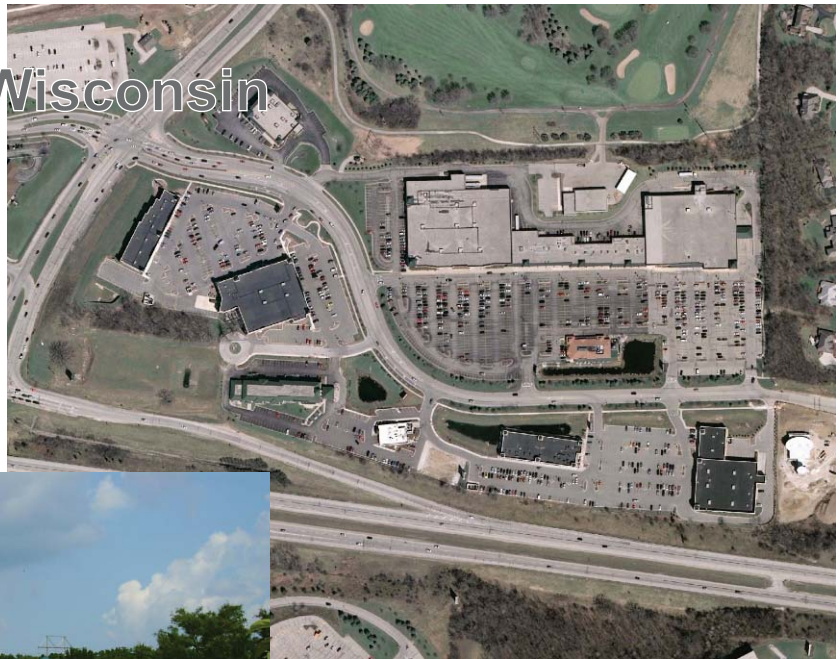


Golf Road Traffic Improvement Feasibility Study

STH 83 to Eastern City Limits

City of Delafield, Wisconsin

June 4, 2010



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Submitted: June 4, 2010

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Table of Contents

INTRODUCTION	1
STUDY AREA.....	1
STH 83 Project	1
SAFETY ASSESSMENT	1
Crash History.....	1
Corridor Safety Concerns.....	2
EXISTING TRAFFIC	4
Traffic Operational Analysis	4
FUTURE TRAFFIC	5
Future Development.....	5
Traffic Forecasts	6
ALTERNATIVES ANALYSIS	6
Feasibility Considerations	6
Golf Road Alternatives.....	7
Project Cost Estimates	10
Construction Schedule.....	10
Alternatives Comparison.....	11
PUBLIC INVOLVEMENT	14
PROJECT FINANCING	14
Funding Opportunities	14
CONCLUSIONS	18

Tables

Table 1	Golf Road Crash Rates
Table 2	Golf Road Intersection Crash Rates
Table 3	Existing Intersection Sight Distances
Table 4	Future Development Trip Generation
Table 5	Daily Traffic Forecasts
Table 6	Alternatives Cost Estimates
Table 7	Conceptual Project Durations
Table 8	Alternatives Comparison
Table 9	Summary of Project Cost Share – Private\Public Partnering Based on Traffic Volumes
Table 10	Summary of Project Cost Share – Estimated Project Costs Associated with STP-U Funding
Table 11	Summary of Project Cost Share – Estimated Project Costs Associated with HSIP Funding

Golf Road Traffic Improvement Feasibility Study

Table of Contents Continued

Exhibits

Exhibit 1	Project Overview
Exhibit 2	Existing (Year 2009) Peak Hour Traffic Volumes
Exhibit 3	Future Development Peak Hour Traffic Volumes
Exhibit 4	Year 2035 Peak Hour Traffic Volumes

Appendix

Appendix 1	Crash Diagram
Appendix 2	Intersection Sight Distance Exhibits
Appendix 3	Existing (Year 2009) Traffic Operational Analysis Summary
Appendix 4	Alternatives – Conceptual Roadway Designs
Appendix 5	Year 2035 Traffic Operational Analysis Summaries
Appendix 6	Construction Cost Estimates
Appendix 7	Public Involvement Summaries

Traffic counts & analysis will be provided upon request.

INTRODUCTION

The City of Delafield plans to resurface or reconstruct the section of Golf Road between STH 83 and the eastern city limits due to the deteriorating pavement condition. In planning for the future of this roadway, the City of Delafield retained GRAEF to conduct a traffic improvement feasibility study to identify and evaluate potential alternatives for this project. The scope of the feasibility study includes data collection, safety assessment, access management, traffic forecasts, traffic operational analysis, conceptual roadway design, cost estimates, funding options and public involvement. This report documents the procedures, findings and recommendations of this traffic improvement feasibility study.

STUDY AREA

The project limits for this feasibility study include the 0.45 mile section of Golf Road from the east approach of the intersection with STH 83 to the eastern city limits, as shown on Exhibit 1. Golf Road is primarily an east-west roadway with four travel lanes provided on the western section that narrows to a two-lane roadway with a two-way left-turn lane (TWLTL) on the east portion of the project. The posted speed limit along this section of Golf Road is 30 miles per hour (mph). According to the Wisconsin Department of Transportation (WisDOT), the Year 2009 annual average daily traffic (AADT) for Golf Road was 18,200 vehicles per day (vpd) east of STH 83.

Golf Road provides access to the Nagawaukee Shopping Center and the Shoppes at Nagawaukee with a total of 360,000 square feet of commercial uses including numerous large-box retailers, a grocery store, a pharmacy, a bank, several restaurants, a hotel and various specialty service providers. Sidewalk is provided throughout the project along the south side of Golf Road. For the western portion of the project, there is also sidewalk on the north side of Golf Road connecting STH 83 to the Kohl's west access. Waukesha County's Naga-Waukee Golf Course is located north of the Nagawaukee Shopping Center. The County's Lake Country Trail runs along the south side of the Nagawaukee Golf Course. The Lake Country Trail is an 8 mile east-west recreational trail connecting the Landsberg Center Trailhead (Golf Road between CTH G & and CTH T) and Cushing Park in the City of Delafield.

STH 83 Project

In 2010, the Wisconsin Department of Transportation (WisDOT) plans to resurface the section of STH 83 from Glacier Pass to Golf Road. As part of the WisDOT's project, signal improvements and island modifications are planned for the STH 83 intersection with Golf Road to eliminate the existing split phasing and allow the eastbound and westbound left-turn movements to operate concurrently. Additionally, the Lake Country Recreational Trail crossing of STH 83 will be relocated to the crosswalk on the north approach of the STH 83 intersection with Golf Road.

SAFETY ASSESSMENT

Crash History

The City provided crash reports for Golf Road for the most recent three year period (October 1, 2006 through September 30, 2009). A crash diagram illustrating the 20 crashes reported over the three year period is included in Appendix 1. As shown on the crash diagram, 14 crashes occurred in the section of Golf Road between the Walgreen's access and Kohl's West Access with 5 of the crashes (25 percent) related to the Sports Authority access. Injuries were reported in 4 of the 20 crashes, which accounts for 20 percent of the crashes. It should be noted that property damage crashes with less than \$1,000 of damage do not need to be reported in Wisconsin.

The crash rates for roadway segments are calculated in units of crashes per 100 million vehicle miles (HMVM). Due to the significant difference in traffic volumes along the project, the Marshall's Access was established as a location to divide Golf Road into two sections for the purpose of crash rates. Table 1 shows the crash rates for Golf Road.

Table 1
Golf Road Crash Rates

Segment	Average Annual Crashes	Length (in Miles)	Crash Rate (Crashes per 100 million vehicle miles)
West Segment (East of STH 83 to Marshall's Access)	5	0.20	352
East Segment (Marshall's Access to Eastern City Limits)	2	0.25	274

As shown in Table 1, the crash rate for the west segment of Golf Road is 352 crashes per 100 million vehicle miles (HMVM). The east segment has a lower crash rate of 274 crashes per HMVM. The Year 2008 statewide average crash rate for an urban street was 257 crashes per HMVM (excluding deer crashes). It should be noted that the urban street category includes both urban state trunk highways and city streets. Therefore, the crash rates for both sections of Golf Road exceed the statewide average.

Of the 20 crashes reported within the study area, 16 crashes occurred at intersections. Intersection crash rates were calculated for the study area intersections with more than two crashes during the three year period. For comparison purposes, intersection crash rates are expressed as crashes per million entering vehicles (MEV) to account for the traffic volumes. The intersection crash rates are shown in Table 2.

Table 2
Golf Road Intersection Crash Rates

Golf Road Intersection	Crash Severity				Crash Rate (Crashes per million entering vehicles)
	Property Damage Only	Injury	Fatal	Total	
Sports Authority / Truck Access	5	1	0	6	0.34
Kohl's West Access	2	2	0	4	0.19

As shown in Table 2, the Golf Road intersection with the Sports Authority/Truck Access has the highest crash rate of 0.34 crashes per million entering vehicles (MEV).

Corridor Safety Concerns

As part of the safety assessment, GRAEF conducted a review of the corridor and identified design elements that are substandard or undesirable resulting in safety concerns. The corridor safety concerns are summarized in this section.

Horizontal Curves

The posted speed limit of 30 mph on Golf Road results in a design speed of 35 mph for the project. The existing roadway alignment within the project study area includes two superelevated horizontal curves. Both horizontal curves have design speeds of 30 mph. The design speed of Golf Road is greater than the design speed of the horizontal alignment resulting in substandard horizontal curves.

Vertical Curves

The existing Golf Road profile east of the STH 83 intersection includes two separate vertical curves. The existing grade extending to the east from the STH 83 intersection has a +3.38% grade leading into the crest vertical curve,

followed by a -5.34% grade leading into the sag vertical curve. East of the sag vertical curve, the profile remains relatively flat, with grades between +0.56% and +1.94%. The crest vertical curve has a design speed of 35 mph and the sag vertical curve has a 45 mph design speed. In each instance, the design speed is based on desirable design standards with an object height of 6 inches.

Stopping Sight Distance

The stopping sight distance along Golf Road is sufficient for the posted 30 mph speed limit. The K Value is defined as the horizontal distance needed to produce a 1% change in gradient; a higher K value indicates a flatter curve making it acceptable for higher speeds. The existing crest vertical curve has a K value of 49, which meets criteria for a 35 mph design speed. The existing sag vertical curve has a K value of 93, which meets criteria for a 45 mph design speed. In both cases, the design speed meets desirable criteria with an object height of 6 inches.

Intersection Sight Distance

There are safety concerns related to the intersection sight distance for the Sports Authority, Walgreens, and Truck Access specifically looking to the west over the crest vertical curve. The existing intersection sight distances for these locations are shown on Exhibits included in Appendix 2 and summarized in Table 3.

Table 3
Existing Intersection Sight Distances

Access	Intersection Sight Distance for Passenger Vehicle		
	Existing	Minimum	Desirable
Walgreen's Access to the right	408'	460'	585'
Sports Authority Access to the left	335'	355'	435'
Truck Access to the right	372'	460'	585'

*Sight distance is limited by the Golf Road intersection with STH 83.

The intersection sight distance looking to the right at the Walgreen's access is limited to 408 feet due to the close proximity to the STH 83 intersection. As shown on the exhibit, vehicles queued in the dual left-turn lanes obstruct the sight distance for the Walgreen's access. The intersection sight distance looking to the left at the Sports Authority access is obstructed by the sidewalk, which results in sight distance of 335 feet (20 feet less than minimum). For the truck access, the intersection sight distance looking to the right is 372 feet (88 feet less than minimum). Similar to the Walgreen's access, vehicles queued in the dual left-turn lanes at the STH 83 intersection may obstruct the sight distance for the truck access.

We have heard many concerns regarding the safety of the left-out movement at the Sports Authority access throughout the public involvement process. Majority of the people at the meetings have witnessed a near miss at this location. Consider restricting the left-out movement at Sports Authority until the intersection sight distance can be improved through a reconstruction project.

The sign at the Sports Authority access obstructs the view to the west resulting in vehicles driving beyond the crosswalk to look for a gap in traffic to safely maneuver the intersection. Additionally, the trees are a sight obstruction specifically at the Kohl's west access, Kohl's east access, Qdoba access and Sentry west access. To improve safety along the corridor, it is recommended to remove any sight obstructions (signs, trees, etc.) within the vision triangle and intersection sight distance of the driveways along Golf Road.

Median Treatment

There are two main types of median treatments including a two-way left-turn lane and a raised median. The two-way left-turn lane section on Golf Road raises safety concerns due to the closely spaced access points. A raised median will reduce the number of conflict points and provide safer access.

EXISTING TRAFFIC

The study area includes the Golf Road intersection with STH 83 and the following twelve access driveways along the project:

Walgreen's Access (#12)	Kohl's East Access (#9)
Sports Authority Access (#1)	Qdoba Access (#4)
Truck Access (#11)	Sentry West Access (#8)
Kohl's West Access (#10)	Best Buy Access (#5)
Marshall's Access (#2)	Sentry East Access (#7)
Applebee's Access (#3)	Best Buy Truck Access (#8)

In some exhibits, the access driveway is referenced by the number shown above. GRAEF utilized the WisDOT's weekday traffic count for the Golf Road intersection with STH 83 from July of 2007. In October of 2009, GRAEF conducted turning movement traffic counts at the study area intersections during the weekday evening peak period (3:00 to 6:00 pm) and the Saturday midday peak period (11:00 am to 2:00 pm). Based on the traffic counts, the weekday evening peak hour was identified to be 4:45 to 5:45 pm and the Saturday midday peak hour was identified to be 12:15 to 1:15 pm. The existing (Year 2009) traffic volumes, including the additional trips generated by a vacant 4,000 square foot retail space, are shown on Exhibit 2.

Traffic Operational Analysis

Level of Service Definition

The study area intersections were analyzed using procedures set forth in the *2000 Highway Capacity Manual* (HCM). For analysis and design purposes, Level of Service (LOS) 'D' was used to define acceptable peak hour operating conditions. Level of Service is a quantitative measure that refers to the overall quality of flow at an intersection ranging from very good, represented by LOS 'A', to very poor, represented by LOS 'F'. Descriptions of the various levels of service are presented below:

LOS A is the highest level of service that can be achieved. Under this condition, intersection approaches appear quite open, turning movements are easily made, and nearly all drivers find freedom of operation. At signalized intersections, average delays are less than 10 seconds. At unsignalized intersections, average delays are less than 10 seconds.

LOS B represents stable operation. At signalized intersections, average vehicle delays are 10 to 20 seconds. At unsignalized intersections, average delays are 10 to 15 seconds.

LOS C still represents stable operation, but periodic backups of a few vehicles may develop behind turning vehicles. Most drivers begin to feel restricted, but not objectionably so. At signalized intersections, average vehicle delays are 20 to 35 seconds. At unsignalized intersections, average delays are 15 to 25 seconds.

LOS D represents increasing traffic restrictions as the intersection approaches instability. Delays to approaching vehicles may be substantial during short peaks within the peak period, but periodic clearance of long lines occurs, thus preventing excessive backups. At signalized intersections, average vehicle delays are 35 to 55 seconds. At unsignalized intersections, average delays are 25 to 35 seconds.

LOS E represents the capacity of the intersection. At signalized intersections, average vehicle delays are 55 to 80 seconds. At unsignalized intersections, average delays are 35 to 50 seconds.

LOS F represents jammed conditions where the intersection is over capacity and acceptable gaps for unsignalized intersections in the mainline traffic flow are minimal. At signalized intersections, average vehicle delays exceed 80 seconds. At unsignalized intersections, average delays exceed 50 seconds.

Existing (Year 2009) Traffic Analysis

The existing (Year 2009) traffic volumes were analyzed with the existing intersection geometrics and traffic control. Based on the existing traffic analysis, the following movements currently operate unacceptably with the existing intersection geometrics:

- Walgreen's Access: The left-turn movement exiting the development currently operates unacceptably at LOS E conditions during the weekday evening peak hour and LOS F conditions during the Saturday midday peak hours.
- Sports Authority Access: The left-turn movement exiting the development currently operates unacceptably at LOS F conditions during the weekday evening and Saturday midday peak hours.
- Kohl's West Access: The left-turn movement exiting the development currently operates unacceptably at LOS E conditions during the weekday evening peak hour and LOS F conditions during the Saturday midday peak hour.
- Marshall's Access: During the Saturday midday peak hour, the left-turn movement exiting the development currently operates unacceptably at LOS F conditions.

All movements at the other study area intersections currently operate acceptably (LOS D or better conditions) during the peak traffic hours. A summary of the existing traffic operations for each intersection is included in Appendix 3.

FUTURE TRAFFIC

The future traffic for this project was developed to include two components: 1) traffic expected to be generated by the future development of parcel in the southwest corner of the Shoppes of Nagawaukee and 2) anticipated growth of the through traffic (i.e. does not stop at any of the commercial uses along the project) along the corridor.

Future Development

An undeveloped parcel in the southwest corner of the Shoppes of Nagawaukee is planned for future development. For the purpose of this feasibility study, a 22,400 square foot high turnover sit down restaurant is anticipated for this site. The expected traffic volumes generated by this site is based on the size and type of proposed land use, and on trip data published in the Institute of Transportation Engineer's (ITE's) *Trip Generation, 8th Edition (2008)*. Table 4 shows the trip generation for the future development.

Table 4
Future Development Trip Generation

Land Use	ITE Land Use Code	Size	Daily Trips	Weekday PM Peak Hour Trips			Saturday Midday Peak Hour Trips		
				In	Out	Total	In	Out	Total
High Turnover Sit Down Restaurant	932	22,400 SF	2,850	150	100	250	165	150	315

As shown in Table 4, the future development is expected to generate 2,850 daily trips on a typical weekday. The development is expected to generate 250 trips (150 entering vehicles/100 exiting vehicles) during the weekday evening peak hour and 315 trips (165 entering vehicles/150 exiting vehicles) during the Saturday midday peak hour.

The Marshall's access will provide access to the future development site. The following directional distribution for the future development is based on existing and anticipated travel patterns of the adjacent roadway system:

- 40% to and from the south on STH 83
- 20% to and from the north on STH 83
- 20% to and from the west on Golf Road
- 20% to and from the east on Golf Road

The development trips were assigned to the adjacent roadway system based on the above directional distribution. The future development trips are shown on Exhibit 3.

Traffic Forecasts

GRAEF developed daily and peak hour intersection traffic forecasts for the anticipated design year (Year 2035). The through traffic along Golf Road (i.e. does not stop at any of the commercial uses along the project) is anticipated to continue to increase in the future. Based on our data collection, the through traffic is approximately 260 vehicles during the weekday evening peak hour (125 eastbound/135 westbound) and approximately 210 vehicles during the Saturday midday peak hour (95 eastbound/115 westbound). The through volumes account for approximately 15% of the traffic during the weekday evening peak hour and 10% of the traffic during the Saturday midday peak hour.

A 0.5% annual growth rate was applied to the through traffic volumes to develop the future traffic forecasts. In addition to the increase in through traffic, the forecasts include the trips expected to be generated by the future development of the vacant parcel in the southwest corner of the Shoppes at Nagawaukee. The final phase of the Shoppes at Nagawaukee was completed in 2008 and the buildings have since been occupied. With the exception of the identified future development, the commercial traffic entering and exiting the driveways along Golf Road is not expected to increase in the future. The daily traffic forecasts are summarized in Table 5.

Table 5
Year 2035 Daily Traffic Forecasts

Golf Road	Year 2009 Daily Traffic	Year 2035 Daily Traffic Forecast
East of STH 83	18,200	20,600
Eastern City Limits	5,900*	6,800*

* Estimated volume assuming 10% of daily traffic occurs during the weekday evening peak hour.

As shown in Table 5, the Year 2035 daily traffic forecasts range from 20,600 vehicles per day (vpd) east of STH 83 to 6,800 vpd at the east project limits. The Year 2035 peak hour traffic forecasts for the study area intersections are shown on Exhibit 4.

ALTERNATIVES ANALYSIS

Feasibility Considerations

GRAEF considered access management, pedestrian and bicycle accommodations and traffic control options throughout the feasibility phase of the study.

Access Management

Access management is critical component to provide safe and efficient traffic flow. Access management recommendations are based on principles identified by the Transportation Research Board's (TRB's) Access Management Manual. Two of the principles that specifically apply to this corridor include the separation of conflict points and the management of left-turn movements with a raised median. Separating conflict points is vital element to ensuring motorists have adequate time to identify and respond to each conflict point. Conflict points include intersections, turn lanes and medians. Proper spacing of intersections and driveways improves safety and operations. Raised medians provide greater flexibility in restricting or eliminating specific movements.

Intersection Control

Three intersection control options were evaluated through the alternatives analysis including maintaining the existing stop control, traffic signal and roundabout. A traffic signal will create gaps in traffic along Golf Road to improve operations at the adjacent stop controlled driveways. Roundabouts typically have less delay and shorter queues than a traffic signal. Roundabouts can also be a type of access management to safely accommodate u-turns from adjacent restricted access.

Pedestrian & Bicycle Accommodations

The following on road and off road pedestrian/bicycle facilities were considered through the feasibility phase:

Sidewalk is an off-road concrete walkway (minimum 5 foot width) to accommodate pedestrians and bicycles. *There is adequate sidewalk throughout the project and therefore no additional sidewalk is recommended.*

Multi-Use Path is an off-road asphalt path to accommodate two-way pedestrian and bicycle traffic (minimum 10 foot width). It should be noted that vehicles yield to the pedestrians and bicycles in a multi-use path. *A multi-use is not recommended along Golf Road due to safety concerns relating to the high number of access points.*

Bicycle Accommodations include a wider outside travel lane (minimum 14 foot width) to accommodate bicyclists on both sides of the roadway. *It is recommended to plan for bicycle accommodations as part of a reconstruction project.*

Bicycle Lane is a designated on-road lane (minimum 5 foot width) provided on both sides of the roadway. *Based on discussions with City staff, bicycle lanes are not desired along this project.*

For alternatives involving reconstruction of Golf Road, it is recommended to plan for bicycle accommodations (14 foot outside lane). There are currently no crosswalks to cross Golf Road along the project. Constructing an intersection to operate under roundabout or traffic signal control would provide an opportunity for a safe pedestrian crossing.

Golf Road Alternatives

Several alternatives considering access management, pedestrian and bicycle accommodations and intersection traffic control options were evaluated through the feasibility phase. Based on discussions with the Public Works Committee (PWC), the following three alternatives have been identified for further evaluation:

Low Build Alternative includes resurfacing with minor widening on the western section of the project to construct a raised median for the access management. The eastern section of the project will be resurfaced to maintain the existing two-way left-turn lane and existing curb.

Medium Build Alternative is a full reconstruction project including widening the roadway to provide a 24 foot raised median throughout the project.

High Build Alternative is a full reconstruction including improving the crest vertical curve by lowering the road approximately 1.5 feet to improve intersection sight distance. The High Build Alternative also includes widening the roadway to provide a 24 foot raised median throughout the project.

The conceptual roadway design for each of the alternatives is included in Appendix 4.

Low Build Alternative

The low build alternative includes the following specific improvements:

- Resurfacing with minor widening on the western section to construct a raised median for access management.
- Extend the westbound dual left-turn lanes and westbound right-turn lane for the intersection with STH 83.
- Restrict the left-out movement at the Sport Authority access due to the sight distance and operational deficiencies. Sports Authority access will allow left-in, right-in and right-out movements.
- *Optional Improvement:* Construct a backage road connecting the parking lot west of Sports Authority to the Marshall's access. The backage road would improve site circulation with the restricted access at Sports Authority.
- Utility impacts include fire hydrant relocations, water valve adjustments, and sanitary and storm manhole adjustments. The existing street lights will remain as part of this alternative.
- The Year 2035 traffic analysis for the low build alternative is summarized in Appendix 5. Based on the Year 2035 traffic analysis, the following movements are expected to operate unacceptably with the low build alternative:
 - Truck Access: The north approach exiting the development is expected to operate unacceptably at LOS F conditions during the weekday evening and Saturday midday peak hours.
 - Kohl's West Access: The left-turn movement exiting the development is expected to operate unacceptably at LOS F conditions during the weekday evening and Saturday midday peak hours.
 - Marshall's Access: The left-turn movement exiting the development is expected to operate unacceptably at LOS F conditions during the weekday evening and Saturday midday peak hours.

Medium Build Alternative

The medium build alternative includes the following improvements:

- Reconstruct the roadway to provide a 24 foot raised median to accommodate a two-stage turn maneuver.
- Extend the westbound dual left-turn lanes and westbound right-turn lane for the intersection with STH 83.
- Provide a wider outside lane (14 foot width) for bicycle accommodations throughout the project.
- Identified the following two traffic control options:
 - Signal Option: Relocate the Kohl's west access to align with Marshall's access. Install a full actuated traffic signal at this intersection.
 - Roundabout Option: Relocate the Kohl's west access to align with Marshall's access. Construct a two-lane hybrid roundabout for this intersection.
- *Optional Improvements:*
 - Backage Road: Construct a backage road connecting the parking lot west of Sports Authority to the Marshall's access. The backage road would improve site circulation with the restricted access at Sports Authority.
 - Multi-Use Path
- Utility impacts include fire hydrant relocations, water valve adjustments, and sanitary and storm manhole adjustments. The removal of the existing street lights and the installation of a new street lighting system is also part of the proposed improvement. One telephone pedestal may need to be relocated depending on the sub-alternate selected.

- The results of the Year 2035 traffic operational analysis for the medium build alternative is included in the level of service tables in Appendix 5 and summarized below:
 - For the signal option, all movements at the study area intersections are expected to operate acceptably at LOS D or better conditions.
 - For the roundabout option, all movements at the study area intersection are expected to operate acceptably at LOS D or better conditions during the weekday evening peak hour. During the Saturday midday peak hour, the movements exiting the truck access are expected to operate unacceptably at LOS E conditions.

High Build Alternative

The high build alternative includes the reconstruction of approximately 650 feet of Golf Road to flatten the existing crest vertical curve at the west end of the study limits. The proposed crest vertical curve would be lowered approximately 1.5 feet to reduce the severity of the curve and improve sight distance at the three access points identified in the Corridor Safety Concerns section of this report.

In addition to lowering the vertical profile, the high build alternative includes the following improvements:

- Reconstruct the roadway to provide a 24 foot raised median to accommodate a two-stage turn maneuver.
- Extend the westbound dual left-turn lanes and westbound right-turn lane for the intersection with STH 83.
- Provide a wider outside lane (14 foot width) for bicycle accommodations throughout the project.
- Identified the following two traffic control options:
 - Stop Control Option: Maintain the existing stop controlled access along the project.
 - Signal Option: Relocate the Kohl's west access to align with Marshall's access. Install a full actuated traffic signal at this intersection.
 - Roundabout Option: Relocate the Kohl's west access to align with Marshall's access. Construct a two-lane hybrid roundabout for this intersection.
- Utility impacts include fire hydrant relocations, water valve adjustments, and sanitary and storm manhole adjustments. The removal of the existing street lights and the installation of a new street lighting system is also part of the proposed improvement. One telephone pedestal may need to be relocated depending on the sub-alternate selected.
- *Optional Improvements:*
 - Backage Road: Construct a backage road connecting the parking lot west of Sports Authority to the Marshall's access. The backage road would improve site circulation with the restricted access at Sports Authority.
 - Bicycle lanes
 - Multi-Use Path
- The results of the Year 2035 traffic operational analysis for the high build alternatives are included in the level of service tables in Appendix 5 and summarized below:
 - For the stop control option, the following movements are expected to operate unacceptably at LOS E or F conditions.
 - Sports Authority Access: The left-turn movement exiting the development is expected to operate unacceptably at LOS F conditions during the weekday evening and Saturday midday peak hours.
 - Marshall's Access: During the Saturday midday peak hour, the left-turn movement exiting the development is expected to operate unacceptably at LOS E conditions.

- For the signal option, all movements at the study area intersections are expected to operate acceptably at LOS D or better conditions.
- For the roundabout option, all movements at the study area intersection are expected to operate acceptably at LOS D or better conditions during the weekday evening peak hour. During the Saturday midday peak hour, the movements exiting the truck access are expected to operate unacceptably at LOS E conditions.

Project Cost Estimates

Pay items were identified for each of the conceptual alternatives and appropriate contingencies were applied to determine total project costs for budgeting purposes. Utility relocations and real estate impacts have been assessed and are included as a line item in the estimated cost. Real estate acquisition costs are based on an average commercial property value of \$375,000 per acre. Topographic surveys were performed and facility maps reviewed to determine existing public and private utilities within the corridor. Utility impacts have been evaluated for the various options and costs associated with the adjustments have been included for each alternative. A worksheet summarizing the costs associated with each alternative is provided in Appendix 6 and summarized in Table 6.

**Table 6
Alternatives Cost Estimates**

	Low Build	Medium Build		High Build		
		Signal	Roundabout	Stop Controlled	Signal	Roundabout
Total Project Cost	\$454k	\$1,793k	\$1,784k	\$1,697k	\$2,012k	\$2,002k

The project costs shown in Table 6 do not assume the construction and design costs for the optional elements developed for each alternative. Optional elements that may be added to the baseline alternatives are summarized as follows:

1. Low\Medium\High Build: A backage road connecting the parking lot west of Sports Authority to the Marshall's access. Construction cost estimated ≈ \$260k.
2. Medium\High Build: Consolidation of two access locations for the Walgreens property. Construction savings estimated ≈ \$5k.
3. Medium\High Build: Construction of a multi-use path for bicycles and pedestrians on the south side of Golf Road. Construction cost estimated ≈ \$56k.
4. High Build: Construction of bike lanes within the pavement of Golf Road. Construction cost estimated ≈ \$42k.

Construction Schedule

Conceptual construction schedules were evaluated based on preliminary quantities prepared as part of the cost estimating process. Standard production rates were used for critical path work items to estimate an approximate duration of impact to the adjacent property owners. These durations shown in Table 7 are dependent on numerous factors including construction start date, weather, ability to perform night work, utility relocations, soil conditions, staged construction, and contract requirements. A more detailed construction schedule will be prepared on the selected alternate during the preparation of construction documents.

**Table 7
Conceptual Project Durations**

	Low Build	Medium Build		High Build		
		Signal	Roundabout	Stop Controlled	Signal	Roundabout
Project Duration	2 months ¹	4 months	4 months	4.5 months	4.5 months	5 months

¹ Project duration for the low-build/resurfacing option could potentially be performed during night-time operations minimizing disturbances to the commercial businesses located in the area.

Alternatives Comparison

With the competing interests along the project, it is not feasible for the alternatives to meet all of the corridor needs including the provision for safe and efficient traffic flow, maintain access to businesses, minimize cost of improvements and duration of construction. This section identifies the key advantages and disadvantages of the three alternatives.

Low Build Alternative

The low build alternative is mainly a resurfacing project and therefore does not address all of the traffic and safety concerns along the corridor. The advantages and disadvantages of the low build alternative are summarized below.

Advantages:

- + Safety/Traffic Operations: Restricting the left-out movement at Sports Authority eliminates the sight distance and operational concerns for this movement.
- + Parking Impacts: No parking impacts anticipated.
- + Cost: Lowest cost when compared to the medium or high build alternates.
- + Construction Schedule: Shorter duration when compared to the medium or high build alternatives.

Disadvantages:

- Safety:
 - Raised median on west section is not wide enough to safely allow a vehicle to make a two-stage turn movement.
 - Truck access does not meet minimum intersection sight distance.
 - Two-way left-turn lanes will remain on the east section.
- Traffic Operations: Traffic operational deficiencies are expected at the Truck access, Kohl’s west access and Marshall’s access.
- Pavement Life Cycle: The low build is classified as a maintenance repair and the corridor will likely be in need of another repair or a full reconstruction in approximately 10 years. Whereas, the reconstruction included in the medium and high build alternatives would not require resurfacing for approximately 20 years.

Medium Build Alternative

The medium build alternative does not address all of the concerns along the corridor. A summary of the advantages and disadvantages of the medium build is included below.

Advantages:

- + Safety/Traffic Operations: Restricting the left-out movement at Sports Authority eliminates the sight distance and operational concerns for this movement.
- + Traffic Operations: Raised median through project is wide enough to safely allow a vehicle to make a two-stage turn movement.
- + Cost: Lower cost when compared to the other reconstruction alternative (High Build)
- + Construction Schedule: Shorter duration of the two alternatives involving reconstruction (medium & high build).
- + Pavement Life Cycle: The medium and high build would not require resurfacing for approximately 20 years. Whereas, the low build will need to be resurfaced or reconstructed in approximately 10 years.

Disadvantages:

- Safety: Truck access does not meet minimum intersection sight distance.
- Parking Impacts: Loss of parking for Kohl's
- Cost: Higher cost when compared to the resurfacing alternative (Low Build)
- Construction Schedule: Due to the reconstruction, the medium and high build alternatives will have a longer duration than the low build alternative.

Signal Option Consideration

The City of Delafield currently does not maintain any traffic signals, as the existing signals within the city limits are under WisDOT's jurisdiction. Therefore, the maintenance of a traffic signal will need to be investigated further.

High Build Alternative

The high build alternative addresses majority of the deficiencies identified along the corridor. A summary of the advantages and disadvantages of the high build is included below.

High Build Stop Control Option

Advantages:

- + Safety: Improved intersection sight distance for the Sports Authority and Truck Access.
- + Traffic Operations: Raised median through project is wide enough to safely allow a vehicle to make a two-stage turn movement.
- + Cost: Lowest cost when compared to the other reconstruction alternatives (Medium/High Build Signal and Roundabout Options)
- + Pavement Life Cycle: The medium and high build would not require resurfacing for approximately 20 years. Whereas, the low build will need to be resurfaced or reconstructed in approximately 10 years.

Disadvantages:

- Traffic Operations: The left-turn movement exiting at the Sports Authority access is expected to operate unacceptably at LOS F conditions.
- Construction Schedule: Due to the reconstruction, the medium and high build alternatives will have a longer duration than the low build alternative.

High Build Signal & Roundabout Options

Advantages:

- + Safety:
 - Restricting the left-out movement at Sports Authority eliminates the sight distance and operational concerns for this movement.
 - Improved intersection sight distance for the Sports Authority and Truck Access.
- + Traffic Operations: Raised median through project is wide enough to safely allow a vehicle to make a two-stage turn movement.
- + Pavement Life Cycle: The medium and high build would not require resurfacing for approximately 20 years. Whereas, the low build will need to be resurfaced or reconstructed in approximately 10 years.

Disadvantages:

- Parking Impacts: Loss of parking for Kohl's
- Cost: Highest cost compared to the other alternatives.
- Construction Schedule: Due to the reconstruction, the medium and high build alternatives will have a longer duration than the low build alternative.

Signal Option Consideration

The City of Delafield currently does not maintain any traffic signals, as the existing signals within the city limits are under WisDOT's jurisdiction. Therefore, the maintenance of a traffic signal will need to be investigated further.

Overall Comparison

The proposed improvement should look to balance the various needs along the corridor including safety, access, traffic operations, and multi-modal accommodations. As summarized in this report, some of this information may be evaluated with hard data and thus specific alternatives clearly outperform others. For example, the high build alternative which includes modifications to the roadway profile clearly improves the site distance for specific access locations. On the other hand, some items are more subjective and need to be framed within the correct context. For example, the construction schedule for the low build has the least impact to the business owners; however, this option will require further maintenance at an earlier point in the future. Table 8 has been prepared to illustrate the favorable aspects of the various alternatives and provide a framework for comparison. A red flag indicates that the alternative does not meet the goals of the study project.

**Table 8
Alternatives Comparison**

Considerations	Existing	Low Build	Medium Build		High Build		
			Signal	Roundabout	Stop Controlled	Signal	Roundabout
Sight Distance	●	●	●	●	●	●	●
Safety	●	●	●	●	●	●	●
Traffic Operations	●	●	●	●	●	●	●
Access	●	●	●	●	●	●	●
Cost	●	●	●	●	●	●	●
Duration of Construction	●	●	●	●	●	●	●

- Optimum
- Favorable
- Caution
- Red Flag

PUBLIC INVOLVEMENT

Public involvement is critical throughout the project. The ultimate goal of the public involvement effort is to involve the area stakeholders in the planning process from the beginning. The public involvement plan developed for this study (provided in Appendix 7) includes community wide and local property owner meetings throughout the project.

Public Information Meetings: Two city wide public information meetings are planned as part of this project. The first meeting held on November 17, 2009 focused on listening to the citizens and business owners to gain an understanding of their concerns. The second meeting to present the alternatives for consideration and feedback is planned for April 27, 2009.

Property Owner Meetings: Three property owner meetings are planned as part of this project. Similar to the public information meeting, the first property owner meeting held on January 20, 2010 focused on listening to their concerns. The property owner meeting on April 20, 2010 included a presentation of the alternatives and listening to their comments and concerns. An additional meeting with the property owners is planned to discuss the recommended alternative.

The education of the public will be critical to the success of building consensus on the project. Public involvement summaries are included in Appendix 7.

PROJECT FINANCING

Funding Opportunities

The study team has identified three funding opportunities for the Golf Road improvement project. These options include city funding, public/private funding, and programs for local governments sponsored by federal and state highway departments.

Municipal Funding

The City of Delafield typically resurfaces 2 to 3 miles of roadway per year with an annual budget allocation expected to be approximately \$620k for FY 2010-2014. This budget includes dollars for engineering and inspection, which typically range from 7% to 8% of the budget. As the need arises, the city may also budget for reconstruction projects separately from the annual resurfacing budget. Currently

there is a place holder item in the Capital Improvement Program for 2010-2014 for the Golf Road Construction project with a dollar amount to be determined.

One option for funding the Golf Road improvement project is to evaluate the six year program and prioritize this roadway in relation to other city infrastructure projects. The low-build “resurfacing” option without the backage road is currently estimated to be ≈ \$454k which would include both engineering and construction inspection. This estimate includes the extension of the left and right turn lanes for the west approach to STH 83 which explains the above average cost in comparison to typical resurfacing per lane mile. Additional funds could be requested from the city for the turn lane work so as not to unfairly reduce the funds for other resurfacing projects within the City.

The medium and high-build alternatives range in cost from \$1.7 – \$2.4 million. If the city were to fund 100% of either of these project concepts, additional funding would need to be approved by elected officials and added to the Capital Improvement Program in the separate line item mentioned above.

Private\Public Partnering

The Golf Road corridor carries an Average Daily Traffic of 18,200 vehicles (2009). Data collection performed in the fall of 2009 indicates that approximately 85% of the traffic along Golf Road is generated by the commercial properties located within the study limits. The city limits are currently located at the east end of the project. It could be argued that improvements to this corridor will primarily benefit the businesses in the area and should not unfairly impact the overall street budget for the municipality. In line with this thinking, the city could approve to assess a portion of the improvements to the property owners located within the project corridor. The determination of and appropriate assessment value could be based on one or a number of factors including: traffic generated per parcel, property values, taxes, and/or land use.

An example of the reduction of city costs that would result from a potential cost share assessed to property owners based on a single factor such as traffic generated by the commercial properties vs. through traffic is summarized in Table 9.

Table 9
Summary of Project Cost Share¹
Private\Public Partnering Based on Traffic Volumes

	Low Build	Medium Build		High Build		
		Signal	Roundabout	Stop Controlled	Signal	Roundabout
Total Project Cost ¹	\$454k	\$1,793k	\$1,784k	\$1,697k	\$2,012k	\$2,002k
City Costs ²	\$68k	\$269k	\$268k	\$255k	\$302k	\$300k
Private Owner Costs ²	\$386k	\$1,524k	\$1,516k	\$1,442k	\$1,710k	\$1,702k

¹ Planning\Budgeting project costs do not assume the construction and design costs for the optional elements developed for each alternative.

²Cost share split assumes a direct ratio of project costs to traffic generated by each property (85%) within the area vs. through traffic (15%) along the roadway.

The costs shown in Table 9 would suggest an unfair allocation to the property owners based on the fact that current taxes paid by the owners should cover a portion of the required infrastructure improvements. If the city would like to pursue this option further, it is recommended that a planning committee be formed to determine an appropriate methodology to determine individual assessments based on the balance of

benefit realized by the motoring public as well as the benefit to the businesses located within the study area.

WisDOT Programs

In partnership with local governments and other groups, WisDOT administers a variety of state and federal programs to complete projects that enhance our comprehensive transportation network. There are two programs that could facilitate the reconstruction of the Golf Road Corridor.

Surface Transportation Program - Urban (STP-U) - The objective of STP-U is to improve federal aid eligible highways within urban areas. Projects must meet federal and state requirements. STP-Urban projects are typically financed by a cost share of 80% federal and 20% local funds. Communities are eligible for funding on roads functionally classified as a major collector or higher. According to functional classification maps prepared by WisDOT, Golf Road is classified as a minor arterial and qualifies for the program.

WisDOT is currently soliciting STP-Urban projects for the 2011-2014 Program Cycle. Applicants are required to complete a WisDOT 2011-2014 STP-Urban Program application form for each eligible project. The application deadline is July 30, 2010. WisDOT will review program applications in September 2010 and award projects on October 18, 2010. FY 2011 is already overscheduled in the 5-20K and 20-50K statewide population categories, new projects will be added to FY's 2012, 2013, and 2014 only. If the Golf Road project was approved for this program, construction would be programmed for the 2012 construction season at the earliest.

One factor that is considered by WisDOT in the evaluation process is the city's funding balance within the program. As of today, the City of Delafield funding balance is -\$316,378.98. A negative balance does not work in the City's favor and may prevent the approval of the project into the statewide program. The estimated project costs associated with the STP-U funding is summarized in Table 10. An additional allocation of shares will occur in September 2010 and will likely reduce the current deficit by \$175,000 based on historical data.

Table 10
Summary of Project Cost Share¹
Estimated Project Costs Associated with STP-U Funding

	Low Build	Medium Build		High Build		
		Signal	Roundabout	Stop Controlled	Signal	Roundabout
Total Project Cost ¹	\$454k	\$1,793k	\$1,784k	\$1,697k	\$2,012k	\$2,002k
City funding	\$91k	\$359k	\$357k	\$339k	\$402k	\$400k
Federal funding	\$363k	\$1,434k	\$1,427k	\$1,358k	\$1,610k	\$1,602k

¹ Planning/Budgeting project costs do not assume the construction and design costs for the optional elements developed for each alternative.

Highway Safety Improvement Program (HSIP) - The Highway Safety Improvement Program (HSIP) funds highway safety projects at sites that have experienced a high crash history. Emphasis is on low-cost options that can be implemented quickly. Projects should reduce the number and severity of crashes and decrease the potential for crashes on all public roads. The crash rate along Golf Road is above the statewide average which will fare favorably in the evaluation process; however, many of the recommended alternatives are larger in scope than is typically approved for HSIP projects.

FHWA looks for projects that contain the following elements when selecting projects.

- Intersection safety improvements (including installing/modifying traffic signals, roundabouts and channelization/turning radii improvements¹)
- Straightening isolated curves or hills¹
- Improving sight distance¹
- Access modifications¹
- Constructing turning, bypass or other auxiliary lanes
- Eliminating a roadside obstacle
- Installing guardrails, barriers and crash attenuators
- Installing signs, delineators, flashing warning lights (including fluorescent, yellow-green signs) at pedestrian-bicycle crossings, in school zones and other problem areas
- Installing countdown pedestrian signals

¹Various elements studied as part of the medium and high build alternatives for the Golf Road Feasibility Study include these elements.

Projects with local funding are capped at \$1.5 million and will require a 10% match by the City of Delafield. (90% Federal HSIP funds). WisDOT is currently soliciting HSIP projects for the 2011-2014 Program Cycle. The deadline for 2011-2012 HSIP submittals is May 15, 2010 and the deadline for 2013-2014 HSIP submittals is August 15, 2010. The low build alternative would not likely qualify for HSIP funding because it does not include enough of the elements required by FHWA in project selection. The estimated project costs associated with the HSIP funding is summarized in Table 11.

Table 11
Summary of Project Cost Share¹
Estimated Project Costs Associated with HSIP Funding

	Low Build	Medium Build		High Build		
		Signal	Roundabout	Stop Controlled	Signal	Roundabout
Total Project Cost ¹	N/A	\$1,793k	\$1,784k	\$1,697k	\$2,012k	\$2,002k
City funding	N/A	\$179k	\$178k	\$170k	\$201k	\$200k
Federal funding ²	N/A	\$1,614k	\$1,606k	\$1,527k	\$1,811k	\$1,802k

¹ Planning/Budgeting project costs do not assume the construction and design costs for the optional elements developed for each alternative.

² HSIP projects are capped at \$1.5M for construction costs, elements will need to be eliminated or scaled back to fit within the budget allocations.

Funding Recommendations

The most beneficial funding option to the City of Delafield would be to try to qualify for funding assistance from one of the various programs available through WisDOT. Due to the uncertainty of obtaining these funds, it is recommended that the city prepare applications for both STP-U and HSIP programs in accordance with the

deadlines outlined in this report. Funding selections will be made for these programs in the fall of 2010. Depending on the availability of funds that the city may approve for this corridor, a final decision on a chosen alternative may need to be postponed until these funding decisions have been made. Independent of the receipt of funding from WisDOT for construction, it is recommended that the city fund the design, utility, and real estate portion of the project to enhance the likelihood of selection by the state.

CONCLUSIONS

The main goal of this study was to improve the safety and operations for the access along the corridor. For the high build stop control option, the left-turn movement exiting at Sports Authority is expected to continue to operate unacceptably (LOS F) during the weekday evening and Saturday midday peak hours. Therefore, the left-turn movement exiting at Sports Authority is recommended to be restricted. It is also recommended to close the median opening at the Kohl's west access to eliminate the unsafe u-turn condition expected to result from the restriction at the Sports Authority access.

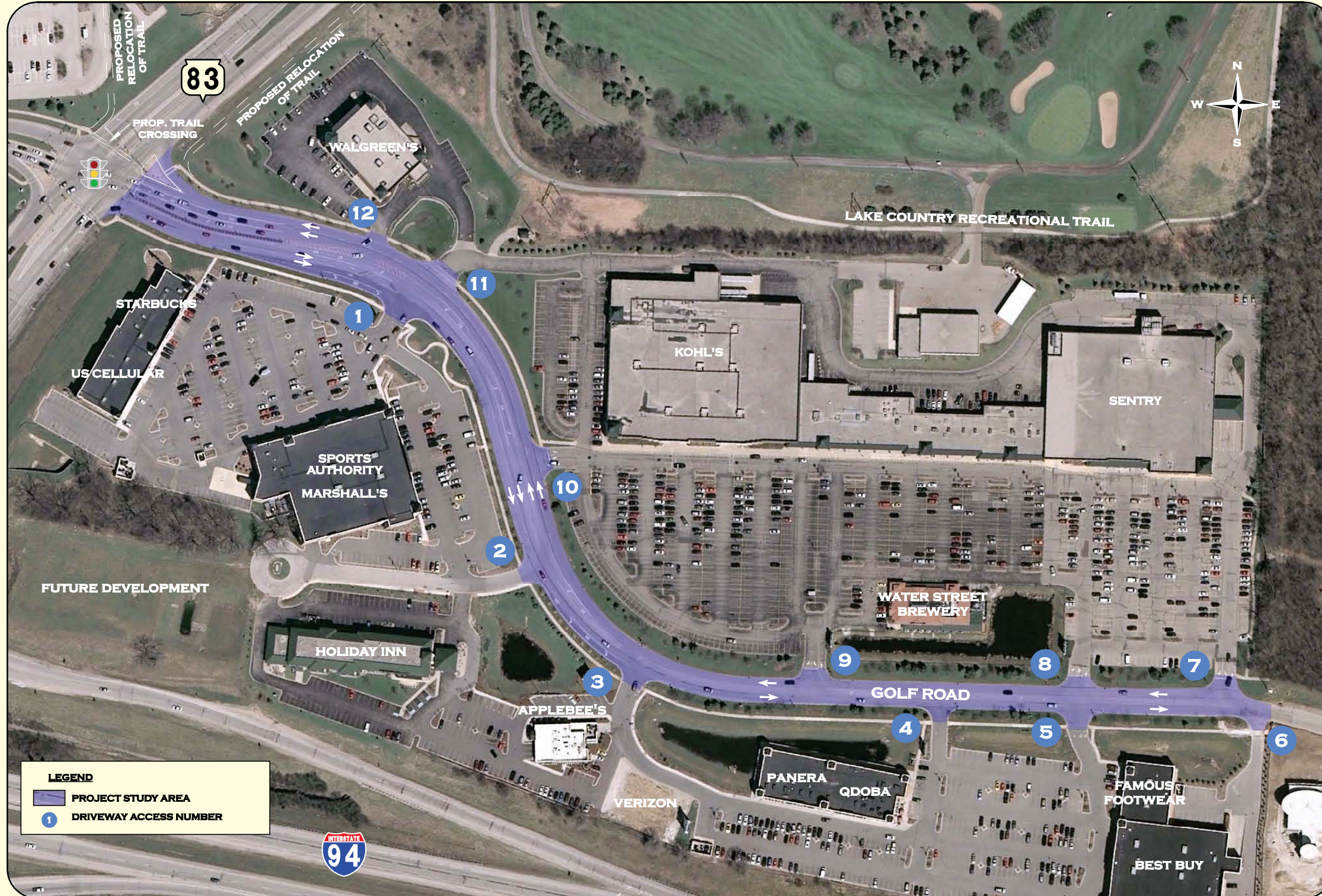
The low build alternative does not meet the needs of the study. It is mainly a resurfacing project and does not address the safety and operational concerns along the corridor. The key difference between the medium build and high build alternatives is the high build alternative includes lowering the vertical profile to improve intersection sight distance. In our opinion, lowering the vertical profile may not alleviate all the safety concerns and does not justify the costs and impacts associated with this improvement. GRAEF recommends the medium build signal option with the backage road. The backage road will connect the parking lot west of Sports Authority to the Marshall's access to improve internal site circulation and provide an alternate access to Golf Road. The need for a traffic signal at the Marshall's access is dependent on the future development. The project should plan for a future signal at this location and the potential for Kohl's to align an access with the signalized intersection. A traffic signal at Marshall's access will create gaps in traffic along Golf Road to improve operations at the adjacent stop controlled driveways.

The City's Public Works Committee (PWC) does not support the backage road as part of the improvement project. If the backage road is not feasible, we concur with the PWC's recommendation of the medium build roundabout alternative. A roundabout at the Marshall's access will safely and efficiently accommodate future traffic including the u-turns movements. The eastbound lane drop at the roundabout should be further evaluated through the design process to avoid creating an unsafe merging condition.

It is recommended that the city apply for WisDOT funding through the STP-U and HSIP programs.

DRAFT

APRIL 23, 2010



LEGEND
PROJECT STUDY AREA
DRIVEWAY ACCESS NUMBER

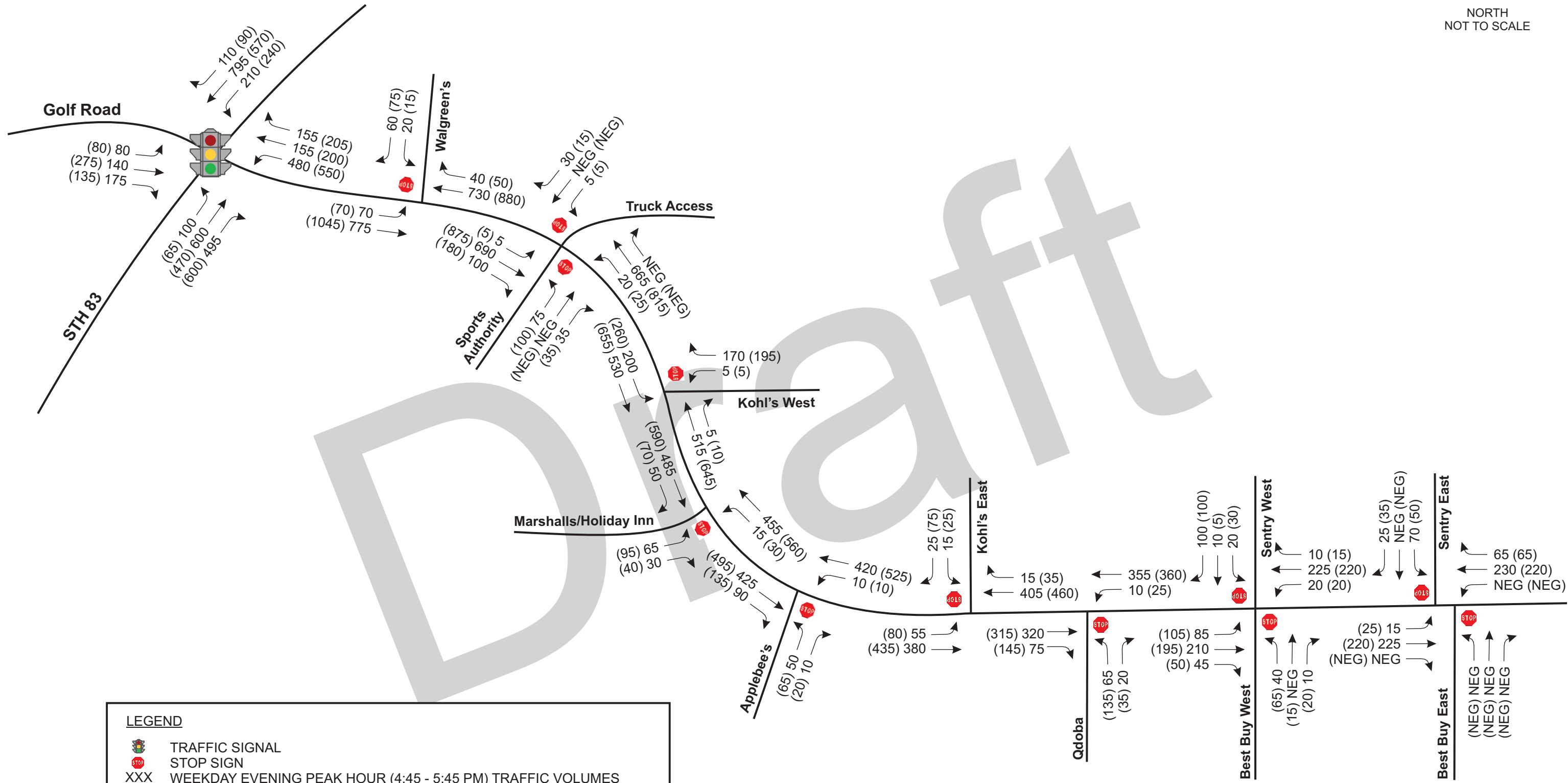


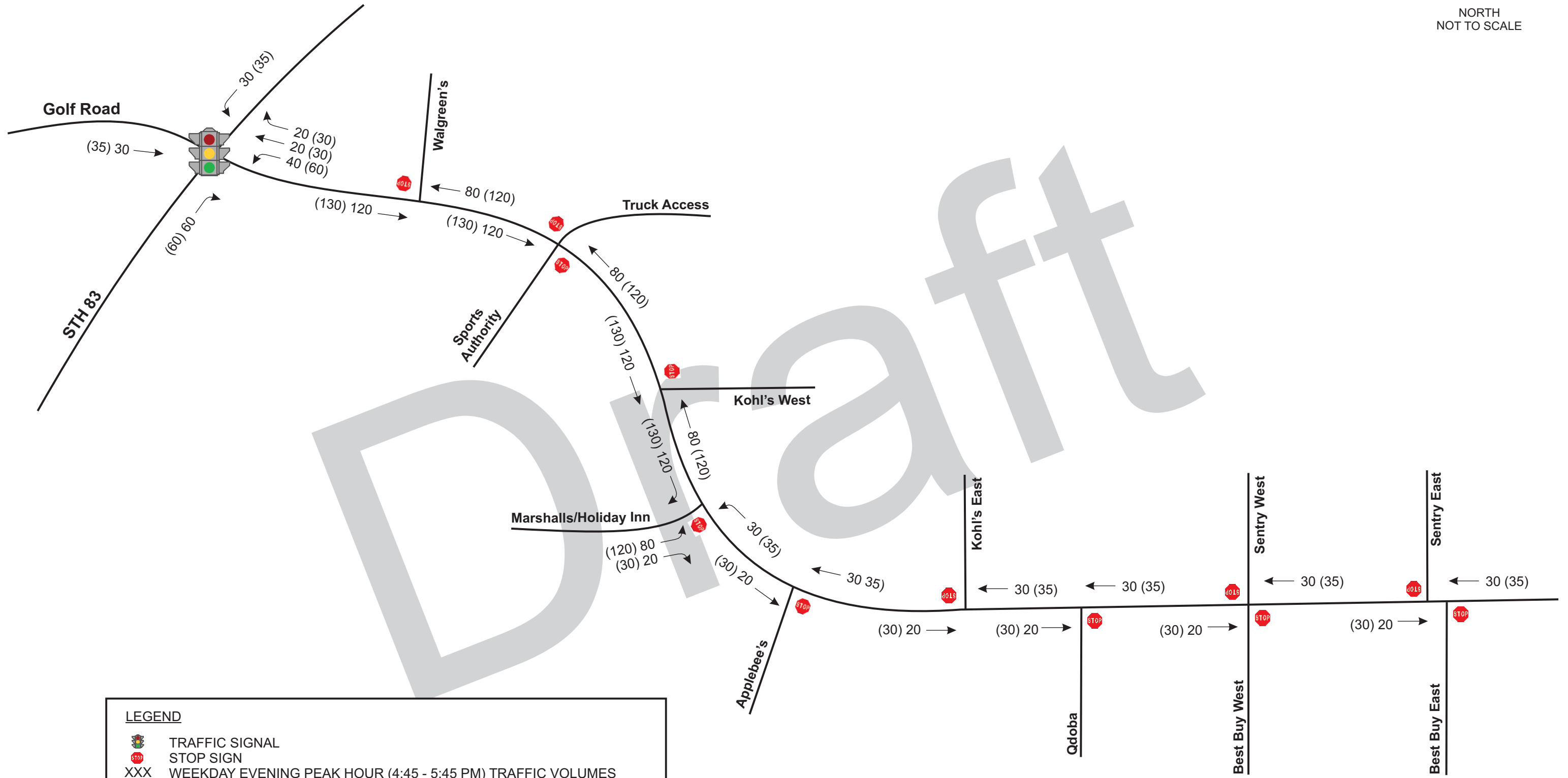
PROJECT OVERVIEW

GOLF ROAD

CITY OF DELAFIELD, WI

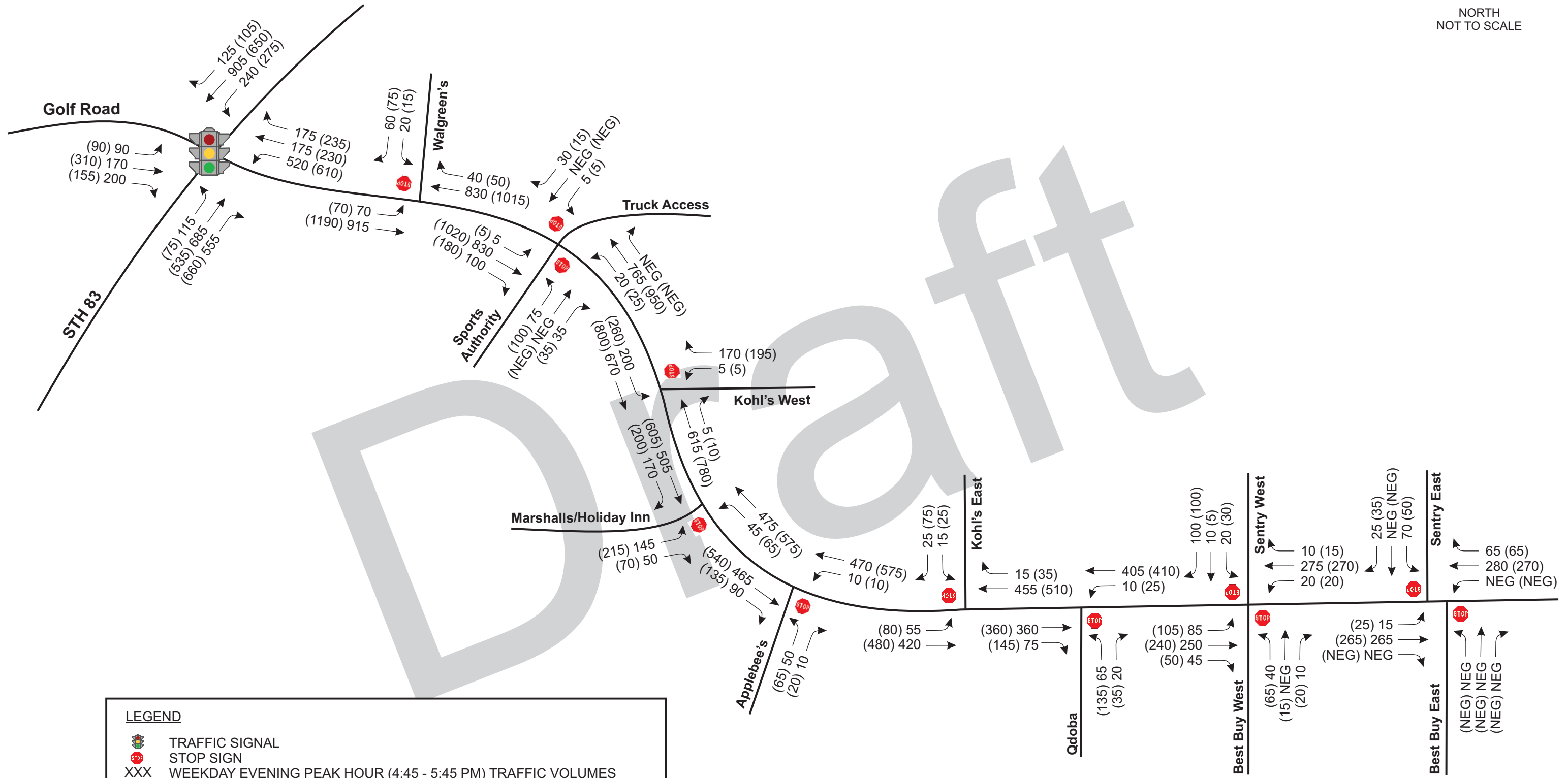






LEGEND

- TRAFFIC SIGNAL
- STOP SIGN
- XXX WEEKDAY EVENING PEAK HOUR (4:45 - 5:45 PM) TRAFFIC VOLUMES
- (XXX) SATURDAY MIDDAY PEAK HOUR (12:15 - 1:15 PM) TRAFFIC VOLUMES



LEGEND

- TRAFFIC SIGNAL
- STOP SIGN
- XXX WEEKDAY EVENING PEAK HOUR (4:45 - 5:45 PM) TRAFFIC VOLUMES
- (XXX) SATURDAY MIDDAY PEAK HOUR (12:15 - 1:15 PM) TRAFFIC VOLUMES
- NEG NEGLIGIBLE TRAFFIC VOLUMES (LESS THAN 3 VEHICLES PER HOUR)