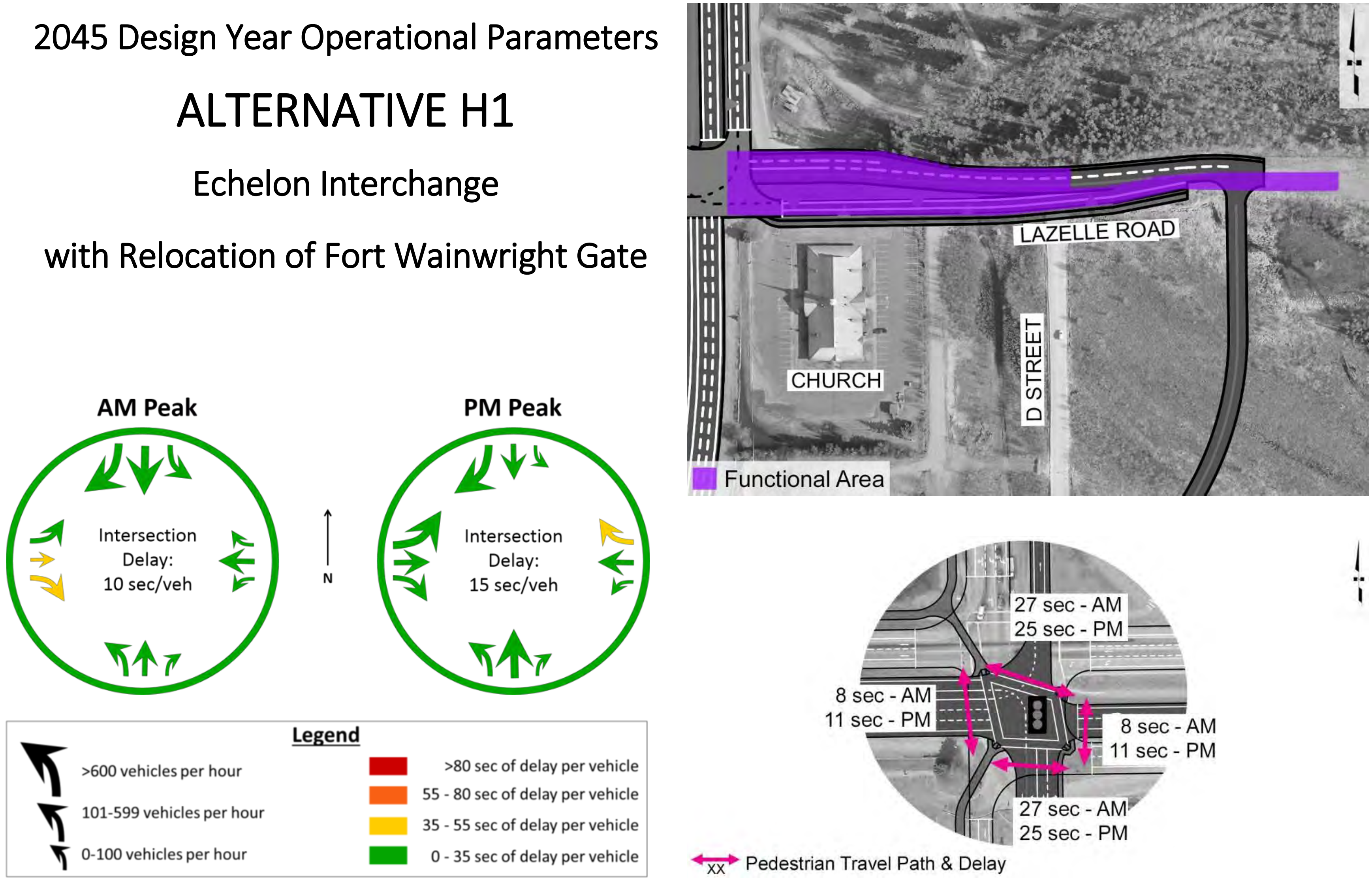


Figure 81: Impacts of Delay for Alternative H1, Echelon Interchange



Vehicle Delay **Pedestrian Delay**

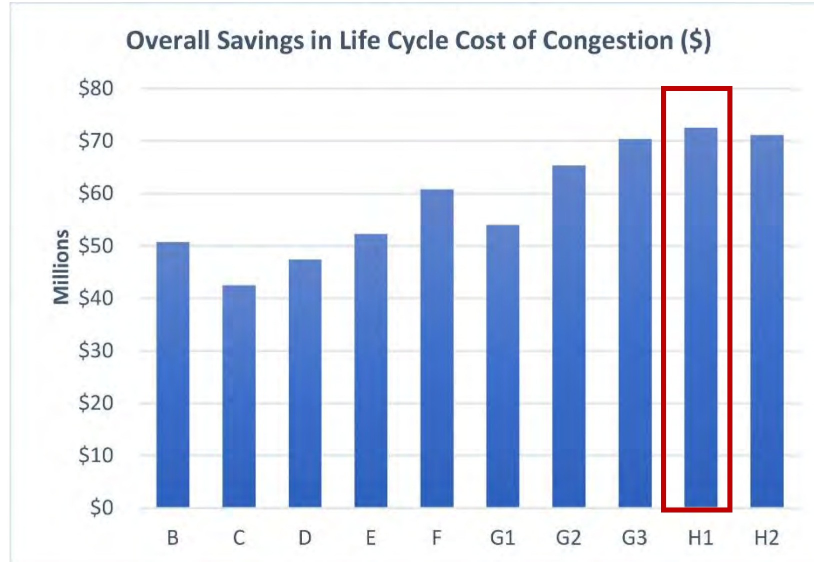
Figure 82: Operational Parameters for Alternative H1, Echelon Interchange with Relocation of Fort Wainwright Gate

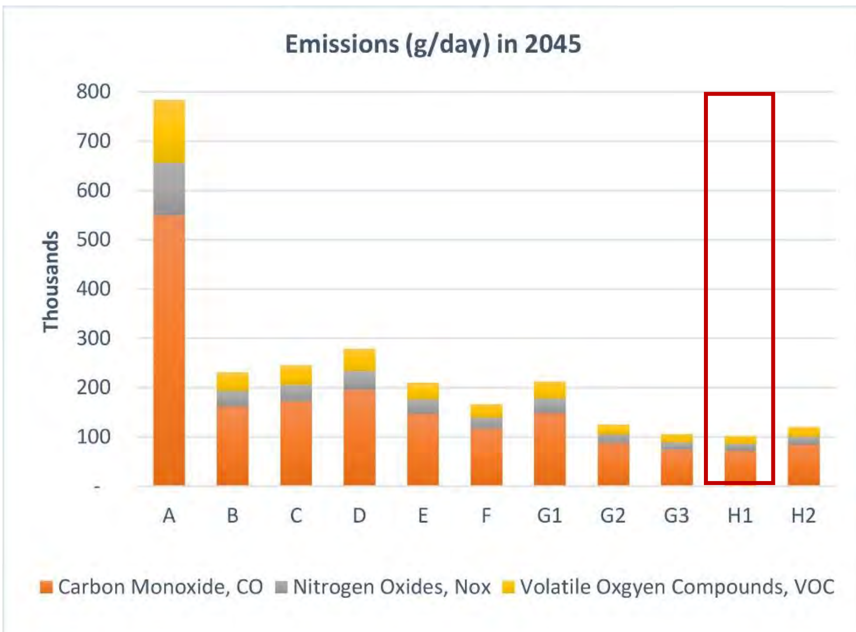
Impacts of Delay

ALTERNATIVE H1

Echelon Interchange

with Relocation of Fort Wainwright Gate





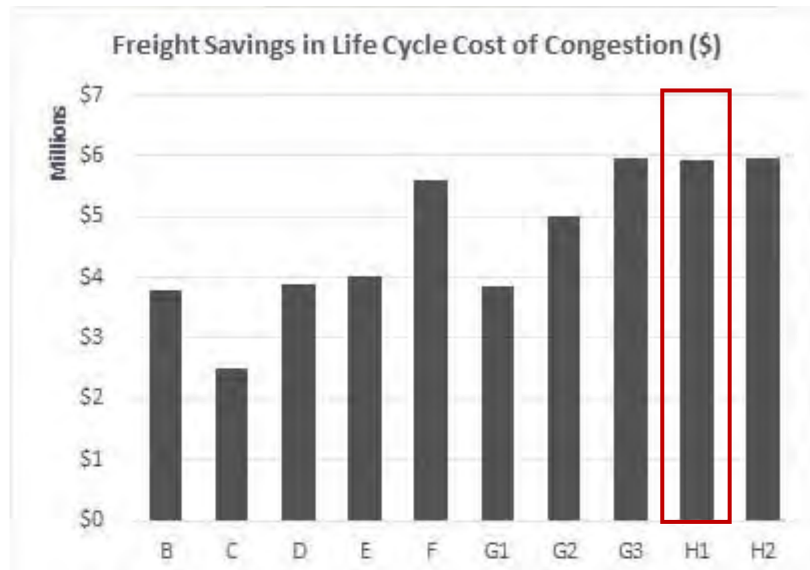


Figure 83: Impacts of Delay for Alternative H1, Echelon Interchange with Relocation of Fort Wainwright Gate

4.11.5 Design Impacts

4.11.5.1 Physical (ROW) impacts and acquisition needs

Figure 84 presents the ROW impacts under Alternative H1 (Echelon Interchange).

***4.11.5.2** Snow storage and snow removal*

DOT&PF M&O considers Alternative H1 (Echelon Interchange) to have the same maintenance and operational needs as the No Build condition.

4.11.6 Cost Estimate

Table 16: Cost Estimate for Alternative H1, Echelon Interchange

Category	Cost
Project Development	$ 3,600,000
Right of Way	$ 2,200,000
Utilities	$ 3,200,000
Construction Total	$ 23,900,000
Total Projected Estimated Cost	**$ 32,900,000**

The above Order-of-Magnitude Estimate is in 2018 dollars based on conceptual design. Final costs of the project will depend on labor and material costs, site conditions, productivity, market conditions, scope, and other variable factors.

4.11.7 Summary

Alternative H1 meets all four concerns identified in the project purpose and need:

Improves Pedestrian and Bicycle Safety	✔
Decreases Pedestrian Delay	✔
Reduces Weaving	✔
Reduces Vehicular Delay	✔

✔ = Meets goal much better than No Build ✓ = Meets goal better than No Build

Figure 84: ROW Impacts for Alternative H1, Echelon Interchange

4.12 Alternative H2 – Partial Echelon Interchange

4.12.1 Alternative Concept

Alternative H2 would construct a partial echelon interchange, without a ramp from the elevated structure down to Lazelle Road, depicted in Figure 85. Instead, the movements that would use the westbound ramp would be accommodated at the ground level intersection. The southbound through and eastbound right and left approaches would still be elevated, but the southbound left turn and eastbound through would remain at grade and intersect with the northbound and westbound approaches on the ground.

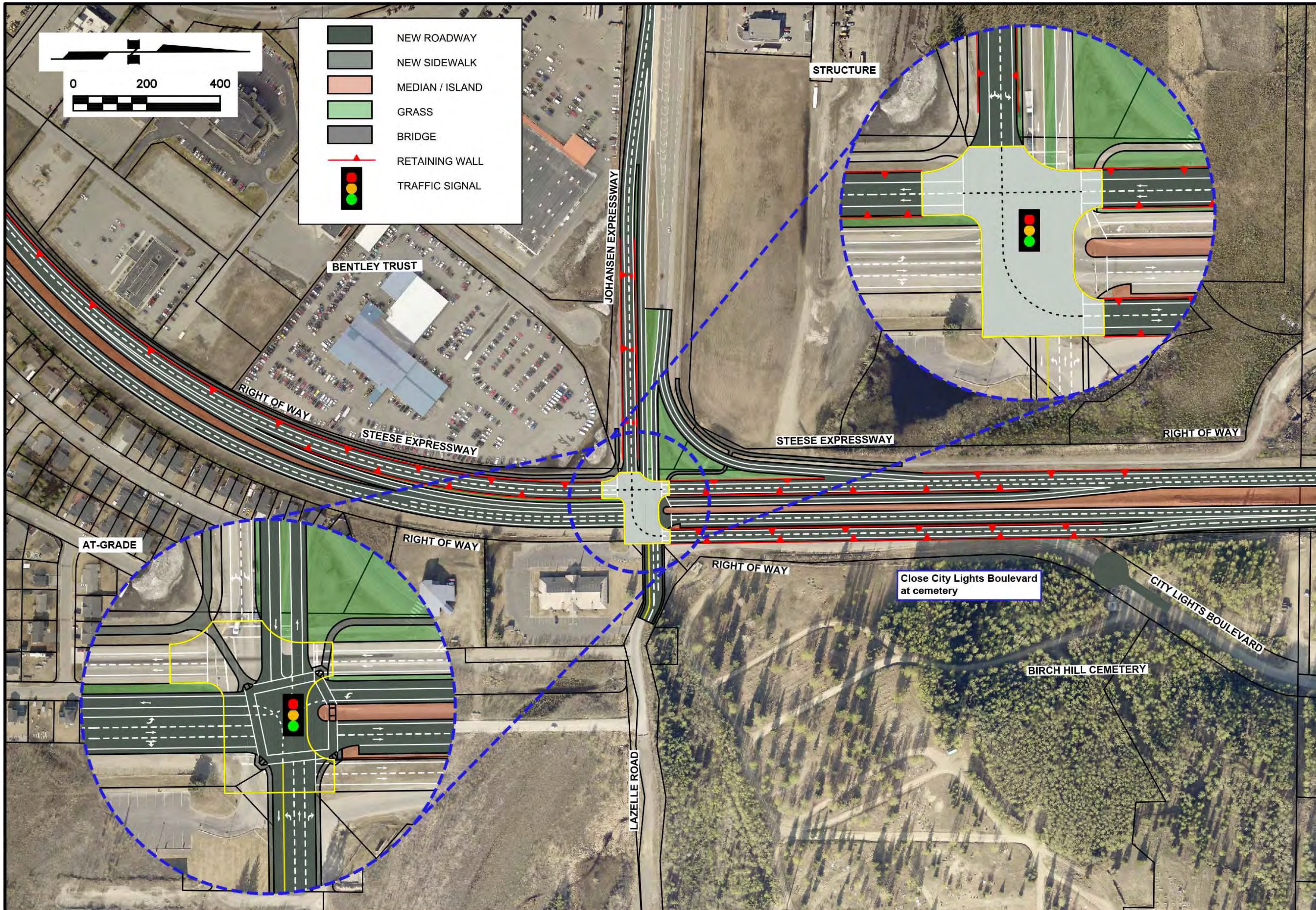
This reduces the cost of the structure and some ROW impacts, while introducing relatively low volume conflicts (and therefore a small amount of delay) to the at-grade intersection.

This alternative is a partial interchange. Only one echelon interchange has been built in the United States to date – in Aventura, Florida.

4.12.2 Pedestrian Safety

As a partial interchange, one of the benefits of this design is that pedestrians no longer cross some of the traffic movements, as that traffic is grade-separated. Additionally, the pedestrian crossings are relatively short.

This design allows pedestrians to cross the north leg of the interchange.



This alternative differs from Alternative H1 in that southbound left turn and eastbound through traffic is brought to the intersection at-grade, eliminating the need for an elevated eastbound ramp to Lazelle Road.

Morning Peak:

- Southbound right turn vehicles operate the same as existing, with no stopping except to allow pedestrians to cross.
- Southbound through traffic is brought up to an elevated intersection, while southbound left turn and northbound traffic is brought to an intersection at-grade. This provides sufficient capacity for northbound left turn traffic without the need for dual lanes.

Evening Peak:

- Eastbound left turn traffic is bought up to an elevated intersection, while eastbound through traffic and northbound traffic is brought to an intersection at-grade. This provides sufficient capacity that only two eastbound left turn lanes and only two northbound through lanes are needed

Pedestrians:

- Pedestrians pass through the intersection at-grade and all crossings are signalized.
- Pedestrians are allowed to cross all legs of the intersection.

Figure 85: Alternative H2 – Partial Echelon Interchange

4.12.3 Design Volumes

The design volumes for this alternative are the same as for the No Build alternative, presented in Section 4.2.3 on page 26.

4.12.4 Daily Operations in 2045 and Annual Cost of Congestion

Figure 86 presents the average vehicle delay, average pedestrian delay, and functional area of the intersection under Alternative H2 (Partial Echelon Interchange).

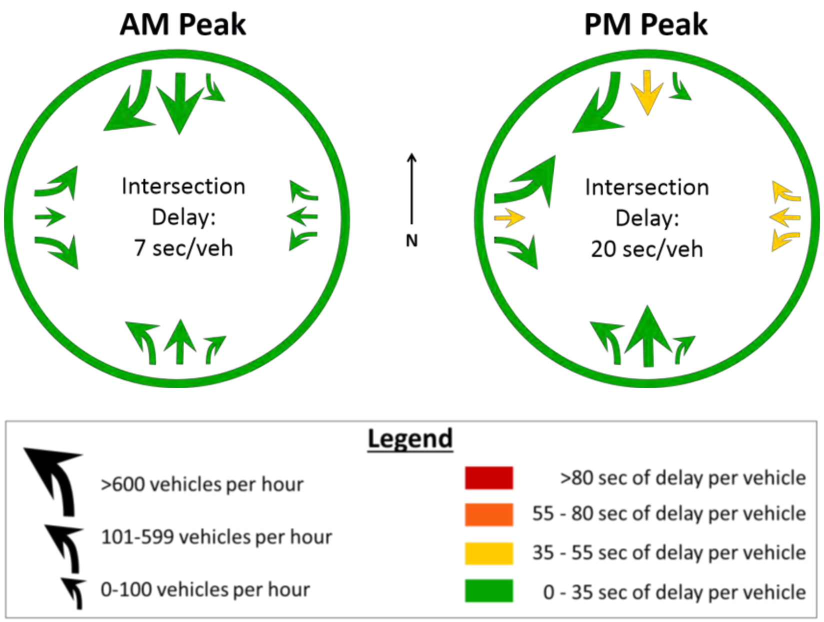
Figure 87 presents the impacts of delay on vehicle emissions, as well as the value of the savings in delay for Alternative H2 (Partial Echelon Interchange) as compared to Alternative A (No Build).

Figure 88 and Figure 89 present the same information for Alternative H2 (Partial Echelon Interchange) with the relocation of the Fort Wainwright main gate.

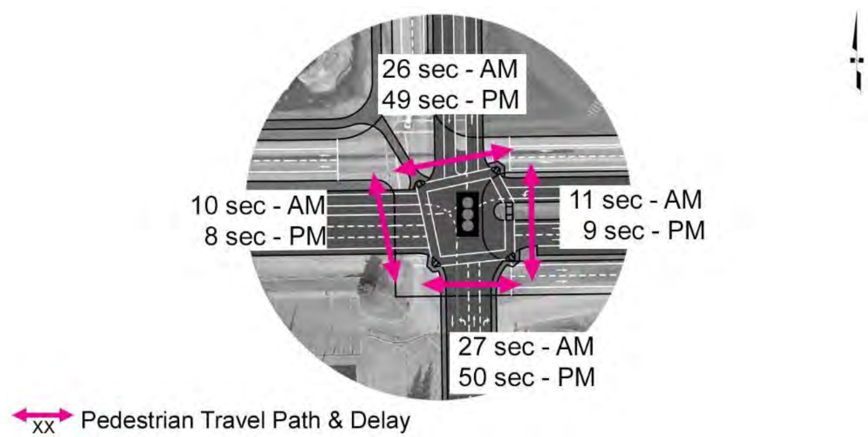
2045 Design Year Operational Parameters

ALTERNATIVE H2

Echelon Interchange



Vehicle Delay



Pedestrian Delay

Figure 86: Operational Parameters for Alternative H2, Partial Echelon Interchange

Impacts of Delay

ALTERNATIVE H2

Echelon Interchange

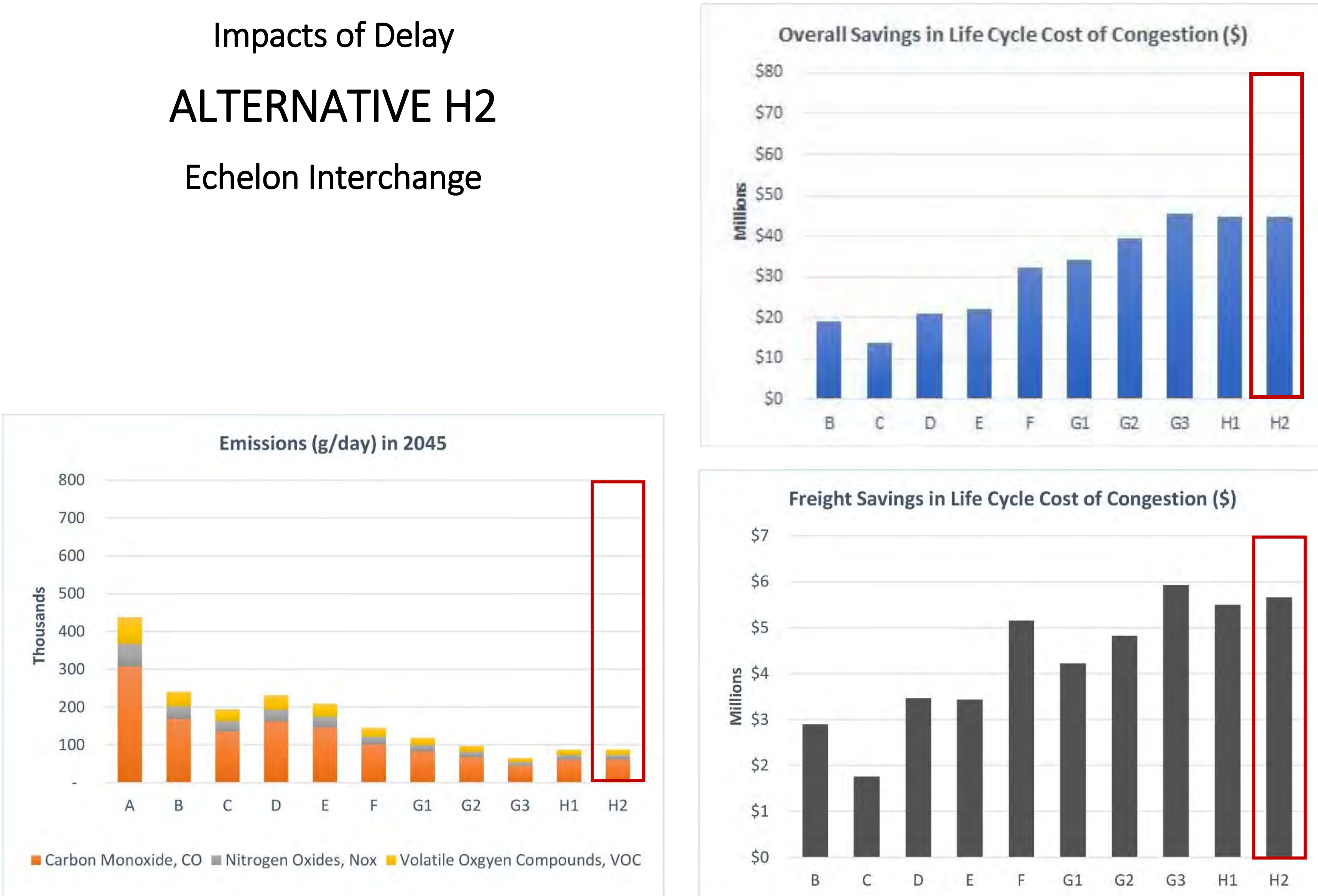
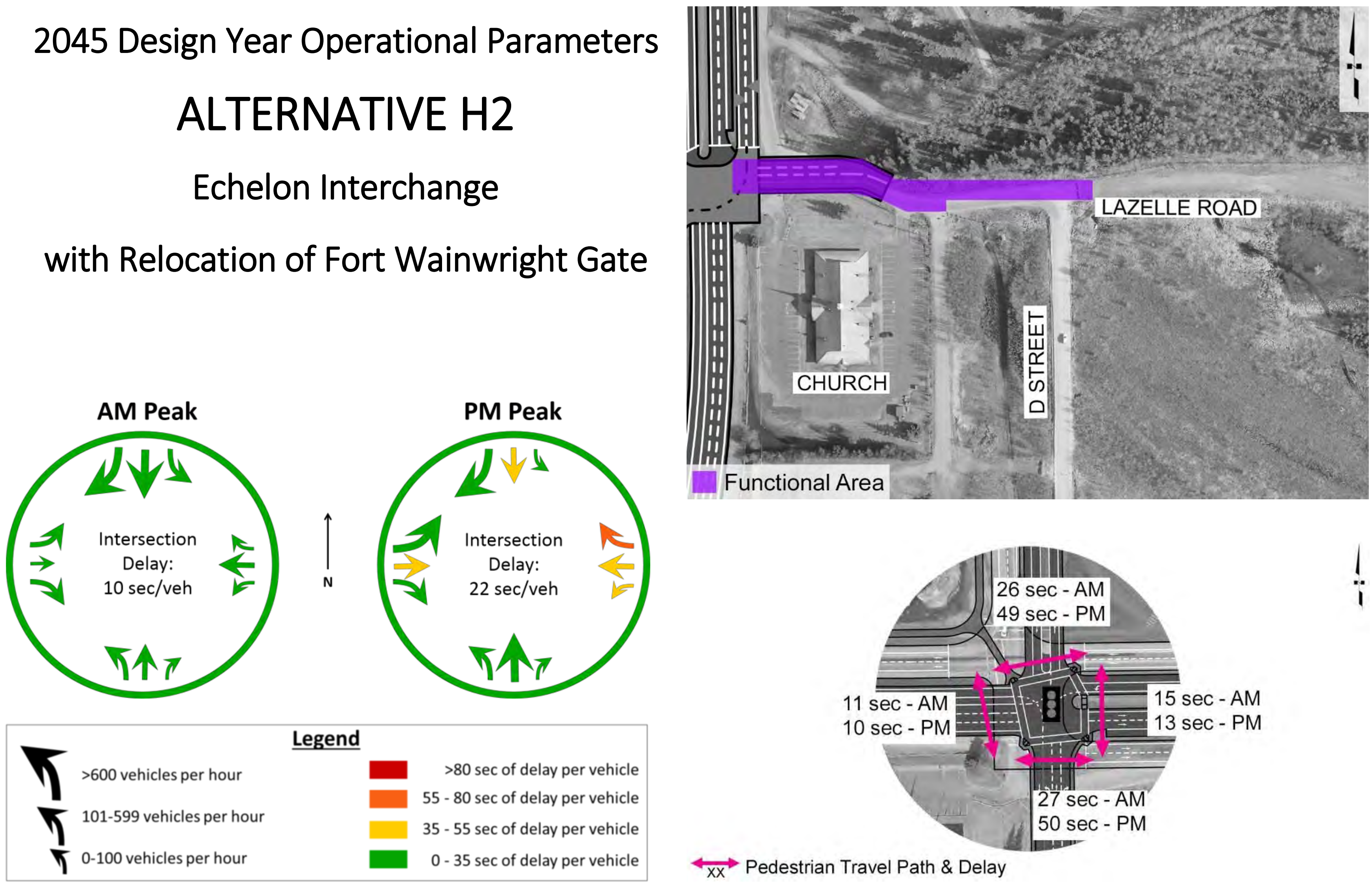


Figure 87: Impacts of Delay for Alternative H2, Partial Echelon Interchange



Vehicle Delay **Pedestrian Delay**

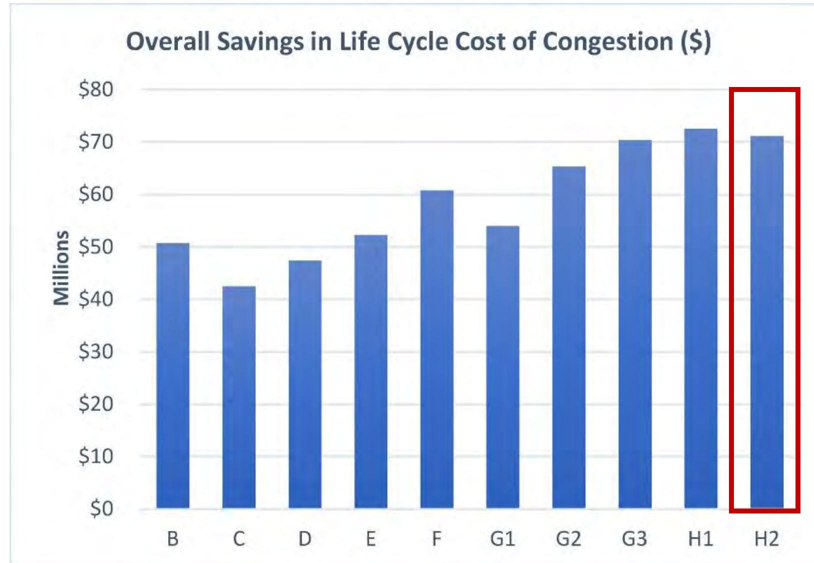
Figure 88: Operational Parameters for Alternative H2, Partial Echelon Interchange with Relocation of Fort Wainwright Gate

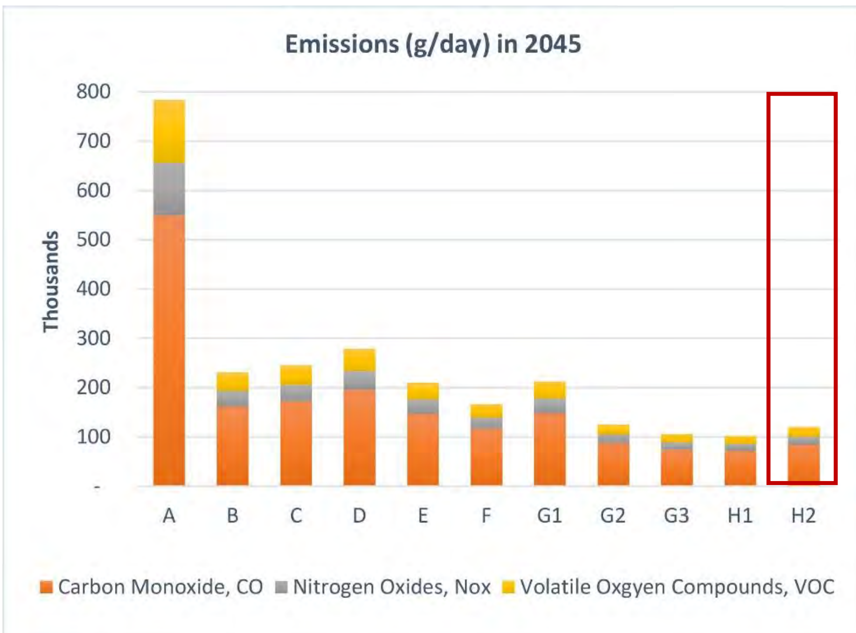
Impacts of Delay

ALTERNATIVE H2

Echelon Interchange

with Relocation of Fort Wainwright Gate





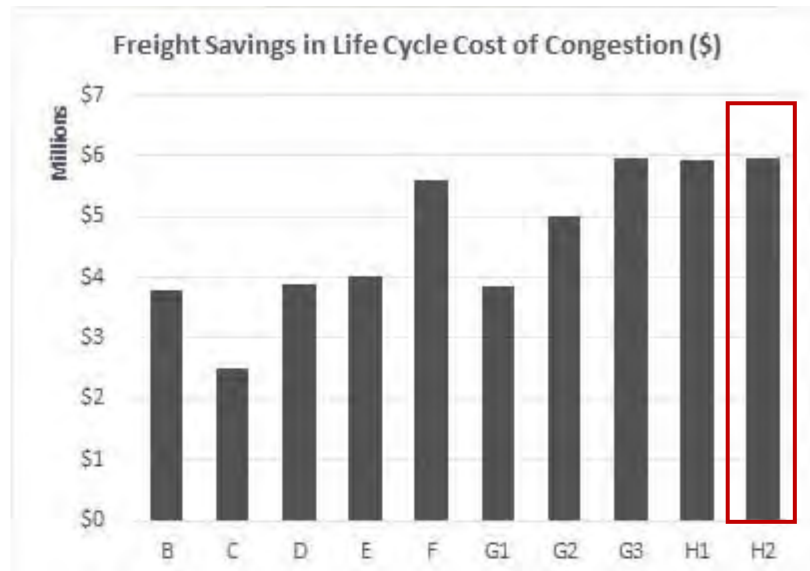


Figure 89: Impacts of Delay for Alternative H2, Partial Echelon Interchange with Relocation of Fort Wainwright Gate

4.12.5 Design Impacts

4.12.5.1 Physical (ROW) impacts and acquisition needs

Figure 90 presents the ROW impacts under Alternative H2 (Partial Echelon Interchange).

***4.12.5.2** Snow storage and snow removal*

DOT&PF M&O considers it easier to maintain and operate Alternative H2 compared to No Build conditions.

4.12.6 Cost Estimate

Table 17: Cost Estimate for Alternative H2, Partial Echelon Interchange

Category	**Cost**
Project Development	$ 3,500,000
Right of Way	$ 400,000
Utilities	$ 3,200,000
Construction Total	$ 23,600,000
Total Projected Estimated Cost	**$ 30,700,000**

The above Order-of-Magnitude Estimate is in 2018 dollars based on conceptual design. Final costs of the project will depend on labor and material costs, site conditions, productivity, market conditions, scope, and other variable factors.

4.12.7 Summary

Alternative H2 meets all four concerns identified in the project purpose and need:

Improves Pedestrian and Bicycle Safety	✔
Decreases Pedestrian Delay	✓
Reduces Weaving	✔
Reduces Vehicular Delay	✔

✔ = Meets goal much better than No Build ✓ = Meets goal better than No Build

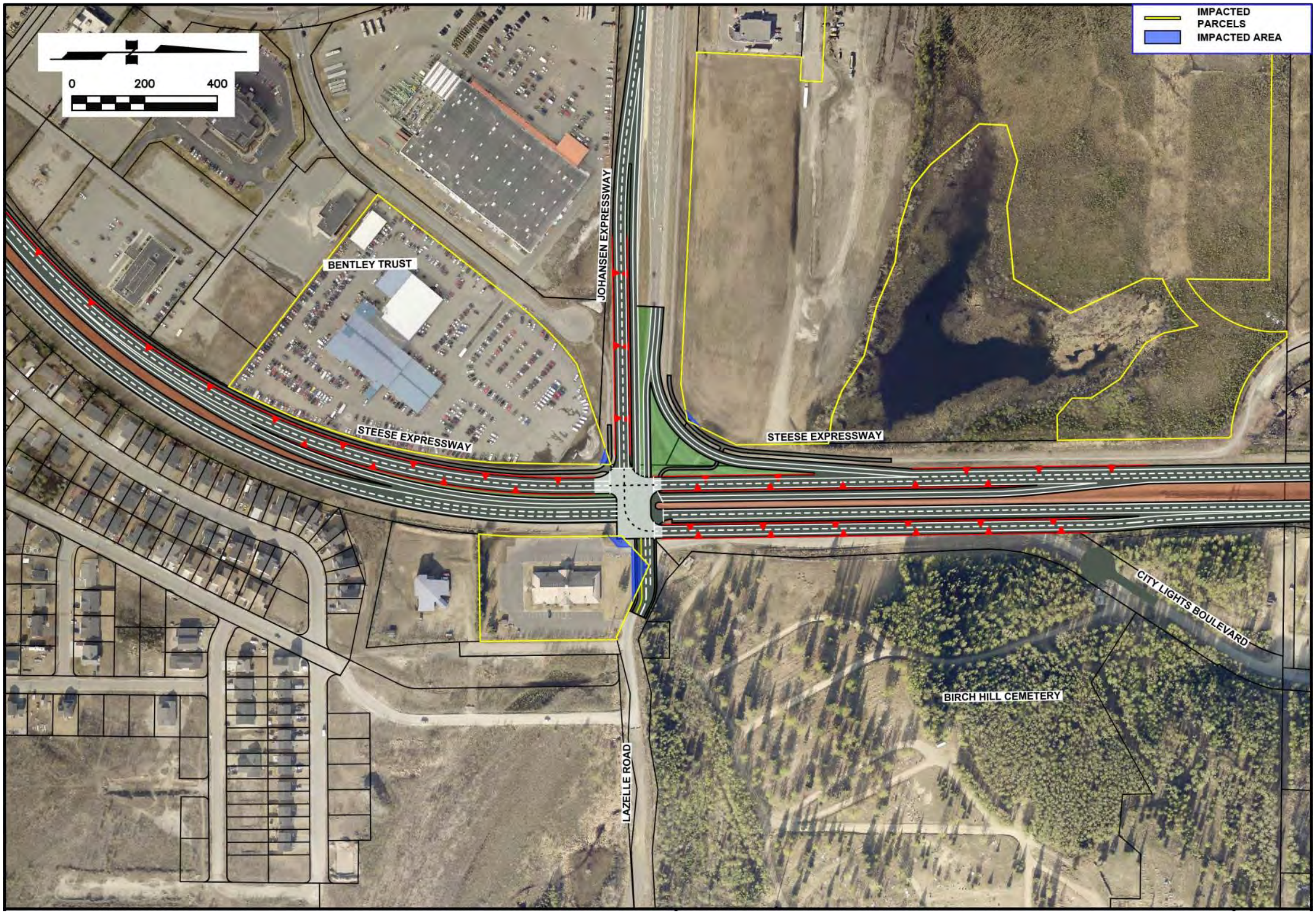


Figure 90: ROW Impacts for Alternative H2, Partial Echelon Interchange

4.13 Alternative I – Pedestrian Overpass

4.13.1 Alternative Concept

This concept is focused solely on separating the most vulnerable pedestrian movements from the highway traffic, and could be added on to most of the other alternatives. As shown in Figure 91, it proposes building a pedestrian overpass that would allow pedestrians originating from the Lazelle Estates residential area to cross the Steese Expressway, where they could access the multi-use trail that runs along the west side of the Steese Expressway as well as the commercial uses in the Bentley Trust area. Pedestrian crossing at the Steese-Jo intersection would still be accommodated as described in the other alternatives.

Pedestrian overpasses are most likely to be used when they are more convenient than the alternative. In this case, the overpass would access the neighborhood closer to many of the residences than either the Steese-Jo intersection or the intersection of Trainor Gate Road with the Steese Expressway. Since there are no other crossing locations between these two intersections, it would hopefully be seen as more convenient and would divert pedestrians from the at-grade crossings.

There are several pedestrian overpasses built in Fairbanks. Some have been removed, but others are in frequent use.

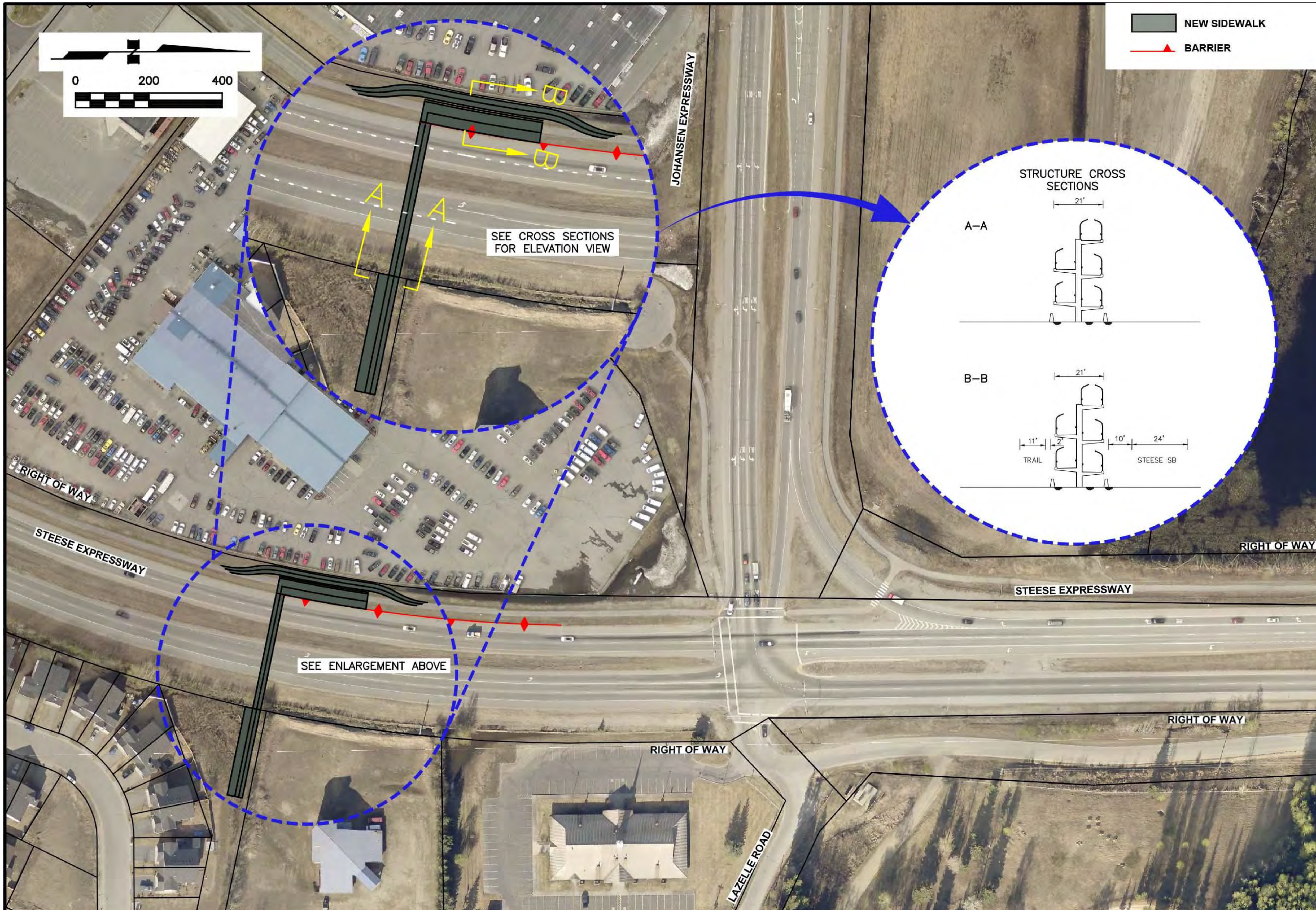
4.13.2 Pedestrian Safety

This alternative allows pedestrians to cross the Steese Expressway without interacting with any vehicles. As such, this alternative is the best alternative for pedestrian safety.

4.13.3 Daily Operations

This alternative would eliminate all pedestrian delay for crossing the Steese Expressway. The goal would be to place the overpass so that few pedestrians would have to travel out of their way to use the overpass.

The alternative would not impact vehicle delay.



Pedestrians:

- Pedestrians climb a ramp to a bridge over the Steese Expressway. The overpass connects to the multi-use trail on the west side of the Steese Expressway and to the churches and neighborhoods on the east side of the Steese Expressway.

Figure 91: Alternative I – Pedestrian Overpass

4.13.4 Design Impacts

4.13.4.1 Physical (ROW) impacts and acquisition needs

Figure 92 presents the ROW impacts under Alternative I (Pedestrian Overpass).

4.13.4.2 *Snow storage and snow removal*

DOT&PF M&O considers Alternative I harder to maintain and operate compared to the No Build condition.

4.13.5 Cost Estimate

Table 18: Cost Estimate for Alternative I, Pedestrian Overpass

Category	Cost	
Project Development	$	600,000
Right of Way	$	300,000
Utilities	$	-
Construction Total	$	3,800,000
Total Projected Estimated Cost	**$**	**4,700,000**

The above Order-of-Magnitude Estimate is in 2018 dollars based on conceptual design. Final costs of the project will depend on labor and material costs, site conditions, productivity, market conditions, scope, and other variable factors.

4.13.6 Summary

Alternative I addresses two of the four concerns identified in the project purpose and need:

Improves Pedestrian and Bicycle Safety	✔
Decreases Pedestrian Delay	✔
Reduces Weaving	
Reduces Vehicular Delay	

✔ = Meets goal much better than No Build ✓ = Meets goal better than No Build

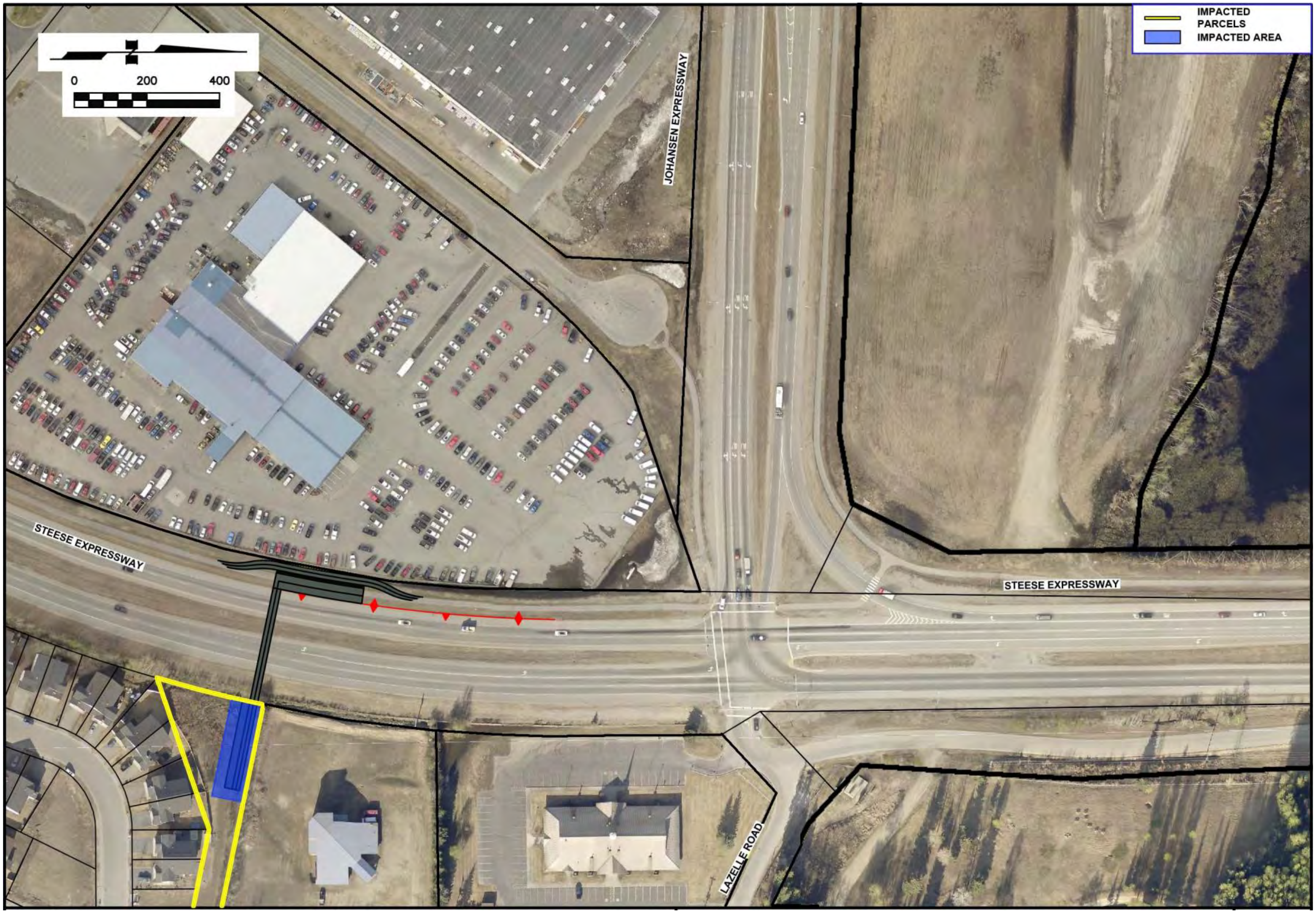


Figure 92: ROW Impacts for Alternative I, Pedestrian Overpass

5 Comparison of Alternatives

Figure 93 presents the AM peak intersection delay in 2045 under each alternative and Figure 94 summarizes the delays during the PM peak.

Figure 95 presents the life cycle savings in delay for each alternative as compared to Alternative A (No Build) and Figure 96 presents the life cycle savings for freight vehicles. Figure 97 summarizes the impacts of delay on vehicle emissions in 2045 for each alternative.

Figure 98 through Figure 102 summarizes the same information for each alternative with the relocation of the Fort Wainwright main gate.

Vehicles experience the least delays under Alternative G3 (Diverging Diamond), Alternative H1 (Echelon Interchange), and Alternative H2 (Partial Echelon Interchange). These three alternatives also have the most life cycle savings for all vehicles including freight and have the lowest vehicle emissions among the other alternatives.

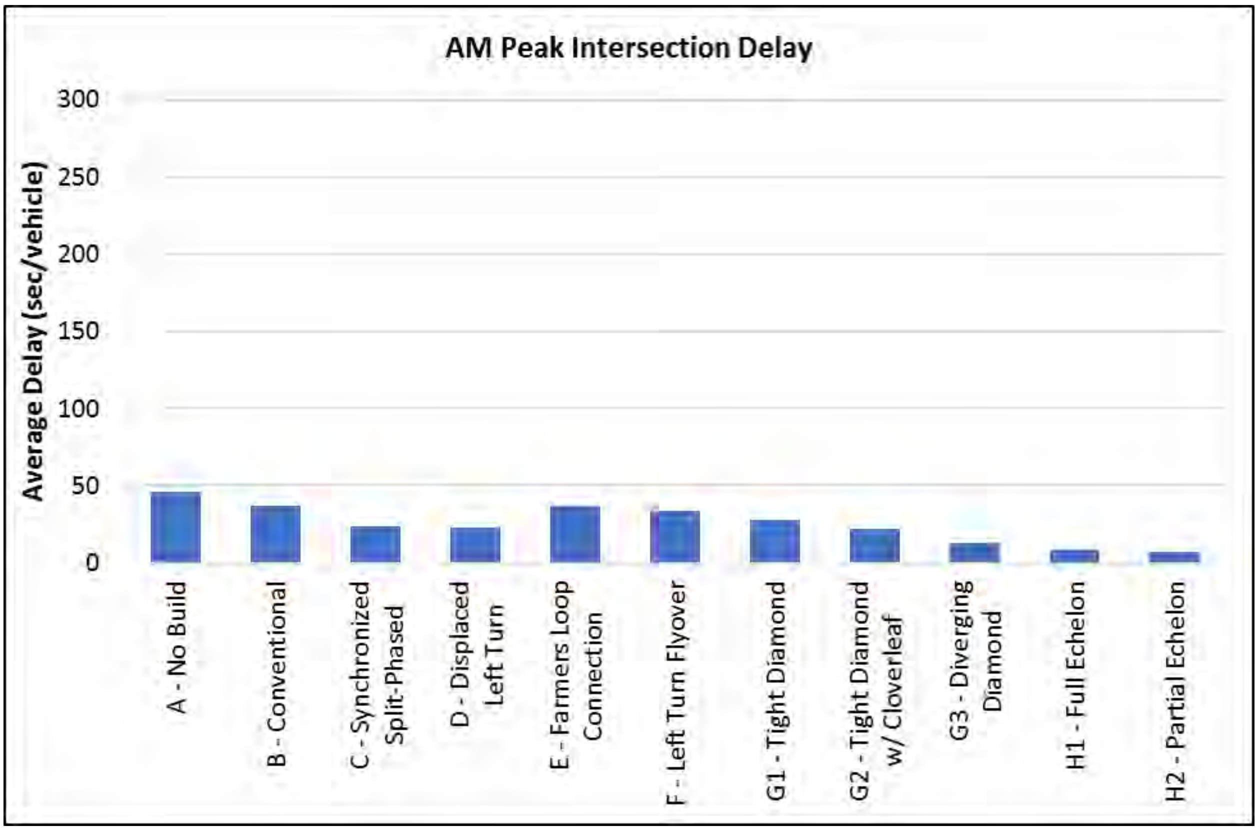


Figure 93: 2045 AM Peak Intersection Delay Summary

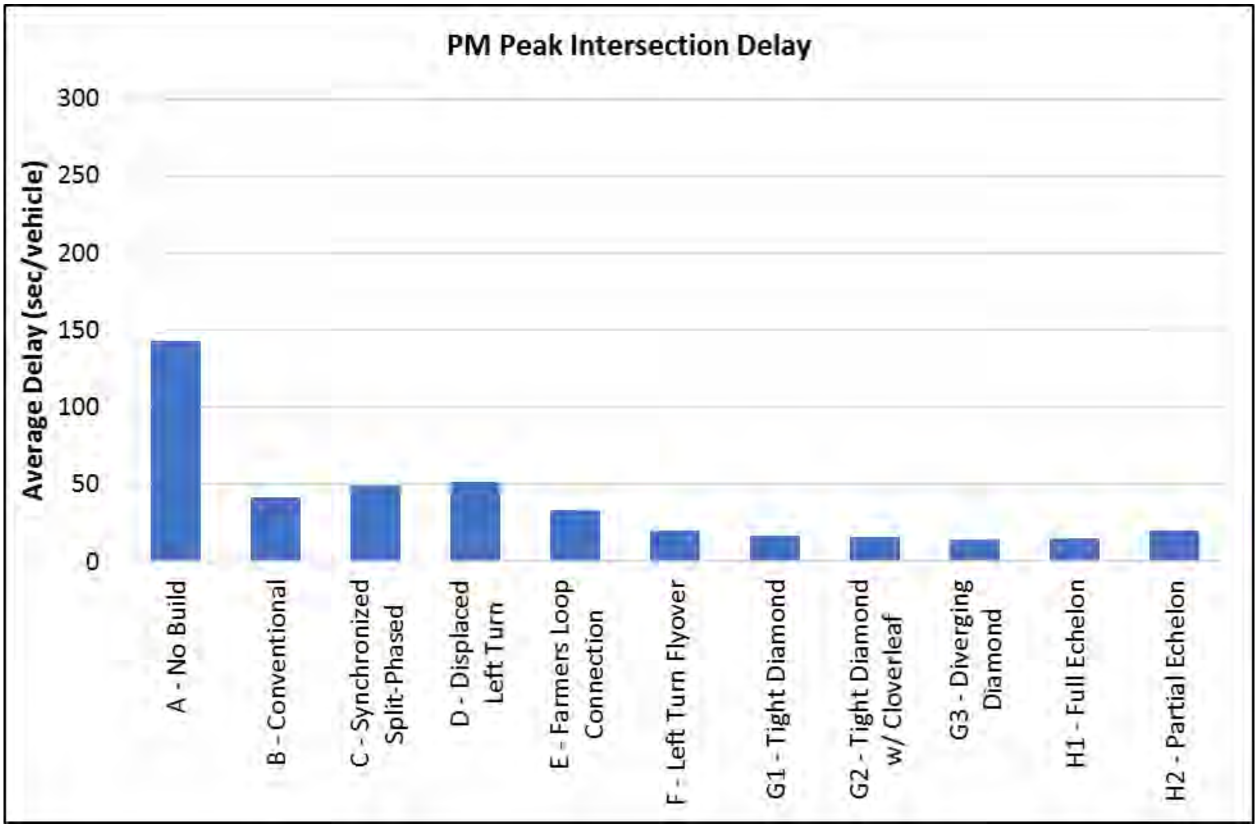


Figure 94: 2045 PM Peak Intersection Delay Summary

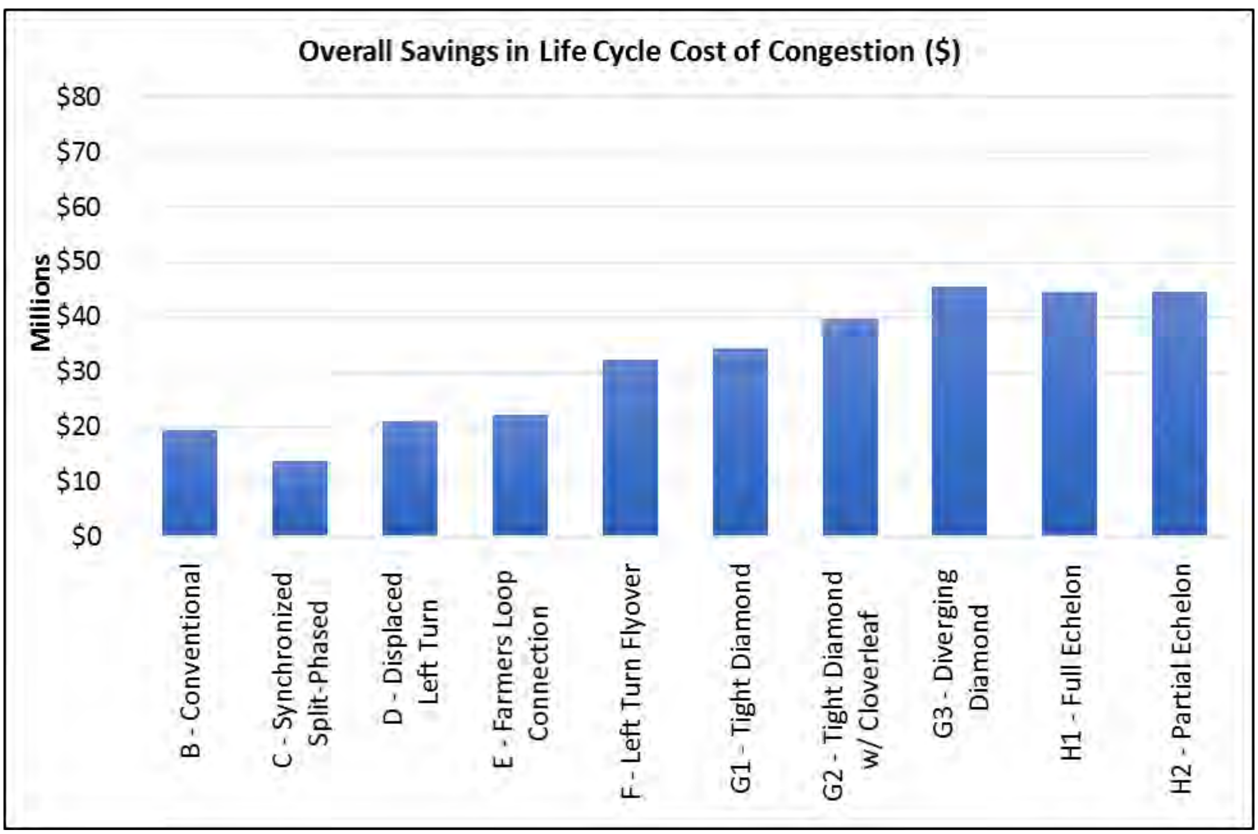


Figure 95: Overall Life Cycle Savings Summary

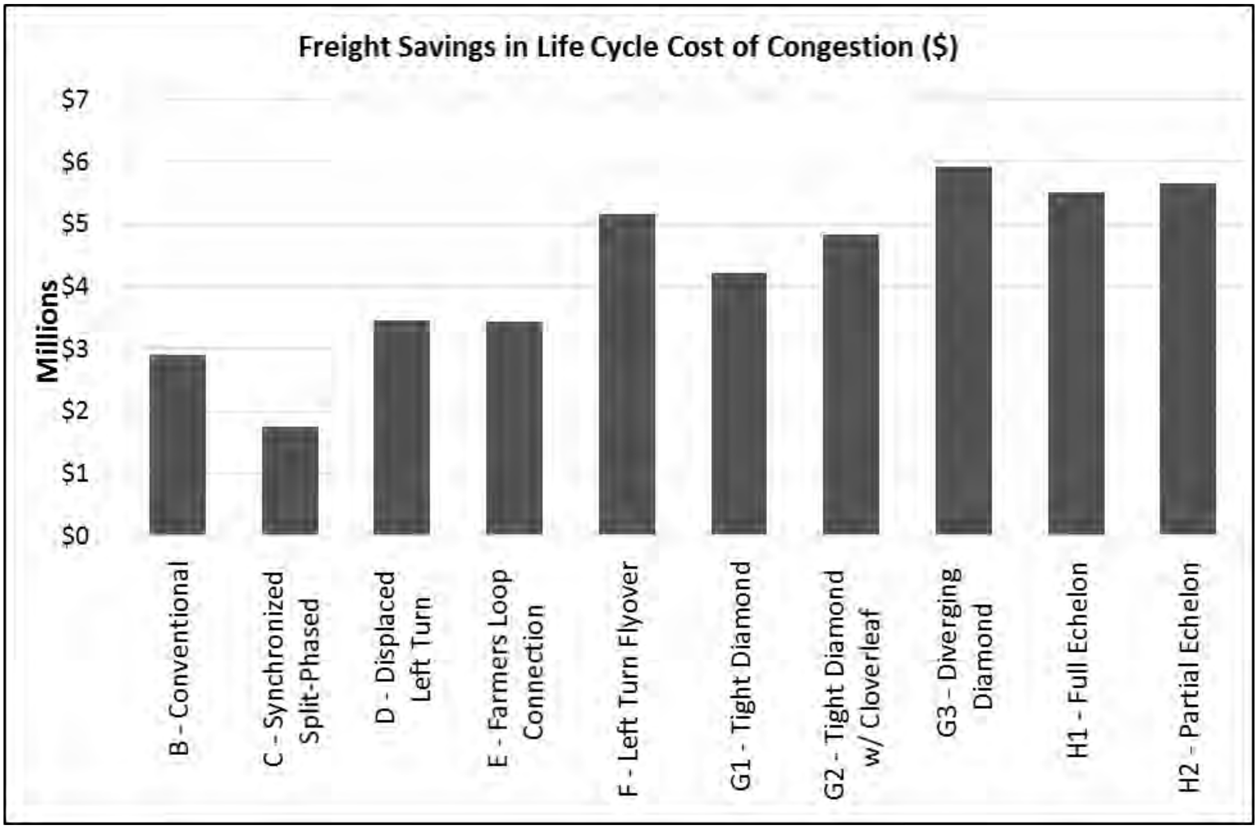


Figure 96: Life Cycle Freight Savings Summary

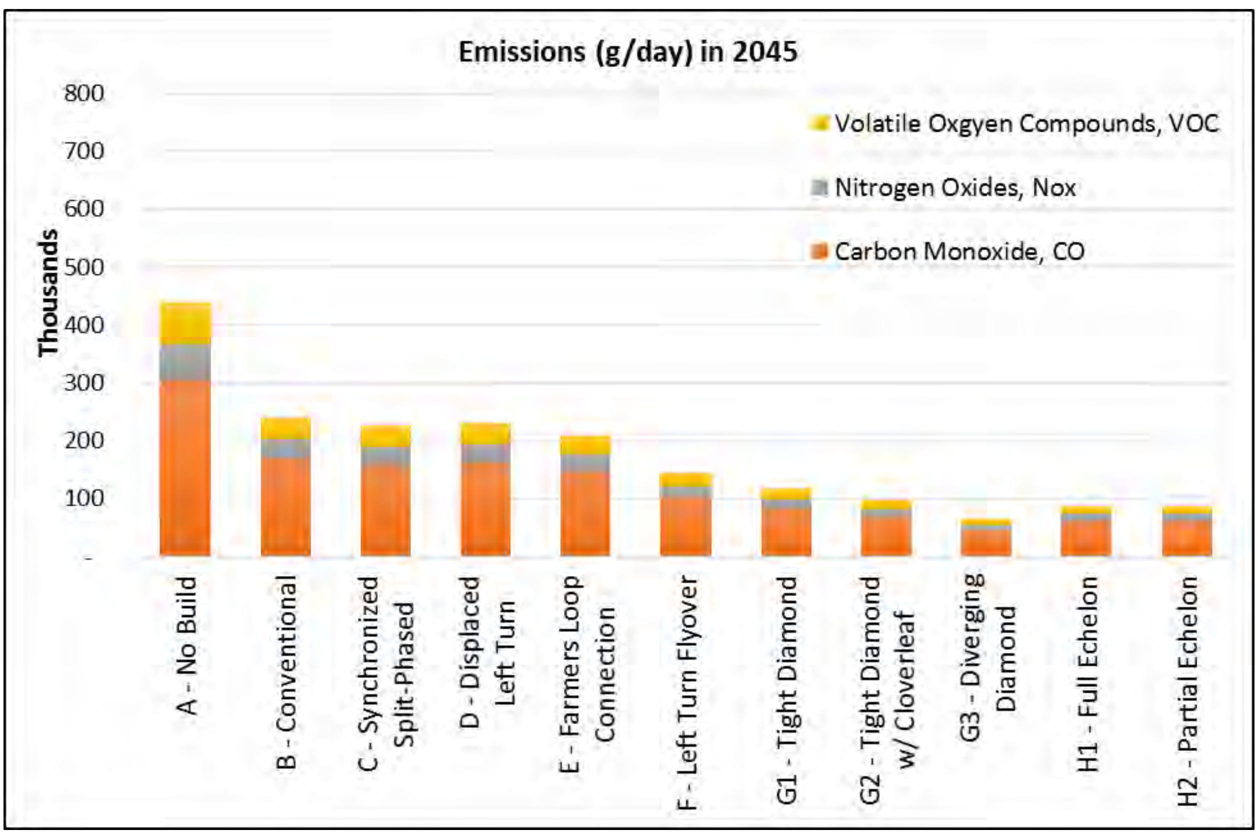


Figure 97: 2045 Vehicle Emissions Summary

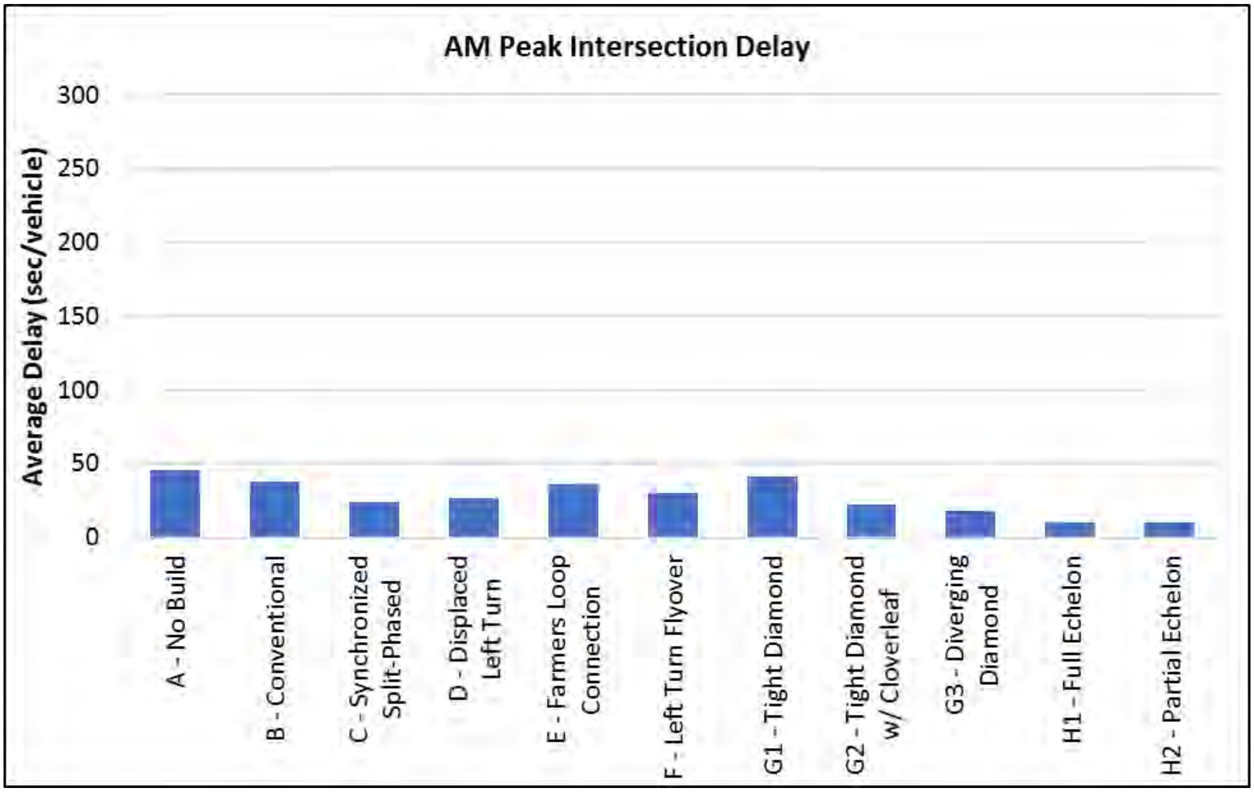


Figure 98: 2045 AM Peak Intersection Delay Summary with Relocation of Fort Wainwright Gate

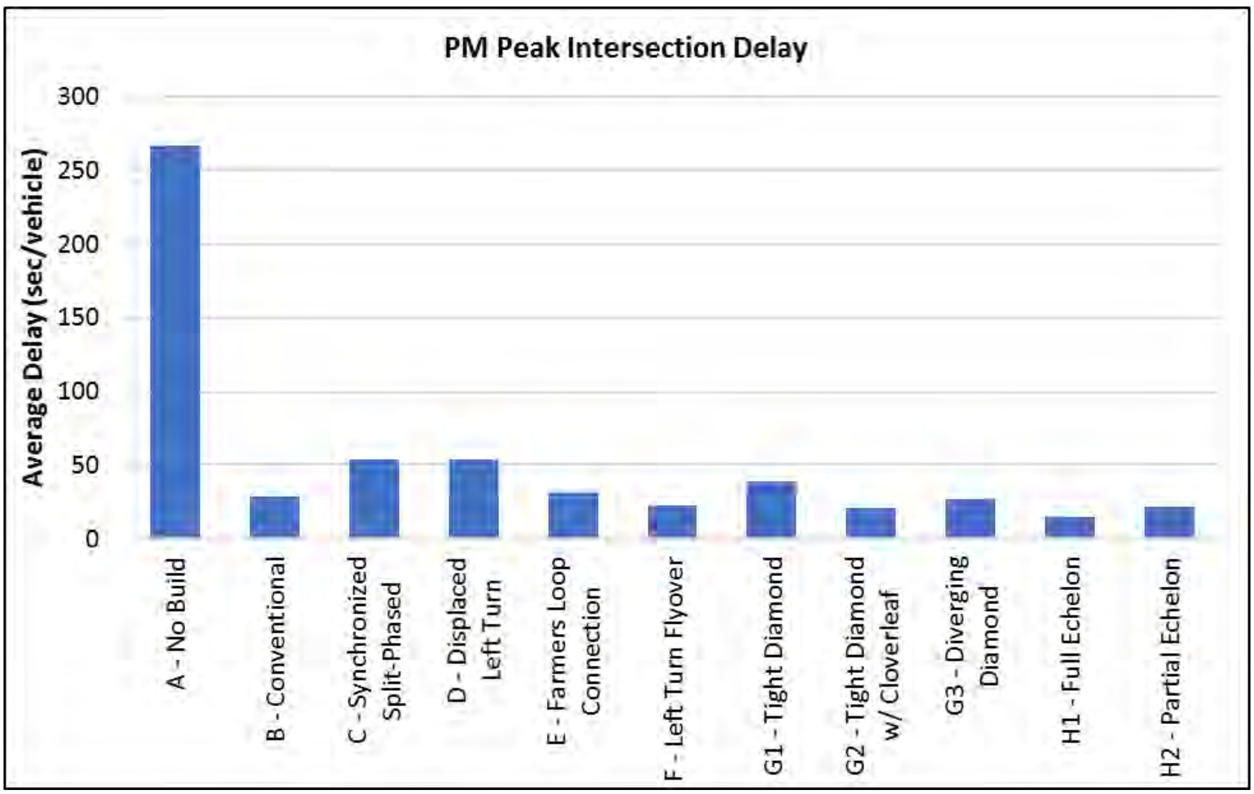


Figure 99: 2045 PM Peak Intersection Delay Summary with Relocation of Fort Wainwright Gate

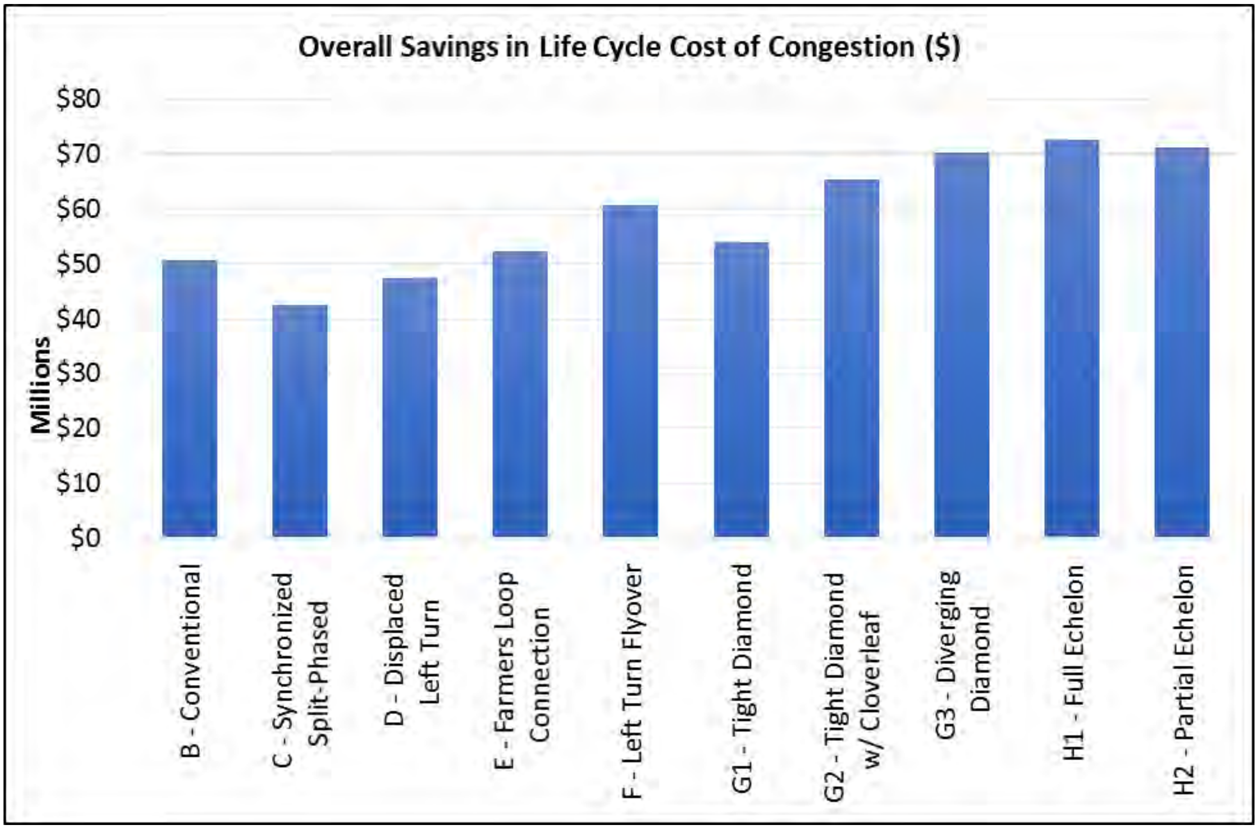


Figure 100: Overall Life Cycle Savings Summary with Relocation of Fort Wainwright Gate

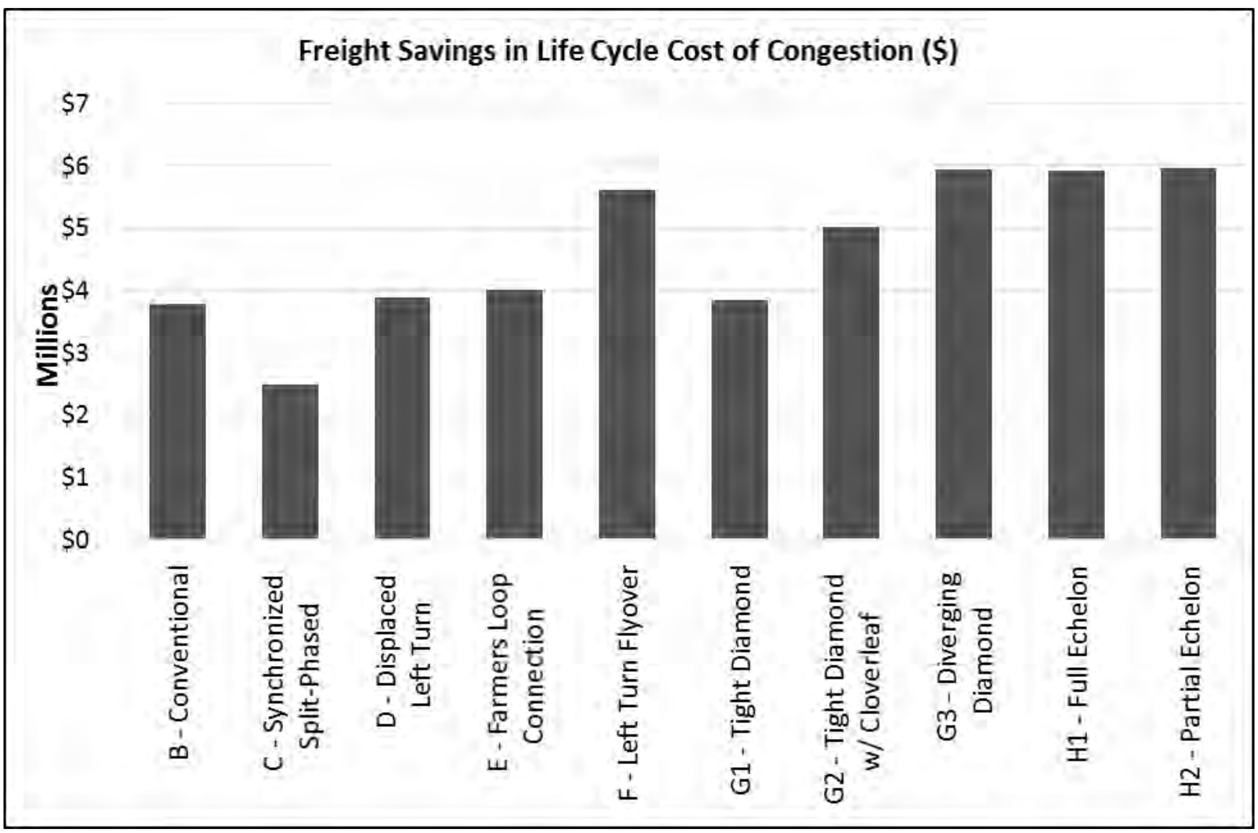


Figure 101: Life Cycle Freight Savings Summary with Relocation of Fort Wainwright Gate

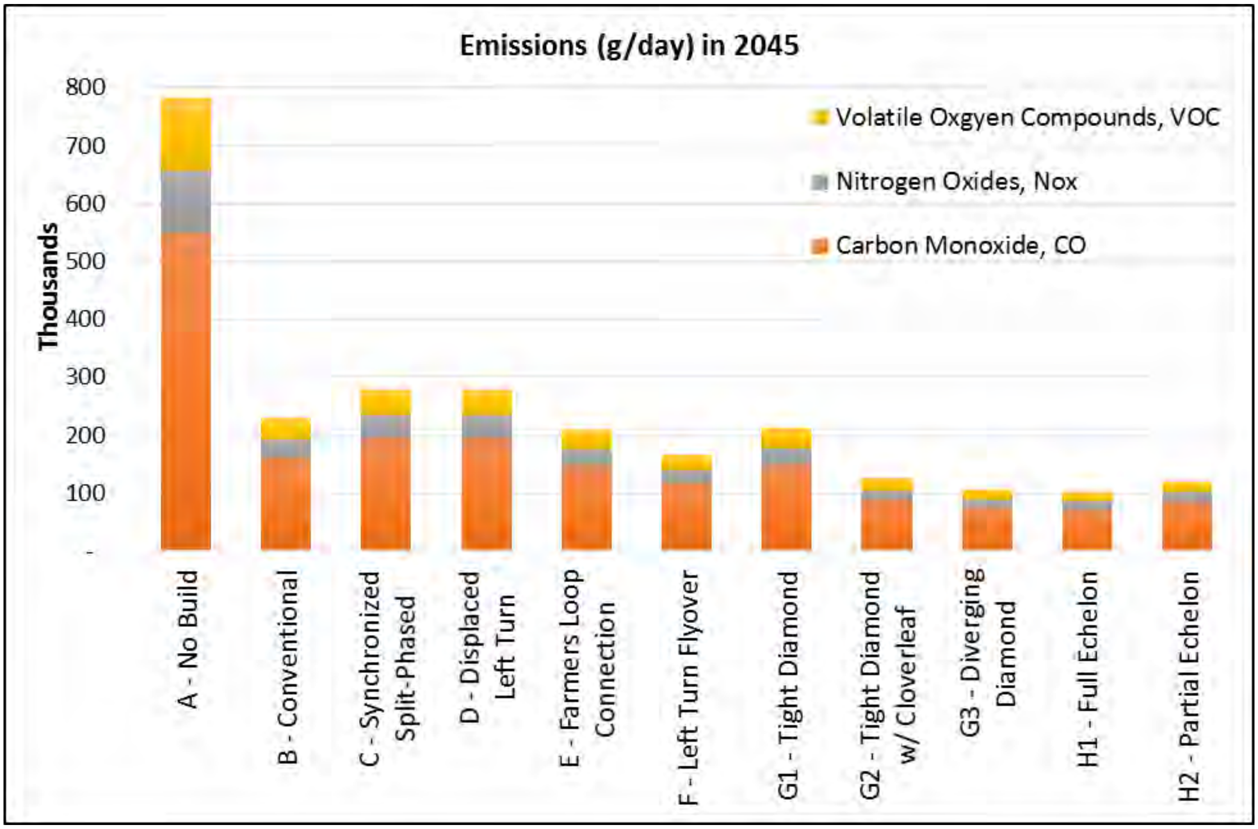


Figure 102: 2045 Vehicle Emissions Summary with Relocation of Fort Wainwright Gate

For each of the screening criteria, the alternatives were scored on a scale of -2 to +2, as shown in Table 19. For each quantitative criteria, a range of values was created so that the alternative with the most or least improvement scored +2 or -2, respectively, and the No Build condition fell within the range scored 0. Where two or more quantitative values were combined to determine the score for a specific criteria, non-integer values were allowed. Table 20 compares the alternatives using the screening criteria. In general, the grade-separated alternatives scored better, mostly because they reduce congestion the most and are also considered to improve the pedestrian experience the most (for both safety and delay).

Table 21 describes the positive and negative aspects of each alternative, and also presents the cost estimate for each alternative. The fully at-grade signal alternatives do not meet purpose and need because they do not significantly improve pedestrian safety and do not improve multimodal connectivity. However, they could meet purpose and need if the pedestrian overpass were also built. Therefore, an option with the pedestrian overpass added to each of those alternatives is included in the table.

Throughout the document, Alternative E (the Old Steese connection to Farmers Loop) is shown in combination with Alternative B (the expanded conventional intersection); however, the Old Steese connection could be built in conjunction with any of the other alternatives. All of the alternatives propose to close City Lights Boulevard, which would remove the only nearby route that parallels the Steese Expressway (the next closest parallel route is 4 miles away). While it might be possible to keep City Lights Boulevard under some of the alternatives, the proximity of the intersection of Lazelle Road with City Lights Boulevard to the intersection of Lazelle Road with the Steese Expressway makes this undesirable. Connecting Old Steese to Farmers Loop would provide an improved nearby parallel route.

Table 19: Criteria Rating Scale

- CRITERIA - - - RATING - -	How well does Alternative incorporate constraints, goals, identified issues?	Rating
	Much More / Much Better	2
	More / Better	1
	Same	0
	Less / Worse	-1
	Much Less / Much Worse	-2

Table 20: Screening Criteria Results

		A	B	C	D	E	F	G1	G2	G3	H1	H2	I
GOALS (50%)	**Weight**												
Reduce congestion.	5	0	1	1	1	1.5	2	2	2	2	2	2	0
Improve non-motorized user safety.	3.5	0	0	0	0	0	1	1	0	1	2	2	2
Improve freight mobility.	3.25	0	1	1	1	1	2	2	2	2	2	2	0
Improve multi-modal connectivity.	2	0	1	0.5	0	1	1.5	1	2	1	2	1.5	2
Improve drainage.	1.25	0	1	1	1	1	1	1	1	1	1	1	1
Goals Score (Rating x Weight):		0	11.5	10.5	9.5	14	24.25	23.25	21.75	23.25	27.75	26.75	12.25
IDENTIFIED ISSUES (35%)	**Weight**												
Vehicular delay.	5	0	2	2	2	2	2	2	2	2	2	2	0
Proximity of Farmers Loop Road.	5	0	1	1	1	1	1	1	1	1	1	1	0
Non-motorized safety.	4	0	0	0	0	0	1	1	0	1	2	2	2
Proximity of Old Steese Highway.	3	0	2	2	1	2	2	2	2	1	2	2	0
Proximity of City Lights Boulevard.	2	0	1	1	1	1	1	0	-1	1	-2	1	0
Identified Issues Score (Rating x Weight):		0	23	23	20	23	27	25	19	24	25	31	8
CONSTRAINTS (15%)	**Weight**												
Maintain Lazelle Rd access, including accommodating Ft Wainwright gate relocation.	5	0	1	-0.5	-0.5	0	0	-2	-0.5	-1.5	0	-0.5	0
Accommodate overheight/overweight vehicles	5	0	0	0	0	0	0	0	0	0	0	0	0
Maintain access to commercial areas (Northside, Bentley).	4	0	0	0	0	0	0	0	0	0	0	0	1
Avoid physical impact to cemetery	4	0	0	0	0	0	0	-1	-2	-1	0	0	0
Avoid physical impact to conservation area	3.5	0	0	0	0	0	0	0	0	0	0	0	0
Snow storage and snow removal techniques.	3	0	-1	-2	-1	-2	-1	0	-1	-2	0	1	-1
Minimize ROW acquisition.	2	0	-0.5	-0.5	-0.5	-1	-0.5	-1	-2	-1	-1	-0.5	-0.5
Constraints Score (Alternative x Weight):		0	1	-9.5	-6.5	-8	-4	-16	-17.5	-19.5	-2	-0.5	0
TOTAL		0	14.0	11.9	10.8	13.9	**21.0**	**18.0**	14.9	17.1	**22.8**	**24.7**	8.9

Table 21: Summary of Alternatives Comparing Score and Cost

Alternative		Score	Cost Estimate ($ million)	Benefit to Cost Comparison (Score/Cost)	Meets Purpose & Need?	Discussion
A	No Build	0.0	0.0	--	No	Does not meet purpose and need
B	Conventional Intersection	14.0	16.4	0.85	No	Improves with Fort Wainwright gate relocation (because volumes are balanced better overall); does not meet purpose and need for pedestrian safety and connectivity
B&I	Conventional Intersection **with Pedestrian Overpass**	18.5	21.1	0.88	Yes	Improves with Fort Wainwright gate relocation (because volumes are balanced better overall); Improves pedestrian access to Bentley Trust commercial area
C	Synchronous Split-Phased Intersection	11.9	25.7	0.46	No	Very difficult to time signals so that southbound traffic does not stop at all intersections; does not meet purpose and need for pedestrian safety and connectivity
C&I	Synchronous Split-Phased Intersection **with Pedestrian Overpass**	16.9	30.4	0.55	Yes	Very difficult to time signals so that southbound traffic does not stop at all intersections. Improves pedestrian access to Bentley Trust commercial area
D	Diverted Left Turn Intersection	10.8	26.5	0.41	No	Modest decreases in vehicular congestion, without clear benefit to pedestrian traffic
D&I	Diverted Left Turn Intersection **with Pedestrian Overpass**	16.3	31.2	0.52	Yes	Modest decreases in vehicular congestion. Improves pedestrian access to Bentley Trust commercial area

Alternative		Score	Cost Estimate ($ million)	Benefit to Cost Comparison (Score/Cost)	Meets Purpose & Need?	Discussion
E	Conventional Intersection with Old Steese Connection to Farmers Loop	13.9	20.4	0.68	No	Improves with Fort Wainwright gate location (because volumes are balanced better overall); does not meet purpose and need for pedestrian safety and connectivity
E&I	Conventional Intersection with Old Steese Connection to Farmers Loop **and Pedestrian Overpass**	18.4	25.1	0.73	Yes	Provides additional route in case of closure to main highway. Could be paired with any other alternative.
F	Eastbound Flyover	21.0	42.9	0.49	Yes	Reduction in congestion is mostly during PM peak period; Modest improvements for pedestrians due to reduction in volumes at the intersection itself.
G1	Tight Diamond Interchange	18.0	36.4	0.49	Yes	Primary concern is the difficulty with handling queues between intersections. Largest increase in congestion when volumes to accommodate Fort Wainwright gate relocation are introduced.
G2	Diamond interchange with Cloverleaf	14.9	42.8	0.35	Yes	Lowest pedestrian crossing delay; however, does not have a clear safety benefit for pedestrians and requires significant ROW
G3	Diverging Diamond Interchange	17.1	33.0	0.52	Yes	Least congestion and emissions (freight and other vehicles, annual and PM peak); with care in the design, it should be beneficial to pedestrians, too. Score equivalent to B&I if only 2-lane westbound
H1	Full Echelon	22.8	32.9	0.69	Yes	Improves safety for pedestrians more than all other alternatives except for Pedestrian Overpass. Can handle changes in traffic volumes due to relocation of Fort Wainwright gate better than partial echelon.

Alternative		Score	Cost Estimate ($ million)	Benefit to Cost Comparison (Score/Cost)	Meets Purpose & Need?	Discussion
H2	Partial Echelon	24.7	30.7	0.80	Yes	Improves safety for pedestrians more than all other alternatives except for Pedestrian Overpass. Reduces impacts to ROW as compared to full echelon; however, is less able to handle changes in traffic due to relocation of the Fort Wainwright gate.
I	Pedestrian Overpass	8.9	4.7	1.90	No	Meets purpose and need for pedestrian safety and connectivity, but not for vehicle delay

6 References

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Alaska Flexible Pavement Manual, DOT

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Congestion Management Process Update & Status of the System (2016), MOA

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Fairbanks Metropolitan Area Transportation System (FMATS) model

Fort Wainwright Chena North District Area Development Plan (2016)

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The Value of Travel Time Savings: Departmental Guidance for Conducting Economic Evaluations, Revision 2, USDOT

User Benefit Analysis for Highways (2003), AASHTO

Development of Guidelines for Triple Left and Dual Right-Turn Lanes: Technical Report (2011), Texas Transportation Institute.

Appendix A Delay with Two Eastbound Left Turn Lanes

Table A-1: Alternative B – 2045 Delay with two EBL turning lanes

Movement	Eastbound			Westbound			Northbound			Southbound			Intersection Delay
	Left	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*	
PM Peak Delay (sec/veh)	102.6	13.3		74.1	76.3		105.2	138.8		164.2	190.6	18.2	95.4
PM Peak LOS	F	B		E	E		F	F		F	F	B	F

Table A-2: Alternative C – 2045 Delay with two EBL turning lanes

Movement	Eastbound			Westbound			Northbound			Southbound			Intersection Delay
	Left	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*	
PM Peak Delay (sec/veh)	67.7	11.4	25.6	114.2	195.5	50.3	72.7	100.6	9.2	118.0	146.5	0.0	69.3
PM Peak LOS	E	B	C	F	F	D	E	F	A	F	F	Free	E

Table A-3: Alternative D – 2045 Delay with two EBL turning lanes

Movement	Eastbound			Westbound			Northbound			Southbound			Intersection Delay
	Left	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*	
PM Peak Delay (sec/veh)	123.5	17.7	45.3	172.0	64.1	65.4	201.6	210.4	9.2	176.3	80.2	0.0	115.7
PM Peak LOS	F	B	D	F	E	E	F	F	A	F	F	Free	F

Table A-4: Alternative G1 (east intersection) – 2045 Delay with two EBL turning lanes

Movement	Eastbound			Westbound			Northbound			Southbound			Intersection Delay
	Left	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*	*Left*	*Through*	*Right*	
PM Peak Delay (sec/veh)	83.5	1.8	-	-	66.7	56.5	44.7	39.5	-	-	-	-	72.5
PM Peak LOS	F	A	-	-	F	E	D	D	-	-	-	-	E