Heller & Associates
500 Pillsbury Dr. SE
Minneapolis, MN 55455

May 3rd, 2018

City of Edina Department of Engineering
7450 Metro Blvd.
Edina, MN 55439

Re: York Avenue & Parklawn Avenue Intersection Design

Dear Chad Millner and Nick Bauler:

Thank you for contacting us about the intersection redesign of York Avenue and Parklawn Avenue in Edina. Our team has worked to propose a safe, multi-modal design that we believe fits the needs of the city and its citizens. The recommended design includes bike lanes, shortened crosswalks, and a buffer between the automobile lanes and the bike and pedestrian areas. The proposed changes will make the intersection much more appealing to pedestrians and cyclists. The addition of a traffic signal also makes the intersection safer for all users of the intersection.

Several designs were created in AutoCAD that matched design requirements. These designs were then evaluated and final design was selected. A traffic signal warrant analysis was performed to ensure the intersection met the criteria for a traffic light. Traffic and level of service analyses were performed using Synchro. Using these analyses alongside the project goals, a design recommendation was reached. The team recommends adding traffic signals at each approach and implementing a shared use bike path on the west side of York Avenue, along with shared use crosswalks at each side of the intersection. The details of our findings, work, and recommendations are included in the attached report.

Best Regards,

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Intersection Improvement Design Analysis

Report on York Avenue and Parklawn Avenue Intersection Multimodal Design

Prepared for:
City of Edina

Prepared by:
Heller & Associates, Inc.

Submittal Date
May 3rd, 2018

Certification Page

By signing below, the team members submit that this report was prepared by them and is their original work to the best of their ability.

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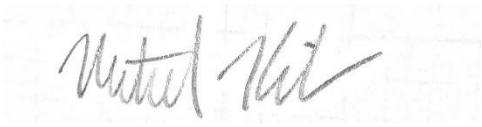
Kate Hvizdos | Project Manager



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Mitch Kiecker | Project Engineer

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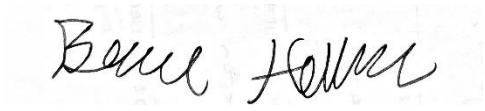
Cade Botten | Project Engineer



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Bryce Heller | Project Engineer

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Executive Summary

The intersection of York Avenue and Parklawn Avenue in Edina, Minnesota has several aspects that the City would like to improve. The City would like to increase safety for all users, create bicycle and pedestrian access, and add new trees and other plantings. This project produced a recommendation for a sustainable intersection redesign that met these needs.

The final design recommendation is a proposed multi-modal intersection with a separated shared-use path for pedestrians and cyclists located parallel to York Avenue. The intersection would also include bicycle lanes on each side of Parklawn Avenue. All paths and bicycle lanes would converge at the intersection into shared crossings controlled by an actuated traffic signal. The design increases safety for motorists, cyclists, and pedestrians.

Traffic data were gathered for the intersection and used to determine if the intersection warranted a traffic signal. The data was also gathered to calculate level of service for the intersection – a performance metric that analyzed wait time.

Eight geometric designs were presented to the City of Edina in several iterations. The City approved a final design after integrating feedback into the preliminary designs. The design team and City of Edina evaluated the final design by its safety, sustainability, cost, and traffic performance to ensure the project was feasible and practical. This report also contains information on the necessary permits and approvals required to move forward with the project.

Should the City of Edina choose to implement this work or a variation of this work, the City would gain a safe, sustainable intersection that will last for decades to come.

Introduction

The intersection of York Avenue and Parklawn Avenue has raised some concerns for the City of Edina. The intersection has long pedestrian crosswalks and lengthy wait times for drivers travelling from Parklawn Avenue to York Avenue. The intersection is part of the shortest path between York Gardens Senior Living and the Southdale YMCA. Many pedestrians, especially the elderly, frequently use the pedestrian crosswalks. With the current road layout, the long walking distance for pedestrians can feel dangerous, considering no traffic signals are present. In 2013 alone, three vehicle crashes occurred at this intersection, all from vehicles making a left turn from eastbound Parklawn Avenue to northbound York Avenue. This movement is particularly dangerous due to the large distance a left-turning driver must cross and the long delays motorists experience before they can safely turn. The delay can increase impatience in drivers, which may lead them to make a risky turn instead of waiting longer for an opening. The City of Edina has requested a design for a safe multi-modal intersection design – one that includes facilities for vehicles, pedestrians, and bicycles – and an impact analysis from the proposed intersection.

This report will explain why the existing conditions raise concern for the City of Edina as well as how a cost-effective final design was chosen. The site information section will introduce the intersection and the concerns present at this time. Next, the traffic signal warrant analysis will be outlined. Using this information, the design process will be explained, along with design considerations. After overviewing the design, the project sustainability is covered. A level of service analysis is included to evaluate the performance of the intersection for motorists. Detailed explanation of the budget will be presented based off the design and level of service. Permits and approvals necessary for the project are considered with the budget. Finally, a short summary of the project and the findings will be listed.

Site Information

The intersection under consideration consists of northbound and southbound approaches for York Avenue and eastbound and westbound approaches of Parklawn Avenue. York Avenue has no traffic signs or signals, and drivers can pass through without stopping or slowing. The eastbound and westbound approaches for Parklawn Avenue are controlled by stop signs. Pedestrian crosswalks are currently located on the southern and western sides of the intersection. The northbound approach of York Avenue has a bus lane that is roughly 200 feet long. Also on York Avenue are two through lanes and a left turn lane that is approximately 150 feet long. The southbound approach has two through lanes, a left turn lane of about 150 meters, and a right turn lane that begins roughly 200 feet before the intersection. The eastbound approach of Parklawn Avenue has two lanes in each direction, where the outside lanes act as limited-access parking lanes. The westbound approach is an entrance to a residential lot that is unmarked, but it is assumed to have one lane in each direction. York Avenue is divided by a median that varies in width from thirty to forty feet. At the southern crosswalk, the median is roughly twelve feet wide, which allows pedestrians to break up the crosswalk into two sections, although this is not on the crosswalk and does not have a button to signal the flasher. The western crosswalk is roughly 65 feet in length.

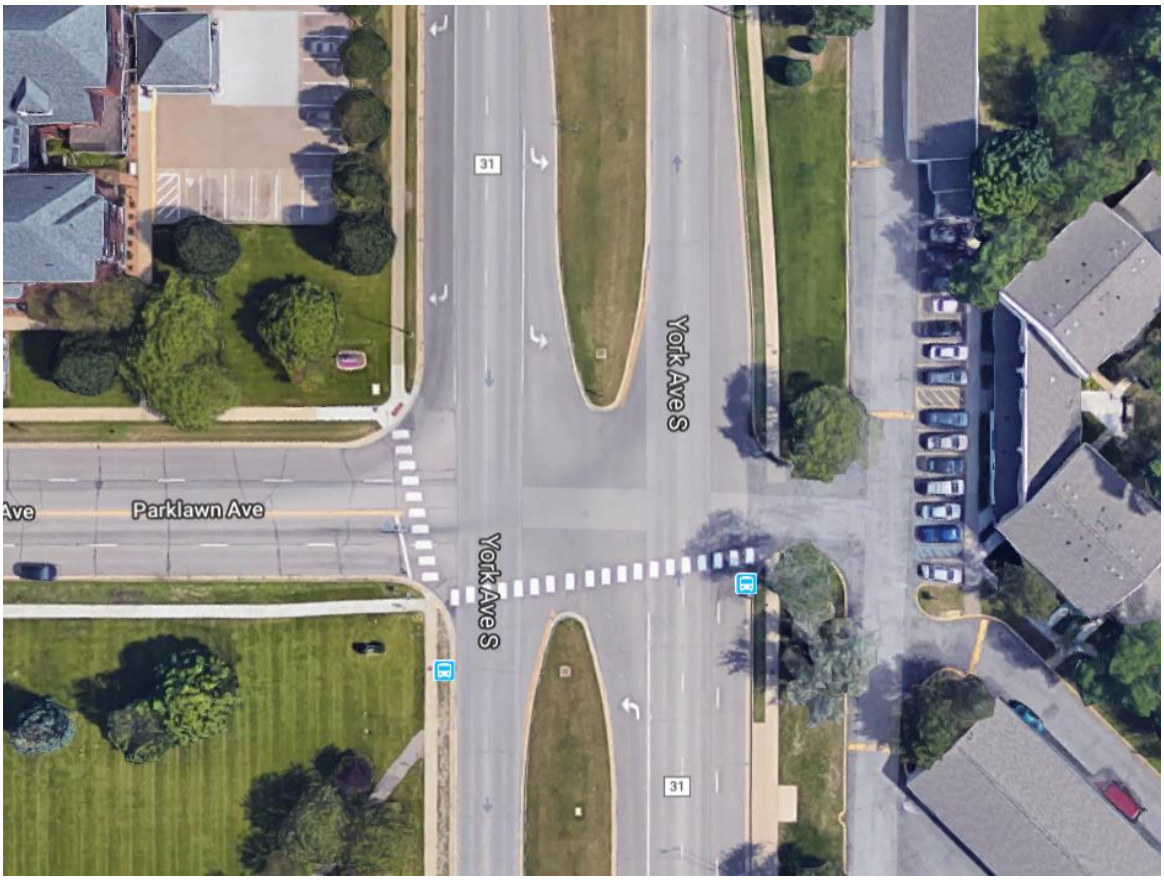

Figure 1: Existing intersection (Google 2018)

Pedestrian Safety Concerns

The total walking distance along the southern crosswalk is roughly 120 feet. Assuming a pedestrian walk speed of 3 miles per hour, this corresponds to a crossing time of roughly 27 seconds. Considering York Avenue has no stop signs, this walking distance can be intimidating for pedestrians. The rectangular rapid flash beacon designated for this crosswalk is helpful, but pedestrians have still expressed concerns for their safety. This is because drivers do not always yield to the flashers. Near the intersection, a clear space is provided voided of trees or other vertical elements to increase the sight distance for approaching drivers. This clear space may encourage higher driver speeds in excess of the 35 miles-per-hour speed limit because drivers' lines of sight are not impeded. To alleviate the dangers of walking across the southern crosswalk, the central median could be widened to allow for more waiting space, the total road width could be shortened to make the walk time shorter, or a traffic signal could be implemented to give the pedestrians a dedicated time frame to safely cross the intersection.

Western Approach-Left Turn Concerns

Left turns from the eastbound approach of Parklawn Avenue have also been concerning. Citizens have complained to the City of Edina stating that drivers have felt unsafe making a left hand turn due to the long curve radius and uncontrolled traffic on York Avenue. An eastbound vehicle must travel roughly 70 feet into the intersection before beginning to turn onto York Avenue. Before doing so, the driver must be sure that there is sufficient time to travel across the southbound lanes, the median width, and finally enter the northbound lane. Heavy traffic with speeds of 35 miles-per-hour or greater can make this left turn even more difficult. To accommodate the requests to mitigate this issue, multiple changes to the intersection could be implemented. The most apparent solution would be to introduce traffic signals at this intersection. By doing so, vehicles waiting at the eastbound approach would not need to use their own judgment to maneuver the intersection. A traffic signal would provide a dedicated time for a safe left turn. By lowering the width of the intersection, the distance required for a left turn would be shortened. Similarly, by shortening the median, the curve radius of the vehicles would be smaller, which would take less time to travel.

2015 Hennepin County Traffic Signal Warrant Analysis

In 2015, Hennepin County conducted a signal warrant analysis on the intersection. The analysis found that the intersection met several warrants for a signal, and marked it as a priority for the county. However, the City of Edina was never contacted about the results of the study or any plans for a new design or signal installation. After contacting the county, it is still unclear why no changes were made. The warrants met during Hennepin County's signal warrant analysis can be found in the *Appendix I* section of the report.

Current Traffic Data

To ensure that the traffic patterns have not changed since 2015, current traffic data were collected. These data contained right, left, and through movement counts for all approaches, in 15-minute increments. These data were collected for a full 24-hour period, although due to time constraints some of the data have only 15 minutes of every hour collected, which is assumed to be representative of the full hour. As shown in *Figure 2*, the data collected in 2018 in similar to the data Hennepin County collected in 2015. All traffic counts were made with COUNTpro™ or custom software. The data collected were used for a warrant analysis, level of service analysis, and to advise the future design and signal timing of a future intersection.

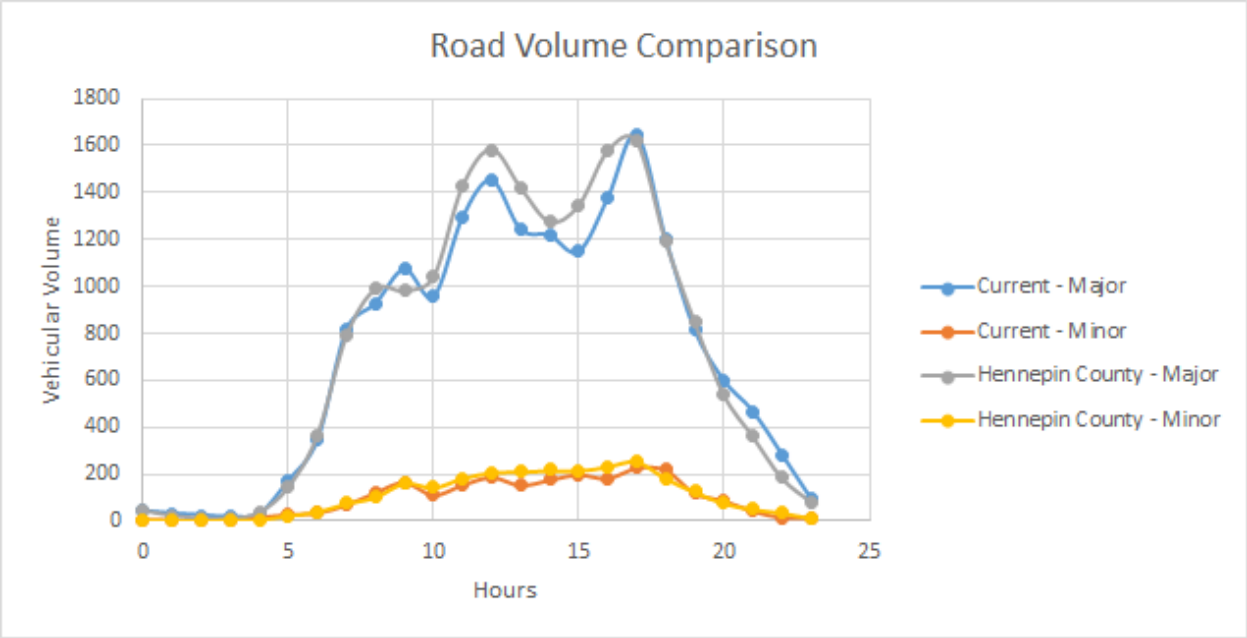

Figure 2: 2015 vs 2018 Comparative Traffic Counts on Major and Minor Roads

Traffic Warrant Analysis

Using the collected data, a signal warrant was performed according to the Minnesota Manual on Uniform Traffic Control Devices (MN MUTCD). *Figures 3, 4,* and *5* and *Tables 1* and *2* will explain the warrants that were tested using the data.

Warrant 1B is a measure of the eight-hour traffic volume at the intersection. The sum of the major approach volumes and the larger minor approach volume are compared to a standard value based on the number of approaches in each direction. Given that there are two or more lanes on each approach, the major approach volume needed to be greater than 900 vehicles-per-hour and the minor approach needed to be at least 100 vehicles-per-hour, according to the MN MUTCD. *Figure 3* shows that the major approach volumes and minor approach volumes were both above the minimum warrant requirements for ten consecutive hours starting at the eighth hour of the recording.

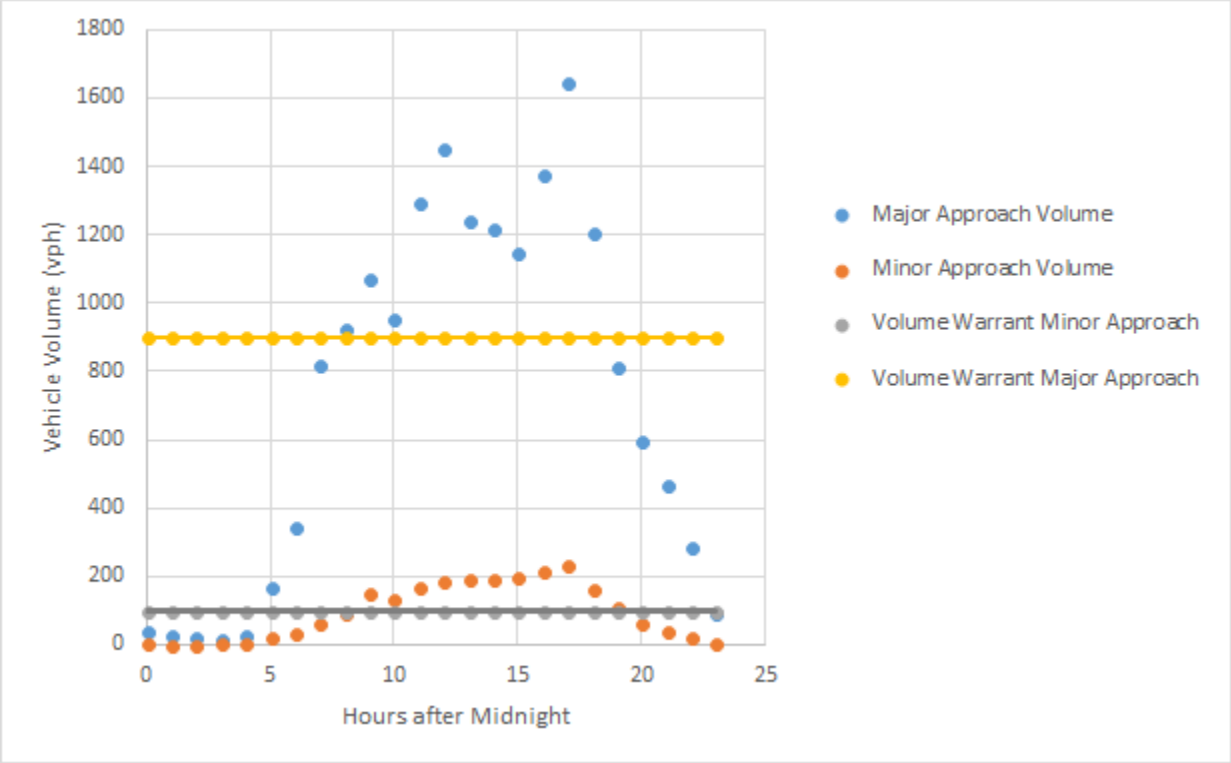

Figure 3: Warrant 1B - Eight Hour Vehicular Volume (MN MUTCD)

Warrant 2 relies on the vehicular volume being higher than the lower limit for four consecutive hours. Because both York Avenue and Parklawn Avenue have two or more lanes, the highest red line in *Figure 4* is used to determine if the warrant passes or not. *Table 1* shows the time period that passes the warrant. The minimum values were met for eight consecutive hours starting at 11:00 AM.

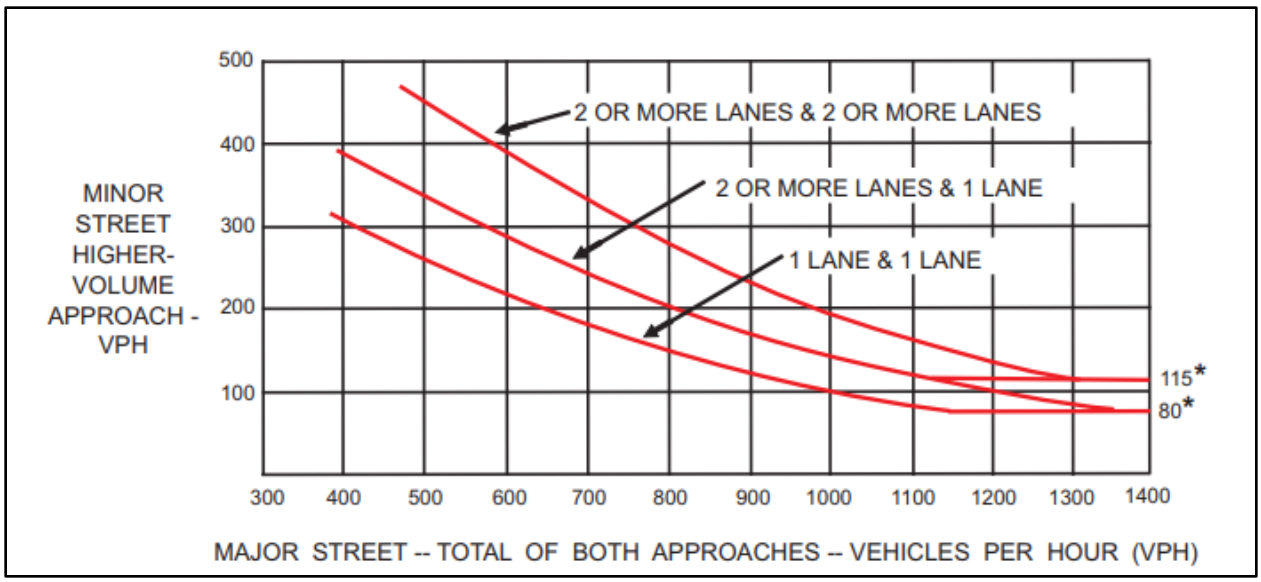

Figure 4: Warrant 2 - Four Hour Vehicular Volume (MN MUTCD)

Table 1: Warrant 2 Passing Time Period

Time	Major Total (vph)	Minor High Volume (vph)
11:00 AM	1425.6	166.7
12:00 PM	1582.7	188.7
1:00 PM	1419.7	192.7
2:00 PM	1275.3	193
3:00 PM	1342.3	198
4:00 PM	1574.7	216.3
5:00 PM	1618	235.7
6:00 PM	1190.7	163.3

The peak-hour volume warrant is similar to the four-hour volume warrant. For Warrant 3 to be passed, the minimum volumes on the higher volume minor street and total of both major approaches must be above the red lines in *Figure 5*. Since the intersection has two or more lanes on both the major and minor approach, the top line in *Figure 5* is used for the analysis. *Table 2* shows the periods where the volumes warrant the addition of a traffic signal.

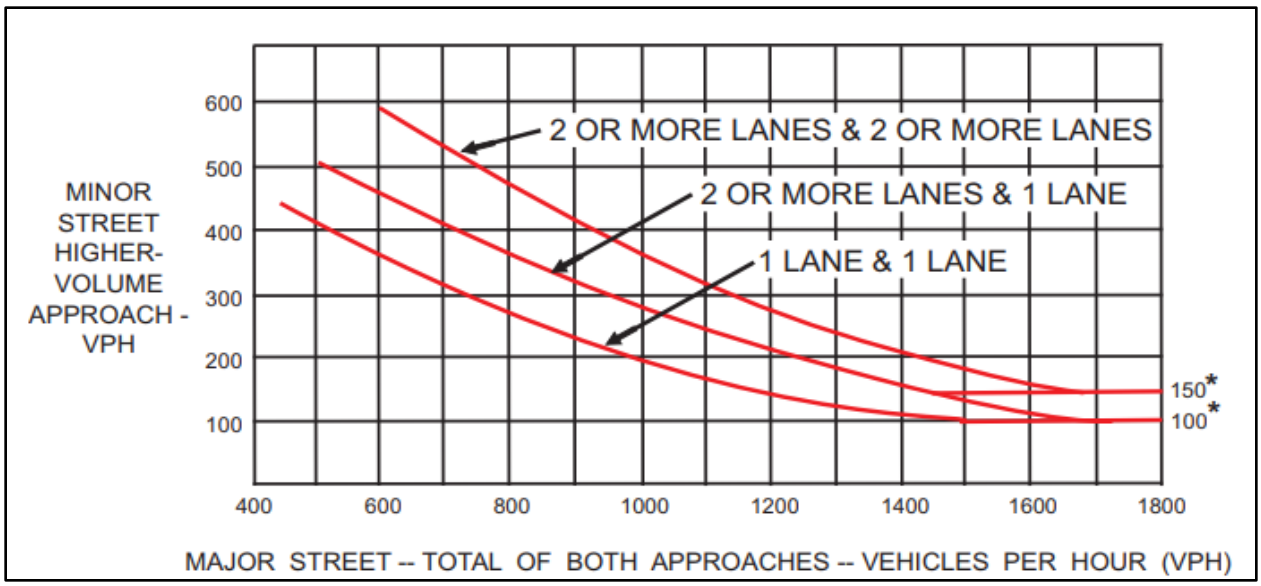

Figure 5: Warrant 3: Peak Hour Volume (MN MUTCD)

Table 2: Warrant 3 passing time period

Time	Major Total (vph)	Minor High Volume (vph)
12:00 PM	1582.7	188.7
4:00 PM	1574.7	216.3
5:00 PM	1618	235.7

In total, nine different warrants can be used to justify the implementation of a traffic signal. The first three were the most relevant to the intersection given the circumstances, so they were tested. All three passed the minimum requirements, proving the need for a traffic signal at this intersection. Warrant 4 focuses on pedestrian volume counts. The data from York Avenue and Parklawn Avenue were collected on February 6th in Minnesota, so the weather was very cold. This will cause fewer pedestrians to use the road than in the summer, skewing the results. Because of this, warrant 4 was not tested. Warrants 5-9 were also not tested. These warrants are listed in Appendix H.

The traffic signal warrant analysis performed by Hennepin County in 2015 had nearly identical results to the analysis performed for this project. The same warrants were tested and yielded similar results, proving that the data represents a typical day and the analysis can be trusted.

Design Considerations

Intersection Design

The design for the York Avenue and Parklawn Avenue intersection focuses on increasing safety. Shorter crossing distances for pedestrians and shortened turning distances for motorists and reduces the chance of an accident occurring. A traffic signal is proposed to control vehicle traffic moving through the intersection. This signal will also provide times of clear right-of-way for pedestrians and bicyclists to cross, which will greatly reduce the chance of a vehicle-pedestrian or vehicle-bicyclist collision. Due to the inclusion of this signal, the queue lengths for turn lanes is increased to accommodate vehicles that may be backed up waiting to turn left.

Pedestrian Design

Major concerns for this intersection centered on pedestrian safety. The crossing distance across York Avenue is reduced from 120 feet to 93 feet, which includes a 33-foot wide refuge median located in the middle of York Avenue. This will reduce the crossing time for pedestrians from roughly 27 seconds to 21 seconds, assuming a 3 miles-per-hour walk speed. For Parklawn Avenue, the crossing distance is reduced from 65 feet to 30 feet. Again, this will reduce the crossing time from about 15 seconds to 7 seconds. The proposed traffic signal will also provide a pedestrian signal to alert pedestrians when it is safe to cross the street. If the time on the pedestrian signal runs out before a person has finished crossing York Avenue, they may wait safely in the refuge median before being prompted to finish crossing.

All proposed pedestrian crossings are also equipped with continental crosswalks, which are a style of crosswalk markings that use a series of long, white painted rectangles to delineate a pedestrian crossing. Continental crosswalks are more easily seen by motorists and reduce the number of vehicle-pedestrian crashes (McGrane 2013). The proposed crosswalks provide space for both pedestrians and bicyclists. The pedestrian space will be striped white, and the bicycle space will be striped green, as shown in *Figure 6*.

Bicycle Design

The proposed bicycle facilities create a safe environment for cyclists that currently does not exist on the intersection. Along York Avenue, the proposed bicycle lanes will be off street and paired together into a shared-use path set back eight feet from the curb. A shared-use path is a form of off-street trail that combines pedestrians and bicyclists all onto one surface, shown in *Figure 7*. The proposed shared-use path is 12 feet wide and striped to allow a width of four feet for northbound bicyclists, four feet for southbound bicyclists, and four feet all pedestrians. The entire path will be bituminous to ease snow clearance and winter maintenance. Putting the bicycle lanes behind the curb and setting them back from traffic creates a safer facility that

encourages more bicycle use from people who would otherwise feel unsafe riding in an on-street bicycle lane. Because the traffic volumes and speeds limits on Parklawn Avenue are significantly lower than those on York Avenue, the proposed bicycle lanes on Parklawn Avenue are located on-street and separated by a four-inch-wide solid white stripe.

Figure 6: Shared bicycle and pedestrian crossing at Texas A&M University (Peters 2017)

Figure 7: Midtown Greenway, Minneapolis, MN - Example of a shared-use path striped to allow pedestrian and two-way bicycle movement (Stark 2015)

The proposed intersection also features a modified bicycle loop to allow bicycle access to the east side of the intersection. Bicyclists using this loop must wait at each corner for the signal, and then proceed counterclockwise through the loop when prompted. Upon reaching the east side of the intersection, bicyclists may exist the loop and either ride on the driveway owned by the adjacent apartment complex or dismount and walk their bicycle along the sidewalks parallel to York Avenue. This loop design is similar to a traffic roundabout, but only cyclists move through the circle, while motorists move through a traditional four-way intersection.

On-Street Bicycle Facilities

Early in the design process, the location of the bicycle facilities was moved from on-street to off-street. Off-street bicycle facilities, especially raised and set back from the curb, induce a greater level of ridership from those who may feel unsafe riding in an on-street bicycle lane (Edina 2018 and Geller 2009). The space between the shared-use path and the roadway also provides a space for tree planting, which can also increase the safety and ridership for bicyclists by acting as a physical barrier between motorists and bicyclists. This design reflects the City of Edina's goal to encourage more bicycle use.

Dutch Junction

One possible design for bicycle facilities involved implementing a Dutch junction. This type of intersection treatment would circulate all bicycle traffic counterclockwise around the intersection, shown in all concepts in *Appendix B*. However, this design also requires bicyclists to move in the same direction as traffic and be located on one-way bicycle lanes adjacent to the roadway. This would force the northbound bicycle lane to be located to the east of the intersection, parallel to York Avenue. Because most bicycle trip origins and destinations are located west of the intersection, the bicycle lanes were consolidated into a shared-use path on the west side of the intersection.

Center Median Path

A bicycle-only two-way path in the center median was briefly considered at this intersection. The logistics involved to connect the path the bicycle lanes on Parklawn Avenue proved to be too complicated and could have confused bicyclists and motorists. The concept was dropped early in the design process.

Motorist Design

The proposed intersection reduces lane widths from thirteen feet to a proposed twelve feet. The narrower lanes help in reducing vehicle speeds, which could then reduce the number of crashes and increase the feeling of safety for all users. The right turn lanes on York Avenue have been eliminated, which reflects the low current turning traffic volumes on this street.

Vehicle Turning Movements

The proposed design reduces vehicle turning radii to 40 feet, down from 70 feet. While this may seem low for large vehicles, traffic recordings for the intersection showed very few tractor-trailers turning at the intersection. The proposed turning radius may require buses and tractor-trailers to significantly reduce their speeds to navigate the turn, but the low volume of these vehicles turning at this intersection will negate any serious traffic impact.

Design Impacts

The overall intersection design fits within the right-of-way owned by the City of Edina and Hennepin County and any easements the city has for transportation uses. No additional land or right-of-way is needed for this intersection; however, the proposed design does reduce the overall width of the center median on York Avenue. Tentative tree planting by the City of Edina on the York Avenue median may encourage motorists to drive more slowly than with the existing conditions. The traffic signal for the proposed intersection design will mitigate visual conflicts because motorists will be prompted to move through the intersection by the traffic signal instead of looking for an opening in traffic.

York Avenue Reconstruction

The proposed design realigns the York Avenue centerline and requires total reconstruction from the Edina Promenade to West 66th Street. In order to accommodate a shared-use path facility in any way on York Avenue, a reconstruction would be required. The limits of this reconstruction from the Edina Promenade to West 66th Street would be the minimum distance required to connect the bicycle facilities to the existing bicycle network. Excluding the full York Avenue reconstruction, a plan of the proposed intersection is shown in *Figure 8*.

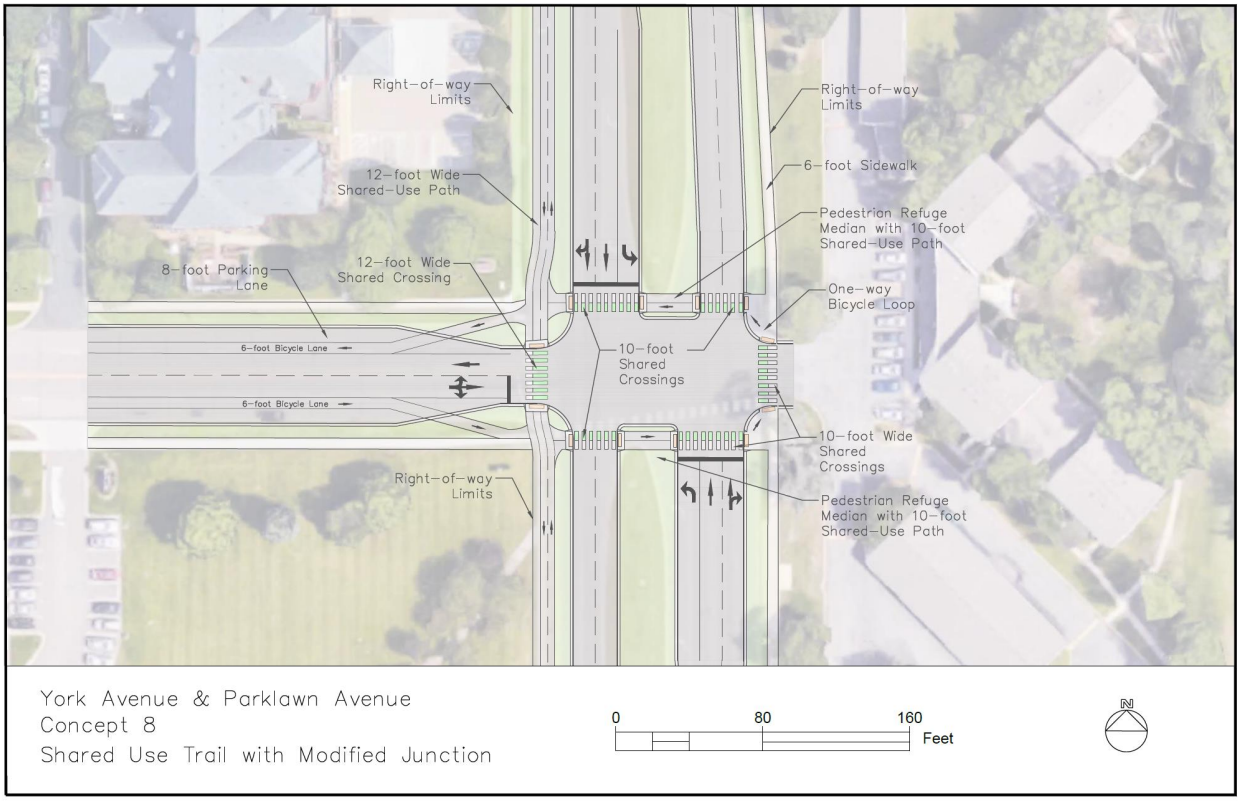

Figure 8: Final Recommended Design

Sustainability Considerations

The intersection redesign has several areas where sustainability practices can be applied. The first comes with one of the main goals of the project, making the intersection multi-modal. The addition of bike lanes and safer pedestrian options encourages the use of greener transportation.

Environmental Sustainability

Greener transportation includes all forms that do not involve using a personal automobile. This could be walking, biking, rolling, or even taking the bus. Personal vehicles, whether they are conventional or electric, all release greenhouse gases and congest roadways. Unless if an electric vehicle is charged entirely from renewable energy sources, the coal or natural gas burned to provide electricity to power the vehicle releases greenhouse gases. The proposed design will make the intersection more environmentally sustainable by providing space and facilities to walk, bike, and catch the bus, not just to drive.

Economic Sustainability

Creating space for more pedestrians and cyclists also creates the opportunity to complete trips on foot or bike. Simple things like a trip to the grocery store, a restaurant, or the YMCA can easily be accomplished by walking or biking. When personal automobiles are required less and less for everyday travel, roadways do not need to be constantly widened and reconfigured to hold more automobiles. Because the roadway would only need to be maintained and not to be widened or reconfigured again in the future, the City of Edina and Hennepin County can save money from construction costs, which increases the project's economic sustainability.

Creating a safe intersection and allowing people the choice to walk or bike also reduces the financial burden on households that need multiple vehicles to complete everyday trips. Two or three car households may now only need one or two cars, which can also be attributed to the project's economic sustainability.

The new design also accounts for future traffic levels and citywide bike plans, increasing the length of time before the intersection will be reconstructed. Traffic projections through the year 2040 were included in the analysis to ensure the new design will account for future traffic volumes. The City of Edina is also adding bicycle lanes and paths throughout the city, including the addition of several bike lanes in nearby streets that the project connects too. Constructing new bicycle facilities at the same time as the intersection prevents the need to add them at a greater cost in the future.

Social Sustainability

The new bicycle and pedestrians facilities also increase mobility for disabled and elderly users who may only be able to walk or use a wheelchair. If all users can use the intersection safely and efficiently, then people can now choose not to drive or arrange a ride with someone else. By increasing mobility for an aging population and for all users, the City of Edina can maintain its social sustainability and allow its citizens to more easily reach their destinations.

Level of Service

Current Design and Traffic Volumes

Several level of service analyses were conducted to evaluate the performance of the intersection. Using Synchro™ software, two scenarios of the current intersection were evaluated, first for the morning peak, and again for the evening peak (Appendix E). In both the morning and evening peak, there are several areas of concern. The worst level of service is for the through and left turn movements from Parklawn Avenue. In the morning peak, they are evaluated as “E”s, indicating an average delay of 35 to 50 seconds. In the evening peak, they drop to “F”s, meaning an average delay of over 50 seconds.

Current Design and Future Traffic Volumes

Recently, the city of Edina contracted work with WSB to model traffic for 2040. WSB produced two models, one with standard, expected values, and one a “high density” value, for a more extreme value. The baseline estimates an increase of 38.1% on Parklawn Avenue and a 14.4% increase on York Avenue. The high density model predicts an increase of 65.5% and 29.4%. Increasing the ratio of the traffic data collected by the team by these percentages and using the values in Synchro gives a level of service estimate for 2040 (Appendix F). The ranks of the movements are worse than the current level of service rankings.

Design Level of Service

Using the design recommended and an actuated traffic signal, the level of service for all scenarios is improved. First, the current traffic volumes raised all the level of service ratings to A except for the Parklawn Avenue movements, which was raised to a B (Appendix G). Though the 2040 baseline estimates for traffic volumes were much higher, the level of service for all movements were the same as the 2018 volumes (Appendix G). The 2040 high density level of service ratings were similar to the 2040 baseline and 2018 volume, though the northbound York Avenue movements decreased to a B rating (Appendix G).

Budget

For the given intersection, setting the limits pertaining to cost estimation was difficult. The proposed design requires changes to both York Avenue and Parklawn Avenue, extending past the intersection on the North, West, and South. Because of this, volumes of materials and necessary hours of work required to complete the reconstruction are variable. Due to the scope of the project, the budget estimation was based on the area of land displayed in Figure C-1 located in the Appendix. The following table shows the cost breakdown for the reconstruction.

Table 3: Cost Estimation for York Avenue and Parklawn Avenue intersection redesign

Item	Unit	Total Quantity	Unit Price	Total Cost
MOBILIZATION	LS	1	$50,000.00	$50,000.00
TRAFFIC CONTROL	LS	1	$50,000.00	$50,000.00
TRAFFIC CONTROL SUPERVISOR	LS	1	$25,000.00	$25,000.00
LANDSCAPE MATERIAL	LS	1	$25,000.00	$25,000.00
CONTRACTOR SUPERINTENDENCE	LS	1	$33,000.00	$33,000.00
COMMON LABORERS	HR	70	$70.00	$4,900.00
EQUIPMENT RENTALS	HR	70	$140.00	$9,800.00
REMOVE CURB & GUTTER	LF	1300	$3.00	$3,900.00
REMOVE CONCRETE WALK	SF	2900	$2.00	$5,800.00
REMOVE BITUMINOUS PAVEMENT	SF	1250	$5.00	$6,250.00
MISCELLANEOUS REMOVALS	SF	10500	$1.00	$10,500.00
REMOVE CONCRETE BUS PAD	SF	550	$2.00	$1,100.00
EXCAVATION - COMMON	CY	2000	$12.00	$24,000.00
EXCAVATION - SUBGRADE	CY	2000	$16.00	$32,000.00
LIGHTWEIGHT AGGREGATE	CY	500	$100.00	$50,000.00
AGGREGATE BASE CLASS 5	CY	1000	$30.00	$30,000.00
BITUMINOUS PAVEMENT 6" THICK	TON	500	$80.00	$40,000.00
SIDEWALK 6"	SF	2000	$7.00	$14,000.00
CONCRETE CURB AND GUTTER DESIGN B612	LF	1500	$30.00	$45,000.00
TRAFFIC CONTROL SIGNAL SYSTEM	EACH	6	$250,000.00	$1,500,000.00
TRAFFIC CONTROL INTERCONNECTION	LS	1	$30,000.00	$30,000.00
TEMPORARY SIGNAL SYSTEM	SYS	1	$75,000.00	$75,000.00
SALVAGE SIGNAGE	LF	20	$50.00	$1,000.00

TRUNCATED DOMES	SF	40	$50.00	$2,000.00
SODDING TYPE LAWN	ST	460	$20.00	$9,200.00
PAVEMENT LT ARROW	EACH	3	$650.00	$1,950.00
PAVEMENT RT ARROW	EACH	3	$650.00	$1,950.00
PAVEMENT THROUGH ARROW	EACH	5	$800.00	$4,000.00
4" SOLID LINE GREEN - POLY PREFORMED - GROUND IN	LF	246	$5.00	$1,230.00
4" SOLID LINE WHITE - POLY PREFORMED - GROUND IN	LF	1300	$5.00	$6,500.00
4" 10' x 30' DASHED LINE WHITE - POLY PREFORMED - GROUND IN	LF	1100	$5.00	$5,500.00
12" SOLID LINE WHITE - POLY PREFORMED - GROUND IN	LF	86	$15.00	$1,290.00
CONSTRUCTION SIGN-SPECIAL	SF	60	$35.00	$2,100.00
SIGN PANELS TYPE SPECIAL	SF	5	$40.00	$200.00
SIGN PANELS TYPE C	SF	100	$32.00	$3,200.00
SIGN PANELS TYPE D	SF	20	$32.00	$640.00
			Subtotal	**$2,106,010.00**
			25% Contingency	**$526,502.50**
			Total	**$2,632,512.50**

Permitting and Approvals

Minnesota Pollution Control Permit

This project will need a Minnesota Pollution Control Permit because the area of land disturbed (1.6 acres) is more than one acre. The estimate of disturbed land includes both the intersection and connecting roads that would be torn up during the intersection. The project may disturb more than the preliminary estimate of 1.6 acres, as the preliminary design does not have any allowance for driveways going onto York Avenue, and does not have north or south project limit for road and trail construction.

Stormwater Pollution Prevention Plan

Because the area of land disturbed is more than one acre, a Stormwater Pollution Prevention Plan is needed. This plan will include location and quantities of inlet protection and silt fences. These are needed in order to prevent the exposed topsoil from going into the stormwater system or surface waters.

Watershed Permits

As there is more than 5000 square feet of disturbed surface, a Watershed Permit is needed for the Nine Mile Creek Watershed District. Since turn lanes are being removed, there is a loss of 0.2 acres of impervious surface, much less than the 1 acres gained requirement for the permit.

Approvals

As Parklawn Avenue is a Municipal State Aid roadway, Minnesota Department of Transportation approval is required to secure funding and build on Parklawn Avenue. York Avenue is a county road, and Hennepin County will have to approve the project. Because Parklawn Avenue is a city street, Edina City Council approval is necessary to construct any changes.

Recommendations

The recommended design for the intersection includes the geometric design shown in *Appendix C* and an added traffic signal. This multi-modal design includes a shared-use path that allows pedestrians and cyclists to travel through to the intersection to adjoining bike trails safely and efficiently. It also contains shared crossings at all four corners, again increasing the safety for bicycle riders.

The pedestrian walkways were shortened and the crosswalks intersect the medians on York Avenue to provide a shelter for pedestrians if they are not able to cross within the allotted time. This also increases the safety of the intersection, especially for any elderly citizens who may live in the nearby retirement facility.

The medians on York Avenue will remain, keeping green space and improving the aesthetics of the area when trees are planted in the future by Hennepin County.

Lastly, an actuated traffic signal should be added to the intersection. The warrants and level of service prove the need for a better traffic control device, and the Synchro analysis proves that this will greatly reduce wait time and idling, especially for the Parklawn Avenue Movements.

The design team believes these changes will provide a multi-modal, safe, and sustainable intersection in Edina for years to come.

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Appendices

Appendix A: Preliminary Designs

Four initial design options were presented to the City of Edina. These designs focused on improving safety and multi-modal options.

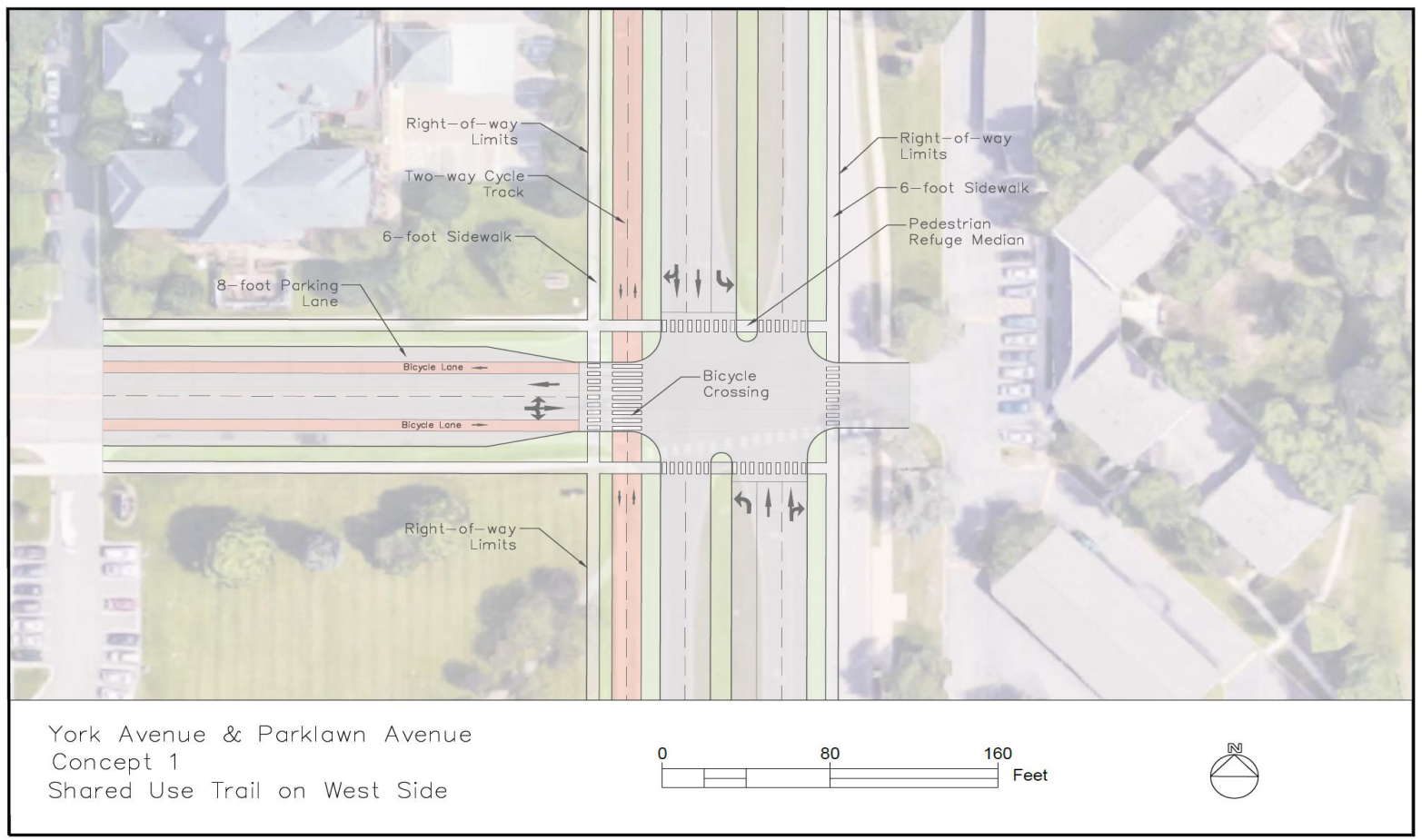


Figure A-1: Concept 1 of the first iteration of designs delivered to mentors

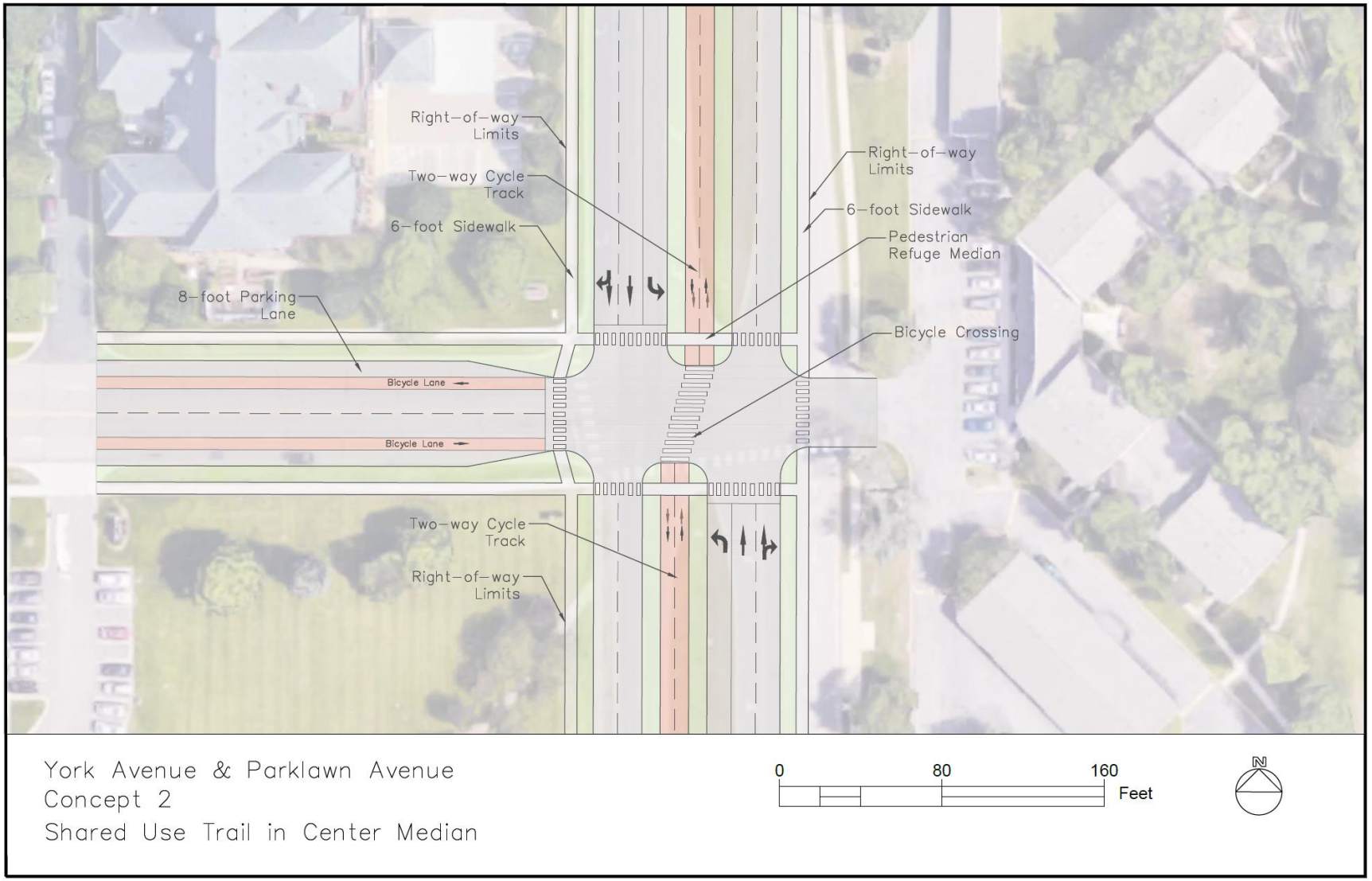


Figure A-2: Concept 2 of the first iteration of designs delivered to mentors

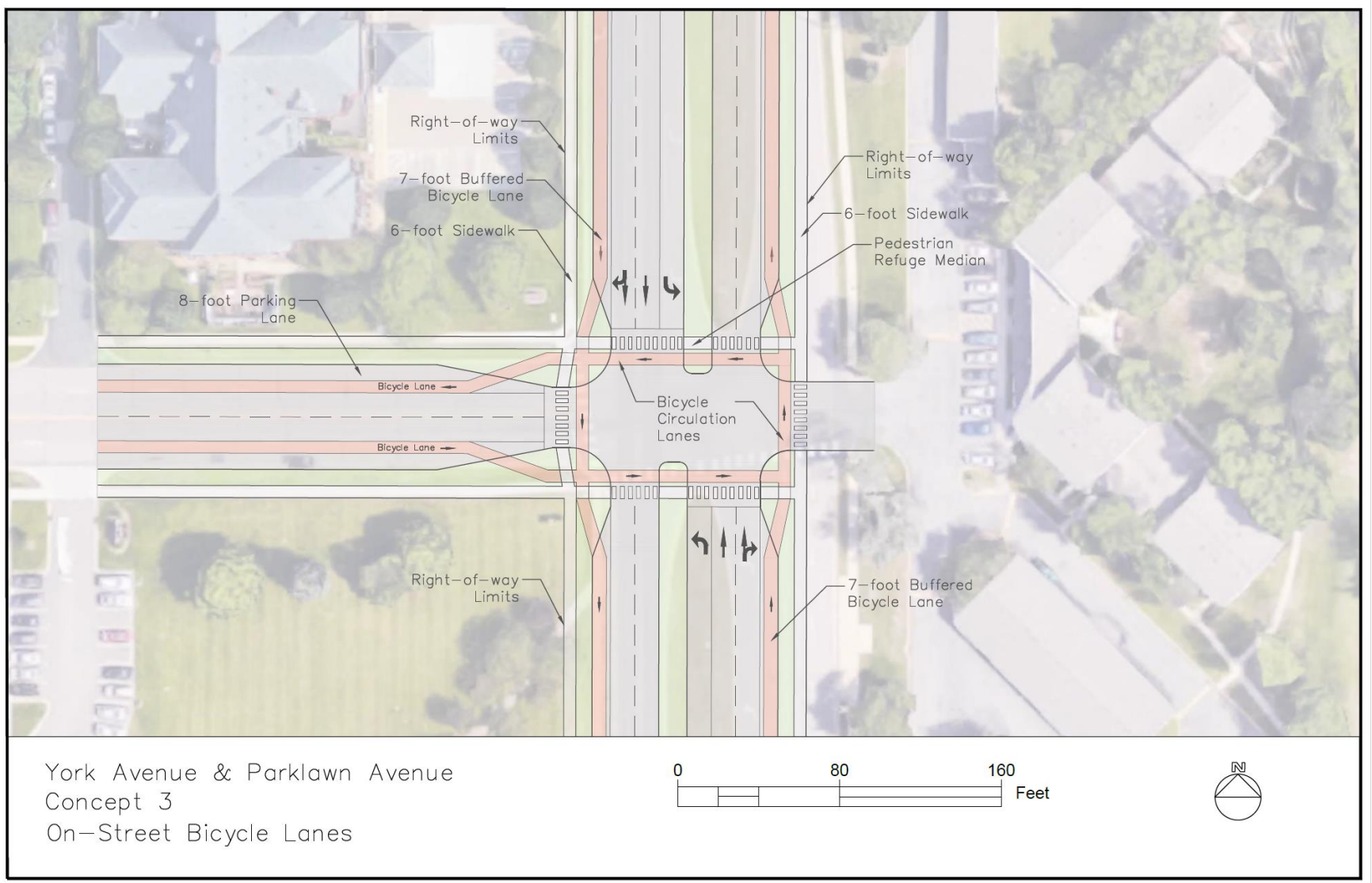


Figure A-3: Concept 3 of the first iteration of designs delivered to mentors

Appendix B: Secondary Designs

After working with the City of Edina, Concept 3 was selected as the best of the preliminary designs. Four more detailed options expanding on the feedback of Concept 3 were created and brought to the City again.

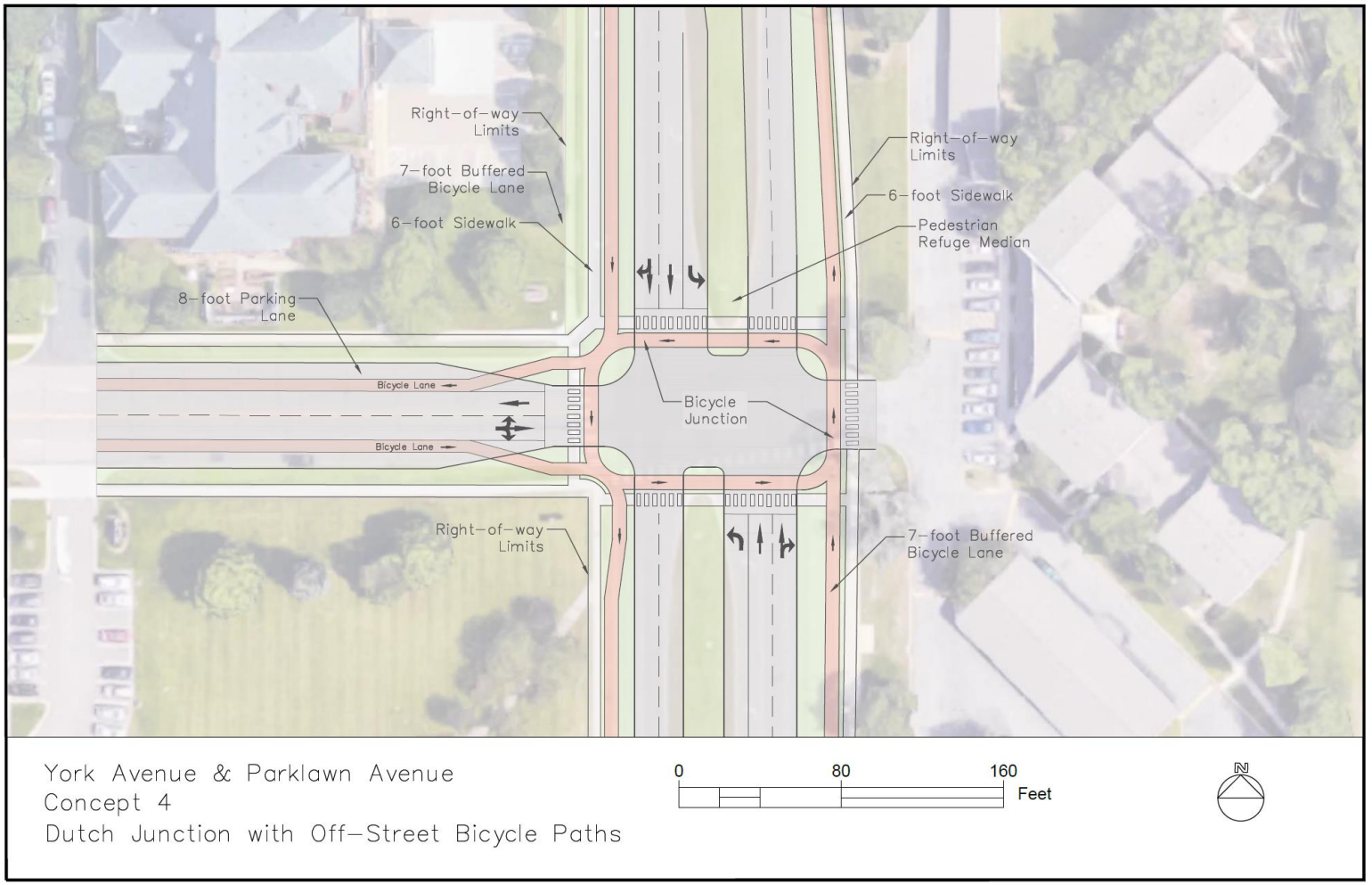


Figure B-1: Concept 4 of the second iteration of designs delivered to mentors

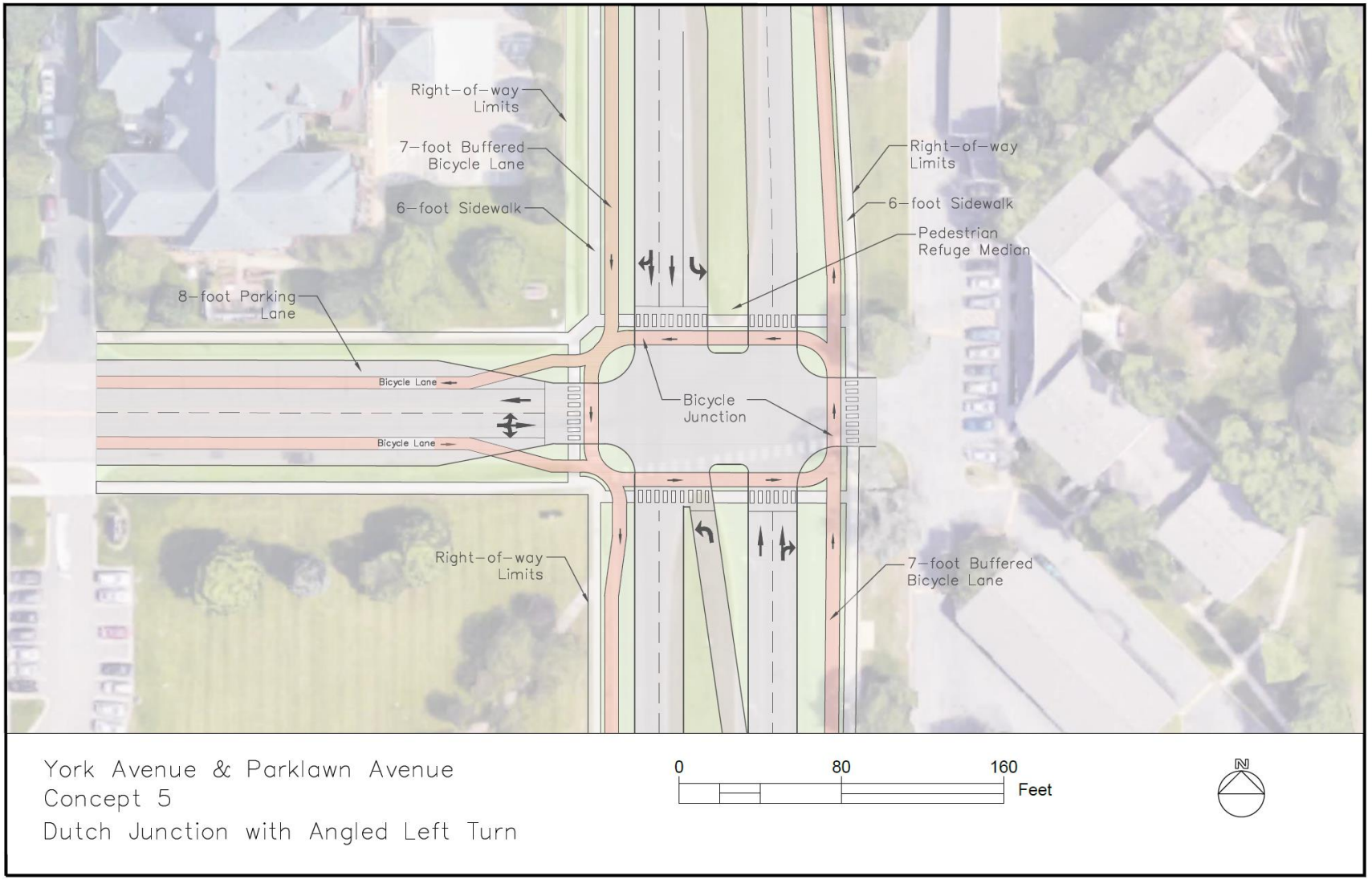


Figure B-2: Concept 5 of the second iteration of designs delivered to mentors

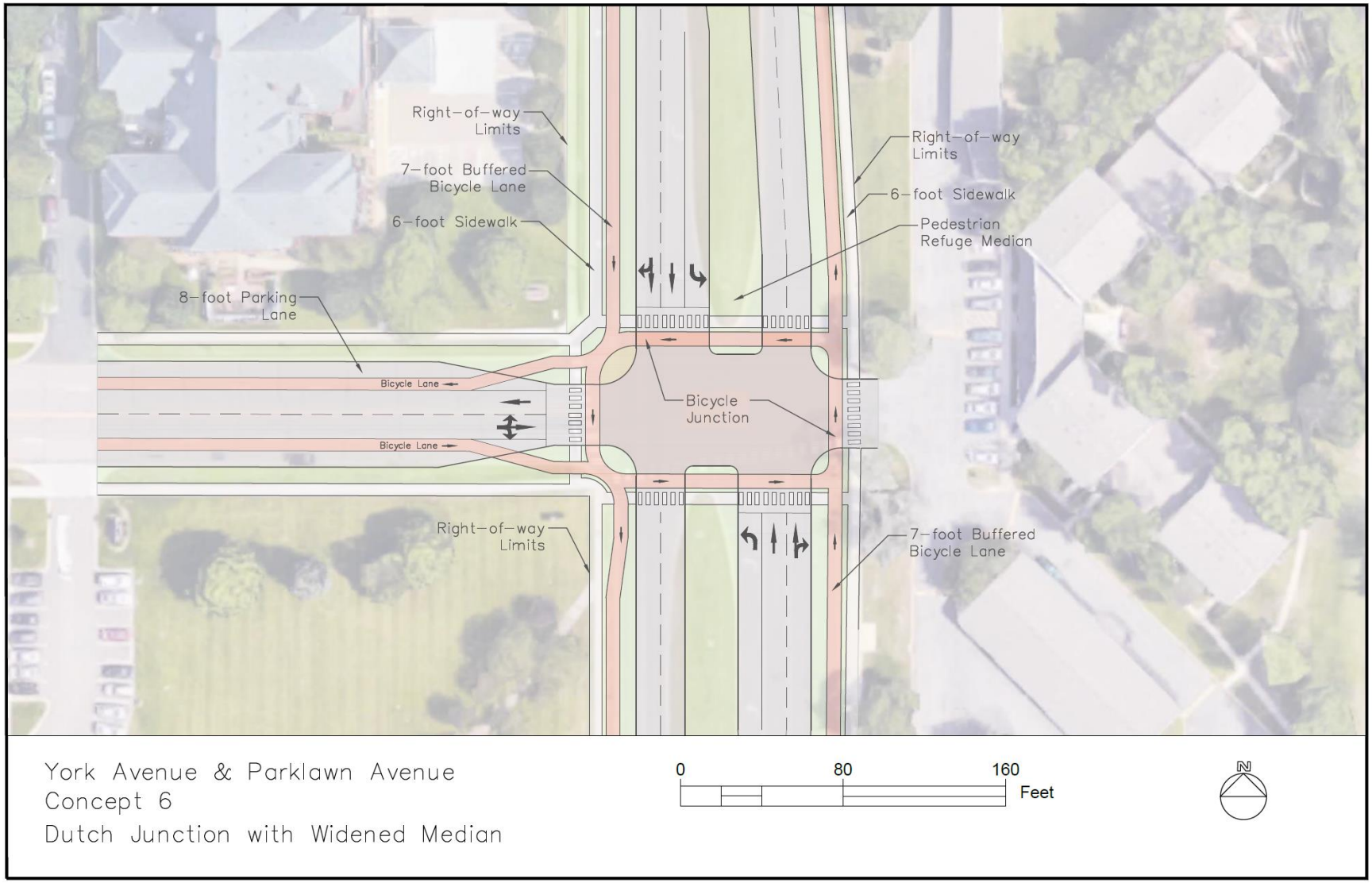


Figure B-3: Concept 6 of the second iteration of designs delivered to mentors

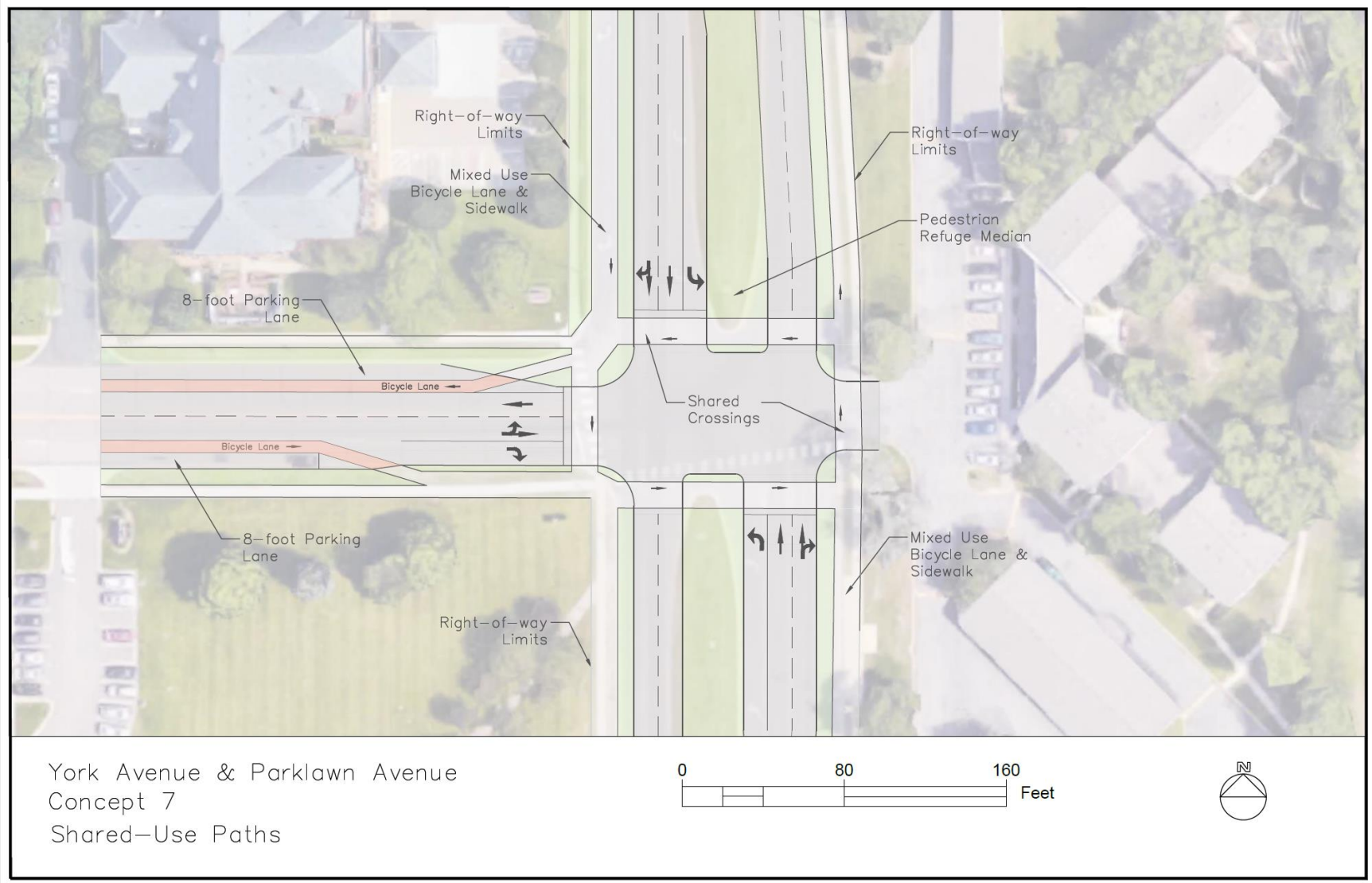


Figure B-4: Concept 7 of the second iteration of designs delivered to mentors

Appendix C: Final Design

After continued research and communication with the City of Edina, the design was altered to the final recommendation, Concept 8. The design incorporates several aspects of earlier designs, including the separated bike and pedestrian trail, and shared crossings.

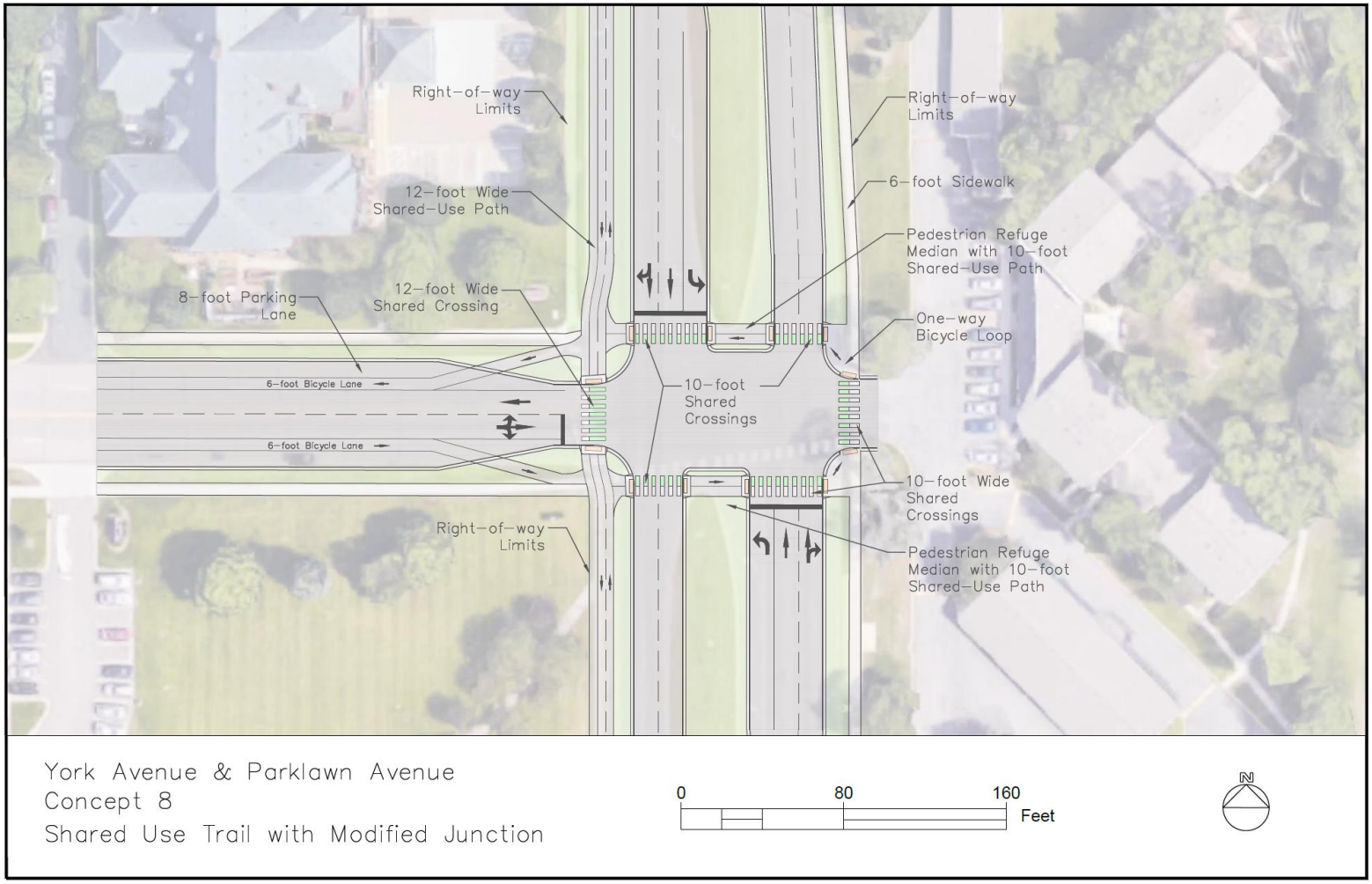


Figure C-1: Final Design (Concept 8) from the final iteration of designs submitted to mentors

Appendix D: Current Traffic Counts

Video of the intersection was taken for a 24-hour period. The vehicles travelling through the intersection and their movements were recorded. The data collected was similar to previous data collected by Hennepin County.

Table D-1: Traffic counts for York Avenue S and Parklawn Avenue on Feb 8th, 2018

Time	SB RIght	SB Thru	SB Left	WB Right	WB Thru	WB Left	NB Right	NB Thru	NB Left	EB Right	EB Thru	EB Left
0:00	0	8	0	0	0	2	2	4	0	0	0	1
0:15	0	13	0	0	0	0	0	4	0	0	0	1
0:30	2	3	1	0	0	0	0	3	0	0	0	1
0:45	0	1	0	0	0	0	0	1	0	0	0	0
1:00	2	4	0	0	0	0	0	6	1	0	0	2
1:15	0	1	0	0	0	0	0	4	0	0	0	0
1:30	1	4	1	0	0	1	0	2	0	0	0	1
1:45	0	4	0	0	0	0	0	1	0	0	0	1
2:00	2	4	1	0	0	0	0	5	0	2	0	0
2:15	0	3	1	0	0	0	0	1	0	0	0	0
2:30	0	3	0	0	0	0	0	0	0	0	0	0
2:45	0	2	0	0	0	0	0	2	0	0	0	1
3:00	1	2	0	0	0	0	0	1	0	0	0	0

3:15	2	1	0	0	0	0	0	2	0	0	0	0
3:30	0	3	0	0	0	0	0	1	0	0	0	2
3:45	0	1	0	0	0	0	0	3	0	0	1	0
4:00	0	2	0	0	0	0	0	0	0	0	0	0
4:15	0	3	0	0	0	0	0	4	0	0	0	0
4:30	0	4	0	0	0	1	0	1	0	2	1	3
4:45	0	4	0	1	0	0	0	12	0	0	0	9
5:00	0	5	0	0	0	1	0	28	0	0	1	9
5:15	1	11	0	0	0	1	0	19	1	0	0	4
5:30	3	14	0	0	0	0	0	17	2	0	0	6
5:45	7	27	2	2	0	0	0	34	1	0	0	5
6:00	7	15	0	1	0	0	0	35	2	1	0	5
6:15	5	34	0	3	0	0	1	27	3	0	0	4
6:30	5	39	0	1	0	1	0	29	7	3	0	6
6:45	10	55	4	0	0	3	0	45	21	3	0	4
7:00	15	68	0	0	0	2	3	53	12	2	0	9
7:15	11	97	0	1	0	1	0	50	11	6	0	11
7:30	16	114	0	0	0	1	0	82	10	5	3	7

7:45	23	133	2	2	0	4	4	99	14	7	0	9
8:00	15	113	0	2	0	4	1	78	14	13	0	12
8:15	11	116	1	0	0	2	1	85	16	10	1	9
8:30	10	116	1	1	0	3	1	84	15	18	2	12
8:45	15	121	1	3	0	2	0	89	23	19	0	10
9:00	23	80	0	2	0	2	2	115	18	28	0	9
9:15	28	110	0	3	0	2	0	119	10	25	0	20
9:30	14	120	1	1	0	1	0	152	16	28	1	9
9:45	9	127	3	0	0	1	1	124	2	21	1	12
10:00	12	90	0	0	0	0	3	92	8	15	0	17
10:15	26	113	2	3	0	0	1	104	8	8	2	15
10:30	17	113	2	1	0	3	1	103	14	12	0	11
10:45	20	123	0	3	0	2	1	93	10	7	1	12
11:00	21	130	0	1	0	0	0	133	14	18	1	18
11:15	13	130	3	2	0	0	1	150	12	9	0	20
11:30	14	151	2	0	0	0	0	145	7	19	0	27
11:45	26	188	4	1	0	0	0	141	10	11	0	28
12:00	29	167	1	2	0	1	2	174	7	16	0	25

12:15	36	152	3	0	0	1	1	134	10	22	1	20
12:30	27	172	3	1	0	1	2	169	5	33	0	23
12:45	19	170	6	1	0	1	4	149	12	19	0	22
13:00	23	164	1	1	0	0	0	131	9	14	1	23
13:15	15	180	1	2	0	0	0	99	15	12	3	16
13:30	23	162	1	2	0	2	3	117	14	14	1	31
13:45	22	137	0	1	0	2	1	115	11	11	0	18
14:00	27	158	9	2	0	0	1	103	11	22	0	17
14:15	14	139	5	3	0	0	1	133	9	21	0	22
14:30	26	159	4	3	0	3	3	119	13	14	1	23
14:45	16	143	4	4	0	2	5	108	9	18	1	21
15:00	22	138	1	1	0	4	1	111	14	21	0	24
16:00	22	154	5	2	0	2	1	151	11	26	1	15
17:00	24	158	3	2	0	3	2	216	9	23	0	29
18:00	27	128	7	7	0	2	3	123	13	21	0	25
19:00	14	91	5	4	0	3	3	82	9	10	0	13
20:00	12	73	1	2	0	0	1	61	2	5	0	15
21:00	8	67	4	0	0	0	1	33	4	1	0	10

22:00	5	38	1	0	0	0	2	21	4	0	0	4
23:00	3	11	1	0	0	0	0	9	0	1	0	3

Appendix E: Present Level of Service - Current Design

Initially, two level of service analyses were conducted to determine how the intersection was performing under the current design. The morning peak hour and evening peak hour were both evaluated and showed several areas of concern, mostly for the through and left-turn movements from Parklawn Avenue.

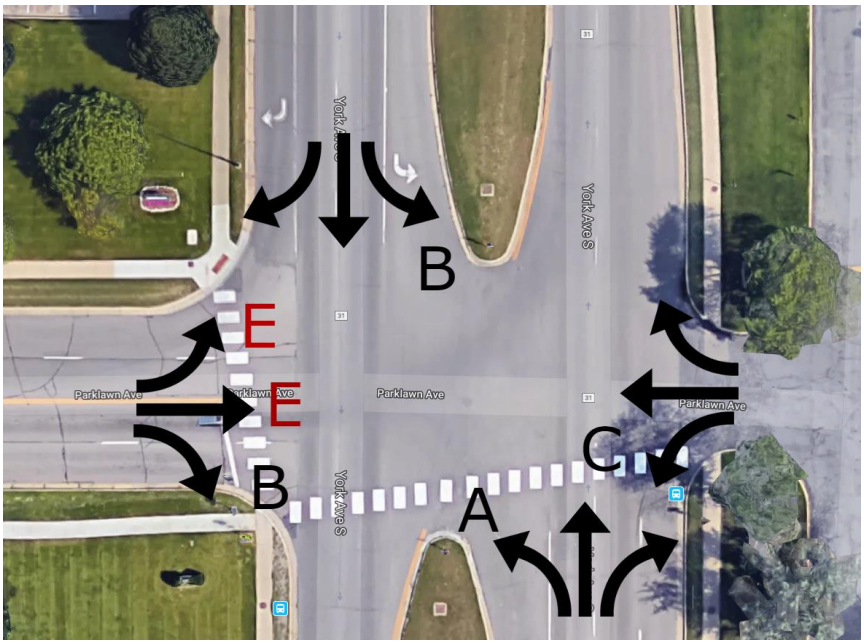


Figure E-1: Level of Service: 2018 Morning Peak Volumes

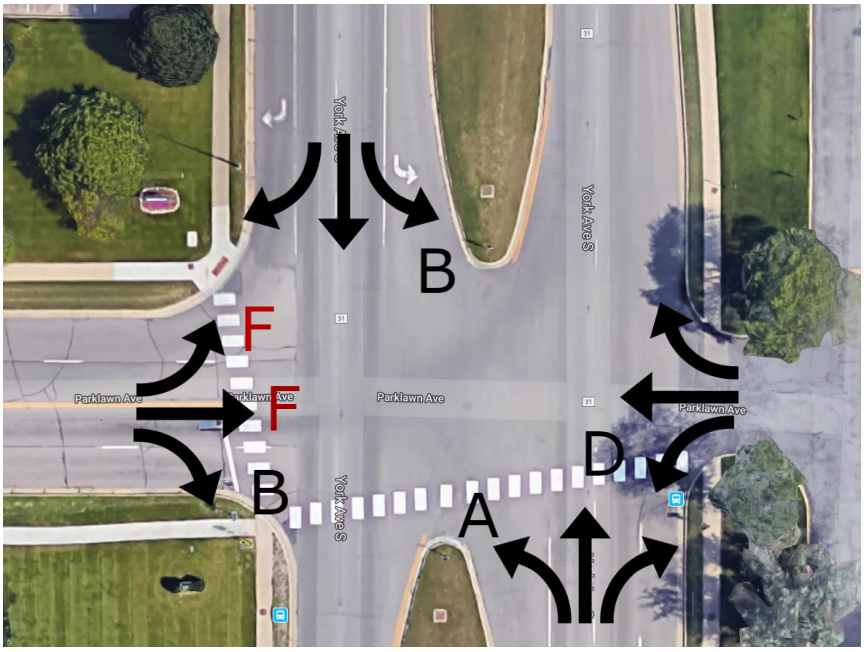


Figure E-2: Level of Service: 2018 Evening Peak Volumes

Appendix F: 2040 Level of Service - Current Design

Two other level of service analyses were performed using the current design but under predicted 2040 volumes, first a baseline prediction, and then a high-density prediction.

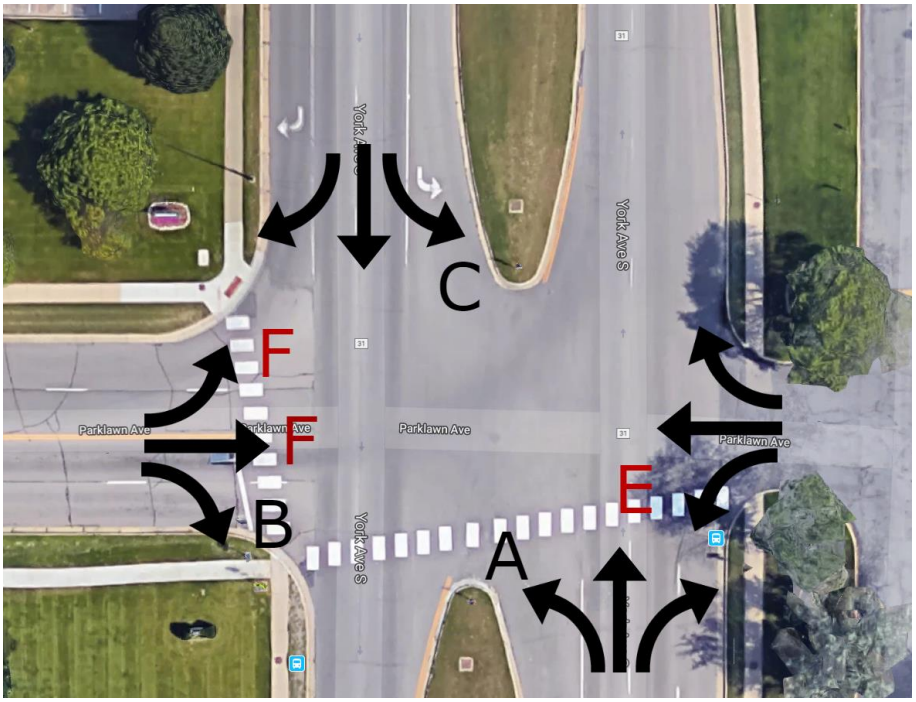


Figure F-1: Level of Service: 2040 Baseline Volumes with Current Design

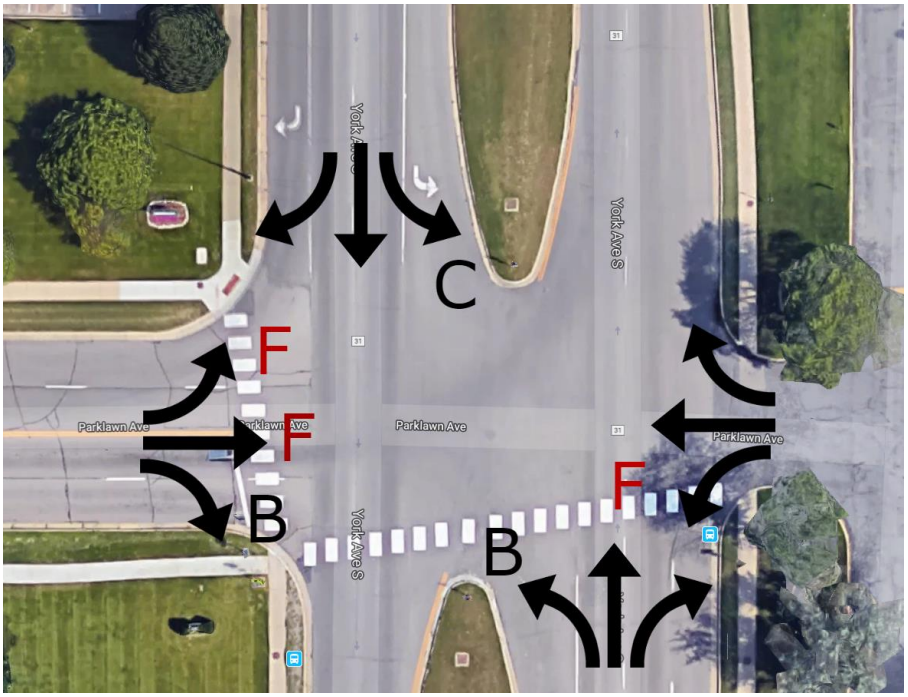
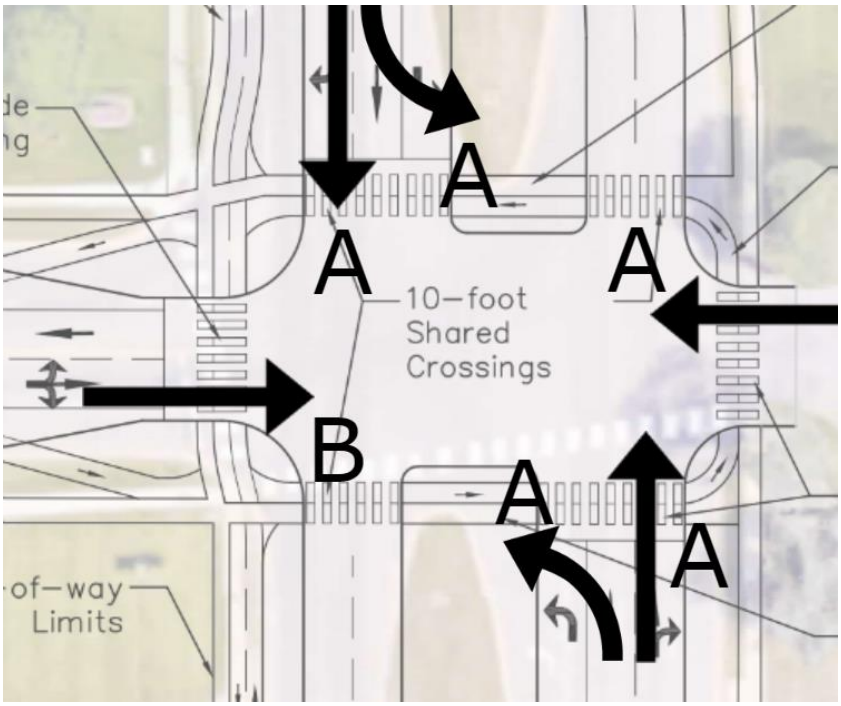


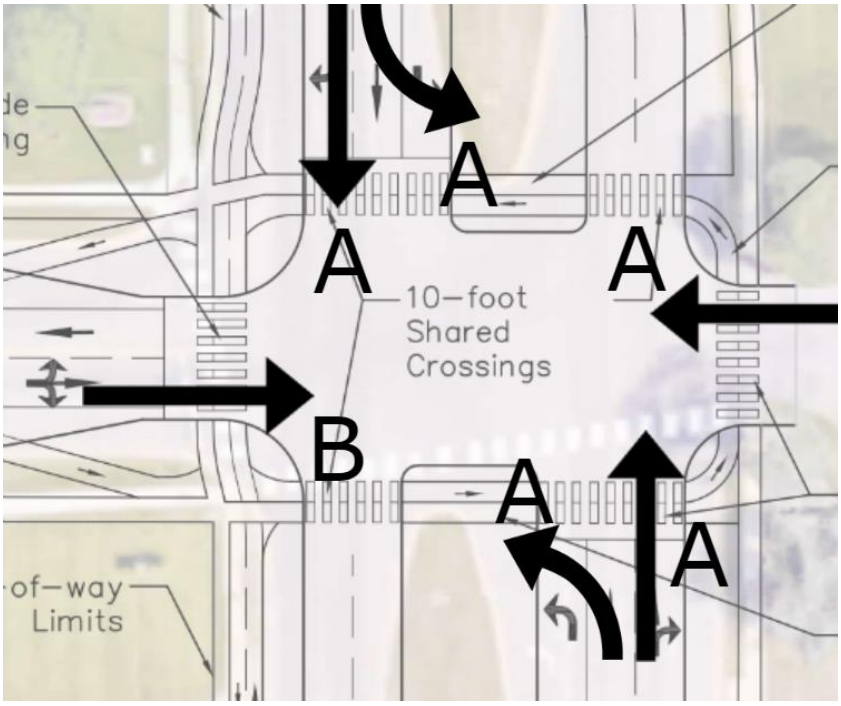
Figure F-2: Level of Service: 2040 High Volumes with Current Design

Appendix G: Level of Service for Recommended Design

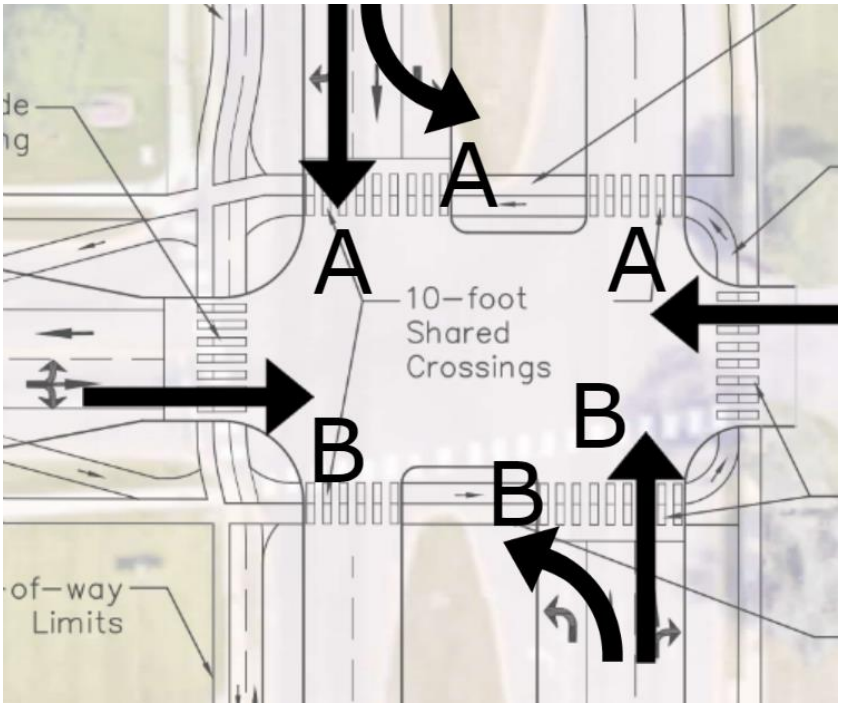
The level of service was evaluated again, this time with the new design and added traffic signal. The level of service is consistently A or B, even under the high-density 2040 prediction.



Level of Service: 2018 Evening Peak with Recommended Design



Level of Service: 2040 Baseline with Recommended Design



Level of Service: 2040 High Density with Recommended Design

Appendix H: Signal Warrants from MN MUTCD

Parameters that are used to justify the installation of a traffic signal at an intersection are found in the Minnesota Manual on Uniform Traffic Control Devices. If any of the warrants are met, the intersection qualifies for the addition of a signal.

4C.1 Studies and Factors for Justifying Traffic Control Signals

STANDARD:

An engineering study of traffic conditions, pedestrian characteristics, and physical characteristics of the location shall be performed to determine whether installation of a traffic control signal is justified at a particular location.

The investigation of the need for a traffic control signal shall include an analysis of factors related to the existing operation and safety at the study location and the potential to improve these conditions, and the applicable factors contained in the following traffic signal warrants:

Warrant 1, Eight-Hour Vehicular Volume.
Warrant 2, Four-Hour Vehicular Volume.
Warrant 3, Peak Hour.
Warrant 4, Pedestrian Volume.
Warrant 5, School Crossing.
Warrant 6, Coordinated Signal System.
Warrant 7, Crash Experience.
Warrant 8, Roadway Network.
Warrant 9, Intersection Near a Grade Crossing

The satisfaction of a traffic signal warrant or warrants shall not in itself require the installation of a traffic control signal.

Figure H-1: All traffic signal warrants as stated by MN MUTCD (Minnesota Department of Transportation 2011).

Appendix I: Traffic Signal Warrant Analysis from Hennepin County

Hennepin County conducted a signal warrant review in 2014. They found that the intersection warranted a signal, but no signal was implemented. Below are their results and a summary of their findings.

SIGNAL WARRANT REVIEW*

HENNEPIN COUNTY TRANSPORTATION DEPARTMENT
TRANSPORTATION PLANNING DIVISION

LOCATION CSAH 31 & Parklawn Ave

STUDY NO. 3582 DATE 10/27/2014 - 10/30/2014

SPEED LIMIT 35 MPH

SPEED STUDY None 85%:

VOLUME REDUCTION No

WARRANT 1	MAINLINE		MINOR		CONCURRENT	WARRANT MET
CONDITION A (MIN. VEH.)	13	HRS.	3	HRS.	3 HRS.	No
CONDITION B (INT. OF TRAF.)	11	HRS.	11	HRS.	10 HRS.	Yes
COMBINATION A & B	13	HRS.	8	HRS.	8 HRS.	Yes
					TIME	
WARRANT 2 (FOUR HR. VOL.)	1425	VEHS	163	VEHS	11:00 AM – 12:00 PM	Yes
	1583	VEHS	191	VEHS	12:00 PM - 1:00 PM PK	
	1575	VEHS	214	VEHS	4:00 PM – 5:00 PM	
	1618	VEHS	240	VEHS	5:00 PM – 6:00 PM PK	
WARRANT 3 (PEAK HR.)	1575	VEHS	214	VEHS	4:00 PM – 5:00 PM	Yes
	1618	VEHS	240	VEHS	5:00 PM – 6:00 PM PK	
MULTIWAY STOP (VEH. VOLUME)	16	HRS.	6	HRS.	6 HRS.	No

WARRANTS MET 1B, 1C, 2, & 3

*Form changed as of 1/1/03 to be consistent with adoption of 2002 MMUTCD.

Traffic\Warrants\Warrant Review Summary Forms

Figure I-1: Tabulation of warrants met during Hennepin County's signal warrant analysis in 2014.

Appendix J: Gantt Chart illustrating schedule completed by 07_L_Edina

Progress of the project was recorded for billing updates. It was also used as a project management tool to keep the group on task.

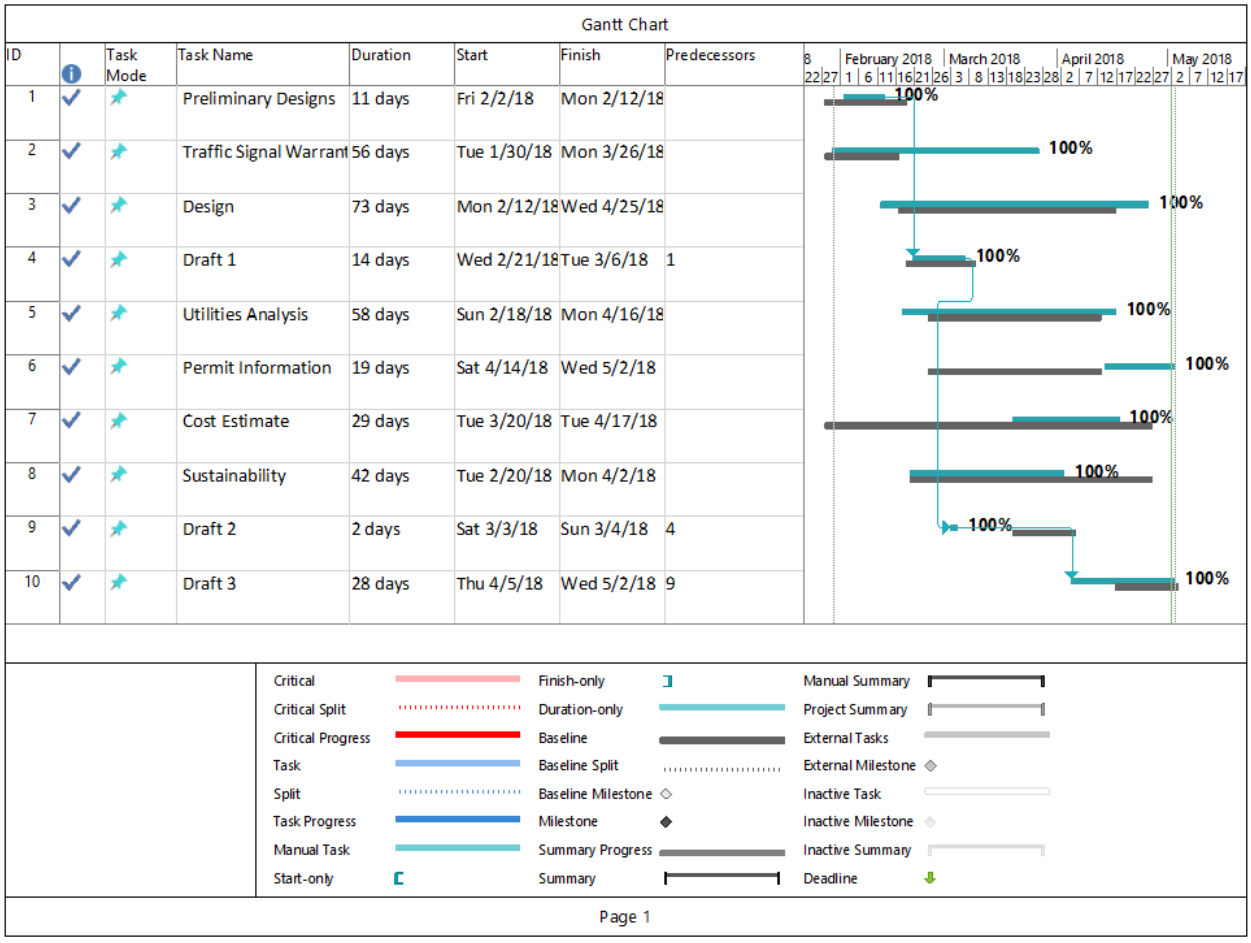


Figure J-1: Gantt Chart showing the time frames for each task completed by all members

Table 5: Hours worked per team member (MK=Mitch Kiecker, KH=Kate Hvizdos, CB=Cade Botten, BH=Bryce Heller)

	Hours per Reporting Period Per Member			
Reporting Period	MK	KH	CB	BH
1	1	3	1	1
2	12	6.25	10	8
3	7	7	6	11.75
4	16	12	11	7.5
5	12.75	11.25	11.25	29.25
6	22	13	19	15.25
7	14	6	17	8
8	20	19	19	10
Total Hours Worked	104.75	77.5	94.25	90.75
Hourly Billing Rate	$ 300.00	$ 480.00	$ 250.00	$ 250.00
Billed Cost	$31,425.00	$37,200.00	$23,562.50	$ 22,687.50
			Total Cost	$114,875.00

Appendix K: Listing of Authors and Contributions

I. Cover Letter
Author: Kate Hvizdos
Editor: Mitch Kiecker

II. Executive Summary
Author: Kate Hvizdos
Editor: Mitch Kiecker

III. Introduction
Author: Cade Botten
Editor: Kate Hvizdos

IV. Site Information
Author: Cade Botten
Editor: Kate Hvizdos

V. Design Considerations
Author: Mitch Kiecker
Editor: Cade Botten

VI. Sustainability Considerations
Author: Kate Hvizdos
Editor: Mitch Kiecker

VII. Level of Service
Author: Kate Hvizdos
Editor: Mitch Kiecker

VIII. Budget
Author: Cade Botten
Editor: Kate Hvizdos

IX. Permitting and Approvals
Author: Bryce Heller
Editor: Cade Botten

X. Recommendations
Author: Kate Hvizdos
Editor: Mitch Kiecker