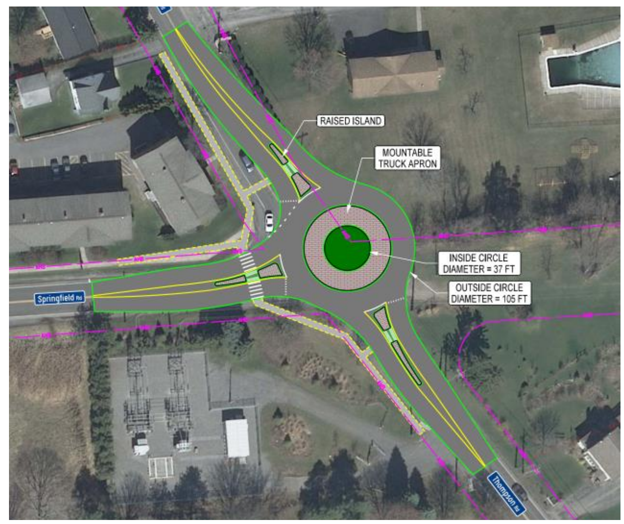
ROUNDABOUT FEASIBILITY ANALYSIS

FINAL REPORT

DECEMBER 2016



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Syracuse Metropolitan Transportation Council

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EXECUTIVE SUMMARY

This Roundabout Feasibility Analysis has been undertaken to evaluate the costs and benefits of installing roundabouts at three existing intersections in the Syracuse region, including the following locations:

- W. Onondaga St / Onondaga Ave / Tallman St / Delaware Ave ("Leavenworth Circle", City of Syracuse)
- E. Colvin St / Comstock Ave (City of Syracuse)
- Thompson Rd / Springfield Rd (Town of DeWitt).

This study includes an analysis of existing and future traffic conditions, presents a conceptual roundabout design, and evaluates the expected benefits and costs of installing a roundabout at each intersection.

Roundabout Benefits and Costs

Roundabouts have three primary types of benefit, including safety, operational and environmental. Safety benefits are realized from the reduction of potentially severe accidents such as right angle, left turn and head on, due to the geometry of a roundabout. The slower, more consistent vehicle speeds through a roundabout also contribute to the reduction in accident severity. The safety benefit is calculated using economic costs for the various types of accidents expected to be reduced. With regard to operational benefits, roundabouts typically operate more efficiently than conventional intersections, resulting in fewer delays for vehicles traveling through the intersection. The operational benefit is calculated by comparing the yearly hours of delay at a roundabout versus conventional intersection, and assigning a cost to the hours saved. Environmental benefits include reduced fuel usage and emissions due to less time spent idling at a roundabout. The benefit is calculated by assigning a value to the fuel savings.

Costs associated with a roundabout consist of upfront construction costs and ongoing operation and maintenance costs, which include periodic maintenance of pavement, signage, striping and landscaping as well as power for lighting. Construction costs are often higher for a roundabout versus conventional intersection, but operation and maintenance costs are typically lower for a roundabout, as there is no traffic signal equipment to power, maintain and periodically replace.

A benefit-cost analysis was performed for each of the studied intersections, per the methodology in Section 3.7 of the Federal Highway Administration's NCHRP Report 672 *Roundabouts: An Informational Guide, Second Edition.* If the calculated result of the benefit-cost equation is greater than 1.0, then the roundabout alternative is economically justified.

Leavenworth Circle Analysis

The benefit-cost analysis indicates that constructing a roundabout at Leavenworth Circle is economically justified, with a benefit-cost ratio of 6.09 to 1. An analysis of traffic operation and other site considerations indicates that a single-lane roundabout is feasible. Expected benefits include a 60% reduction of accidents with injury (minimal to no reduction of other less severe types of accidents), an 80% reduction in the overall vehicular delay at the 2040 Design Year, and a corresponding 80% reduction in fuel usage and emissions at the intersection.

Costs include an initial construction cost of $1,562,646 and yearly operation costs of approximately $3,000, which is a $2,000/year savings when compared to the existing signalized intersection.

A roundabout at Leavenworth Circle would simplify the intersection and allow for the removal of two traffic signals. Adjacent property impacts and additional right-of-way needs are minimal. Pedestrian and bicycle mobility would likely be improved due to the shorter crossing distances, refuge islands and lower vehicle speeds through the intersection. One concern is the possible alternative intersection plans being pursued by the Atlantic States Legal Foundation, which is a community organization seeking to improve the intersection and incorporate (or re-imagine) the historic fountain that occupied the center of the former Leavenworth Circle. ASLF's current plans do not include a roundabout at this location. However, ASLF's work does not preclude the further study of a roundabout at Leavenworth Circle.

Thompson Rd / Springfield Rd Intersection Analysis

The benefit-cost analysis indicates that constructing a roundabout at the Thompson Rd / Springfield Rd intersection is economically justified, with a benefit-cost ratio of 41.42 to 1. An analysis of traffic operation and other site considerations indicates that a single-lane roundabout is feasible. A safety benefit was not assumed for this location, as data indicates that converting an all-way stop intersection to a roundabout results in minimal to no accident reduction. However, a significant operational benefit would be realized by installing a roundabout. Existing traffic operation is fair to poor, particularly during the evening peak hour, and is expected to worsen through the 20 year design period. A roundabout would reduce the yearly hours of delay by approximately 90% at Year 2040. A corresponding reduction in fuel usage and emissions is expected as well.

Costs include the initial construction cost of $840,595 and yearly operational costs of approximately $3,000 (operation & maintenance costs are comparable to the existing all-way stop intersection). The analysis of traffic operation at the Thompson Rd / Springfield Rd intersection indicated that the all-way stop control is expected to result in unacceptable Level of Service and delay within the 20 year analysis period. Conceptual designs for conventional intersection improvements, including a traffic signal and turn lanes, were prepared and analyzed. It was determined that a signalized intersection would be less effective than a roundabout, with regard to traffic operation, and would cost approximately ten percent more to construct than a roundabout.

There are some site constraints at the Thompson Rd / Springfield Rd intersection, including the grade of Thompson Rd, limited right-of-way and proximity to adjacent LeMoyne College housing. The intersection also experiences high traffic volumes during special events at LeMoyne College, but police control of a roundabout is feasible. Constructing a roundabout would also provide an opportunity for gateway treatments for LeMoyne. None of the identified concerns are likely to preclude the further study or construction of a roundabout at this intersection.

E. Colvin St / Comstock Ave Intersection Analysis

A single lane roundabout was considered at the E. Colvin St / Comstock Ave intersection, both to enhance the Syracuse University's southern gateway and to improve pedestrian and bicycle access. However, a single lane roundabout was determined to not be feasible with regard to traffic operation due to the high traffic volumes on E. Colvin Street. A conceptual design for a partial two-lane roundabout (two lanes for E. Colvin Street eastbound and westbound, and single entering lanes for

Comstock Ave northbound and southbound traffic) was developed and analyzed. A detailed benefit-cost analysis was not performed, but an evaluation of benefits, costs and other considerations indicates that a two-lane roundabout is feasible. A two-lane roundabout would likely result in safety benefits (60% reduction in accidents with injury), operational benefits in the form of reduced vehicular delays at the intersection, and corresponding environmental benefits from reduced fuel consumption and emissions. Costs include a construction cost of $1,675,000 and yearly operational costs of approximately $4,000, which is a $1,000 / year savings compared to the signalized intersection.

There most significant concern with installing a roundabout at the E. Colvin St / Comstock Ave intersection is the potential impact to adjacent properties. A two-lane roundabout would require right-of-way from all adjoining properties, with potentially significant impacts to the City of Syracuse's Comfort Tyler Park and the Syracuse University property (although there would be an opportunity to enhance the Syracuse University gateway treatments at the intersection). Another concern is special event traffic, where police control would likely be required. It is noted that there are possible low-cost improvements that could be made to the existing signalized intersection that would improve pedestrian and bicycle safety and mobility.

Overall, although a roundabout is technically feasible, the high construction cost, site constraints and stakeholder concerns noted above indicate that a roundabout may not be the most suitable type of intersection for the E. Colvin St / Comstock Ave project setting.

1.0 INTRODUCTION

This Roundabout Feasibility Analysis has been undertaken to evaluate the costs and benefits of installing roundabouts at three existing intersections in the Syracuse region, including the following locations:

- W. Onondaga St / Onondaga Ave / Tallman St / Delaware Ave ("Leavenworth Circle", City of Syracuse)
- E. Colvin St / Comstock Ave (City of Syracuse)
- Thompson Rd / Springfield Rd (Town of DeWitt).

The intersections were previously identified as possible candidates for conversion to roundabouts based on a preliminary review of traffic volumes, safety history, intersection geometry and other considerations such as the potential for aesthetic upgrades. This study includes a more in-depth analysis of existing and future traffic conditions, presents a conceptual roundabout design, and evaluates the expected benefits and costs of installing a roundabout at each intersection.

2.0 GENERAL ROUNDABOUT BENEFITS AND COSTS

2.1 Roundabout Benefits

Roundabouts have three primary types of benefit, including safety, operational and environmental. A general discussion of these benefits and the methodology used to quantify the benefits follows, while intersection-specific benefits are discussed in Sections 3.0, 4.0 and 5.0.

2.1.1 Safety Benefits

Roundabouts typically have lower accident rates and result in accidents with reduced severity when compared to conventional signalized and stop-controlled intersections. There are fewer conflict points at a roundabout than a traditional intersection, and the most severe crashes such as right angle, left turn and head on are significantly reduced or eliminated due to the geometry of a roundabout. The low and consistent speed that vehicles enter and travel through a roundabout also reduces the severity of crashes. The safety benefits of a roundabout are quantified in terms of the reduction in accidents, using an assumed economic cost per accident. A breakdown of the accident types occurring at a typical roundabout is shown in Table 2-1 (data is from a national study of 39 roundabouts, summarized in Section 5.3.2 of *NCHRP 672*). Note the absence of certain types of severe accidents such as head-on and right angle crashes commonly occurring at conventional intersections.

Table 2-1: Typical Roundabout Accident Types and Frequency of Occurrence

Accident Type	Percentage
Rear-end accident at approach leg	31%
Rear-end with exiting vehicle and circulating vehicle	31%
Sideswipe with entering vehicle and circulating vehicle	23%
Loss of control accident	13%
Pedestrian accident	1%
Bicycle accident	1%

Data on crash reduction as a result of converting an intersection to a roundabout varies and depends on the type of intersection being compared to (signal, two-way stop, all-way stop) as well as the location of the intersection (urban or rural). The greatest improvements to safety are typically experienced when converting a two-way stop intersection in a rural high-speed environment, while roundabout conversions in urban settings often have diminished safety benefits. In the absence of local data, Section 5.3.1 of *NCHRP 672* was used to estimate the expected safety benefits of converting intersections to roundabouts, as described below:

Table 2-2: Expected Crash Reduction from Roundabout Conversion

Intersection Conversion Type	Reduction in Fatal and Injury Crashes	Reduction in Overall Crash Rate
Urban signalized intersection to roundabout (e.g. Leavenworth Circle, E. Colvin St / Comstock Ave)	60.1%	Insignificant Reduction
Urban all-way stop intersection to roundabout (e.g. Thompson Rd / Springfield Rd)	Insignificant Reduction	Insignificant Reduction

The data indicates that when converting an urban signalized intersection to a roundabout, a significant reduction in severe accidents can be expected, but the rate of less severe property damage accidents is likely to remain similar to existing levels. It is noted that other national case studies and data have indicated an overall reduction in crashes by 35% or more as a result of converting a signalized intersection to a roundabout, but this study conservatively uses the data in *NCHRP 672*.

The data also indicates that converting an all-way stop intersection to a roundabout is likely to result in insignificant safety benefits.

The monetary value of expected safety benefits was calculated using the National Safety Council's 2012 Economic Cost per Crash for the various crash severity levels including fatality, serious injury, non-serious injury, and property damage. The Safety Council's data establishes an economic cost of $4,538,000 per fatality, $230,000 per serious injury, $58,700 per non-serious injury, and $2,500 per property damage crash.

2.1.2 Operational Benefits

Roundabouts operate more efficiently than conventional intersections, resulting in fewer delays for vehicles traveling through the intersection. The operational benefits of a roundabout are quantified in terms of the reduction in person-hours of delay, using an assumed cost per hour of delay.

The yearly total of person-hours of delay was calculated for both the "no-build" (conventional intersection control) and "build" (roundabout) intersection types, and the results were compared to calculate the operational benefits of the roundabout. Traffic modeling was performed for the conventional and roundabout intersections (Synchro traffic software for conventional intersections, and VISSIM for the roundabouts) to determine the average delay per vehicle traveling through the intersection during the peak hour. The peak hour delays were used to calculate a yearly total of person-hours of delay using the following steps:

- An intersection-specific "K" factor was used to convert peak hour delay to daily delays (peak hour volumes are typically 8% - 10% of the total daily volume, and a "K" factor for each intersection was determined from existing traffic data).
- The total delay per day was multiplied by 260, which is the number of weekdays in a year (this is a conservative but standard approach that takes into account that operational benefits will not be experienced equally during all days of the year).
- The total vehicular delay per year was multiplied by a vehicle occupancy factor of 1.25, which results in a total person-hour delay per year.

The value of person-hours of delay was calculated using hourly costs provided by the New York State Department of Transportation (the NYSDOT-provided data from 2013 was inflated to 2016 dollars). The value used for a passenger vehicle occupant's time is $15.83 per hour, while a value of $36.20 is used for trucks. It was assumed that 95% of the traffic is passenger cars and 5% is truck traffic. The total cost of person-hour delays per year at the conventional intersection was compared with the roundabout intersection to determine the yearly operational benefit of the roundabout.

2.1.3 Environmental Benefits

Environmental benefits of a roundabout include reduced fuel consumption and improved air quality, which are both directly related to the increased efficiency of roundabouts and the ability for vehicles to travel through a roundabout with less delay and reduced emissions due to less time spent idling. This analysis focuses on the fuel consumption aspect of the environmental benefits, as the benefit of reduced emissions is not easily quantified in monetary value, and assigns a value to the yearly fuel savings.

The comparison of fuel consumption at a conventional intersection versus a roundabout was performed using the vehicular hours of delay per year described above in Section 2.1.2: Operational Benefits. Fuel consumption data for various types of vehicles was obtained from the US Department of Energy, and an overall consumption rate of 0.25 gallons per hour of delay was calculated based on the expected type of traffic (75% standard engine cars, 20% large engine cars, and 5% trucks / buses). The consumption rate was multiplied by the number of vehicular hours of delay per year, and the resulting number of gallons per year was converted to a monetary value using an average cost of $3 per gallon of fuel.

2.2 Roundabout Costs

Roundabouts have two primary types of cost, including initial construction cost and ongoing operation and maintenance costs. A general discussion of these costs and the methodology used to quantify the costs follows, while intersection-specific costs are discussed in Sections 3.0, 4.0 and 5.0.

2.2.1 Construction Cost

Construction costs of a roundabout vary significantly from location to location but can be comparable to or less than reconstructing a signalized intersection, especially if auxiliary turn lanes typically found at a signalized intersection can be avoided. When compared to the “no-build” alternative, installing a roundabout would obviously involve upfront construction costs that the “no-build” alternative would not.

Construction costs for the roundabouts were estimated using standard preliminary engineering techniques and include items such as pavement, curb, concrete sidewalk and island treatments, excavation and grading, drainage, erosion control, signage and pavement markings. Work zone traffic control, survey, mobilization, construction inspection, and a 20% contingency are also included. Since detailed mapping (survey, right-of-way, utility) was not available, assumptions were made for certain items. Additional right-of-way needed for the roundabouts, including the cost of land and the cost of preparing maps and completing the legal process of acquiring the right-of-way, is also included in the construction cost estimates.

Items that are not included in the construction cost estimates are design costs (typically 7 to 10 percent of construction cost), private utility relocations (typically the responsibility of the utility owner), and special landscape or gateway treatments that may be installed at the roundabout.

2.2.2 Operational Cost

The operation and maintenance costs associated with a roundabout are typically less than costs for a signalized intersection but similar to or slightly higher than costs for an un-signalized intersection. Operation and maintenance costs of a roundabout include signage, pavement markings, landscaping, power for lighting, and periodic pavement maintenance and rehabilitation. Additional maintenance may be required during the winter season to keep pedestrian routes clear of snow and ice. Signalized intersection operation and maintenance costs include power and maintenance (and periodic replacement) of the signal, signage, pavement markings and periodic pavement maintenance and rehabilitation.

2.3 Benefit-Cost Analysis

A benefit-cost analysis was performed for the roundabout feasibility analysis per the methodology described in Section 3.7 of the Federal Highway Administration's *NCHRP Report 672 Roundabouts: an Information Guide, Second Edition.* The benefit-cost method is often used to evaluate public works projects and compares the incremental benefits between two alternatives to the incremental costs of the alternatives, accounting for the fact that benefits generally accrue over a period of time while capital costs are incurred upfront. For this analysis, the "build" (roundabout) alternative was compared to a "no-build" alternative (maintain the intersection in its current state) over a twenty-year design period. The benefit-cost method is expressed using the following equation:

$$B/C = \frac{\text{Benefits}_B - \text{Benefits}_A}{\text{Costs}_B - \text{Costs}_A}$$

where $_B$ = "build" alternative and $_A$ = "no-build" alternative.

If the calculated result of the benefit-cost equation is greater than 1.0, than the "build" alternative is considered to be economically justified. If the result is less than 1.0, then the value of the expected benefits is less than the value of the cost.

The Present Value method was used to convert the costs and benefits expected in future years to the present year. A Discount Rate of 3% per year was assumed in the valuation of future year costs and benefits.

The individual intersection benefit-cost analyses are discussed in Sections 3.3, 4.4 and 5.3, and benefit-cost tables are included in Appendix D.

3.0 LEAVENWORTH CIRCLE INTERSECTION ANALYSIS

3.1 Existing Conditions

3.1.1 Traffic Operation

Traffic counts were performed during the morning and evening peak hours at Leavenworth Circle in May 2015. The existing Level of Service and vehicular delay at each intersection approach were modeled using the Synchro software package, Version 8, and are summarized in Table 3-1. All intersection approaches operate at Level of Service “C” or better, which is considered acceptable operation for an urban signalized intersection.

Table 3-1: Existing Level of Service at Leavenworth Circle

Intersection	Approach	2015 AM Peak Hour	2015 PM Peak Hour
W. Onondaga St / Delaware St	Delaware St EB Thru/Right	C (27)	C (27)
	Delaware St WB Left	A (1)	A (1)
	Delaware St WB Thru	A (1)	A (1)
	W. Onondaga St NB Right	C (29)	C (27)
	Overall Intersection	**B (17)**	**B (11)**
W. Onondaga St / Tallman St / Onondaga Ave	Delaware St EB Left	A (2)	A (1)
	Delaware St EB Thru/Right	A (1)	A (1)
	Tallman St WB Left/Thru/Right	C (24)	C (28)
	Onondaga Ave NB Left	C (23)	C (21)
	Onondaga Ave NB Thru/Right	C (25)	B (18)
	W. Onondaga St SB Left/Thru	C (22)	C (23)
	W. Onondaga St SB Right	A (6)	A (6)
	Overall Intersection	**B (14)**	**B (14)**

Key: A (1) = Signalized Level of Service (Average Delay per Vehicle, in seconds)

3.1.2 Accident History

Accident records for the five-year period between January 2009 and December 2013 were reviewed. A total of 19 accidents occurred at Leavenworth Circle, including five with injury (1 serious injury), four with property damage, and ten non-reportable accidents. No fatal accidents occurred during the analysis period. The types of accidents are summarized in Table 3-2, and additional accident data and diagrams are included in Appendix B.

Table 3-2: Accident History at Leavenworth Circle

Accident Type	Number of Occurrences
Rear End	6
Right Angle	4
Overtaking / Sideswipe	3
Other / Unknown	3
Fixed Object	2
Bicycle	1
Total	**19**

The types of accidents are typical for an urban signalized intersection. Nearly all were attributed to driver error / inattention, but it is possible that the unusual intersection geometry (two signals, skew of approaches) was a contributing factor for some of the accidents. The accident rate was calculated at 0.81 Accidents per Million Entering Vehicles (Acc/MEV), which is 3.84 times higher than the statewide average accident rate of 0.21 Acc/MEV for this type of intersection.

3.2 Future Conditions: “No-Build” Alternative

Traffic analysis was completed for the “no-build” alternative (maintaining the existing signalized intersection) for analysis years 2020 and 2040 using a projected traffic volume growth rate of 1% per year. The analysis indicates that average vehicular delays will increase slightly, but acceptable traffic operation with Level of Service “C” or better will be experienced at the Design Year 2040. Possible improvements to traffic signal timing were identified and also analyzed. Reducing the cycle length to 60 seconds and optimizing the signal timings would improve the average delays slightly at the 2040 Design Year (see “2040 AM / PM Peak Improved” columns). A summary of the traffic analysis for Years 2020, 2040 and 2040 with improvements is provided in Table 3-3.

Table 3-3: Future Signalized Level of Service at Leavenworth Circle

Intersection	Approach	Year 2020 AM Peak	Year 2020 PM Peak	Year 2040 AM Peak	Year 2040 PM Peak	Year 2040 AM Peak Improved	Year 2040 PM Peak Improved
W. Onondaga St / Delaware St	EB Thru/Right	C (28)	C (27)	C (32)	C (29)	C (28)	C (24)
	WB Left	A (1)	A (1)	A (1)	A (1)	A (1)	A (1)
	WB Thru	A (1)	A (1)	A (1)	A (1)	A (1)	A (1)
	NB Right	C (30)	C (28)	C (33)	C (31)	C (31)	C (33)
	Overall Intersection	**B (18)**	**B (12)**	**C (21)**	**B (13)**	**B (18)**	**B (12)**
W. Onondaga St / Tallman St / Onondaga Ave	EB Left	A (2)	A (1)	A (2)	A (2)	A (3)	A (3)
	EB Thru/Right	A (1)	A (1)	A (1)	A (1)	A (1)	A (1)
	WB Left/Thru/Right	C (25)	C (29)	C (27)	C (31)	C (22)	C (26)
	NB Left	C (23)	C (23)	C (25)	C (30)	C (22)	C (26)
	NB Thru/Right	C (26)	B (19)	C (29)	C (21)	C (28)	C (17)
	SB Left/Thru	C (23)	C (24)	C (24)	C (28)	C (22)	C (25)
	SB Right	A (6)	A (6)	A (7)	A (7)	A (6)	A (7)
	Overall Intersection	**B (14)**	**B (15)**	**B (16)**	**B (17)**	**B (14)**	**B (15)**

3.3 Roundabout Analysis

The expected safety, operational and environmental benefits of a roundabout conversion at Leavenworth Circle were calculated and compared to the expected construction and operation & maintenance costs over the twenty-year design period. The benefit-cost ratio was calculated to be 6.09:1, which indicates that constructing a roundabout at this intersection would be economically justified. An overview of the benefits, costs, and additional considerations is provided below, and a larger figure depicting the conceptual roundabout design is included in Appendix C.

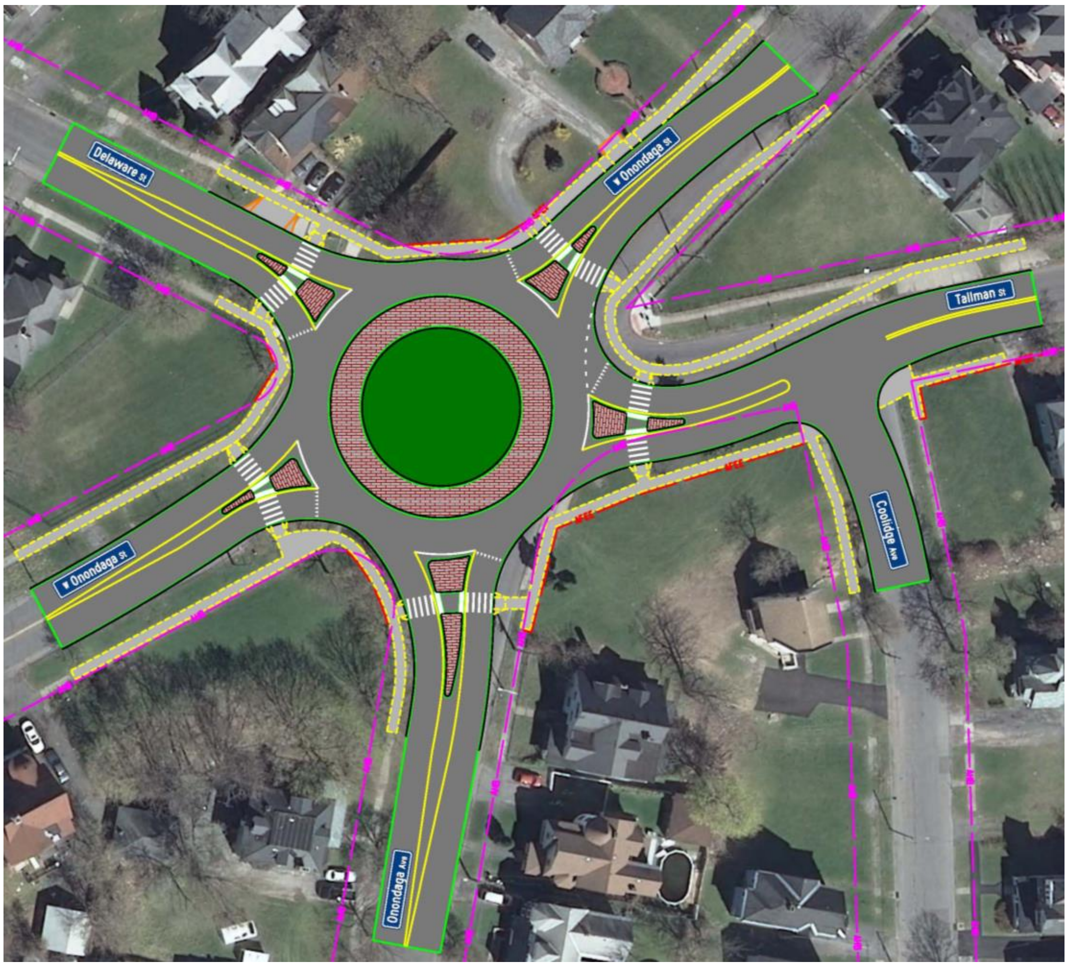


Figure 3-1: Conceptual Roundabout Design for Leavenworth Circle

3.3.1 Roundabout Benefits

Safety Benefit: The Leavenworth Circle intersection experienced 5 accidents with injury (1 serious injury) and 14 with property damage during the five year accident analysis period. No fatal accidents occurred. A 60.1% reduction of injury accidents per year can be expected, while property damage accidents are likely to remain at or near existing levels. An annual benefit of $55,776 was calculated for the expected reduction of injury accidents.

Operational Benefit: The roundabout is expected to operate very efficiently and reduce the yearly hours of delay by approximately 80%. The projected Level of Service for vehicles traveling through the roundabout during morning and afternoon peak hours is “A”, which indicates nearly free-flowing traffic operation. The roundabout also simplifies this five-approach intersection, vehicles would not have to travel through two traffic signal-controlled intersections, and all turning movements would be accommodated (left turns from Onondaga St to Delaware St are currently prohibited). The yearly operational benefit of a roundabout at the Leavenworth Circle intersection was calculated to be $507,931.

Environmental Benefit: A reduction in fuel consumption of approximately 80% is expected with the roundabout, similar to the reduction in delay hours. The yearly benefit of the reduced fuel consumption was calculated to be $18,087.

3.3.2 Roundabout Costs

Construction Cost: The cost to reconstruct the Leavenworth Circle intersection as a roundabout is estimated to be $1,562,646. The cost includes $40,000 for additional right-of-way from five adjacent properties.

Operation and Maintenance Cost: The roundabout is expected to result in an annual maintenance savings of $2,000, based on an expected signal operation cost of $5,000 per year and an expected roundabout intersection maintenance cost of $3,000 per year. Maintenance of special gateway treatments and landscaping is not included in the operation and maintenance cost estimates.

It was assumed that under the no-build option, the existing traffic signal system would need to be replaced at Year 10 due to the age and condition of the signal equipment, at a cost of $150,000.

3.3.3 Other Considerations

Site Considerations: The roundabout fits well within the available space, and although the five-approach design is challenging due to the angles between some of the legs, minimal approach re-alignment is expected to be needed, and the design simplifies the existing intersection layout. Adjacent property impacts are minimal, though a landscaped raised bed and fountain base that served as the center of a previous roundabout at the intersection would need to be relocated (this feature could be relocated either to the center of the proposed roundabout or more desirably to an area adjacent to the roundabout, and enhanced as a community gathering space or gateway feature). There are no significant grading or sight distance concerns and no unusual traffic generators that would impact traffic operation in the roundabout.

Pedestrian and Bicycle Traffic: A roundabout would likely improve safety and accessibility for pedestrians and bicyclists traveling through the intersection. The existing layout with two traffic signals can be confusing and difficult to navigate. Pedestrian crossing distances would be shorter, and the low vehicular speeds through a roundabout would benefit bicycle mobility.

Another consideration related to pedestrian and bicycle safety is the need to keep pedestrian routes and crossings free of snow and ice during the winter season. Although snow removal within the roundabout's travel lanes is generally not an issue, removing snow within the pedestrian crossing areas and splitter islands may require additional City of Syracuse maintenance resources.

Alternative Intersection Plans: It is noted that the Atlantic States Legal Foundation (ASLF), a non-profit community organization, is currently studying design options for the Leavenworth Circle intersection, with a focus on the fountain that formerly occupied the center of the intersection. Several design concepts were unveiled to the public in June 2016, and the concept titled "The Magnet" was subsequently chosen to be studied further. The concept involves removing the southern Onondaga Street intersection approach and constructing a new park and re-imagined fountain in the southwestern portion of the intersection. None of the ASLF design concepts involved installing a roundabout at Leavenworth Circle. Although ASLF's work does not preclude further study of a roundabout, coordination will be needed to ensure that the ASLF organization and neighborhood are involved in any future intersection improvements.

3.3.4 Summary of Roundabout Feasibility

The benefit-cost analysis results in a 6:1 ratio of benefits to costs over the 20 year design period, which indicates that a roundabout would be economically justified at the Leavenworth Circle intersection. Although the majority of the benefit is related to improved traffic operation in the form of less delay time and fuel usage, a reduction in accidents with injury can be expected, as well as reduced annual operation and maintenance costs when compared to the existing signalized intersection. The conceptual design and review of other traffic and site characteristics indicate that a roundabout is feasible at this intersection.

4.0 THOMPSON RD & SPRINGFIELD RD INTERSECTION ANALYSIS

4.1 Existing Conditions

4.1.1 Traffic Operation

Traffic counts were performed during the morning and evening peak hours at the Thompson Rd / Springfield Rd intersection in November 2015. The existing Level of Service and vehicular delay at each intersection approach were modeled using the Synchro software package, Version 8, and are summarized in Table 4-1. All intersection approaches operate at Level of Service "B" during the morning peak hour, but the Level of Service worsens during the evening peak hour where the northbound, eastbound and southbound approaches operate at Level of Service "C", "D", and "E", respectively.

Table 4-1: Existing Level of Service at Thompson Rd / Springfield Rd Intersection

Approach	2015 AM Peak Hour	2015 PM Peak Hour
Springfield Rd EB	B (12)	D (29)
Thompson Rd NB	B (12)	C (18)
Thompson Rd SB	B (14)	E (35)

Key: A (1) = Signalized Level of Service (Average Delay per Vehicle, in seconds)

4.1.2 Accident History

Accident records for the five-year period between January 2009 and December 2013 were reviewed. A total of 16 accidents occurred at the Thompson Rd / Springfield Rd intersection, including four with injury (none with serious injury), five with property damage, and seven non-reportable accidents. No fatal accidents occurred during the analysis period. The types of accidents are summarized in Table 4-2, and additional accident data and diagrams are included in Appendix B.

Table 4-2: Accident History at Thompson Rd / Springfield Rd Intersection

Accident Type	Number of Occurrences
Rear End	7
Right Angle	5
Overtaking / Sideswipe	2
Other / Unknown	1
Animal	1
Total	**16**

The types of accidents occurring are typical for this type of intersection. Most accidents were attributed to driver inattention or error, and there are no unusual patterns or apparent deficiencies at the intersection that contributed to the accidents. The accident rate was calculated at 0.72 Accidents per Million Entering Vehicles (Acc/MEV), which is

4.79 times higher than the statewide average accident rate of 0.15 Acc/MEV for this type of intersection.

4.2 Future Conditions: “No-Build” Alternative

Traffic analysis was completed for the “no-build” alternative (maintaining the existing all-way stop intersection) for analysis years 2020 and 2040 using a projected traffic volume growth rate of 1% per year. The analysis indicates that average vehicular delays will increase, and Level of Service will worsen to “F” for the eastbound and southbound approaches during the evening peak hour at Design Year 2040. During the 2040 morning peak hour, Level of Service “D” or better is projected for all approaches. A summary of the traffic analysis for Years 2020 and 2040 is provided in Table 4-3:

Table 4-3: Future Level of Service at Thompson Rd / Springfield Rd Intersection

Approach	2020 AM Peak Hour	2020 PM Peak Hour	2040 AM Peak Hour	2040 PM Peak Hour
Springfield Rd EB	B (12)	E (36)	C (15)	F (76)
Thompson Rd NB	B (13)	C (21)	C (17)	D (32)
Thompson Rd SB	C (15)	E (48)	D (25)	F (130)

4.3 Future Conditions with Signalized Intersection

This study included a comparison of a roundabout to other types of improvements that may be warranted or considered at the studied intersections. Because traffic conditions with the existing all-way stop control are expected to worsen through the 20 year design period, an analysis of traffic signal control at the intersection was performed. A conceptual layout, analysis of traffic operation, and estimate of construction costs were developed for the reconstruction of the Thompson Rd / Springfield Rd intersection with a traffic signal and auxiliary turn lanes. The signal alternative includes 150 ft turn lanes for northbound left, southbound right, and eastbound right turning traffic, as well as a 3-color traffic signal, and is shown in Figure 4-1. A larger figure depicting the conceptual signalized intersection design is included in Appendix C.

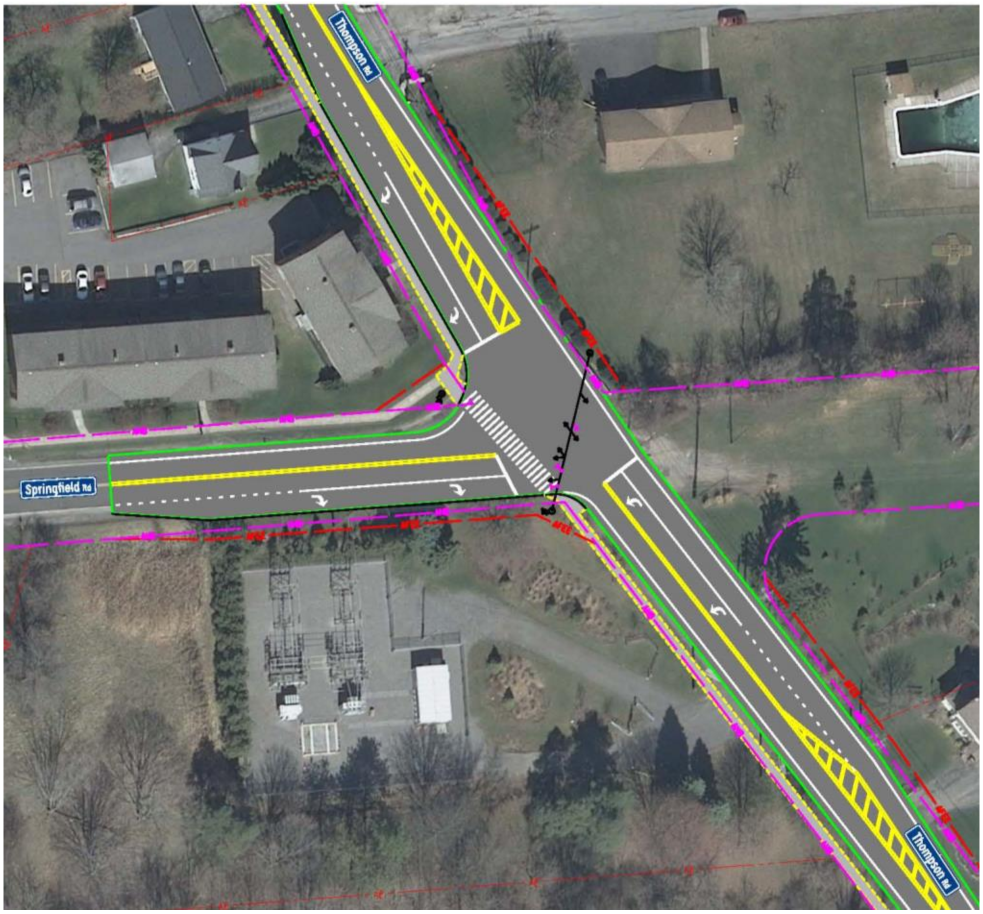


Figure 4-1: Conceptual Signalized Intersection Design at the Thompson Rd / Springfield Rd Intersection

Traffic modeling for the signalized intersection alternative indicates that the intersection approaches would operate at Level of Service "C" or better during the morning and afternoon peak hours at the Design Year 2040. This is a marked improvement when compared to operation with all-way stop control, but the roundabout alternative would result in significantly better operation, with Level of Service "A" at all approaches during both peak hours (see Section 4.4).

Cost estimates indicate that the signalized intersection alternative would have a slightly higher construction cost than the roundabout, due to the significant reconstruction required to install the three auxiliary turn lanes as well as the cost of the traffic signal. The construction cost of the signalized intersection is estimated at $916,974, while the roundabout alternative is estimated at $840,595. This amounts to an approximately 10% construction cost savings for the roundabout alternative.

With regard to safety, a signalized intersection would likely experience a higher accident rate and greater severity of accidents when compared to all-way stop control or roundabout, due to the higher speed of vehicles traveling through the intersection. The additional pavement width due to the turn lanes is also a safety concern for pedestrians and bicyclists at the intersection.

In summary, installation of a traffic signal at the Thompson Rd / Springfield Rd intersection is feasible and would improve Level of Service at the design year. However, a roundabout would provide significant benefits when compared to a traffic signal, and for a similar construction cost.

4.4 Roundabout Analysis

The expected safety, operational and environmental benefits of a roundabout conversion at the Thompson Rd / Springfield Rd intersection, as compared to the existing all-way stop control, were calculated and compared to the expected construction and operation & maintenance costs over the twenty-year design period. The benefit-cost ratio was calculated to be 41.42:1, which indicates that constructing a roundabout at this intersection would be economically justified. An overview of the benefits, costs and other considerations is provided below, and a larger figure depicting the conceptual roundabout design is provided in Appendix C.

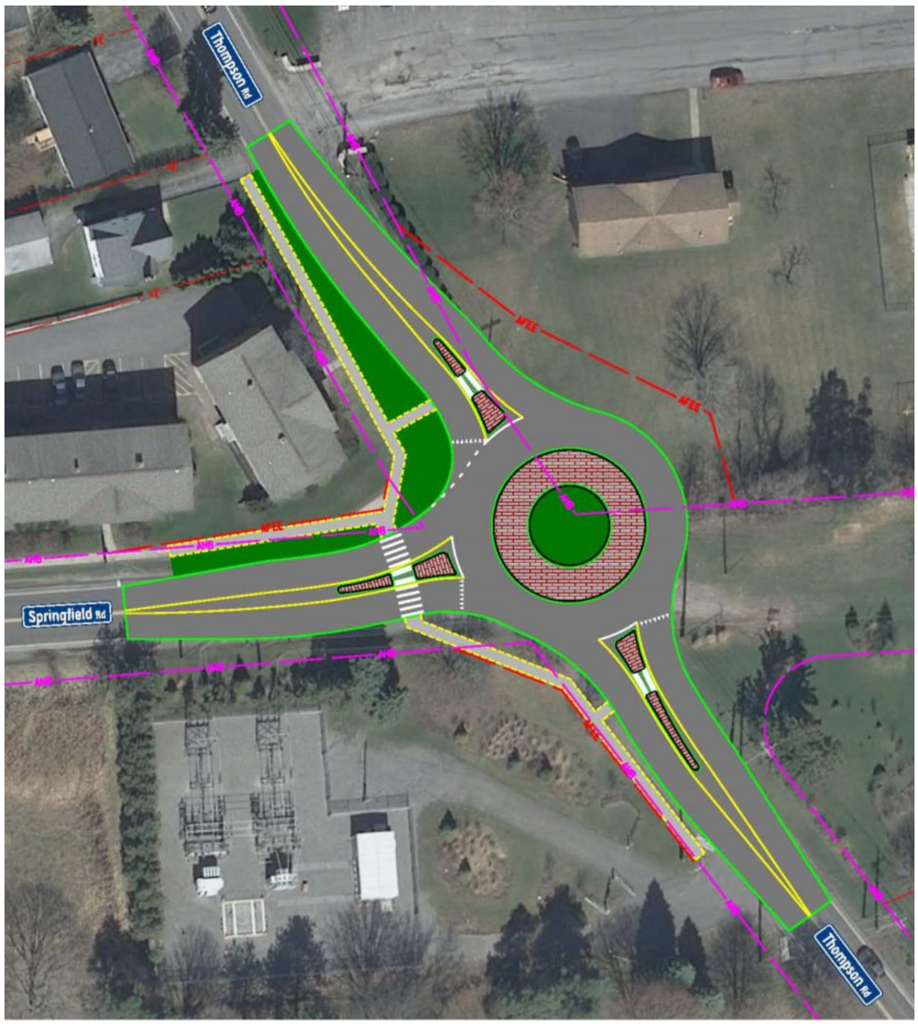


Figure 4-2: Conceptual Roundabout Design at the Thompson Rd / Springfield Rd intersection

4.4.1 Roundabout Benefits

<u>Safety Benefit:</u> The Thompson Rd / Springfield Rd intersection experienced 4 accidents with injury (none with serious injury) and 12 with property damage during the five year accident analysis period. No fatal accidents occurred. Data indicates that minimal safety benefits are experienced when converting all-way stop intersections to roundabouts, and therefore no annual safety benefit has been calculated for this analysis. However, five right angle accidents and two left turn accidents occurred at the intersection during the

analysis period, and these types of accidents can be expected to be significantly reduced or eliminated. It is likely that at least a minor improvement in safety would be experienced if the intersection were converted to a roundabout.

Operational Benefit: The roundabout is expected to operate very efficiently, and traffic modeling indicates that the roundabout would reduce the yearly hours of delay by approximately 90% when compared to the future operation of the all-way stop intersection. All roundabout approaches are projected to operate at Level of Service “A”. The yearly operational benefit of a roundabout at the Thompson Rd / Springfield Rd intersection was calculated to be $2,260,041.

Environmental Benefit: A reduction in fuel consumption of approximately 90% is expected with the roundabout, similar to the reduction in delay hours. The yearly benefit of the reduced fuel consumption was determined to be $80,481.

4.4.2 Roundabout Costs

Construction Cost: The cost to reconstruct the Thompson Rd / Springfield Rd intersection as a roundabout is estimated at $840,595. The cost includes $25,000 for additional right-of-way from three adjacent properties.

Operation and Maintenance Cost: The roundabout is expected to have a similar or slightly higher annual maintenance cost when compared to the all-way stop intersection. This analysis assumed the maintenance costs for both intersection types would be comparable.

4.4.3 Other Considerations

Thompson Rd Grade: A primary concern at the Thompson Rd / Springfield Rd intersection is the grade of Thompson Rd, which is approximately 6% through the intersection. Although a detailed grading design has not been completed for this study, it is believed that a roundabout could be constructed despite the Thompson Rd grade. Careful consideration would be required during the design phases to maintain adequate sight distance, accommodate turning movements through the roundabout, maintain positive drainage at the intersection, and minimize grading impacts to adjacent properties (particularly the Swiss Village property in the northeast corner). The New York State Department of Transportation’s Roundabout Division was contacted and determined that the grade alone would likely not preclude the installation of a roundabout at the intersection.

Right-of-way and Adjacent Properties: Additional constraints at the Thompson Rd / Springfield Rd intersection are the limited right-of-way, adjacent property ownership and proximity to nearby structures. The majority of additional right-of-way necessary for the roundabout is in the northeast corner and is not expected to significantly impact the Swiss Village property, but additional right-of-way would likely be needed in the northwest quadrant (LeMoyne student housing) and southwest quadrant (National Grid substation).

Special Events: Because of the intersection's proximity to the LeMoyne College campus, higher-than-typical traffic volumes are experienced during special events such as commencement, sporting events and move-in days. Police control of the Thompson Rd / Springfield Rd intersection currently occurs during certain events, and police control would likely still be needed if a roundabout were constructed at the intersection.

Bus Stops: Centro bus service currently runs along Springfield Road and Thompson Rd, and bus stops are located on Springfield Rd (south side, just west of the intersection) and Thompson Rd (east side, just south of the intersection). If a roundabout were constructed at the intersection, these bus stops would need to be relocated further away from the intersection as to not affect traffic entering or circulating through the roundabout.

Gateway Opportunity: An important benefit of converting the intersection to a roundabout is the opportunity to install gateway treatments and aesthetic upgrades, as the intersection serves as a primary gateway to LeMoyne College.

4.4.4 Summary of Roundabout Feasibility

The benefit-cost analysis results in a very high 41:1 ratio of benefits to costs over the 20 year design period, which indicates that a roundabout would be economically justified at the Thompson Rd / Springfield Rd intersection. However, the benefits are entirely based upon time and fuel savings related to the improved operation of the roundabout. Only minor (if any) safety benefits can be expected, and there is little to no difference in future operation and maintenance costs. Still, the roundabout appears to be a very beneficial and viable option considering the projected future poor traffic operation at the all-way stop intersection and the likely need for intersection capacity improvements. The roundabout alternative would also serve as an attractive gateway to the LeMoyne College campus. The conceptual design and review of other traffic and site characteristics indicate that a roundabout is feasible at this intersection.

5.0 E. COLVIN ST & COMSTOCK AVE INTERSECTION ANALYSIS

5.1 Existing Conditions

5.1.1 Traffic Operation

Traffic counts were performed during the morning and evening peak hours at the E. Colvin St / Comstock Ave intersection in October 2015. The existing Level of Service and vehicular delay at each intersection approach were modeled using the Synchro software package, Version 8, and are summarized in Table 5-1. All intersection approaches operate at Level of Service "D" or better, which is considered acceptable operation for an urban signalized intersection.

Table 5-1: Existing Level of Service at E. Colvin St / Comstock Ave Intersection

Approach	2015 AM Peak Hour	2015 PM Peak Hour
E. Colvin St EB Left	B (18)	B (15)
E. Colvin St EB Thru/Right	C (29)	C (31)
E. Colvin St WB Left	B (16)	B (16)
E. Colvin St WB Thru	D (42)	C (32)
E. Colvin St WB Right	A (8)	A (7)
Comstock Ave NB Left	D (36)	D (44)
Comstock Ave NB Thru	D (47)	D (47)
Comstock Ave NB Right	A (1)	A (1)
Comstock Ave SB Left	D (53)	D (43)
Comstock Ave SB Thru	D (46)	C (35)
Comstock Ave SB Right	A (6)	A (7)
Overall Intersection	**C (27)**	**C (25)**

Key: A (1) = Signalized Level of Service (Average Delay per Vehicle, in seconds)

5.1.2 Accident History

Accident records for the five-year period between January 2009 and December 2013 were reviewed. A total of 22 accidents occurred at the E. Colvin St / Comstock Ave intersection, including four with injury (1 serious injury), seven with property damage, and eleven non-reportable accidents. No fatal accidents occurred during the analysis period. The types of accidents are summarized in Table 5-2, and additional accident data and diagrams are included in Appendix B.

Table 5-2: Accident History at E. Colvin St / Comstock Ave Intersection

Accident Type	Number of Occurrences
Rear End	15
Right Angle	2
Overtaking	2
Sideswipe (Opposite Direction)	1
Head On	1
Bicycle	1
Total	**22**

The types of accidents are typical for an urban signalized intersection. Nearly all of the accidents were attributed to driver error / inattention, and no apparent deficiencies are present at the intersection that would contribute to the accidents. The accident rate was calculated at 0.66 Accidents per Million Entering Vehicles (Acc/MEV), which is 3.16 times higher than the statewide average accident rate of 0.21 Acc/MEV for this type of intersection.

5.2 Future Conditions: "No-Build" Alternative

Traffic analysis was completed for the "no-build" alternative (maintaining the existing signalized intersection) for analysis years 2020 and 2040 using a projected traffic volume growth rate of 1% per year. The analysis indicates that average vehicular delays will increase, with most approaches operating at Level of Service "D" or better at Year 2040. The Comstock Ave northbound thru movement is projected to operate at LOS "E" during both peak hours at Year 2040, and the Comstock Ave southbound left movement is projected to operate at LOS "E" during the morning peak hour. Level of Service "E" for a particular movement is not ideal, but still may be considered acceptable traffic operation as the overall intersection Level of Service is "C".

Possible improvements to traffic signal timing were identified and also analyzed. Reducing the cycle length to 100 seconds, implementing protected / permitted northbound / southbound left turn phasing, and having concurrent northbound / southbound thru phasing would improve traffic operations at the 2040 Design Year, with all approaches operating at LOS "D" or better (see Table 5-3, "2040 AM / PM Improved" columns).

A summary of the traffic analysis for Years 2020, 2040 and 2040 with improvements is provided in Table 5-3.

Table 5-3: Future Signalized Level of Service at E. Colvin St / Comstock Ave Intersection

Approach	Year 2020 AM Peak	Year 2020 PM Peak	Year 2040 AM Peak	Year 2040 PM Peak	Year 2040 AM Peak Improved	Year 2040 PM Peak Improved
E. Colvin St EB Left	B (19)	B (16)	C (27)	B (19)	C (23)	B (14)
E. Colvin St EB Thru/Right	C (30)	C (32)	C (33)	C (36)	C (28)	C (27)
E. Colvin St WB Left	B (16)	B (17)	B (18)	B (20)	B (14)	B (16)
E. Colvin St WB Thru	D (43)	D (34)	D (48)	D (40)	D (40)	C (33)
E. Colvin St WB Right	A (8)	A (8)	B (12)	B (11)	A (5)	A (4)
Comstock Ave NB Left	D (37)	D (46)	D (41)	D (49)	C (21)	C (22)
Comstock Ave NB Thru	D (49)	D (49)	E (61)	E (58)	D (44)	D (45)
Comstock Ave NB Right	A (1)	A (1)	A (1)	A (1)	A (1)	A (1)
Comstock Ave SB Left	E (56)	D (43)	E (67)	D (54)	C (30)	C (33)
Comstock Ave SB Thru	D (48)	C (35)	D (54)	D (40)	C (32)	C (30)
Comstock Ave SB Right	A (7)	A (7)	B (11)	B (7)	A (3)	A (6)
Overall Intersection	**C (28)**	**C (26)**	**C (33)**	**C (30)**	**C (24)**	**C (22)**

Key: A (1) = Signalized Level of Service (Average Delay per Vehicle, in seconds)

In addition to signal timing improvements noted above, several low-cost intersection improvements have been identified that would benefit pedestrian and bicyclist safety and comfort, including the following:

- Reduce the skew and overall length of existing crosswalks: The crosswalk at the southbound Comstock Ave approach is more than 80 feet long, and the crosswalk at the E. Colvin St westbound approach is more than 90 feet long (none of the intersection approaches are more than 65 feet wide). Realigning these crosswalks would shorten the pedestrian crossing distance. Extending curbs at the intersection's northwest and southeast corners would allow for even shorter crossing distances. Sidewalk ramps would need to be installed / replaced as necessary to align with the new crosswalks.

- Increase pedestrian comfort at the Comstock Ave northbound right turn slip ramp: A crosswalk and pedestrian crossing signage could be installed. The ramp could also be re-aligned to be nearly perpendicular to E. Colvin St, which would reduce vehicle speeds on the slip ramp and reduce the pedestrian crossing distance.

- Upgrade bicycle facilities: Bicycle lanes are present on E. Colvin St on both sides of the Comstock Ave intersection, but do not continue through the intersection. "Sharrows" could be installed on the E. Colvin St approaches to guide bicyclists through the intersection. Bicycle lane markings could be upgraded along E. Colvin St outside of the intersection. It also may be possible to re-stripe the E. Colvin St intersection approaches with 10 ft travel lanes and 5 ft bicycle lanes.

  Bicycle lanes are also present on Comstock Ave north of E. Colvin St. The bicycle lanes could be continued along Comstock Ave south of the intersection, with similar "sharrows" or travel lane narrowing with bicycle lanes added to the Comstock Ave intersection approaches.

5.3 Roundabout Analysis

A detailed benefit-cost analysis of the E. Colvin St / Comstock Ave intersection has not been performed. This study originally included an analysis of a single-lane roundabout at the intersection, but traffic modeling indicated that a single-lane roundabout would not have sufficient capacity to handle the expected 2040 Design Year traffic volumes. Approaches with poor Level of Service under the single-lane roundabout scenario include E. Colvin St eastbound (PM peak hour) and E. Colvin St westbound (AM peak hour), which both are projected to operate at LOS “F” during the respective peak hours with vehicle queues of approximately 800 feet. The Comstock Ave southbound is also projected to have queues of approximately 725 feet during the PM peak hour despite the acceptable Level of Service “C”. The traffic modeling determined that at a minimum, a partial two-lane roundabout would be needed, with two lanes provided for E. Colvin St eastbound and westbound traffic and single entering lanes for Comstock Ave northbound and southbound traffic.

The scope of the analysis was modified to include a design concept for the two-lane roundabout and a more general description of the benefits, costs and other considerations of a roundabout at the E. Colvin St / Comstock Ave intersection. The conceptual two-lane roundabout design is depicted in Figure 5-1, and a larger figure is included in Appendix C.

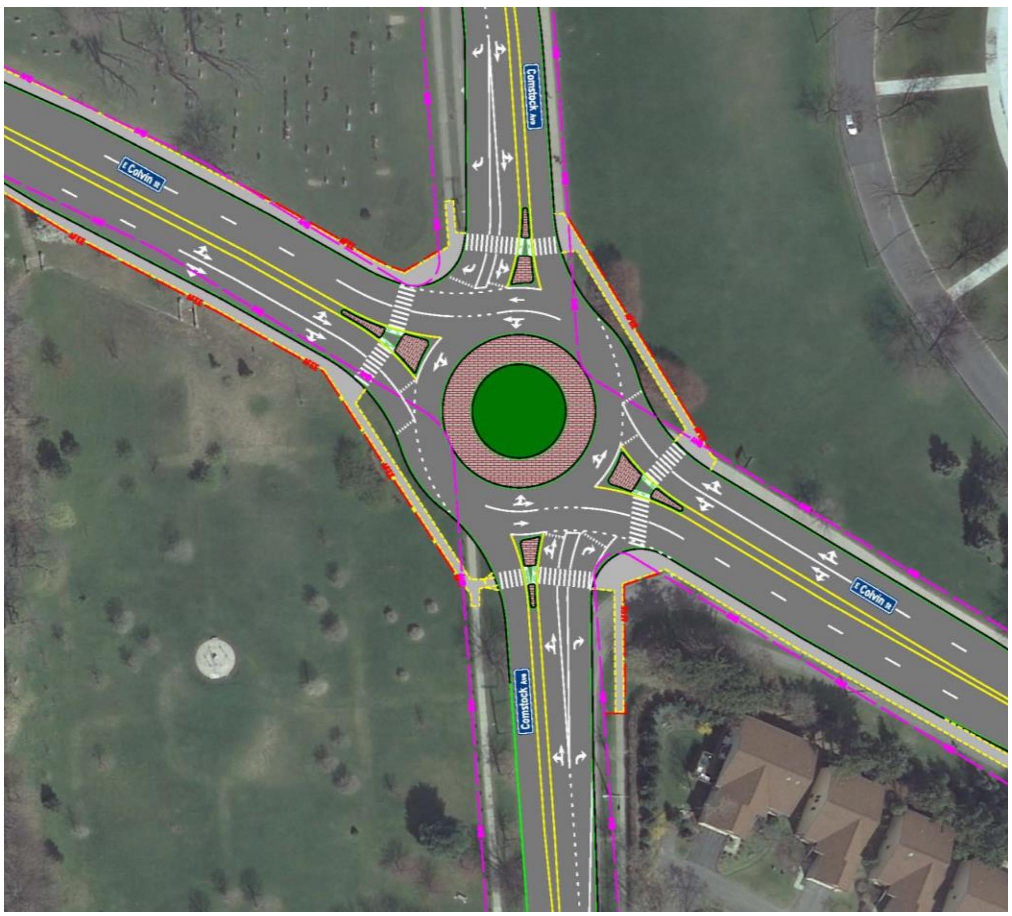


Figure 5-1: Conceptual Roundabout Design at the E. Colvin St / Comstock Ave Intersection

5.3.1 Roundabout Benefits

Safety Benefit: The E. Colvin St / Comstock Ave intersection experienced 4 accidents with injury (1 serious injury) and 18 with property damage during the five year accident analysis period. No fatal accidents occurred. Data indicates that the accidents with injury would be reduced by approximately 60%, while a similar or slightly lower rate of other types of accidents can be expected. Two-lane roundabouts have a greater number of conflict points than single-lane roundabouts, due to the potential for vehicles to be entering, exiting or circulating through the roundabout side-by-side. Traffic on E. Colvin St would also be merging back to a single lane after passing through the roundabout.

Operational Benefit: Although it was determined that a single-lane roundabout would not provide enough capacity for the projected traffic volumes, a two-lane roundabout is expected to accommodate traffic efficiently and result in reduced delay times at the intersection. It is important to note that there may be occasions such as concerts and sporting events at Syracuse University where even a two-lane roundabout would not handle the volume of traffic and police control would be required at the intersection.

Environmental Benefit: A reduction in fuel consumption is expected with the roundabout, similar to the reduction in delay hours. A corresponding reduction in vehicular emissions is another environmental benefit.

5.3.2 Roundabout Costs

Construction Cost: The cost to reconstruct the E. Colvin St / Comstock Ave intersection as a two-lane roundabout is estimated to be $1,675,000. The cost includes $35,000 for additional right-of-way from four adjacent properties.

Operation and Maintenance Cost: A roundabout is expected to result in an annual maintenance savings of $1,000, based on an expected signal operation cost of $5,000 per year and an expected roundabout intersection maintenance cost of $4,000 per year. Periodic pavement maintenance would be required at the roundabout, similar to the existing intersection, but there would be no traffic signal equipment to maintain and periodically replace. There would be, however, a greater number of signs and pavement markings to maintain than a signalized intersection. The operation and maintenance cost estimates do not include special gateway or landscape features that may be installed at the intersection.

5.3.3 Other Considerations

Adjacent Property Impacts: Existing right-of-way constraints and potential impacts to adjacent properties are significant concerns regarding a roundabout at the E. Colvin St / Comstock Ave intersection. A two-lane roundabout would likely require a significant amount of right-of-way from the Syracuse University property (northeast corner) and the City of Syracuse's Comfort Tyler Park (southwest corner). Small right-of-way takings may also be required from the Comstock Commons property at the southeast corner and Oakwood Cemetery at the northwest corner. Although no significant impact to the cemetery or any building structure is expected, the existing signage and landscaping on the Syracuse University property would need to be relocated. Acquiring right-of-way from these adjacent properties – particularly the park – would likely be a difficult and lengthy process.

Bicycle Traffic: Another important consideration is bicycle accessibility, especially given the intersection's location at the Syracuse University campus and proximity to other destinations like the park and cemetery. Bicyclists may choose to ride through the roundabout with traffic or dismount and use sidewalks and pedestrian crossings. The low-speed travel of vehicles through a roundabout benefits bicyclists, as it minimizes the speed differential, but the additional lanes and complexity of a two-lane roundabout result in additional conflict points and challenges for bicyclists.

At multi-lane roundabouts, it is recommended that cyclists travel through the roundabout in the same manner as vehicles. Therefore, cyclists making left turns may encounter multiple merging conflicts as they change into a lane designated for left turn movements. At roundabouts where right turn only or bypass lanes are present, cyclists making through movements or left turn movements may also experience additional merging conflicts. When circulating at a roundabout, bicyclists are less visible and therefore more vulnerable to the merging and exiting conflicts that occur at multi-lane roundabouts. This is especially true if cyclists hug the curb, because motorists further to the right are more out of the primary sight lines of entering drivers. In addition, since cyclists typically travel slightly slower than other vehicles in roundabouts, it is possible for motorists to pass cyclists and cut them off when exiting.

A consideration related to pedestrian and bicycle accessibility is the need to keep pedestrian routes and crossings clear of snow and ice during the winter season. Although snow removal within the roundabout's travel lanes is generally not an issue, removing snow within the pedestrian crossing areas and splitter islands may require additional City of Syracuse maintenance resources.

Special Events: The occurrence of special event traffic is another unique consideration for a roundabout at the E. Colvin St / Comstock Ave intersection. Concentrated periods of high traffic volumes are experienced before and after events at the Syracuse University main campus and south campus. Police control is often utilized at the existing signalized intersection during events, and it is expected that police control would be required at a roundabout as well (police would be stationed at the approaches, periodically stopping traffic from entering the roundabout to allow circulating traffic to clear). Although this type of arrangement is believed to be feasible, the two-lane roundabout complicates the special event situation, and drivers at special events are often unfamiliar with the area and may find a two-lane roundabout challenging to navigate.

Bus Stops: Centro bus service currently runs along E. Colvin St and Comstock Ave, and a bus stop is located on the south side of E. Colvin St just west of the intersection. If a roundabout were constructed at the intersection, the bus stop would need to be relocated further away from the intersection as to not affect traffic entering or circulating through the roundabout.

Gateway Opportunity: An important benefit of converting the intersection to a roundabout is the opportunity to install gateway treatments and aesthetic upgrades, as the intersection serves as a primary gateway to Syracuse University.

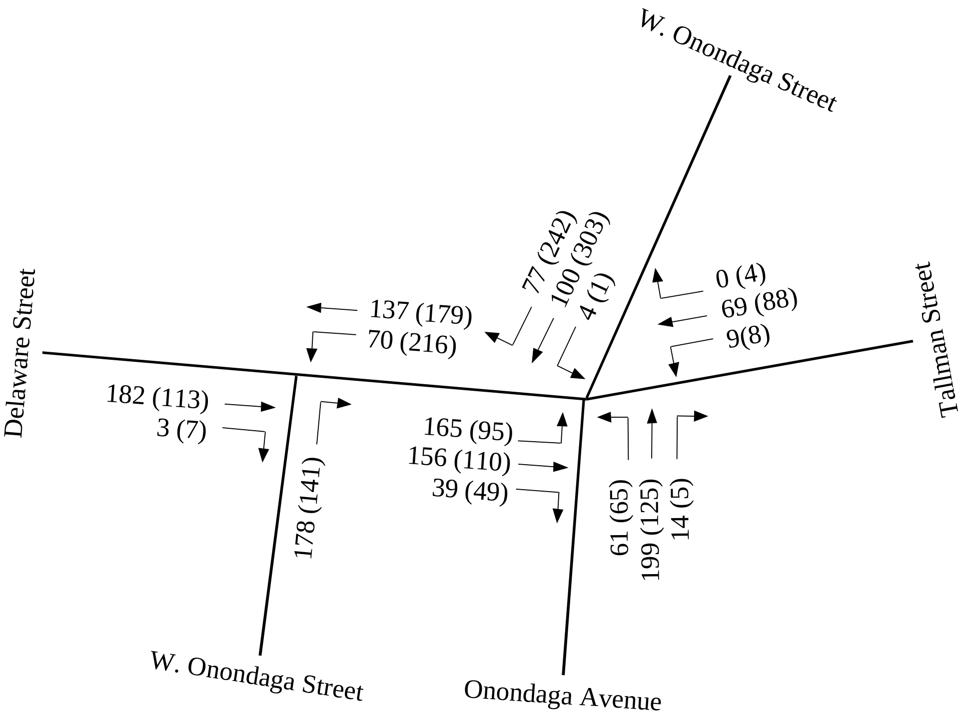
5.3.4 Summary of Roundabout Feasibility

An evaluation of benefits, costs and other considerations of a two-lane roundabout at the E. Colvin St / Comstock Ave intersection indicates that a two-lane roundabout is feasible and would likely provide safety and operational benefits, but involves a high estimated initial cost of $1.7 million and may not be the most suitable type of intersection given the project setting. The expected benefits would need to be weighed carefully against the property impacts and general complexity of the two-lane roundabout that may affect vehicular, pedestrian and bicycle mobility through the intersection. As noted in Section 5.2, other low-cost improvements to the existing traffic signal and pedestrian and bicycle facilities could be implemented to benefit all users of the intersection, if a roundabout is not pursued at this location.

APPENDIX A

Traffic Data

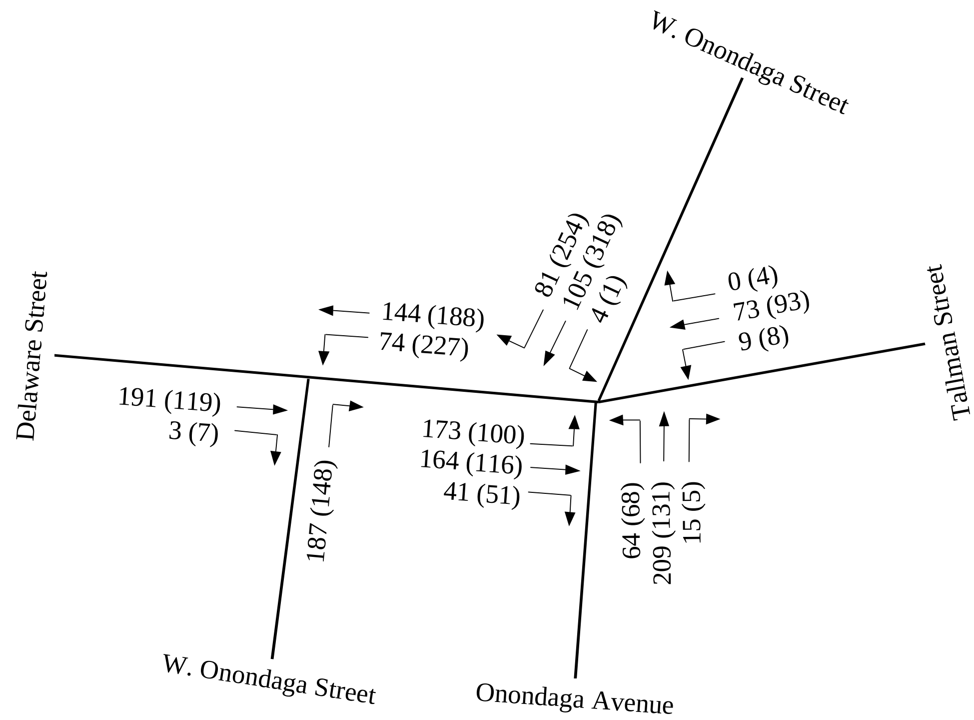
Leavenworth Circle



2015 Existing Traffic Volumes
Morning(Evening) Peak Hour

Counts Collected May 2015

Morning Peak Hour - 7:30am-8:30am
Evening Peak Hour - 4:30pm - 5:30pm

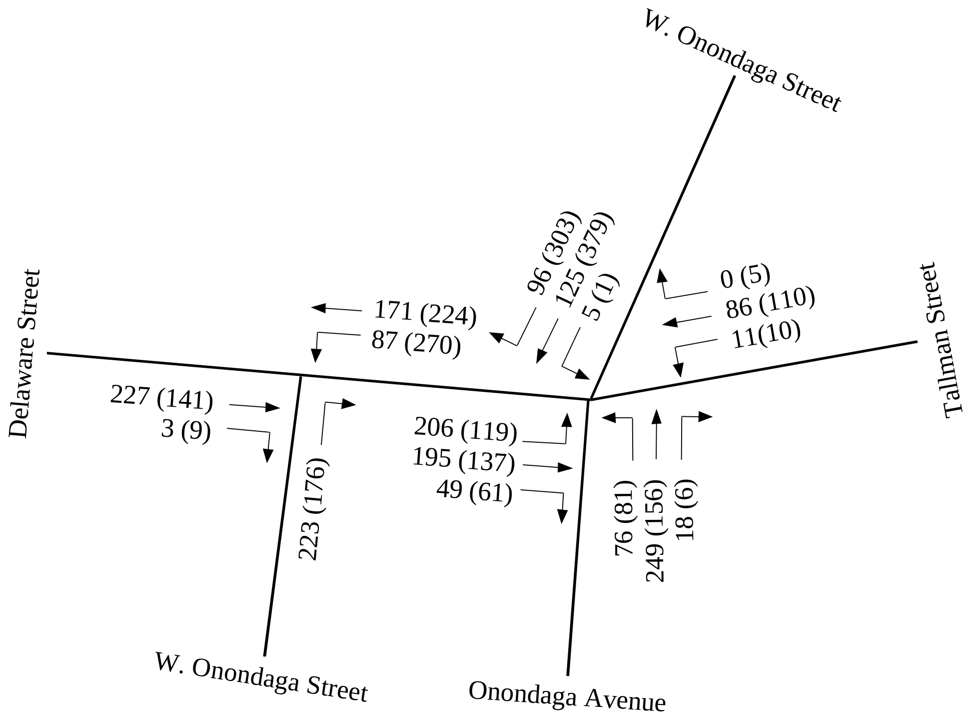


2020 Build Year Traffic Volumes
Morning(Evening) Peak Hour

1% Growth Per Year (5% Total)

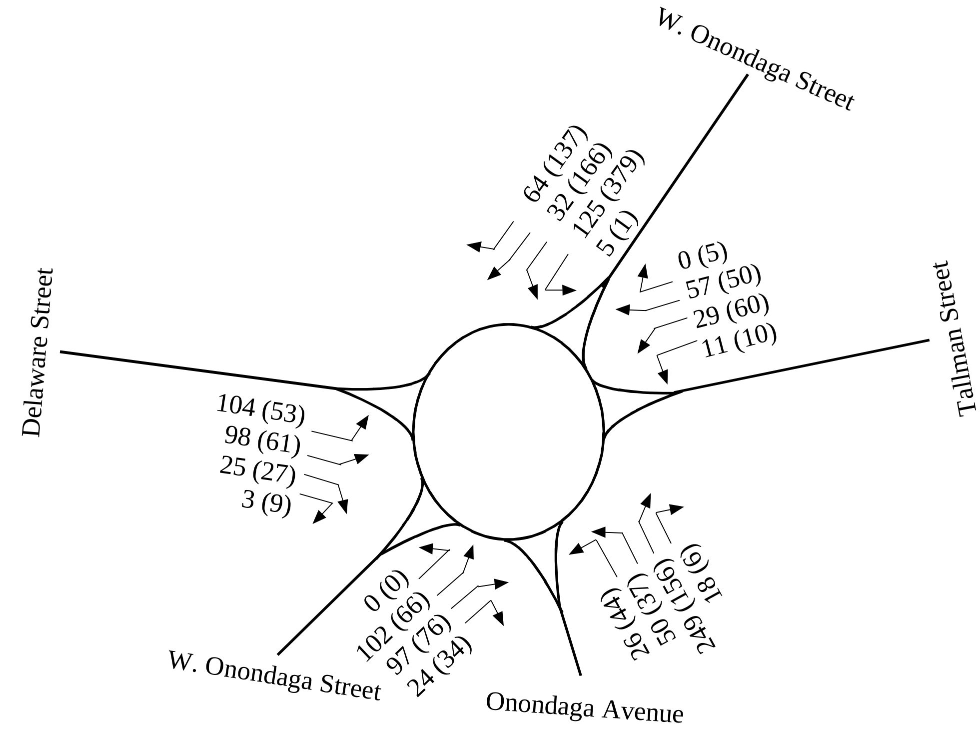
Roundabout Feasibility Study - Leavenworth Cicrle - Delaware St, W. Onondaga St, Onondaga Ave, Tallman Street
2015 Existing & 2020 Build Year Traffic Volumes
Morning (Evening) Peak Hour

N
W E
GTS Consulting



2040 Design Year Traffic Volumes
Existing Signalized Layout
Morning(Evening) Peak Hour

1% Growth (25% Total)



2040 Design Year Traffic Volumes
Roundabout Layout
Morning(Evening) Peak Hour

1% Growth (25% Total)

Traffic volumes carried through adjacent intersection proportionately

Roundabout Feasibility Study - Leavenworth Cicrle - Delaware St, W. Onondaga St, Onondaga Ave, Tallman Street
2040 Design Year Traffic Volumes
Morning (Evening) Peak Hour

N
W E

GTS Consulting

Roundabout Feasibility Study
Leavenworth Circle – Delaware St. / W. Onondaga St. / Onondaga Ave. / Tallman St.
Intersection Level of Service Summary

Morning Peak Hour

Intersection	2015 Existing	2020 Build Year	2040 Design Year	2040 Design Year Improved
West Onondaga Street @ Delaware Street	**B(17)**	**B(18)**	**C(21)**	**B(18)**
EB Through/Right	C(27)	C(28)	C(32)	C(28)
WB Left	A(1)	A(1)	A(1)	A(1)
WB Through	A(1)	A(1)	A(1)	A(1)
NB Right	C(29)	C(30)	C(33)	C(31)
West Onondaga Street @ Tallman Street/Onondaga Avenue	**B(14)**	**B(14)**	**B(16)**	**B(14)**
EB Left	A(2)	A(2)	A(2)	A(3)
EB Through/Right	A(1)	A(1)	A(1)	A(1)
WB Left/Through/Right	C(24)	C(25)	C(27)	C(22)
NB Left	C(23)	C(23)	C(25)	C(22)
NB Through/Right	C(25)	C(26)	C(29)	C(28)
SB Left/Through	C(22)	C(23)	C(24)	C(22)
SB Right	A(6)	A(6)	A(7)	A(6)

B(17) – Signalized Level of Service (Average Delay per Vehicle)
Improvements include a reduced 60 second cycle length and optimized timings

Evening Peak Hour

Intersection	2015 Existing	2020 Build Year	2040 Design Year	2040 Design Year Improved
West Onondaga Street @ Delaware Street	**B(11)**	**B(12)**	**B(13)**	**B(12)**
EB Through/Right	C(27)	C(27)	C(29)	C(24)
WB Left	A(1)	A(1)	A(1)	A(1)
WB Through	A(1)	A(1)	A(1)	A(1)
NB Right	C(27)	C(28)	C(31)	C(33)
West Onondaga Street @ Tallman Street/Onondaga Avenue	**B(14)**	**B(15)**	**B(17)**	**B(15)**
EB Left	A(1)	A(1)	A(2)	A(3)
EB Through/Right	A(1)	A(1)	A(1)	A(1)
WB Left/Through/Right	C(28)	C(29)	C(31)	C(26)
NB Left	C(21)	C(23)	C(30)	C(26)
NB Through/Right	B(18)	B(19)	C(21)	C(17)
SB Left/Through	C(23)	C(24)	C(28)	C(25)
SB Right	A(6)	A(6)	A(7)	A(7)

B(17) – Signalized Level of Service (Average Delay per Vehicle)
Improvements include a reduced 60 second cycle length and optimized timings

Roundabout Feasibility Study
Leavenworth Circle – Delaware St. / W. Onondaga St. / Onondaga Ave. / Tallman St.
Queue Summary

Morning Peak Hour

Intersection	Available Storage	2015 Existing	2020 Build Year	2040 Design Year	2040 Design Year Improved
West Onondaga Street @ Delaware Street					
EB Through/Right	-	155	165	195	144
WB Left	20	1	1	1	1
WB Through	20	0	0	0	0
NB Right	-	155	164	196	84
West Onondaga Street @ Tallman Street/Onondaga Avenue					
EB Left	20	2	2	3	12
EB Through/Right	20	0	0	0	0
WB Left/Through/Right	-	073	80	93	69
NB Left	90	60	62	72	58
NB Through/Right	-	167	176	211	164
SB Left/Through	-	89	92	107	85
SB Right	95	34	35	41	33

95th Percentile Queue from Synchro Analysis – in Feet
Improvements include a reduced 60 second cycle length and optimized timings

Evening Peak Hour

Intersection	Available Storage	2015 Existing	2020 Build Year	2040 Design Year	2040 Design Year Improved
West Onondaga Street @ Delaware Street					
EB Through/Right	-	102	109	128	96
WB Left	20	1	1	1	1
WB Through	20	0	0	0	0
NB Right	-	119	125	153	68
West Onondaga Street @ Tallman Street/Onondaga Avenue					
EB Left	20	2	2	2	11
EB Through/Right	20	0	0	0	0
WB Left/Through/Right	-	86	92	108	82
NB Left	90	59	64	87	64
NB Through/Right	-	91	99	125	89
SB Left/Through	-	207	227	297	211
SB Right	95	80	87	118	90

95th Percentile Queue from Synchro Analysis – in Feet
Improvements include a reduced 60 second cycle length and optimized timings

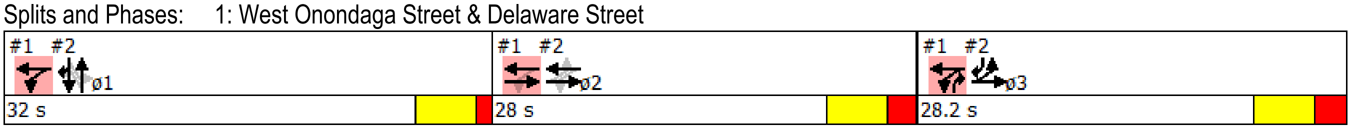
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR	ø1
Lane Configurations							
Volume (vph)	182	3	70	137	0	178	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Lane Width (ft)	16	16	10	10	15	15	
Satd. Flow (prot)	1934	0	1416	1642	0	1738	
Flt Permitted			0.606				
Satd. Flow (perm)	1934	0	901	1642	0	1738	
Right Turn on Red		Yes				No	
Satd. Flow (RTOR)	1						
Link Speed (mph)	30			30	30		
Link Distance (ft)	823			100	1020		
Travel Time (s)	18.7			2.3	23.2		
Confl. Peds. (#/hr)		4	4			9	
Confl. Bikes (#/hr)		2				2	
Peak Hour Factor	0.85	0.85	0.81	0.81	0.87	0.87	
Heavy Vehicles (%)	10%	67%	19%	8%	2%	4%	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	218	0	86	169	0	205	
Enter Blocked Intersection	No	No	No	No	No	No	
Lane Alignment	Left	Right	Left	Left	Left	Right	
Median Width(ft)	10			10	0		
Link Offset(ft)	0			0	0		
Crosswalk Width(ft)	16			16	16		
Two way Left Turn Lane							
Headway Factor	0.85	0.85	1.09	1.09	0.88	0.88	
Turning Speed (mph)		9	15		15	9	
Turn Type	NA		D.P+P	NA		Prot	
Protected Phases	2		1 3	1 2 3		3	1
Permitted Phases			2				
Detector Phase	2		1 3	1 2 3		3	
Switch Phase							
Minimum Initial (s)	7.0					7.0	10.0
Minimum Split (s)	13.0					13.2	15.0
Total Split (s)	28.0					28.2	32.0
Total Split (%)	31.7%					32.0%	36%
Maximum Green (s)	22.0					22.0	27.0
Yellow Time (s)	4.0					4.0	4.0
All-Red Time (s)	2.0					2.2	1.0
Lost Time Adjust (s)	0.0					0.0	
Total Lost Time (s)	6.0					6.2	
Lead/Lag	Lag						Lead
Lead-Lag Optimize?	Yes						Yes
Vehicle Extension (s)	3.0					3.0	3.0
Recall Mode	None					None	Min
Act Effct Green (s)	13.4		49.8	60.5		13.4	
Actuated g/C Ratio	0.22		0.82	1.00		0.22	
v/c Ratio	0.51		0.08	0.10		0.53	
Control Delay	27.2		0.3	0.1		28.5	
Queue Delay	0.0		0.0	0.0		0.0	

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR	ø1
Total Delay	27.2		0.3	0.1		28.5	
LOS	C		A	A		C	
Approach Delay	27.2			0.2			
Approach LOS	C			A			
Queue Length 50th (ft)	64		0	0		62	
Queue Length 95th (ft)	155		1	0		155	
Internal Link Dist (ft)	743			20	940		
Turn Bay Length (ft)							
Base Capacity (vph)	750		1243	1628		673	
Starvation Cap Reductn	0		0	0		0	
Spillback Cap Reductn	0		0	0		0	
Storage Cap Reductn	0		0	0		0	
Reduced v/c Ratio	0.29		0.07	0.10		0.30	

Intersection Summary

Area Type: Other
Cycle Length: 88.2
Actuated Cycle Length: 60.5
Natural Cycle: 50
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.53
Intersection Signal Delay: 17.4 Intersection LOS: B
Intersection Capacity Utilization 36.5% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 1: West Onondaga Street & Delaware Street



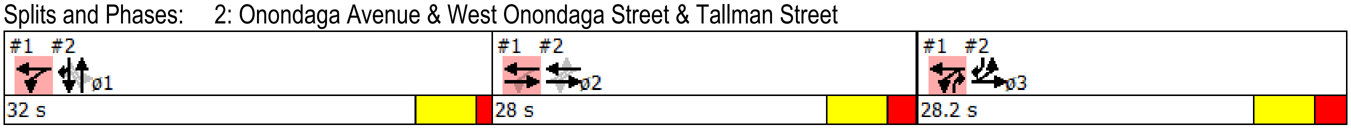
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	165	156	39	6	69	0	61	199	14	4	100	77
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	10	12	12	12	12	12	12	12	12	12
Storage Length (ft)	0		0	0		0	90		0	0		95
Storage Lanes	1		0	0		0	1		0	0		1
Taper Length (ft)	25			25			25			25		
Satd. Flow (prot)	1652	1582	0	0	1664	0	1641	1843	0	0	1700	1429
Flt Permitted	0.702				0.964		0.677				0.985	
Satd. Flow (perm)	1216	1582	0	0	1607	0	1163	1843	0	0	1678	1429
Right Turn on Red			Yes			Yes			Yes			No
Satd. Flow (RTOR)		23						4				
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		100			748			599			651	
Travel Time (s)		2.3			17.0			13.6			14.8	
Confl. Peds. (#/hr)	4		15	15		4	7		8	8		7
Confl. Bikes (#/hr)			3			3			3			2
Peak Hour Factor	0.94	0.94	0.94	0.88	0.88	0.88	0.86	0.86	0.86	0.84	0.84	0.84
Heavy Vehicles (%)	2%	8%	8%	33%	12%	2%	10%	1%	14%	0%	12%	13%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	176	207	0	0	85	0	71	247	0	0	124	92
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		10			10			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.09	1.09	1.09	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	D.P+P	NA		Perm	NA		Perm	NA		Perm	NA	pt+ov
Protected Phases	3	2 3			2			1			1	1 3
Permitted Phases	2			2			1			1		
Detector Phase	3	2		2	2		1	1		1	1	1
Switch Phase												
Minimum Initial (s)	7.0			7.0	7.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	13.2			13.0	13.0		15.0	15.0		15.0	15.0	
Total Split (s)	28.2			28.0	28.0		32.0	32.0		32.0	32.0	
Total Split (%)	32.0%			31.7%	31.7%		36.3%	36.3%		36.3%	36.3%	
Maximum Green (s)	22.0			22.0	22.0		27.0	27.0		27.0	27.0	
Yellow Time (s)	4.0			4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.2			2.0	2.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0				0.0		0.0	0.0			0.0	
Total Lost Time (s)	6.2				6.0		5.0	5.0			5.0	
Lead/Lag				Lag	Lag		Lead	Lead		Lead	Lead	
Lead-Lag Optimize?				Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0			3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None			None	None		Min	Min		Min	Min	
Act Effct Green (s)	26.5	33.3			13.4		15.4	15.4			15.4	35.4
Actuated g/C Ratio	0.44	0.55			0.22		0.25	0.25			0.25	0.59

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio	0.28	0.23			0.24		0.24	0.52			0.29	0.11
Control Delay	1.6	0.7			23.9		22.5	25.1			22.3	6.4
Queue Delay	0.0	0.0			0.0		0.0	0.0			0.0	0.0
Total Delay	1.6	0.7			23.9		22.5	25.1			22.3	6.4
LOS	A	A			C		C	C			C	A
Approach Delay		1.1			23.9			24.5			15.5	
Approach LOS		A			C			C			B	
Queue Length 50th (ft)	1	0			24		19	72			34	12
Queue Length 95th (ft)	2	0			73		60	167			89	34
Internal Link Dist (ft)		20			668			519			571	
Turn Bay Length (ft)							90					95
Base Capacity (vph)	904	884			622		553	878			797	1151
Starvation Cap Reductn	0	0			0		0	0			0	0
Spillback Cap Reductn	0	0			0		0	0			0	0
Storage Cap Reductn	0	0			0		0	0			0	0
Reduced v/c Ratio	0.19	0.23			0.14		0.13	0.28			0.16	0.08

Intersection Summary

Area Type: Other
Cycle Length: 88.2
Actuated Cycle Length: 60.5
Natural Cycle: 50
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.53
Intersection Signal Delay: 13.6 Intersection LOS: B
Intersection Capacity Utilization 38.9% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 2: Onondaga Avenue & West Onondaga Street & Tallman Street



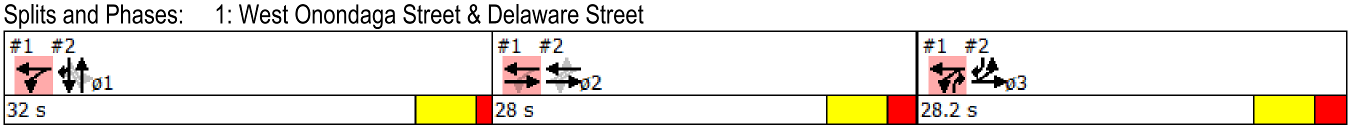
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR	ø1
Lane Configurations							
Volume (vph)	191	3	74	144	0	187	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Lane Width (ft)	16	16	10	10	15	15	
Satd. Flow (prot)	1935	0	1416	1642	0	1738	
Flt Permitted			0.577				
Satd. Flow (perm)	1935	0	858	1642	0	1738	
Right Turn on Red		Yes				No	
Satd. Flow (RTOR)	1						
Link Speed (mph)	30			30	30		
Link Distance (ft)	823			100	1020		
Travel Time (s)	18.7			2.3	23.2		
Confl. Peds. (#/hr)		4	4			9	
Confl. Bikes (#/hr)		2				2	
Peak Hour Factor	0.85	0.85	0.81	0.81	0.87	0.87	
Heavy Vehicles (%)	10%	67%	19%	8%	2%	4%	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	229	0	91	178	0	215	
Enter Blocked Intersection	No	No	No	No	No	No	
Lane Alignment	Left	Right	Left	Left	Left	Right	
Median Width(ft)	10			10	0		
Link Offset(ft)	0			0	0		
Crosswalk Width(ft)	16			16	16		
Two way Left Turn Lane							
Headway Factor	0.85	0.85	1.09	1.09	0.88	0.88	
Turning Speed (mph)		9	15		15	9	
Turn Type	NA		D.P+P	NA		Prot	
Protected Phases	2		1 3	1 2 3		3	1
Permitted Phases			2				
Detector Phase	2		1 3	1 2 3		3	
Switch Phase							
Minimum Initial (s)	7.0					7.0	10.0
Minimum Split (s)	13.0					13.2	15.0
Total Split (s)	28.0					28.2	32.0
Total Split (%)	31.7%					32.0%	36%
Maximum Green (s)	22.0					22.0	27.0
Yellow Time (s)	4.0					4.0	4.0
All-Red Time (s)	2.0					2.2	1.0
Lost Time Adjust (s)	0.0					0.0	
Total Lost Time (s)	6.0					6.2	
Lead/Lag	Lag						Lead
Lead-Lag Optimize?	Yes						Yes
Vehicle Extension (s)	3.0					3.0	3.0
Recall Mode	None					None	Min
Act Effct Green (s)	13.7		51.1	61.8		13.8	
Actuated g/C Ratio	0.22		0.83	1.00		0.22	
v/c Ratio	0.53		0.09	0.11		0.56	
Control Delay	28.1		0.3	0.1		29.5	
Queue Delay	0.0		0.0	0.0		0.0	

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR	ø1
Total Delay	28.1		0.3	0.1		29.5	
LOS	C		A	A		C	
Approach Delay	28.1			0.2			
Approach LOS	C			A			
Queue Length 50th (ft)	70		0	0		68	
Queue Length 95th (ft)	165		1	0		164	
Internal Link Dist (ft)	743			20	940		
Turn Bay Length (ft)							
Base Capacity (vph)	734		1230	1624		659	
Starvation Cap Reductn	0		0	0		0	
Spillback Cap Reductn	0		0	0		0	
Storage Cap Reductn	0		0	0		0	
Reduced v/c Ratio	0.31		0.07	0.11		0.33	

Intersection Summary

Area Type: Other
Cycle Length: 88.2
Actuated Cycle Length: 61.8
Natural Cycle: 50
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.56
Intersection Signal Delay: 18.0 Intersection LOS: B
Intersection Capacity Utilization 37.0% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 1: West Onondaga Street & Delaware Street



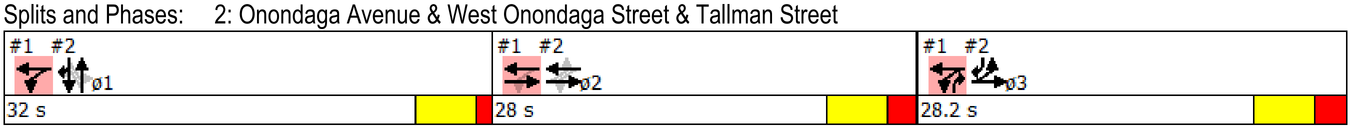
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	173	164	41	9	73	0	64	209	15	4	105	81
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	10	12	12	12	12	12	12	12	12	12
Storage Length (ft)	0		0	0		0	90		0	0		95
Storage Lanes	1		0	0		0	1		0	0		1
Taper Length (ft)	25			25			25			25		
Satd. Flow (prot)	1652	1581	0	0	1655	0	1641	1842	0	0	1700	1429
Flt Permitted	0.697				0.950		0.674				0.986	
Satd. Flow (perm)	1208	1581	0	0	1576	0	1158	1842	0	0	1679	1429
Right Turn on Red			Yes			Yes			Yes			No
Satd. Flow (RTOR)		24						4				
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		100			748			599			651	
Travel Time (s)		2.3			17.0			13.6			14.8	
Confl. Peds. (#/hr)	4		15	15		4	7		8	8		7
Confl. Bikes (#/hr)			3			3			3			2
Peak Hour Factor	0.94	0.94	0.94	0.88	0.88	0.88	0.86	0.86	0.86	0.84	0.84	0.84
Heavy Vehicles (%)	2%	8%	8%	33%	12%	2%	10%	1%	14%	0%	12%	13%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	184	218	0	0	93	0	74	260	0	0	130	96
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		10			10			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.09	1.09	1.09	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	D.P+P	NA		Perm	NA		Perm	NA		Perm	NA	pt+ov
Protected Phases	3	2 3			2			1			1	1 3
Permitted Phases	2			2			1			1		
Detector Phase	3	2		2	2		1	1		1	1	1
Switch Phase												
Minimum Initial (s)	7.0			7.0	7.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	13.2			13.0	13.0		15.0	15.0		15.0	15.0	
Total Split (s)	28.2			28.0	28.0		32.0	32.0		32.0	32.0	
Total Split (%)	32.0%			31.7%	31.7%		36.3%	36.3%		36.3%	36.3%	
Maximum Green (s)	22.0			22.0	22.0		27.0	27.0		27.0	27.0	
Yellow Time (s)	4.0			4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.2			2.0	2.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0				0.0		0.0	0.0			0.0	
Total Lost Time (s)	6.2				6.0		5.0	5.0			5.0	
Lead/Lag				Lag	Lag		Lead	Lead		Lead	Lead	
Lead-Lag Optimize?				Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0			3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None			None	None		Min	Min		Min	Min	
Act Effct Green (s)	27.3	34.1			13.7		16.0	16.0			16.0	36.3
Actuated g/C Ratio	0.44	0.55			0.22		0.26	0.26			0.26	0.59

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio	0.29	0.25			0.27		0.25	0.54			0.30	0.11
Control Delay	1.7	0.7			24.7		22.8	25.7			22.5	6.4
Queue Delay	0.0	0.0			0.0		0.0	0.0			0.0	0.0
Total Delay	1.7	0.7			24.7		22.8	25.7			22.5	6.4
LOS	A	A			C		C	C			C	A
Approach Delay		1.2			24.7			25.1			15.7	
Approach LOS		A			C			C			B	
Queue Length 50th (ft)	1	0			27		21	78			37	13
Queue Length 95th (ft)	2	0			80		62	176			92	35
Internal Link Dist (ft)		20			668			519			571	
Turn Bay Length (ft)							90					95
Base Capacity (vph)	891	880			597		539	859			781	1136
Starvation Cap Reductn	0	0			0		0	0			0	0
Spillback Cap Reductn	0	0			0		0	0			0	0
Storage Cap Reductn	0	0			0		0	0			0	0
Reduced v/c Ratio	0.21	0.25			0.16		0.14	0.30			0.17	0.08

Intersection Summary

Area Type: Other
Cycle Length: 88.2
Actuated Cycle Length: 61.8
Natural Cycle: 50
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.56
Intersection Signal Delay: 13.9 Intersection LOS: B
Intersection Capacity Utilization 39.5% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 2: Onondaga Avenue & West Onondaga Street & Tallman Street



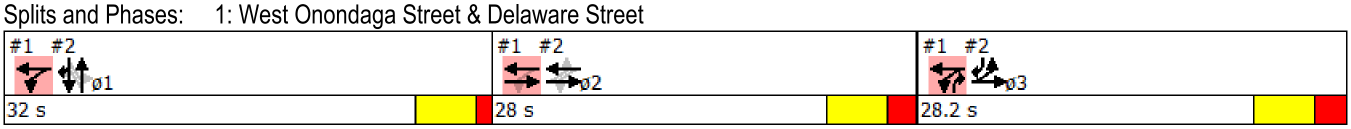
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR	ø1
Lane Configurations							
Volume (vph)	227	3	87	171	0	223	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Lane Width (ft)	16	16	10	10	15	15	
Satd. Flow (prot)	1938	0	1416	1642	0	1738	
Flt Permitted			0.473				
Satd. Flow (perm)	1938	0	704	1642	0	1738	
Right Turn on Red		Yes				No	
Satd. Flow (RTOR)	1						
Link Speed (mph)	30			30	30		
Link Distance (ft)	823			100	1020		
Travel Time (s)	18.7			2.3	23.2		
Confl. Peds. (#/hr)		4	4			9	
Confl. Bikes (#/hr)		2				2	
Peak Hour Factor	0.85	0.85	0.81	0.81	0.87	0.87	
Heavy Vehicles (%)	10%	67%	19%	8%	2%	4%	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	271	0	107	211	0	256	
Enter Blocked Intersection	No	No	No	No	No	No	
Lane Alignment	Left	Right	Left	Left	Left	Right	
Median Width(ft)	10			10	0		
Link Offset(ft)	0			0	0		
Crosswalk Width(ft)	16			16	16		
Two way Left Turn Lane							
Headway Factor	0.85	0.85	1.09	1.09	0.88	0.88	
Turning Speed (mph)		9	15		15	9	
Turn Type	NA		D.P+P	NA		Prot	
Protected Phases	2		1 3	1 2 3		3	1
Permitted Phases			2				
Detector Phase	2		1 3	1 2 3		3	
Switch Phase							
Minimum Initial (s)	7.0					7.0	10.0
Minimum Split (s)	13.0					13.2	15.0
Total Split (s)	28.0					28.2	32.0
Total Split (%)	31.7%					32.0%	36%
Maximum Green (s)	22.0					22.0	27.0
Yellow Time (s)	4.0					4.0	4.0
All-Red Time (s)	2.0					2.2	1.0
Lost Time Adjust (s)	0.0					0.0	
Total Lost Time (s)	6.0					6.2	
Lead/Lag	Lag						Lead
Lead-Lag Optimize?	Yes						Yes
Vehicle Extension (s)	3.0					3.0	3.0
Recall Mode	None					None	Min
Act Effct Green (s)	15.6		57.7	68.4		16.0	
Actuated g/C Ratio	0.23		0.84	1.00		0.23	
v/c Ratio	0.61		0.10	0.13		0.63	
Control Delay	32.2		0.3	0.2		33.4	
Queue Delay	0.0		0.0	0.0		0.0	

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR	ø1
Total Delay	32.2		0.3	0.2		33.4	
LOS	C		A	A		C	
Approach Delay	32.2			0.2			
Approach LOS	C			A			
Queue Length 50th (ft)	102		1	0		97	
Queue Length 95th (ft)	195		1	0		196	
Internal Link Dist (ft)	743			20	940		
Turn Bay Length (ft)							
Base Capacity (vph)	665		1162	1598		595	
Starvation Cap Reductn	0		0	0		0	
Spillback Cap Reductn	0		0	0		0	
Storage Cap Reductn	0		0	0		0	
Reduced v/c Ratio	0.41		0.09	0.13		0.43	

Intersection Summary

Area Type: Other
Cycle Length: 88.2
Actuated Cycle Length: 68.4
Natural Cycle: 55
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.63
Intersection Signal Delay: 20.5 Intersection LOS: C
Intersection Capacity Utilization 38.9% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 1: West Onondaga Street & Delaware Street



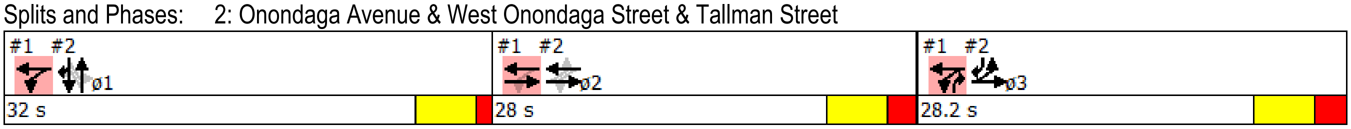
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	206	195	49	11	86	0	76	249	18	5	125	96
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	10	12	12	12	12	12	12	12	12	12
Storage Length (ft)	0		0	0		0	90		0	0		95
Storage Lanes	1		0	0		0	1		0	0		1
Taper Length (ft)	25			25			25			25		
Satd. Flow (prot)	1652	1582	0	0	1654	0	1641	1842	0	0	1700	1429
Flt Permitted	0.788				0.946		0.659				0.984	
Satd. Flow (perm)	1365	1582	0	0	1569	0	1132	1842	0	0	1676	1429
Right Turn on Red			Yes			Yes			Yes			No
Satd. Flow (RTOR)		24						4				
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		100			748			599			651	
Travel Time (s)		2.3			17.0			13.6			14.8	
Confl. Peds. (#/hr)	4		15	15		4	7		8	8		7
Confl. Bikes (#/hr)			3			3			3			2
Peak Hour Factor	0.94	0.94	0.94	0.88	0.88	0.88	0.86	0.86	0.86	0.84	0.84	0.84
Heavy Vehicles (%)	2%	8%	8%	33%	12%	2%	10%	1%	14%	0%	12%	13%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	219	259	0	0	110	0	88	311	0	0	155	114
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		10			10			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.09	1.09	1.09	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	D.P+P	NA		Perm	NA		Perm	NA		Perm	NA	pt+ov
Protected Phases	3	2 3			2			1			1	1 3
Permitted Phases	2			2			1			1		
Detector Phase	3	2		2	2		1	1		1	1	1
Switch Phase												
Minimum Initial (s)	7.0			7.0	7.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	13.2			13.0	13.0		15.0	15.0		15.0	15.0	
Total Split (s)	28.2			28.0	28.0		32.0	32.0		32.0	32.0	
Total Split (%)	32.0%			31.7%	31.7%		36.3%	36.3%		36.3%	36.3%	
Maximum Green (s)	22.0			22.0	22.0		27.0	27.0		27.0	27.0	
Yellow Time (s)	4.0			4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.2			2.0	2.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0				0.0		0.0	0.0			0.0	
Total Lost Time (s)	6.2				6.0		5.0	5.0			5.0	
Lead/Lag				Lag	Lag		Lead	Lead		Lead	Lead	
Lead-Lag Optimize?				Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0			3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None			None	None		Min	Min		Min	Min	
Act Effct Green (s)	31.4	38.3			15.6		18.4	18.4			18.4	41.0
Actuated g/C Ratio	0.46	0.56			0.23		0.27	0.27			0.27	0.60

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio	0.32	0.29			0.31		0.29	0.62			0.34	0.13
Control Delay	1.7	0.8			27.3		24.9	29.2			24.4	6.8
Queue Delay	0.0	0.0			0.0		0.0	0.0			0.0	0.0
Total Delay	1.7	0.8			27.3		24.9	29.2			24.4	6.8
LOS	A	A			C		C	C			C	A
Approach Delay		1.2			27.3			28.3			16.9	
Approach LOS		A			C			C			B	
Queue Length 50th (ft)	2	0			39		29	113			52	18
Queue Length 95th (ft)	3	0			93		72	211			107	41
Internal Link Dist (ft)		20			668			519			571	
Turn Bay Length (ft)							90					95
Base Capacity (vph)	874	876			537		476	777			705	1073
Starvation Cap Reductn	0	0			0		0	0			0	0
Spillback Cap Reductn	0	0			0		0	0			0	0
Storage Cap Reductn	0	0			0		0	0			0	0
Reduced v/c Ratio	0.25	0.30			0.20		0.18	0.40			0.22	0.11

Intersection Summary

Area Type: Other
Cycle Length: 88.2
Actuated Cycle Length: 68.4
Natural Cycle: 55
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.63
Intersection Signal Delay: 15.5 Intersection LOS: B
Intersection Capacity Utilization 54.0% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 2: Onondaga Avenue & West Onondaga Street & Tallman Street



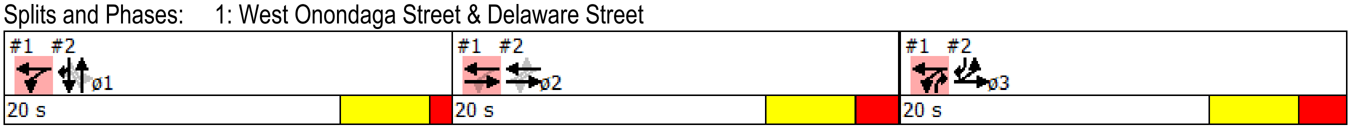
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR	ø1
Lane Configurations							
Volume (vph)	227	3	87	171	0	223	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Lane Width (ft)	16	16	10	10	15	15	
Satd. Flow (prot)	1938	0	1416	1642	0	1738	
Flt Permitted			0.513				
Satd. Flow (perm)	1938	0	763	1642	0	1738	
Right Turn on Red		Yes				No	
Satd. Flow (RTOR)	1						
Link Speed (mph)	30			30	30		
Link Distance (ft)	823			100	1020		
Travel Time (s)	18.7			2.3	23.2		
Confl. Peds. (#/hr)		4	4			9	
Confl. Bikes (#/hr)		2				2	
Peak Hour Factor	0.85	0.85	0.81	0.81	0.87	0.87	
Heavy Vehicles (%)	10%	67%	19%	8%	2%	4%	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	271	0	107	211	0	256	
Enter Blocked Intersection	No	No	No	No	No	No	
Lane Alignment	Left	Right	Left	Left	Left	Right	
Median Width(ft)	10			10	0		
Link Offset(ft)	0			0	0		
Crosswalk Width(ft)	16			16	16		
Two way Left Turn Lane							
Headway Factor	0.85	0.85	1.09	1.09	0.88	0.88	
Turning Speed (mph)		9	15		15	9	
Turn Type	NA		D.P+P	NA		Prot	
Protected Phases	2		1 3	1 2 3		3	1
Permitted Phases			2				
Detector Phase	2		1 3	1 2 3		3	
Switch Phase							
Minimum Initial (s)	7.0					7.0	10.0
Minimum Split (s)	13.0					13.2	15.0
Total Split (s)	20.0					20.0	20.0
Total Split (%)	33.3%					33.3%	33%
Maximum Green (s)	14.0					13.8	15.0
Yellow Time (s)	4.0					4.0	4.0
All-Red Time (s)	2.0					2.2	1.0
Lost Time Adjust (s)	0.0					0.0	
Total Lost Time (s)	6.0					6.2	
Lead/Lag	Lag						Lead
Lead-Lag Optimize?	Yes						Yes
Vehicle Extension (s)	3.0					3.0	3.0
Recall Mode	None					None	Min
Act Effct Green (s)	12.1		45.0	55.2		12.1	
Actuated g/C Ratio	0.22		0.82	1.00		0.22	
v/c Ratio	0.64		0.11	0.13		0.68	
Control Delay	27.9		0.4	0.2		30.9	
Queue Delay	0.0		0.0	0.0		0.0	

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR	ø1
Total Delay	27.9		0.4	0.2		30.9	
LOS	C		A	A		C	
Approach Delay	27.9			0.2			
Approach LOS	C			A			
Queue Length 50th (ft)	87		1	0		84	
Queue Length 95th (ft)	144		1	0		#145	
Internal Link Dist (ft)	743			20	940		
Turn Bay Length (ft)							
Base Capacity (vph)	500		1029	1594		441	
Starvation Cap Reductn	0		0	0		0	
Spillback Cap Reductn	0		0	0		0	
Storage Cap Reductn	0		0	0		0	
Reduced v/c Ratio	0.54		0.10	0.13		0.58	

Intersection Summary

Area Type: Other
Cycle Length: 60
Actuated Cycle Length: 55.2
Natural Cycle: 55
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.68
Intersection Signal Delay: 18.4 Intersection LOS: B
Intersection Capacity Utilization 38.9% ICU Level of Service A
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: West Onondaga Street & Delaware Street



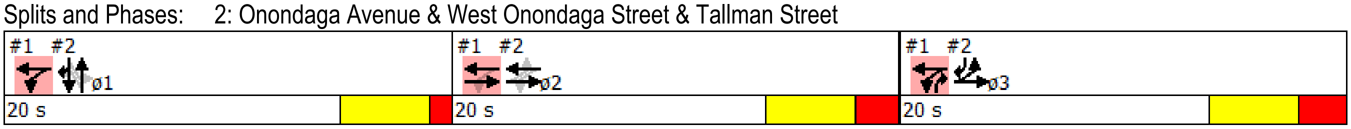
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	206	195	49	11	86	0	76	249	18	5	125	96
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	10	12	12	12	12	12	12	12	12	12
Storage Length (ft)	0		0	0		0	90		0	0		95
Storage Lanes	1		0	0		0	1		0	0		1
Taper Length (ft)	25			25			25			25		
Satd. Flow (prot)	1652	1582	0	0	1654	0	1641	1841	0	0	1700	1429
Flt Permitted	0.686				0.939		0.659				0.982	
Satd. Flow (perm)	1188	1582	0	0	1557	0	1131	1841	0	0	1672	1429
Right Turn on Red			Yes			Yes			Yes			No
Satd. Flow (RTOR)		35						6				
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		100			748			599			651	
Travel Time (s)		2.3			17.0			13.6			14.8	
Confl. Peds. (#/hr)	4		15	15		4	7		8	8		7
Confl. Bikes (#/hr)			3			3			3			2
Peak Hour Factor	0.94	0.94	0.94	0.88	0.88	0.88	0.86	0.86	0.86	0.84	0.84	0.84
Heavy Vehicles (%)	2%	8%	8%	33%	12%	2%	10%	1%	14%	0%	12%	13%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	219	259	0	0	110	0	88	311	0	0	155	114
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		10			10			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.09	1.09	1.09	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	D.P+P	NA		Perm	NA		Perm	NA		Perm	NA	pt+ov
Protected Phases	3	2 3			2			1			1	1 3
Permitted Phases	2			2			1			1		
Detector Phase	3	2		2	2		1	1		1	1	1
Switch Phase												
Minimum Initial (s)	7.0			7.0	7.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	13.2			13.0	13.0		15.0	15.0		15.0	15.0	
Total Split (s)	20.0			20.0	20.0		20.0	20.0		20.0	20.0	
Total Split (%)	33.3%			33.3%	33.3%		33.3%	33.3%		33.3%	33.3%	
Maximum Green (s)	13.8			14.0	14.0		15.0	15.0		15.0	15.0	
Yellow Time (s)	4.0			4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.2			2.0	2.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0				0.0		0.0	0.0			0.0	
Total Lost Time (s)	6.2				6.0		5.0	5.0			5.0	
Lead/Lag				Lag	Lag		Lead	Lead		Lead	Lead	
Lead-Lag Optimize?				Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0			3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None			None	None		Min	Min		Min	Min	
Act Effct Green (s)	23.9	30.4			12.1		13.6	13.6			13.6	32.0
Actuated g/C Ratio	0.43	0.55			0.22		0.25	0.25			0.25	0.58

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio	0.36	0.29			0.32		0.32	0.68			0.38	0.14
Control Delay	2.6	1.2			22.0		21.9	28.3			21.6	6.1
Queue Delay	0.0	0.0			0.0		0.0	0.0			0.0	0.0
Total Delay	2.6	1.2			22.0		21.9	28.3			21.6	6.1
LOS	A	A			C		C	C			C	A
Approach Delay		1.8			22.0			26.9			15.0	
Approach LOS		A			C			C			B	
Queue Length 50th (ft)	2	0			33		26	99			46	16
Queue Length 95th (ft)	12	0			69		58	164			85	33
Internal Link Dist (ft)		20			668			519			571	
Turn Bay Length (ft)							90					95
Base Capacity (vph)	675	869			401		312	513			462	870
Starvation Cap Reductn	0	0			0		0	0			0	0
Spillback Cap Reductn	0	0			0		0	0			0	0
Storage Cap Reductn	0	0			0		0	0			0	0
Reduced v/c Ratio	0.32	0.30			0.27		0.28	0.61			0.34	0.13

Intersection Summary

Area Type: Other
Cycle Length: 60
Actuated Cycle Length: 55.2
Natural Cycle: 55
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.68
Intersection Signal Delay: 14.4 Intersection LOS: B
Intersection Capacity Utilization 54.0% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 2: Onondaga Avenue & West Onondaga Street & Tallman Street



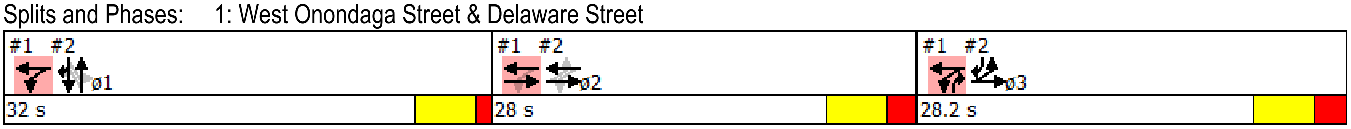
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR	ø1
Lane Configurations							
Volume (vph)	113	7	216	179	0	141	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Lane Width (ft)	16	16	10	10	15	15	
Satd. Flow (prot)	2002	0	1668	1739	0	1772	
Flt Permitted			0.666				
Satd. Flow (perm)	2002	0	1166	1739	0	1772	
Right Turn on Red		Yes				No	
Satd. Flow (RTOR)	3						
Link Speed (mph)	30			30	30		
Link Distance (ft)	823			100	1020		
Travel Time (s)	18.7			2.3	23.2		
Confl. Peds. (#/hr)		6	6			2	
Confl. Bikes (#/hr)		4				1	
Peak Hour Factor	0.84	0.84	0.89	0.89	0.86	0.86	
Heavy Vehicles (%)	6%	14%	1%	2%	2%	2%	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	143	0	243	201	0	164	
Enter Blocked Intersection	No	No	No	No	No	No	
Lane Alignment	Left	Right	Left	Left	Left	Right	
Median Width(ft)	10			10	0		
Link Offset(ft)	0			0	0		
Crosswalk Width(ft)	16			16	16		
Two way Left Turn Lane							
Headway Factor	0.85	0.85	1.09	1.09	0.88	0.88	
Turning Speed (mph)		9	15		15	9	
Turn Type	NA		D.P+P	NA		Prot	
Protected Phases	2		1 3	1 2 3		3	1
Permitted Phases			2				
Detector Phase	2		1 3	1 2 3		3	
Switch Phase							
Minimum Initial (s)	7.0					7.0	10.0
Minimum Split (s)	13.0					13.2	15.0
Total Split (s)	28.0					28.2	32.0
Total Split (%)	31.7%					32.0%	36%
Maximum Green (s)	22.0					22.0	27.0
Yellow Time (s)	4.0					4.0	4.0
All-Red Time (s)	2.0					2.2	1.0
Lost Time Adjust (s)	0.0					0.0	
Total Lost Time (s)	6.0					6.2	
Lead/Lag	Lag						Lead
Lead-Lag Optimize?	Yes						Yes
Vehicle Extension (s)	3.0					3.0	3.0
Recall Mode	None					None	Min
Act Effct Green (s)	11.0		48.7	59.3		12.1	
Actuated g/C Ratio	0.19		0.82	1.00		0.20	
v/c Ratio	0.38		0.19	0.12		0.45	
Control Delay	26.7		0.5	0.1		27.4	
Queue Delay	0.0		0.0	0.0		0.0	

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR	ø1
Total Delay	26.7		0.5	0.1		27.4	
LOS	C		A	A		C	
Approach Delay	26.7			0.3			
Approach LOS	C			A			
Queue Length 50th (ft)	43		1	0		49	
Queue Length 95th (ft)	102		1	0		119	
Internal Link Dist (ft)	743			20	940		
Turn Bay Length (ft)							
Base Capacity (vph)	788		1456	1721		696	
Starvation Cap Reductn	0		0	0		0	
Spillback Cap Reductn	0		0	0		0	
Storage Cap Reductn	0		0	0		0	
Reduced v/c Ratio	0.18		0.17	0.12		0.24	

Intersection Summary

Area Type: Other
Cycle Length: 88.2
Actuated Cycle Length: 59.3
Natural Cycle: 45
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.57
Intersection Signal Delay: 11.3 Intersection LOS: B
Intersection Capacity Utilization 30.1% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 1: West Onondaga Street & Delaware Street



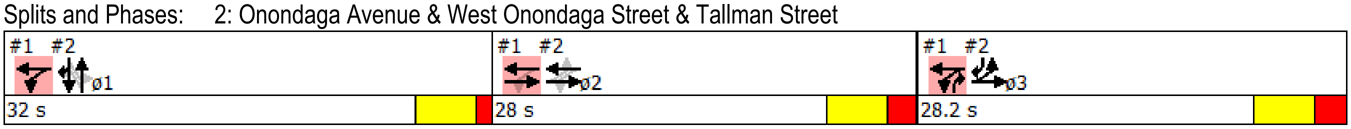
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	95	110	49	8	88	4	65	125	5	1	303	242
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	10	12	12	12	12	12	12	12	12	12
Storage Length (ft)	0		0	0		0	90		0	0		95
Storage Lanes	1		0	0		0	1		0	0		1
Taper Length (ft)	25			25			25			25		
Satd. Flow (prot)	1604	1656	0	0	1829	0	1752	1853	0	0	1881	1599
Flt Permitted	0.777				0.961		0.445				0.999	
Satd. Flow (perm)	1305	1656	0	0	1764	0	818	1853	0	0	1879	1599
Right Turn on Red			Yes			Yes			Yes			No
Satd. Flow (RTOR)		43			2			2				
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		100			748			599			651	
Travel Time (s)		2.3			17.0			13.6			14.8	
Confl. Peds. (#/hr)	7		1	1		7	7					7
Confl. Bikes (#/hr)			3						1			41
Peak Hour Factor	0.97	0.97	0.97	0.74	0.74	0.74	0.93	0.93	0.93	0.94	0.94	0.94
Heavy Vehicles (%)	5%	1%	2%	13%	2%	0%	3%	2%	0%	0%	1%	1%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	98	164	0	0	135	0	70	139	0	0	323	257
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		10			10			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.09	1.09	1.09	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	D.P+P	NA		Perm	NA		Perm	NA		Perm	NA	pt+ov
Protected Phases	3	2 3			2			1			1	1 3
Permitted Phases	2			2			1			1		
Detector Phase	3	2		2	2		1	1		1	1	1
Switch Phase												
Minimum Initial (s)	7.0			7.0	7.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	13.2			13.0	13.0		15.0	15.0		15.0	15.0	
Total Split (s)	28.2			28.0	28.0		32.0	32.0		32.0	32.0	
Total Split (%)	32.0%			31.7%	31.7%		36.3%	36.3%		36.3%	36.3%	
Maximum Green (s)	22.0			22.0	22.0		27.0	27.0		27.0	27.0	
Yellow Time (s)	4.0			4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.2			2.0	2.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0				0.0		0.0	0.0			0.0	
Total Lost Time (s)	6.2				6.0		5.0	5.0			5.0	
Lead/Lag				Lag	Lag		Lead	Lead		Lead	Lead	
Lead-Lag Optimize?				Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0			3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None			None	None		Min	Min		Min	Min	
Act Effct Green (s)	22.9	29.6			11.0		18.0	18.0			18.0	36.7
Actuated g/C Ratio	0.39	0.50			0.19		0.30	0.30			0.30	0.62

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio	0.17	0.19			0.41		0.28	0.25			0.57	0.26
Control Delay	1.4	0.5			27.9		20.9	17.9			22.7	6.0
Queue Delay	0.0	0.0			0.0		0.0	0.0			0.0	0.0
Total Delay	1.4	0.5			27.9		20.9	17.9			22.7	6.0
LOS	A	A			C		C	B			C	A
Approach Delay		0.9			27.9			18.9			15.3	
Approach LOS		A			C			B			B	
Queue Length 50th (ft)	1	1			41		18	34			90	32
Queue Length 95th (ft)	2	0			86		59	91			207	80
Internal Link Dist (ft)		20			668			519			571	
Turn Bay Length (ft)							90					95
Base Capacity (vph)	866	857			693		394	894			905	1273
Starvation Cap Reductn	0	0			0		0	0			0	0
Spillback Cap Reductn	0	0			0		0	0			0	0
Storage Cap Reductn	0	0			0		0	0			0	0
Reduced v/c Ratio	0.11	0.19			0.19		0.18	0.16			0.36	0.20

Intersection Summary

Area Type: Other
Cycle Length: 88.2
Actuated Cycle Length: 59.3
Natural Cycle: 45
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.57
Intersection Signal Delay: 14.2 Intersection LOS: B
Intersection Capacity Utilization 49.6% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 2: Onondaga Avenue & West Onondaga Street & Tallman Street



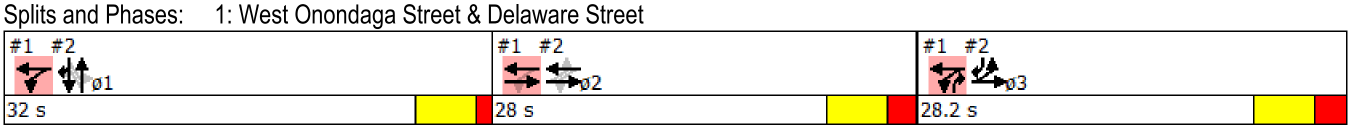
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR	ø1
Lane Configurations							
Volume (vph)	119	7	227	188	0	148	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Lane Width (ft)	16	16	10	10	15	15	
Satd. Flow (prot)	2005	0	1668	1739	0	1772	
Flt Permitted			0.662				
Satd. Flow (perm)	2005	0	1159	1739	0	1772	
Right Turn on Red		Yes				No	
Satd. Flow (RTOR)	3						
Link Speed (mph)	30			30	30		
Link Distance (ft)	823			100	1020		
Travel Time (s)	18.7			2.3	23.2		
Confl. Peds. (#/hr)		6	6			2	
Confl. Bikes (#/hr)		4				1	
Peak Hour Factor	0.84	0.84	0.89	0.89	0.86	0.86	
Heavy Vehicles (%)	6%	14%	1%	2%	2%	2%	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	150	0	255	211	0	172	
Enter Blocked Intersection	No	No	No	No	No	No	
Lane Alignment	Left	Right	Left	Left	Left	Right	
Median Width(ft)	10			10	0		
Link Offset(ft)	0			0	0		
Crosswalk Width(ft)	16			16	16		
Two way Left Turn Lane							
Headway Factor	0.85	0.85	1.09	1.09	0.88	0.88	
Turning Speed (mph)		9	15		15	9	
Turn Type	NA		D.P+P	NA		Prot	
Protected Phases	2		1 3	1 2 3		3	1
Permitted Phases			2				
Detector Phase	2		1 3	1 2 3		3	
Switch Phase							
Minimum Initial (s)	7.0					7.0	10.0
Minimum Split (s)	13.0					13.2	15.0
Total Split (s)	28.0					28.2	32.0
Total Split (%)	31.7%					32.0%	36%
Maximum Green (s)	22.0					22.0	27.0
Yellow Time (s)	4.0					4.0	4.0
All-Red Time (s)	2.0					2.2	1.0
Lost Time Adjust (s)	0.0					0.0	
Total Lost Time (s)	6.0					6.2	
Lead/Lag	Lag						Lead
Lead-Lag Optimize?	Yes						Yes
Vehicle Extension (s)	3.0					3.0	3.0
Recall Mode	None					None	Min
Act Effct Green (s)	11.6		50.4	61.0		12.7	
Actuated g/C Ratio	0.19		0.83	1.00		0.21	
v/c Ratio	0.39		0.20	0.12		0.47	
Control Delay	27.2		0.5	0.1		28.0	
Queue Delay	0.0		0.0	0.0		0.0	

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR	ø1
Total Delay	27.2		0.5	0.1		28.0	
LOS	C		A	A		C	
Approach Delay	27.2			0.3			
Approach LOS	C			A			
Queue Length 50th (ft)	47		1	0		55	
Queue Length 95th (ft)	109		1	0		125	
Internal Link Dist (ft)	743			20	940		
Turn Bay Length (ft)							
Base Capacity (vph)	770		1443	1707		679	
Starvation Cap Reductn	0		0	0		0	
Spillback Cap Reductn	0		0	0		0	
Storage Cap Reductn	0		0	0		0	
Reduced v/c Ratio	0.19		0.18	0.12		0.25	

Intersection Summary

Area Type: Other
Cycle Length: 88.2
Actuated Cycle Length: 61
Natural Cycle: 50
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.59
Intersection Signal Delay: 11.5 Intersection LOS: B
Intersection Capacity Utilization 35.8% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 1: West Onondaga Street & Delaware Street



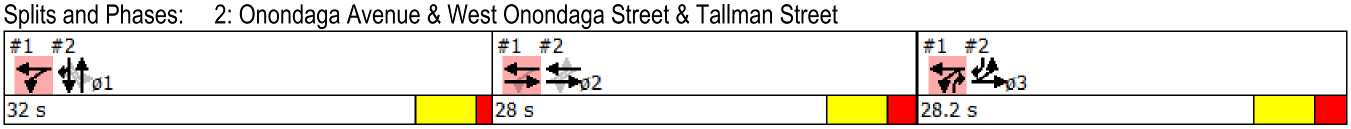
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	100	116	51	8	93	4	68	131	5	1	318	254
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	10	12	12	12	12	12	12	12	12	12
Storage Length (ft)	0		0	0		0	90		0	0		95
Storage Lanes	1		0	0		0	1		0	0		1
Taper Length (ft)	25			25			25			25		
Satd. Flow (prot)	1604	1658	0	0	1830	0	1752	1853	0	0	1881	1599
Flt Permitted	0.747				0.963		0.419				0.999	
Satd. Flow (perm)	1255	1658	0	0	1769	0	770	1853	0	0	1879	1599
Right Turn on Red			Yes			Yes			Yes			No
Satd. Flow (RTOR)		42			2			2				
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		100			748			599			651	
Travel Time (s)		2.3			17.0			13.6			14.8	
Confl. Peds. (#/hr)	7		1	1		7	7					7
Confl. Bikes (#/hr)			3						1			41
Peak Hour Factor	0.97	0.97	0.97	0.74	0.74	0.74	0.93	0.93	0.93	0.94	0.94	0.94
Heavy Vehicles (%)	5%	1%	2%	13%	2%	0%	3%	2%	0%	0%	1%	1%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	103	173	0	0	142	0	73	146	0	0	339	270
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		10			10			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.09	1.09	1.09	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	D.P+P	NA		Perm	NA		Perm	NA		Perm	NA	pt+ov
Protected Phases	3	2 3			2			1			1	1 3
Permitted Phases	2			2			1			1		
Detector Phase	3	2		2	2		1	1		1	1	1
Switch Phase												
Minimum Initial (s)	7.0			7.0	7.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	13.2			13.0	13.0		15.0	15.0		15.0	15.0	
Total Split (s)	28.2			28.0	28.0		32.0	32.0		32.0	32.0	
Total Split (%)	32.0%			31.7%	31.7%		36.3%	36.3%		36.3%	36.3%	
Maximum Green (s)	22.0			22.0	22.0		27.0	27.0		27.0	27.0	
Yellow Time (s)	4.0			4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.2			2.0	2.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0				0.0		0.0	0.0			0.0	
Total Lost Time (s)	6.2				6.0		5.0	5.0			5.0	
Lead/Lag				Lag	Lag		Lead	Lead		Lead	Lead	
Lead-Lag Optimize?				Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0			3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None			None	None		Min	Min		Min	Min	
Act Effct Green (s)	24.0	30.8			11.6		18.5	18.5			18.5	37.8
Actuated g/C Ratio	0.39	0.50			0.19		0.30	0.30			0.30	0.62

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio	0.18	0.20			0.42		0.31	0.26			0.59	0.27
Control Delay	1.4	0.6			28.6		22.5	18.7			24.1	6.3
Queue Delay	0.0	0.0			0.0		0.0	0.0			0.0	0.0
Total Delay	1.4	0.6			28.6		22.5	18.7			24.1	6.3
LOS	A	A			C		C	B			C	A
Approach Delay		0.9			28.6			20.0			16.2	
Approach LOS		A			C			B			B	
Queue Length 50th (ft)	1	1			45		20	38			101	37
Queue Length 95th (ft)	2	0			92		64	99			227	87
Internal Link Dist (ft)		20			668			519			571	
Turn Bay Length (ft)							90					95
Base Capacity (vph)	848	861			679		362	872			883	1256
Starvation Cap Reductn	0	0			0		0	0			0	0
Spillback Cap Reductn	0	0			0		0	0			0	0
Storage Cap Reductn	0	0			0		0	0			0	0
Reduced v/c Ratio	0.12	0.20			0.21		0.20	0.17			0.38	0.21

Intersection Summary

Area Type: Other
Cycle Length: 88.2
Actuated Cycle Length: 61
Natural Cycle: 50
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.59
Intersection Signal Delay: 14.9 Intersection LOS: B
Intersection Capacity Utilization 50.7% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 2: Onondaga Avenue & West Onondaga Street & Tallman Street



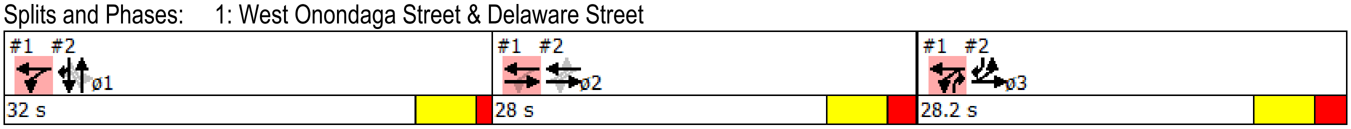
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR	ø1
Lane Configurations							
Volume (vph)	141	9	270	224	0	176	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Lane Width (ft)	16	16	10	10	15	15	
Satd. Flow (prot)	2001	0	1668	1739	0	1772	
Flt Permitted			0.644				
Satd. Flow (perm)	2001	0	1127	1739	0	1772	
Right Turn on Red		Yes				No	
Satd. Flow (RTOR)	4						
Link Speed (mph)	30			30	30		
Link Distance (ft)	823			100	1020		
Travel Time (s)	18.7			2.3	23.2		
Confl. Peds. (#/hr)		6	6			2	
Confl. Bikes (#/hr)		4				1	
Peak Hour Factor	0.84	0.84	0.89	0.89	0.86	0.86	
Heavy Vehicles (%)	6%	14%	1%	2%	2%	2%	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	179	0	303	252	0	205	
Enter Blocked Intersection	No	No	No	No	No	No	
Lane Alignment	Left	Right	Left	Left	Left	Right	
Median Width(ft)	10			10	0		
Link Offset(ft)	0			0	0		
Crosswalk Width(ft)	16			16	16		
Two way Left Turn Lane							
Headway Factor	0.85	0.85	1.09	1.09	0.88	0.88	
Turning Speed (mph)		9	15		15	9	
Turn Type	NA		D.P+P	NA		Prot	
Protected Phases	2		1 3	1 2 3		3	1
Permitted Phases			2				
Detector Phase	2		1 3	1 2 3		3	
Switch Phase							
Minimum Initial (s)	7.0					7.0	10.0
Minimum Split (s)	13.0					13.2	15.0
Total Split (s)	28.0					28.2	32.0
Total Split (%)	31.7%					32.0%	36%
Maximum Green (s)	22.0					22.0	27.0
Yellow Time (s)	4.0					4.0	4.0
All-Red Time (s)	2.0					2.2	1.0
Lost Time Adjust (s)	0.0					0.0	
Total Lost Time (s)	6.0					6.2	
Lead/Lag	Lag						Lead
Lead-Lag Optimize?	Yes						Yes
Vehicle Extension (s)	3.0					3.0	3.0
Recall Mode	None					None	Min
Act Effct Green (s)	13.2		56.8	67.4		14.6	
Actuated g/C Ratio	0.20		0.84	1.00		0.22	
v/c Ratio	0.45		0.23	0.14		0.54	
Control Delay	29.4		0.5	0.2		31.2	
Queue Delay	0.0		0.0	0.0		0.0	

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR	ø1
Total Delay	29.4		0.5	0.2		31.2	
LOS	C		A	A		C	
Approach Delay	29.4			0.4			
Approach LOS	C			A			
Queue Length 50th (ft)	66		1	0		78	
Queue Length 95th (ft)	128		1	0		153	
Internal Link Dist (ft)	743			20	940		
Turn Bay Length (ft)							
Base Capacity (vph)	695		1407	1705		613	
Starvation Cap Reductn	0		0	0		0	
Spillback Cap Reductn	0		0	0		0	
Storage Cap Reductn	0		0	0		0	
Reduced v/c Ratio	0.26		0.22	0.15		0.33	

Intersection Summary

Area Type: Other
Cycle Length: 88.2
Actuated Cycle Length: 67.4
Natural Cycle: 50
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.68
Intersection Signal Delay: 12.6 Intersection LOS: B
Intersection Capacity Utilization 39.4% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 1: West Onondaga Street & Delaware Street



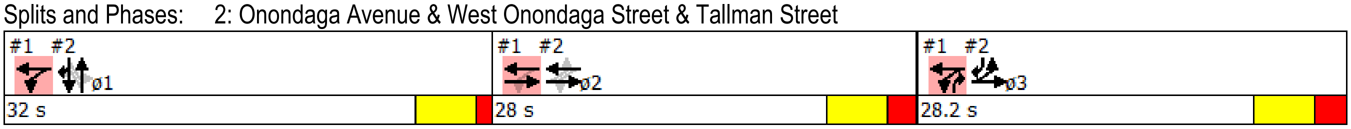
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	119	137	61	10	110	5	81	156	6	1	379	303
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	10	12	12	12	12	12	12	12	12	12
Storage Length (ft)	0		0	0		0	90		0	0		95
Storage Lanes	1		0	0		0	1		0	0		1
Taper Length (ft)	25			25			25			25		
Satd. Flow (prot)	1604	1658	0	0	1827	0	1752	1853	0	0	1881	1599
Flt Permitted	0.641				0.958		0.328					
Satd. Flow (perm)	1077	1658	0	0	1757	0	603	1853	0	0	1881	1599
Right Turn on Red			Yes			Yes			Yes			No
Satd. Flow (RTOR)		42			2			2				
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		100			748			599			651	
Travel Time (s)		2.3			17.0			13.6			14.8	
Confl. Peds. (#/hr)	7		1	1		7	7					7
Confl. Bikes (#/hr)			3						1			41
Peak Hour Factor	0.97	0.97	0.97	0.74	0.74	0.74	0.93	0.93	0.93	0.94	0.94	0.94
Heavy Vehicles (%)	5%	1%	2%	13%	2%	0%	3%	2%	0%	0%	1%	1%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	123	204	0	0	170	0	87	174	0	0	404	322
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		10			10			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.09	1.09	1.09	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	D.P+P	NA		Perm	NA		Perm	NA		Perm	NA	pt+ov
Protected Phases	3	2 3			2			1			1	1 3
Permitted Phases	2			2			1			1		
Detector Phase	3	2		2	2		1	1		1	1	1
Switch Phase												
Minimum Initial (s)	7.0			7.0	7.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	13.2			13.0	13.0		15.0	15.0		15.0	15.0	
Total Split (s)	28.2			28.0	28.0		32.0	32.0		32.0	32.0	
Total Split (%)	32.0%			31.7%	31.7%		36.3%	36.3%		36.3%	36.3%	
Maximum Green (s)	22.0			22.0	22.0		27.0	27.0		27.0	27.0	
Yellow Time (s)	4.0			4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.2			2.0	2.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0				0.0		0.0	0.0			0.0	
Total Lost Time (s)	6.2				6.0		5.0	5.0			5.0	
Lead/Lag				Lag	Lag		Lead	Lead		Lead	Lead	
Lead-Lag Optimize?				Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0			3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None			None	None		Min	Min		Min	Min	
Act Effct Green (s)	27.5	34.3			13.2		21.4	21.4			21.4	42.5
Actuated g/C Ratio	0.41	0.51			0.20		0.32	0.32			0.32	0.63

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio	0.22	0.24			0.49		0.46	0.29			0.68	0.32
Control Delay	1.6	0.7			31.3		30.2	20.6			28.1	7.1
Queue Delay	0.0	0.0			0.0		0.0	0.0			0.0	0.0
Total Delay	1.6	0.7			31.3		30.2	20.6			28.1	7.1
LOS	A	A			C		C	C			C	A
Approach Delay		1.0			31.3			23.8			18.8	
Approach LOS		A			C			C			B	
Queue Length 50th (ft)	1	1			64		28	51			140	51
Queue Length 95th (ft)	2	0			108		87	125			297	118
Internal Link Dist (ft)		20			668			519			571	
Turn Bay Length (ft)							90					95
Base Capacity (vph)	762	848			609		256	788			799	1180
Starvation Cap Reductn	0	0			0		0	0			0	0
Spillback Cap Reductn	0	0			0		0	0			0	0
Storage Cap Reductn	0	0			0		0	0			0	0
Reduced v/c Ratio	0.16	0.24			0.28		0.34	0.22			0.51	0.27

Intersection Summary

Area Type: Other
Cycle Length: 88.2
Actuated Cycle Length: 67.4
Natural Cycle: 50
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.68
Intersection Signal Delay: 17.2 Intersection LOS: B
Intersection Capacity Utilization 56.4% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 2: Onondaga Avenue & West Onondaga Street & Tallman Street



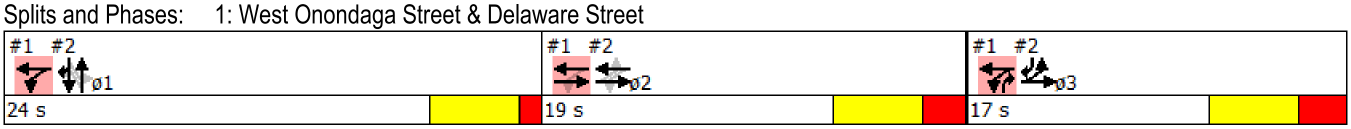
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR	ø1
Lane Configurations							
Volume (vph)	141	9	270	224	0	176	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	
Lane Width (ft)	16	16	10	10	15	15	
Satd. Flow (prot)	2001	0	1668	1739	0	1772	
Flt Permitted			0.644				
Satd. Flow (perm)	2001	0	1127	1739	0	1772	
Right Turn on Red		Yes				No	
Satd. Flow (RTOR)	5						
Link Speed (mph)	30			30	30		
Link Distance (ft)	823			100	1020		
Travel Time (s)	18.7			2.3	23.2		
Confl. Peds. (#/hr)		6	6			2	
Confl. Bikes (#/hr)		4				1	
Peak Hour Factor	0.84	0.84	0.89	0.89	0.86	0.86	
Heavy Vehicles (%)	6%	14%	1%	2%	2%	2%	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	179	0	303	252	0	205	
Enter Blocked Intersection	No	No	No	No	No	No	
Lane Alignment	Left	Right	Left	Left	Left	Right	
Median Width(ft)	10			10	0		
Link Offset(ft)	0			0	0		
Crosswalk Width(ft)	16			16	16		
Two way Left Turn Lane							
Headway Factor	0.85	0.85	1.09	1.09	0.88	0.88	
Turning Speed (mph)		9	15		15	9	
Turn Type	NA		D.P+P	NA		Prot	
Protected Phases	2		1 3	1 2 3		3	1
Permitted Phases			2				
Detector Phase	2		1 3	1 2 3		3	
Switch Phase							
Minimum Initial (s)	7.0					7.0	10.0
Minimum Split (s)	13.0					13.2	15.0
Total Split (s)	19.0					17.0	24.0
Total Split (%)	31.7%					28.3%	40%
Maximum Green (s)	13.0					10.8	19.0
Yellow Time (s)	4.0					4.0	4.0
All-Red Time (s)	2.0					2.2	1.0
Lost Time Adjust (s)	0.0					0.0	
Total Lost Time (s)	6.0					6.2	
Lead/Lag	Lag						Lead
Lead-Lag Optimize?	Yes						Yes
Vehicle Extension (s)	3.0					3.0	3.0
Recall Mode	None					None	Min
Act Effct Green (s)	10.6		44.5	54.7		9.9	
Actuated g/C Ratio	0.19		0.81	1.00		0.18	
v/c Ratio	0.46		0.24	0.14		0.64	
Control Delay	24.0		0.6	0.2		33.0	
Queue Delay	0.0		0.0	0.0		0.0	

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR	ø1
Total Delay	24.0		0.6	0.2		33.0	
LOS	C		A	A		C	
Approach Delay	24.0			0.4			
Approach LOS	C			A			
Queue Length 50th (ft)	54		1	0		68	
Queue Length 95th (ft)	96		1	0		#135	
Internal Link Dist (ft)	743			20	940		
Turn Bay Length (ft)							
Base Capacity (vph)	488		1266	1649		356	
Starvation Cap Reductn	0		0	0		0	
Spillback Cap Reductn	0		0	0		0	
Storage Cap Reductn	0		0	0		0	
Reduced v/c Ratio	0.37		0.24	0.15		0.58	

Intersection Summary

Area Type: Other
Cycle Length: 60
Actuated Cycle Length: 54.7
Natural Cycle: 50
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.71
Intersection Signal Delay: 12.0 Intersection LOS: B
Intersection Capacity Utilization 39.4% ICU Level of Service A
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: West Onondaga Street & Delaware Street



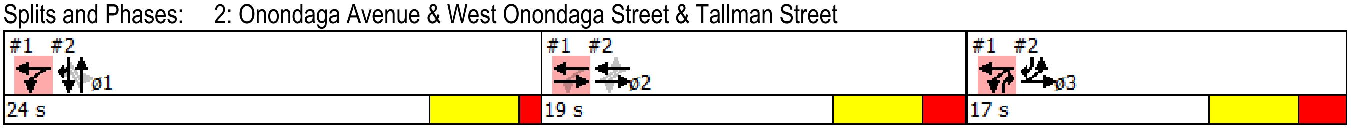
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	119	137	61	10	110	5	81	156	6	1	379	303
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	10	10	10	12	12	12	12	12	12	12	12	12
Storage Length (ft)	0		0	0		0	90		0	0		95
Storage Lanes	1		0	0		0	1		0	0		1
Taper Length (ft)	25			25			25			25		
Satd. Flow (prot)	1604	1658	0	0	1827	0	1752	1853	0	0	1881	1599
Flt Permitted	0.713				0.954		0.337				0.999	
Satd. Flow (perm)	1196	1658	0	0	1749	0	620	1853	0	0	1879	1599
Right Turn on Red			Yes			Yes			Yes			No
Satd. Flow (RTOR)		54			3			3				
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		100			748			599			651	
Travel Time (s)		2.3			17.0			13.6			14.8	
Confl. Peds. (#/hr)	7		1	1		7	7					7
Confl. Bikes (#/hr)			3						1			41
Peak Hour Factor	0.97	0.97	0.97	0.74	0.74	0.74	0.93	0.93	0.93	0.94	0.94	0.94
Heavy Vehicles (%)	5%	1%	2%	13%	2%	0%	3%	2%	0%	0%	1%	1%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	123	204	0	0	170	0	87	174	0	0	404	322
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		10			10			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.09	1.09	1.09	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	D.P+P	NA		Perm	NA		Perm	NA		Perm	NA	pt+ov
Protected Phases	3	2 3			2			1			1	1 3
Permitted Phases	2			2			1			1		
Detector Phase	3	2		2	2		1	1		1	1	1
Switch Phase												
Minimum Initial (s)	7.0			7.0	7.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	13.2			13.0	13.0		15.0	15.0		15.0	15.0	
Total Split (s)	17.0			19.0	19.0		24.0	24.0		24.0	24.0	
Total Split (%)	28.3%			31.7%	31.7%		40.0%	40.0%		40.0%	40.0%	
Maximum Green (s)	10.8			13.0	13.0		19.0	19.0		19.0	19.0	
Yellow Time (s)	4.0			4.0	4.0		4.0	4.0		4.0	4.0	
All-Red Time (s)	2.2			2.0	2.0		1.0	1.0		1.0	1.0	
Lost Time Adjust (s)	0.0				0.0		0.0	0.0			0.0	
Total Lost Time (s)	6.2				6.0		5.0	5.0			5.0	
Lead/Lag				Lag	Lag		Lead	Lead		Lead	Lead	
Lead-Lag Optimize?				Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0			3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None			None	None		Min	Min		Min	Min	
Act Effct Green (s)	20.4	26.9			10.6		16.6	16.6			16.6	32.8
Actuated g/C Ratio	0.37	0.49			0.19		0.30	0.30			0.30	0.60

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio	0.24	0.24			0.50		0.47	0.31			0.71	0.34
Control Delay	2.9	1.3			25.8		25.7	16.7			25.4	6.9
Queue Delay	0.0	0.0			0.0		0.0	0.0			0.0	0.0
Total Delay	2.9	1.3			25.8		25.7	16.7			25.4	6.9
LOS	A	A			C		C	B			C	A
Approach Delay		1.9			25.8			19.7			17.2	
Approach LOS		A			C			B			B	
Queue Length 50th (ft)	1	1			53		24	44			121	47
Queue Length 95th (ft)	m11	0			82		64	89			211	90
Internal Link Dist (ft)		20			668			519			571	
Turn Bay Length (ft)							90					95
Base Capacity (vph)	551	804			426		219	657			665	1041
Starvation Cap Reductn	0	0			0		0	0			0	0
Spillback Cap Reductn	0	0			0		0	0			0	0
Storage Cap Reductn	0	0			0		0	0			0	0
Reduced v/c Ratio	0.22	0.25			0.40		0.40	0.26			0.61	0.31

Intersection Summary

Area Type: Other
Cycle Length: 60
Actuated Cycle Length: 54.7
Natural Cycle: 50
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.71
Intersection Signal Delay: 15.3 Intersection LOS: B
Intersection Capacity Utilization 56.4% ICU Level of Service B
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 2: Onondaga Avenue & West Onondaga Street & Tallman Street



Roundabout Feasibility Study
VISSIM Roundabout Analysis
2040 Design Year Conditions

Intersection Level of Service and Queue Summary

Leavenworth Circle – Delaware St. / W. Onondaga St. / Onondaga Ave. / Tallman St.

Intersection	Morning Peak Hour		Evening Peak Hour	
	LOS	Queue	LOS	Queue
Delaware Street EB Approach	a(2)	122	a(6)	150
Onondaga Street NB Approach	a(3)	108	a(5)	108
Onondaga Avenue NB Approach	a(4)	178	a(2)	68
Tallman Street WB Approach	a(4)	71	a(1)	22
Onondaga Street SB Approach	a(2)	60	a(6)	414

LOS - a(9) – Unsignalized Level of Service (Average Delay per Vehicle)
Maximum Queue Lengths Shown in Feet

East Colvin Street @ Comstock Avenue

Intersection	Morning Peak Hour		Evening Peak Hour	
	LOS	Queue	LOS	Queue
Colvin Street EB Approach	b(12)	278	f(60)	791
Comstock Avenue NB Left/Through	a(6)	153	a(4)	49
Comstock Avenue NB Right	a(2)	60	a(2)	67
Colvin Street WB Approach	f(56)	808	a(9)	136
Comstock Avenue SB Left/Through	a(6)	182	c(28)	725
Comstock Avenue SB Right	a(4)	183	b(11)	726

LOS - a(9) – Unsignalized Level of Service (Average Delay per Vehicle)
Maximum Queue Lengths Shown in Feet

Thompson Road @ Springfield Road

Intersection	Morning Peak Hour		Evening Peak Hour	
	LOS	Queue	LOS	Queue
Springfield Road EB Approach	a(2)	46	a(7)	170
Thompson Road NB Approach	a(2)	83	a(5)	175
Thompson Road SB Approach	a(3)	95	a(8)	326

LOS - a(9) – Unsignalized Level of Service (Average Delay per Vehicle)
Maximum Queue Lengths Shown in Feet

Table of Delay

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Comment:
Date: Wednesday, April 13, 2016 8:39:23 AM
VISSIM: 5.10-12 [24505]

No. 1: Travel time section(s) 1 Delaware Street EB
No. 2: Travel time section(s) 2 Onondaga Street NB
No. 3: Travel time section(s) 3 Onondaga Avenue NB
No. 4: Travel time section(s) 4 Tallman Street WB
No. 5: Travel time section(s) 5 Onondaga Street SB

Time	Delay	Stopd	Stops	#Veh	Pers.	#Pers	Delay	Stopd	Stops	#Veh	Pers.	#Pers
VehC	All							All				
No.:	1	1	1	1	1	1	2	2	2	2	2	2
900												
4500	1.6	0.1	0.02	232	1.6	232	2.9	0.1	0.03	226	2.9	226
Total	1.6	0.1	0.02	232	1.6	232	2.9	0.1	0.03	226	2.9	226

Delay	Stopd	Stops	#Veh	Pers.	#Pers	Delay	Stopd	Stops	#Veh	Pers.	#Pers
	All						All				
3	3	3	3	3	3	4	4	4	4	4	4
3.6	0.3	0.06	331	3.6	331	3.9	1.1	0.31	104	3.9	104
3.6	0.3	0.06	331	3.6	331	3.9	1.1	0.31	104	3.9	104

Delay	Stopd	Stops	#Veh	Pers.	#Pers
	All				
5	5	5	5	5	5
2.3	0.2	0.1	235	2.3	235
2.3	0.2	0.1	235	2.3	235

Queue Length Record

File: c:\gts consulting\active projects\390 - smtc - roundabout feasibility study\analysis\vissim\leavenwortham.inp
Comment:
Date: Wednesday, April 13, 2016 8:39:23 AM
VISSIM: 5.10-12 [24505]

Queue Counter	1: Link 10001	At	3.100 ft	Delaware Street EB
Queue Counter	2: Link 4	At	443.200 ft	Onondaga Street NB
Queue Counter	3: Link 6	At	368.900 ft	Onondaga Avenue NB
Queue Counter	4: Link 8	At	461.600 ft	Tallman Street WB
Queue Counter	5: Link 10	At	428.100 ft	Onondaga Street SB

Avg.: average queue length [ft] within time interval
Max.: maximum queue length [ft] within time interval
Stop: number of stops within queue

Time	Avg.	max	Stop	Avg.	max	Stop	Avg.	max	Stop
No.:	1	1	1	2	2	2	3	3	3
4500	1	122	41	1	108	57	3	178	109

	Avg.	max	Stop	Avg.	max	Stop
	4	4	4	5	5	5
	1	71	39	1	60	45

Table of Delay

File: C:\GTS Consulting\Active Projects\390 - SMTC - Roundabout Feasibility Study\analysis\Vissim\LeavenworthPM.inp
Comment:
Date: Wednesday, April 13, 2016 9:04:21 AM
VISSIM: 5.10-12 [24505]

No. 1: Travel time section(s) 1 Delaware Street EB
No. 2: Travel time section(s) 2 Onondaga Street NB
No. 3: Travel time section(s) 3 Onondaga Avenue NB
No. 4: Travel time section(s) 4 Tallman Street WB
No. 5: Travel time section(s) 5 Onondaga Street SB

Time	Delay	Stopd	Stops	#Veh	Pers.	#Pers	Delay	Stopd	Stops	#Veh	Pers.	#Pers
VehC	All							All				
No.:	1	1	1	1	1	1	2	2	2	2	2	2
900												
4500	5.5	1.8	0.18	146	5.5	146	5.2	0.8	0.14	174	5.2	174
Total	5.5	1.8	0.18	146	5.5	146	5.2	0.8	0.14	174	5.2	174

Delay	Stopd	Stops	#Veh	Pers.	#Pers	Delay	Stopd	Stops	#Veh	Pers.	#Pers
	All						All				
3	3	3	3	3	3	4	4	4	4	4	4
2.4	0.1	0.02	235	2.4	235	1.2	0	0.05	133	1.2	133
2.4	0.1	0.02	235	2.4	235	1.2	0	0.05	133	1.2	133

Delay	Stopd	Stops	#Veh	Pers.	#Pers
	All				
5	5	5	5	5	5
6.3	0.2	0.12	697	6.3	697
6.3	0.2	0.12	697	6.3	697

Queue Length Record

File: C:\GTS Consulting\Active Projects\390 - SMTC - Roundabout Feasibility Study\analysis\Vissim\LeavenworthPM.inp
Comment:
Date: Wednesday, April 13, 2016 9:04:21 AM
VISSIM: 5.10-12 [24505]

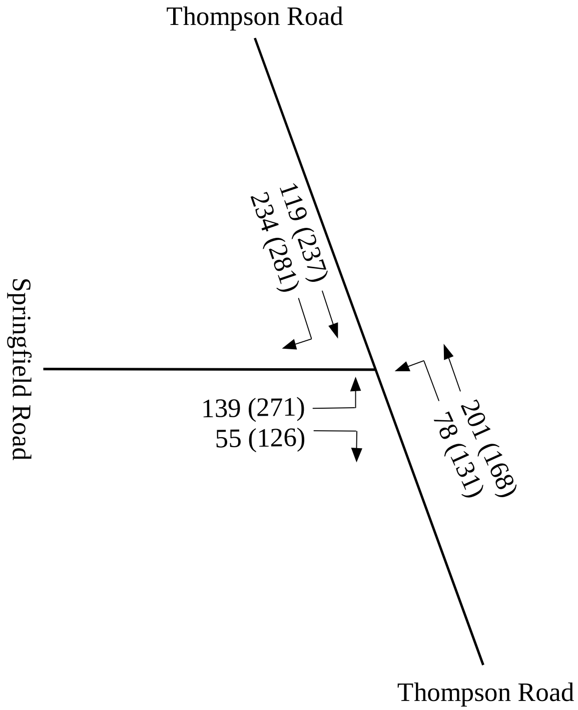
Queue Counter	1: Link 10001	At	3.100 ft		Delaware Street EB
Queue Counter	2: Link 4	At	443.200 ft		Onondaga Street NB
Queue Counter	3: Link 6	At	368.900 ft		Onondaga Avenue NB
Queue Counter	4: Link 8	At	461.600 ft		Tallman Street WB
Queue Counter	5: Link 10	At	428.100 ft		Onondaga Street SB

Avg.: average queue length [ft] within time interval
Max.: maximum queue length [ft] within time interval
Stop: number of stops within queue

Time	Avg.	max	Stop	Avg.	max	Stop	Avg.	max	Stop
No.:	1	1	1	2	2	2	3	3	3
4500	5	150	90	3	108	89	1	68	62

	Avg.	max	Stop	Avg.	max	Stop
	4	4	4	5	5	5
	0	22	20	9	414	212

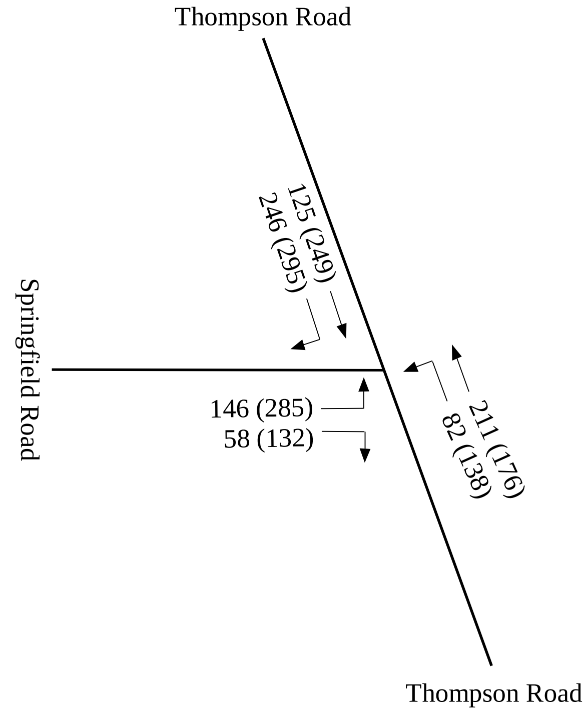
Thompson Rd / Springfield Rd



2015 Existing Traffic Volumes
Morning(Evening) Peak Hour

Counts Collected November 2015

Morning Peak Hour - 7:30am-8:30am
Evening Peak Hour - 4:30pm - 5:30pm

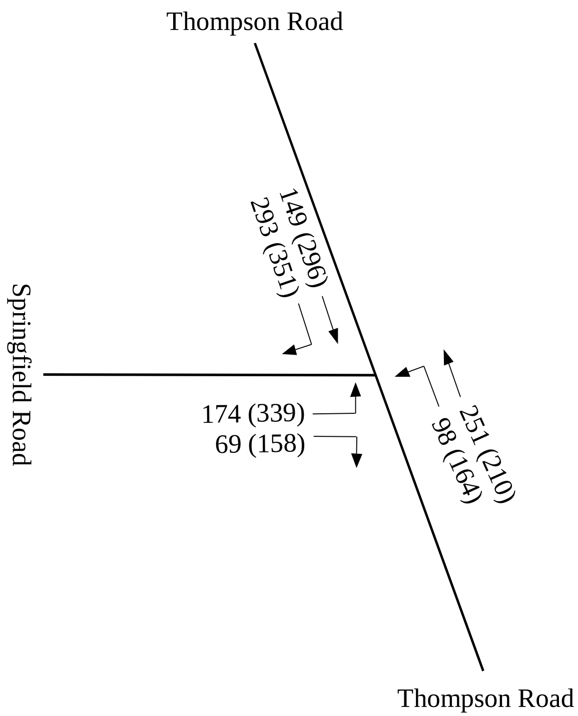


2020 Build Year Traffic Volumes
Morning(Evening) Peak Hour

1% Growth Per Year (5% Total)

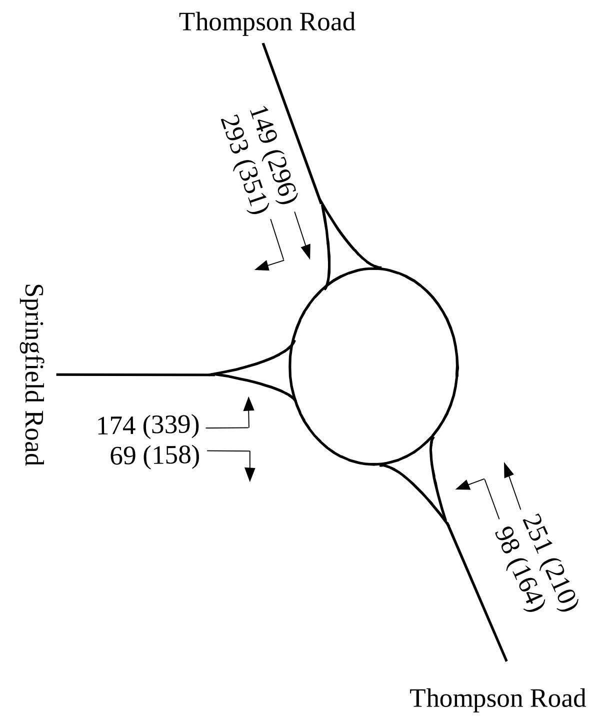
Roundabout Feasibility Study - Thompson Road @ Springfield Road
2015 Existing & 2020 Build Year Traffic Volumes
Morning (Evening) Peak Hour

N
W E
GTS Consulting



2040 Design Year Traffic Volumes
Existing Signalized Layout
Morning(Evening) Peak Hour

1% Growth (25% Total)



2040 Design Year Traffic Volumes
Roundabout Layout
Morning(Evening) Peak Hour

1% Growth (25% Total)

Roundabout Feasibility Study - Thompson Road @ Springfield Road
2040 Design Year Traffic Volumes
Morning (Evening) Peak Hour

N
W E

GTS Consulting

Roundabout Feasibility Study
Thompson Road @ Springfield Road
Intersection Level of Service Summary

Morning Peak Hour

Intersection	2015 Existing	2020 Build Year	2040 Design Year	2040 Design Year Improved
Thompson Road @ Springfield Road				**A(9)**
EB Left/(Right)	b(12)	b(12)	c(15)	B(18)
EB Right	-	-	-	A(2)
NB Left	-	-	-	A(7)
NB (Left)/Through	b(12)	b(13)	c(17)	A(8)
SB Through/(Right)	b(14)	c(15)	d(25)	B(18)
SB Right	-	-	-	A(1)

a(5) – Unsignalized Level of Service (Average Delay per Vehicle)
B(17) – Signalized Level of Service (Average Delay per Vehicle)
Improvements include 150 foot NB Left, SB Right, and EB Right turn lanes, and installation of a 75 second semi-actuated signal with protected/permitted NB Left phasing and EB/SB right turn overlap phases.

Evening Peak Hour

Intersection	2015 Existing	2020 Build Year	2040 Design Year	2040 Design Year Improved
Thompson Road @ Springfield Road				**B(13)**
EB Left/(Right)	d(29)	e(36)	f(76)	C(25)
EB Right	-	-	-	A(2)
NB Left	-	-	-	B(11)
NB (Left)/Through	c(18)	c(21)	d(32)	A(9)
SB Through/(Right)	e(35)	e(48)	f(130)	C(24)
SB Right	-	-	-	A(1)

a(5) – Unsignalized Level of Service (Average Delay per Vehicle)
B(17) – Signalized Level of Service (Average Delay per Vehicle)
Improvements include 150 foot NB Left, SB Right, and EB Right turn lanes, and installation of a 75 second semi-actuated signal with protected/permitted NB Left phasing and EB/SB right turn overlap phases.

Roundabout Feasibility Study
Thompson Road @ Springfield Road
Queue Summary

Morning Peak Hour

Intersection	Available Storage	2015 Existing	2020 Build Year	2040 Design Year	2040 Design Year Improved
Thompson Road @ Springfield Road					
EB Left/(Right)	-	NC	NC	NC	92
EB Right	150	-	-	-	13
NB Left	150	-	-	-	36
NB (Left)/Through	-	NC	NC	NC	82
SB Through/(Right)	-	NC	NC	NC	81
SB Right	150	-	-	-	11

95^{th} Percentile Queue from Synchro Analysis – in Feet
NC - Queues not calculated for unsignalized all-way stop control
Improvements include 150 foot NB Left, SB Right, and EB Right turn lanes, and installation of a 75 second semi-actuated signal with protected/permitted NB Left phasing and EB/SB right turn overlap phases.

Evening Peak Hour

Intersection	Available Storage	2015 Existing	2020 Build Year	2040 Design Year	2040 Design Year Improved
Thompson Road @ Springfield Road					
EB Left/(Right)	-	NC	NC	NC	211
EB Right	150	-	-	-	24
NB Left	150	-	-	-	68
NB (Left)/Through	-	NC	NC	NC	85
SB Through/(Right)	-	NC	NC	NC	171
SB Right	150	-	-	-	15

95^{th} Percentile Queue from Synchro Analysis – in Feet
NC - Queues not calculated for unsignalized all-way stop control
Improvements include 150 foot NB Left, SB Right, and EB Right turn lanes, and installation of a 75 second semi-actuated signal with protected/permitted NB Left phasing and EB/SB right turn overlap phases.

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Stop	Stop	
Volume (vph)	139	55	78	201	119	234
Peak Hour Factor	0.88	0.88	0.92	0.92	0.79	0.79
Hourly flow rate (vph)	158	62	85	218	151	296

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total (vph)	220	303	447
Volume Left (vph)	158	85	0
Volume Right (vph)	63	0	296
Hadj (s)	0.03	0.11	-0.34
Departure Headway (s)	5.7	5.3	4.7
Degree Utilization, x	0.35	0.44	0.58
Capacity (veh/h)	574	656	743
Control Delay (s)	11.8	12.4	14.0
Approach Delay (s)	11.8	12.4	14.0
Approach LOS	B	B	B

Intersection Summary			
Delay	13.0		
Level of Service	B		
Intersection Capacity Utilization	56.8%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Stop	Stop	
Volume (vph)	146	58	82	211	125	246
Peak Hour Factor	0.88	0.88	0.92	0.92	0.79	0.79
Hourly flow rate (vph)	166	66	89	229	158	311

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total (vph)	232	318	470
Volume Left (vph)	166	89	0
Volume Right (vph)	66	0	311
Hadj (s)	0.03	0.11	-0.34
Departure Headway (s)	5.8	5.4	4.8
Degree Utilization, x	0.38	0.47	0.62
Capacity (veh/h)	564	645	732
Control Delay (s)	12.3	13.1	15.2
Approach Delay (s)	12.3	13.1	15.2
Approach LOS	B	B	C

Intersection Summary			
Delay	13.9		
Level of Service	B		
Intersection Capacity Utilization	59.1%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Stop	Stop	
Volume (vph)	174	69	98	251	149	293
Peak Hour Factor	0.88	0.88	0.92	0.92	0.79	0.79
Hourly flow rate (vph)	198	78	107	273	189	371

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total (vph)	276	379	559
Volume Left (vph)	198	107	0
Volume Right (vph)	78	0	371
Hadj (s)	0.03	0.11	-0.34
Departure Headway (s)	6.3	5.8	5.1
Degree Utilization, x	0.48	0.61	0.80
Capacity (veh/h)	521	594	689
Control Delay (s)	15.1	17.3	25.1
Approach Delay (s)	15.1	17.3	25.1
Approach LOS	C	C	D

Intersection Summary			
Delay	20.4		
Level of Service	C		
Intersection Capacity Utilization	68.4%	ICU Level of Service	C
Analysis Period (min)	15		

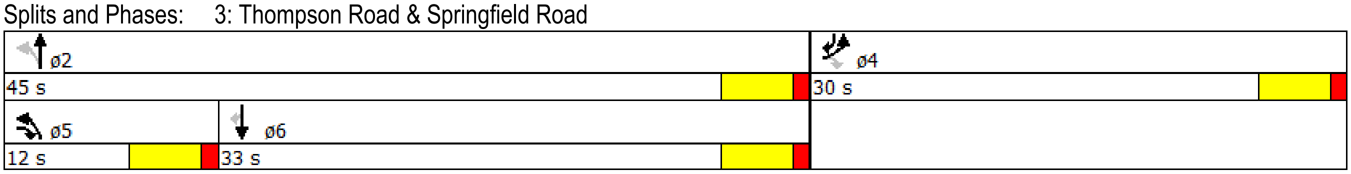
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	174	69	98	251	149	293
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	13	13	11	11
Storage Length (ft)	0	150	150			150
Storage Lanes	1	1	1			1
Taper Length (ft)	25		25			
Satd. Flow (prot)	1678	1531	1760	1925	1717	1531
Flt Permitted	0.950		0.447			
Satd. Flow (perm)	1678	1496	828	1925	1717	1531
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)		78				371
Link Speed (mph)	30			30	30	
Link Distance (ft)	724			766	745	
Travel Time (s)	16.5			17.4	16.9	
Confl. Peds. (#/hr)		2				
Peak Hour Factor	0.88	0.88	0.92	0.92	0.79	0.79
Heavy Vehicles (%)	4%	2%	6%	2%	7%	2%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	198	78	107	273	189	371
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	11			13	13	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.04	1.04	0.96	0.96	1.04	1.04
Turning Speed (mph)	15	9	15			9
Turn Type	Prot	pm+ov	pm+pt	NA	NA	pm+ov
Protected Phases	4	5	5	2	6	4
Permitted Phases		4	2			6
Detector Phase	4	5	5	2	6	4
Switch Phase						
Minimum Initial (s)	6.0	3.0	3.0	10.0	10.0	6.0
Minimum Split (s)	11.0	12.0	12.0	15.0	15.0	11.0
Total Split (s)	30.0	12.0	12.0	45.0	33.0	30.0
Total Split (%)	40.0%	16.0%	16.0%	60.0%	44.0%	40.0%
Maximum Green (s)	25.0	7.0	7.0	40.0	28.0	25.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag		Lead	Lead		Lag	
Lead-Lag Optimize?		Yes	Yes		Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	None	Min	Min	None
Act Effct Green (s)	11.0	17.9	20.6	20.6	11.8	29.6
Actuated g/C Ratio	0.26	0.42	0.49	0.49	0.28	0.70
v/c Ratio	0.45	0.11	0.19	0.29	0.40	0.31

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Control Delay	17.9	2.4	7.1	7.6	17.5	1.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	17.9	2.4	7.1	7.6	17.5	1.2
LOS	B	A	A	A	B	A
Approach Delay	13.5			7.5	6.7	
Approach LOS	B			A	A	
Queue Length 50th (ft)	41	0	12	32	39	0
Queue Length 95th (ft)	92	13	36	82	81	11
Internal Link Dist (ft)	644			686	665	
Turn Bay Length (ft)		150	150			150
Base Capacity (vph)	1051	703	567	1737	1187	1435
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.19	0.11	0.19	0.16	0.16	0.26

Intersection Summary

Area Type: Other
Cycle Length: 75
Actuated Cycle Length: 42.2
Natural Cycle: 40
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.45
Intersection Signal Delay: 8.5 Intersection LOS: A
Intersection Capacity Utilization 35.9% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 3: Thompson Road & Springfield Road



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Stop	Stop	
Volume (vph)	271	126	131	168	237	281
Peak Hour Factor	0.89	0.89	0.93	0.93	0.96	0.96
Hourly flow rate (vph)	304	142	141	181	247	293

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total (vph)	446	322	540
Volume Left (vph)	304	141	0
Volume Right (vph)	142	0	293
Hadj (s)	-0.03	0.11	-0.31
Departure Headway (s)	6.3	6.6	5.8
Degree Utilization, x	0.78	0.59	0.87
Capacity (veh/h)	549	519	603
Control Delay (s)	28.6	18.4	35.4
Approach Delay (s)	28.6	18.4	35.4
Approach LOS	D	C	E

Intersection Summary			
Delay	28.9		
Level of Service	D		
Intersection Capacity Utilization	78.6%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Stop	Stop	
Volume (vph)	285	132	138	176	249	295
Peak Hour Factor	0.89	0.89	0.93	0.93	0.96	0.96
Hourly flow rate (vph)	320	148	148	189	259	307

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total (vph)	469	338	567
Volume Left (vph)	320	148	0
Volume Right (vph)	148	0	307
Hadj (s)	-0.03	0.11	-0.31
Departure Headway (s)	6.5	6.8	6.0
Degree Utilization, x	0.85	0.64	0.94
Capacity (veh/h)	540	512	589
Control Delay (s)	35.7	21.0	48.4
Approach Delay (s)	35.7	21.0	48.4
Approach LOS	E	C	E

Intersection Summary			
Delay	37.3		
Level of Service	E		
Intersection Capacity Utilization	82.0%	ICU Level of Service	E
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Stop	Stop	
Volume (vph)	339	158	164	210	296	351
Peak Hour Factor	0.89	0.89	0.93	0.93	0.96	0.96
Hourly flow rate (vph)	381	178	176	226	308	366

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total (vph)	558	402	674
Volume Left (vph)	381	176	0
Volume Right (vph)	178	0	366
Hadj (s)	-0.03	0.11	-0.31
Departure Headway (s)	6.7	7.1	6.4
Degree Utilization, x	1.0	0.79	1.0
Capacity (veh/h)	542	501	563
Control Delay (s)	75.6	32.1	130.2
Approach Delay (s)	75.6	32.1	130.2
Approach LOS	F	D	F

Intersection Summary			
Delay	87.4		
Level of Service	F		
Intersection Capacity Utilization	95.8%	ICU Level of Service	F
Analysis Period (min)	15		

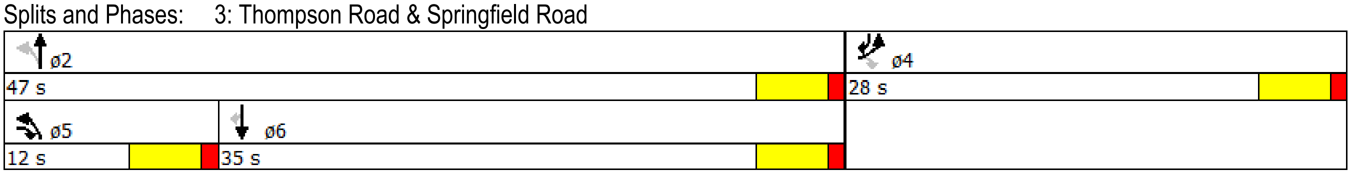
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	339	158	164	210	296	351
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	11	13	13	11	11
Storage Length (ft)	0	150	150			150
Storage Lanes	1	1	1			1
Taper Length (ft)	25		25			
Satd. Flow (prot)	1728	1531	1829	1944	1818	1546
Flt Permitted	0.950		0.341			
Satd. Flow (perm)	1728	1531	656	1944	1818	1513
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)		178				366
Link Speed (mph)	30			30	30	
Link Distance (ft)	724			766	745	
Travel Time (s)	16.5			17.4	16.9	
Confl. Peds. (#/hr)			2			2
Peak Hour Factor	0.89	0.89	0.93	0.93	0.96	0.96
Heavy Vehicles (%)	1%	2%	2%	1%	1%	1%
Shared Lane Traffic (%)						
Lane Group Flow (vph)	381	178	176	226	308	366
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	11			13	13	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.04	1.04	0.96	0.96	1.04	1.04
Turning Speed (mph)	15	9	15			9
Turn Type	Prot	pm+ov	pm+pt	NA	NA	pm+ov
Protected Phases	4	5	5	2	6	4
Permitted Phases		4	2			6
Detector Phase	4	5	5	2	6	4
Switch Phase						
Minimum Initial (s)	6.0	3.0	3.0	10.0	10.0	6.0
Minimum Split (s)	11.0	12.0	12.0	15.0	15.0	11.0
Total Split (s)	28.0	12.0	12.0	47.0	35.0	28.0
Total Split (%)	37.3%	16.0%	16.0%	62.7%	46.7%	37.3%
Maximum Green (s)	23.0	7.0	7.0	42.0	30.0	23.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag		Lead	Lead		Lag	
Lead-Lag Optimize?		Yes	Yes		Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	None	Min	Min	None
Act Effct Green (s)	17.3	29.5	27.3	27.3	15.0	32.3
Actuated g/C Ratio	0.32	0.54	0.50	0.50	0.27	0.59
v/c Ratio	0.70	0.20	0.37	0.23	0.62	0.35

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Control Delay	24.8	2.1	10.9	9.4	24.1	1.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	24.8	2.1	10.9	9.4	24.1	1.3
LOS	C	A	B	A	C	A
Approach Delay	17.6			10.1	11.7	
Approach LOS	B			B	B	
Queue Length 50th (ft)	105	0	30	40	88	0
Queue Length 95th (ft)	211	24	68	85	171	15
Internal Link Dist (ft)	644			686	665	
Turn Bay Length (ft)		150	150			150
Base Capacity (vph)	745	908	480	1531	1023	1189
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.51	0.20	0.37	0.15	0.30	0.31

Intersection Summary

Area Type: Other
Cycle Length: 75
Actuated Cycle Length: 54.8
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.70
Intersection Signal Delay: 13.3 Intersection LOS: B
Intersection Capacity Utilization 55.9% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 3: Thompson Road & Springfield Road



Roundabout Feasibility Study
VISSIM Roundabout Analysis
2040 Design Year Conditions

Intersection Level of Service and Queue Summary

Leavenworth Circle – Delaware St. / W. Onondaga St. / Onondaga Ave. / Tallman St.

Intersection	Morning Peak Hour		Evening Peak Hour	
	LOS	Queue	LOS	Queue
Delaware Street EB Approach	a(2)	122	a(6)	150
Onondaga Street NB Approach	a(3)	108	a(5)	108
Onondaga Avenue NB Approach	a(4)	178	a(2)	68
Tallman Street WB Approach	a(4)	71	a(1)	22
Onondaga Street SB Approach	a(2)	60	a(6)	414

LOS - a(9) – Unsignalized Level of Service (Average Delay per Vehicle)
Maximum Queue Lengths Shown in Feet

East Colvin Street @ Comstock Avenue

Intersection	Morning Peak Hour		Evening Peak Hour	
	LOS	Queue	LOS	Queue
Colvin Street EB Approach	b(12)	278	f(60)	791
Comstock Avenue NB Left/Through	a(6)	153	a(4)	49
Comstock Avenue NB Right	a(2)	60	a(2)	67
Colvin Street WB Approach	f(56)	808	a(9)	136
Comstock Avenue SB Left/Through	a(6)	182	c(28)	725
Comstock Avenue SB Right	a(4)	183	b(11)	726

LOS - a(9) – Unsignalized Level of Service (Average Delay per Vehicle)
Maximum Queue Lengths Shown in Feet

Thompson Road @ Springfield Road

Intersection	Morning Peak Hour		Evening Peak Hour	
	LOS	Queue	LOS	Queue
Springfield Road EB Approach	a(2)	46	a(7)	170
Thompson Road NB Approach	a(2)	83	a(5)	175
Thompson Road SB Approach	a(3)	95	a(8)	326

LOS - a(9) – Unsignalized Level of Service (Average Delay per Vehicle)
Maximum Queue Lengths Shown in Feet

Table of Delay

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Comment:
Date: Wednesday, April 13, 2016 2:27:28 PM
VISSIM: 5.10-12 [24505]

No. 1: Travel time section(s) 1 Springfield Road EB
No. 3: Travel time section(s) 3 Thompson Road NB
No. 4: Travel time section(s) 4 Thompson Road SB

Time	Delay	Stopd	Stops	#Veh	Pers.	#Pers	Delay	Stopd	Stops	#Veh	Pers.	#Pers
VehC	All							All				
No.:	1	1	1	1	1	1	3	3	3	3	3	3
900												
4500	1.6	0.1	0.07	252	1.6	252	2.3	0.2	0.09	369	2.3	369
Total	1.6	0.1	0.07	252	1.6	252	2.3	0.2	0.09	369	2.3	369

Delay	Stopd	Stops	#Veh	Pers.	#Pers
	All				
4	4	4	4	4	4
2.6	0	0.01	427	2.6	427
2.6	0	0.01	427	2.6	427

Queue Length Record

File: C:\GTS Consulting\Active Projects\390 - SMTC - Roundabout Feasibility Study\analysis\Vissim\ThompsonAM.inp
Comment:
Date: Wednesday, April 13, 2016 2:27:28 PM
VISSIM: 5.10-12 [24505]

Queue Counter 1: Link 2 At 482.300 ft Springfield Road EB
Queue Counter 3: Link 10006 At 3.800 ft Thompson Road NB
Queue Counter 4: Link 4 At 374.000 ft Thompson Road SB

Avg.: average queue length [ft] within time interval
Max.: maximum queue length [ft] within time interval
Stop: number of stops within queue

Time	Avg.	max	Stop	Avg.	max	Stop	Avg.	max	Stop
No.:	1	1	1	3	3	3	4	4	4
4500	0	46	38	1	83	65	2	95	72

Table of Delay

File: C:\GTS Consulting\Active Projects\390 - SMTC - Roundabout Feasibility Study\analysis\Vissim\Thompson PM.inp
Comment:
Date: Wednesday, April 13, 2016 2:34:35 PM
VISSIM: 5.10-12 [24505]

No. 1: Travel time section(s) 1 Springfield EB
No. 3: Travel time section(s) 3 Thompson NB
No. 4: Travel time section(s) 4 Thompson SB

Time	Delay	Stopd	Stops	#Veh	Pers.	#Pers	Delay	Stopd	Stops	#Veh	Pers.	#Pers
VehC	All								All			
No.:	1	1	1	1	1	1	3	3	3	3	3	3
900												
4500	7.3	0.6	0.3	514	7.3	514	5.2	0.5	0.2	395	5.2	395
Total	7.3	0.6	0.3	514	7.3	514	5.2	0.5	0.2	395	5.2	395

Delay	Stopd	Stops	#Veh	Pers.	#Pers
	All				
4	4	4	4	4	4
7.8	0.1	0.04	629	7.8	629
7.8	0.1	0.04	629	7.8	629

Queue Length Record

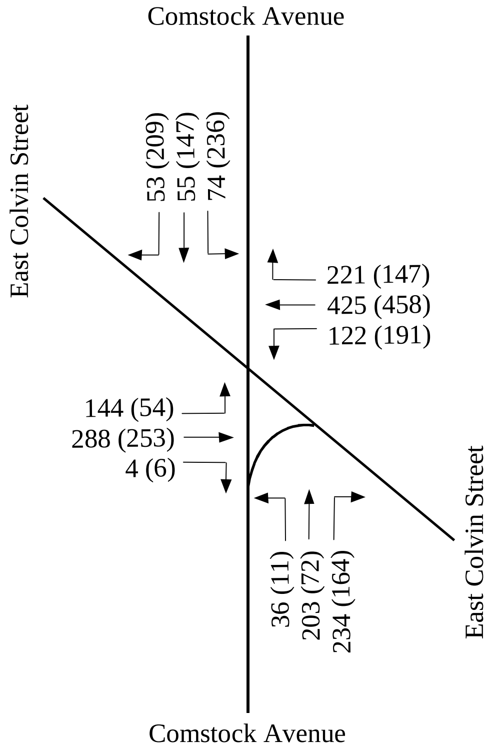
File: C:\GTS Consulting\Active Projects\390 - SMTC - Roundabout Feasibility Study\analysis\Vissim\Thompson PM.inp
Comment:
Date: Wednesday, April 13, 2016 2:34:35 PM
VISSIM: 5.10-12 [24505]

Queue Counter	1: Link 2 At 482.300 ft	Springfield EB
Queue Counter	3: Link 10006 At 3.800 ft	Thompson NB
Queue Counter	4: Link 4 At 374.000 ft	Thompson SB

Avg.: average queue length [ft] within time interval
Max.: maximum queue length [ft] within time interval
Stop: number of stops within queue

Time	Avg.	max	Stop	Avg.	max	Stop	Avg.	max	Stop
No.:	1	1	1	3	3	3	4	4	4
4500	8	170	235	4	175	151	10	326	285

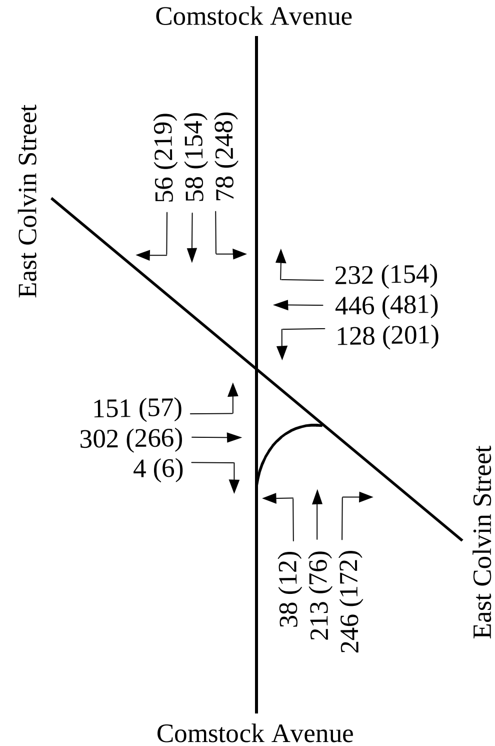
E. Colvin St / Comstock Ave



2015 Existing Traffic Volumes
Morning(Evening) Peak Hour

Counts Collected October 2015

Morning Peak Hour - 7:45am-8:45am
Evening Peak Hour - 4:45pm - 5:45pm



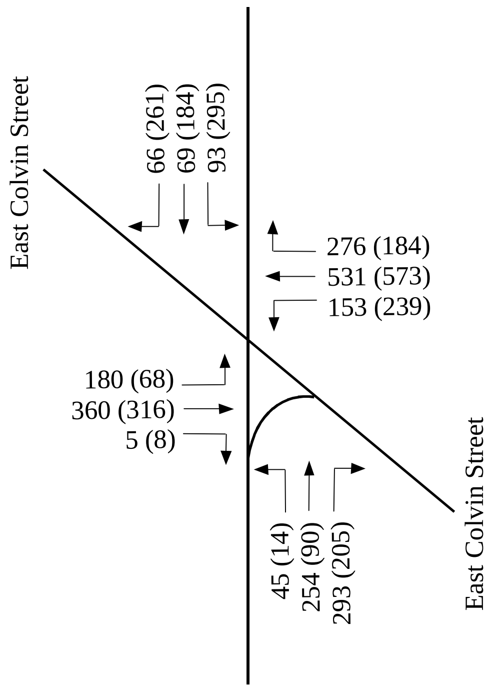
2020 Build Year Traffic Volumes
Morning(Evening) Peak Hour

1% Growth Per Year (5% Total)

Roundabout Feasibility Study - East Colvin Street @ Comstock Avenue
2015 Existing & 2020 Build Year Traffic Volumes
Morning (Evening) Peak Hour

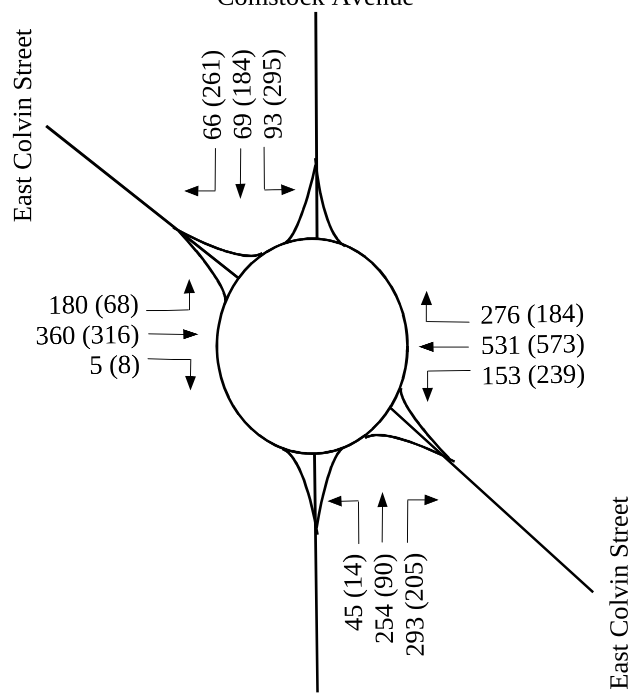
N
W E

GTS Consulting



2040 Design Year Traffic Volumes
Existing Signalized Layout
Morning(Evening) Peak Hour

1% Growth (25% Total)



2040 Design Year Traffic Volumes
Roundabout Layout
Morning(Evening) Peak Hour

1% Growth (25% Total)

Roundabout Feasibility Study - East Colvin Street @ Comstock Avenue
2040 Design Year Traffic Volumes
Morning (Evening) Peak Hour

N W E
GTS Consulting

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	144	288	4	122	425	221	36	203	234	74	55	53
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	10	10	12	11	10	12	13	11	11	12	15
Storage Length (ft)	117		0	154		240	120		160	145		145
Storage Lanes	1		0	1		1	1		1	1		1
Taper Length (ft)	25			25			25			25		
Satd. Flow (prot)	1662	1692	0	1719	1783	1396	1752	1925	1501	1385	1681	1518
Flt Permitted	0.218			0.478			0.950			0.950		
Satd. Flow (perm)	381	1692	0	864	1783	1355	1738	1925	1460	1364	1681	1474
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						210			220			90
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1068			1129			1168			1266	
Travel Time (s)		24.3			25.7			26.5			28.8	
Confl. Peds. (#/hr)	4		1	1		4	4		9	9		4
Confl. Bikes (#/hr)			1			3			8			
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.81	0.81	0.81	0.83	0.83	0.83
Heavy Vehicles (%)	5%	4%	50%	5%	3%	8%	3%	2%	4%	26%	13%	17%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	153	310	0	130	452	235	44	251	289	89	66	64
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.04	1.09	1.09	1.00	1.04	1.09	1.00	0.96	1.04	1.04	1.00	0.88
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Split	NA	Free	Split	NA	Perm
Protected Phases	5	2		1	6		3	3		4	4	
Permitted Phases	2			6		6			Free			4
Detector Phase	5	2		1	6	6	3	3		4	4	4
Switch Phase												
Minimum Initial (s)	8.0	8.0		4.0	8.0	8.0	8.0	8.0		8.0	8.0	8.0
Minimum Split (s)	12.5	13.0		8.5	13.0	13.0	13.0	13.0		13.0	13.0	13.0
Total Split (s)	19.5	50.0		19.5	50.0	50.0	35.0	35.0		35.0	35.0	35.0
Total Split (%)	14.0%	35.8%		14.0%	35.8%	35.8%	25.1%	25.1%		25.1%	25.1%	25.1%
Maximum Green (s)	15.0	45.0		15.0	45.0	45.0	30.0	30.0		30.0	30.0	30.0
Yellow Time (s)	3.5	4.0		3.5	4.0	4.0	4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	4.5	5.0		4.5	5.0	5.0	5.0	5.0		5.0	5.0	5.0
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lead		Lag	Lag	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Vehicle Extension (s)	2.5	2.5		2.5	2.5	2.5	2.5	2.5		2.5	2.5	2.5
Recall Mode	None	None		Min	Min	Min	None	None		None	None	None
Act Effct Green (s)	45.1	32.4		39.9	29.8	29.8	18.3	18.3	93.3	12.3	12.3	12.3
Actuated g/C Ratio	0.48	0.35		0.43	0.32	0.32	0.20	0.20	1.00	0.13	0.13	0.13

Lanes, Volumes, Timings
3: Comstock Avenue & East Colvin Street

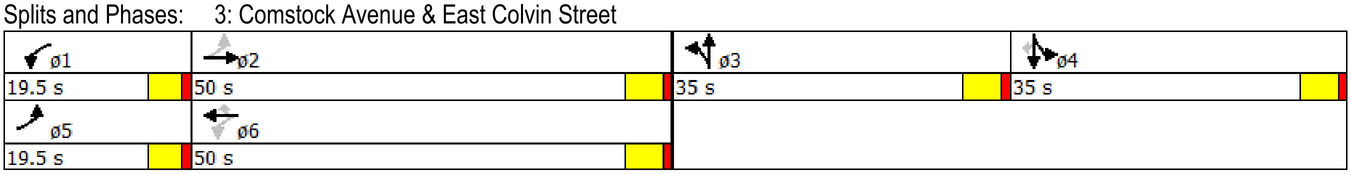
12/1/2015

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio	0.44	0.53		0.28	0.79	0.41	0.13	0.67	0.20	0.49	0.30	0.24
Control Delay	17.8	29.3		15.5	41.5	7.6	36.3	46.6	0.3	52.8	46.0	6.4
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	17.8	29.3		15.5	41.5	7.6	36.3	46.6	0.3	52.8	46.0	6.4
LOS	B	C		B	D	A	D	D	A	D	D	A
Approach Delay		25.5			27.6			22.9			37.2	
Approach LOS		C			C			C			D	
Queue Length 50th (ft)	45	139		38	235	10	21	136	0	49	35	0
Queue Length 95th (ft)	105	286		90	443	74	56	242	0	112	86	15
Internal Link Dist (ft)		988			1049			1088			1186	
Turn Bay Length (ft)	117			154		240	120		160	145		145
Base Capacity (vph)	409	870		566	913	796	598	657	1460	473	574	562
Starvation Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.37	0.36		0.23	0.50	0.30	0.07	0.38	0.20	0.19	0.11	0.11

Intersection Summary

Area Type: Other
Cycle Length: 139.5
Actuated Cycle Length: 93.3
Natural Cycle: 65
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.79
Intersection Signal Delay: 26.8 — Intersection LOS: C
Intersection Capacity Utilization 63.9% — ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 3: Comstock Avenue & East Colvin Street



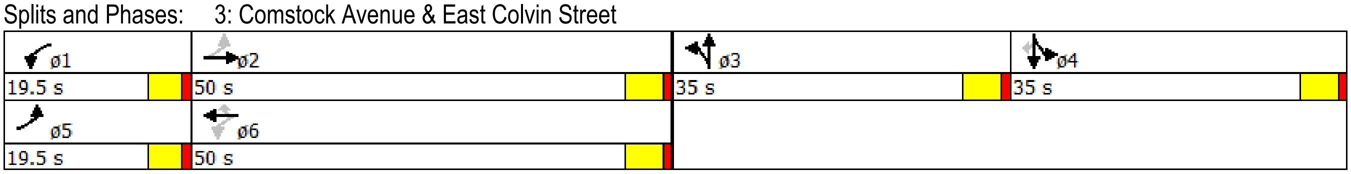
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	151	302	4	128	446	232	38	213	246	78	58	56
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	10	10	12	11	10	12	13	11	11	12	15
Storage Length (ft)	117		0	154		240	120		160	145		145
Storage Lanes	1		0	1		1	1		1	1		1
Taper Length (ft)	25			25			25			25		
Satd. Flow (prot)	1662	1692	0	1719	1783	1396	1752	1925	1501	1385	1681	1518
Flt Permitted	0.203			0.460			0.950			0.950		
Satd. Flow (perm)	354	1692	0	832	1783	1355	1738	1925	1460	1365	1681	1474
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						210			221			90
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1068			1129			1168			1266	
Travel Time (s)		24.3			25.7			26.5			28.8	
Confl. Peds. (#/hr)	4		1	1		4	4		9	9		4
Confl. Bikes (#/hr)			1			3			8			
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.81	0.81	0.81	0.83	0.83	0.83
Heavy Vehicles (%)	5%	4%	50%	5%	3%	8%	3%	2%	4%	26%	13%	17%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	161	325	0	136	474	247	47	263	304	94	70	67
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.04	1.09	1.09	1.00	1.04	1.09	1.00	0.96	1.04	1.04	1.00	0.88
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Split	NA	Free	Split	NA	Perm
Protected Phases	5	2		1	6		3	3		4	4	
Permitted Phases	2			6		6			Free			4
Detector Phase	5	2		1	6	6	3	3		4	4	4
Switch Phase												
Minimum Initial (s)	8.0	8.0		4.0	8.0	8.0	8.0	8.0		8.0	8.0	8.0
Minimum Split (s)	12.5	13.0		8.5	13.0	13.0	13.0	13.0		13.0	13.0	13.0
Total Split (s)	19.5	50.0		19.5	50.0	50.0	35.0	35.0		35.0	35.0	35.0
Total Split (%)	14.0%	35.8%		14.0%	35.8%	35.8%	25.1%	25.1%		25.1%	25.1%	25.1%
Maximum Green (s)	15.0	45.0		15.0	45.0	45.0	30.0	30.0		30.0	30.0	30.0
Yellow Time (s)	3.5	4.0		3.5	4.0	4.0	4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	4.5	5.0		4.5	5.0	5.0	5.0	5.0		5.0	5.0	5.0
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lead		Lag	Lag	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Vehicle Extension (s)	2.5	2.5		2.5	2.5	2.5	2.5	2.5		2.5	2.5	2.5
Recall Mode	None	None		Min	Min	Min	None	None		None	None	None
Act Effct Green (s)	47.8	34.8		42.6	32.3	32.3	19.4	19.4	97.5	12.8	12.8	12.8
Actuated g/C Ratio	0.49	0.36		0.44	0.33	0.33	0.20	0.20	1.00	0.13	0.13	0.13

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio	0.47	0.54		0.30	0.80	0.42	0.14	0.69	0.21	0.52	0.32	0.25
Control Delay	19.0	30.2		16.0	42.7	8.4	37.4	48.8	0.3	55.5	47.9	7.2
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	19.0	30.2		16.0	42.7	8.4	37.4	48.8	0.3	55.5	47.9	7.2
LOS	B	C		B	D	A	D	D	A	E	D	A
Approach Delay		26.5			28.6			23.9			39.2	
Approach LOS		C			C			C			D	
Queue Length 50th (ft)	50	154		42	263	16	24	153	0	56	40	0
Queue Length 95th (ft)	114	310		97	482	86	59	254	0	119	91	18
Internal Link Dist (ft)		988			1049			1088			1186	
Turn Bay Length (ft)	117			154		240	120		160	145		145
Base Capacity (vph)	391	828		553	871	769	570	627	1460	451	547	540
Starvation Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.41	0.39		0.25	0.54	0.32	0.08	0.42	0.21	0.21	0.13	0.12

Intersection Summary

Area Type: Other
Cycle Length: 139.5
Actuated Cycle Length: 97.5
Natural Cycle: 65
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.80
Intersection Signal Delay: 28.0 Intersection LOS: C
Intersection Capacity Utilization 66.0% ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 3: Comstock Avenue & East Colvin Street



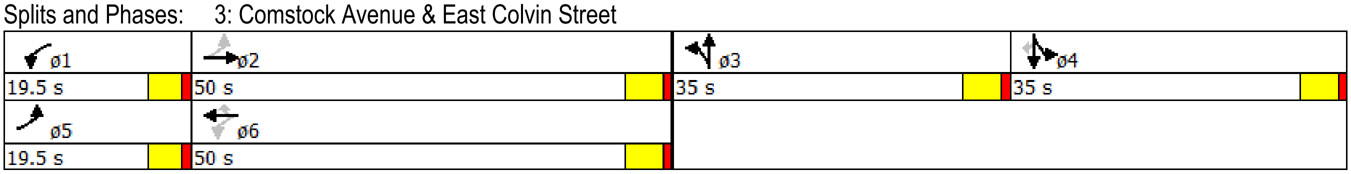
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	180	360	5	153	531	276	45	254	293	93	69	66
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	10	10	12	11	10	12	13	11	11	12	15
Storage Length (ft)	117		0	154		240	120		160	145		145
Storage Lanes	1		0	1		1	1		1	1		1
Taper Length (ft)	25			25			25			25		
Satd. Flow (prot)	1662	1692	0	1719	1783	1396	1752	1925	1501	1385	1681	1518
Flt Permitted	0.149			0.403			0.950			0.950		
Satd. Flow (perm)	260	1692	0	729	1783	1355	1738	1925	1460	1366	1681	1474
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						210			220			90
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1068			1129			1168			1266	
Travel Time (s)		24.3			25.7			26.5			28.8	
Confl. Peds. (#/hr)	4		1	1		4	4		9	9		4
Confl. Bikes (#/hr)			1			3			8			
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.81	0.81	0.81	0.83	0.83	0.83
Heavy Vehicles (%)	5%	4%	50%	5%	3%	8%	3%	2%	4%	26%	13%	17%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	191	388	0	163	565	294	56	314	362	112	83	80
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.04	1.09	1.09	1.00	1.04	1.09	1.00	0.96	1.04	1.04	1.00	0.88
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Split	NA	Free	Split	NA	Perm
Protected Phases	5	2		1	6		3	3		4	4	
Permitted Phases	2			6		6			Free			4
Detector Phase	5	2		1	6	6	3	3		4	4	4
Switch Phase												
Minimum Initial (s)	8.0	8.0		4.0	8.0	8.0	8.0	8.0		8.0	8.0	8.0
Minimum Split (s)	12.5	13.0		8.5	13.0	13.0	13.0	13.0		13.0	13.0	13.0
Total Split (s)	19.5	50.0		19.5	50.0	50.0	35.0	35.0		35.0	35.0	35.0
Total Split (%)	14.0%	35.8%		14.0%	35.8%	35.8%	25.1%	25.1%		25.1%	25.1%	25.1%
Maximum Green (s)	15.0	45.0		15.0	45.0	45.0	30.0	30.0		30.0	30.0	30.0
Yellow Time (s)	3.5	4.0		3.5	4.0	4.0	4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	4.5	5.0		4.5	5.0	5.0	5.0	5.0		5.0	5.0	5.0
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lead		Lag	Lag	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Vehicle Extension (s)	2.5	2.5		2.5	2.5	2.5	2.5	2.5		2.5	2.5	2.5
Recall Mode	None	None		None	Min	Min	None	None		None	None	None
Act Effct Green (s)	61.2	46.6		54.7	43.2	43.2	23.5	23.5	115.5	14.6	14.6	14.6
Actuated g/C Ratio	0.53	0.40		0.47	0.37	0.37	0.20	0.20	1.00	0.13	0.13	0.13

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio	0.61	0.57		0.37	0.85	0.46	0.16	0.80	0.25	0.64	0.39	0.30
Control Delay	26.7	33.4		18.1	48.3	11.7	40.9	61.1	0.4	66.8	53.9	10.9
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	26.7	33.4		18.1	48.3	11.7	40.9	61.1	0.4	66.8	53.9	10.9
LOS	C	C		B	D	B	D	E	A	E	D	B
Approach Delay		31.2			32.9			29.5			46.7	
Approach LOS		C			C			C			D	
Queue Length 50th (ft)	71	223		60	389	42	36	230	0	83	59	0
Queue Length 95th (ft)	159	399		121	#687	136	68	312	0	138	105	30
Internal Link Dist (ft)		988			1049			1088			1186	
Turn Bay Length (ft)	117			154		240	120		160	145		145
Base Capacity (vph)	323	704		503	706	663	462	508	1460	366	444	455
Starvation Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.59	0.55		0.32	0.80	0.44	0.12	0.62	0.25	0.31	0.19	0.18

Intersection Summary

Area Type: Other
Cycle Length: 139.5
Actuated Cycle Length: 115.5
Natural Cycle: 80
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.85
Intersection Signal Delay: 33.0 Intersection LOS: C
Intersection Capacity Utilization 74.2% ICU Level of Service D
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Comstock Avenue & East Colvin Street



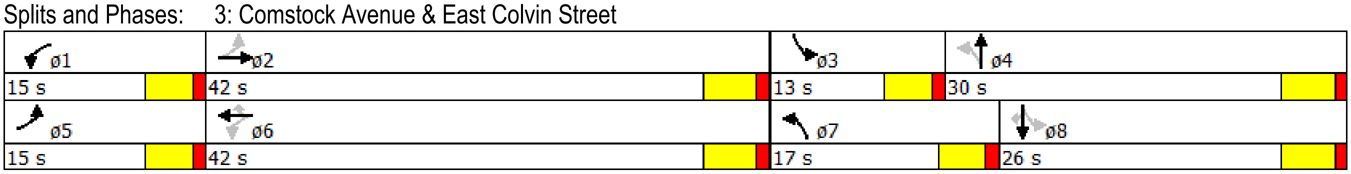
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	180	360	5	153	531	276	45	254	293	93	69	66
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	10	10	12	11	10	12	13	11	11	12	15
Storage Length (ft)	117		0	154		240	120		160	145		145
Storage Lanes	1		0	1		1	1		1	1		1
Taper Length (ft)	25			25			25			25		
Satd. Flow (prot)	1662	1692	0	1719	1783	1396	1752	1925	1501	1385	1681	1518
Flt Permitted	0.165			0.392			0.703			0.292		
Satd. Flow (perm)	288	1692	0	709	1783	1356	1291	1925	1460	422	1681	1474
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1				294			307			120
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1068			1129			1168			1266	
Travel Time (s)		24.3			25.7			26.5			28.8	
Confl. Peds. (#/hr)	4		1	1		4	4		9	9		4
Confl. Bikes (#/hr)			1			3			8			
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.81	0.81	0.81	0.83	0.83	0.83
Heavy Vehicles (%)	5%	4%	50%	5%	3%	8%	3%	2%	4%	26%	13%	17%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	191	388	0	163	565	294	56	314	362	112	83	80
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.04	1.09	1.09	1.00	1.04	1.09	1.00	0.96	1.04	1.04	1.00	0.88
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Free	pm+pt	NA	Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases	2			6		6	4		Free	8		8
Detector Phase	5	2		1	6	6	7	4		3	8	8
Switch Phase												
Minimum Initial (s)	8.0	8.0		4.0	8.0	8.0	8.0	8.0		8.0	8.0	8.0
Minimum Split (s)	12.5	13.0		8.5	13.0	13.0	12.5	13.0		12.5	13.0	13.0
Total Split (s)	15.0	42.0		15.0	42.0	42.0	17.0	30.0		13.0	26.0	26.0
Total Split (%)	15.0%	42.0%		15.0%	42.0%	42.0%	17.0%	30.0%		13.0%	26.0%	26.0%
Maximum Green (s)	10.5	37.0		10.5	37.0	37.0	12.5	25.0		8.5	21.0	21.0
Yellow Time (s)	3.5	4.0		3.5	4.0	4.0	3.5	4.0		3.5	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	4.5	5.0		4.5	5.0	5.0	4.5	5.0		4.5	5.0	5.0
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Vehicle Extension (s)	2.5	2.5		2.5	2.5	2.5	2.5	2.5		2.5	2.5	2.5
Recall Mode	None	None		None	Min	Min	None	None		None	None	None
Act Effct Green (s)	44.1	33.4		41.9	32.2	32.2	25.9	19.2	86.5	26.0	19.3	19.3
Actuated g/C Ratio	0.51	0.39		0.48	0.37	0.37	0.30	0.22	1.00	0.30	0.22	0.22

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio	0.62	0.60		0.36	0.85	0.43	0.13	0.74	0.25	0.50	0.22	0.19
Control Delay	22.7	27.6		14.0	40.4	4.8	20.7	44.4	0.4	29.6	31.9	3.2
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	22.7	27.6		14.0	40.4	4.8	20.7	44.4	0.4	29.6	31.9	3.2
LOS	C	C		B	D	A	C	D	A	C	C	A
Approach Delay		26.0			26.0			20.8			22.6	
Approach LOS		C			C			C			C	
Queue Length 50th (ft)	55	179		46	301	0	22	180	0	47	42	0
Queue Length 95th (ft)	#129	300		88	#520	54	43	239	0	79	76	9
Internal Link Dist (ft)		988			1049			1088			1186	
Turn Bay Length (ft)	117			154		240	120		160	145		145
Base Capacity (vph)	325	765		488	803	772	504	585	1460	226	450	482
Starvation Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.59	0.51		0.33	0.70	0.38	0.11	0.54	0.25	0.50	0.18	0.17

Intersection Summary

Area Type: Other
Cycle Length: 100
Actuated Cycle Length: 86.5
Natural Cycle: 80
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.85
Intersection Signal Delay: 24.2 Intersection LOS: C
Intersection Capacity Utilization 73.8% ICU Level of Service D
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Comstock Avenue & East Colvin Street



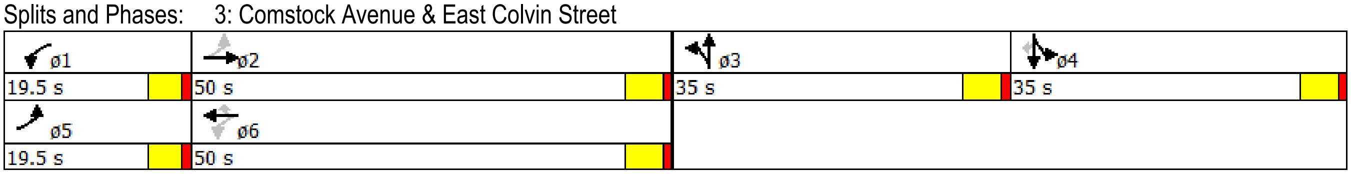
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	54	253	6	191	458	147	11	72	164	236	147	209
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	10	10	12	11	10	12	13	11	11	12	15
Storage Length (ft)	117		0	154		240	120		160	145		145
Storage Lanes	1		0	1		1	1		1	1		1
Taper Length (ft)	25			25			25			25		
Satd. Flow (prot)	1466	1750	0	1805	1801	1492	1656	1944	1561	1728	1863	1708
Flt Permitted	0.338			0.402			0.950			0.950		
Satd. Flow (perm)	518	1750	0	763	1801	1424	1623	1944	1517	1688	1863	1631
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1				130			180			243
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1068			1129			1168			1266	
Travel Time (s)		24.3			25.7			26.5			28.8	
Confl. Peds. (#/hr)	15		2	2		15	11		11	11		11
Confl. Bikes (#/hr)			1			3			8			
Peak Hour Factor	0.94	0.94	0.94	0.98	0.98	0.98	0.91	0.91	0.91	0.86	0.86	0.86
Heavy Vehicles (%)	19%	1%	0%	0%	2%	1%	9%	1%	0%	1%	2%	4%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	57	275	0	195	467	150	12	79	180	274	171	243
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.04	1.09	1.09	1.00	1.04	1.09	1.00	0.96	1.04	1.04	1.00	0.88
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Split	NA	Free	Split	NA	Perm
Protected Phases	5	2		1	6		3	3		4	4	
Permitted Phases	2			6		6			Free			4
Detector Phase	5	2		1	6	6	3	3		4	4	4
Switch Phase												
Minimum Initial (s)	8.0	8.0		4.0	8.0	8.0	8.0	8.0		8.0	8.0	8.0
Minimum Split (s)	12.5	13.0		8.5	13.0	13.0	13.0	13.0		13.0	13.0	13.0
Total Split (s)	19.5	50.0		19.5	50.0	50.0	35.0	35.0		35.0	35.0	35.0
Total Split (%)	14.0%	35.8%		14.0%	35.8%	35.8%	25.1%	25.1%		25.1%	25.1%	25.1%
Maximum Green (s)	15.0	45.0		15.0	45.0	45.0	30.0	30.0		30.0	30.0	30.0
Yellow Time (s)	3.5	4.0		3.5	4.0	4.0	4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	4.5	5.0		4.5	5.0	5.0	5.0	5.0		5.0	5.0	5.0
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lead		Lag	Lag	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Vehicle Extension (s)	2.5	2.5		2.5	2.5	2.5	2.5	2.5		2.5	2.5	2.5
Recall Mode	None	None		Min	Min	Min	None	None		None	None	None
Act Effct Green (s)	36.0	25.6		41.9	32.6	32.6	10.7	10.7	85.5	20.7	20.7	20.7
Actuated g/C Ratio	0.42	0.30		0.49	0.38	0.38	0.13	0.13	1.00	0.24	0.24	0.24

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio	0.17	0.52		0.38	0.68	0.24	0.06	0.33	0.12	0.66	0.38	0.42
Control Delay	15.2	30.9		16.3	32.3	7.3	44.3	46.7	0.2	41.4	34.3	7.0
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	15.2	30.9		16.3	32.3	7.3	44.3	46.7	0.2	41.4	34.3	7.0
LOS	B	C		B	C	A	D	D	A	D	C	A
Approach Delay		28.2			23.8			15.7			27.5	
Approach LOS		C			C			B			C	
Queue Length 50th (ft)	16	126		60	230	7	6	42	0	139	80	0
Queue Length 95th (ft)	44	244		124	419	53	28	107	0	265	165	53
Internal Link Dist (ft)		988			1049			1088			1186	
Turn Bay Length (ft)	117			154		240	120		160	145		145
Base Capacity (vph)	442	1020		591	1050	884	665	781	1517	694	748	800
Starvation Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.13	0.27		0.33	0.44	0.17	0.02	0.10	0.12	0.39	0.23	0.30

Intersection Summary

Area Type: Other
Cycle Length: 139.5
Actuated Cycle Length: 85.5
Natural Cycle: 70
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.68
Intersection Signal Delay: 24.7 Intersection LOS: C
Intersection Capacity Utilization 62.6% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 3: Comstock Avenue & East Colvin Street



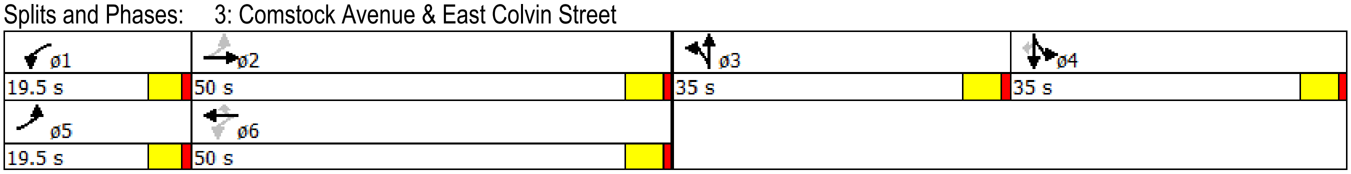
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	57	266	6	201	481	154	12	76	172	248	154	219
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	10	10	12	11	10	12	13	11	11	12	15
Storage Length (ft)	117		0	154		240	120		160	145		145
Storage Lanes	1		0	1		1	1		1	1		1
Taper Length (ft)	25			25			25			25		
Satd. Flow (prot)	1466	1750	0	1805	1801	1492	1656	1944	1561	1728	1863	1708
Flt Permitted	0.312			0.388			0.950			0.950		
Satd. Flow (perm)	478	1750	0	736	1801	1424	1623	1944	1517	1688	1863	1631
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1				129			189			255
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1068			1129			1168			1266	
Travel Time (s)		24.3			25.7			26.5			28.8	
Confl. Peds. (#/hr)	15		2	2		15	11		11	11		11
Confl. Bikes (#/hr)			1			3			8			
Peak Hour Factor	0.94	0.94	0.94	0.98	0.98	0.98	0.91	0.91	0.91	0.86	0.86	0.86
Heavy Vehicles (%)	19%	1%	0%	0%	2%	1%	9%	1%	0%	1%	2%	4%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	61	289	0	205	491	157	13	84	189	288	179	255
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.04	1.09	1.09	1.00	1.04	1.09	1.00	0.96	1.04	1.04	1.00	0.88
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Split	NA	Free	Split	NA	Perm
Protected Phases	5	2		1	6		3	3		4	4	
Permitted Phases	2			6		6			Free			4
Detector Phase	5	2		1	6	6	3	3		4	4	4
Switch Phase												
Minimum Initial (s)	8.0	8.0		4.0	8.0	8.0	8.0	8.0		8.0	8.0	8.0
Minimum Split (s)	12.5	13.0		8.5	13.0	13.0	13.0	13.0		13.0	13.0	13.0
Total Split (s)	19.5	50.0		19.5	50.0	50.0	35.0	35.0		35.0	35.0	35.0
Total Split (%)	14.0%	35.8%		14.0%	35.8%	35.8%	25.1%	25.1%		25.1%	25.1%	25.1%
Maximum Green (s)	15.0	45.0		15.0	45.0	45.0	30.0	30.0		30.0	30.0	30.0
Yellow Time (s)	3.5	4.0		3.5	4.0	4.0	4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	4.5	5.0		4.5	5.0	5.0	5.0	5.0		5.0	5.0	5.0
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lead		Lag	Lag	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Vehicle Extension (s)	2.5	2.5		2.5	2.5	2.5	2.5	2.5		2.5	2.5	2.5
Recall Mode	None	None		Min	Min	Min	None	None		None	None	None
Act Effct Green (s)	38.1	27.8		44.8	35.1	35.1	10.7	10.7	90.1	22.6	22.6	22.6
Actuated g/C Ratio	0.42	0.31		0.50	0.39	0.39	0.12	0.12	1.00	0.25	0.25	0.25

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio	0.20	0.54		0.40	0.70	0.25	0.07	0.36	0.12	0.67	0.38	0.42
Control Delay	15.9	31.8		17.0	33.7	7.9	45.8	49.2	0.2	42.5	35.0	6.8
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	15.9	31.8		17.0	33.7	7.9	45.8	49.2	0.2	42.5	35.0	6.8
LOS	B	C		B	C	A	D	D	A	D	C	A
Approach Delay		29.0			24.9			16.7			28.0	
Approach LOS		C			C			B			C	
Queue Length 50th (ft)	19	142		67	260	11	7	48	0	157	90	0
Queue Length 95th (ft)	47	259		131	451	59	29	112	0	281	173	54
Internal Link Dist (ft)		988			1049			1088			1186	
Turn Bay Length (ft)	117			154		240	120		160	145		145
Base Capacity (vph)	417	977		570	1006	852	616	723	1517	643	693	767
Starvation Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.15	0.30		0.36	0.49	0.18	0.02	0.12	0.12	0.45	0.26	0.33

Intersection Summary

Area Type: Other
Cycle Length: 139.5
Actuated Cycle Length: 90.1
Natural Cycle: 70
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.70
Intersection Signal Delay: 25.5 Intersection LOS: C
Intersection Capacity Utilization 64.5% ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 3: Comstock Avenue & East Colvin Street



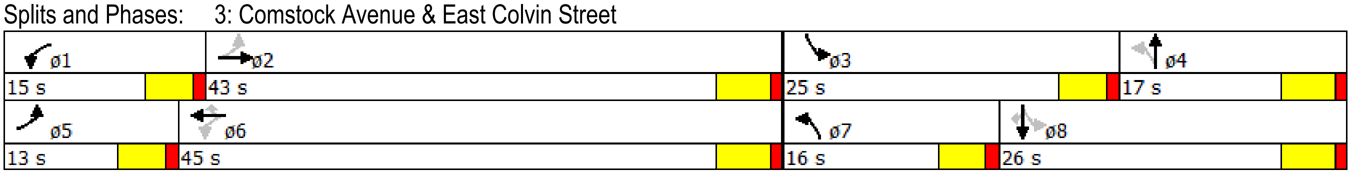
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	68	316	8	239	573	184	14	90	205	295	184	261
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	10	10	12	11	10	12	13	11	11	12	15
Storage Length (ft)	117		0	154		240	120		160	145		145
Storage Lanes	1		0	1		1	1		1	1		1
Taper Length (ft)	25			25			25			25		
Satd. Flow (prot)	1466	1748	0	1805	1801	1492	1656	1944	1561	1728	1863	1708
Flt Permitted	0.217			0.354			0.624			0.458		
Satd. Flow (perm)	333	1748	0	672	1801	1431	1069	1944	1517	823	1863	1630
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		2				188			225			303
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1068			1129			1168			1266	
Travel Time (s)		24.3			25.7			26.5			28.8	
Confl. Peds. (#/hr)	15		2	2		15	11		11	11		11
Confl. Bikes (#/hr)			1			3			8			
Peak Hour Factor	0.94	0.94	0.94	0.98	0.98	0.98	0.91	0.91	0.91	0.86	0.86	0.86
Heavy Vehicles (%)	19%	1%	0%	0%	2%	1%	9%	1%	0%	1%	2%	4%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	72	345	0	244	585	188	15	99	225	343	214	303
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.04	1.09	1.09	1.00	1.04	1.09	1.00	0.96	1.04	1.04	1.00	0.88
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Free	pm+pt	NA	Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases	2			6		6	4		Free	8		8
Detector Phase	5	2		1	6	6	7	4		3	8	8
Switch Phase												
Minimum Initial (s)	8.0	8.0		4.0	8.0	8.0	8.0	8.0		8.0	8.0	8.0
Minimum Split (s)	12.5	13.0		8.5	13.0	13.0	12.5	13.0		12.5	13.0	13.0
Total Split (s)	13.0	43.0		15.0	45.0	45.0	16.0	17.0		25.0	26.0	26.0
Total Split (%)	13.0%	43.0%		15.0%	45.0%	45.0%	16.0%	17.0%		25.0%	26.0%	26.0%
Maximum Green (s)	8.5	38.0		10.5	40.0	40.0	11.5	12.0		20.5	21.0	21.0
Yellow Time (s)	3.5	4.0		3.5	4.0	4.0	3.5	4.0		3.5	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	4.5	5.0		4.5	5.0	5.0	4.5	5.0		4.5	5.0	5.0
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Vehicle Extension (s)	2.5	2.5		2.5	2.5	2.5	2.5	2.5		2.5	2.5	2.5
Recall Mode	None	None		Min	Min	Min	None	None		None	None	None
Act Effct Green (s)	37.8	28.0		42.0	34.0	34.0	16.7	10.6	81.9	28.0	23.3	23.3
Actuated g/C Ratio	0.46	0.34		0.51	0.42	0.42	0.20	0.13	1.00	0.34	0.28	0.28

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio	0.26	0.58		0.50	0.78	0.27	0.05	0.39	0.15	0.73	0.40	0.44
Control Delay	13.7	27.2		15.8	33.2	4.2	21.5	44.7	0.2	33.1	30.1	6.2
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	13.7	27.2		15.8	33.2	4.2	21.5	44.7	0.2	33.1	30.1	6.2
LOS	B	C		B	C	A	C	D	A	C	C	A
Approach Delay		24.9			23.7			14.2			22.9	
Approach LOS		C			C			B			C	
Queue Length 50th (ft)	20	157		73	304	0	5	55	0	154	88	0
Queue Length 95th (ft)	44	253		126	#509	42	19	111	0	240	178	55
Internal Link Dist (ft)		988			1049			1088			1186	
Turn Bay Length (ft)	117			154		240	120		160	145		145
Base Capacity (vph)	287	917		509	989	870	362	322	1517	585	647	764
Starvation Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.25	0.38		0.48	0.59	0.22	0.04	0.31	0.15	0.59	0.33	0.40

Intersection Summary

Area Type: Other
Cycle Length: 100
Actuated Cycle Length: 81.9
Natural Cycle: 80
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.78
Intersection Signal Delay: 22.4 Intersection LOS: C
Intersection Capacity Utilization 71.9% ICU Level of Service C
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3: Comstock Avenue & East Colvin Street



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	68	316	8	239	573	184	14	90	205	295	184	261
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	11	10	10	12	11	10	12	13	11	11	12	15
Storage Length (ft)	117		0	154		240	120		160	145		145
Storage Lanes	1		0	1		1	1		1	1		1
Taper Length (ft)	25			25			25			25		
Satd. Flow (prot)	1466	1748	0	1805	1801	1492	1656	1944	1561	1728	1863	1708
Flt Permitted	0.217			0.354			0.624			0.458		
Satd. Flow (perm)	333	1748	0	672	1801	1431	1069	1944	1517	823	1863	1630
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		2				188			225			303
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1068			1129			1168			1266	
Travel Time (s)		24.3			25.7			26.5			28.8	
Confl. Peds. (#/hr)	15		2	2		15	11		11	11		11
Confl. Bikes (#/hr)			1			3			8			
Peak Hour Factor	0.94	0.94	0.94	0.98	0.98	0.98	0.91	0.91	0.91	0.86	0.86	0.86
Heavy Vehicles (%)	19%	1%	0%	0%	2%	1%	9%	1%	0%	1%	2%	4%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	72	345	0	244	585	188	15	99	225	343	214	303
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.04	1.09	1.09	1.00	1.04	1.09	1.00	0.96	1.04	1.04	1.00	0.88
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Free	pm+pt	NA	Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases	2			6		6	4		Free	8		8
Detector Phase	5	2		1	6	6	7	4		3	8	8
Switch Phase												
Minimum Initial (s)	8.0	8.0		4.0	8.0	8.0	8.0	8.0		8.0	8.0	8.0
Minimum Split (s)	12.5	13.0		8.5	13.0	13.0	12.5	13.0		12.5	13.0	13.0
Total Split (s)	13.0	43.0		15.0	45.0	45.0	16.0	17.0		25.0	26.0	26.0
Total Split (%)	13.0%	43.0%		15.0%	45.0%	45.0%	16.0%	17.0%		25.0%	26.0%	26.0%
Maximum Green (s)	8.5	38.0		10.5	40.0	40.0	11.5	12.0		20.5	21.0	21.0
Yellow Time (s)	3.5	4.0		3.5	4.0	4.0	3.5	4.0		3.5	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	4.5	5.0		4.5	5.0	5.0	4.5	5.0		4.5	5.0	5.0
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Vehicle Extension (s)	2.5	2.5		2.5	2.5	2.5	2.5	2.5		2.5	2.5	2.5
Recall Mode	None	None		Min	Min	Min	None	None		None	None	None
Act Effct Green (s)	37.8	28.0		42.0	34.0	34.0	16.7	10.6	81.9	28.0	23.3	23.3
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Approach LOS		C			C			B			C	
Queue Length 50th (ft)	20	157		73	304	0	5	55	0	154	88	0
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Spillback Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0		0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.25	0.38		0.48	0.59	0.22	0.04	0.31	0.15	0.59	0.33	0.40

Intersection Summary

Area Type: Other
Cycle Length: 100
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Control Type: Actuated-Uncoordinated
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Intersection Capacity Utilization 71.9% ICU Level of Service C
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
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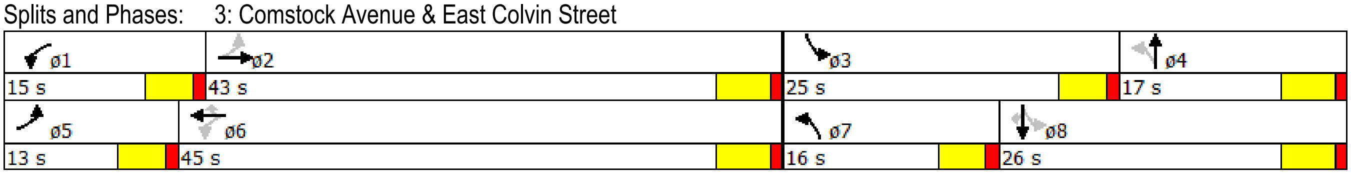
Splits and Phases: 3: Comstock Avenue & East Colvin Street



Roundabout Feasibility Study
VISSIM Roundabout Analysis
2040 Design Year Conditions

Intersection Level of Service and Queue Summary

Leavenworth Circle – Delaware St. / W. Onondaga St. / Onondaga Ave. / Tallman St.

Intersection	Morning Peak Hour		Evening Peak Hour	
	LOS	Queue	LOS	Queue
Delaware Street EB Approach	a(2)	122	a(6)	150
Onondaga Street NB Approach	a(3)	108	a(5)	108
Onondaga Avenue NB Approach	a(4)	178	a(2)	68
Tallman Street WB Approach	a(4)	71	a(1)	22
Onondaga Street SB Approach	a(2)	60	a(6)	414

LOS - a(9) – Unsignalized Level of Service (Average Delay per Vehicle)
Maximum Queue Lengths Shown in Feet

East Colvin Street @ Comstock Avenue

Intersection	Morning Peak Hour		Evening Peak Hour	
	LOS	Queue	LOS	Queue
Colvin Street EB Approach	b(12)	278	f(60)	791
Comstock Avenue NB Left/Through	a(6)	153	a(4)	49
Comstock Avenue NB Right	a(2)	60	a(2)	67
Colvin Street WB Approach	f(56)	808	a(9)	136
Comstock Avenue SB Left/Through	a(6)	182	c(28)	725
Comstock Avenue SB Right	a(4)	183	b(11)	726

LOS - a(9) – Unsignalized Level of Service (Average Delay per Vehicle)
Maximum Queue Lengths Shown in Feet

Thompson Road @ Springfield Road

Intersection	Morning Peak Hour		Evening Peak Hour	
	LOS	Queue	LOS	Queue
Springfield Road EB Approach	a(2)	46	a(7)	170
Thompson Road NB Approach	a(2)	83	a(5)	175
Thompson Road SB Approach	a(3)	95	a(8)	326

LOS - a(9) – Unsignalized Level of Service (Average Delay per Vehicle)
Maximum Queue Lengths Shown in Feet

Table of Delay

File: c:\gts consulting\active projects\390 - smtc - roundabout feasibility study\analysis\vissim\colvinam.inp
Comment:
Date: Friday, April 22, 2016 8:44:15 AM
VISSIM: 5.10-12 [24505]

No. 2: Travel time section(s) 2 Colvin WB
No. 4: Travel time section(s) 4 Colvin EB
No. 12: Travel time section(s) 12 Comstock NB Left/Through
No. 13: Travel time section(s) 13 Comstock NB Right
No. 32: Travel time section(s) 32 Comstock SB Left/Through
No. 33: Travel time section(s) 33 Comstock SB Right

Time	Delay	Stopd	Stops	#Veh	Pers.	#Pers	Delay	Stopd	Stops	#Veh	Pers.	#Pers
VehC	All							All				
No.:	2	2	2	2	2	2	4	4	4	4	4	4
900												
4500	55.8	0.7	0.38	909	55.8	909	11.7	0.7	0.47	532	11.7	532
Total	55.8	0.7	0.38	909	55.8	909	11.7	0.7	0.47	532	11.7	532

	Delay	Stopd	Stops	#Veh	Pers.	#Pers	Delay	Stopd	Stops	#Veh	Pers.	#Pers
		All						All				
	12	12	12	12	12	12	13	13	13	13	13	13
	5.5	1	0.32	291	5.5	291	2.2	0.1	0.02	283	2.2	283
	5.5	1	0.32	291	5.5	291	2.2	0.1	0.02	283	2.2	283

	Delay	Stopd	Stops	#Veh	Pers.	#Pers	Delay	Stopd	Stops	#Veh	Pers.	#Pers
		All						All				
	32	32	32	32	32	32	33	33	33	33	33	33
	6	1.7	0.56	160	6	160	3.6	0.9	0.35	81	3.6	81
	6	1.7	0.56	160	6	160	3.6	0.9	0.35	81	3.6	81

Queue Length Record

File: c:\gts consulting\active projects\390 - smtc - roundabout feasibility study\analysis\vissim\colvinam.inp
Comment:
Date: Friday, April 22, 2016 8:44:15 AM
VISSIM: 5.10-12 [24505]

Queue Counter	2: Link 10012 At	3.898 ft	Colvin WB
Queue Counter	4: Link 10007 At	1.499 ft	Colvin EB
Queue Counter	12: Link 10009 At	145.899 ft	Comstock NB Left/Through
Queue Counter	13: Link 10010 At	248.599 ft	Comstock NB Right
Queue Counter	32: Link 10005 At	33.999 ft	Comstock SB Left/Through
Queue Counter	33: Link 10003 At	33.999 ft	Comstock SB Right

Avg.: average queue length [ft] within time interval
Max.: maximum queue length [ft] within time interval
Stop: number of stops within queue

Time	Avg.	max	Stop	Avg.	max	Stop	Avg.	max	Stop
No.:	2	2	2	4	4	4	12	12	12
4500	262	808	1218	18	278	374	5	153	148

	Avg.	max	Stop	Avg.	max	Stop	Avg.	max	Stop
	13	13	13	32	32	32	33	33	33
	1	60	70	4	182	91	3	183	45

Table of Delay

File: C:\GTS Consulting\Active Projects\390 - SMTC - Roundabout Feasibility Study\analysis\Vissim\ColvinPM.inp
Comment:
Date: Friday, April 22, 2016 8:13:19 AM
VISSIM: 5.10-12 [24505]

No. 2: Travel time section(s) 2 Colvin WB
No. 4: Travel time section(s) 4 Colvin EB
No. 12: Travel time section(s) 12 Comstock NB Left/Through
No. 13: Travel time section(s) 13 Comstock NB Right
No. 32: Travel time section(s) 32 Comstock SB Left/Through
No. 33: Travel time section(s) 33 Comstock SB Right

Time	Delay	Stopd	Stops	#Veh	Pers.	#Pers	Delay	Stopd	Stops	#Veh	Pers.	#Pers
VehC	All							All				
No.:	2	2	2	2	2	2	4	4	4	4	4	4
900												
4500	9	0.1	0.06	996	9	996	60.8	13	2.57	380	60.8	380
Total	9	0.1	0.06	996	9	996	60.8	13	2.57	380	60.8	380

Delay	Stopd	Stops	#Veh	Pers.	#Pers	Delay	Stopd	Stops	#Veh	Pers.	#Pers
	All						All				
12	12	12	12	12	12	13	13	13	13	13	13
3.5	1	0.27	105	3.5	105	2.1	0.1	0.02	199	2.1	199
3.5	1	0.27	105	3.5	105	2.1	0.1	0.02	199	2.1	199

Delay	Stopd	Stops	#Veh	Pers.	#Pers	Delay	Stopd	Stops	#Veh	Pers.	#Pers
	All						All				
32	32	32	32	32	32	33	33	33	33	33	33
27.5	4.9	1.1	508	27.5	508	11.4	1.9	0.54	249	11.4	249
27.5	4.9	1.1	508	27.5	508	11.4	1.9	0.54	249	11.4	249

Queue Length Record

File: C:\GTS Consulting\Active Projects\390 - SMTC - Roundabout Feasibility Study\analysis\Vissim\ColvinPM.inp
Comment:
Date: Friday, April 22, 2016 8:13:19 AM
VISSIM: 5.10-12 [24505]

Queue Counter	2: Link 10012 At	3.898 ft	Colvin WB
Queue Counter	4: Link 10007 At	1.470 ft	Colvin EB
Queue Counter	12: Link 10009 At	145.899 ft	Comstock NB Left/Through
Queue Counter	13: Link 10010 At	248.599 ft	Comstock NB Right
Queue Counter	32: Link 10005 At	33.999 ft	Comstock SB Left/Through
Queue Counter	33: Link 10003 At	33.999 ft	Comstock SB Right

Avg.: average queue length [ft] within time interval
Max.: maximum queue length [ft] within time interval
Stop: number of stops within queue

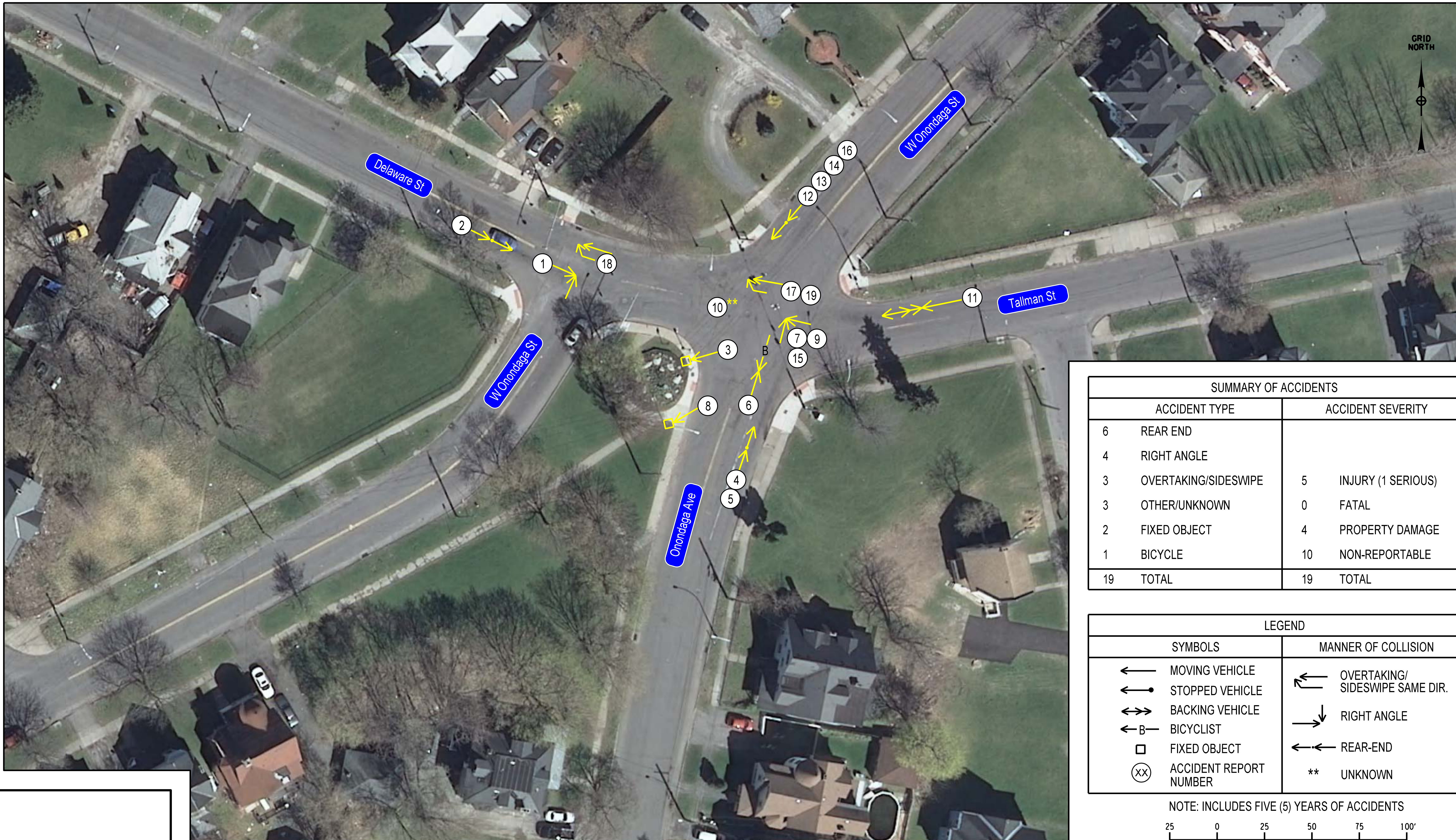
Time	Avg.	max	Stop	Avg.	max	Stop	Avg.	max	Stop
No.:	2	2	2	4	4	4	12	12	12
4500	3	136	149	180	791	604	1	49	54

	Avg.	max	Stop	Avg.	max	Stop	Avg.	max	Stop
	13	13	13	32	32	32	33	33	33
	1	67	68	83	725	656	80	726	478

APPENDIX B

Accident Data

####



SUMMARY OF ACCIDENTS			
ACCIDENT TYPE		ACCIDENT SEVERITY	
6	REAR END		
4	RIGHT ANGLE		
3	OVERTAKING/SIDESWIPE	5	INJURY (1 SERIOUS)
3	OTHER/UNKNOWN	0	FATAL
2	FIXED OBJECT	4	PROPERTY DAMAGE
1	BICYCLE	10	NON-REPORTABLE
19	TOTAL	19	TOTAL

LEGEND			
SYMBOLS		MANNER OF COLLISION	
←	MOVING VEHICLE		OVERTAKING/ SIDESWIPE SAME DIR.
←•	STOPPED VEHICLE		RIGHT ANGLE
↔	BACKING VEHICLE	←·←	REAR-END
←B—	BICYCLIST	**	UNKNOWN
□	FIXED OBJECT		
(XX)	ACCIDENT REPORT NUMBER		

NOTE: INCLUDES FIVE (5) YEARS OF ACCIDENTS

25 0 25 50 75 100'
1" = 50'

PLOTDRVR Color_Half.pltcfg
MODEL AD-01 Leavenworth Circle
FILE PATH J:\Syracuse Metropolitan Trans. Council\2151384 - Roundabout Feasibility Analysis\Drawings\Transportation\Figures\Accident Diagram.dgn
DATE TIME 8/23/2016 8:56:33 AM

PROJECT MANAGER: WADE DALEY
ENGINEER: TOM MILLER
DESIGNER: COLE NORRIS

RECORD PLANS

I HEREBY CERTIFY BY MY SIGNATURE, THAT I HAVE PREPARED THIS RECORD DRAWING WHICH IS, TO THE BEST OF MY KNOWLEDGE, INFORMATION AND BELIEF, A TRUE REPRESENTATION OF THE WORK AS CONSTRUCTED.

DATE: ____________

NO.	REVISION	BY	DATE
1			
2			
3			
4			
5			

It is a violation of New York Education Law Article 145 Sec.7209, for any person, unless acting under the direction of a licensed architect, professional engineer, or land surveyor, to alter an item in any way. If an item bearing the seal of an architect, engineer, or land surveyor is altered; the altering architect, engineer, or land surveyor shall affix to the item their seal and notation "altered by" followed by their signature and date of such alteration, and a specific description of the alteration.

LABELLA Associates, D.P.C.
300 STATE STREET
ROCHESTER, NY 14614

SMTC

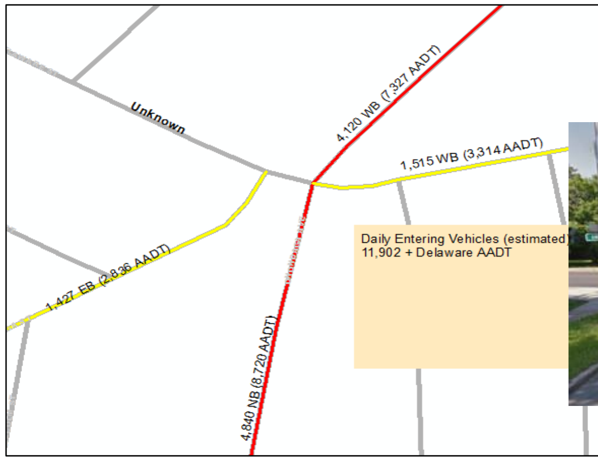
PROJECT/CLIENT
ROUNDABOUT FEASIBILITY ANALYSIS
SYRACUSE METROPOLITAN TRANSPORTATION COUNCIL

DRAWING TITLE
ACCIDENT DIAGRAM
LEAVENWORTH CIRCLE INTERSECTION
(W. ONONDAGA ST, ONONDAGA AVE, TALLMAN ST, DELAWARE ST)

PROJECT NUMBER
2151384
DATE
AUGUST 2016
DRAWING NUMBER
AD-01

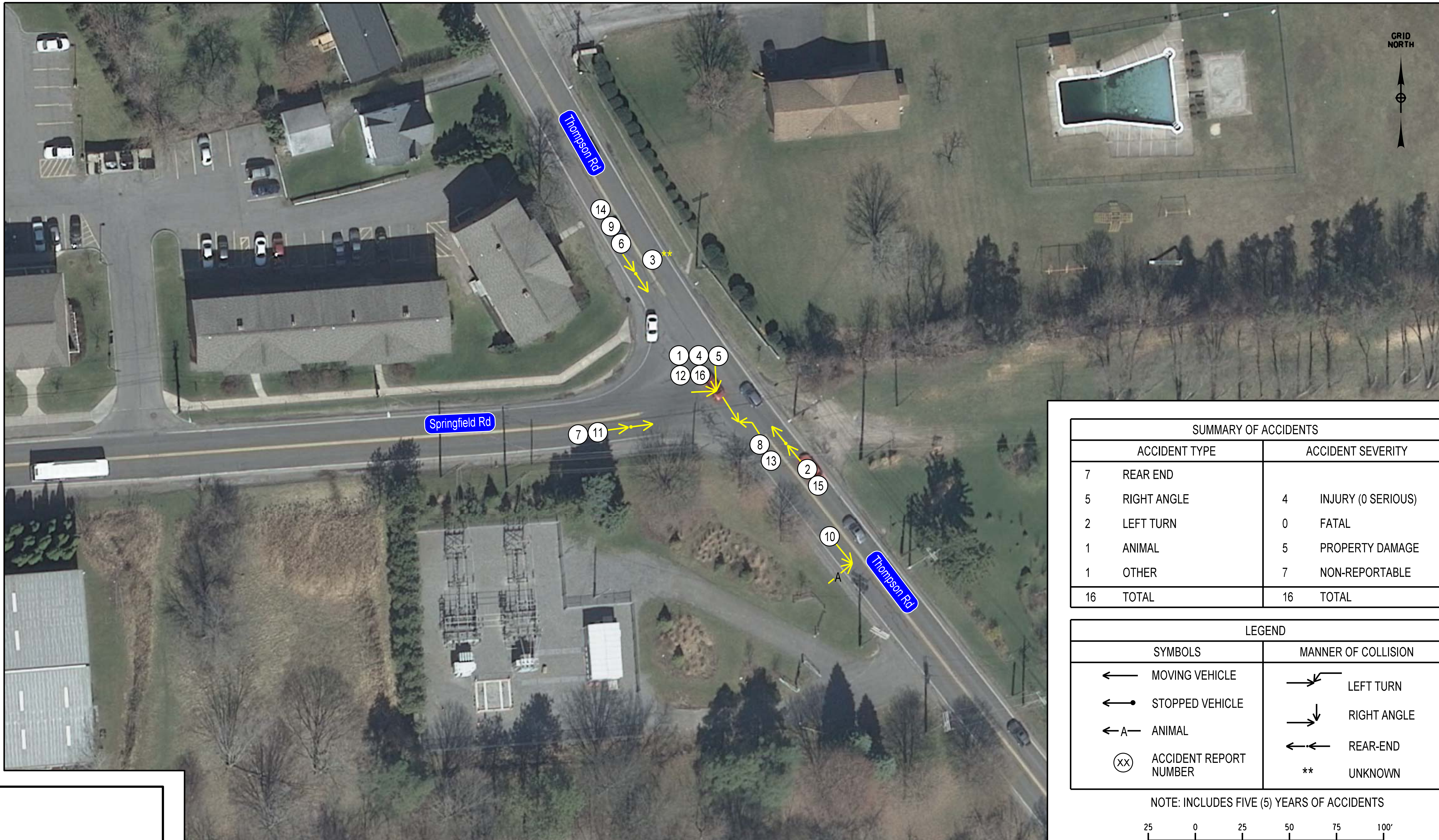
Onondaga / Tallman / Onondaga Ave / Delaware

Entering Vehicles (from past NYSDOT counts):		11,902	Total Accidents * 1M	NYSDOT Average Rates
Assumed entering volume for Delaware:		1,000	19,000,000	Urban Functional Class
		12,902	Entering Vehicles * 365 * # of years of accident data (5)	4 Legged & > Intersections
			23546150	SIGNAL W/ LEFT TURN LANES, 5 & > LANES
Accidents (5 year)				
	Total:	19	ACCIDENTS PER MEV	All Collisions 0.21
	Injury:	4	0.81	
	Serious Injury:	1		# of times > NYS avg
	Fatalities:	0		**3.84**



Street	Segment	Year		Direction 1		Direction 2	
Onondaga Ave	Bellevue – W. Onondaga	2011	NB	**4,840**	SB	3,880	38%
W. Onondaga Street	Midland – Delaware	2010	EB	3,207	WB	**4,120**	32%
W. Onondaga Street	Geddes – Delaware	2010	EB	**1,427**	WB	1,409	11%
Tallman	Midland – W. Onondaga	2010	EB	1,799	WB	**1,515**	12%
Delaware	ESTIMATE		SB	1000			8%
	TOTAL ENTERING			12,902			

####



SUMMARY OF ACCIDENTS			
ACCIDENT TYPE		ACCIDENT SEVERITY	
7	REAR END		
5	RIGHT ANGLE	4	INJURY (0 SERIOUS)
2	LEFT TURN	0	FATAL
1	ANIMAL	5	PROPERTY DAMAGE
1	OTHER	7	NON-REPORTABLE
16	TOTAL	16	TOTAL

LEGEND			
SYMBOLS		MANNER OF COLLISION	
←	MOVING VEHICLE		LEFT TURN
←•	STOPPED VEHICLE		RIGHT ANGLE
←A—	ANIMAL		REAR-END
(XX)	ACCIDENT REPORT NUMBER	**	UNKNOWN

NOTE: INCLUDES FIVE (5) YEARS OF ACCIDENTS

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PLOTDRVR Color_Half.pltcfg
MODEL AD-03 Thompson-Springfield
FILE PATH J:\Syracuse Metropolitan Trans. Council\2151384 - Roundabout Feasibility Analysis\Drawings\Transportation\Figures\Accident Diagram.dgn
DATE TIME 8/23/2016 4:32:05 PM

PROJECT MANAGER: WADE DALEY
ENGINEER: TOM MILLER
DESIGNER: COLE NORRIS

RECORD PLANS

I HEREBY CERTIFY BY MY SIGNATURE, THAT I HAVE PREPARED THIS RECORD DRAWING WHICH IS, TO THE BEST OF MY KNOWLEDGE, INFORMATION AND BELIEF, A TRUE REPRESENTATION OF THE WORK AS CONSTRUCTED.

DATE: ____________

NO.	REVISION	BY	DATE
1			
2			
3			
4			
5			

It is a violation of New York Education Law Article 145 Sec.7209, for any person, unless acting under the direction of a licensed architect, professional engineer, or land surveyor, to alter an item in any way. If an item bearing the seal of an architect, engineer, or land surveyor is altered; the altering architect, engineer, or land surveyor shall affix to the item their seal and notation "altered by" followed by their signature and date of such alteration, and a specific description of the alteration.

LABELLA Associates, D.P.C.
300 STATE STREET
ROCHESTER, NY 14614

SMTC

PROJECT/CLIENT

ROUNDABOUT FEASIBILITY ANALYSIS

SYRACUSE METROPOLITAN TRANSPORTATION COUNCIL

DRAWING TITLE

ACCIDENT DIAGRAM THOMPSON RD & SPRINGFIELD RD INTERSECTION

PROJECT NUMBER 2151384

DATE AUGUST 2016

DRAWING NUMBER AD-02

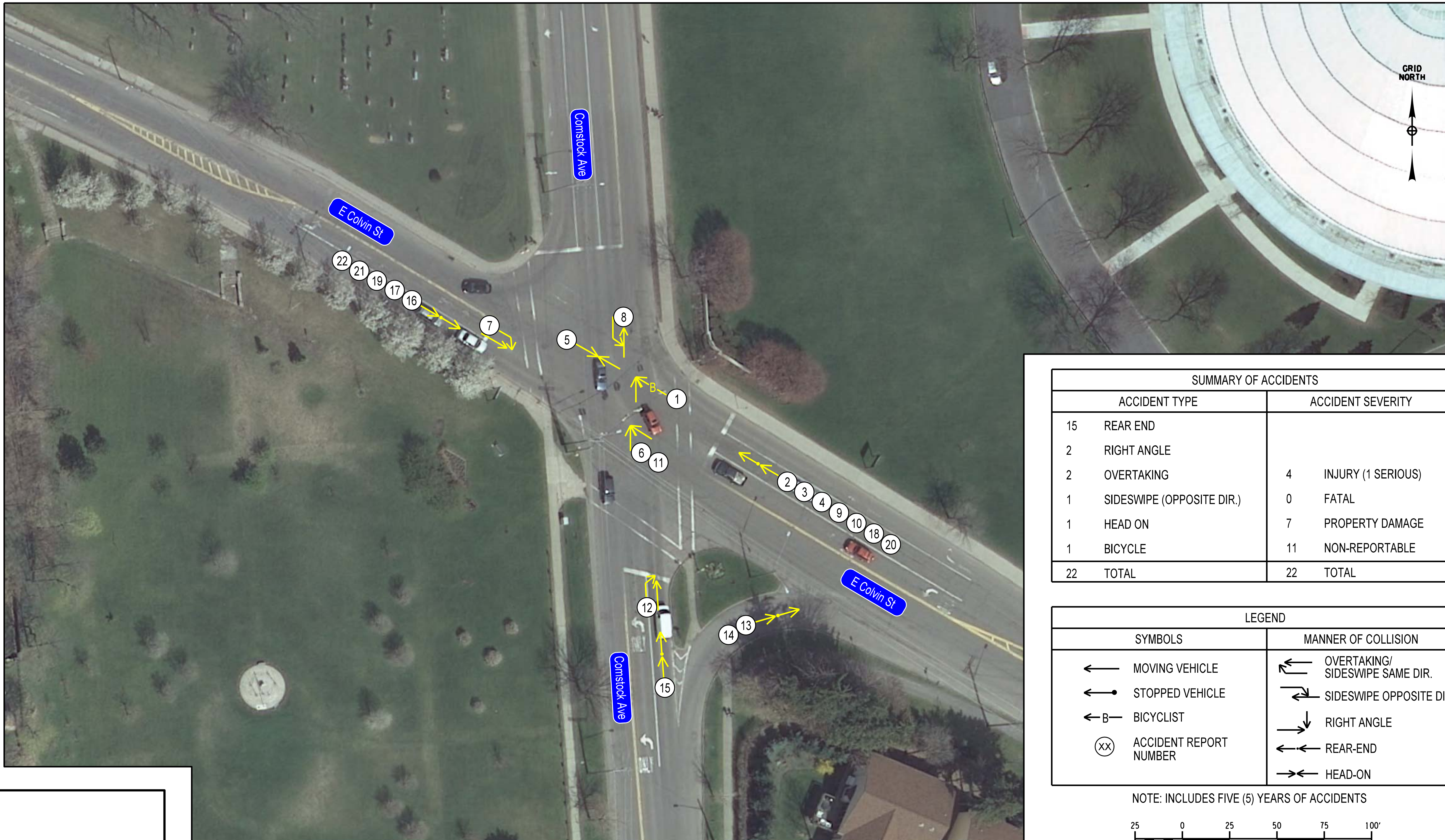
Springfield/Thompson

Entering Vehicles (estimate):		12,211	Total Accidents * 1M	NYSDOT Average Rates	
			16,000,000	Urban Functional Class	
		12,211	Entering Vehicles * 365 * # of years of accident data (5)	3 Legged Intersections	
			22285075	SIGN 1-3 LANES	
Accidents (5 year)					
	Total:	16	ACCIDENTS PER MEV	All Collisions	0.15
	Injury:	4	0.72		
	Serious Injury:	0			# of times > NYS avg
	Fatalities:	0			**4.79**

RC Stations

	approach vol	
42%	5180	SB Thompson
24%	2990	NB Thompson
33%	4041	EB Springfield
	12,211	

####



SUMMARY OF ACCIDENTS			
ACCIDENT TYPE		ACCIDENT SEVERITY	
15	REAR END		
2	RIGHT ANGLE		
2	OVERTAKING	4	INJURY (1 SERIOUS)
1	SIDESWIPE (OPPOSITE DIR.)	0	FATAL
1	HEAD ON	7	PROPERTY DAMAGE
1	BICYCLE	11	NON-REPORTABLE
22	TOTAL	22	TOTAL

LEGEND	
SYMBOLS	MANNER OF COLLISION
MOVING VEHICLE	OVERTAKING/ SIDESWIPE SAME DIR.
STOPPED VEHICLE	SIDESWIPE OPPOSITE DIR.
BICYCLIST	RIGHT ANGLE
XX ACCIDENT REPORT NUMBER	REAR-END
	HEAD-ON

NOTE: INCLUDES FIVE (5) YEARS OF ACCIDENTS

25 0 25 50 75 100'
1" = 50'

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MODEL AD-02 Colvin-Comstock
FILE PATH J:\Syracuse Metropolitan Trans. Council\2151384 - Roundabout Feasibility Analysis\Drawings\Transportation\Figures\Accident Diagram.dgn
DATE TIME 8/23/2016 4:32:51 PM

PROJECT MANAGER: WADE DALEY
ENGINEER: TOM MILLER
DESIGNER: COLE NORRIS

RECORD PLANS

I HEREBY CERTIFY BY MY SIGNATURE, THAT I HAVE PREPARED THIS RECORD DRAWING WHICH IS, TO THE BEST OF MY KNOWLEDGE, INFORMATION AND BELIEF, A TRUE REPRESENTATION OF THE WORK AS CONSTRUCTED.

DATE: ____________

NO.	REVISION	BY	DATE
1			
2			
3			
4			
5			

It is a violation of New York Education Law Article 145 Sec.7209, for any person, unless acting under the direction of a licensed architect, professional engineer, or land surveyor, to alter an item in any way. If an item bearing the seal of an architect, engineer, or land surveyor is altered; the altering architect, engineer, or land surveyor shall affix to the item their seal and notation "altered by" followed by their signature and date of such alteration, and a specific description of the alteration.

LABELLA Associates, D.P.C.
300 STATE STREET
ROCHESTER, NY 14614

SMTC

PROJECT/CLIENT
ROUNDABOUT FEASIBILITY ANALYSIS

SYRACUSE METROPOLITAN TRANSPORTATION COUNCIL

DRAWING TITLE
ACCIDENT DIAGRAM E. COLVIN ST & COMSTOCK AVE INTERSECTION

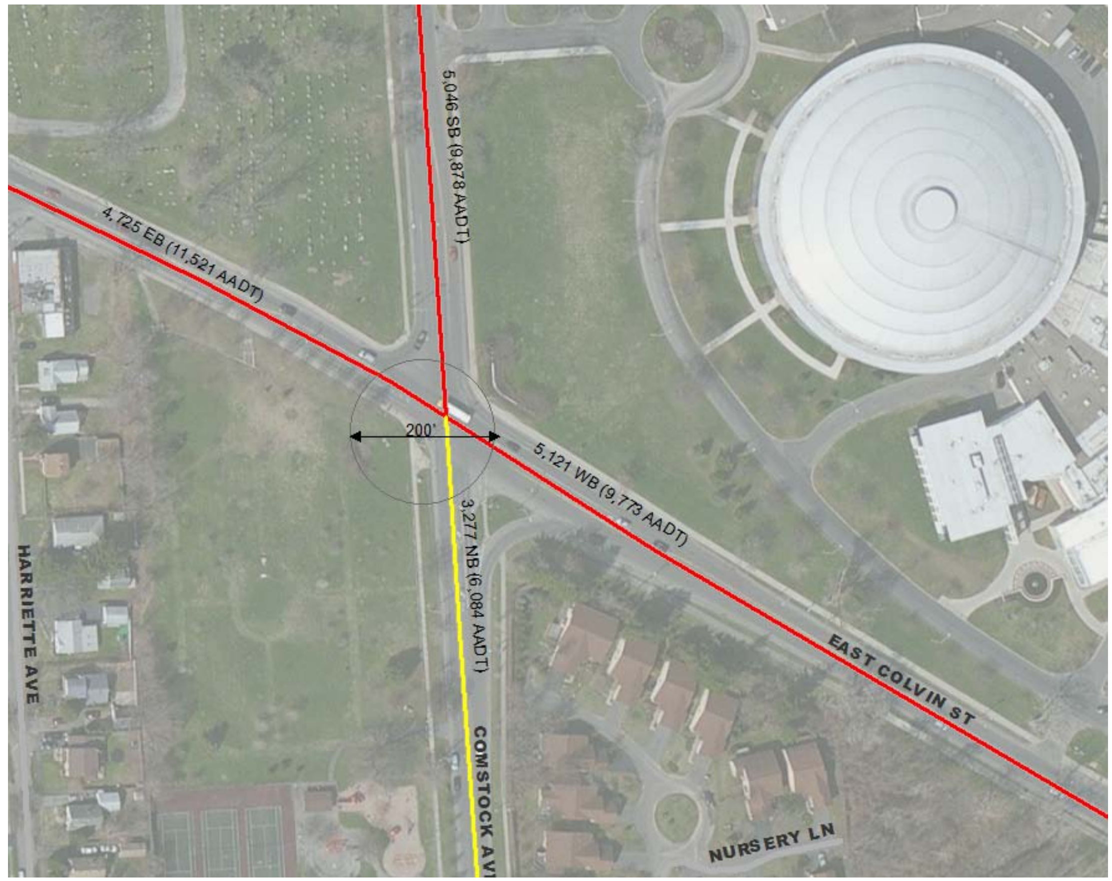
PROJECT NUMBER
2151384
DATE
AUGUST 2016
DRAWING NUMBER
AD-03

Colvin / Comstock

Entering Vehicles (estimate):	18,169	Total Accidents * 1M		NYSDOT Average Rates	
		22,000,000		Urban Functional Class	
	18,169	Entering Vehicles * 365 * # of years of accident data (5)		4 Legged & > Intersections	
		33158425		SIGNAL W/LEFT TURN 5&> LANES	
Accidents (5 year)					
Total:	22	ACCIDENTS PER MEV		All Collisions	0.21
Injury:	3	0.66			
Serious Injury:	1				# of times > NYS avg
Fatalities:	0				**3.16**

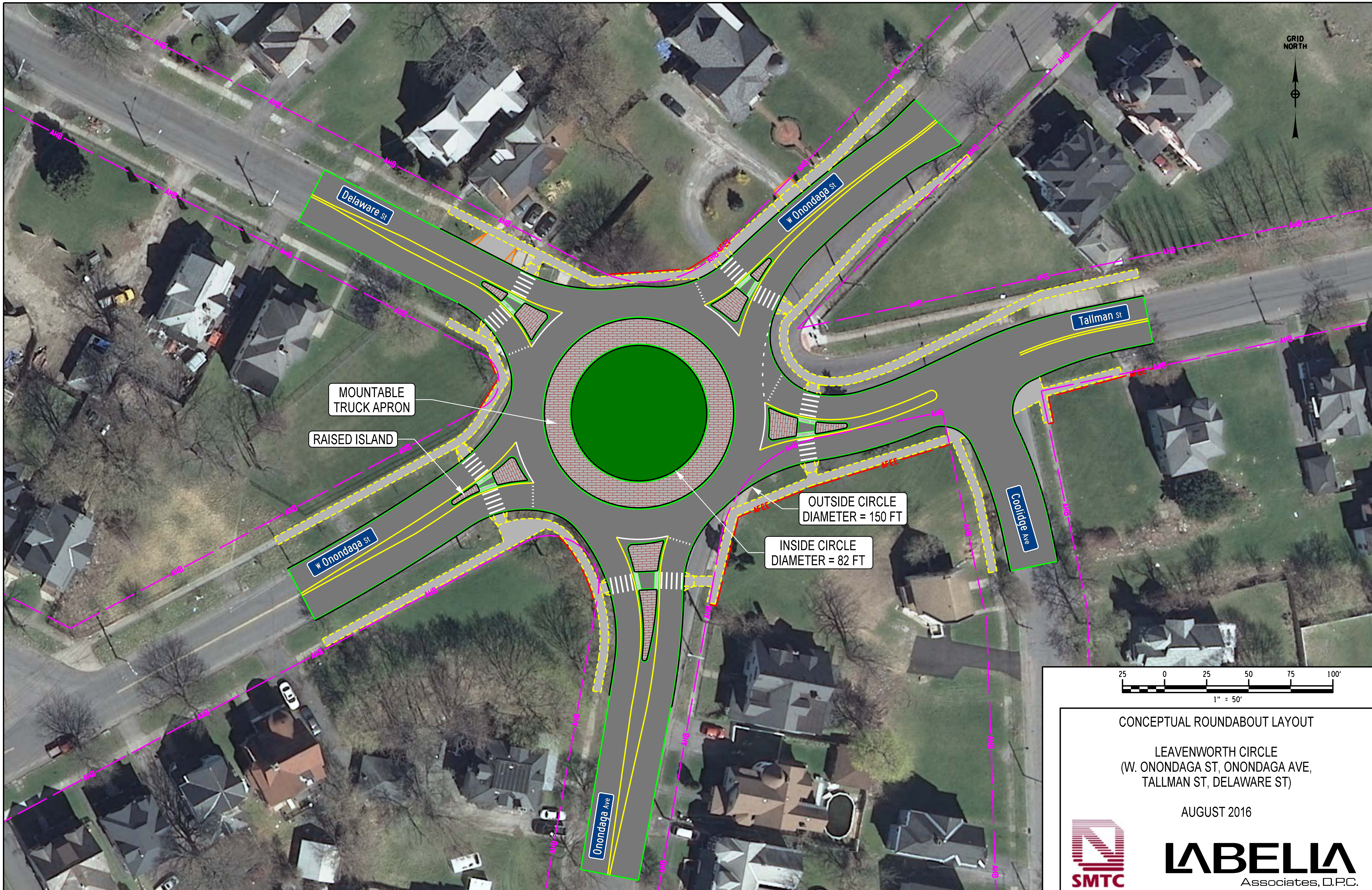
RC Stations

	approach vol		
28%	5046	4019	SB Comstock
18%	3277	4020	NB Comstock
26%	4725	4031	EB Colvin
28%	5121	2123	WB Colvin
	18,169		

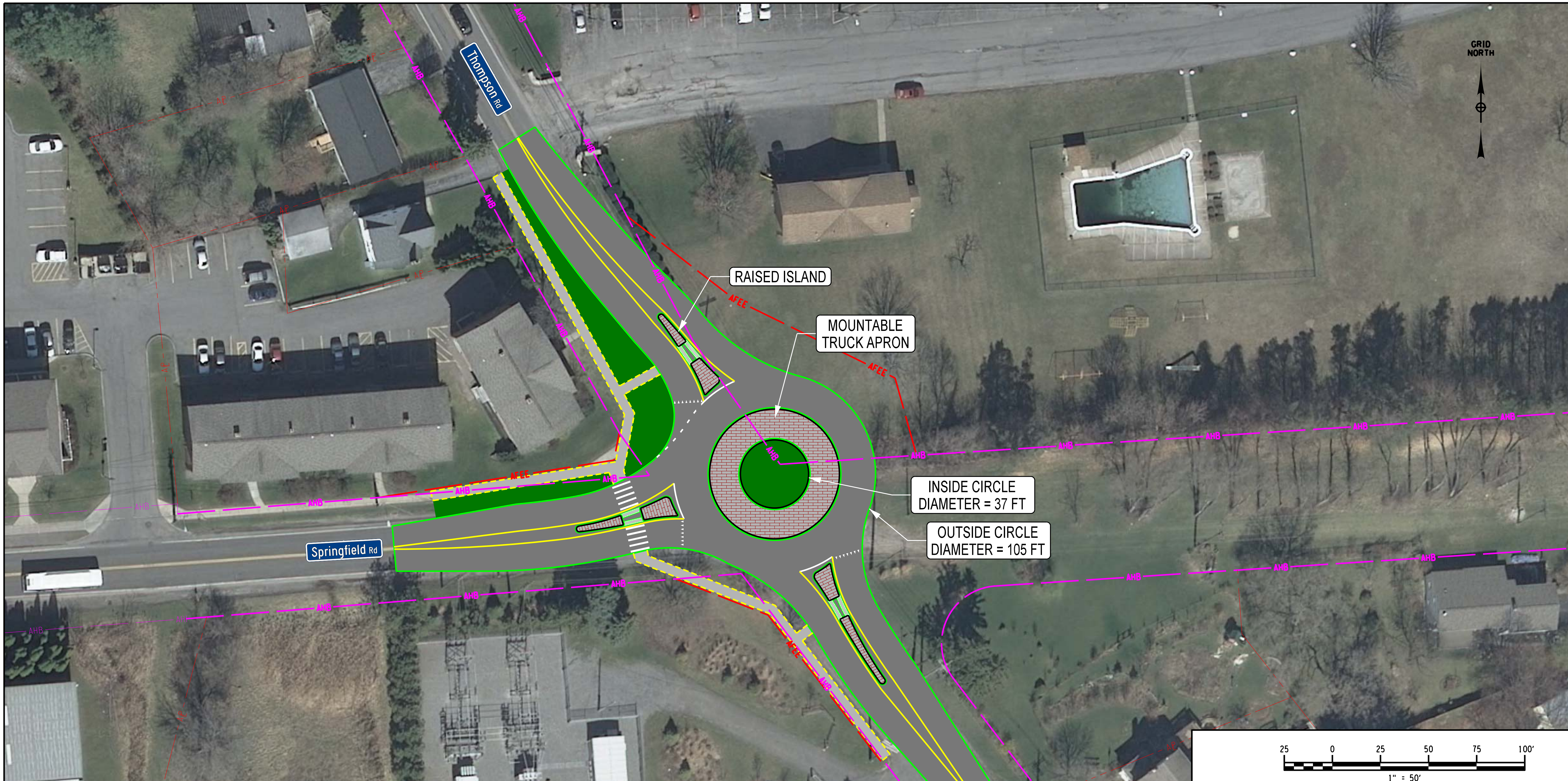


APPENDIX C

Intersection Concept Figures



Delaware St
W Onondaga St
Tallman St
Coolidge Ave
Onondaga Ave
W Onondaga St
MOUNTABLE TRUCK APRON
RAISED ISLAND
OUTSIDE CIRCLE DIAMETER = 150 FT
INSIDE CIRCLE DIAMETER = 82 FT
GRID NORTH
25 0 25 50 75 100'
1" = 50'
CONCEPTUAL ROUNDABOUT LAYOUT
LEAVENWORTH CIRCLE
(W. ONONDAGA ST, ONONDAGA AVE, TALLMAN ST, DELAWARE ST)
AUGUST 2016
SMTC
LABELLA Associates, D.P.C.



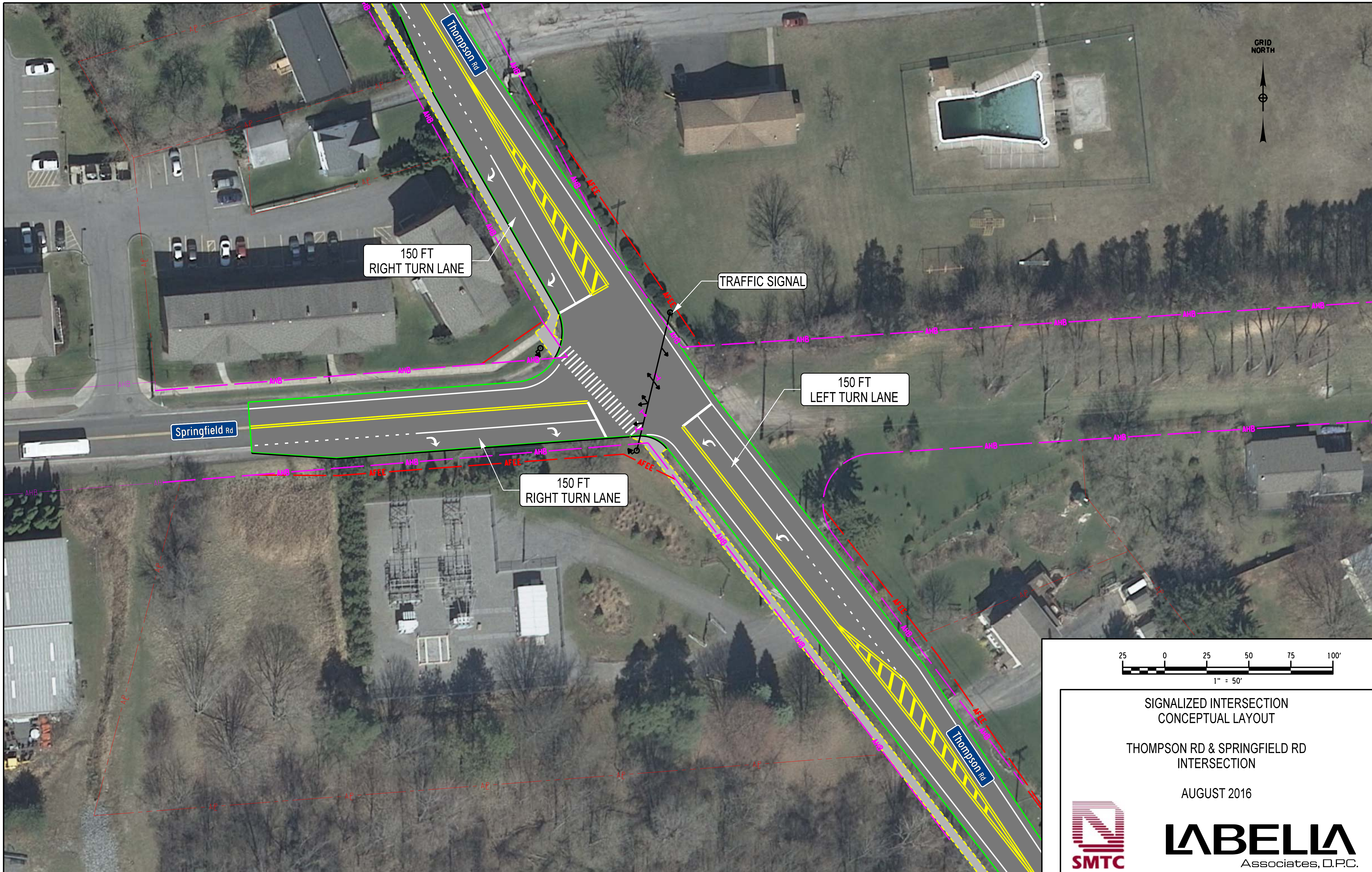
CONCEPTUAL ROUNDABOUT LAYOUT

THOMPSON RD & SPRINGFIELD RD
INTERSECTION

AUGUST 2016

SMTC

LABELLA Associates, D.P.C.



SIGNALIZED INTERSECTION
CONCEPTUAL LAYOUT

THOMPSON RD & SPRINGFIELD RD
INTERSECTION

AUGUST 2016

CONCEPTUAL ROUNDABOUT LAYOUT

E. COLVIN ST & COMSTOCK AVE INTERSECTION

AUGUST 2016

SMTC

LABELLA Associates, D.P.C.

APPENDIX D

Benefit-Cost Analysis Tables

SMTC Roundabout Feasibility Analysis
Leavenworth Circle Intersection : Roundabout vs. Traffic Signal

Year	Construction Cost	O&M Cost[1]	Replacement Cost[1, 2]	Total Cost	Safety Benefit	Operational Benefit	Environmental Benefit	Total Benefit	PV Benefits[3]	PV Costs[3]
Construction Year	$1,562,646	$0	$0	$1,562,646	$0	$0	$0	$0	$0	$1,562,646
Service Year 1	$0	-$2,000	$0	-$2,000	$55,776	$507,931	$18,087	$581,794	$564,849	-$1,942
Service Year 2	$0	-$2,000	$0	-$2,000	$55,776	$507,931	$18,087	$581,794	$548,397	-$1,885
Service Year 3	$0	-$2,000	$0	-$2,000	$55,776	$507,931	$18,087	$581,794	$532,437	-$1,830
Service Year 4	$0	-$2,000	$0	-$2,000	$55,776	$507,931	$18,087	$581,794	$516,920	-$1,777
Service Year 5	$0	-$2,000	$0	-$2,000	$55,776	$507,931	$18,087	$581,794	$501,849	-$1,725
Service Year 6	$0	-$2,000	$0	-$2,000	$55,776	$507,931	$18,087	$581,794	$487,224	-$1,675
Service Year 7	$0	-$2,000	$0	-$2,000	$55,776	$507,931	$18,087	$581,794	$473,042	-$1,626
Service Year 8	$0	-$2,000	$0	-$2,000	$55,776	$507,931	$18,087	$581,794	$459,263	-$1,579
Service Year 9	$0	-$2,000	$0	-$2,000	$55,776	$507,931	$18,087	$581,794	$445,888	-$1,533
Service Year 10	$0	-$2,000	-$150,000	-$152,000	$55,776	$507,931	$18,087	$581,794	$432,915	-$113,104
Service Year 11	$0	-$2,000	$0	-$2,000	$55,776	$507,931	$18,087	$581,794	$420,311	-$1,445
Service Year 12	$0	-$2,000	$0	-$2,000	$55,776	$507,931	$18,087	$581,794	$408,047	-$1,403
Service Year 13	$0	-$2,000	$0	-$2,000	$55,776	$507,931	$18,087	$581,794	$396,183	-$1,362
Service Year 14	$0	-$2,000	$0	-$2,000	$55,776	$507,931	$18,087	$581,794	$384,632	-$1,322
Service Year 15	$0	-$2,000	$0	-$2,000	$55,776	$507,931	$18,087	$581,794	$373,424	-$1,284
Service Year 16	$0	-$2,000	$0	-$2,000	$55,776	$507,931	$18,087	$581,794	$362,556	-$1,246
Service Year 17	$0	-$2,000	$0	-$2,000	$55,776	$507,931	$18,087	$581,794	$352,005	-$1,210
Service Year 18	$0	-$2,000	$0	-$2,000	$55,776	$507,931	$18,087	$581,794	$341,749	-$1,175
Service Year 19	$0	-$2,000	$0	-$2,000	$55,776	$507,931	$18,087	$581,794	$331,790	-$1,141
Service Year 20	$0	-$2,000	$0	-$2,000	$55,776	$507,931	$18,087	$581,794	$322,127	-$1,107
									$8,655,608	**$1,421,275**
									6.09 : 1	

Notes:

[1] A negative cost indicates savings in favor of the roundabout

[2] Assumes the existing Leavenworth Circle traffic signal would require replacement at Year 10

[3] Present Value of costs and benefits were calculated using a 3% Discount Rate

SMTC Roundabout Feasibility Analysis

Thompson Rd & Springfield Rd Intersection : Roundabout vs. All-Way Stop

Year	Construction Cost	O&M Cost[1]	Replacement Cost	Total Cost	Safety Benefit	Operational Benefit	Environmental Benefit	Total Benefit	PV Benefits[2]	PV Costs[2]
Construction Year	$840,595	$0	$0	$840,595	$0	$0	$0	$0	$0	$840,595
Service Year 1	$0	$0	$0	$0	$0	$2,260,041	$80,481	$2,340,522	$2,272,351	$0
Service Year 2	$0	$0	$0	$0	$0	$2,260,041	$80,481	$2,340,522	$2,206,166	$0
Service Year 3	$0	$0	$0	$0	$0	$2,260,041	$80,481	$2,340,522	$2,141,962	$0
Service Year 4	$0	$0	$0	$0	$0	$2,260,041	$80,481	$2,340,522	$2,079,540	$0
Service Year 5	$0	$0	$0	$0	$0	$2,260,041	$80,481	$2,340,522	$2,018,910	$0
Service Year 6	$0	$0	$0	$0	$0	$2,260,041	$80,481	$2,340,522	$1,960,072	$0
Service Year 7	$0	$0	$0	$0	$0	$2,260,041	$80,481	$2,340,522	$1,903,018	$0
Service Year 8	$0	$0	$0	$0	$0	$2,260,041	$80,481	$2,340,522	$1,847,586	$0
Service Year 9	$0	$0	$0	$0	$0	$2,260,041	$80,481	$2,340,522	$1,793,778	$0
Service Year 10	$0	$0	$0	$0	$0	$2,260,041	$80,481	$2,340,522	$1,741,589	$0
Service Year 11	$0	$0	$0	$0	$0	$2,260,041	$80,481	$2,340,522	$1,690,884	$0
Service Year 12	$0	$0	$0	$0	$0	$2,260,041	$80,481	$2,340,522	$1,641,550	$0
Service Year 13	$0	$0	$0	$0	$0	$2,260,041	$80,481	$2,340,522	$1,593,818	$0
Service Year 14	$0	$0	$0	$0	$0	$2,260,041	$80,481	$2,340,522	$1,547,350	$0
Service Year 15	$0	$0	$0	$0	$0	$2,260,041	$80,481	$2,340,522	$1,502,261	$0
Service Year 16	$0	$0	$0	$0	$0	$2,260,041	$80,481	$2,340,522	$1,458,542	$0
Service Year 17	$0	$0	$0	$0	$0	$2,260,041	$80,481	$2,340,522	$1,416,095	$0
Service Year 18	$0	$0	$0	$0	$0	$2,260,041	$80,481	$2,340,522	$1,374,837	$0
Service Year 19	$0	$0	$0	$0	$0	$2,260,041	$80,481	$2,340,522	$1,334,772	$0
Service Year 20	$0	$0	$0	$0	$0	$2,260,041	$80,481	$2,340,522	$1,295,898	$0
									$34,820,979	**$840,595**
									41.42 : 1	

Notes:

[1] Assumes the roundabout would have similar operation & maintenance costs to an all-way stop intersection

[2] Present Value of costs and benefits were calculated using a 3% Discount Rate

APPENDIX E

Cost Estimates

ROUNDABOUT FEASIBILITY ANALYSIS CONCEPTUAL COST ESTIMATE: LEAVENWORTH CIRCLE					
Item No.	**Item Description**	**Unit**	**Estimated Total**	**Unit Cost**	**Total Cost**
203.02	Unclassified Excavation and Disposal	CY	3,500	$25.00	$87,500.00
203.03	Embankment in Place	CY	100	$30.00	$3,000.00
203.07	Select Granular Fill	CY	1,045	$30.00	$31,350.00
206.0201	Trench and Culvert Excavation	CY	1,270	$30.00	$38,100.00
207.21	Geotextile Separation	SY	5,000	$2.00	$10,000.00
209.13	Silt Fence - Temporary	LF	1,000	$7.00	$7,000.00
304.15	Subbase Course - Optional Type	CY	1,800	$40.00	$72,000.00
402.126202	12.5 F2 Top Course HMA, 60 Series Compaction	TON	400	$100.00	$40,000.00
402.125212	Plant Production Quality Adjustment to 402.126202	QU	20	$100.00	$2,000.00
402.125222	Pavement Density Quality Adjustment to 402.126202	QU	1	$100.00	$100.00
402.125252	Test Section Adjustment to 402.126202	QU	1	$100.00	$100.00
402.196902	19 F9 Binder Course HMA, 60 Series Compaction	TON	800	$85.00	$68,000.00
402.256912	Plant Production Quality Adjustment to 402.256902	QU	40	$100.00	$4,000.00
402.256922	Pavement Density Quality Adjustment to 402.256902	QU	1	$100.00	$100.00
402.256952	Test Section Adjustment to 402.256902	QU	1	$100.00	$100.00
402.376902	37.5 F9 Base Course HMA, 60 Series Compaction	TON	1,500	$75.00	$112,500.00
402.376912	Plant Production Quality Adjustment to 402.376902	QU	75	$100.00	$7,500.00
402.376922	Pavement Density Quality Adjustment to 402.376902	QU	1	$100.00	$100.00
402.376952	Test Section Adjustment to 402.376902	QU	1	$100.00	$100.00
407.0102	Diluted Tack Coat	GAL	1,000	$5.00	$5,000.00
490.10	Production Cold Milling of Bituminous Concrete	SY	1,500	$7.00	$10,500.00
603.9818	Smooth Interior Corrugated Polyethylene Culvert and Storm Drain Pipe, 18 Inch Diameter	LF	2,500	$40.00	$100,000.00
604.31XXYY	Rectangular Drainage Structure with Round Option	EA	20	$2,000.00	$40,000.00
608.0101	Concrete Sidewalks and Driveways	CY	130	$380.00	$49,400.00
608.01020005	Color and Imprinted Portland Cement Concrete Sidewalk	CY	180	$1,000.00	$180,000.00
609.0201	Stone Curb, Granite Type A	LF	1,840	$50.00	$92,000.00
609.0211	Stone Curb, Granite, Traversable Sloped	LF	1,270	$60.00	$76,200.00
619.01	Basic Work Zone Traffic Control	LS	1	$42,000.00	$42,000.00
625.01	Survey Operations	LS	1	$16,000.00	$16,000.00
645.5202	Ground-Mounted Sign Panels Less than or Equal to 30 SF with Z-Bars, High Visibility Sheeting	SF	250	$25.00	$6,250.00
645.81	Type A Sign Post	EA	25	$150.00	$3,750.00
685.11	White Epoxy Reflectorized Pavmeent Stripes - 20 Mils	LF	1,200	$1.50	$1,800.00
685.12	Yellow Epoxy Reflectorized Pavement Stripes - 20 Mils	LF	1,380	$1.50	$2,070.00
699.040001	Mobilization	LS	1	$45,000.00	$45,000.00
	SUBTOTAL				**$1,153,520.00**
	CONTINGENCY (20%)				**$230,704.00**
	CONSTRUCTION INSPECTION (12%)				**$138,422.40**
	RIGHT-OF-WAY				**$40,000.00**
	TOTAL				**$1,562,646.40**

ROUNDABOUT FEASIBILITY ANALYSIS CONCEPTUAL COST ESTIMATE: THOMPSON RD & SPRINGFIELD RD (ROUNDABOUT)					
Item No.	**Item Description**	**Unit**	**Estimated Total**	**Unit Cost**	**Total Cost**
203.02	Unclassified Excavation and Disposal	CY	1,300	$25.00	$32,500.00
203.03	Embankment in Place	CY	2,100	$30.00	$63,000.00
203.07	Select Granular Fill	CY	630	$30.00	$18,900.00
206.0201	Trench and Culvert Excavation	CY	760	$30.00	$22,800.00
207.21	Geotextile Separation	SY	2,500	$2.00	$5,000.00
209.13	Silt Fence - Temporary	LF	500	$7.00	$3,500.00
304.15	Subbase Course - Optional Type	CY	800	$40.00	$32,000.00
402.126202	12.5 F2 Top Course HMA, 60 Series Compaction	TON	200	$100.00	$20,000.00
402.125212	Plant Production Quality Adjustment to 402.126202	QU	10	$100.00	$1,000.00
402.125222	Pavement Density Quality Adjustment to 402.126202	QU	1	$100.00	$100.00
402.125252	Test Section Adjustment to 402.126202	QU	1	$100.00	$100.00
402.196902	19 F9 Binder Course HMA, 60 Series Compaction	TON	400	$85.00	$34,000.00
402.256912	Plant Production Quality Adjustment to 402.256902	QU	20	$100.00	$2,000.00
402.256922	Pavement Density Quality Adjustment to 402.256902	QU	1	$100.00	$100.00
402.256952	Test Section Adjustment to 402.256902	QU	1	$100.00	$100.00
402.376902	37.5 F9 Base Course HMA, 60 Series Compaction	TON	800	$75.00	$60,000.00
402.376912	Plant Production Quality Adjustment to 402.376902	QU	40	$100.00	$4,000.00
402.376922	Pavement Density Quality Adjustment to 402.376902	QU	1	$100.00	$100.00
402.376952	Test Section Adjustment to 402.376902	QU	1	$100.00	$100.00
407.0102	Diluted Tack Coat	GAL	500	$5.00	$2,500.00
490.10	Production Cold Milling of Bituminous Concrete	SY	800	$7.00	$5,600.00
603.9818	Smooth Interior Corrugated Polyethylene Culvert and Storm Drain Pipe, 18 Inch Diameter	LF	1,500	$40.00	$60,000.00
604.31XXYY	Rectangular Drainage Structure with Round Option	EA	12	$2,000.00	$24,000.00
608.0101	Concrete Sidewalks and Driveways	CY	40	$380.00	$15,200.00
608.01020005	Color and Imprinted Portland Cement Concrete Sidewalk	CY	100	$1,000.00	$100,000.00
609.0211	Stone Curb, Granite, Traversable Sloped	LF	790	$60.00	$47,400.00
619.01	Basic Work Zone Traffic Control	LS	1	$23,000.00	$23,000.00
625.01	Survey Operations	LS	1	$9,000.00	$9,000.00
645.5202	Ground-Mounted Sign Panels Less than or Equal to 30 SF with Z-Bars, High Visibility Sheeting	SF	150	$25.00	$3,750.00
645.81	Type A Sign Post	EA	15	$150.00	$2,250.00
685.11	White Epoxy Reflectorized Pavmeent Stripes - 20 Mils	LF	300	$1.50	$450.00
685.12	Yellow Epoxy Reflectorized Pavement Stripes - 20 Mils	LF	950	$1.50	$1,425.00
699.040001	Mobilization	LS	1	$24,000.00	$24,000.00
	SUBTOTAL				**$617,875.00**
	CONTINGENCY (20%)				**$123,575.00**
	CONSTRUCTION INSPECTION (12%)				**$74,145.00**
	RIGHT-OF-WAY				**$25,000.00**
	TOTAL				**$840,595.00**

ROUNDABOUT FEASIBILITY ANALYSIS CONCEPTUAL COST ESTIMATE: THOMPSON RD & SPRINGFIELD RD (TRAFFIC SIGNAL)					
Item No.	**Item Description**	**Unit**	**Estimated Total**	**Unit Cost**	**Total Cost**
203.02	Unclassified Excavation and Disposal	CY	1,200	$25.00	$30,000.00
203.07	Select Granular Fill	CY	630	$25.00	$15,750.00
206.0201	Trench and Culvert Excavation	CY	760	$30.00	$22,800.00
207.21	Geotextile Separation	SY	4,000	$2.00	$8,000.00
209.13	Silt Fence - Temporary	LF	1,000	$7.00	$7,000.00
304.15	Subbase Course - Optional Type	CY	610	$40.00	$24,400.00
402.126202	12.5 F2 Top Course HMA, 60 Series Compaction	TON	320	$100.00	$32,000.00
402.125212	Plant Production Quality Adjustment to 402.126202	QU	16	$100.00	$1,600.00
402.125222	Pavement Density Quality Adjustment to 402.126202	QU	1	$100.00	$100.00
402.125252	Test Section Adjustment to 402.126202	QU	1	$100.00	$100.00
402.196902	19 F9 Binder Course HMA, 60 Series Compaction	TON	620	$85.00	$52,700.00
402.256912	Plant Production Quality Adjustment to 402.256902	QU	31	$100.00	$3,100.00
402.256922	Pavement Density Quality Adjustment to 402.256902	QU	1	$100.00	$100.00
402.256952	Test Section Adjustment to 402.256902	QU	1	$100.00	$100.00
402.376902	37.5 F9 Base Course HMA, 60 Series Compaction	TON	1,200	$75.00	$90,000.00
402.376912	Plant Production Quality Adjustment to 402.376902	QU	60	$100.00	$6,000.00
402.376922	Pavement Density Quality Adjustment to 402.376902	QU	1	$100.00	$100.00
402.376952	Test Section Adjustment to 402.376902	QU	1	$100.00	$100.00
407.0102	Diluted Tack Coat	GAL	1,000	$5.00	$5,000.00
490.10	Production Cold Milling of Bituminous Concrete	SY	2,400	$7.00	$16,800.00
603.9818	Smooth Interior Corrugated Polyethylene Culvert and Storm Drain Pipe, 18 Inch Diameter	LF	1,500	$40.00	$60,000.00
604.31XXYY	Rectangular Drainage Structure with Round Option	EA	12	$2,000.00	$24,000.00
608.0101	Concrete Sidewalks and Driveways	CY	50	$380.00	$19,000.00
609.0201	Stone Curb, Granite Type A	LF	480	$50.00	$24,000.00
619.01	Basic Work Zone Traffic Control	LS	1	$25,000.00	$25,000.00
625.01	Survey Operations	LS	1	$10,000.00	$10,000.00
645.5202	Ground-Mounted Sign Panels Less than or Equal to 30 SF with Z-Bars, High Visibility Sheeting	SF	150	$25.00	$3,750.00
645.81	Type A Sign Post	EA	15	$150.00	$2,250.00
680.XX	Traffic Signal	LS	1	$150,000.00	$150,000.00
685.11	White Epoxy Reflectorized Pavmeent Stripes - 20 Mils	LF	2,400	$1.50	$3,600.00
685.12	Yellow Epoxy Reflectorized Pavement Stripes - 20 Mils	LF	5,200	$1.50	$7,800.00
685.14	White Epoxy Reflectorized Pavement Symbols - 20 Mils	EA	4	$200.00	$800.00
699.040001	Mobilization	LS	1	$26,000.00	$26,000.00
	SUBTOTAL				**$671,950.00**
	CONTINGENCY (20%)				**$134,390.00**
	CONSTRUCTION INSPECTION (12%)				**$80,634.00**
	RIGHT-OF-WAY				**$30,000.00**
	TOTAL				**$916,974.00**

ROUNDABOUT FEASIBILITY ANALYSIS CONCEPTUAL COST ESTIMATE: E. COLVIN ST & COMSTOCK AVE INTERSECTION					
Item No.	**Item Description**	**Unit**	**Estimated Total**	**Unit Cost**	**Total Cost**
203.02	Unclassified Excavation and Disposal	CY	4,160	$25.00	$104,000.00
203.03	Embankment in Place	CY	100	$30.00	$3,000.00
203.07	Select Granular Fill	CY	840	$30.00	$25,200.00
206.0201	Trench and Culvert Excavation	CY	1,020	$30.00	$30,600.00
207.21	Geotextile Separation	SY	6,000	$2.00	$12,000.00
209.13	Silt Fence - Temporary	LF	1,500	$7.00	$10,500.00
304.15	Subbase Course - Optional Type	CY	2,080	$40.00	$83,200.00
402.126202	12.5 F2 Top Course HMA, 60 Series Compaction	TON	850	$100.00	$85,000.00
402.125212	Plant Production Quality Adjustment to 402.126202	QU	43	$100.00	$4,300.00
402.125222	Pavement Density Quality Adjustment to 402.126202	QU	1	$100.00	$100.00
402.125252	Test Section Adjustment to 402.126202	QU	1	$100.00	$100.00
402.196902	19 F9 Binder Course HMA, 60 Series Compaction	TON	875	$85.00	$74,375.00
402.256912	Plant Production Quality Adjustment to 402.256902	QU	44	$100.00	$4,400.00
402.256922	Pavement Density Quality Adjustment to 402.256902	QU	1	$100.00	$100.00
402.256952	Test Section Adjustment to 402.256902	QU	1	$100.00	$100.00
402.376902	37.5 F9 Base Course HMA, 60 Series Compaction	TON	1,750	$75.00	$131,250.00
402.376912	Plant Production Quality Adjustment to 402.376902	QU	88	$100.00	$8,800.00
402.376922	Pavement Density Quality Adjustment to 402.376902	QU	1	$100.00	$100.00
402.376952	Test Section Adjustment to 402.376902	QU	1	$100.00	$100.00
407.0102	Diluted Tack Coat	GAL	1,500	$5.00	$7,500.00
490.10	Production Cold Milling of Bituminous Concrete	SY	4,800	$7.00	$33,600.00
603.9818	Smooth Interior Corrugated Polyethylene Culvert and Storm Drain Pipe, 18 Inch Diameter	LF	2,000	$40.00	$80,000.00
604.31XXYY	Rectangular Drainage Structure with Round Option	EA	16	$2,000.00	$32,000.00
608.0101	Concrete Sidewalks and Driveways	CY	180	$380.00	$68,400.00
608.01020005	Color and Imprinted Portland Cement Concrete Sidewalk	CY	135	$1,000.00	$135,000.00
609.0201	Stone Curb, Granite Type A	LF	3,065	$50.00	$153,250.00
609.0211	Stone Curb, Granite, Traversable Sloped	LF	725	$60.00	$43,500.00
619.01	Basic Work Zone Traffic Control	LS	1	$46,000.00	$46,000.00
625.01	Survey Operations	LS	1	$15,000.00	$15,000.00
645.5202	Ground-Mounted Sign Panels Less than or Equal to 30 SF with Z-Bars, High Visibility Sheeting	SF	200	$25.00	$5,000.00
645.81	Type A Sign Post	EA	20	$150.00	$3,000.00
685.11	White Epoxy Reflectorized Pavmeent Stripes - 20 Mils	LF	3,000	$1.50	$4,500.00
685.12	Yellow Epoxy Reflectorized Pavement Stripes - 20 Mils	LF	2,500	$1.50	$3,750.00
685.14	White Epoxy Reflectorized Pavement Symbols - 20 Mils	EA	26	$200.00	$5,200.00
699.040001	Mobilization	LS	1	$48,500.00	$48,500.00
	SUBTOTAL				**$1,261,425.00**
	CONTINGENCY (20%)				**$252,285.00**
	CONSTRUCTION INSPECTION (12%)				**$126,142.50**
	RIGHT-OF-WAY				**$35,000.00**
	TOTAL				**$1,674,852.50**

APPENDIX F

Meeting Minutes

Syracuse Metropolitan Transportation Council
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Roundabout Feasibility Study
Working Group Meeting #1

October 26, 2015
SMTC Lower Level Conference Room
10:00 – 12:00

A. Introductions

B. Study Objectives & Scope

C. Schedule

D. Intersections
   a. Colvin / Comstock
   b. Leavenworth Circle

E. Available Data & Data Needs

F. Considerations
   a. Right-of-way
   b. Stakeholder interest
   c. Costs and benefits

G. Next Steps

SMTC Roundabouts Feasibility Analysis

Working Group Kick-off Meeting

SMTC Lower Level Conference Room

October 26, 2015

10:00 AM

Draft Meeting Summary

Attendees

Name	*Affiliation*
Aaron McKeon	SMTC
Meghan Vitale	SMTC
Mary Robison	City of Syracuse - Engineering
Matt Jackson	City of Syracuse - DPW
Wayne Frye	LaBella Associates
Tom Miller	LaBella Associates
Jeff Hinman	Bryant Associates
Gordon Stansbury	GTS Consultants
Rex Giardine	Syracuse University
Jim Blum	Syracuse University
Scot Vanderpool	Syracuse University

Introductions and Project Overview

Mr. McKeon began the meeting with introductions and a review of the project's scope and objectives. The goal of the study is to analyze existing intersections in the SMTC's study area for the feasibility of converting them to roundabouts, and to evaluate this conversion's possible operational, safety, or aesthetic improvements.

Discussions with Syracuse University staff prior to this meeting had indicated that the East Colvin / Skytop intersection was a low priority for a roundabout feasibility study (as explained below). Prior to the start of the Working Group meeting, SMTC staff had met with LaBella Associates staff and sub-consultants to discuss alternatives to the Colvin / Skytop intersection. One alternative discussed was the intersection of Springfield Road and Thompson Road, near the LeMoyne College campus. The consultant team stated that they would evaluate this location as a possible alternative.

East Colvin / Skytop Road Intersection

Mr. McKeon provided some project history. Three candidate intersections were identified by a Study Advisory Committee in late 2014: Leavenworth Circle, East Colvin Street / Comstock Ave and East Colvin Street / Skytop Road. On discussing the East Colvin Street / Skytop Road intersection with representatives of Syracuse University, there seemed to be a much greater interest in developing a short-term solution for getting pedestrians across East Colvin Street than in investigating a roundabout at this intersection.

Mr. Giardine clarified that the East Colvin / Skytop intersection is unusual in that it is comprised of a city street (East Colvin) and two University-created and owned roads: northbound Skytop Road, which functions as a "normal" road connecting SU's south campus housing to East Colvin, and southbound Skytop Road, which is a route through the parking lot at Manley Field House. SU owns the property on all four corners at this intersection. Roughly 3,000 students currently live in south campus.

Mr. Giardine stated that the University is not opposed to studying a roundabout at this intersection, but that the higher priority is on making improvements to get pedestrians across East Colvin safely. There are periodic backups for westbound traffic during the morning peak periods, but otherwise there is not a recurring traffic issue at this location. Mr. Giardine noted that knowing accident rates at this intersection would be helpful. Mr. McKeon stated that he had this information and could provide it as necessary; there are no records of fatalities in the accident data that SMTC reviewed.

Mr. Vanderpool noted his concerns related to special event traffic and how a roundabout might/might not accommodate this traffic. He also noted that there are 400 bus trips a day running through the Manley Field House parking lot.

Mr. Giardine pointed out that there is a soccer field with a relatively steep embankment (supported by retaining walls) just north of East Colvin, immediately east of Manley Field House, which would constrain roadway improvements to the north. Mr. Giardine stated that his conversations with the City (specifically with Paul Mercurio in early 2015 - Mr. Mercurio is no longer with the City) resulted in plans to improve the Colvin / Skytop intersection for pedestrian crossings.

Mr. McKeon asked Ms. Robison about the timeline for implementing these improvements. Ms. Robison stated that it is a question of whether or not funding has been allocated. She asked Mr.

Jackson to look into the funding question. Mr. Giardine pointed out that SU had previously expressed a willingness to share the financial burden of these improvements.

On the topic of long-term campus planning, Mr. Giardine stated that the general theme of the existing campus master plan is to "de-populate" south campus, but this would be a long-term process and it is not clear what would replace student housing.

Ms. Vitale suggested that we await clarification from the City on the timeline for implementing short-term improvements to Skytop / Colvin before permanently eliminating this intersection from the process. Similarly, Mr. Giardine stated that he would like more time to discuss this with other University staff. He stated that clarification should be available within the next two weeks.

Schedule

Mr. McKeon walked meeting attendees through the project schedule, which outlines an eleven-month process to a final report. Mr. Frye asked if this schedule was built around the idea of doing all of the intersections concurrently. Mr. McKeon stated that it was, but could be altered as needed. Mr. Miller indicated that doing the analyses concurrently would be likely to work.

Intersection Details

Colvin / Comstock
Mr. McKeon described the intent of a roundabout analysis at this intersection as providing a "gateway" to the University. Mr. Giardine expanded on this idea: there is currently nothing special about this intersection. A roundabout would create an opportunity for a special entry point to campus for visitors coming from the south, east and west.

Mr. Vanderpool clarified that most bus traffic (for events) does not go through this intersection, since it passes through the Manley Field House parking lot. During big sports events and concerts, Syracuse Police currently use one officer to operate signals and another to control the flow of traffic in the intersection. After a game or other event, the heaviest vehicle flows are southbound on Comstock and westbound on Colvin. The Syracuse Police Department typically does traffic control after events and infrequently controls traffic before events.

Mr. Giardine stated that it might be possible for SU's security forces to provide video of traffic flow through this intersection before and after a special event, such as an upcoming football game. While the scope of work for this project does not include modelling or quantitative analysis of special event traffic, knowing how traffic flows during special events could be useful to the analysis.

Mr. McKeon stated that he had been in contact with the New York State Department of Transportation's (NYSDOT) Main Office Roundabout Design Unit regarding special event traffic. The Roundabout Design Unit provided information from several sources, including other universities, which suggested that roundabouts could handle large amounts of special event traffic. Mr. McKeon stated he would forward this information from NYSDOT.

The group discussed possible right-of-way constraints at this intersection, specifically:

- The property on the southeast corner is owned by a homeowners' association, which may be much more complicated than dealing with an individual property owner.
- The boundary of Comfort Tyler Park appears (based on parcel data) to run very close to the curbs of East Colvin and Comstock. A roundabout design may require taking some park property. Mr. Hinman pointed out that federally-funded transportation projects typically face a difficult process (Section 4(f)) if they require use/taking of park property. Ms. Robison said that it would take a State-level action to split property off of this park and "de-park" it; this is also a lengthy process.
    - Additionally, Mr. Giardine pointed out that a recent Save the Rain project was installed in the park near this intersection. This would also be something to avoid.
- All stakeholders would prefer not to disrupt Morningside Cemetery on the northwestern corner of the intersection.
- SU owns the northeastern corner and may be amenable to a design that encroaches on its property.

Mr. Frye asked about the need for a two-lane roundabout vs. a single lane at this location. Mr. Stansbury opined that a single lane would be likely to work, based on daily traffic volumes. Mr. McKeon clarified that, since we are working toward implementing one of the first roundabouts in the region, a single-lane would be preferable.

Mr. Stansbury also requested clarification on the analysis: what design year should be used and what future year should be used in the analysis? Mr. McKeon stated that he would provide this information.

Mr. Vanderpool asked about construction-period impacts. Mr. Stansbury responded that he has seen some very creative techniques during roundabout construction that have maintained traffic flow through much of the construction period. Complete intersection closures may be necessary for 24-hour periods.

Mr. Blum raised a question related to road races (such as the Festival of Races and the Mountain Goat) that use East Colvin Street. Currently, these events include partial closure of the Colvin / Comstock intersection. Would that be possible under a roundabout design? The consensus of the group was that this should be something a roundabout can accommodate.

Leavenworth Circle

Mr. McKeon reviewed the history of Leavenworth Circle as well as the activities being undertaken by the Atlantic States Legal Foundation (ASLF). SMTC has been coordinating with ASLF, which is working with neighborhood residents to consider new design options for this intersection. This may include a fountain that utilizes the existing fountain base on site. The ASLF conducted a survey of residents earlier this year that included the question "Do you think a traffic circle would improve traffic flow at Leavenworth Circle?" The majority of respondents said yes.

There was general discussion of the historic value of the fountain base, and whether or not it could be relocated, if required, farther away from the intersection. Mr. Jackson pointed out that if a roundabout were only considered for the Tallman / Onondaga Ave / West Onondaga Street portion of the intersection, the most likely "center" of such a roundabout would be well away from the fountain base.

Mr. Stansbury asked if the modelling should/would include pedestrian movements. Ms. Vitale said that, no, pedestrian volumes at these sites would not be high enough to justify this analysis.

Mr. Stansbury asked if the two parts of the existing intersection were under a single controller. Mr. McKeon stated that he thought that they were.

Data Needs

Mr. Stansbury requested signal timing sheets. Mr. Jackson said that he would provide these.

Action Items

- SU staff will discuss the Colvin / Skytop roundabout further, to ensure that this is not an idea that the University would like to pursue further. He will also discuss the idea of getting video footage of event traffic with SU's security office.
- Mr. McKeon will distribute the following:
  - Construction year and future design year parameters for analysis
  - East Colvin / Skytop information sheet (which includes accident data)
  - NYSDOT's collection of testimonials related to roundabouts and special events
- Mr. Jackson/City Department of Public Works will provide the signal timing sheets for the East Colvin / Comstock and Leavenworth Circle traffic signals.

- Ms. Robison will look for Hopkins Map data for these intersections.
- Ms. Robison will also research the status of the projects to put pedestrian improvements in place at Skytop / Colvin.

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Roundabout Feasibility Study
Working Group Meeting #2

February 18, 2016
SMTC Lower Level Conference Room
10:00 – 12:00

A. Introductions, Schedule & Progress Overview *(10:00 – 10:15)*

B. Intersection Analysis
   a. Leavenworth Circle *(10:15 – 10:45)*
      i. Accident Diagram
      ii. Existing & Projected Traffic Volumes
      iii. Level of Service Summary (2015, 2020, 2040)
      iv. Preliminary Roundabout Schematic
   b. Comstock / Colvin *(10:45 – 11:15)*
      i. Accident Diagram
      ii. Existing & Projected Traffic Volumes
      iii. Level of Service Summary (2015, 2020, 2040)
      iv. Preliminary Roundabout Schematic
   c. Springfield / Thompson *(11:15 – 11:45)*
      i. Accident Diagram
      ii. Existing & Projected Traffic Volumes
      iii. Level of Service Summary (2015, 2020, 2040)
      iv. Preliminary Roundabout Schematic

C. Summary & Next Steps *(11:45 – 12:00)*

(Times shown in italics are estimates.)

SMTC Roundabouts Feasibility Analysis

Working Group Meeting #2

SMTC Lower Level Conference Room

February 18, 2016

10:00 AM

Draft Meeting Summary

Attendees

Name	*Affiliation*
Meghan Vitale	SMTC
Aaron McKeon	SMTC
Odean Dyer	City of Syracuse – Engineering
Wayne Frye	LaBella Associates
Tom Miller	LaBella Associates
Jeff Hinman	Bryant Associates
Gordon Stansbury	GTS Consultants
Rex Giardine	Syracuse University
Diana Napolitano	Syracuse University
Ike Achufusi	NYSDOT
Samuel Sage	Atlantic States Legal Foundation
Hongbin Gao	Atlantic States Legal Foundation
William E. Roberts	NOMAD Studio (ASLF's design team)
Laura Santin	NOMAD Studio (ASLF's design team)
Jed Schneider	LeMoyne College
Sam Gordon	Town of DeWitt
James Effinger	Centro

Introductions and Project Overview

Mr. McKeon began the meeting with introductions and a brief description of the project's schedule. The project is currently on track to be completed within this calendar year.

Intersection Details

For each intersection discussion, the consultant team (Mr. Miller and Mr. Stansbury) provided an overview of the traffic analysis so far. This included:

- A review of accident data
- Existing and projected traffic volumes
- Level of service (LOS) under existing and improved conditions for 2015, 2020 and 2040

They also invited stakeholders' comments on preliminary roundabout schematics.

Leavenworth Circle

The consultant team characterized traffic operations at this intersection as being fine under existing conditions: the analysis does not indicate a critical need for improvements. A roundabout would probably function very well given the traffic volumes here. Representatives from Atlantic States Legal Foundation (ASLF), who are currently looking at design options for this intersection, were present to discuss operational and design issues. They have not heard complaints from community members about the inability to make left-hand turns from northbound West Onondaga Street at the Delaware/Onondaga intersection. The consultants stated that this movement could be added, but would affect LOS for southbound right movements on West Onondaga Street.

The ASLF representatives were concerned about pedestrian circulation and safety at a roundabout. The consultant team stressed the safety improvements that are typically seen, with pedestrians getting a refuge between lanes and drivers needing to worry about only one conflicting movement at a time. Ms. Napolitano suggested that a public education campaign might be needed to make drivers and pedestrians more comfortable with this roadway design.

Mr. Giardine asked about the truck apron in the roundabout's center – specifically, which vehicles would be using it? Mr. Miller said that it's designed to accommodate a tractor-trailer with a total length of about 43 feet (also known as a WB-40). This is the largest vehicle that would be likely to use this roadway: buses and smaller vehicles would also be able to utilize the roundabout, utilizing the truck apron as necessary.

There was a question about the logistics of plowing roundabouts. Mr. Dyer stated that the plow drivers would be able to do it. It was pointed out that there is a video on the NYSDOT website of how a roundabout gets plowed.

ASLF representatives were curious about what this design [which shows the original Leavenworth Circle fountain at the center of the roundabout] would do to fountain access. It was stated that roundabouts in general preclude access to whatever is in the center, since the design keeps traffic flowing in the circulating roadway. Can the circulating roadway and the fountain be separated? Moving the fountain (e.g., to the north) would likely require a right-of-way acquisition from an adjacent parcel. Moving the roundabout to the east is also possible, but it would be very difficult / impossible to get all five roads to connect to a roundabout located farther east. It would likely need to be designed as a four-leg intersection (W. Onondaga SB leg, Tallman, Onondaga Ave., Delaware) with the W. Onondaga NB approach continuing to intersect Delaware Street to the west of the roundabout. Mr. Stansbury said that this would be likely to work, operationally: if a five-leg roundabout works, a four-leg roundabout would also work.

There was a question about reducing the diameter of the inside circle. Mr. Miller stated that, as currently shown, it is roughly as small as it can be while incorporating all five intersecting roadways.

The consultant team was asked if they knew of other examples of urban, five-legged roundabouts. Mr. Stansbury mentioned a roundabout in Kinderhook [Route 9, State Farm Road, Route 9H, Hannaford driveway]. This is a five-leg intersection, though in a more suburban setting. (For an example of a more urban setting, see downtown Glens Falls, NY; screenshot provided at the end of these notes.)

The ASLF representatives provided an outline of their project's timeframe: they expect to have preliminary designs in July and a final report in October. They also conducted a meeting of stakeholders on February 18.

East Colvin Street / Comstock Avenue

In discussing existing operations, Mr. Stansbury explained that a relatively minor change to signal operations would net a fairly substantial improvement in peak hour operations. Mr. Giardine asked if this was possible given existing signal equipment. Mr. Stansbury believes it is.

Mr. Giardine asked about the roundabout's placement as shown in the conceptual layout. Could the facility be shifted to the south? Would impacts to Comfort Tyler Park be significant? If federal transportation funding constrains or prevents use of park property, would federal funding definitely be necessary to construct this project?

Ms. Napolitano asked about non-motorized access, particularly given the slip ramps for northbound and southbound right-turns. Would joggers, cyclists, parents with strollers, etc., be safe crossing this facility? There was also a question about how event traffic would be controlled at a roundabout during sports events and concerts.

Mr. Gordon pointed out that non-motorized access through this intersection is currently a problem that he experiences as a cyclist and pedestrian in this area. He opined that the pedestrian refuges that would be built into a roundabout would be an improvement for pedestrians.

Control of special event traffic under a roundabout would likely be similar to current traffic control, which requires two police officers. The project team will research this issue. Event traffic is believed to be primarily from the south and west prior to an event and from the east and north following an event.

SU would be interested in a presentation on roundabout pros and cons to its staff. The project team may do this when more analysis has been conducted.

Springfield Road and Thompson Road
Mr. Miller noted in his introduction that, of the three intersections being considered, this intersection has the biggest gap between its accident rate and the statewide average.

There was a question about the grade at this location: how would the roundabout concept fit with the downhill grade north of the intersection? The consultant team stated that there would be grading impacts, particularly on the northeast corner.

Mr. Gordon noted that the Town of DeWitt is working on the design of a sidewalk for the west side of Thompson Road; the Town has applied to the County for federal community development funds to build this sidewalk. The Town would like to provide sidewalks on both sides of Thompson, but the cost is likely to be prohibitive.

Mr. Snyder asked if the public right-of-way for Springfield Road (extending east of the intersection) could be tied into the roundabout's design. Mr. Miller stated that the roundabout concept was pushed to the north to avoid impacts to the National Grid substation on the southwest corner.

Mr. Snyder asked about the existing bus stops at this intersection; they could be relocated away from a roundabout.

There was a discussion of the pros and cons of placing signage in the center of the roundabout. The project team will research this further, including how roundabouts work with wayfinding programs.

Mr. Gordon asked if he could see a schematic of the intersection as it would look under signalized conditions, which would likely require additional turn lanes. Mr. Miller shared a draft of such a schematic.

Mr. Miller stated that, given the volumes at this location, a mini-roundabout might be a possibility. This would decrease the roundabout's diameter.

There was a question about traffic volumes in year 2040: are these realistic? Mr. Stansbury noted that, regionally, volumes tend to be either stable or falling. The one percent annual increase shown is probably very conservative given this context.

Special event traffic may also be an issue at this site, particularly for commencement ceremonies at LeMoyne. Mr. Snyder said that police control is typically necessary for this event.

Next Steps

The meeting concluded at noon. The consultant team will proceed with an operational analysis of the roundabout concepts. The next working group meeting will be in late spring or early summer.

Google Streetview of “Centennial Circle” roundabout in downtown Glens Falls, New York.

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Roundabout Feasibility Study
Working Group Meeting #3

June 29, 2016
SMTC Lower Level Conference Room
10:00 – 12:00

A. Introductions, Schedule & Progress Overview *(10:00 – 10:15)*

B. Costs & Benefits of Roundabout Conversion
   a. Springfield / Thompson *(10:15 – 10:45)*
      i. Costs
      ii. Benefits
      iii. Other Considerations
   b. Leavenworth Circle *(10:45 – 11:15)*
      i. Costs
      ii. Benefits
      iii. Neighborhood Design Concept
      iv. Other Considerations
   c. Comstock / Colvin *(11:15 – 11:50)*
      i. Costs
      ii. Benefits
      iii. Other Considerations

C. Next Steps / Project Conclusion *(11:50 – 12:00)*

(Times shown in italics are estimates.)

SMTC Roundabouts Feasibility Analysis
Working Group Meeting #2
SMTC Lower Level Conference Room
June 29, 2016
10:00 AM

Draft Meeting Summary

Attendees

Name	*Affiliation*
Meghan Vitale	SMTC
Aaron McKeon	SMTC
Andrew Frasier	SMTC
Mary Robison	City of Syracuse – Engineering
Wayne Frye	LaBella Associates
Tom Miller	LaBella Associates
Cory Keegan	Bryant Associates
Rex Giardine	Syracuse University
Diana Napolitano	Syracuse University
Scot Vanderpool	Syracuse University
Jim Blum	Syracuse University
Bobby Maldonado	Syracuse University
Jim Millet	Syracuse University
Khris Dodson	Outer Comstock Neighborhood Association
Ike Achufusi	NYSDOT
Samuel Sage	Atlantic States Legal Foundation
Hongbin Gao	Atlantic States Legal Foundation
William E. Roberts	NOMAD Studio
Laura Santin	NOMAD Studio
Sam Gordon	Town of DeWitt
James Effinger	Centro

Introductions and Project Overview

Mr. McKeon began the meeting with introductions and a brief description of the project's status. LaBella Associates has completed the benefit-cost analysis for the three intersections and prepared a draft technical analysis. The purpose of the meeting was to discuss the findings of this analysis and to determine what additional steps are needed.

Cost-Benefit Results

For each intersection, Mr. Miller provided an overview of the costs and benefits of a roundabout, relative to existing conditions and anticipated future improvements. For each intersection, his overview was followed by a general discussion that included costs, benefits, alternatives and next steps.

LEAVENWORTH CIRCLE

The cost of constructing a roundabout at Leavenworth Circle is estimated at $1.5 million, not including utility relocations or a gateway treatment in the roundabout's center. The annual costs of operating and maintaining a roundabout are expected to be $2,000 less than those for a signalized intersection. Annual safety and environmental benefits are expected to be on the order of $74,000, through a combination of reduced crashes and reduced idling time. Operational benefits, measured in the value of time saved by improving intersection operations, are anticipated to be on the order of $508,000 annually. The net result is a benefit-to-cost ratio of 6:1.

Representatives from Atlantic States Legal Foundation (ASLF) were present to discuss this concept; ASLF has also been working on re-designing the Leavenworth Circle intersection. ASLF's consultant team, nomad.studio, was on hand as well, but wanted to wait until a meeting the following day (6/30) to discuss their proposals for the intersection.

Mr. Sage noted that, in talking to neighbors, he has learned that the parcel to the northeast of the intersection (between the northern leg of West Onondaga Street and Tallman Street) has recently been purchased and the new owner is concerned about rumored right-of-way takings that could be needed.

Mr. Gao asked if it would be possible to increase the width of the splitter islands, to provide pedestrians with a larger refuge. Mr. Miller said that this would be possible, but would likely require more right-of-way. As designed, these splitter islands provide a six foot wide refuge.

Mr. Sage asked about snow removal on these splitter islands, pointing out that – unlike sidewalks – adjacent homeowners would not technically be responsible for shoveling snow out of the splitter islands. Mr. McKeon opined that this would technically be the City Department of Public Works' responsibility [much like sidewalks adjacent to City parks].

Mr. Achufusi asked if the speed limit would be reduced on the approaches to the roundabout. Mr. Miller said that the posted speed limit would not change, but advisory speed limit signs (e.g., yellow 20 MPH signs) could be used.

Ms. Robison asked if there was a minimum benefit-to-cost ratio needed to ensure funding. Ms. Vitale clarified that there is no such minimum specified in the Long Range Transportation Plan, but perhaps there is one in the TIP Guidebook. [Upon further research, the TIP process does not typically include a cost-benefit analysis.]

SMTC staff stated that they would attend the ASLF meeting the following morning to learn more about the nomad.studio proposals.

[This ended discussion of Leavenworth Circle; ASLF representatives excused themselves and Sam Gordon, Town of DeWitt Planner, joined the meeting.]

SPRINGFIELD / THOMPSON INTERSECTION

Mr. Miller summarized the costs of constructing a roundabout at this intersection: $840,595, including minor right-of-way acquisitions, but not including utility relocations or a gateway improvement in the roundabout's center.

A roundabout at this intersection is expected to provide significant benefits over existing conditions in terms of improving the flow of traffic. The benefit-to-cost ratio is 41:1.

Mr. Gordon asked about special events, like LeMoyne's graduation and sporting events, and how a roundabout would accommodate this. Specifically, would a police presence still be needed to control traffic? Mr. Miller said that it seemed likely that police control would still be needed.

Mr. Gordon also asked about right-of-way impacts to the National Grid substation on the intersection's southwest corner. Mr. Miller said these impacts were minimized in the roundabout design concept, because utility owners can be difficult to work with on real estate negotiations.

Mr. Gordon stated that the Town currently has plans to build a sidewalk along the west side of Thompson from this intersection northbound to Erie Boulevard. The long-term plan is to have a sidewalk along Thompson between its two connections to Erie Boulvevard. LeMoyne College sees this intersection as the gateway to its campus and would like to see streetscape and aesthetic upgrades. Ultimately, this may mean re-constructing Springfield Road to the west of this intersection to add sidewalks on both sides of the road.

Mr. Miller pointed out that, if a roundabout is not constructed, it is likely that a signal would be needed at some point in the next 20 years; a signal would likely cost on the order of $900,000. Since this would be more expensive than a roundabout, and would not be expected to provide a better level of service, a signal would be expected to provide a lower benefit-to-cost ratio.

Mr. McKeon asked about what further analysis would be needed to ensure that the grade through the intersection does not make a roundabout infeasible. Mr. Frye said that there are a number of potential ways to analyze and/or design around this grade.

[This ended the discussion of the Springfield / Thompson intersection. At this point, the Syracuse University representatives, and Mr. Dodson, joined the meeting.]

COLVIN / COMSTOCK INTERSECTION

Mr. Miller summarized the analysis done for this intersection: traffic modeling indicated that a single-lane roundabout would be insufficient to accommodate traffic, particularly east-west traffic. As a result, a partial two-lane roundabout is proposed. A complete benefit-to-cost ratio was not completed, nor was a traffic model for the two-lane facility, however it seems likely that the proposed roundabout would be sufficient to accommodate anticipated traffic volumes.

Mr. Giardine pointed out that, from SU's perspective, the operative questions relating to a roundabout are: how would it handle special event traffic and how would it accommodate non-motorized traffic? The Campus Framework plan emphasizes the importance of cyclists and pedestrians.

Mr. Gordon pointed out that there is a bike lane on East Colvin (on either side of the intersection) but it is not shown going through the intersection. Mr. McKeon said that the Federal Highway Administration does not currently support bike lanes within a roundabout: cyclists navigate a roundabout either by "taking the lane" or by dismounting and using crosswalks, like a pedestrian. Mr. Gordon pointed out that this would be similar to the existing bike lane striping, which does not continue through the intersection.

Mr. Miller discussed the complexity of "de-parking" municipal parkland for a transportation project.

Generally, there was consensus that it would be more cost-effective to upgrade the existing signalized intersection for cyclists and pedestrians than to replace it with a roundabout. Although

Mr. Dodson pointed out that, if changes to I-81 eliminate the Colvin Street on-ramp, the traffic volumes could be dramatically different in ten or 15 years, making a single-lane roundabout worth discussing. Also, it may be that more roundabouts are built in the region (including at the I-690 / Teall Ave interchange), increasing residents' comfort level.

Next Steps

Mr. McKeon clarified that there are no plans to hold additional working group meetings. LaBella will be preparing a final report, which will be circulated to Working Group members.