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Memo

To:	Linda Small		
From:	Smith Siromaskul and Jeremy Jackson	Project:	NE 119th Street Access Management Plan
CC:	Don Moe		
Date:	August 19, 2010	Job No:	132495

RE: NE 119th Street Fatal Flaw VISSIM Analysis

Introduction

This memorandum for NE 119th Street 1.) outlines the methodology used for the fatal flaw analysis, 2.) describes the various alternatives, 3.) discusses the results, and 4.) provides recommendations for preferred options. This work is a follow up on the April 15, 2010, technical memo entitled: *NE 119th Street Level I Screening Report*.

Subsequent to the delivery of the Level I Screening Report delivered on April, 12, 2010, significant changes were made by the County to the projected 2030 PM peak hour volumes. It was also recognized that output with more detail would be needed to hold internal discussions at the County regarding the direction of the project and for identifying a preferred alternative.

In place of turning movement volumes, the traffic volumes provided for this round of analysis were in the form of Origin-Destination tables. These tables report both internal and external zones and the traffic traveling to and from each zone. This data was used in the VISSIM analysis to generate turning movement volumes based on shortest path and least delay for each alternative. The VISSIM models developed for this analysis are functional, but have not been completely tuned nor have the signals been optimized as this round of analyses is to determine which alternatives are worth pursuing and which are fatally flawed. The next round of analyses will involve fine tuning the VISSIM models by optimizing and interconnecting signals and performing refinements of the traffic models for the preferred alternatives to bring them to design-level quality.

This memo concludes with a list of alternatives that should be advanced to Level II Screening.

Methodology

The traffic volumes provided by the county identified zones in which traffic would enter and exit the roadway network. These zones were both internal to and external to the study area. Trips traversing the entire study area would travel from one external zone to another. Some of the alternatives that were analyzed include new roadways and thus create the potential for multiple paths motorists may choose to travel from one point to another. However, it is not possible to collect traffic data for roadway networks that do not exist, thus direct calculation of specific turning movement counts at the intersections cannot be

made. To work around this limitation the dynamic assignment capabilities of VISSIM were used to perform the analysis.

Dynamic assignment is an iterative process that accounts for the length of a path as well as the delay encountered on each path. Multiple paths are possible from one zone to another. Within VISSIM, the amount of traffic generated by each zone is input as well as the percentage of traffic going from each zone to every other zone. During the first few iterations, VISSIM attempts to find all of the available paths. Once all of the paths are found the program then accounts for the delay on each path and begins to vary the traffic volume assigned to each path to reach a convergence point where the travel times become more consistent. In cases where extreme congestion is present and convergence has not been reached even after dozens of runs (as would be the case in a fatally flawed alternative), queues and congestion within the network can vary significantly from one run to the next.

For alternatives that are not fatally flawed and the dynamic assignment algorithms have reached convergence, the traffic patterns are used to create more traditional static routes which can then be used for tweaking coordinated signal timing.

Alternatives

A fatal flaw analysis using VISSIM was performed on eleven alternatives considered for improvements along NE 119th Street between NE 72nd Avenue and NE 87th and along NE 72nd Avenue between St. Johns Road and the Synagogue. The eleven alternatives can be subdivided into four categories, each representing the different roadway improvements required for each alternative. The four categories are:

- Existing Alignment,
- St. Johns Extension,
- Full Quadrant Road and
- Southeast Quadrant Road

A Northwest Quadrant Road was assumed in all of the alternatives, with traffic signals at NE 119th Street and NE 72nd Avenue. A roundabout at NE 119th Street and NE 87th Avenue was also assumed in all of the alternatives. A preliminary analysis using SIDRA, a roundabout intersection analysis software package, indicated that a two-lane roundabout with single-lane approaches on NE 87th Avenue would operate at an acceptable level of service (LOS). When analyzed using VISSIM, however, traffic queuing indicated that northbound NE 87th Avenue would require a short, two-lane approach. The platooning of eastbound traffic from the upstream signal produced fewer gaps for northbound traffic on NE 87th Avenue, resulting in queuing that could be reduced or eliminated by increasing the capacity with a two-lane approach, thus allowing multiple vehicles to enter the roundabout at the same time.

It is important to note that the lane configurations developed for the fatal flaw analysis are for comparative purposes only and may need to be modified in a detailed analysis of the preferred alternatives. Alternative layouts and the results of the fatal flaw analysis using VISSIM are attached.

Alternatives on Existing Alignments

Alternatives in this category make improvements to NE 119th Street and NE 72nd Avenue without providing any new alignments. The alternatives on the existing alignments include Baseline, Full Access – Low Speed,

Full Build Out – 2 Lane, Full Build Out – 3 Lane Version 1, Full Build Out – 3 lane Version 3 and Northwest Small Quadrant Road.

Baseline

The Baseline alternative assumes two through lanes in each direction on NE 119th Street and NE 72nd Avenue. It reflects the minimum standard improvements and includes full access control with the exception of 70th Avenue at NE 119th Street. Left-turn storage bays are included at all signalized intersections and exclusive right-turn lanes are provided on all approaches at the intersection of NE 119th Street and NE 72nd Avenue.

A fatal flaw analysis indicates that the Baseline alternative fails due to significant queuing on westbound NE 119th Street. The inability to serve the demand of westbound left-turns at NE 72nd Avenue creates a gridlock condition on NE 119th Street that extends through the roundabout at NE 87th Avenue. There is also excessive queuing on northbound NE 72nd Avenue that nearly extends to the intersection with St. Johns Road.

Full Access – Low Speed

The Full Access – Low Speed alternative is identical to the Baseline alternative but includes no access control. A two-way-left-turn-lane (TWLTL) or left-turn storage bays are provided at all intersections and driveways, with the exception of 70th Avenue at St. Johns Road, which remains right-in-right-out (RIRO). The Full Access – Low Speed alternative fails in the same manner as the Baseline Alternative, with gridlock queuing on westbound NE 119th Street. In addition to the gridlock on NE 119th Street, traffic queuing at the intersection of St. Johns Road and NE 72nd Avenue extends beyond 109th Street. This is due to queuing south of NE 119th Street that extends to St. Johns Road, hindering the movement of northbound traffic.

Full Build Out – 2 Lane

The Full Build Out – 2 Lane alternative includes two through lanes in each direction on NE 119th Street and NE 72nd Avenue and includes full access control with the exception of 70th Avenue at NE 119th Street. It is identical to the Baseline alternative with the addition of another westbound left-turn lane at NE 72nd Avenue. The dual left-turn lanes help reduce queuing on westbound NE 119th Street, but this alternative still fails due to gridlock on NE 119th Street and excessive queuing on northbound NE 72nd Avenue.

Full Build Out – 3 Lane Version 1

The Full Build Out – 3 Lane alternative version 1 includes two through lanes in each direction on NE 119th Street, two through lanes on southbound NE 72nd Avenue and three through lanes on northbound NE 72nd Avenue. It includes full access control with the exception of 70th Avenue at NE 119th Street. The 3-Lane alternative is identical to the Full Build Out – 2 Lane alternative with the addition of another northbound through lane along NE 72nd Avenue between St. Johns Road and just north of NE 119th Street.

A fatal flaw analysis indicates that this alternative is not fatally flawed because the additional capacity on NE 72nd Avenue, combined with the dual westbound left-turn lanes, reduces queuing on NE 119th Street. Providing three through lanes on NE 72nd Avenue allows the traffic signal to serve more northbound traffic with less green time, distributing the extra green time to the westbound left-turns. More capacity on NE 72nd Avenue also results in less queuing on NE 72nd Avenue.

Full Build Out – 3 Lane Version 3

The Full Build Out – 3 Lane alternative version 3 includes two through lanes in each direction on NE 119th Street, two through lanes on southbound NE 72nd Avenue and three through lanes on northbound NE 72nd Avenue. It includes full access control with the exception of 70th Avenue at NE 119th Street. In an attempt to further reduce queuing on NE 72nd Avenue this version of the 3 lane alternative adds an additional northbound left-turn lane on NE 72nd Avenue at NE 119th Street.

Similar to version 1, this alternative is not fatally flawed, as the additional capacity on NE 72nd Avenue, combined with the dual westbound and northbound left-turn lanes, significantly reduces the queuing on NE 119th Street and NE 72nd Avenue. The only difference between the two alternatives is that the dual northbound left-turn lanes reduces the northbound queue but increases the southbound queue.

Northwest Small Quadrant Road

The Northwest Small Quadrant Road alternative was developed to test a concept that eliminates a heavy left-turn movement and replaces it with a series of right-turns. An existing example of this concept can be found at the intersection of SW 185th Avenue and SW Jenkins Road in Beaverton, Oregon (see Figure 1). On NE 119th Street, a small loop road in the northwest quadrant of the NE 119th Street/NE 72nd Avenue intersection would serve westbound left-turning traffic. This alternative assumes two through lanes in each direction on NE 119th Street and NE 72nd Avenue and includes full access control with the exception of 70th Avenue at NE 119th Street. Left-turn storage bays are included at all signalized intersections, with the exception of westbound NE 119th Street at NE 72nd Avenue. Exclusive right-turn lanes are provided on all approaches at the intersection of NE 119th Street and NE 72nd Avenue.

Figure 1 - Example of a Small Quadrant Road in Beaverton, OR

A fatal flaw analysis indicates that the Northwest Small Quadrant Road alternative fails. A single lane quadrant road that is unsignalized at NE 72nd Avenue does not provide enough capacity for the heavy volume of westbound left-turns. Queuing on the quadrant road extends back onto NE 119th Street,

effectively reducing westbound NE 119th Street to a single through lane and causing gridlock throughout the network.

Southeast CFI

The Southeast CFI alternative improves operations at the NE 119th Street/NE 72nd Avenue intersection by building a continuous flow intersection (CFI) and removing left turn conflicts with the through movements. A CFI moves the left-turning vehicles, which conflict with the through movements, out of the main intersection. The heavy westbound left-turns on NE 119th Street would be moved several hundred feet to the east, eliminating the left-turn phase at the traffic signal. The NE 119th Street/NE 72nd Avenue CFI includes dual westbound left-turn lanes and dual northbound left-turn lanes on NE 72nd Avenue. Single left-turn lanes are assumed on all remaining approaches and at all other signalized intersections. Exclusive right-turn lanes are also provided on all approaches of the NE 119th Street/NE 72nd Avenue intersection. The Southeast CFI alternative includes full access control with the exception of 70th Avenue at NE 119th Street.

A fatal flaw analysis of the CFI resulted in only minor queuing at all signalized intersections; queuing that would be reasonably expected during peak periods. The CFI reduces the overall queue lengths on NE 119th Street as well as NE 72nd Avenue and can be considered a viable alternative for improving operations on NE 119th Street and NE 72nd Avenue.

Alternatives with New Roadway on New Alignment

St. Johns Extension

The St. Johns Extension alternative is the first of four alternatives that includes a new alignment designed to redistribute traffic and reduce the impact to the NE 119th Street and NE 72nd Avenue intersection. This alternative assumes two through lanes in each direction on NE 119th Street and NE 72nd Avenue and an extension of St. Johns Road from NE 72nd Avenue to NE 119th Street. As with most alternatives it includes full access control with the exception of 70th Avenue at NE 119th Street. Left-turn storage bays are included at all signalized intersections and exclusive right-turn lanes are provided on northbound NE 72nd Avenue and the St. Johns Road Extension at NE 119th Street.

In order to extend St. Johns Road, the existing intersection with NE 72nd Avenue will need to be realigned further to the north to avoid a designated wetland on the east side of NE 72nd Avenue. The fatal flaw analysis also assumed a single through lane in each direction on the St. Johns Extension along with a single westbound left-turn storage lane at NE 72nd in order to reduce right of way that may impact the wetland.

The results of the fatal flaw analysis were favorable, with only minor queuing at the intersections along NE 119th Street. There was moderate queuing in the southwest direction of the St. Johns Extension that could be addressed with additional improvements. Improvements that could be considered include adding a dual westbound left-turn lane at NE 72nd Avenue and/or providing two through lanes in each direction on the St. Johns Extension. It was also desired to include a dedicated right-turn lane on NE 72nd Avenue at St. Johns Road, but the proximity of NE 72nd Avenue to the wetland prohibits an additional lane without shifting the alignment of NE 72nd Avenue further to the west.

Full Quadrant Roads

Constructing full quadrant roads surrounding the NE 119th Street/NE 72nd Avenue intersection will eliminate all left-turns and redistribute traffic to the four quadrant roads. Quadrant roads will be offset from the intersection 600 feet to the north, south and west and approximately 1,000 feet to the east. There will be full access control, with 70th Avenue being converted into a cul-de-sac south of NE 119th Street, and all quadrant road intersections will be signalized.

Full Quadrant Road Version 1

Version one of the Full Quadrant Road alternative assumes two through lanes in each direction on NE 119th Street and NE 72nd Avenue and asymmetrical quadrant roads surrounding the NE 119th Street/NE 72nd Avenue intersection. Left-turn storage bays are included at all signalized intersections with the exception of NE 119th Street and NE 72nd Avenue. Exclusive northbound right-turn lanes are provided at the South Quadrant Road/NE 72nd Avenue intersection and the East Quadrant Road/NE 119th Street intersection.

The Full Quadrant Road alternative version 1 fails due to significant queuing in the southeast quadrant and along St. Johns Road and NE 72nd Avenue. A single westbound left-turn lane at the South Quadrant Road/NE 72nd Avenue intersection does not provide adequate capacity for the heavy volume of left-turns, resulting in queues that nearly extend to NE 119th Street. The failure of the South Quadrant Road signal also results in queuing of northbound traffic on NE 72nd Avenue that spills back onto St. Johns Road.

Full Quadrant Road Version 2

In an attempt to make the Full Quadrant Road a viable alternative, dual westbound left-turn lanes were provided on NE 119th Street at the South Quadrant Road as well as on the South Quadrant Road at NE 72nd Avenue. Exclusive right-turn lanes were also added to the northbound and westbound approaches of the NE 119th Street/NE 72nd Avenue intersection but there were no notable changes in queuing at this intersection. The addition of the dual left-turn lanes significantly reduced queuing in the southeast quadrant and in turn NE 72nd Avenue and St. Johns Road, but adversely impacted the southwest quadrant.

The reason for this shift is that dynamic traffic assignment (DTA) was still fluctuating traffic volumes significantly while it was trying to find equilibrium. In both versions of the Full Quadrant Road alternative, the failure of the signal at the South Quadrant Road/NE 72nd Avenue intersection resulted in gridlock somewhere in the network. Additional model runs using DTA would have likely shifted the failure back to the southeast quadrant and then back to the southwest until the delay on both quadrants is even.

Southeast Quadrant Road

With the failure of the full quadrant road alternatives, an option was evaluated that removed the quadrant roads west of NE 72nd Avenue and focused primarily on a southeast quadrant road. The Southeast Quadrant Road alternative assumes two through lanes in each direction on NE 119th Street and NE 72nd Avenue and full access control, with the exception of 70th Avenue south of NE 119th Street. Left-turn storage bays are included at all signalized intersections, with a dual left –turn lane on the westbound approach of the South Quadrant Road at NE 72nd Avenue. Exclusive right-turn lanes are provided on all approaches at the NE 119th Street/NE 72nd Avenue intersection as well as the northbound approach at the South Quadrant Road/NE 72nd Avenue intersection and the East Quadrant Road/NE 119th Street intersection.

The southeast quadrant road is designed to provide an alternate route for westbound NE 119th Street to southbound NE 72nd Avenue traffic and vice versa. Reducing or eliminating westbound left-turns from the NE 119th Street/NE 72nd Avenue intersection improves operations and reduces queuing. The Southeast Quadrant Road alternative results in only minor queuing along NE 119th Street and NE 72nd Avenue and is a viable alternative for improvements.

Recommendations

Based on the fatal flaw analysis performed using VISSIM, seven of the eleven alternatives are considered fatally flawed and fail to provide acceptable traffic operations on NE 119th Street and NE 72nd Avenue. The fatal flaw analysis was designed to identify three preferred alternatives that could be carried forward to the next phase of the NE 119th Street project. In the end, there are four alternatives that are considered viable options for improvements to NE 119th Street and NE 72nd Avenue.

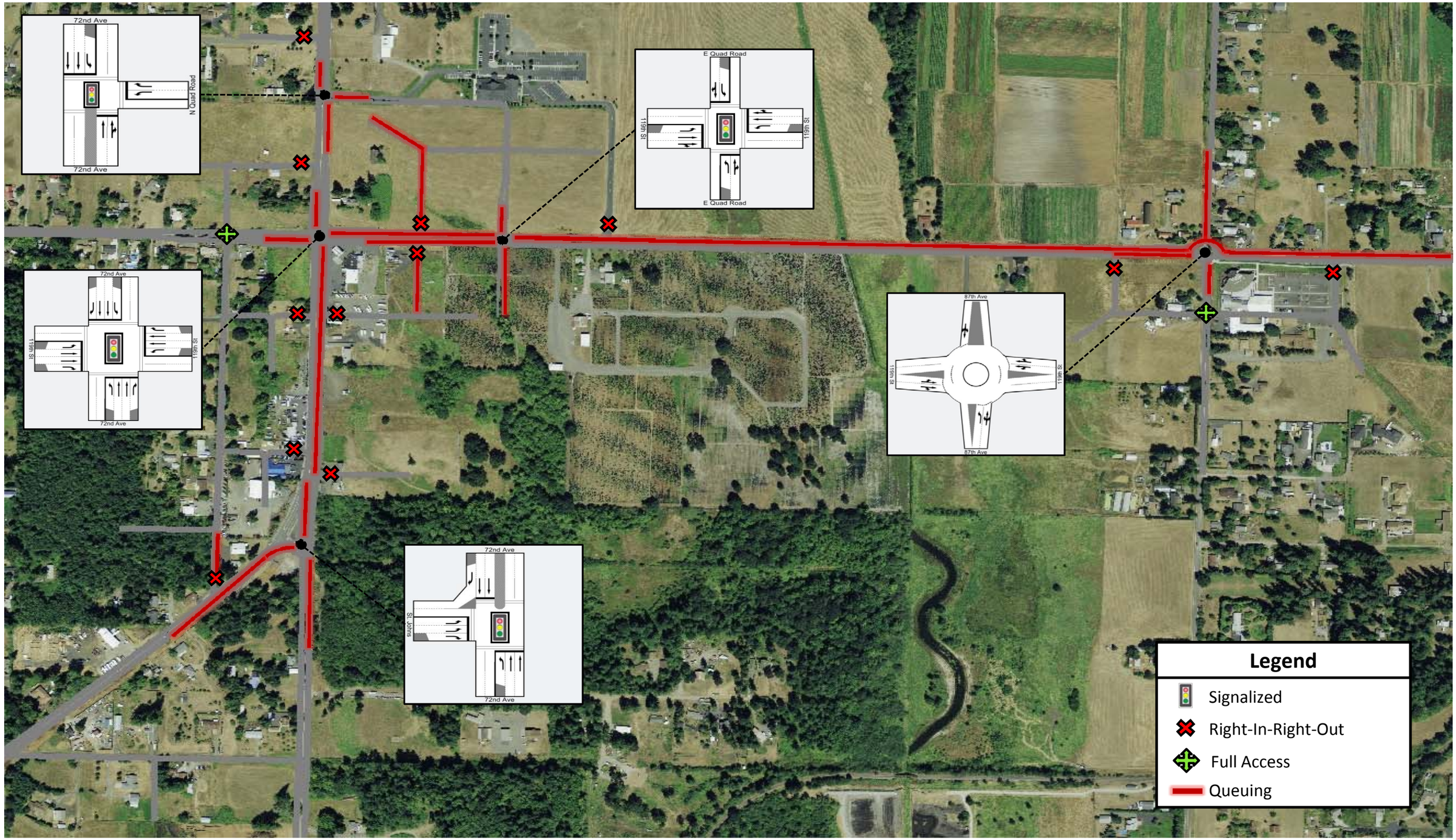
It is recommended that the following alternatives be considered for the next phase of the NE 119th Street project:

- St. Johns Road Extension
- Southeast Quadrant Road
- Southeast Continuous Flow Intersection (CFI)
- Full Build Out – 3 Lane (with or without a dual NB left-turn lane at NE 119th Street)

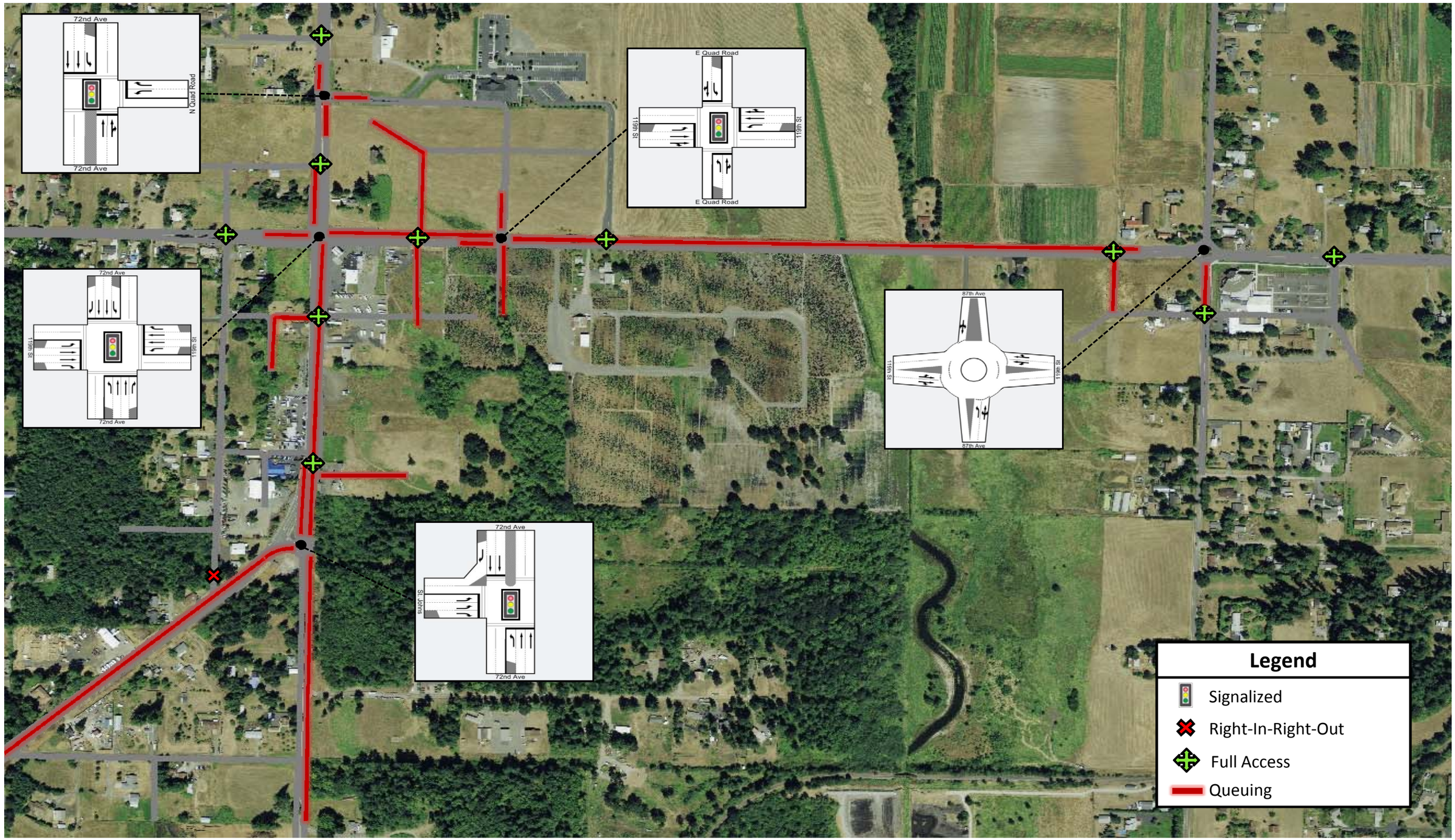
The Southeast CFI and the Full Build Out – 3 Lane alternative significantly improve operations compared to the Baseline alternative and require no new alignments. The Southeast CFI performs better than the 3-Lane option, especially in reducing spillback queuing on westbound NE 119th Street, but a CFI may require more right-of-way north of the intersection.

The St. Johns Extension and Southeast Quadrant Road alternatives propose new alignments in the southeast quadrant, but improve operations at the NE 119th Street/NE 72nd intersection without requiring additional through or left-turn lanes compared to the Baseline alternative. There is less queuing on the new alignment with a southeast quadrant road versus the St. Johns extension, but the southeast quadrant road introduces more instances of queuing, although minor, on NE 72nd Avenue due to the additional traffic signal between NE 119th Street and St. Johns Road.

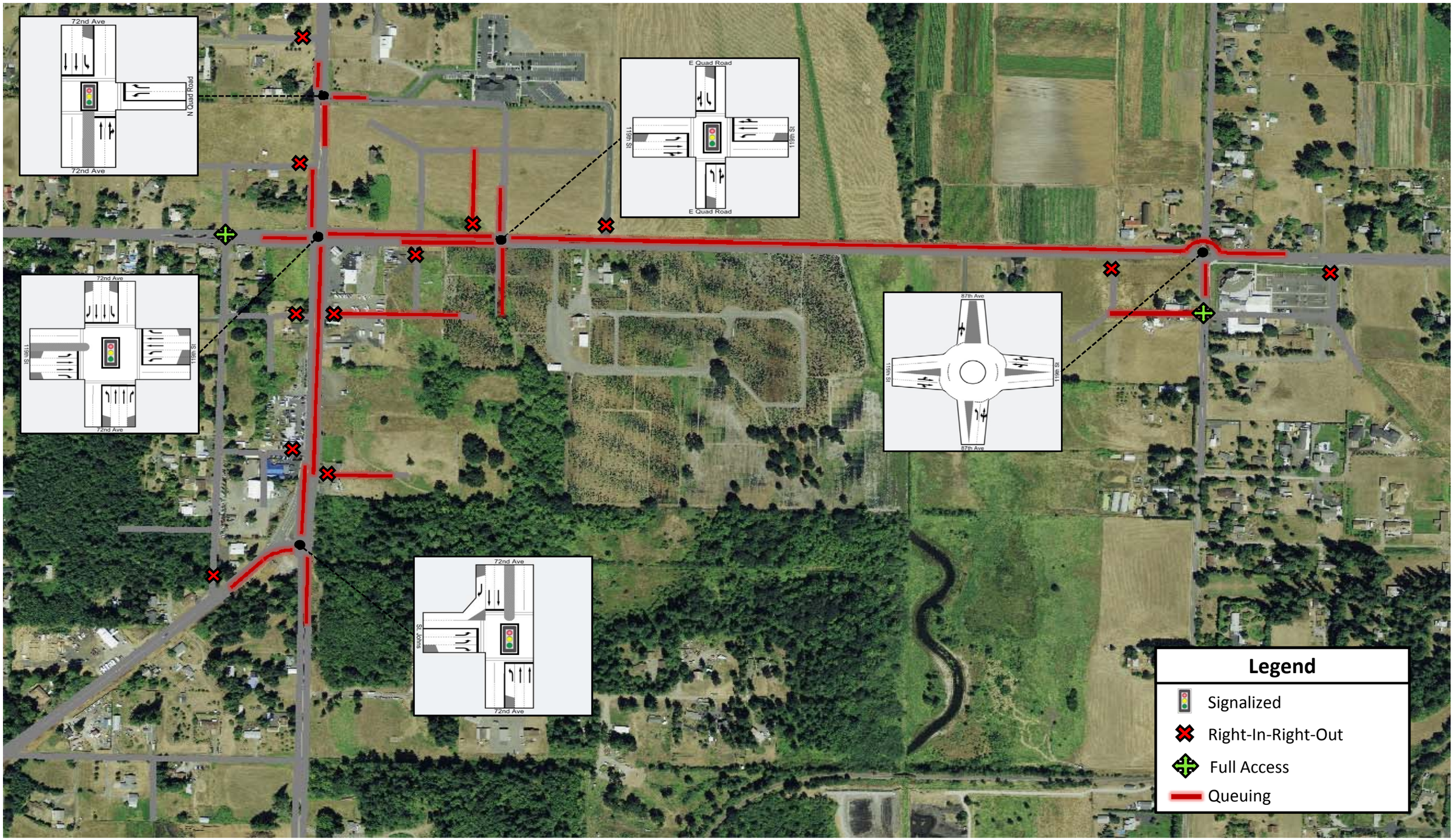
Attachment: Fatal Flaw Analysis of NE 119th Street Alternatives



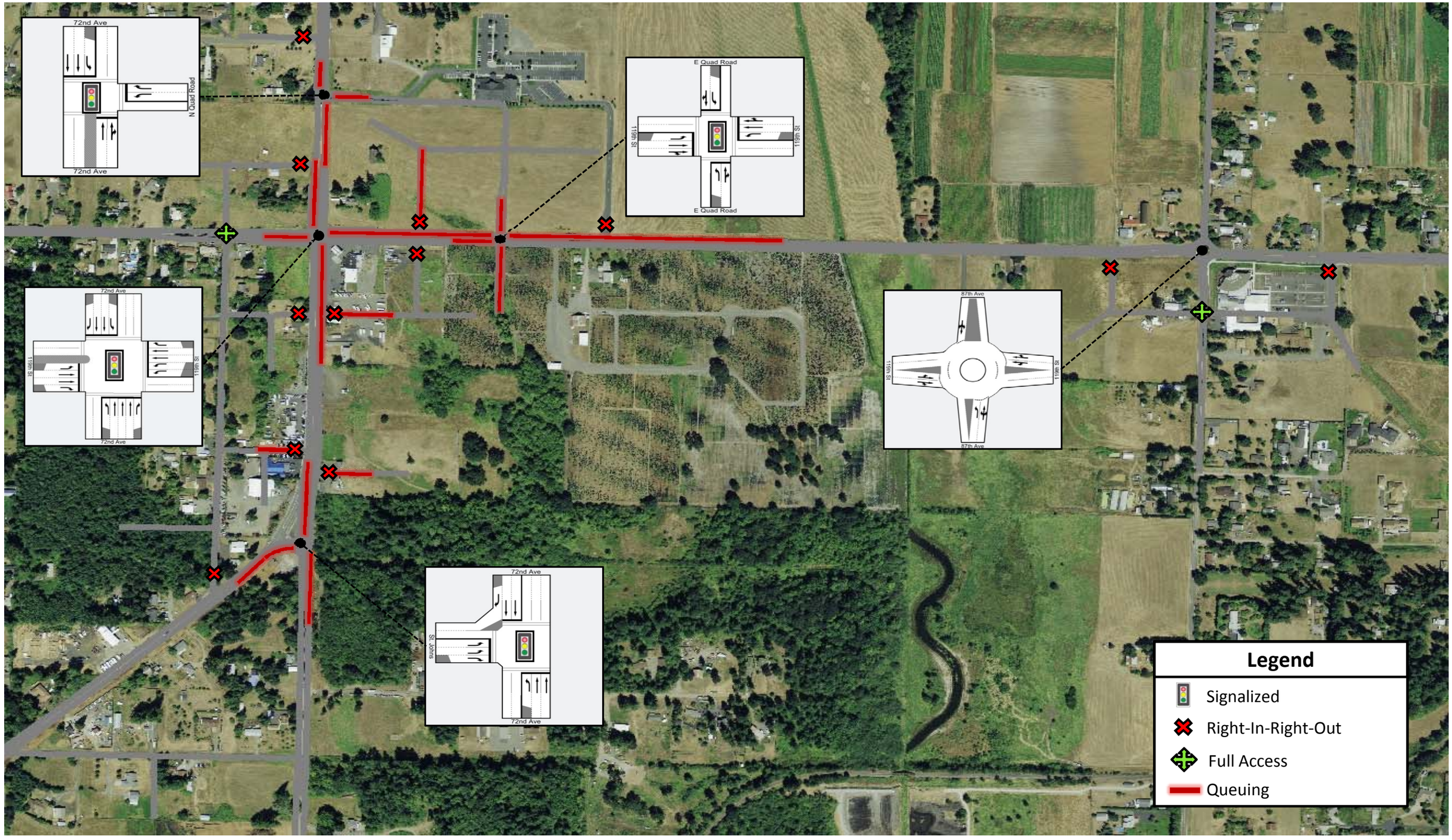
NE 119th Street: Baseline Alternative



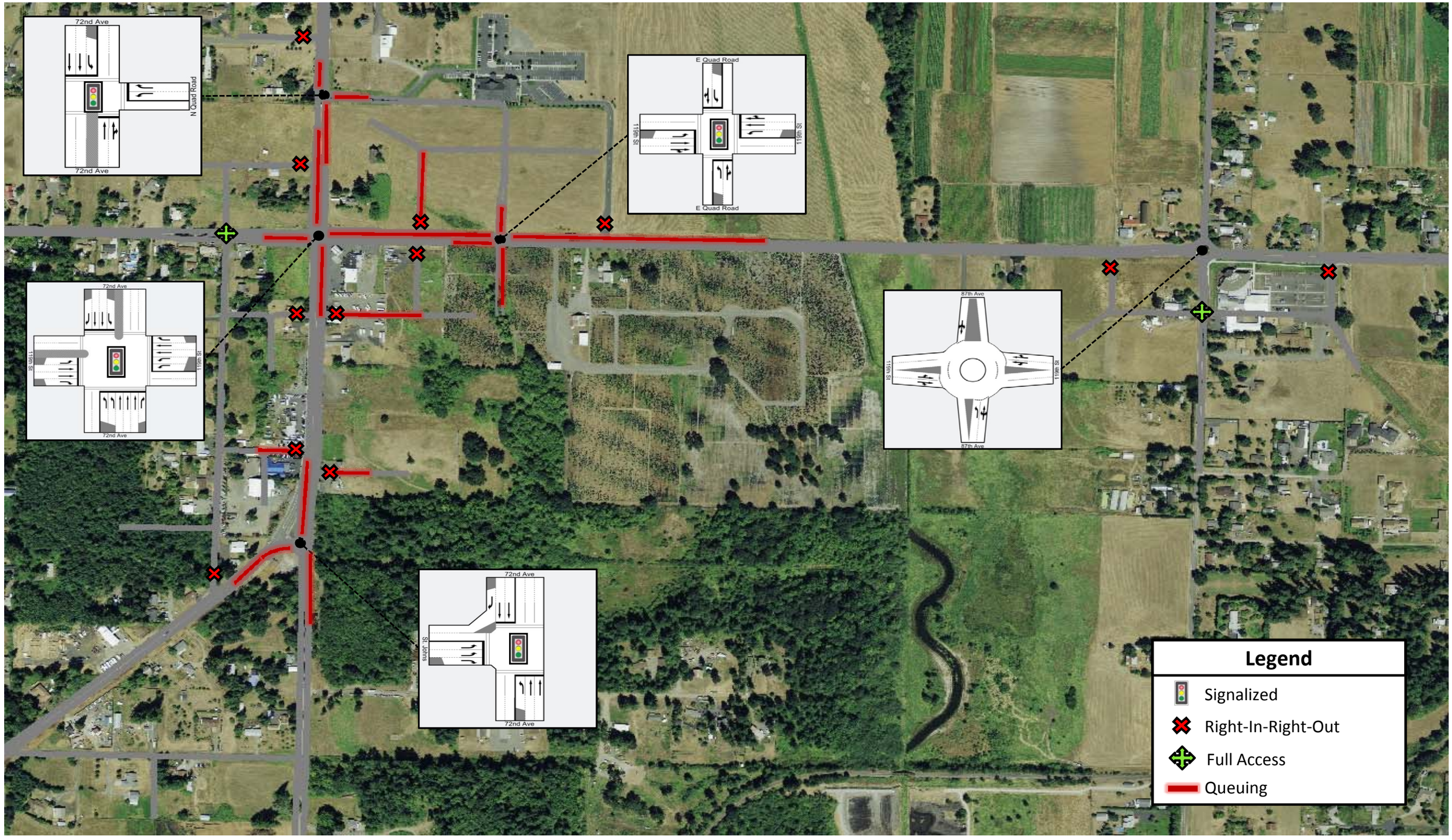
NE 119th Street: Full Access - Low Speed Alternative



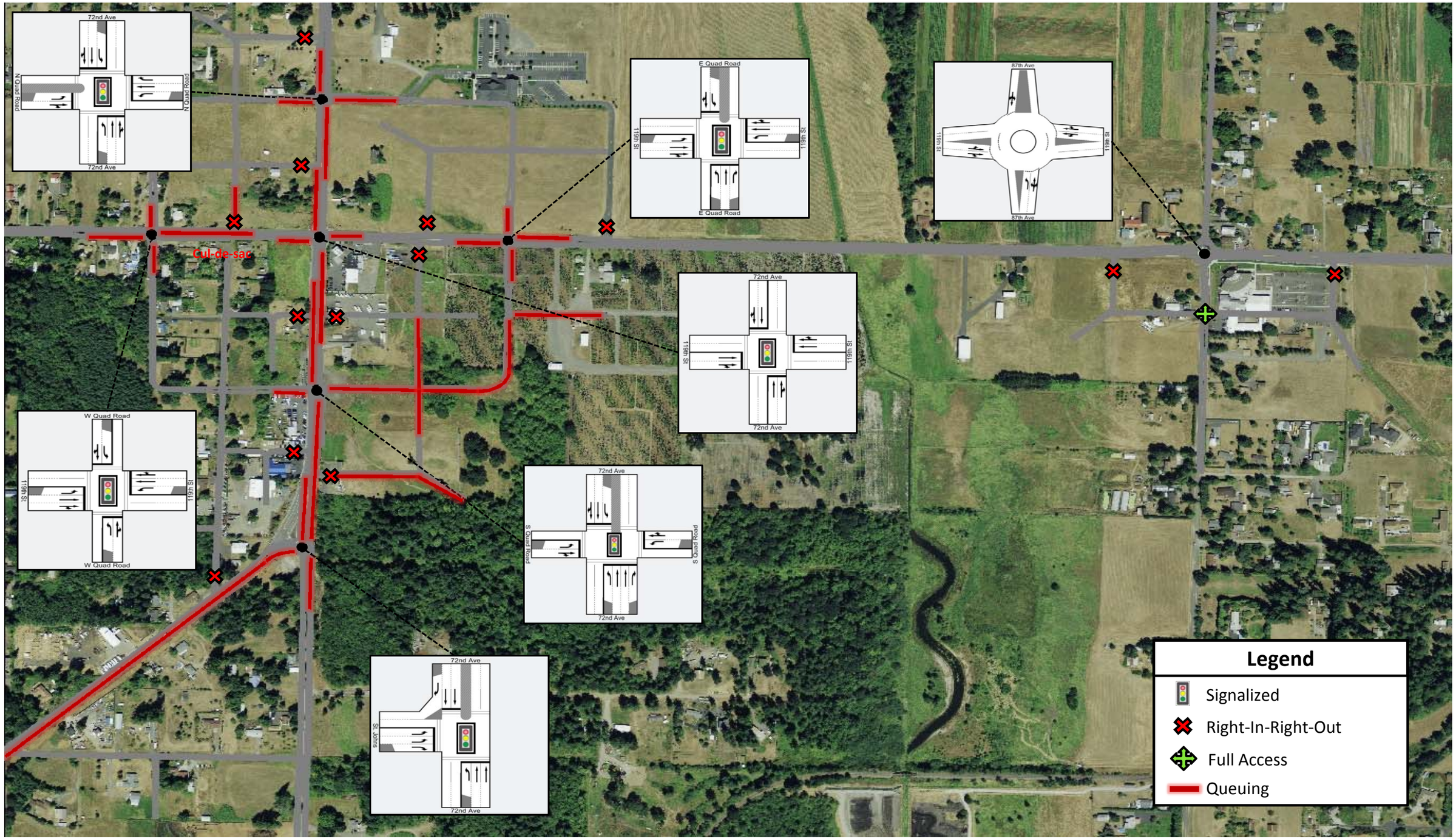
NE 119th Street: Full Build Out - 2 Lane Alternative



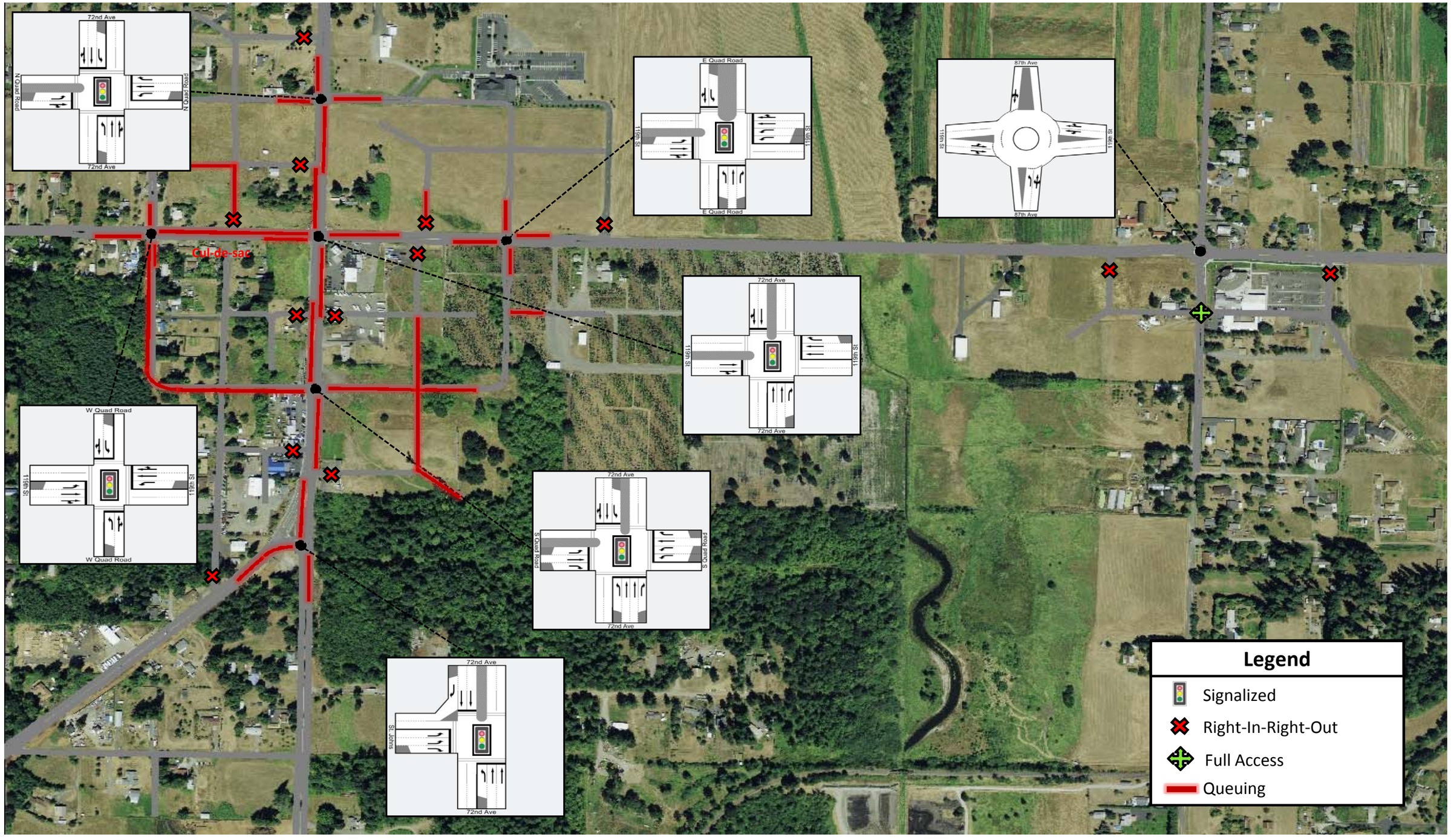
NE 119th Street: Full Build Out - 3 Lane Alternative



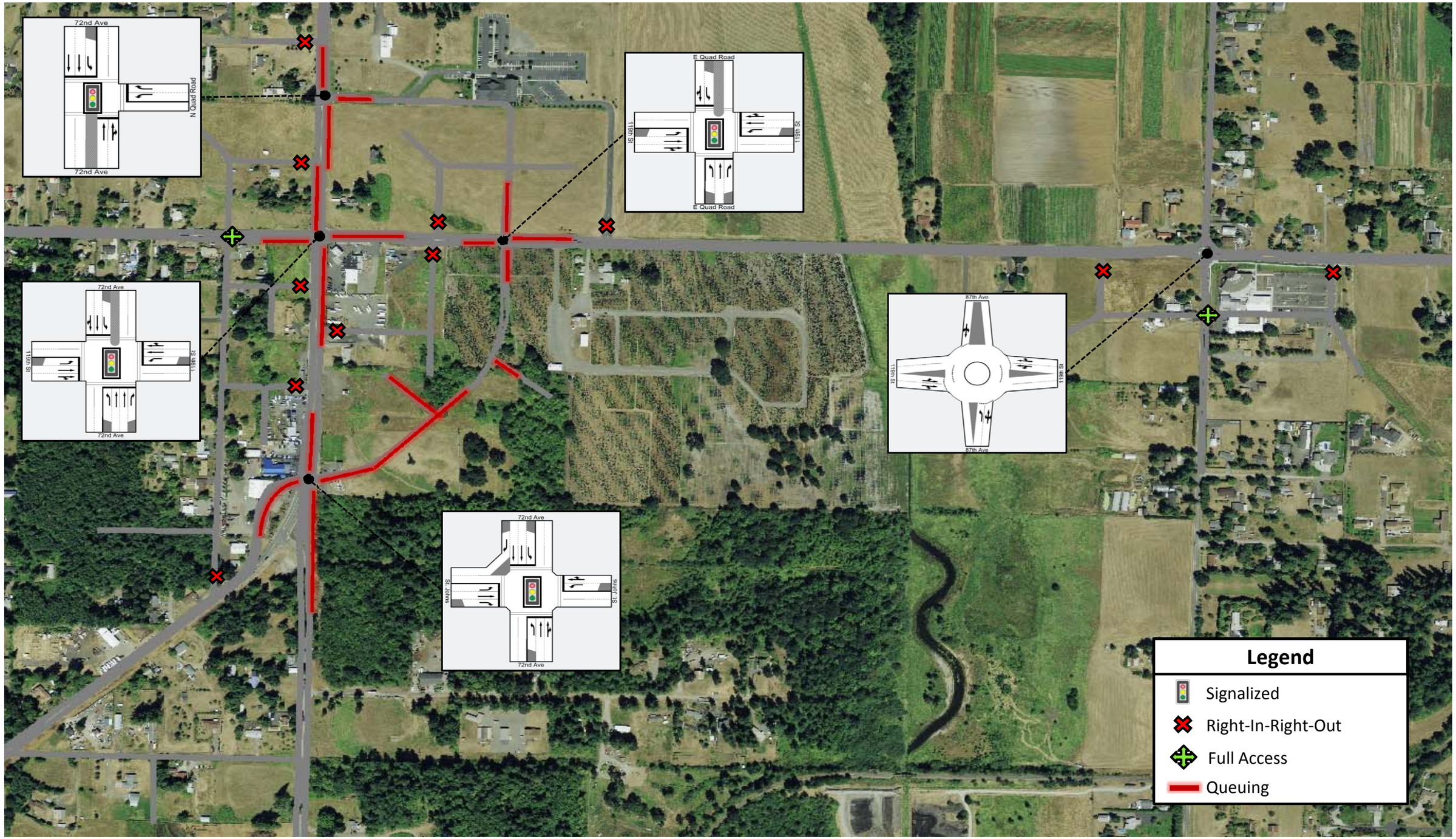
NE 119th Street: Full Build Out - 3 Lane Alternative Version 3



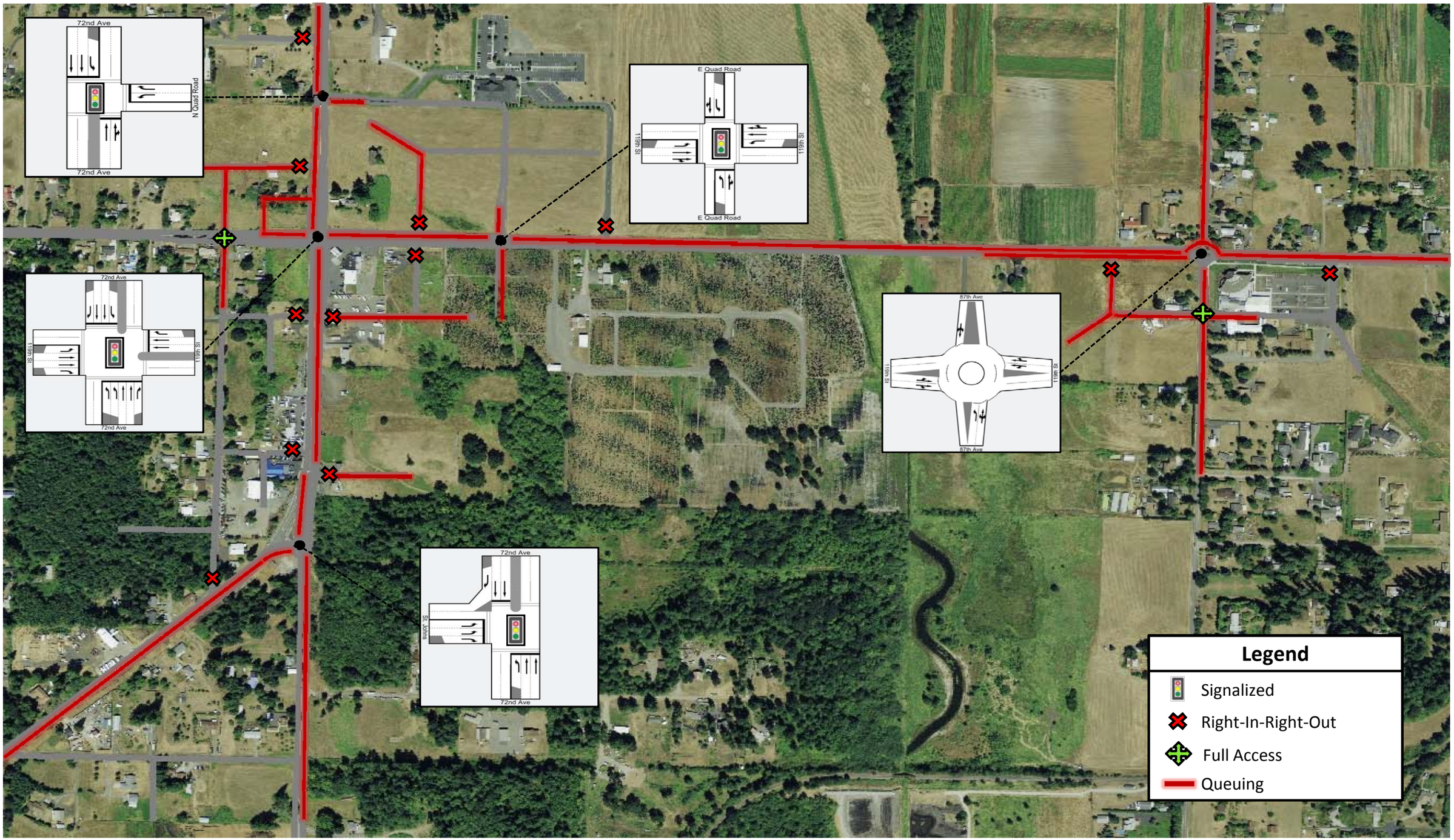
NE 119th Street: Full Quadrant Road Alternative Version 1



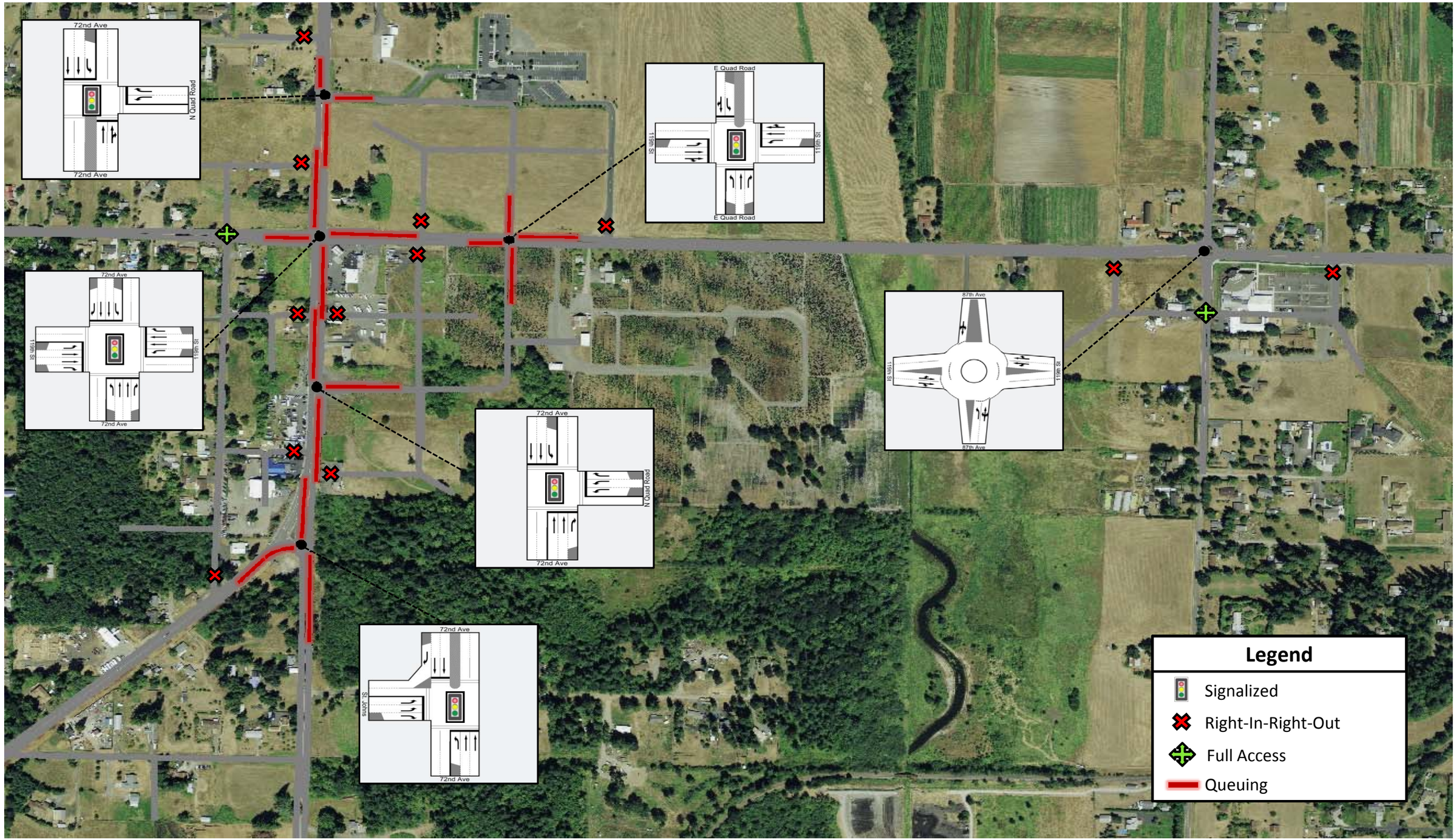
NE 119th Street: Full Quadrant Road Alternative Version 2



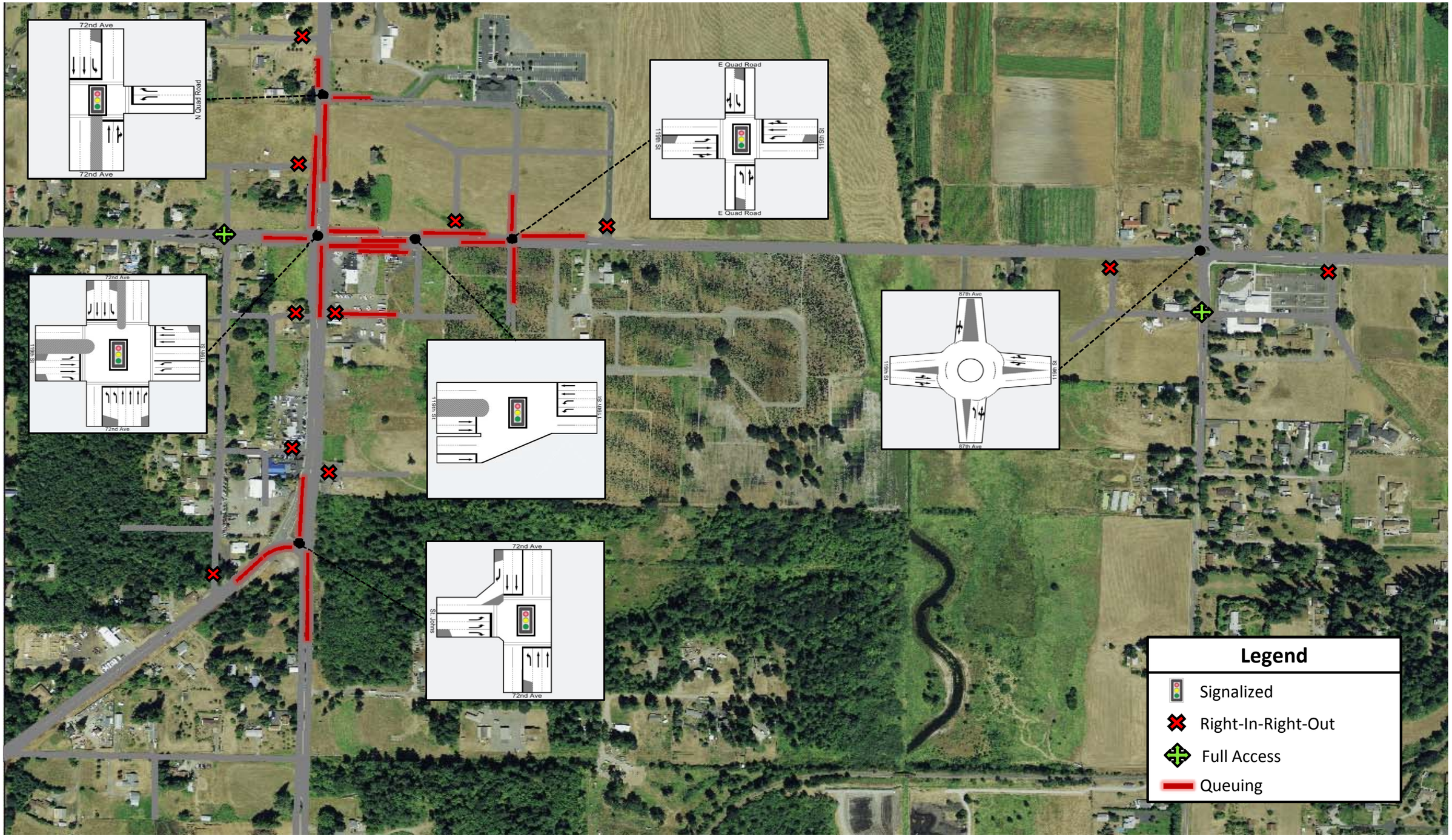
NE 119th Street: St. Johns Extension Alternative



NE 119th Street: Northwest Small Quadrant Road Alternative



NE 119th Street: Southeast Quadrant Road Alternative



NE 119th Street: Southeast CFI Alternative