08-28.09

Report of

Preliminary Interchange Study

for

CTH A at USH 41

Outagamie County, Wisconsin

September, 1999

E1408A98

AGENDA

I. Purpose

Investigate feasibility, costs and impacts of a full partial and no interchange at CTH A & USH 41 Intersection.

II. Background

USH 41 is being upgraded to meet current freeway standards. The structure at CTH A will be replaced within the next 5 years. The decision as to build a partial, full interchange, or interchange needs to be made soon because the decision could have a major impact on other projects in the area most notably the design of STH 47/USH 41 Interchange located 1.5 miles to the east of CTH A.

II. Existing Conditions

The existing CTH A structure over USH 41 is a 40 year old two lane structure. At the time of construction right-of-way was acquired for a full diamond interchange but the interchange was not built. The corridor along CTH A south of USH 41 is fully developed and to the north the area is pretty much rural although water and sewer will be provided to the area this fall.

IV. Methodology

HCS by McTrans software was used to analyze capacity and levels of service for the various scenarios. Traffic projections were provided by the DOT central office traffic section for the alternates and also for the worst case traffic scenario. Findings of the 1993 origin designation study and the Town of Grand Chute Comprehensive Plan were incorporated in the report. The impacts of the alternates are discussed separately and compiled in the summary and conclusions.

V. Impacts Of The No Interchange Alternate

A. Impacts on CTH A
Intercession at Capitol Drive will be at capacity in year 2011 and signals would be warranted at first CTH JJ intersection at time of construction.

B. Impacts on USH 41
Four lane facility would be at capacity in year 2019 and a six lane facility would be at LOS D in year 2020.

C. Impacts on USH 41
The projected traffic alone warrants an Urban Design Class 5.

D. Impacts on CTH 47 & CTH A Intersection.
Capacity would need to be increased in around year 2020.

E. Road user costs
The indirection for the traffic from the north would cost the motorists $9,500,000.00 over the next twenty years.

F. Impacts of Communities.
The current noise impacts along USH 41 at CTH A are severe but would not be mitigated under this alternate.

The original destination study shows a considerable amount of truck through traffic on CTH A south of USH 41 that rightfully belongs on USH 41.

G. Construction Costs.
The construction costs of a four lane facility similar to that at Meade Street would cost about $1,500,000.00

VI. Impacts Of The Partial Interchange Alternate

A. Impacts on CTH A.
CTH A south of USH 41 would reach capacity 15 years later when compared to the no interchange alternate. The traffic increase to the north of USH 41 would warrant a stronger pavement section.

B. Impacts on USH 41.
The traffic west of CTH A would increase to where conversion to six lane facility would be warranted 8-years earlier when compared to no interchange alternate. To the east this conversion would be delayed by seven years.

The added ramps would have an adverse impact on USH 41 traffic but would not affect the level of services.

C. Impacts on STH 47.
Traffic would decrease and the length of turning lanes would decrease. The level of service at the northwest ramp would increase from F to D fore a four lane facility the year 2020.

D. Impacts on STH 47& CTH A Intersection.
The traffic on CTH A is increased by about 20% while traffic on STH 47 is decreased by the same amount. The level of service does not change for the current configuration because half of traffic on CTH A bypasses the T intersection.

E. Road User Costs.
The partial interchange eliminates road user costs associated with the no-interchange alternate.

F. Impacts on Communities.
This alternate would force noise mitigation along the south ramp.

Through traffic especially heavy trucks would be removed from CTH A south of USH 41.

G. Construction Costs.
The cost of this alternate would be about $2,500,000.00 which includes noise wall along south ramp.

VII. Impacts Of The Full Interchange Alternate

A. Impacts on CTH A
Traffic would increase on both sides of USH 41. The intersection with Capitol Drive would be over capacity at time of construction. The level of service at the south intersection with CTH JJ would improve by eliminating the heavy left turn from the north.

B. Impacts on USH 41.
The traffic would increase on both sides of CTH A to where conversion to six lanes would be warranted is 2013 to the east and 2014 to the west.

The additional ramps would have an adverse impact on USH 41 traffic but would not impact the overall level of service for six lanes in year 2020.

C. Impacts on STH 47.
Traffic on STH 47 would be further reduced and the required turn lanes would be further shortened when compared to the partial interchange alternate.

D. Impacts on STH 47 & CTH A Intersection.
There is an additional 10% shift in traffic from STH 47 to CTH A. This shift has little effect on the overall capacity of the current configuration.

E. Road User Costs.
This alternate also eliminates the road user costs associated with the no interchange alternate.

F. Impacts of Communities.
Noise impact mitigation would be needed along both south ramps. Traffic between Capitol Drive and USH 41 would be increased and make up of the traffic would be altered.

G. Construction Costs.
The construction costs of a full interchange should be about $3,500,000.00 including noise walls along the south ramps.

VIII. Worst Case Scenario

The worst case scenario traffic projections assume an industrial park in the corridor along CTH A north of USH 41. These projections show a significant impact on local street system including CTH A but little or no impact on USH 41 traffic.

IX. Summary

The following table shows the timing of the conversion for USH 41 from four lanes to six lanes.

	Alternates		
Location	**No Interchange**	**Partial Interchange**	**Full Interchange**
USH 41 West of CTH A	2019	2011	2014
USH 41 East of CTH A	2019	2026	2013

The following table summarizes the costs of each alternate.

Description	Alternates No Interchange	Partial Interchange	Full Interchange
Construction Costs	1,500,000	2,500,000	3,500,000
Road User Costs	9,500,000		
Resurface 5 miles of CTH A		350,000	350,000
Timing of 6 Lanes on USH 41 west of CTH A		200,000	120,000
Timing of 6 Lanes on USH 41 East of CTH A		-140,000	140,000
Turning Lanes in 47 Interchange		-20,000	-40,000
Left Turn Lane on CTH A @ CTH JJ		100,000	0
CTH A Reconstruction Timing South of USH 41		-410,000	630,000
Right-of-way & Damages		100,000	200,000
CTH A & STH 47 Intersection		0	0
Total	**11,000,000**	**2,700,000**	**4,900,000**

Following is a brief summary of the advantages and disadvantages of each of the alternates.

NO INTERCHANGE ALTERNATE

ADVANTAGES	DISADVANTAGES
1. Construction costs minimized. 2. The severe noise impacts along USH 41 would not have to be addresses at this time. 3. Traffic on this segment of USH 41 minimized. 4. The adverse effects of additional ramp terminals on USH 41 avoided.	1. The large road user costs associated with the indirection of traffic from north wishing to go south or west would continue. 2. Five to six thousand vehicles per day would continue to cross USH 41 on CTH A and travel on CTH A and CTH OO to head south on USH 41 or west on STH 15, USH 10 etc. This traffic contains a relatively large number of trucks from the quarries along CTH A north of USH 41. This traffic constitutes an unwarranted safety hazard along local streets especially in the Houdini primary school and Twin Willows school areas.

PARTIAL INTERCHANGE ALTERNATE

ADVANTAGES	DISADVANTAGES
1. Eliminates road user costs associated with indirection from the north. 2. Minimizes traffic on local streets south of USH 41 and improves safety in the area by reducing traffic, especially trucks from the quarries from the two school zones. 3. Reduces the amount of traffic on STH 47 to a point where traffic on STH 47 and CTH A would be nearly equal. The urban design class of STH 47 would be reduced. 4. Due to access form only one direction, unplanned development and zoning changes would be discouraged.	1. Higher construction costs when compared to no interchange alternate. 2. The severe noise impacts along the south ramp would have to be mitigated. 3. Traffic on USH 41 increased but not to the extend where this segment of USH 41 would govern the conversion of USH 41 from four lanes to six lanes. 4. Added ramp terminals would have a disruptive impact on USH 41 traffic. 5. Intersections along CTH A north on USH 41 might have to be modified.

FULL INTERCHANGE ALTERNATE

ADVANTAGES	DISADVANTAGES
1. Eliminates road user costs associated with the indirection from the north. 2. Minimizes the traffic on STH 47. 3. Eliminates some indirection or inconvenience for motorists from the area south of USH 41 along CTH A wishing to head east on USH 41. 4. Eliminates truck traffic from quarries north of USH 41 from the local streets south of USH 41.	1. Highest construction costs plus noise abatement measures needed along south side of USH 41 on both sides of CTH A. 2. CTH A south of USH 41 would be at capacity right after the construction of a full interchange. 3. With full interchange development along CTH A north of USH 41 would be more difficult to control. 4. There would be more traffic on CTH A than on USH 47. 5. Traffic on USH 41 would further increase but should not control the six lane conversion of USH 41. 6. The added ramp terminals should have a disruptive impact on USH 41 traffic. 7. Some local traffic between USH 47 area and CTH A area would use USH 41 in lieu of local streets. 8. Modifications will be needed to intersections along CTH A north of USH 41.

X. Preliminary Findings

Savings in road user costs more than offset the construction costs of a partial or full interchange at the intersection of CTH A and USH 41. The construction cost estimates associated with the alternatives are very rough but conservative. Detailed construction cost estimates would not change the overall cost advantage for the interchange alternates.

A full interchange at CTH A saves the same amount in road user costs as the partial interchange but the overall cost is about $2,000,000 higher than that of the partial interchange.

The partial interchange minimizes the amount of traffic on CTH A south of USH 41 as well as traffic on USH 41 east of CTH A. This alternate removes traffic with a considerable amount of truck traffic from local streets especially school zones traffic that legitimately belongs on an urban freeway such as USH 41.

A compelling reason for selecting the full interchange alternate would be to shift the marked route of STH 47 from its present location to CTH A.

With a full interchange, CTH A south of USH 41 would be over capacity upon the opening of the interchange to traffic. This means that the local units of government would have to invest $2,000,000.00 in the reconstruction of CTH A between CTH OO and USH 41 at the same time as full interchange construction.

If the interchange alternates induce changes on the zoning north of USH 41, worst-case scenario traffic analysis reveal that the impact of such a change would be minimal as far as traffic on USH 41 is concerned.

ames

	Lamers, James
	Monday, September 20, 1999 7:14 AM
	Robb, Jack; Hollister, Joseph; Wacker, Lawrence; Dobson, Marc; Ringblom, Lee; Schuurmans, Robert; Cavanaugh, Jeanette; 'Walt Raith'
ct:	RE: Preliminary Study for USH 41/CTH A Interchange Report

quested Agris put together a summary of the significant changes for the USH 41 and CTH A interchange study that e a result of the earlier meetings we had with OMNNI to discuss the draft study. I received this summary and will get ou a copy to assist in reviewing the latest report you received.

-----Original Message-----
From: Lamers, James
Sent: Wednesday, September 15, 1999 7:04 AM
To: Robb, Jack; Hollister, Joseph; Wacker, Lawrence; Dobson, Marc; Ringblom, Lee; Schuurmans, Robert; Cavanaugh, Jeanette; 'Walt Raith'
Subject: Preliminary Study for USH 41/CTH A Interchange Report

I have a number of 41 and CTH A interchange study reports that OMNNI has completed for our review. I have put a copy in each of your baskets for your review and comment. This report should address the concerns we had at our last meeting with OMNNI concerning the study. If desired, I will set up another meeting with OMNNI to discuss. If we are in agreement with the study as presented, OMNNI will then set up a meeting with the local officials to discuss at a joint meeting. Any comments are appreciated.

George and Carroll, I have one copy for your review.
Marc and Lee, I have one copy for your review.

ENGINEERING
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ENVIRONMENTAL

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FAX

To: Jim Lamers
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Fax Number: (920) 492-5640
From: Agris Rozite

Date: Sept 17, 1999
Project No.:
Project: 41/A Interchange
Client: Wis DOT.
Page 1 Of 2
INCLUDING THIS PAGE

RE: CTH "A" & USH 41 Interchange Study

Attached is a summary of revisions in the interchange study report.

[signature]

CC:

PLEASE CALL OUR OFFICE IF YOU DO NOT RECEIVE ALL PAGES OF THIS FAX

Summary of Changes
For
Preliminary Interchange Study
CTH A at USH 41
Outagamie County, Wisconsin

Following is a list of items in the September 1999 version of the interchange study report that were added to or revised in the March 1999 version of the report.

1. Traffic projections for the worst case scenario are included in the report. The impacts are discussed in a new section of the report on Page 20 called Worst Case Scenario.

2. The 1993 origin-destination study is addressed on Page 5 of Appendix A. The findings are incorporated in the discussion of the alternates.

3. The road user costs are now computed for a 20 year period instead of the 50 year period used in the earlier report.

4. Present and future noise levels were computed for the alternates and the fact that the present noise impacts are classified as severe for all alternates in mentioned in the report.

5. Maps showing the existing and proposed land use from the Grand Chute comprehensive plan are included in the interchange report.

6. Traffic projection along CTH A for all three alternates north of USH 41 were added to the report. CTH JJ intersections and STH 47 intersection with CTH A were analyzed and are discussed in the discussion of impacts.

7. The discussion of impacts for the alternates was revised by adding a new subsection entitled "Impacts on Communities".

8. The summary has been revised and includes a discussion of the advantages and disadvantages of each alternate in a more understandable table format.

9. The rough preliminary design of the ramps was expanded to include drainage ditches to establish the approximate location of slope intercepts. The possible need for added right-of-way is now discussed in the report.

10. The entire report has been revised to shift emphasis away from economic and road user factors toward impacts on communities.

11. The discussion of impacts on USH 41 has been revised. In particular, the timing of conversion of USH 41 from four lanes to six lanes looks at the entire stretch of USH 41 in Outagamie County not just at the location of the USH 41 and CTH A intersection.

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Preliminary
Interchange Study
CTH A at USH 41
Outagamie County
June 1999

I. PURPOSE

The purpose of this study is to investigate the feasibility, costs, and impacts of building a full or a partial diamond interchange at CTH A and USH 41 intersection in Outagamie County as well as investigating the impacts of not building an interchange.

For sake of brevity, the three alternates will be called the "no interchange", "partial interchange", and "full interchange", and will refer to the intersection of USH 41 and CTH A intersection.

II. BACKGROUND

Highway 41 in Outagamie County was designed and built at its present location at around 1960. At that time, right-of-way was purchased for a full diamond interchange at CTH A (Lynndale Avenue) and USH 41 intersection in the Town of Grand Chute. However, at the time a two-lane structure on CTH A over USH 41 was built but no interchange.

Currently, USH 41 is being upgraded to a freeway from Milwaukee to Green Bay. In 1960+/- much of USH 41 in Outagamie County including the location of the CTH A intersection was built to WisDOT's 1960 freeway standards.

The current freeway standards require a 16.5 ft. of clearance above the freeway pavement. Since the clearance under the 1960 vintage bridges is only 15+/- ft., they are being raised or replaced.

The structure on CTH A at USH 41 is scheduled for reconstruction in year 2005 while the interchange at STH 47 located 1.5 miles east of CTH A is currently being designed by WisDOT District staff and is scheduled for construction in year 2003.

There are positive impacts for building an interchange at CTH A for the general traveling public and for the local street system. There are also negative impacts primarily to the USH 41 traffic. There is strong local support for a partial interchange at CTH A and USH 41 making the interchange alternates viable options. The selection among the alternates needs to be made at this time. Primarily because each of the alternates would have a different impact on the design of the STH 47 interchange.

WisDOT has made the traffic studies and traffic projections for the three basic alternate designs at CTH A and OMNNI Associates were retained to study the alternates and prepare this report.

III. EXISTING CONDITIONS

CTH A is a north-south route at the intersection with USH 41 with a rural two-lane typical section. USH 41 runs in an east-west direction at CTH A even though USH 41 in general is a north-south route. USH 41 at CTH A is a four-lane divided freeway with a 60-foot median. Just west of CTH A, USH 41 curves to the south and then parallels CTH A one mile to the west. Exhibits A-1 and A-2 show the general area of this study.

The recently completed interchange of USH 41 with STH 15 and CTH OO is located one and one half miles westerly of CTH A. South of this interchange, USH 41 is a six-lane facility.

There is a full diamond interchange at USH 41 intersection with STH 47. At USH 41, STH 47 runs in a true north-south direction. About six miles north of USH 41, STH 47 bears to the north-west and merges with CTH A at about eight miles north of USH 41. From there both routes run concurrently for a short distance where STH 47 heads due north toward Black Creek and CTH A heads west toward Shiocton. Exhibits A-3 shows the roadway configuration at the merger point.

From the merger point of CTH A and STH 47 to the south, traffic wishing to reach USH 41 to travel south has two choices, either to take STH 47 to its interchange with USH 41 or take CTH A across USH 41 to CTH OO, turn right and enter USH 41 at an interchange one mile to the west of CTH A. The STH 47 route is 2.1 miles longer. The percentage of traffic traveling though the urbanized area on CTH A is more than double that on STH 47. About one fourth of trucks on CTH A from the north use the CTH A, CTH OO route to head south on USH 41 or west of USH 41 on various routes.

The heavy truck traffic can further be explained because in the traffic corridor north of USH 41 along CTH A up to the merger point with STH 47 there are a number of active and inactive stone quarries. Due to lack of a satisfactory alternate route, most of the material from the quarries going to Appleton and points south comes down CTH A across USH 41 to CTH OO intersection with CTH A and then beyond.

The area along CTH A south of USH 41 in nearly fully developed. The area north of USH 41 for the most part is agricultural or vacant. In the fall of 1998, the Town of Grand Chute adopted a comprehensive development plan. Exhibit A-5 shown the current land use while Exhibit A-6 also includes the proposed development as shown in the comprehensive plan. The development to the north of STH 41 is limited by large environmentally sensitive wetlands and flood plains. This area contains the Buboltz Nature Preserve. The wetlands and flood plain is shown on Exhibit A-7.

The signalized CTH A intersection with Capitol Drive was built in 1992. The intersection is located about one-fourth mile south of USH 41. Exhibit A-4 shows the lane configurations at the intersection.

In the fall of 1999, the Town will be installing a watermain across USH 41 just east of CTH A to serve the area north of USH 41 and will install a sanitary sewer along Gillett Street to serve the same area. Exhibit A-6 also shown the proposed collector roads to serve this area.

Along the south side of USH 41 single family residences abut USH 41 right-of-way on both sides of CTH "A". The backs of the homes are located approximately 120 to 180 feet from USH 41 traffic. Using computer modeling, the noise impacts on the residences are classified as severe even with todays traffic volumes.

IV. METHODOLOGY

HCS by Mc Trans software was used to analyze capacity and levels of service for roadway segments, intersections, and ramp junctures for this study. Appendix A discusses the assumptions and parameters used in computing traffic capacities and levels of service within the study area. Actual computer printouts are not made part of this study but are available from OMNNI Associates. Appendix A also discusses the relevant findings of the 1993 origin – destination study conducted for the entire Appleton Urban Area.

Appendix B addresses the economics of the three alternates including an explanation of the values and assumptions made in the computation of road user costs and construction costs.

Since the no interchange alternate can be considered a reconstruction of an existing facility, the impacts and costs of the other two alternates will be addressed in terms relative to the no interchange alternate.

This study also assumes that an urban typical section will be built along CTH A in the area of the USH 41 intersection.

The impacts of each alternate will be discussed separately and then combined in a summary of impacts. The impacts are based on traffic projections that assume that development is orderly and adheres to the "Town of Grand Chute Comprehensive Plan". Since there is a possibility that the plan might be abandoned or revised a "Worst Case" traffic projection was made and these impacts discussed in a separate section of this report.

V. IMPACTS OF THE NO INTERCHANGE ALTERNATE

A. Impacts on CTH A

The no interchange alternate would keep the traffic patterns at their present location. Exhibits B-1 and C-1 show the current and projected traffic for the no interchange alternate.

The projected year 2020 traffic on CTH A is 17,000 vehicles for the no interchange alternate. Based on the projected traffic, according to procedure 11-20-1 of the WisDOT's Facilities Development Manual (FDM), the urban design class for CTH A is on the border of Class 3 and Class 4. The difference between the two classes is that Class 4 calls for a median and both call

What is the LOS.

for four traffic lanes. However, building a median on a bridge on a fairly high fill would serve no purpose. Therefore, a median on the bridge for this alternate will not be considered.

The signalized CTH A intersection with Capitol Drive was built in 1992. The intersection is located about one-fourth mile south of USH 41. Exhibit A-4 shows the lane configurations at the intersection. Using rough assumptions of traffic movements indicate that about 1,600 vehicles per hour on CTH A should put the intersection with Capitol Drive at its capacity. (Level of Service "F"). Using a K30 factor of 11.2, the 14,300 vehicles per day CTH A south of USH 41, would reach capacity in the year 2011.

The first three miles of CTH A north of USH 41 have been graded to accommodate a rural four lane section but only the center two lanes consisting of the pre-existing roadway were resurfaced. The County has scheduled reconstruction of this segment in year 2003 anticipating the possible construction of a partial interchange at the USH 41 intersection. If the no interchange alternate is selected, the reconstruction of this segment could be delayed.

Figure B-4 shows the year 2000 and year 2020 traffic projections for CTH A, STH 47 and CTH JJ north of USH 41. CTH JJ from the east forms a "T" intersection with CTH A about one mile north of USH 41. CTH JJ would be used by southbound CTH A traffic wishing to head east and north on USH 41. This traffic would turn left on CTH JJ then right on STH 47 to enter eastbound USH 41 at the STH 47 interchange. Currently there is a stop sign on CTH JJ. This intersection would be at or near capacity for the year 2000 traffic, and over capacity in the year 2020. With four lanes on CTH A with no separate left turn lane, a signalized intersection would be at a LOS "B" in the year 2000 and a LOS "C" in the year 2020.

For about one mile CTH A and CTH JJ run concurrently toward the north where CTH JJ turns to the west forming another "T" intersection with CTH A. With a stop sign on CTH JJ this intersection would be at a LOS B in the year 2000 as well as in the year 2020.

The five mile segment of CTH A just south of CTH A and STH 47 intersection was reconstructed in 1996. The typical section consists of two twelve foot driving lanes and ten foot shoulders.

B. Impacts on USH 41

Traffic analysis indicate that the capacity of the existing four lane facility on USH 41 is 66,000 vehicles per day. Using the year 2000 and year 2020 projections, this capacity will be reached in year 2019. However this segment of USH 41 has the least amount of traffic projected for the four lane facility from CTH OO to STH 441. Therefore, the conversion to six lanes from CTH OO, where six lanes currently end, would be governed by the traffic warrants on the segments east of STH 47. (See Exhibit B-4)

The level of service for a six lane facility in year 2020 will be "D" if no interchange is built at CTH A. Exhibit D-1 shows the traffic volumes and level of service (LOS) along USH 41 for both year 2000 and year 2020.

C. Impacts on STH 47

By not building an interchange at CTH A, the projected traffic on STH 47 would be 26,600 vehicles north of USH 41 and 28,400 vehicles south of USH 41. These volumes would put STH 47 in Urban Design Class 5 which calls for a 6 lane facility according to the FDM.

what is the LOS?

The level of service in the year 2020 at both of the west ramps at STH 47/USH 41 interchange would be a LOS "F" for a four lane facility. For a six lane facility on USH 41 the level of service would be "C" for the northwest on ramp and a LOS "D" for the southwest off ramp.

D. Impacts on STH 47 and CTH A Intersection

Eight miles north of USH 41, CTH A makes a right turn to form a "T" intersection with STH 47. STH 47 runs in a north-south direction with CTH A abutting from the west. This intersection handles all of the traffic on STH 47 but only the south to north traffic from CTH A. The north to south traffic on CTH A has a separate roadway and avoids the "T" intersection. See Exhibit A-3 for a sketch of the area.

Currently all legs of the "T" intersection have two lanes with a stop for CTH A. With this configuration, the level of service for STH 47 through the intersection is a LOS "A" for the years 2000 and 2020. The left turn movement from CTH A would drop from a LOS "D" in year 2000 to a LOS "F" in the year 2020. In other words for the no interchange alternate the intersection would have to be signalized or capacity increased through the construction of additional lanes by the year 2020.

E. Road User Costs

Road user costs are based on the fact that with no interchange at CTH A, traffic from the north needs to travel extra distance to get to USH 41 to travel south on USH 41 toward Oshkosh and Milwaukee.

In the year 2020, the north to west (south via USH 41) at STH 47 interchange for the no interchange alternate is 5,000 vehicles and 2,400 vehicles for the partial interchange alternative

(See Exhibits C-1 & C-2). This means that 2,600 vehicles avoided the indirection of STH 47 due to westbound on ramp at CTH A. This also applies to the west to north movement.

Exhibits C-1 and C-2 also shown that the southbound movement on CTH A in year 2020 at STH 41 is 8,500 vehicles for the no interchange alternate and 5,500 vehicles for the partial interchange alternate. This means that a total of 3,000 vehicles are avoiding the inconvenience and indirection of getting to southbound USH 41 via CTH A and CTH OO. This also applies to the northbound movement. The reduction in north to west traffic at STH 47 plus the reduction in north to south direction at CTH A (namely 5600 vehicles) should equal the north to west movement for the interchange alternates at CTH A. This movement as can be seen on exhibits C-2 and C-3 is 5,500 vehicles which is close to the 5,600 vehicles used in computing the road user costs.

2020

The cost of not providing the west ramps at CTH A is $9,500,000 in road user costs. The parameters and assumptions used to compute the road user costs are contained in Appendix B.

F. Impacts on Communities

The south side of USH 41 on both sides of CTH A is a fully developed residential area. Noise predictions were made at five house locations utilizing the FHWA Traffic Noise Model. Both the year 2000 and year 2020 noise impacts are severe, with year 2000 noise levels ranging from 70.1dB to 70.9dB. The year 2020 noise levels are about 1.5 dB higher than the year 2000 levels. For the no interchange alternative possible noise mitigation along USH 41 should not need to be addressed at this time. However, the severe noise impacts would have to be addressed when USH 41 is converted to six lanes.

71.6 - 72.4

is this in year 2000 or 2020

Under this alternative 5,000 to 6,000 vehicles would continue using CTH A south of USH 41 and using CTH OO west of CTH A. This traffic would contain a relatively large truck traffic coming from quarries north of USH 41. This segment of traffic is of particular concern to the local government because it passes Twin Willows School and within a block of Houdini Elementary School.

The 1993 comprehensive origin-destination study for Appleton Urban Area found that the highest concentration of heavy trucks in the entire urban area is on CTH A north of USH 41 at 16.2%. The origin-destination study also shows that the amount of through-traffic on CTH A is double that on STH 47 even though the total number of trips on STH 47 and CTH A were similar. Through Traffic is traffic whose origin and destination are outside the Appleton Urban Area. This through traffic rightfully belongs on USH 41 and not through residential area with school zones. The origin-destination study is discussed more fully in Appendix A.

G. Construction Costs

The recently completed Meade Street over USH 41 project is very similar to the no interchange alternate. Adjusting the Meade Street project costs for inflation, wider lanes, and box culvert extension at CTH A, the rough construction cost estimate of the no interchange alternate is $1,500,000.

VI. IMPACTS OF THE PARTIAL INTERCHANGE ALTERNATE

A. Impacts on CTH A

Building the west ramps at the CTH A and USH 41 intersection would increase the traffic on CTH A north of USH 41 and reduce the traffic on CTH A south of USH 41. Exhibits B-2, B-5 and C-2 show the current and projected traffic volumes and movements for the partial interchange alternate.

Based on traffic alone, the urban design class for CTH A north of USH 41 would be 4 and south of USH 41 the class would be 3.

Under this alternate, the capacity of CTH A south of USH 41 would be reached in the year 2026 or 15 years later when compared to the no interchange alternate. Conversion of a rural two lane road to a four lane urban street costs about $2,000,000 per mile. The delay of 15 years results in a savings of $370,000 when compared to the no interchange alternate.

The added traffic would warrant a stronger pavement structure for the segment of CTH A north of USH 41. However, the increase of traffic on CTH A is offset by a similar drop in traffic on STH 47. Since the first three miles of both STH 47 and STH A are scheduled for reconstruction in the near future, the additional costs on CTH A would be offset by savings on STH 47. However, since the two roadways are under different jurisdictions, it is likely that the savings would not be realized.

The existing south CTH A intersection with CTH JJ would be over capacity based on the year 2000 traffic. The intersection would have to be reconstructed and signalized at the time of construction of a partial interchange at USH 41. The signals would be warranted primarily due to increase in left turns from CTH JJ onto CTH A because the traffic generated along CTH JJ would access southbound USH 41 at CTH A instead of STH 47. A signalized intersection with no separate left turn lane on CTH A would function at a LOS "C" in the year 2000 and a LOS

"D" in the year 2020. It is reasonable to assume that a left turn lane would be built on CTH A under this alternate at an approximate cost of $200,000.00.

With a stop sign on CTH JJ, the north intersection with CTH A would be at a LOS "B" in the year 2000 and at a LOS "C" in the year 2020.

The north five mile segment of CTH A north of USH 41 and just south of juncture of STH 47 and CTH A was built in 1996. The typical section included six inches of breaker run which was given no value in the computation of the structural number for the section. Breaker run stone does have a structural value, but the value is limited to 10% of the structural number. Since traffic under this alternate would increase 18 to 20 percent, an overlay would be warranted by the year 2020. The overlay would cost about $350,000 for the five mile segment including added shouldering.

B. Impacts on USH 41

Under this partial interchange alternate, anticipated traffic on USH 41 west of CTH A would increase from 67,000 vehicles to 74,400 vehicles per day. The USH 41 traffic east of CTH A, however, would drop from 67,000 vehicles to 61,400 vehicles. This means that a six-lane facility west of CTH A would be warranted in year 2011 or eight years earlier when compared to the no interchange alternate. East of CTH A six lanes would be warranted in year 2026 or seven years later than for the no interchange alternate. The estimate for adding two lanes and median barrier to USH 41 is roughly $800,000 per mile. The hastening of six lane conversion west of CTH A would result in a $200,000 cost to the partial interchange alternative while delay to the east of CTH A would result in $140,000 savings. Since segments of USH 41 east of STH 47 would dictate when six lane conversion takes place, these savings are valid only for the comparison of the alternatives.

The ramp terminals onto USH 41 would have an adverse impact on USH 41 traffic. However, converting USH 41 to a six-lane facility at the time of ramp construction would mitigate this adverse impact. Exhibit D-2 shows the traffic volumes and level of service (LOS) for year 2000 and year 2020.

The proximity of ramps one to another adversely affects the level of service if the merge or diverge influence areas overlap. Intersections with diamond interchanges would have to be spaced less than one mile apart for this to happen. CTH A is a mile and a half from the nearest cross road with an interchange.

The level of service is based on the density of vehicles on a given section of road in terms of passenger cars per lane per mile. It should be noted that the density allowed for levels of service B, C, and D in ramp-freeway junction areas is higher than that on a freeway segment alone. For this reason, the level of service in a ramp influence area can be higher than on a freeway segment alone. Therefore, discussion of level of service for a non-existent ramp is of little value unless it is to evaluate alternate ramp designs.

C. Impacts on STH 47

A partial interchange at CTH A would reduce the traffic on STH 47 to the extent that the urban design class for STH 47 would be reduced from 5 to 4. This drop in design class was not used in computing savings in the construction costs of the STH 47 interchange. However, the reduced traffic in this interchange would result in the reduction of lengths of turning lanes that would result in $20,000 savings in construction costs because reduced turning movements require less storage space.

Due to reduction of traffic, the level of service at the northwest on ramp would improve from a LOS "F to a LOS "D" in the year 2020 for a four-lane facility on USH 41. The level of service would remain at a LOS "C" for a six-lane facility when compared to the no build alternate.

D. Impacts on STH 47 and CTH A Intersection

For the partial interchange alternate about 1,000 vehicles per day would be shifted from STH 47 to CTH A in the year 2000 and 1,500 vehicles in year 2020 when compared to the no interchange alternate. However, the amount of traffic at the "T" intersection would be reduced by one half of the shifted vehicles because the southbound traffic on CTH A by passes the "T" intersection. As a result, the level of service remains the same, a LOS "A" on STH 47 and a LOS "D" on CTH A in the year 2000 and a LOS "F" in the year 2020. The timing when all way stop or signals are warranted also remains nearly the same. However, the capacity for the critical left turn movement from CTH A to northbound STH 47 is about 20 percent higher for the partial interchange alternate.

E. Road User Costs

The partial interchange alternate eliminates the road user costs associated with the no interchange alternate because the indirection of using STH 47 to go west on USH 41 would be eliminated as well as eliminating in direction and inconvenience of the CTH A to CTH OO route.

figures for road user costs on page 8-9 but not here. It is kind of hard to compare the road user costs.

F. Impacts on Communities

The noise impact on the residences on the south side of USH 41 is already severe. The construction of the southwest ramp would require consideration of noise abatement measures. FDM states that plans will not be approved unless noise abatement measures which are reasonable and feasible are incorporated in the plans. Therefore the construction of noise walls or berms for this alternate are inevitable along the southwest ramp. The estimated cost of this noise wall is $500,000.00

Traffic under this alternate would be reduced throughout the developed areas along CTH A south of USH 41. The reduced traffic would improve the traffic related safely along CTH A and CTH OO which is particularly significant in the school zone at Houdini and Twin Willows Schools. The inconvenience due to construction along CTH A would also be delayed.

No homes would be affected?

Preliminary design indicated that slight amounts of right-of-way may be needed for ramp construction and that proximity damages might have to be paid to owner of group of farm buildings at the northwest ramp. $100,000 should cover the right-of-way costs plus fencing and proximity costs.

G. Construction Costs

The project at Ballard Road and USH 41 is similar to the full interchange alternate at CTH A. The construction costs of the Ballard Interchange was $2,300,000. Making allowances for differences in the two projects, the rough estimated construction cost for a full interchange at CTH A is $3,500,000. About one third of this cost is for the construction of noise walls along the south ramps and the extension at a twin box culvert under the northeast and southwest ramps.

Making adjustments to the no interchange construction costs and the full interchange costs, the rough estimate for the partial interchange alternate is $2,500,000. This cost includes $500,000.00 for the construction of a noise wall along the south ramp.

VII. IMPACTS OF THE FULL INTERCHANGE ALTERNATE

A. Impacts on CTH A

Building a full diamond interchange at CTH A would increase the traffic on CTH A on both sides of USH 41 when compared to the no build alternate. The urban design class would be 4 on both sides of USH 41. Exhibit B-3, B-6, and C-3 show the current and projected traffic for this alternate.

Under this alternate CTH A south of USH 41 would exceed capacity in the year 2000. Based on the $2,000,000 reconstruction cost, moving up the reconstruction date by eleven years results in a $410,000 cost when compared to the no interchange alternate.

As with the partial interchange alternate, the stop sign controlled south intersection with CTH JJ would have to be signalized at the time of construction of the full interchange. A signalized intersection in the year 2000 would function at a level of service a LOS "B" in the year 2000 and a LOS "C" in the year 2020 without a left turn lane on CTH A. The construction of a left turn lane on CTH A would not be warranted. This alternate reduces the traffic on CTH JJ to the east by about one third, because traffic along CTH A wishing to head east or north on USH 41 would not have to make a jog on CTH JJ to access USH 41 at STH 47.

The north CTH JJ intersection with CTH A would be at a LOS "B" in year 2000 and a LOS "C" in the year 2020 with a stop sign on CTH JJ. These levels of service are the same as for the partial interchange alternate.

North of USH 41, the traffic on CTH A for a full interchange increases about 10 percent when compared to the partial interchange alternate with a similar reduction in traffic on STH 47. As with the partial interchange alternate, the increase in pavement structure for the first three miles of CTH A north of USH 41 would be offset by a similar reduction in pavement structure on STH 47. For the next five mile segment which was completed in 1996, the traffic will increase 30 percent when compared to the no interchange alternate and 10% when compared to the partial interchange alternate. An overlay of one and one half inches at a cost of $350,000.00 should compensate for the increase in traffic.

B. Impacts on USH 41

Under the full interchange alternate, the traffic on USH 41 would increase on both sides of CTH A as compared to the no build alternate. The traffic would warrant upgrading USH 41 to six lanes in the year 2014 west of CTH A and in the year 2013 east of CTH A. The cost of moving up the date of six laning of USH 41 would be $260,000 when compared to the no interchange alternate. Exhibit D-3 shows the traffic volumes and levels of service (LOS) for this alternate. However, even with a full interchange at CTH A, the segment of USH 41 at CTH A should not control the timing of six lane conversion of USH 41. This alternate increases the traffic on USH 41 east of STH 47 by 4,000 vehicles when compared to the other two alternatives. This 4,000 vehicle increase is balanced by a reduction of traffic CTH OO and Capitol Drive east of CTH A.

G. Construction Costs

Adjusting the actual costs of the completed USH 41 and Ballard Road interchange, the cost of a full diamond interchange with noise walls along south side should be about $3,500,000 for the full interchange alternate.

VIII. WORST CASE SCENARIO

The area along CTH A south of USH 41 is nearly fully developed and a full or partial interchange at CTH A and USH 41 would have no impact on the further development of this area.

The area along CTH A and STH 47 north of USH 41 for the most part is open to development. However, large tracks of environmentally sensitive wetland which included the Buboltz Nature Center, would curb the area that can be developed.

The traffic projections on which the impacts of the three alternates assume the orderly development of the area north of USH 41 in accordance with the adopted "Town of Grand Chute Comprehensive Plan". Since the comprehensive plan is based on no interchange at CTH A and USH 41, the construction of a full or partial interchange could result in changes to the plan.

Figures A-8, A-9 and A-10 show the traffic projections for the three alternates for the worst-case scenario. These projections assume that some of the planned residential areas north of USH 41 will be replaced by an industrial park.

The industrial park would have a significant impact on the amount of traffic on CTH A and other local streets when compared to the traffic projected for development in accordance to be approved comprehensive plan.. The traffic on CTH A at USH 41 would increase by 20 to 25 percent. The increase on Capitol Drive would be about 20 percent and increase on CTH A south of Capitol would be 12 percent. The traffic on USH 41 at CTH A is actually projected to decrease slightly.

The worst case scenario for the partial interchange alternate results in a 15-20 percent increase in traffic on CTH A north of USH 41 and about 10% increase south of USH 41. The impact on USH 41 traffic would be minimal with a slight decrease on USH 41 in the year 2000 and about a 2 percent increase in the year 2020 for the segment of USH 41 west of CTH A.

The worst case scenario for the full interchange alternate on CTH A and local streets is the same as for the partial interchange. The traffic on USH 41 on both sides of CTH A increases by about 2,000 vehicles per day. This 3-4 percent increase should have no or little effect on the timing of conversion to six lanes or on the level of service.

In general, if the town revises the zoning along CTH A north of USH 41 to create the worst-case scenario, the impact on USH 41 would be minimal for any of the alternates. The impacts on CTH A and other local streets would be significant and the town would be aware of this when possible, changes in the zoning plan are considered.

IX. SUMMARY

In the year 2020, the total amount of traffic from the north on USH 47 and CTH A is between 43,000 and 44,000 vehicles per day for all three alternates. With the partial interchange, traffic is nearly split between the two roadways. The no interchange alternate puts about 60% of the traffic on STH 47 while the full interchange alternate puts about 60% on CTH A.

From the south, the full interchange alternate reduces the amount of traffic on STH 47 to where the traffic on CTH A and STH 47 are nearly equal. The partial interchange substantially reduces the traffic from the south on CTH A.

The time when the projected traffic would warrant conversion to six lanes varies with each alternate. Using the capacity of a four lane facility as 66,000 vehicles per day, the following table shows the years when such conversion would be warranted. The table is for the comparison of alternates only, because the interchange alternates put more traffic on USH 41 but not to the extent that this segment would control the timing of the conversion of USH 41 from four lanes to six lanes. The controlling segment with the highest amount of traffic on USH 41 would remain the segment between CTH E and STH 441.

TABLE 1

	Alternates		
Location	**No Interchange**	**Partial Interchange**	**Full Interchange**
USH 41 West of CTH A	2019	2011	2014
USH 41 East of CTH A	2019	2026	2013

CTH A south of USH 41 will be rebuilt to a four lane urban street in the foreseeable future. Assuming that the capacity of present two lane section is 14.300 vehicles per day, the capacity will be reached at the different time for each of the alternates:

No Interchange Alternate 2011

Partial Interchange Alternate 2026

Full Interchange Alternate 2000

The three mile segment of CTH A just north of USH 41 is scheduled to be rebuilt to four lanes in 2003. This schedule would be probably set back if the no interchange alternate is selected. Any increase in pavement structure for this three mile segment of CTH A, warranted by traffic shift from STH 47, would be offset by a similar decrease in pavement structure on STH 47. However, due to different jurisdictions, the transfer of costs associated with the different pavement structures may not be realized.

The next five mile section of CTH A to its intersection with STH 47 was built in 1996 and should be able to handle the traffic for all three alternates at the outset, however the higher traffic generated by the interchange alternates would warrant the rehabilitation of the pavement surface prior to the planned 20 years. A one and one half inch overlay at a cost of $350,000.00 at the time of construction would extend the initial life of the pavement to 20 years and be equitable to the no interchange alternate.

The level of service and timing of all way stop or signals at the CTH A and STH 47 intersection is the same for all three alternates.

CTH JJ forms two "T" intersections with CTH A. At the north intersection CTH JJ abuts CTH A from the west. With a stop sign of CTH JJ, the intersection would function at a level of service B for all three alternates in the year 2000. It would also function at a LOS "B" for the no interchange alternate in the year 2020 but would drop to a LOS "C" for the other two alternates.

CTH JJ abuts CTH A from the east at the south intersection located about one mile north of USH 41. The stop sign controlled intersection would be at or over capacity for all alternates in the year 2000. A signalized intersection would function at a LOS "C" in the year 2020 for the no interchange and full interchange alternates without a separate left turn lane on CTH A. For the partial interchange alternate to function at this level of service, a left turn lane on CTH A would be needed at a cost of about $200,000.00

A full or partial interchange at CTH A would reduce the urban design class of STH 47 from 5 to 4. The interchange alternates would reduce the lengths of turning lanes in the STH 47 interchange.

The construction of ramps at CTH A would have adverse impacts on USH 41, but could be mitigated by converting USH 41 to a six lane facility at the same time as when the ramps are built. The ramps, however, do not have an impact on the overall level of service on USH 41 because for a given level of service, the vehicular density of a ramp influence area is higher than that of a freeway segment alone.

The no interchange alternate would perpetuate the considerable road user costs that the traveling public must bear. The road user costs are associated with the extra distance that the traffic from north has to travel if they wish to go south via USH 41 due to the eastward jog of STH 47.

The 1993 original destination study for Appleton Urban Area shown that the highest concentration of heavy trucks for all thirty two stations was on CTH A north of USH 41. The study also shows that the amount of through traffic on CTH A is double that on STH 47 even though overall traffic on north highways is nearly the same. Through traffic consists of trips whose origin and destination are located outside the Appleton Urban Area. The interchange alternate would put the through traffic on USH 41 where it belongs and would reduce the heavy trucks in a residential areas with school zones.

The noise impacts on the residences along south side of USH 41 on both sides of CTH A is already severe. For the interchange alternates the noise impacts would have to be mitigated at the tine of construction while for the no interchange alternate, the mitigation could be delayed probably until the conversion of USH 41 from four lanes to six lanes.

Preliminary design indicates that some additional right-of-way may be needed for the construction of ramps and that the groups of farm buildings at the north ramps may suffer some proximity damages.

The following table summarizes the costs associated with each of the three alternates. The interchange alternate construction costs include the cost of noise walls along the south ramps because the noise impact on the abutting residences is already severe. With the no interchange alternate, the noise impacts would not have to be addressed until the conversion of USH 41 from four lanes to six lanes per FHWA directive.

TABLE 2

Description	Alternates		
	No Interchange	**Partial Interchange**	**Full Interchange**
Construction Costs	1,500,000	2,500,000	3,500,000
Road User Costs	9,500,000		
Resurface 5 miles of CTH A		350,000	350,000
Timing of 6 Lanes on USH 41 west of CTH A		200,000	120,000
Timing of 6 Lanes on USH 41 East of CTH A		-140,000	140,000
Turning Lanes in 47 Interchange		-20,000	-40,000
Left Turn Lane on CTH A @ CTH JJ		100,000	0
CTH A Reconstruction Timing South of USH 41		-410,000	630,000
Right-of-way & Damages		100,000	200,000
CTH A & STH 47 Intersection		0	0
Total	**11,000,000**	**2,700,000**	**4,900,000**

Following is a brief summary of the advantages and disadvantages of each of the alternates.

NO INTERCHANGE ALTERNATE

ADVANTAGES	DISADVANTAGES
1. Construction costs minimized. 2. The severe noise impacts along USH 41 would not have to be addresses at this time. 3. Traffic on this segment of USH 41 minimized. 4. The adverse effects of additional ramp terminals on USH 41 avoided.	1. The large road user costs associated with the indirection of traffic from north wishing to go south or west would continue. 2. Five to six thousand vehicles per day would continue to cross USH 41 on CTH A and travel on CTH A and CTH OO to head south on USH 41 or west on STH 15, USH 10 etc. This traffic contains a relatively large number of trucks from the quarries along CTH A north of USH 41. This traffic constitutes an unwarranted safety hazard along local streets especially in the Houdini primary school and Twin Willows school areas.

PARTIAL INTERCHANGE ALTERNATE

ADVANTAGES	DISADVANTAGES
1. Eliminates road user costs associated with indirection from the north. 2. Minimizes traffic on local streets south of USH 41 and improves safety in the area by reducing traffic, especially trucks from the quarries from the two school zones. 3. Reduces the amount of traffic on STH 47 to a point where traffic on STH 47 and CTH A would be nearly equal. The urban design class of STH 47 would be reduced. 4. Due to access form only one direction, unplanned development and zoning changes would be discouraged.	1. Higher construction costs when compared to no interchange alternate. 2. The severe noise impacts along the south ramp would have to be mitigated. 3. Traffic on USH 41 increased but not to the extend where this segment of USH 41 would govern the conversion of USH 41 from four lanes to six lanes. 4. Added ramp terminals would have a disruptive impact on USH 41 traffic. 5. Intersections along CTH A north on USH 41 might have to be modified.

FULL INTERCHANGE ALTERNATE

ADVANTAGES	DISADVANTAGES
1. Eliminates road user costs associated with the indirection from the north. 2. Minimizes the traffic on STH 47. 3. Eliminates some indirection or inconvenience for motorists from the area south of USH 41 along CTH A wishing to head east on USH 41. 4. Eliminates truck traffic from quarries north of USH 41 from the local streets south of USH 41.	1. Highest construction costs plus noise abatement measures needed along south side of USH 41 on both sides of CTH A. 2. CTH A south of USH 41 would be at capacity right after the construction of a full interchange. 3. With full interchange development along CTH A north of USH 41 would be more difficult to control. 4. There would be more traffic on CTH A than on USH 47. 5. Traffic on USH 41 would further increase but should not control the six lane conversion of USH 41. 6. The added ramp terminals should have a disruptive impact on USH 41 traffic. 7. Some local traffic between USH 47 area and CTH A area would use USH 41 in lieu of local streets. 8. Modifications will be needed to intersections along CTH A north of USH 41.

IX. PRELIMINARY FINDINGS

Savings in road user costs more than offset the construction costs of a partial or full interchange at the intersection of CTH A and USH 41. The construction cost estimates associated with the alternatives are very rough but conservative. Detailed construction cost estimates would not change the overall cost advantage for the interchange alternates.

A full interchange at CTH A saves the same amount in road user costs as the partial interchange but the overall cost is about $2,000,000 higher than that of the partial interchange.

The partial interchange minimizes the amount of traffic on CTH A south of USH 41 as well as traffic on USH 41 east of CTH A. This alternate removes traffic with a considerable amount of truck traffic from local streets especially school zones traffic that legitimately belongs on an urban freeway such as USH 41.

A compelling reason for selecting the full interchange alternate would be to shift the marked route of STH 47 from its present location to CTH A.

With a full interchange, CTH A south of USH 41 would be over capacity upon the opening of the interchange to traffic. This means that the local units of government would have to invest $2,000,000.00 in the reconstruction of CTH A between CTH OO and USH 41 at the same time as full interchange construction.

If the interchange alternates induce changes on the zoning north of USH 41, worst-case scenario traffic analysis reveal that the impact of such a change would be minimal as far as traffic on USH 41 is concerned.

Appendix A
Traffic
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Appendix A
Traffic

A. USH 41

A major focus of the CTH A interchange study is to investigate the impacts of the three alternatives on USH 41 traffic. The traffic design parameters for the three alternates are shown on Exhibit E-1. The parameters are very close and only one set will be used to analyze existing and future levels of service (L.O.S.).

The level of service is based on the density of vehicles on a given section of road in terms of passenger cars per lane per mile. Exhibits F-1 thru F-3 show and discuss the various levels of service. It should be noted that the density allowed for levels of service B, C, and D in ramp-freeway junction areas is higher than that on a freeway segment alone.

HCS (Freeway Release 3.1) by McTrans software was used to analyze the capacity of the existing 4-lane section on USH 41 and a six-lane future section using the following parameters: peak hour factor – 0.9, terrain type-level, trucks and busses – 10 percent , truck and busses passenger car equivalency – 1.5, heavy vehicle adjustment – 0.9, driver population adjustment – 1.0, and a measured free-flow speed of 65 miles per hour.

A four-lane freeway is at a LOS "E" with a volume of 4,000 vehicles per hour (VPH) and at LOS "F" (over capacity) at 4,100 vehicles. For a six-lane freeway the corresponding volumes are 6,000 vehicles and 6,100 vehicles.

Using a peak hour factor (K 30) of 11 percent and a directional factor (D) of 55 percent, the capacity of USH 41 in terms of Average Daily Traffic (ADT) is 66,000 for four lanes and 99,000 for six lanes.

Using a straight-line interpolation, the current four lane section on USH 41 west of STH 47 would reach capacity in the year 2019. For the partial interchange alternate, four-lanes on USH 41 west of CTH A would reach capacity in year 2011. For the segment of USH 41 between STH 47 and CTH A, the 4 lanes would reach capacity in the year 2026. As compared to the no interchange alternate, four lanes on USH 41 west of CTH A would reach capacity 8 years sooner while east of CTH A the capacity would be reached 7 years later.

For the full interchange alternate, four lanes on USH 41 would reach capacity in year 2014 west of CTH A and year 2013 east of CTH A. In other wards, USH 41 would warrant upgrading to a six-lane facility about 5 years earlier as compared to the no interchange alternate.

B. CTH A NORTH OF USH 41

CTH A north of USH 41 is a two-lane rural highway. In around 1990, Outagamie County acquired enough right-of-way for a four-lane highway from USH 41 for a length of about 2.5 miles. At the time, this segment was graded for a four-lane typical section, but only the center two lanes were resurfaced over the preexisting pavement structure. The County has scheduled the reconstruction to a four-lane facility in the year 2003. This scheduled reconstruction is in anticipation that at least a partial interchange will be built at the USH 41 and CTH A intersection.

The signalized CTH A intersection with Capitol Drive was built in 1992. The intersection is located about one-fourth mile south of USH 41. Exhibit A-4 shows the lane configuration at the intersection. Using rough assumptions of traffic movements, indicate that about 16,000 vehicles on CTH A should put the intersection at its capacity. (Level of Service "F"). Using 16,000 vehicles per day as the capacity of CTH A south of USH 41, this segment of CTH A would reach capacity in the year 2017.

The overall capacity and level of service of a four-lane facility on CTH A north of USH 41 would be controlled by the capacity of the CTH A and CTH JJ intersection. Detailed traffic analysis would be needed to analyze the impact of the three alternates. However, using rough estimate of volumes and movements, the intersection would warrant signalization in the not too far future for any of the three alternates. The interchange alternates would increase the traffic on CTH A but should reduce the traffic on CTH JJ especially the north to east movement.

The north 5 miles of the 8 mile segment of CTH A, between USH 41 and STH 47, were reconstructed in 1996 to a rural two-lane section with 12-foot lanes and 10-foot shoulders. For this segment, the design ADT was 7,780 vehicles in year 1995 and 8,350 vehicles in year 2015.

C. CTH A AND STH 47 INTERSECTION

Exhibits G-1 thru G-3 are traffic projections along STH 47 from USH 41 to Black Creek. On this projection the predicted year 2021 traffic on STH 47 just north of USH 41 is 11 percent lower than that shown on Exhibit C-1 for the year 2020. To be on the conservative side, the values shown on the G Exhibits will be increased by 11 percent. Thereby the adjusted traffic on STH 47 just south of its juncture with CTH A is 7,600 vehicles per day in year 2000 and 9,700, say 10,000, vehicles in the year 2020 for the no interchange alternate. Using the same proportions as at USH 41 means that total traffic north of juncture is 10000/.6 = 17,000 vehicles. This puts 7,000 vehicles on CTH A. For the partial interchange alternate, the traffic on CTH A would be 9,000 vehicles leaving 8,000 vehicles on STH 47. For the full interchange, the daily traffic on CTH A would be 10,000 vehicles with 7,000 vehicles on STH 47. The year 2000 traffic would be 30 percent less than the year 2020 traffic.

For analysis we assume peak hour factor of .1 and 10 percent trucks and a 50/50 peak hour distribution. Exhibits H-1 thru H-3 show the assumed traffic movements at CTH A and STH 47 for all three alternates in year 2020. Since half of CTH A traffic by passed the "T" intersection, the level of service and the time when the intersection would need to be upgraded is the same for all three alternatives.

D. RAMPS AT CTH A AND USH 41

Exhibit I-1 is an excerpt from the Highway Capacity Manual dealing with operational characteristics of ramps. The proximity of ramps one to another adversely affects the level of service if the merge or diverge influence areas (Figure 5-1, Exhibit I-1) overlap. Since the distance from the crossroad to the gore area is 900 to 1,200 feet for a typical diamond interchange design and with the 1,500 ft. influence area, the intersections with diamond interchanges would have to be spaced less than one mile for this to happen. Since CTH A is located one and a half miles from both STH 47 and CTH OO proximity to the ramps is not a factor in determining the level of service.

HCS-3 software for ramps and ramp junctions, Release 3.1, was used to compute the level of service at ramp junctions in both STH 47 and CTH A interchanges with USH 41 for both year 2000 and year 2020.

Since none of the ramps analyzed are existing, we assume that all the ramps will conform to the design parameters established in Procedure 11-30-1 of the Facilities Development Manual (FDM). The typical ramp terminals are shown on Exhibits I-1 and I-2. For the analysis, the following parameters were used: peak hour factor – 0.9, passenger car equivalent of 1.5 for trucks and busses, driver population factor – 1.0, thirtieth highest traffic factor (K-30). Based on observations, free flow speed of 65 mph was used for USH 41 traffic and 50 mph for the ramp traffic. Traffic design parameters for USH 41 traffic were also used for the ramp traffic although a case could be made for using the cross road parameters, but cross road parameters are very close to those on USH 41.

E. ORIGIN-DESTINATION STUDY

An extensive origin-destination study was conducted around the Appleton Urbanized Area in 1993 as one of the initial steps in developing a transportation plan for The Appleton Urban Area. Thirty two interview stations recorded the vehicle travel patterns over a six week period. The study found that for all the stations 83 percent were local trips and 17 were through trips. Ten percent of all the vehicles were medium and heavy duty trucks. For the truck traffic, 66 percent of the trips were local with 34 percent of the trips being through trips. A through trip is a trip whose origin and destination are located outside of the study area.

Two interview stations are of particular interest to this interchange study. One (#74) is located on STH 47, 0.8 miles north of Broadway and the other (#73) is located on CTH A, 1.2 miles south of CTH JJ. The total number of trips for the two locations is similar with 7,560 trips on CTH A and 7,237 trips on STH 47. However, the amount of thru traffic on CTH A was more than double that on STH 47. (1,355 on CTH A and 586 on STH 47).

The study found that the largest concentration of heavy trucks was on CTH A north (16.2) STH 55 south (14.7) STH 47 (14.3), USH 41 north (14.1) and USH 45 south (13.5).

Of the total 1,355 through trips on CTH A, 381 were heavy trucks. The vast majority (289) of the through trucks were headed towards or coming from USH 41 at Neenah while 25 trucks were headed or coming from points west of USH 41. These 314 trucks would have used the west ramps at USH 41 and CTH A intersection if the ramps had been available. This represents 26 percent of trucks on CTH A. Similarly 830 of the 970 through passenger cars including light weight trucks were headed south on USH 41 or west on various routes. The 830 represents 13 percent of total passenger vehicles and light trucks on CTH A.

Of the 586 through trips on STH 47, 143 are heavy trucks. Of these trucks, 90 percent were headed south on USH 41 or to the west of USH 41. Some of these 128 trucks might have used a southbound on ramp at CTH A if one had been available. The 128 trucks represent 12 percent of total truck traffic on STH 47. About 370 through passenger cars and light trucks on STH 47 were headed south on USH 41 or points west of USH 41 representing about 6 percent of all passenger cars and light trucks.

The data indicates that much of the through traffic, if familiar with the Appleton Urban Area, and avoids the indirection of the STH 47 route to head south on USH 41 or to points west of USH 41. This is particularly true of truck traffic, meaning that heavy trucks are using CTH A south of USH 41 and CTH OO that would be entering southbound USH 41 at CTH A if the west ramps were available.

Appendix B
Economic Impacts
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Appendix B
Economic Impacts

A. CONSTRUCTION COSTS

The recently completed Meade Street project is very similar to the no interchange alternate. Meade Street crosses USH 41 two and one half miles east of CTH A. The work under this project consisted of removing an existing two lane structure and replacing it with a four lane structure. The work also involved the widening of embankments and the construction of a four lane urban section for both approaches to the bridge. The lanes on the Meade Street project were 11 foot wide and the anticipated lane width for CTH A is 12 feet. Adjusting the Meade Street project costs for inflation, wider lanes, and box culvert extension required at CTH A, the rough construction cost estimate to the no interchange alternate is $1,500,000.

The project at Ballard Road and USH 41 located 3.5 miles east of CTH A is similar to the full interchange alternate at CTH A. The construction costs of the Ballard Interchange was $2,300,000. Making allowances for differences in the two projects, the rough estimated construction cost for a full interchange at CTH A is $3,500,000. About one third of this cost is for the construction of noise walls along the south ramps and the extension of a twin box culvert under the northeast and southwest ramps at CTH A. Making adjustments to the no interchange construction costs and the full interchange costs, the rough estimate for the partial interchange alternate is $2,500,000.

B. ROAD USER COSTS

For the alternates to be economically equal, the additional construction costs of the full or partial interchange alternatives plus incurred costs to peripheral facilities caused by these alternates would have to be offset by savings in road user costs and savings in construction costs of peripheral traffic facilities. Peripheral facilities would include the CTH A/Capitol Drive intersection, USH 41/STH 47 interchange, USH 41, CTH A and the local street system in general.

Following tables show the values that WisDOT central office planners uses in computing road user costs. The costs of the alternates are normally compared over a 50 year period with money valued at 5%.

Vehicle Operating costs ($/vehicle mile)

Auto	$0.17
Single Unit Truck	$0.41
Combination Truck	$0.74

Values of Travel Time ($/hour) 1998 dollars

Auto	$7.50	(per person)
Single Unit Truck	$19.59	(per vehicle)
Combination Truck	$22.25	(per vehicle)

In the year 2020, the north to west movement of the STH 47 interchange is 5,000 vehicles for the no interchange alternate and 2,400 vehicles for the partial interchange alternate. This means that 2,600 vehicles avoided the indirection of STH 47 by using the northwest ramp at CTH A. This also applies to the return trip. The total vehicles avoiding this indirection in year 2020 would be 5,200. See exhibits C-1 and C-2 for the projected traffic movements. Using the proportion of traffic decrease on STH 47 in the year 2020, the traffic avoiding the indirection in the year 2000 would be 3,500.

Since there is debate as to whether the travel time costs of persons in passenger cars are legitimate road user costs, these costs will not be included in the calculations. Road user costs will be computed for a 20 year period because that is the time when structures normally need maintenance work such as redecking and would be the logical time to add ramps not built at this time. The right-of-way for ramp construction is already available. For this reason the ramps could also be added at a later date such as adding ramps at time of conversion of USH 41 from four lanes to six lanes.

For the calculation of user costs, the average traffic design parameters were used for CTH A and STH 47 assuming 10% trucks of which 70% would be single unit trucks. Figures G1 thru G3 show the traffic volumes along CTH A and STH 47 north of USH 41. The amount of traffic at the merge of CTH A and STH 47 is 10,600 vehicles in the year 2000 and 15,700 vehicles in the year 2020. For the partial interchange alternate, 900 vehicles would be diverted from STH 47 to CTH A in year 2000 and 1,400 vehicles in the year 2020. This is the amount of traffic at the merger point that is avoiding the 2.1 mile extra travel distance along STH 47 route to head west and south on USH 41.

For the full interchange alternate the amount of traffic diverted onto CTH A is greater, however, this is traffic that would head east at USH 41 and there would be no indirection for this traffic and no savings in the user costs.

Most of the traffic diverted from the west ramps at STH 47 to the west ramps at CTH A would be generated in the area located between CTH A and STH 47 from USH 41 to the merge of CTH A and STH 47. The following computations assume the indirection of this traffic is one mile and two miles for traffic diverted at the merge.

Road User Cost Computations

CTH A route vs. STH 47 route

Vehicles					**Extra Vehicle Miles**	
Total Year	**2000**		**2020**			
	At Merge	**Rest**	**At Merge**	**Rest**	**2000**	**2020**
Total Vehicles	900	2,600	1,400	3,800	4,400	6600
Passenger Vehicle	810	2,340	1,260	3,420	3,960	5,940
Trucks	90	260	140	380	440	660
Single Unit Trucks	60	180	100	260	300	460
Combination Trucks	30	80	40	120	140	200

Using a 1.5 percent inflation rate, the 1998 user costs would increase by a factor of 1.03 for year 2000 and 1.388 for year 2020. The average travel speed is assumed to be 55 mph.

Year	**2000**	**2020**
Passenger Vehicle Operating Costs	$ 690	$1,400
Single Unit Truck Operating Costs	$ 130	$ 260
Combination Truck Operating Costs	$ 110	$ 210
Single Unit Time Costs	$ 110	$ 230
Combination Truck Time Cost	$ 60	$ 110
Total Cost Per Day	$ 1,100	$2,210
User Cost Per Year	$401,000	$807,000

Following road user costs are incurred by the traveling public due to distance and inconvenience of travel from north of USH 41 via CTH A and CTH "OO". The extra distance traveled is 0.3 miles.

The north to west movement at CTH A for the full and partial interchange alternates is 5,500 vehicles in the year 2020. Subtracting the 2,600 vehicles reduction at STH 47 leaves 2,900 vehicles or a total of 5,800 vehicles in both directions are avoiding the inconvenience and indirection of getting to southbound USH 41 via CTH A and CTH OO. In the year 2000 this number would be 3,700 vehicles.

	Vehicles		**Extra Vehicle Miles**	
Total Year	**2000**	**2020**	**2000**	**2020**
All Vehicles	3,700	5,800	1,110	1,740
Passenger Vehicle	3,330	5,200	1,000	1,560
All Trucks	370	600	110	180
Single Unit Trucks	260	420	80	130
Combination Trucks	110	180	30	50

The assumed average travel speed along USH 41is 60 mph and the average speed along the CTH A and CTH OO route is 40 mph. To travel the CTH OO route would take 1.7/40 = .043 hours and 1.4/60 = .023 hours via USH 41 route, a difference of .02 hours per vehicle.

Year	**2000**	**2020**
Passenger Vehicle Operating Costs	\$ 180	\$ 370
Single Unit Truck Operating Costs	\$ 30	\$ 70
Combination Truck Operating Costs	\$ 20	\$ 50
Single Unit Time Costs	\$ 100	\$ 230
Combination Truck Time Cost	\$ 50	\$ 110
Total Cost Per Day	\$ 380	\$ 830
User Cost Per Year	\$139,000	\$303,000

Using present worth factors for a uniform series and gradient series, the present worth of road user costs is $9,500,000 with money valued at 5% over a 20 year period.

These same savings in road user costs would also apply when comparing the full interchange alternate to the no interchange alternate. The full interchange alternate eliminates the same indirection from the north as the partial interchange. The full interchange further eliminates some indirection and inconvenience to the traffic generated from south of USH 41. However these savings in user costs would be very minor when compared to the savings for the traffic from the north and will not be computed.

One of the major cost factors would be associated with the timing of improving USH 41 from four to six lanes. USH 41 is six lanes already from CTH "OO" to the south. The next logical segment to be converted to six lanes would include the area of CTH A and USH 41 intersection. Exhibit B-4 shown the projected traffic for USH 41 in Outagamie County. The segment at CTH A has the least projected traffic when compared to the next three segments to the east. Therefore it would be one of these other segments that would dictate the time of conversion of USH 41 from four lanes to six lanes at CTH A.

Even though the traffic at CTH A on USH 41 will not govern the timing of the conversion of USH 41 from four lanes to six lanes, the costs associated with the timing of the conversion were computed for the alternates. The computations assume that the conversion will be warranted when the daily traffic on USH 41 reaches 66,000 at a cost of $800,000 for a 1½ mile segment in year 2000 dollars.

Another cost to be considered is the timing of when CTH A south of USH 41 will be converted from a rural 2 lane section to an urban four lane section. Using CTH OO (Richmond Street to Meade Street) as an example of such a conversion, the cost would be about $2,000,000 per mile in year 2000 dollars. This conversion was computed for the time when traffic on CTH A would reach 14,300 vehicles per day.

C. Summary of Costs

The following table summarized the overall costs of the three alternates.

TABLE 1

	Alternates		
Description	**No Interchange**	**Partial Interchange**	**Full Interchange**
Construction Costs	1,500,000	2,500,000	3,500,000
Road User Costs	9,500,000		
Resurface 5 miles of CTH A no push 41		350,000	350,000
Timing of 6 Lanes on USH 41 west of CTH A		200,000	120,000
Timing of 6 Lanes on USH 41 East of CTH A		-140,000	140,000
Turning Lanes in 47 Interchange		-20,000	-40,000
Intersections along CTH A north of USH 41		100,000	0
CTH A Reconstruction Timing South of USH 41		-410,000	630,000
Right-of-way & Damages		100,000	200,000
CTH A & STH 47 Intersection		0	0
Total	**11,000,000**	**2,700,000**	**4,900,000**

The partial interchange and full interchange alternates should generate a fair amount of left turns at cross roads along CTH A north of USH 41. Traffic analysis of the cross roads would be needed to asses the impacts of the two interchange alternates. Therefore, the amounts in the table allowed for intersection improvements along CTH A is very rough.

Exhibit A-1

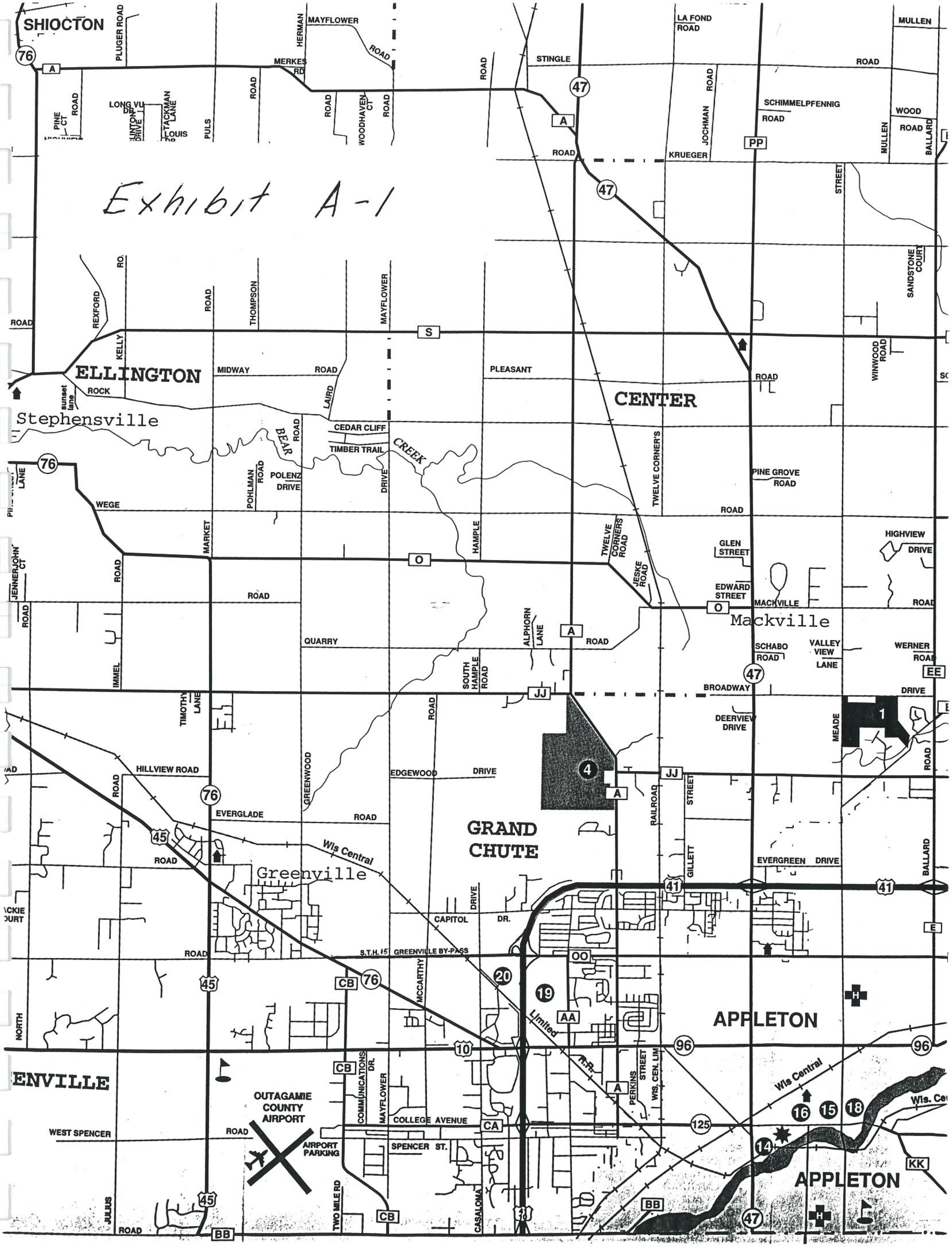
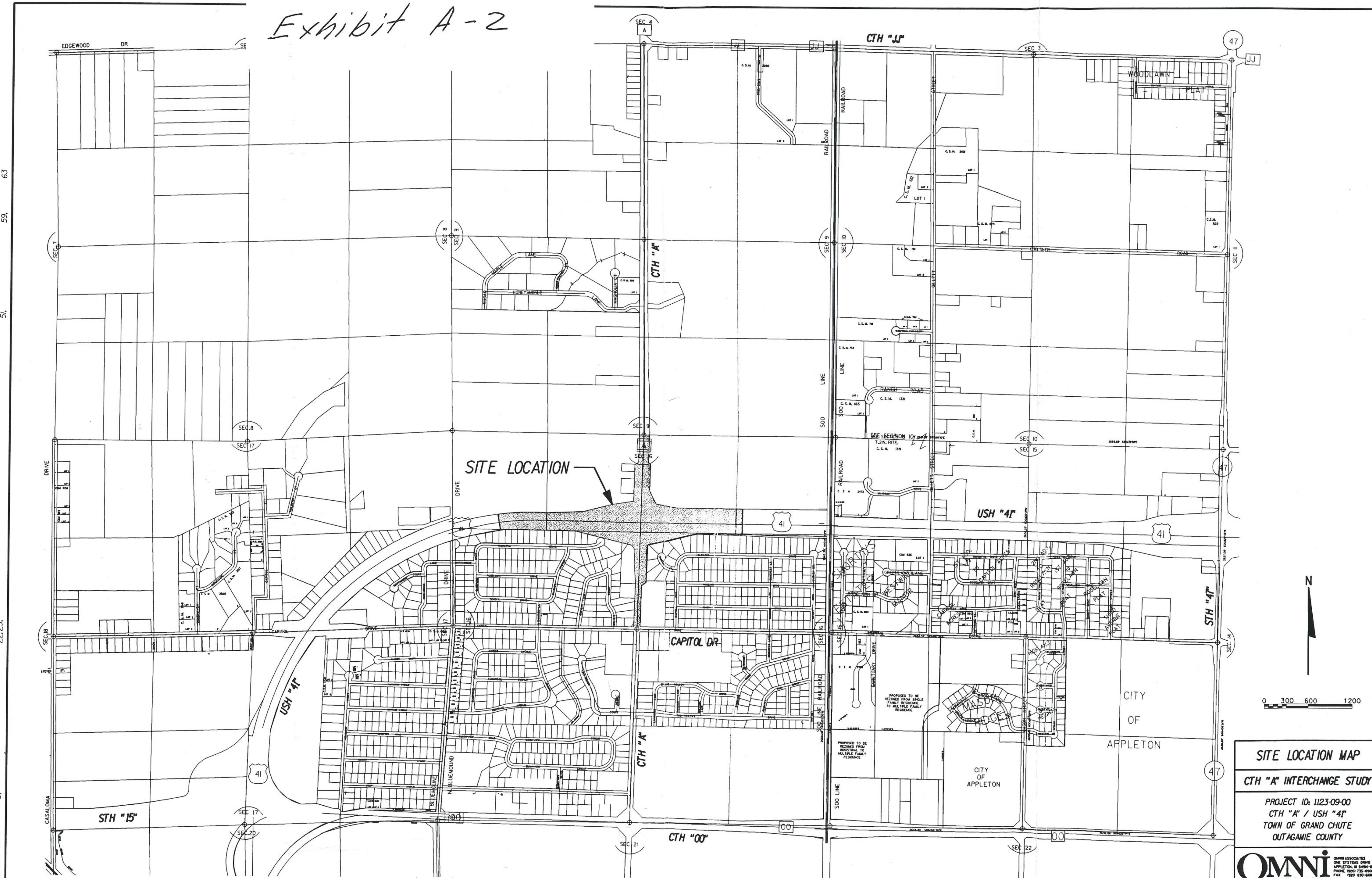

SHIOCTON
ELLINGTON
Stephensville
CENTER
Mackville
GRAND CHUTE
Greenville
APPLETON
ENVILLE
OUTAGAMIE COUNTY AIRPORT
AIRPORT PARKING
MAYFLOWER ROAD
STINGLE ROAD
LA FOND ROAD
MULLEN
SCHIMMELPFENNIG ROAD
WOOD ROAD
KRUEGER
JOCHMAN ROAD
MIDWAY ROAD
PLEASANT ROAD
ROCK
CEDAR CLIFF
TIMBER TRAIL
BEAR CREEK
PINE GROVE ROAD
WEGE ROAD
TWELVE CORNER'S
HIGHVIEW DRIVE
GLEN STREET
EDWARD STREET
MACKVILLE ROAD
QUARRY
SCHABO ROAD
VALLEY VIEW LANE
WERNER ROAD
BROADWAY DRIVE
DEERVIEW DRIVE
HILLVIEW ROAD
EDGEWOOD DRIVE
EVERGLADE ROAD
Wis Central
EVERGREEN DRIVE
CAPITOL DR.
S.T.H. 15 GREENVILLE BY-PASS
Limited R.R.
COLLEGE AVENUE
SPENCER ST.
WEST SPENCER ROAD
4
1
14
15
16
18
19
20

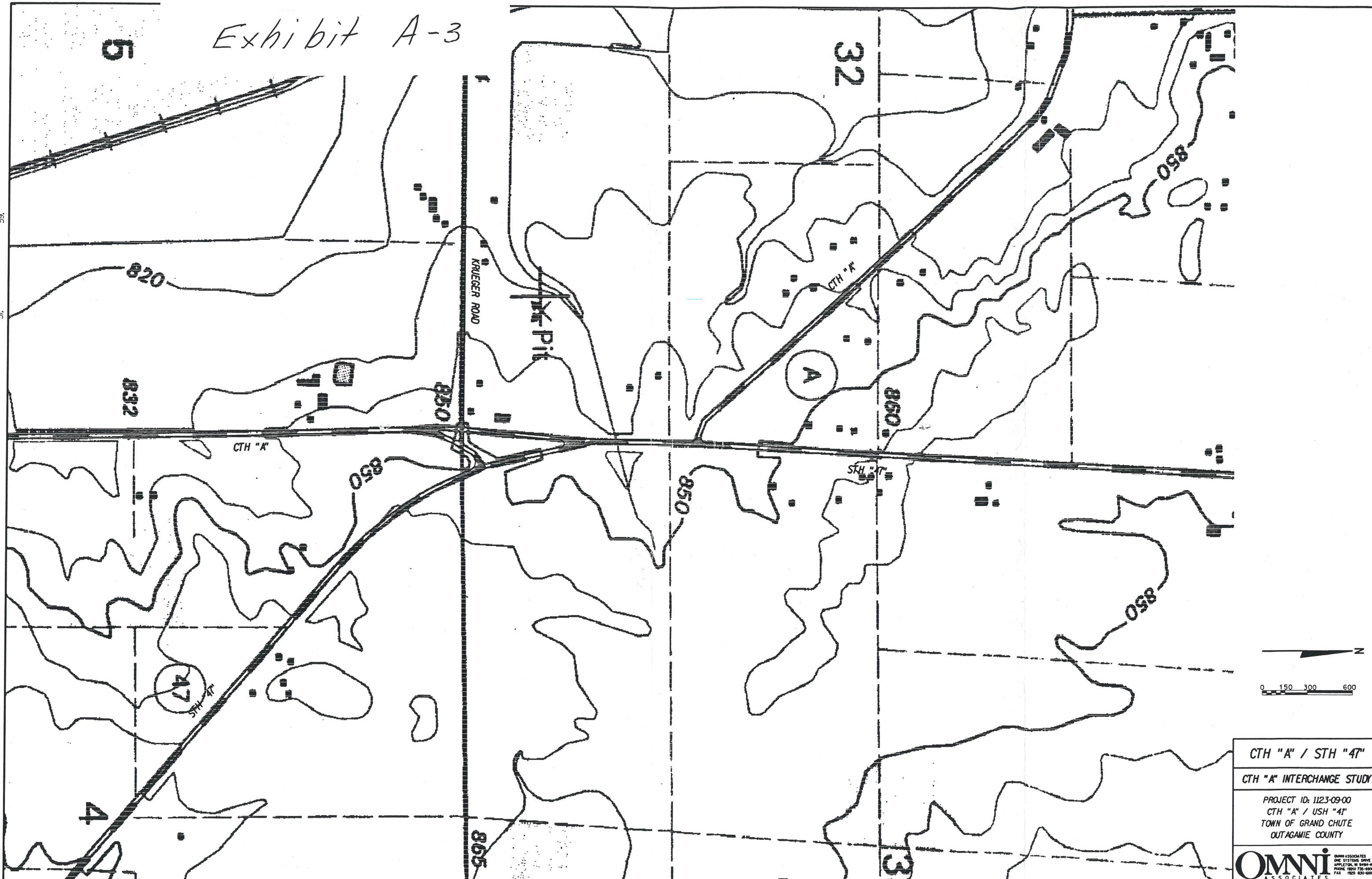
Exhibit A-2



FILE NAME: E1408A98/SHEETS /DISPLAY /SITEPLAN.DGN TECH/ENGR: CRK/MAH PLOT DATE: 03/16/99 PLOT SCALE: 1:
ORIGINATOR: OMNI ASSOCIATES ONE SYSTEMS DRIVE APPLETON, WI 54914-1654 REV. DATE: / / PLOT NAME: SEE FILE NAME
LEVELS ON • 5, 22,23, 51, 59, 63

Exhibit A-3

FILE NAME: E1408A98/SHEETS /DISPLAY /CTHA 47 .DGN TECH/ENGR: CRK/MAH PLOT DATE: 03/16/99 PLOT NAME: SEE FILE NAME PLOT SCALE: 1:
ORIGINATOR: OMNI ASSOCIATES ONE SYSTEMS DRIVE APPLETON, WI 54914-1654 REV. DATE: / /
LEVELS ON - 3, 51, 59,



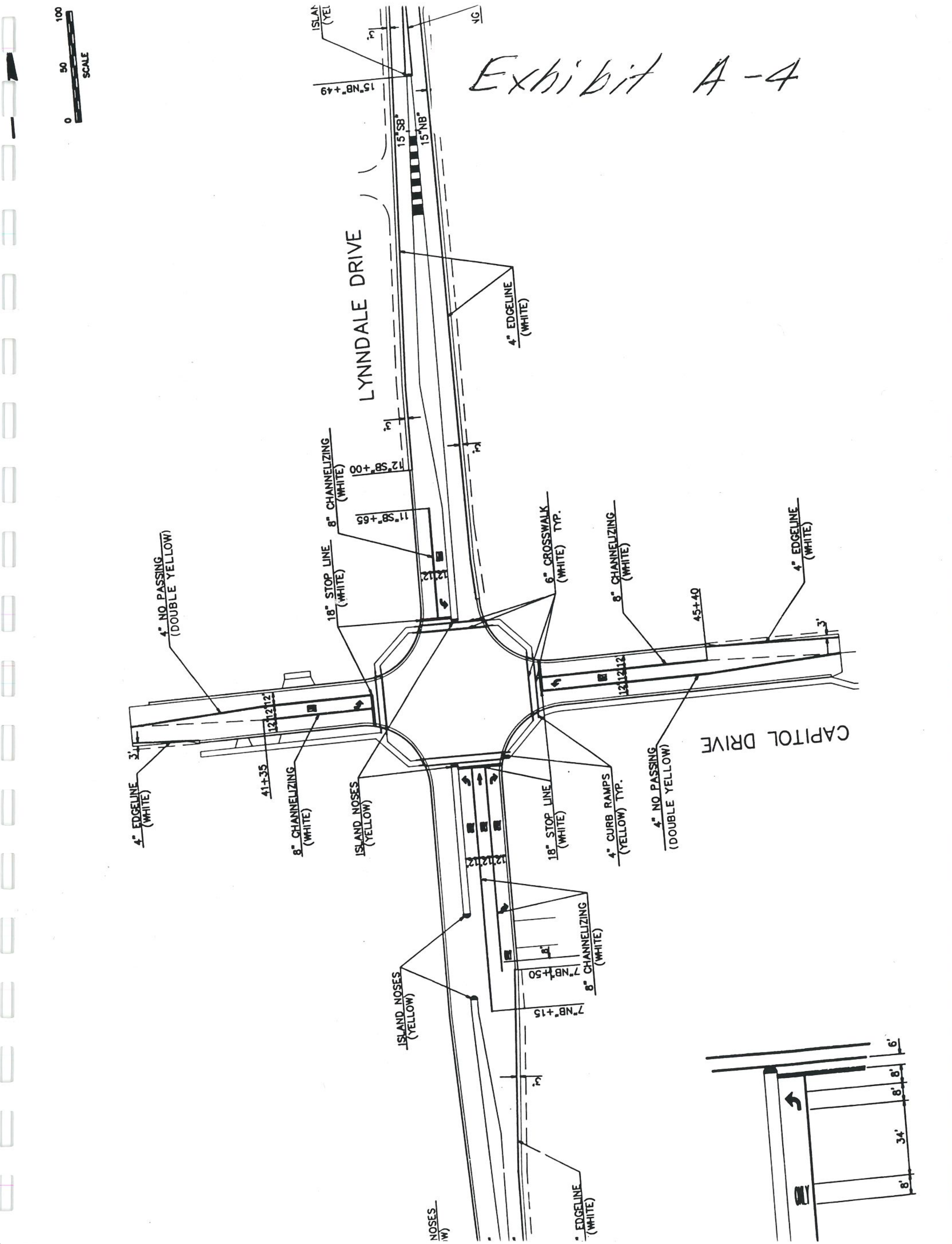
CTH "A" / STH "47"

CTH "A" INTERCHANGE STUDY

PROJECT ID: 1123-09-00
CTH "A" / USH "41"
TOWN OF GRAND CHUTE
OUTAGAMIE COUNTY

OMNNI ASSOCIATES
OMNNI ASSOCIATES
ONE SYSTEMS DRIVE
APPLETON, WI 54914-1654
PHONE (920) 735-6900
FAX (920) 830-6100

Exhibit A-4



SCALE
0
50
100
LYNNDALE DRIVE
CAPITOL DRIVE
15"NB"+49
15"SB"
15"NB"
4" EDGELINE (WHITE)
12"SB"+00
11"SB"+65
8" CHANNELIZING (WHITE)
18" STOP LINE (WHITE)
4" NO PASSING (DOUBLE YELLOW)
6" CROSSWALK (WHITE) TYP.
8" CHANNELIZING (WHITE)
45+40
4" EDGELINE (WHITE)
3'
4" NO PASSING (DOUBLE YELLOW)
4" CURB RAMPS (YELLOW) TYP.
18" STOP LINE (WHITE)
ISLAND NOSES (YELLOW)
8" CHANNELIZING (WHITE)
41+35
4" EDGELINE (WHITE)
3'
7"NB"+50
7"NB"+15
8" CHANNELIZING (WHITE)
ISLAND NOSES (YELLOW)
4" EDGELINE (WHITE)
6'
8'
8'
34'
8'

Exhibit A-5

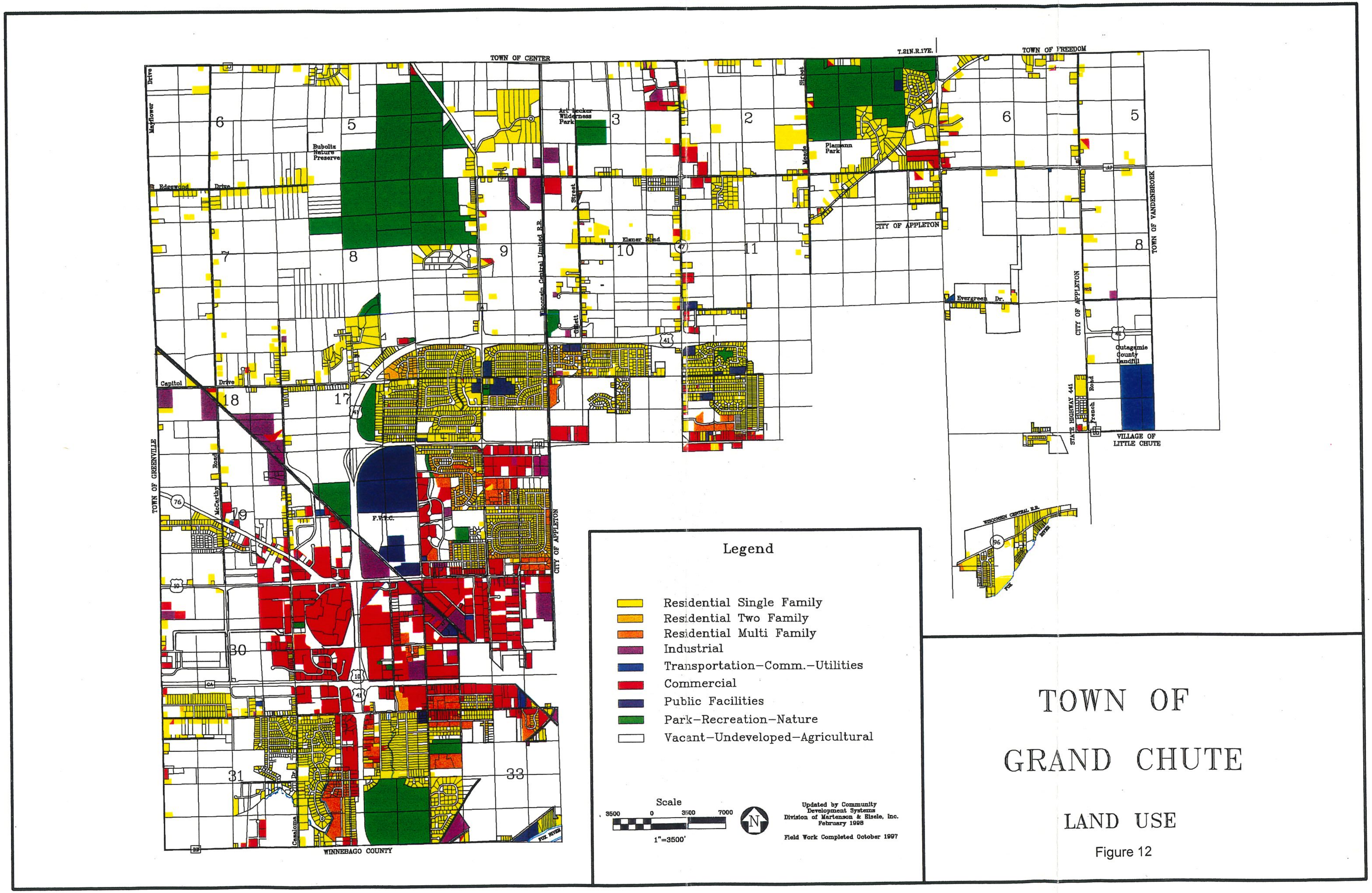
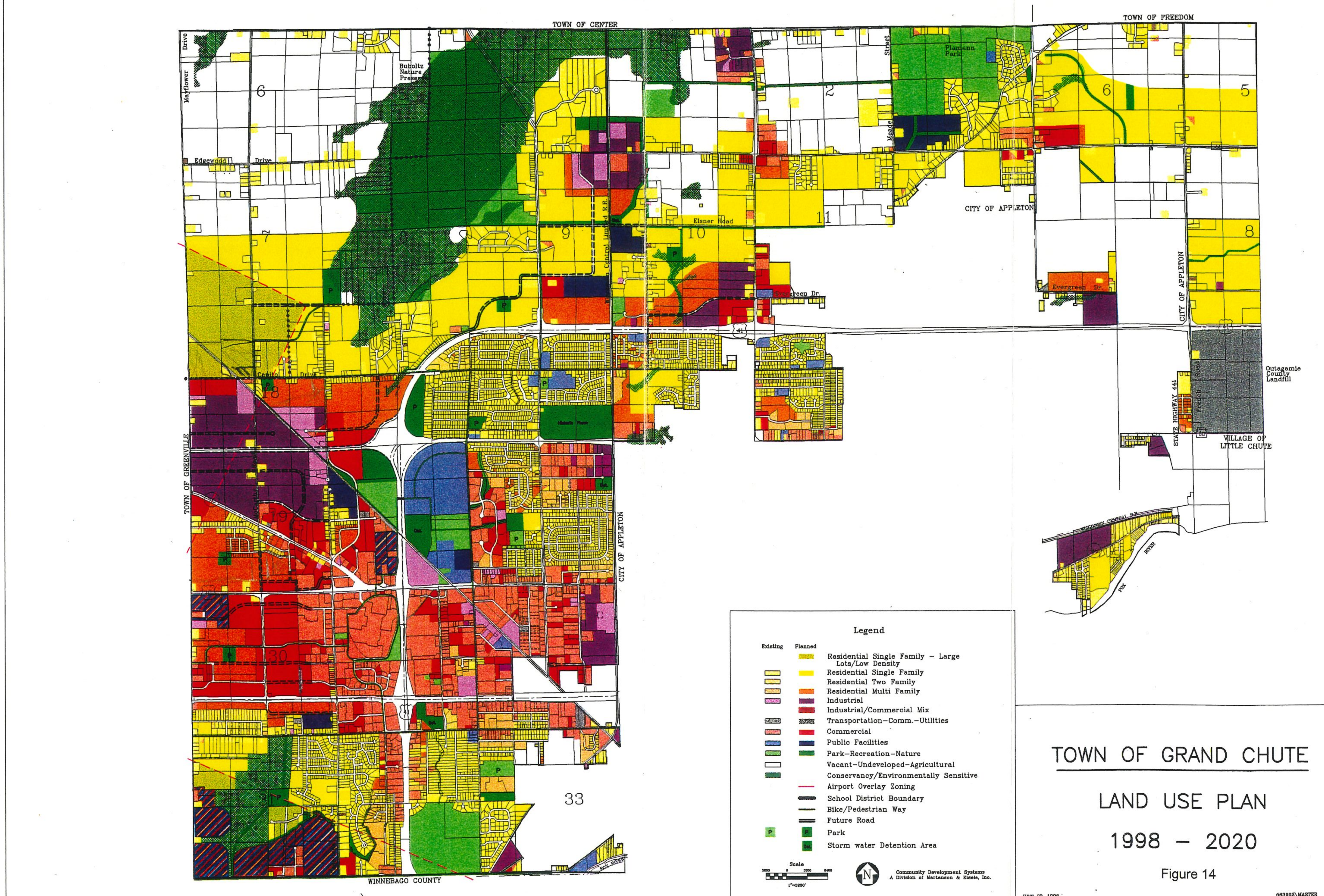
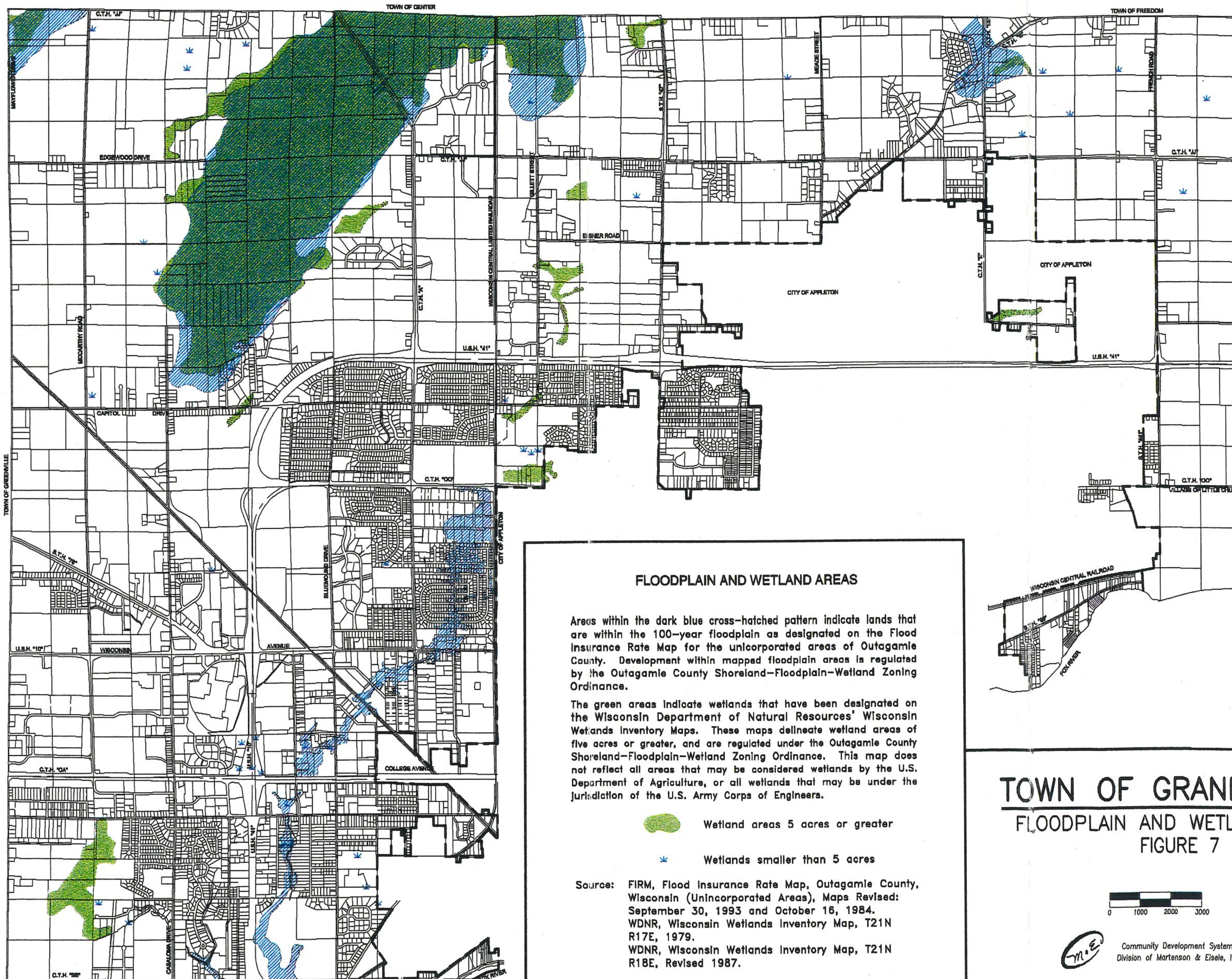

TOWN OF CENTER
TOWN OF FREEDOM
T.21N.R.17E.
TOWN OF GREENVILLE
TOWN OF VANDENBROEK
WINNEBAGO COUNTY
CITY OF APPLETON
VILLAGE OF LITTLE CHUTE
Bubolitz Nature Preserve
Art Decker Wilderness Park
Plamann Park
Outagamie County Landfill
F.V.T.C.
Mayflower Drive
Edgewood Drive
Capitol Drive
McCarthy Road
Elsner Road
Evergreen Dr.
French Road
State Highway 441
Wisconsin Central Limited R.R.
Wisconsin Central R.R.
Fox River
Legend
Residential Single Family
Residential Two Family
Residential Multi Family
Industrial
Transportation–Comm.–Utilities
Commercial
Public Facilities
Park–Recreation–Nature
Vacant–Undeveloped–Agricultural
Scale
3500 0 3500 7000
1"=3500'
N
Updated by Community Development Systems Division of Martenson & Eisele, Inc. February 1998
Field Work Completed October 1997
TOWN OF GRAND CHUTE
LAND USE
Figure 12

Exhibit A-6



TOWN OF CENTER
TOWN OF FREEDOM
TOWN OF GREENVILLE
CITY OF APPLETON
WINNEBAGO COUNTY
VILLAGE OF LITTLE CHUTE
Outagamie County Landfill
STATE HIGHWAY 441
Mayflower Drive
Edgewood Drive
Buboltz Nature Preserve
Plamann Park
Elsner Road
Evergreen Dr.
Centre Lumber R.R.
Meade Street
FOX RIVER
WISCONSIN CENTRAL R.R.
Legend
Existing
Planned
Residential Single Family - Large Lots/Low Density
Residential Single Family
Residential Two Family
Residential Multi Family
Industrial
Industrial/Commercial Mix
Transportation-Comm.-Utilities
Commercial
Public Facilities
Park-Recreation-Nature
Vacant-Undeveloped-Agricultural
Conservancy/Environmentally Sensitive
Airport Overlay Zoning
School District Boundary
Bike/Pedestrian Way
Future Road
Park
Storm water Detention Area
Scale
1"=3200'
Community Development Systems
A Division of Martenson & Eisele, Inc.
TOWN OF GRAND CHUTE
LAND USE PLAN
1998 - 2020
Figure 14
JUNE 22, 1998
563902\MASTER

Exhibit A-7



FLOODPLAIN AND WETLAND AREAS

Areas within the dark blue cross-hatched pattern indicate lands that are within the 100-year floodplain as designated on the Flood Insurance Rate Map for the unincorporated areas of Outagamie County. Development within mapped floodplain areas is regulated by the Outagamie County Shoreland-Floodplain-Wetland Zoning Ordinance.

The green areas indicate wetlands that have been designated on the Wisconsin Department of Natural Resources' Wisconsin Wetlands Inventory Maps. These maps delineate wetland areas of five acres or greater, and are regulated under the Outagamie County Shoreland-Floodplain-Wetland Zoning Ordinance. This map does not reflect all areas that may be considered wetlands by the U.S. Department of Agriculture, or all wetlands that may be under the jurisdiction of the U.S. Army Corps of Engineers.

Wetland areas 5 acres or greater

Wetlands smaller than 5 acres

Source: FIRM, Flood Insurance Rate Map, Outagamie County, Wisconsin (Unincorporated Areas), Maps Revised: September 30, 1993 and October 16, 1984.
WDNR, Wisconsin Wetlands Inventory Map, T21N R17E, 1979.
WDNR, Wisconsin Wetlands Inventory Map, T21N R18E, Revised 1987.

TOWN OF GRAND CHUTE

FLOODPLAIN AND WETLAND AREAS

FIGURE 7

0 1000 2000 3000

Community Development Systems
Division of Martenson & Eisele, Inc.

Exhibit B-1

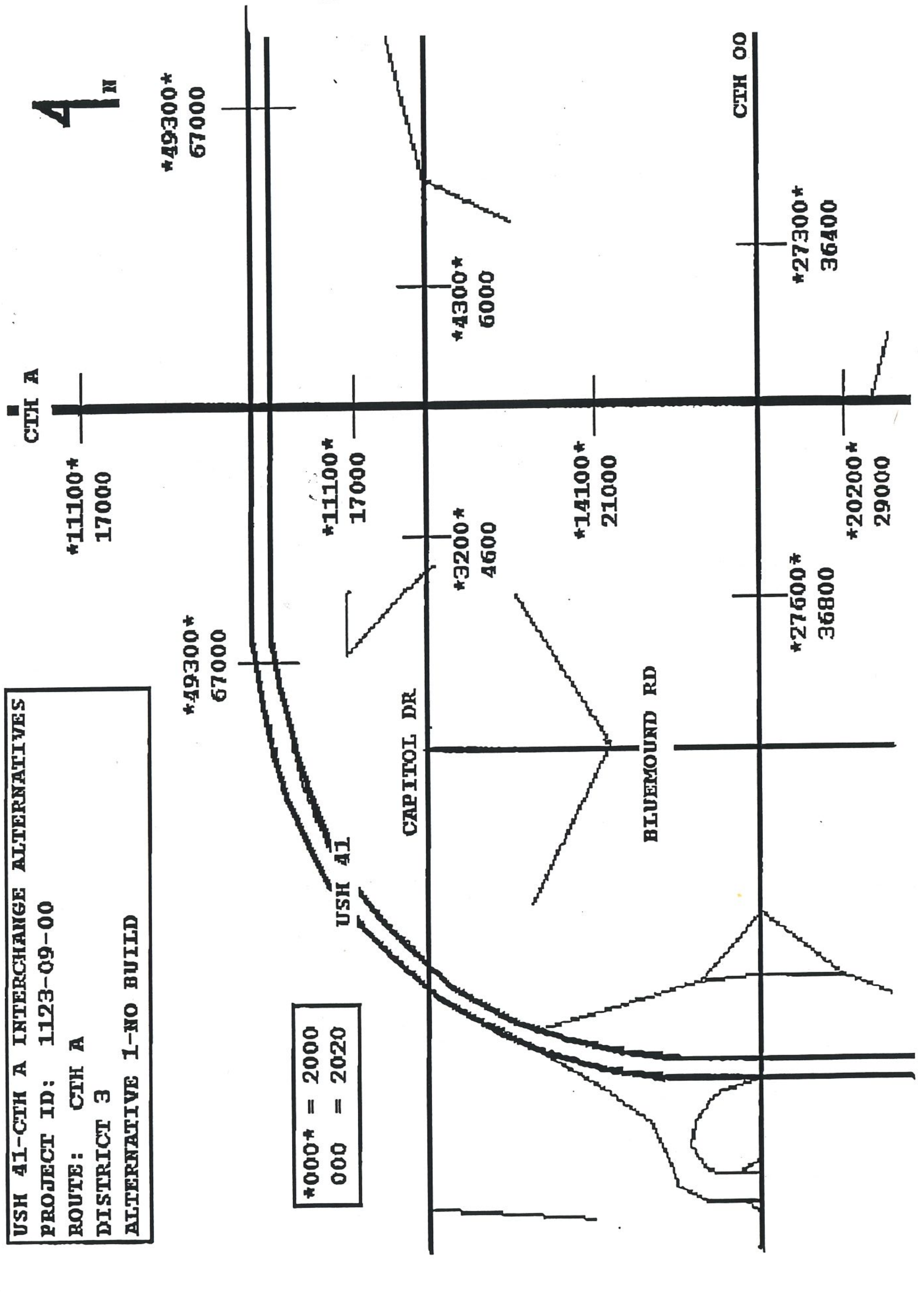

USH 41-CTH A INTERCHANGE ALTERNATIVES
PROJECT ID: 1123-09-00
ROUTE: CTH A
DISTRICT 3
ALTERNATIVE 1-NO BUILD
000 = 2000
000 = 2020
N
CTH A
CTH OO
USH 41
CAPITOL DR
BLUEMOUND RD
49300
67000
11100
17000
11100
17000
4300
6000
3200
4600
14100
21000
27300
36400
27600
36800
20200
29000
49300
67000

Exhibit B-2

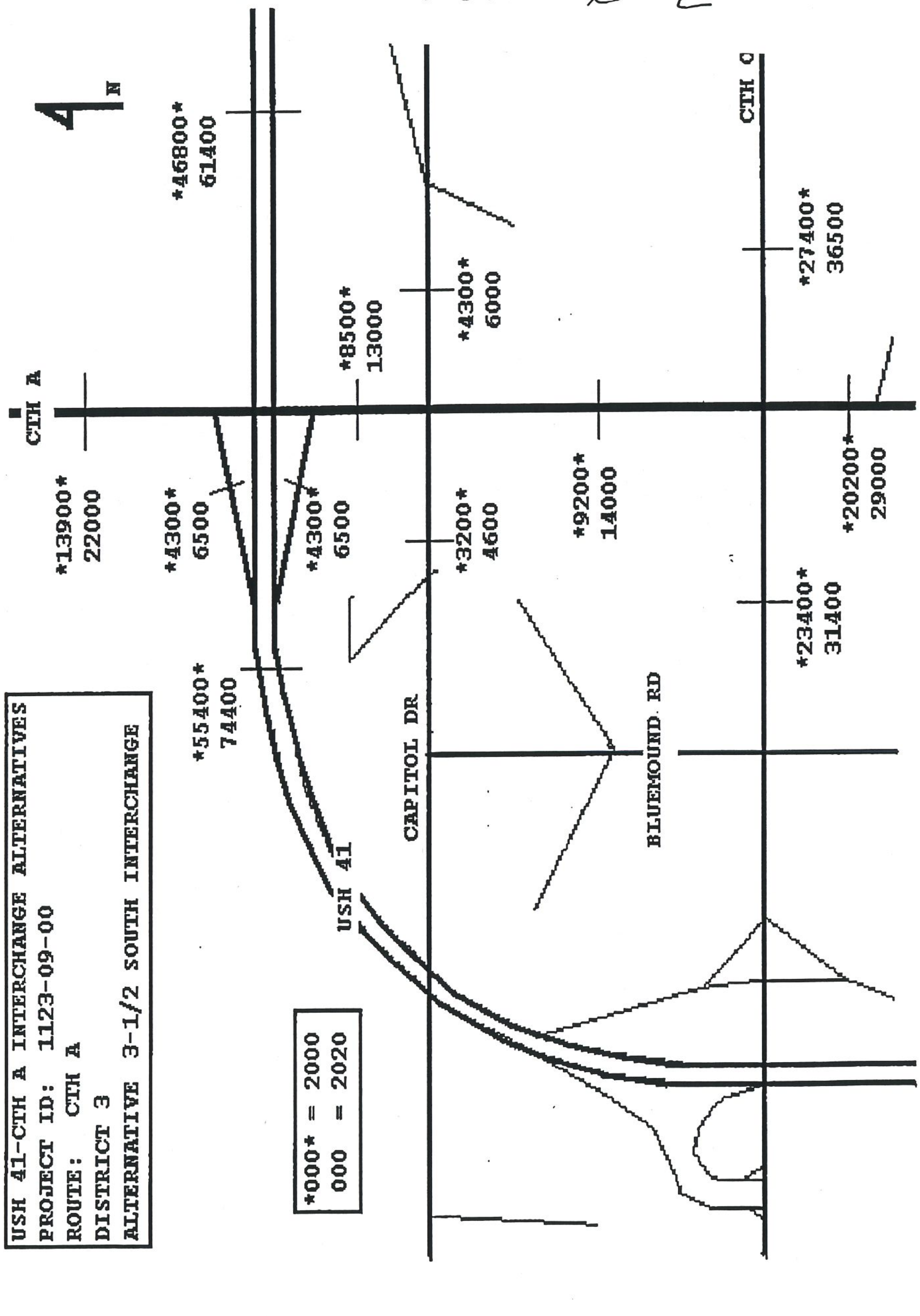

USH 41-CTH A INTERCHANGE ALTERNATIVES
PROJECT ID: 1123-09-00
ROUTE: CTH A
DISTRICT 3
ALTERNATIVE 3-1/2 SOUTH INTERCHANGE
000 = 2000
000 = 2020
N
CTH A
CTH Q
USH 41
CAPITOL DR
BLUEMOUND RD
46800 61400
8500 13000
4300 6000
27400 36500
13900 22000
4300 6500
4300 6500
3200 4600
9200 14000
20200 29000
23400 31400
55400 74400

Exhibit B-3

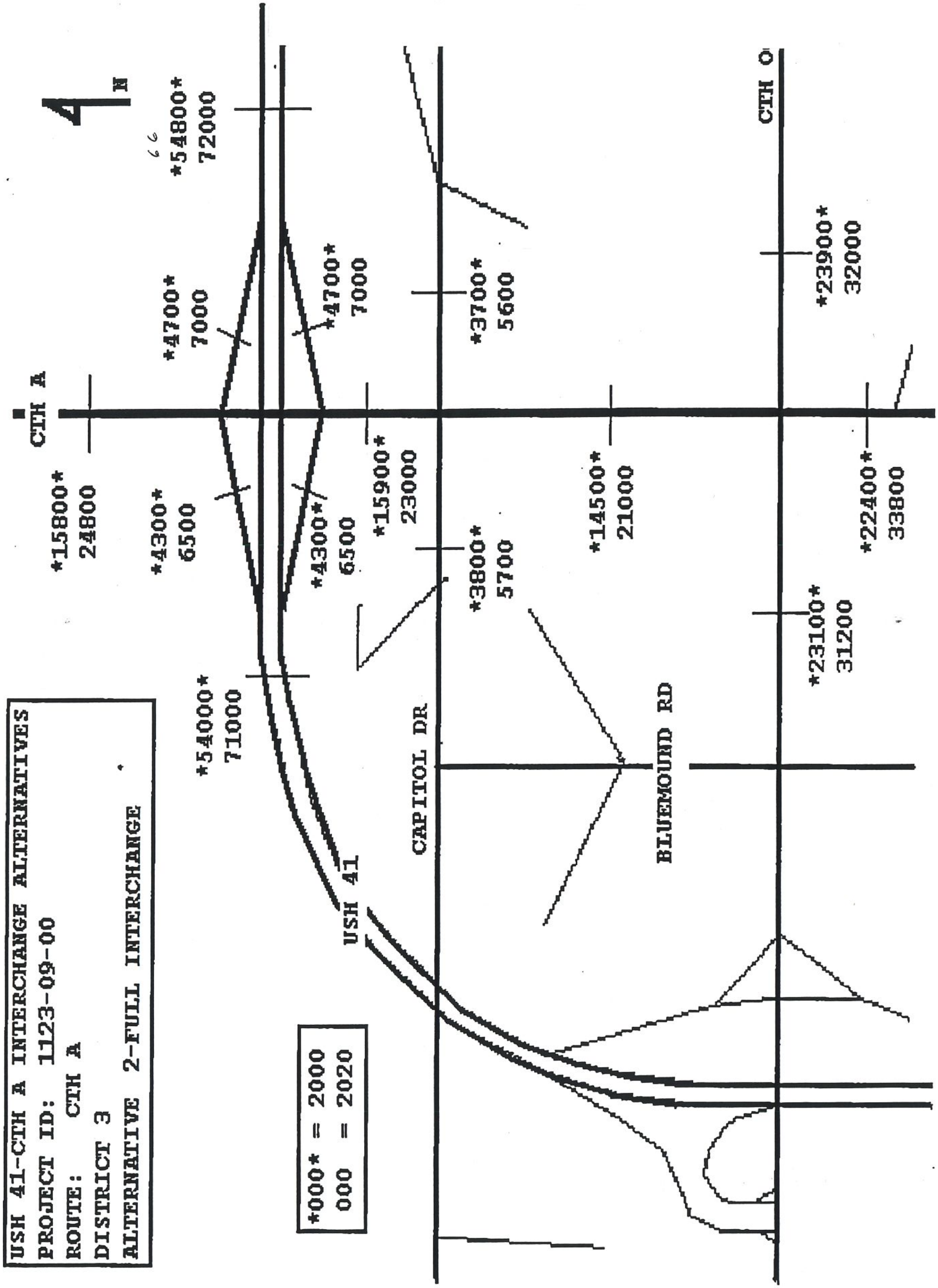

USH 41-CTH A INTERCHANGE ALTERNATIVES
PROJECT ID: 1123-09-00
ROUTE: CTH A
DISTRICT 3
ALTERNATIVE 2-FULL INTERCHANGE
000 = 2000
000 = 2020
N
CTH A
CTH O
CAPITOL DR
BLUEMOUND RD
USH 41
54800
72000
54000
71000
4700
7000
4700
7000
4300
6500
4300
6500
15800
24800
15900
23000
3700
5600
3800
5700
14500
21000
23900
32000
23100
31200
22400
33800

EXHIBIT B-4

USH 41-CTH A INTERCHANGE ALTERNATIVES
PROJECT ID: 1123-09-00
ROUTE: CTH A
COUNTY: OUTAGAMIE
DISTRICT: 3
ALTERNATIVE 1: NO BUILD

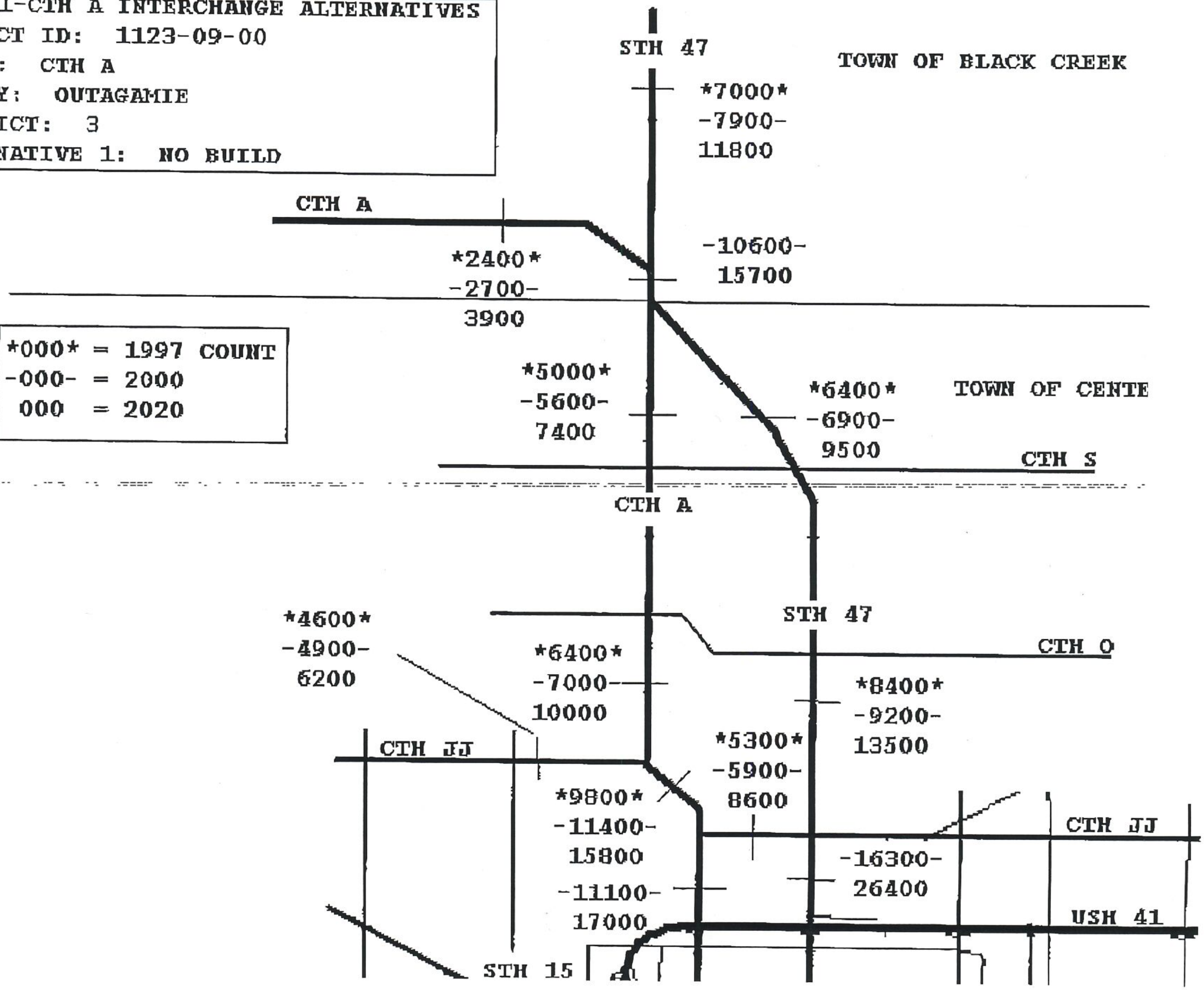


EXHIBIT B-5

USH 41-CTH A INTERCHANGE ALTERNATIVES
PROJECT ID: 1123-09-00
ROUTE: CTH A
COUNTY: OUTAGAMIE
DISTRICT: 3
ALTERNATIVE 3: 1/2 SOUTH INTERCHANGE

000 = 1997 COUNT
-000- = 2000
000 = 2020

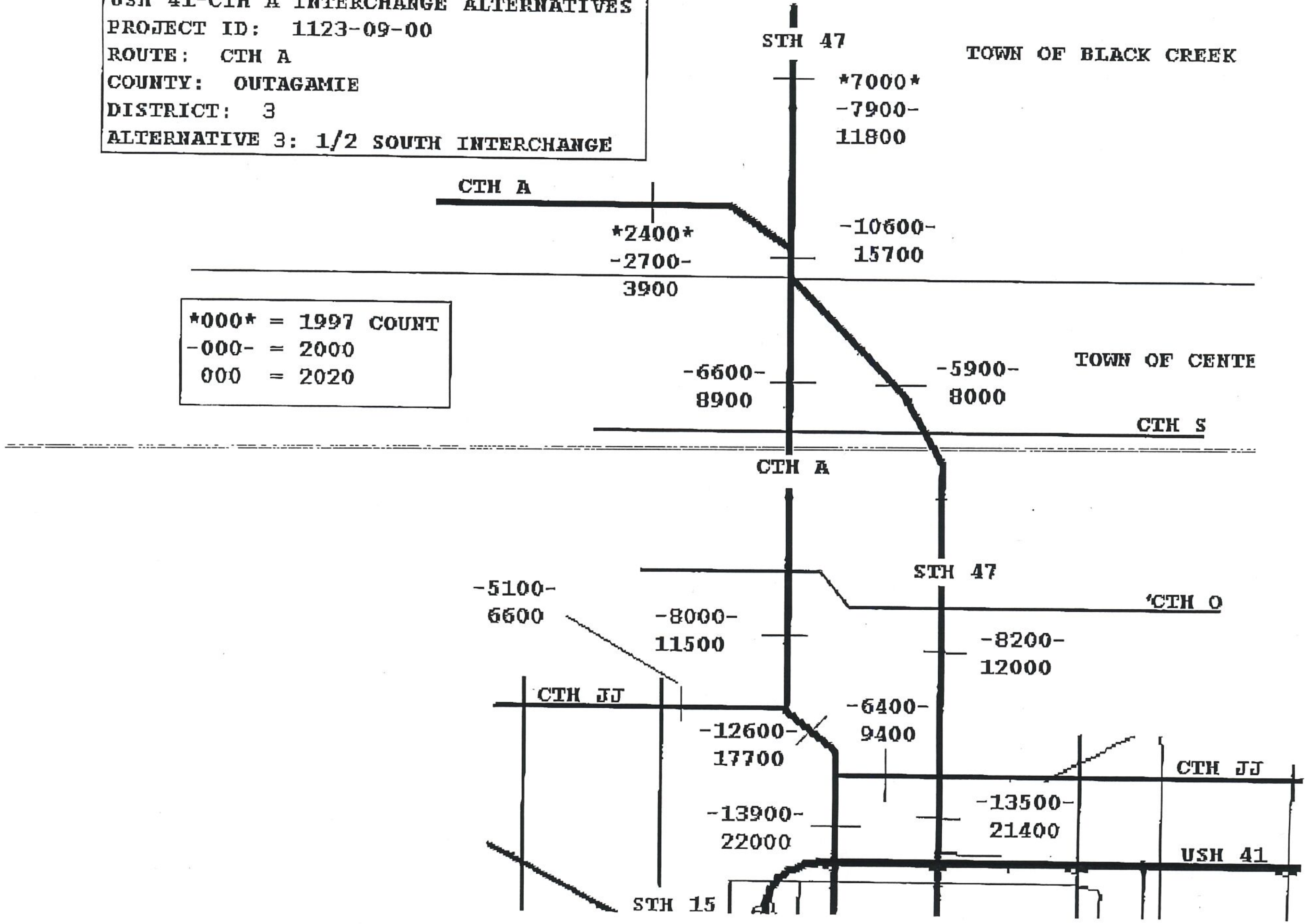


EXHIBIT B-6

USH 41-CTH A INTERCHANGE ALTERNATIVES
PROJECT ID: 1123-09-00
ROUTE: CTH A
COUNTY: OUTAGAMIE
DISTRICT: 3
ALTERNATIVE 2: FULL INTERCHANGE

000 = 1997 COUNT
-000- = 2000
000 = 2020

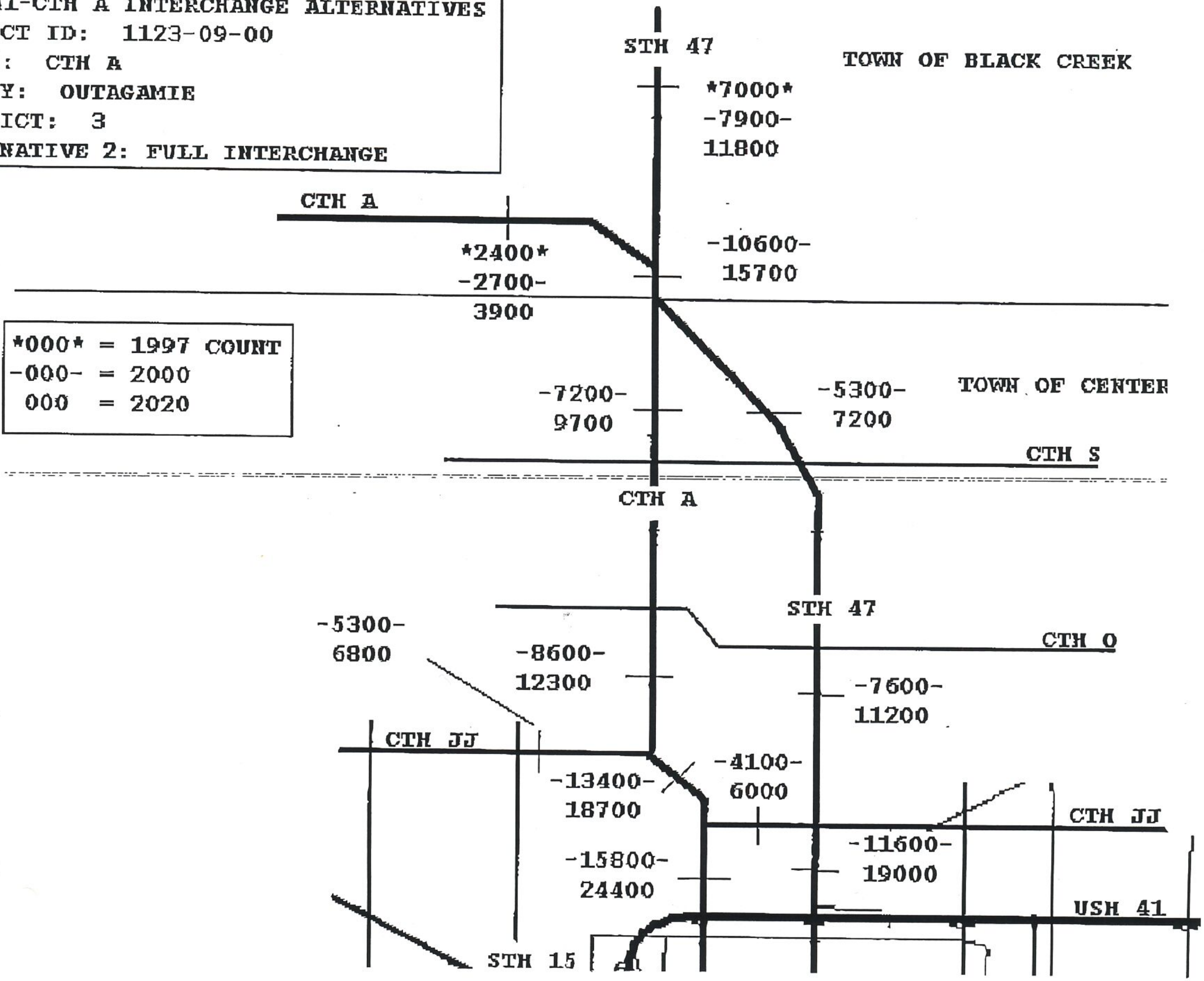
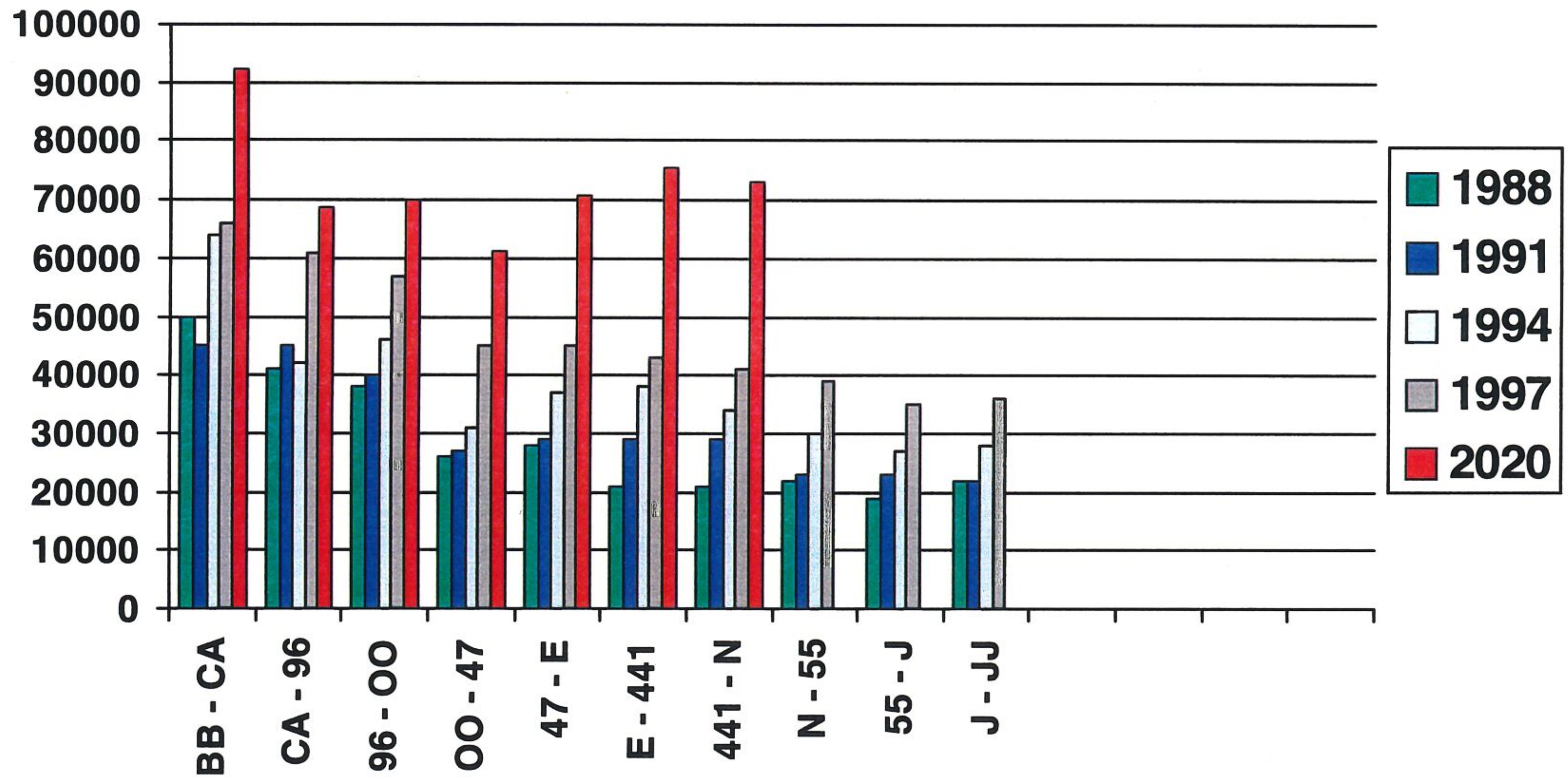


Exhibit B-7

USH 41 OUTAGAMIE COUNTY 1988 - 1997

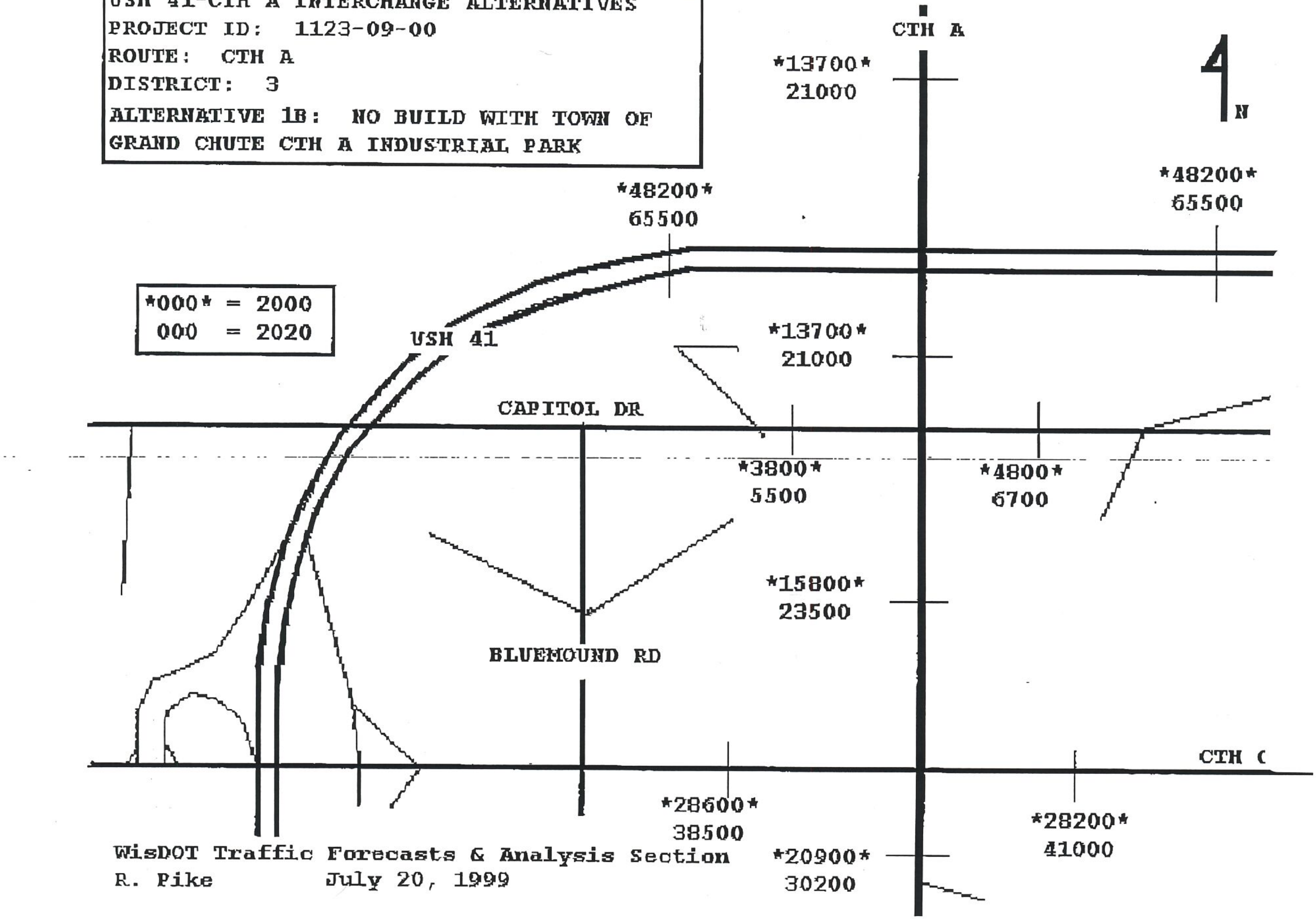


6 Lanes open from SCL - OO in 1992.

Exhibit B-8

USH 41-CTH A INTERCHANGE ALTERNATIVES
PROJECT ID: 1123-09-00
ROUTE: CTH A
DISTRICT: 3
ALTERNATIVE 1B: NO BUILD WITH TOWN OF GRAND CHUTE CTH A INDUSTRIAL PARK

000 = 2000
000 = 2020

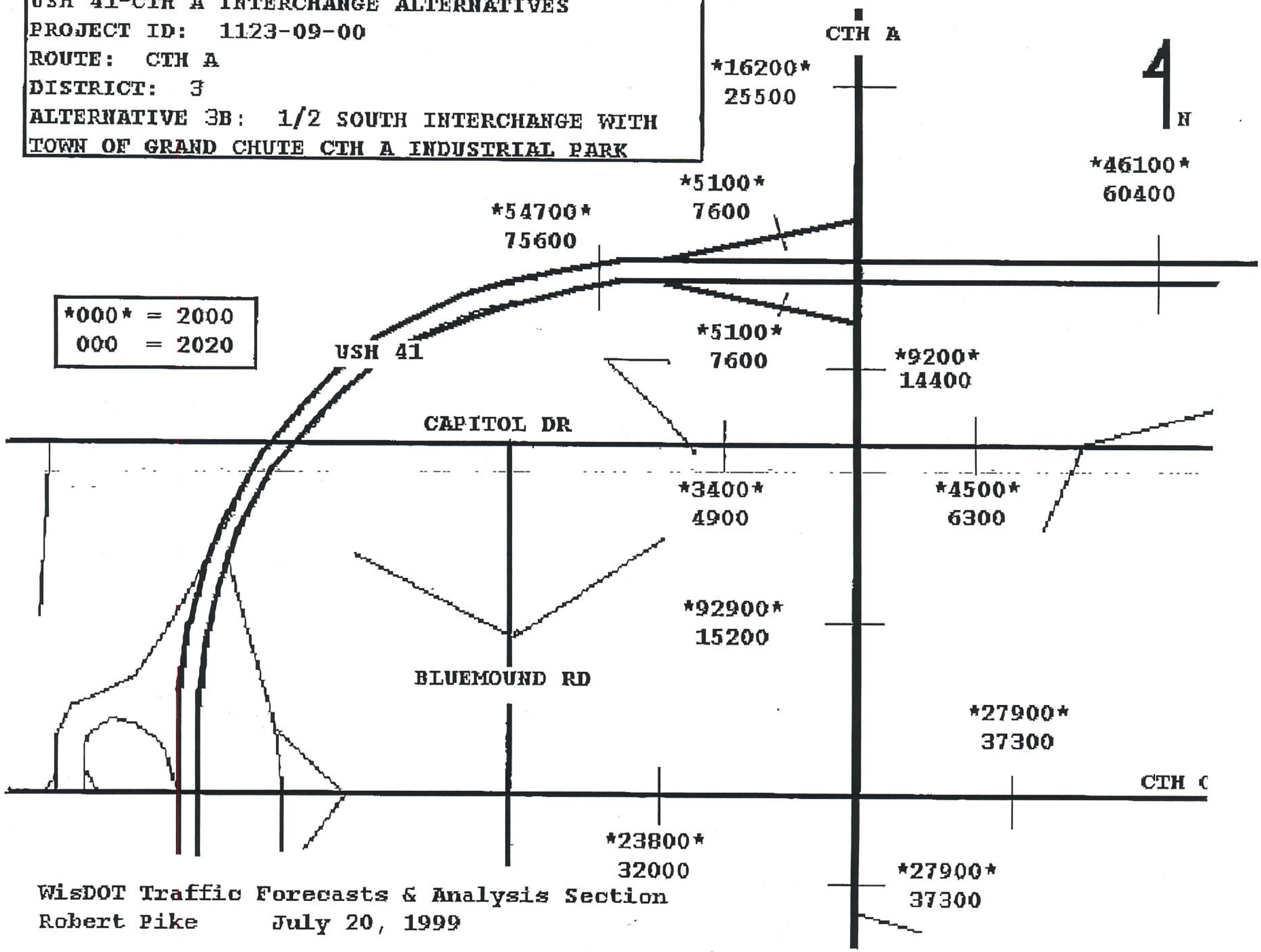


WisDOT Traffic Forecasts & Analysis Section
R. Pike July 20, 1999

Exhibit B-9

USH 41-CTH A INTERCHANGE ALTERNATIVES
PROJECT ID: 1123-09-00
ROUTE: CTH A
DISTRICT: 3
ALTERNATIVE 3B: 1/2 SOUTH INTERCHANGE WITH
TOWN OF GRAND CHUTE CTH A INDUSTRIAL PARK

000 = 2000
000 = 2020



WisDOT Traffic Forecasts & Analysis Section
Robert Pike July 20, 1999

Exhibit B-10

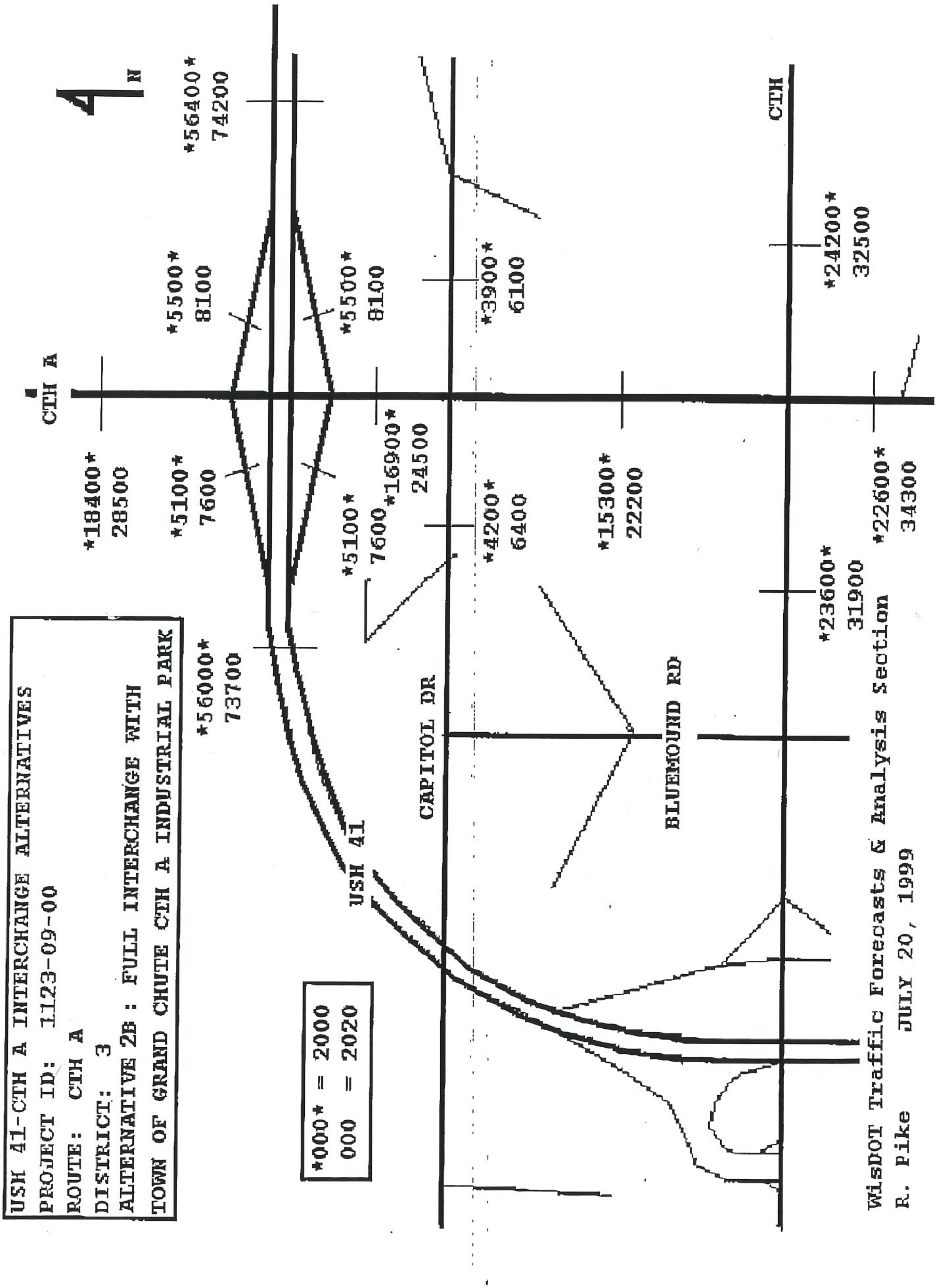

USH 41-CTH A INTERCHANGE ALTERNATIVES
PROJECT ID: 1123-09-00
ROUTE: CTH A
DISTRICT: 3
ALTERNATIVE 2B : FULL INTERCHANGE WITH
TOWN OF GRAND CHUTE CTH A INDUSTRIAL PARK
000 = 2000
000 = 2020
N
CTH A
USH 41
USH 41
CAPITOL DR
BLUEMOUND RD
CTH
56400
74200
5500
8100
5500
8100
3900
6100
24200
32500
18400
28500
5100
7600
5100
7600
16900
24500
4200
6400
15300
22200
22600
34300
23600
31900
56000
73700
WisDOT Traffic Forecasts & Analysis Section
R. Pike JULY 20, 1999

Exhibit C-1

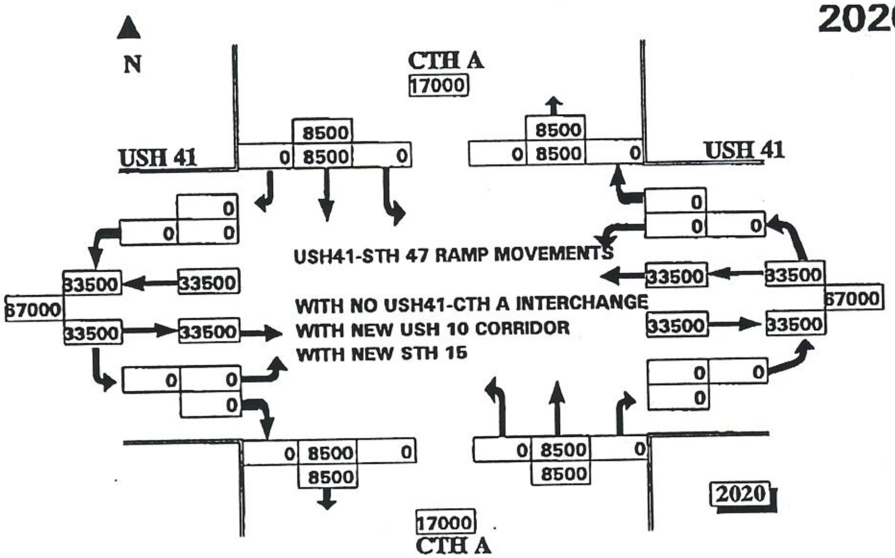
File Ref: U:\LOTUS\I41AA120.WK1

PROJECT ID: 1123-09-00
2020 USH 41- CTH A Interchange Alternatives
ALTERNATIVE 1: NO BUILD
2020 RAMP MOVEMENTS

INTERCHANGE FORECAST

ALTERNATIVE 1: NO BUILD USH 41-CTH A INTERCHANGE

2020 AADT



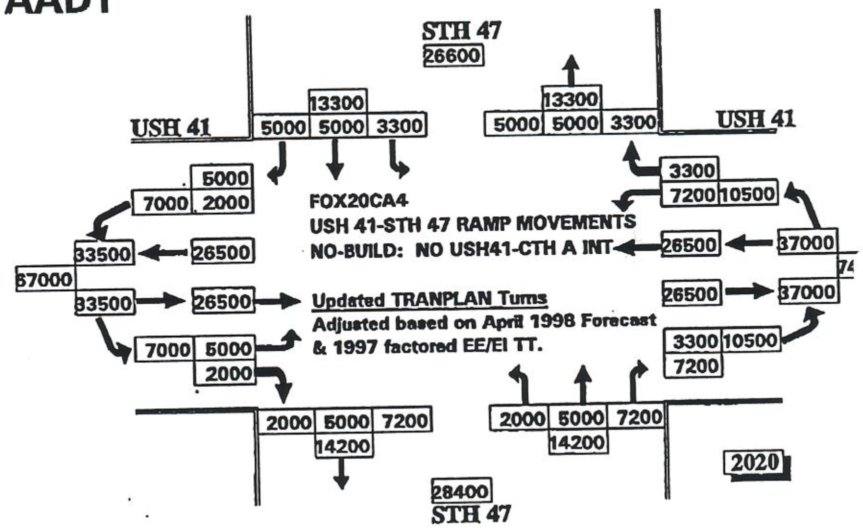


Exhibit C-2

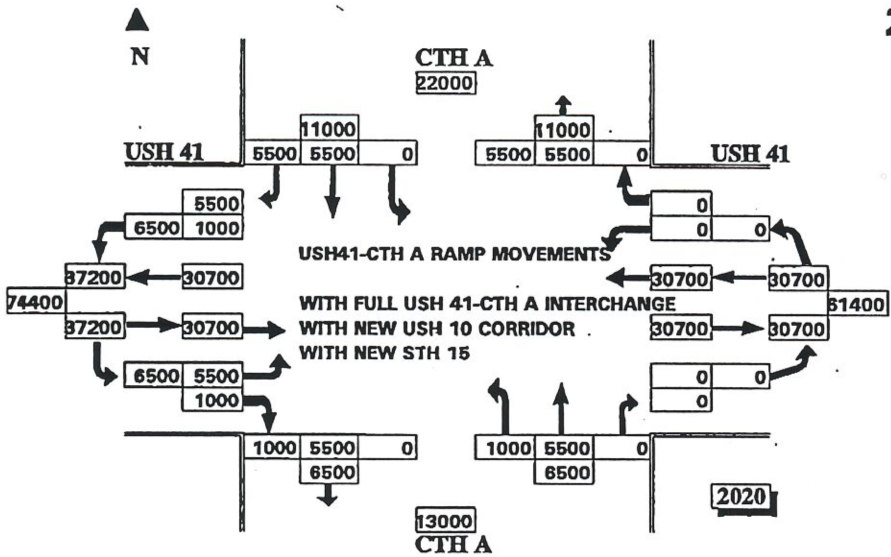
File Ref: U:\LOTUS\141AA320.WK1

PROJECT ID: 1123-09-00
2020 USH 41- CTH A Interchange Alternatives
ALTERNATIVE 3: 1/2 SOUTH INTERCHANGE
2020 RAMP MOVEMENTS

INTERCHANGE FORECAST

ALTERNATIVE 3: WITH 1/2 SOUTH USH 41- CTH A INTERCHANGE

2020 AADT



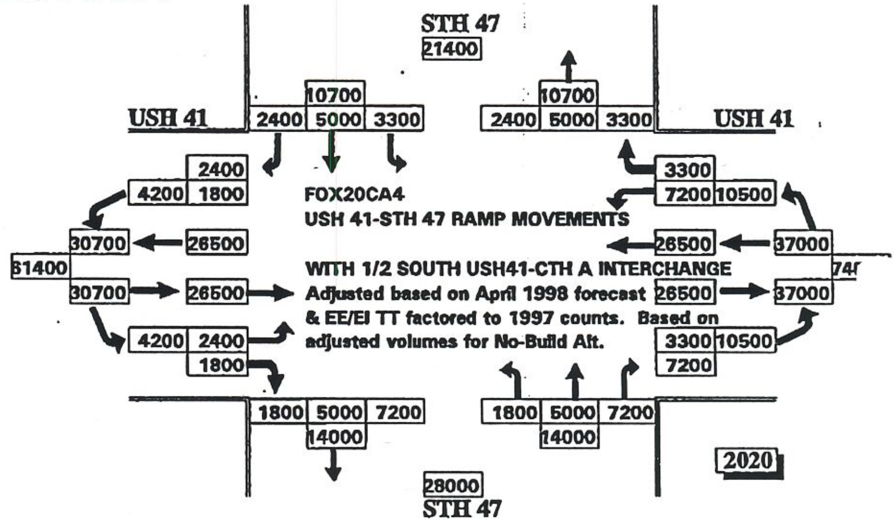


Exhibit C-3

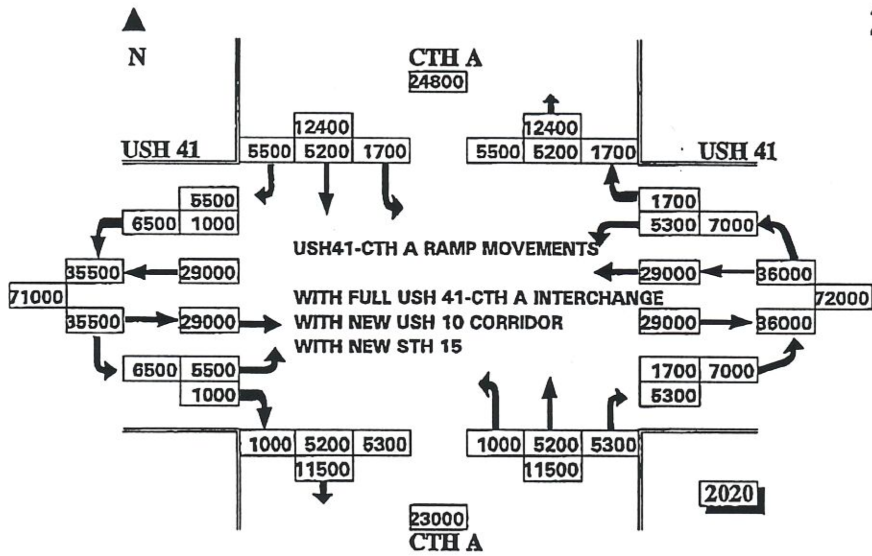
File Ref: U:\LOTUS\I41AA220.WK1

PROJECT ID: 1123-09-00
2020 USH 41- CTH A Interchange Alternatives
ALTERNATIVE 2: FULL INTERCHANGE
2020 RAMP MOVEMENTS

INTERCHANGE FORECAST

ALTERNATIVE 2: WITH FULL USH 41-CTH A INTERCHANGE

2020 AADT



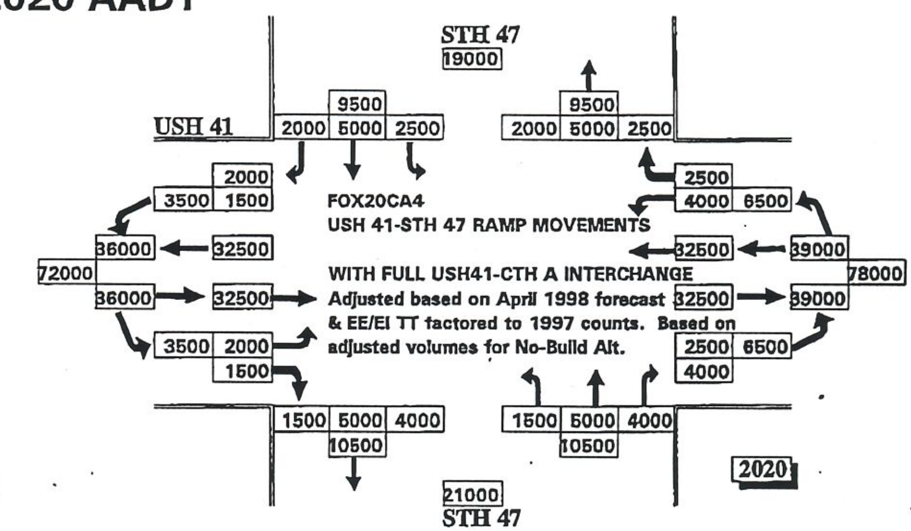
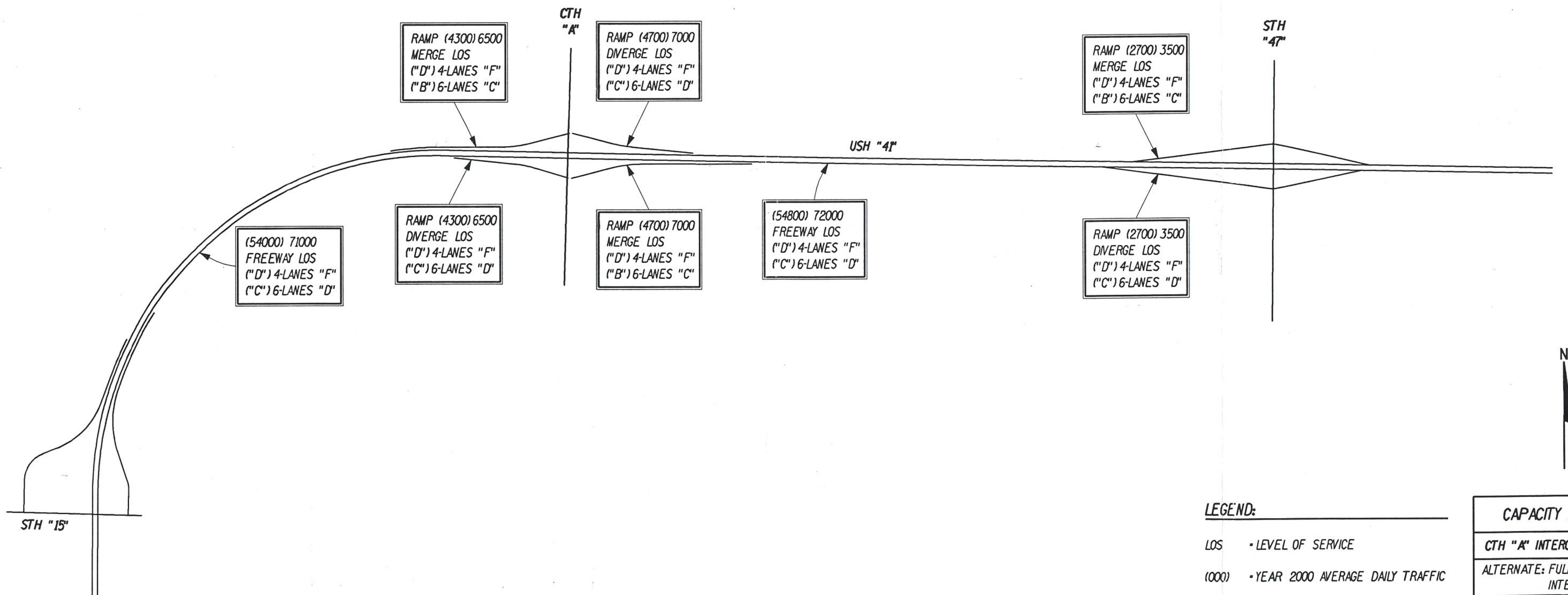


Exhibit D-3



LEGEND:

LOS	- LEVEL OF SERVICE
(000)	- YEAR 2000 AVERAGE DAILY TRAFFIC
000	- YEAR 2020 AVERAGE DAILY TRAFFIC
("X")	- YEAR 2000 LOS
"X"	- YEAR 2020 LOS

CAPACITY ANALYSIS

CTH "A" INTERCHANGE STUDY

ALTERNATE: FULL INTERCHANGE

PROJECT ID: 1123-09-00
CTH "A" / USH "41"
TOWN OF GRAND CHUTE
OUTAGAMIE COUNTY

OMNNI ASSOCIATES
OMNNI ASSOCIATES ONE SYSTEMS DRIVE APPLETON, WI 54914-1654 PHONE (920) 735-6900 FAX (920) 830-6100

FILE NAME: E1408A98/SHEETS /DISPLAY /FULL20XX.DGN TECH/ENGR: CRK/MAH PLOT DATE: 03/25/99 PLOT NAME: SEE FILE NAME PLOT SCALE: 1:
ORIGINATOR: OMNNI ASSOCIATES ONE SYSTEMS DRIVE APPLETON, WI 54914-1654 REV. DATE: / /
LEVELS ON - 50,51,52,53, 58,59, 63

PROJECT ID: 1123-09-00
ROUTE: CTH A
LOCATION: USH 41-CTH A INT
2000, & 2020 AADT FORECAST

Exhibit E-1

Truck Classification/Design Parameters for USH 41 Between STH 47 and the Proposed CTH A Interchanges

ALTERNATIVE 1: NO BUILD

Truck Classification

Truck Type	%AADT
2D	3.7
3AXSU+	1.7
2S1+2S2	0.7
3S2+	6.7
DBL BTM	0.2
TOTAL	13.0

Design Parameters

Factor	%AADT
P(K1)	13.6
K30	11.1
K50	10.8
K100	10.2
T(DHV)	10.5
T(PHV)	7.9
D	55/45

ALTERNATIVE 2: FULL INTERCHANGE

Truck Classification

Truck Type	%AADT
2D	3.7
3AXSU+	1.7
2S1+2S2	1.0
3S2+	6.8
DBL BTM	0.2
TOTAL	13.4

Design Parameters

Factor	%AADT
P(K1)	13.4
K30	10.9
K50	10.6
K100	10.0
T(DHV)	10.7
T(PHV)	8.1
D	55/45

ALTERNATIVE 3: ½ HALF SOUTH INTERCHANGE

Truck Classification

Truck Type	%AADT
2D	3.7
3AXSU+	1.7
2S1+2S2	0.7
3S2+	6.7
DBL BTM	0.2
TOTAL	13.0

Design Parameters

Factor	%AADT
P(K1)	13.6
K30	11.1
K50	10.8
K100	10.2
T(DHV)	10.5
T(PHV)	7.9
D	55/45

The following major assumptions are reflected in the USH 41Truck Classification and Design Parameters for Project ID: 1123-09-00:

1. Truck classification data is based on Vehicle Classification data collected in 1996 on USH 41 North of USH 10/Wisconsin Av. (Site ID: 440165/WIM Site 14C06). With the changes in access to USH 41 under Alternatives 2 & 3, the truck classification data is adjusted based on the site North of USH 10. This reflects the basic assumption that under the existing no access conditions at USH 41-CTH A, significant numbers of trucks on CTH A North of CTH JJ are using a CTH A to CTH JJ to STH 47 route to access USH 41. Alternatives 2 & 3 provide different levels of access at USH 41-CTH A.
2. Design parameters are based on ATR STA. 5-0001, 1.5 Mi. N. of Outagamie-Brown Co. line as well as Factor Group 1- Urban Interstate values.

WisDOT Traffic Forecasts & Analysis Section
Robert Pike Feb 14, 1999

PROJECT ID: 6240-0
ROUTE: STH 47
LOCATION: USH 41-
2002, 2012 & 2022 AA

Exhibit E-2

Truck Classification/Design Parameters

Truck Classification

Truck Type	%AADT
2D	2.6
3AXSU+	1.9
2S1+2S2	1.3
3S2+	1.2
DBL BTM	0.2
TOTAL	7.2

Design Parameters

Factor	%AADT
P(K1)	11.9
K30	10.6
K50	10.4
K100	9.9
T(DHV)	5.8
T(PHV)	5.4
D	55/45

The following major assumptions are reflected in the 2002, 2012 & 2022 AADT Forecast for the USH 41-CTH OO segment of Project ID: 6240-05-00:

1. The forecast volumes are based on an analysis of historic traffic volumes and the 2020 travel demand model for the Fox Cities area. Year 2020 Socio-Economic forecasts developed by the ECWRPC for the Fox Cities Area Long Range Transportation Plan adopted in July, 1997 are incorporated into the travel model. This land use plan reflects major residential development along the STH 47 corridor between CTH JJ and Evergreen Drive North of the project area. Continued moderate expansion of residential development is identified for the Richmond Street corridor South of USH 41 and the Capitol Drive corridor East and West of STH 47/Richmond Street.
2. The estimated turning movements are based on a review of previous turning movement projections at the Richmond-Capitol intersection (1988) and the 1994 and 2020 turning movements generated in the Fox Cities travel model.
3. Truck classification data was obtained from site ID 441157 - STH 47/Richmond North of CTH OO/Northland Av..
4. Design parameters are based on the functional classification of this segment of STH 47 as an urban principal arterial in Factor Group 2.

WisDOT Traffic Forecasts & Analysis Section
Robert Pike April 28,1998

Exhibit E-3

PROJECT ID: 11
ROUTE: CTH A
LOCATION: USI
2000, & 2020 AADT FORECAST

Truck Classification/Design Parameters

ALTERNATIVE 1: NO BUILD

Truck Classification

Truck Type	%AADT
2D	3.2
3AXSU+	3.5
2S1+2S2	1.9
3S2+	0.8
DBL BTM	0.2
TOTAL	9.6

Design Parameters

Factor	%AADT
P(K1)	13.1
K30	11.2
K50	11.0
K100	10.4
T(DHV)	7.7
T(PHV)	5.8
D	55/45

ALTERNATIVE 2: FULL INTERCHANGE

Truck Classification

Truck Type	%AADT
2D	3.2
3AXSU+	3.5
2S1+2S2	4.2
3S2+	1.4
DBL BTM	0.2
TOTAL	12.5

Design Parameters

Factor	%AADT
P(K1)	12.1
K30	10.7
K50	10.5
K100	10.0
T(DHV)	10.0
T(PHV)	7.5
D	55/45

ALTERNATIVE 3: ½ HALF SOUTH INTERCHANGE

Truck Classification

Truck Type	%AADT
2D	3.2
3AXSU+	3.5
2S1+2S2	3.1
3S2+	1.1
DBL BTM	0.2
TOTAL	11.1

Design Parameters

Factor	%AADT
P(K1)	12.4
K30	10.9
K50	10.6
K100	10.1
T(DHV)	8.9
T(PHV)	6.7
D	55/45

The following major assumptions are reflected in the Truck Classification and Design Parameters for Project ID: 1123-09-00:

1. Truck classification data is based on Vehicle Classification data collected in 1996 on CTH A North of Capitol Dr. (Site ID: 441216) and in 1993 on CTH A North of CTH JJ (Site ID: 440073). Alternative 1: No Build is based on the site North of Capitol Dr. With the changes in access to USH 41 under Alternatives 2 & 3, the truck classification data is adjusted based on the site North of CTH JJ. This reflects the basic assumption that under the existing no access conditions at USH 41-CTH A, significant numbers of trucks on CTH A North of CTH JJ are using a CTH A to CTH JJ to STH 47 route to access USH 41. Alternatives 2 & 3 provide different levels of access at USH 41-CTH A.
2. Design parameters are a composite of Factor Group 2, Urban Other and Factor Group 4, Rural Other values reflecting the existing rural character evolving to a more urban character over the forecast period.

WisDOT Traffic Forecasts & Analysis Section
Robert Pike Dec 16,1998

Exhibit F-1

Level of Servi	
A	0–10.0
B	10.1–16.0
C	16.1–24.0
D	24.1–32.0
E	32.1–45.0
F	> 45.0

For any given level of service, the maximum allowable density is somewhat lower than that for the corresponding level of service on multilane highways. This reflects the higher service quality drivers expect when using freeways as compared with surface multilane facilities. This *does not* imply that under similar conditions an at-grade multilane highway will perform better than a freeway with the same number of lanes. For any given density, a freeway will carry higher flow rates at higher speeds than will a comparable multilane highway.

Although the specification of maximum densities for LOS A through D is based on the collective professional judgment of the members of the Committee on Highway Capacity and Quality of Service, the upper value shown for LOS E (45 pc/mi/ln) is not. That value is the density at which capacity occurs for different free-flow speeds; it is the maximum density at which sustained flows at capacity are expected to occur.

LOS criteria for basic freeway sections are provided in Table 3-1 for free-flow speeds of 75, 70, 65, 60, and 55 mph. To be within a given level of service, the *density* criterion must be met. In effect, under ideal conditions, these are the speeds and flow rates *expected* to occur at the designated densities. Local variations in driving behavior, however, may cause some variance from these expectations.

It should be noted that the LOS F operations observed within a queue are the result of a breakdown or bottleneck at a downstream point. LOS F is also used to describe conditions at the upstream point of the breakdown or bottleneck as well as the operations within the queue that forms behind it.

Failure, breakdown, congestion, and LOS F occur when queues begin to form on the freeway. Density tends to increase sharply within the queue and may be expected to be considerably higher than the maximum value of 45 pc/mi/ln for LOS E.

Figure 3-4 shows the relationship among speed, flow, and density for basic freeway sections. It also shows the definition of the various levels of service using density boundary values.

Operational characteristics for the six levels of service are shown in Illustrations 3-5 through 3-10. The levels of service were defined to represent reasonable ranges in the three critical flow variables: speed, density, and flow rate.

LOS A describes free-flow operations. Free-flow speeds prevail. Vehicles are almost completely unimpeded in their ability to maneuver within the traffic stream. Even at the maximum density for LOS A, the average spacing between vehicles is about 530 ft, or 26 car lengths, which affords the motorist a high level of physical and psychological comfort. The effects of incidents or point breakdowns are easily absorbed at this level.

LOS B represents reasonably free flow, and free-flow speeds are maintained. The lowest average spacing between vehicles is about 330 ft, or 17 car lengths. The ability to maneuver within the traffic stream is only slightly restricted, and the general level of physical and psychological comfort provided to drivers is still high. The effects of minor incidents and point breakdowns are still easily absorbed.

LOS C provides for flow with speeds at or near the free-flow speed of the freeway. Freedom to maneuver within the traffic stream is noticeably restricted at LOS C, and lane changes require more care and vigilance on the part of the driver. Minimum average spacings are in the range of 220 ft, or 11 car lengths. Minor incidents may still be absorbed, but the local deterioration in service will be substantial. Queues may be expected to form behind any significant blockage.

LOS D is the level at which speeds begin to decline slightly with increasing flows. In this range, density begins to increase somewhat more quickly with increasing flow. Freedom to maneuver within the traffic stream is more noticeably limited, and the

TABLE

Level of Service	Maximum Density (pc/mi/ln)	Minimum Speed (mph)	Maximum Service Flow Rate (pcphpl)	Maximum v/c Ratio
		Free-Flow Speed = 75 mph		
A	10.0	75.0	750	0.31
B	16.0	75.0	1,200	0.50
C	24.0	71.0	1,704	0.71
D	32.0	65.0	2,080	0.87
E	45.0	53.0	2,400	1.00
F	>45.0	<53.0	<2,400	<1.00
		Free-Flow Speed = 70 mph		
A	10.0	70.0	700	0.29
B	16.0	70.0	1,120	0.47
C	24.0	68.0	1,632	0.68
D	32.0	64.0	2,048	0.85
E	45.0	53.0	2,400	1.00
F	var	var	var	var
		Free-Flow Speed = 65 mph		
A	10.0	65.0	650	0.28
B	16.0	65.0	1,040	0.44
C	24.0	64.5	1,548	0.66
D	32.0	62.0	1,984	0.84
E	45.0	52.0	2,350	1.00
F	var	var	var	var
		Free-Flow Speed = 60 mph		
A	10.0	60.0	600	0.26
B	16.0	60.0	960	0.42
C	24.0	60.0	1,440	0.63
D	32.0	58.0	1,856	0.81
E	45.0	51.0	2,300	1.00
F	var	var	var	var
		Free-Flow Speed = 55 mph		
A	10.0	55.0	550	0.24
B	16.0	55.0	880	0.39
C	24.0	55.0	1,320	0.59
D	32.0	54.5	1,744	0.78
E	45.0	50.0	2,250	1.00
F	var	var	var	var

capacity, and downstream operations improve (assuming that there are no additional downstream bottlenecks) as discharging vehicles move away from the bottleneck.

It should be noted that LOS F operations within a queue are the result of a breakdown or bottleneck at a downstream point. LOS F is also used to describe both conditions at the point of the breakdown or bottleneck and the operations within the queue that forms upstream.

Whenever LOS F conditions exist, there is the potential for these conditions to extend upstream for significant distances. A prerequisite for valid analyses using these procedures is the assumption that the section under consideration is free from downstream effects that promulgate upstream. In such cases, upstream operations will reflect the effect of the downstream bottleneck and will not be as indicated by the procedures of this chapter.

Exhibit F-3

FREEWAY FREE-FLOW SPEED (MPH)	MAXIMUM UPSTREAM (V_F) OR DOWNSTREAM (V_{FO}) FREEWAY FLOW (PCPH) BY NO. OF LANES IN ONE DIRECTION				MAX FLOW ENTERING MERGE INFLUENCE AREA (V_{R12}) (PCPH)	MAX FLOW ENTERING DIVERGE INFLUENCE AREA (V_{12}) (PCPH)
	2	3	4	>4		
70	4,800	7,200	9,600	2,400/ln	4,600	4,400
65	4,700	7,050	9,400	2,350/ln	4,600	4,400
60	4,600	6,900	9,200	2,300/ln	4,600	4,400
55	4,500	6,750	9,000	2,250/ln	4,600	4,400

NOTE: For capacity of ramp roadways, see Table 5-6.

It is possible, however, to experience congestion in the merge influence area even if the capacity of the downstream freeway segment is adequate. Studies (*2*) have shown that there is a practical maximum flow that may enter the merge influence area and still maintain stable operations. In a ramp merge junction, both the flow in Lanes 1 and 2 and the flow in the on-ramp enter the merge influence area. Thus,

$$V_{R12} = V_R + V_{12}$$

Table 5-1 shows capacity values for the downstream freeway flow (V_{FO}) and the merge influence area (V_{R12}). If the demand expected at either point exceeds the capacity values shown, failure, or LOS F, is expected to exist. When this is the case, the analysis ends, and solutions are sought to alleviate the problem. Where stable operations are expected (i.e., demand does not exceed capacity at either point), the next step of the analysis—estimation of density in the merge influence area—is implemented to find the level of service.

Diverge Areas

Three capacity values should be checked in a diverge area: (*a*) the total flow that may leave the diverge area, (*b*) the maximum flow that may enter Lanes 1 and 2 immediately before the deceleration lane, and (*c*) the capacity of each of the exiting legs of the freeway.

The total flow that can leave the diverge area is generally limited by the capacity of the freeway lanes approaching the diverge junction. In all appropriate diverge designs, the number of lanes leaving the diverge area is either equal to or one greater than the number entering. This departing flow is designated V_{FO}.

The flow entering Lanes 1 and 2 just upstream of the deceleration lane is simply the flow in Lanes 1 and 2 (V_{12}). This flow *includes* the off-ramp flow. Table 5-1 gives capacity values for the first two capacity checks.

The third limit is most important because it is the primary reason for failure of diverge areas. Failure at a diverge is most often related to the capacity of one of the exit legs, usually the ramp. The capacity of each exit leg must be checked against the expected demand. For a downstream freeway leg (at a major diverge area there may be two), capacity values may be drawn from Table 5-1 for the appropriate number of freeway lanes. The capacity of ramp roadways is discussed later in the chapter.

The failure of any of these capacity checks, that is, an expected demand that exceeds the capacities given, indicates that the merge area will fail. In such cases, breakdown and formation of queues are expected to occur. Where an off-ramp terminates at an at-grade intersection (either signalized or unsignalized), the capacity of the ramp-street junction should also be checked using the procedures for signalized intersections (Chapter 9) or those for unsignalized intersections (Chapter 10) to ensure that queues will not form and spread upstream on the ramp, affecting traffic operations on the diverge area.

LEVEL-OF-SERVICE CRITERIA

LOS A through E for ramp-freeway terminals are based on the density in the influence area of the ramp and the expectation that no breakdown will occur. LOS F signifies that a breakdown condition exists or is expected to exist. LOS F occurs whenever demand exceeds the limits indicated in Table 5-1. When none of these limits is exceeded, no breakdown is expected, and the level of service is based on density, as indicated in Table 5-2. Table 5-2 also gives average speed of vehicles in the ramp influence area as a secondary LOS parameter. This is particularly useful in comparing these criteria with field data, since density is rarely measured directly.

The density values shown for LOS A through E assume stable, nonbreakdown operations. Studies (*2*) have shown that there is an overlap in the density range such that some breakdown operations may actually have lower densities than those achieved under stable operation. This is due to the wavelike movement of vehicles in a queue and the rather short length of the defined ramp influence area. The model first calls for determination of whether LOS F exists using the maximum flow levels of Table 5-1. Then density is estimated and the level of service assigned if flow is stable.

Except for LOS A, each of the density boundaries is higher than that of a similar basic freeway section (Chapter 3). This is because (*a*) drivers expect increased turbulence and greater proximity of other vehicles in a merge or diverge area and (*b*) drivers are generally traveling at somewhat lower speeds at any given per-lane flow rate in the merge or diverge area than on open freeway.

TABLE 5-2. LEVEL-OF-SERVICE CRITERIA FOR RAMP-FREEWAY JUNCTION AREAS OF INFLUENCE

LEVEL OF SERVICE	MAXIMUM DENSITY (PRIMARY MEASURE) (PC/MI/LN)	MINIMUM SPEED (SECONDARY MEASURE) (MPH)
A	10	58
B	20	56
C	28	52
D	35	46
E	>35	42
F	[a]	[a]

[a] Demand flows exceed limits of Table 5-1.

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ENVIRONMENTAL

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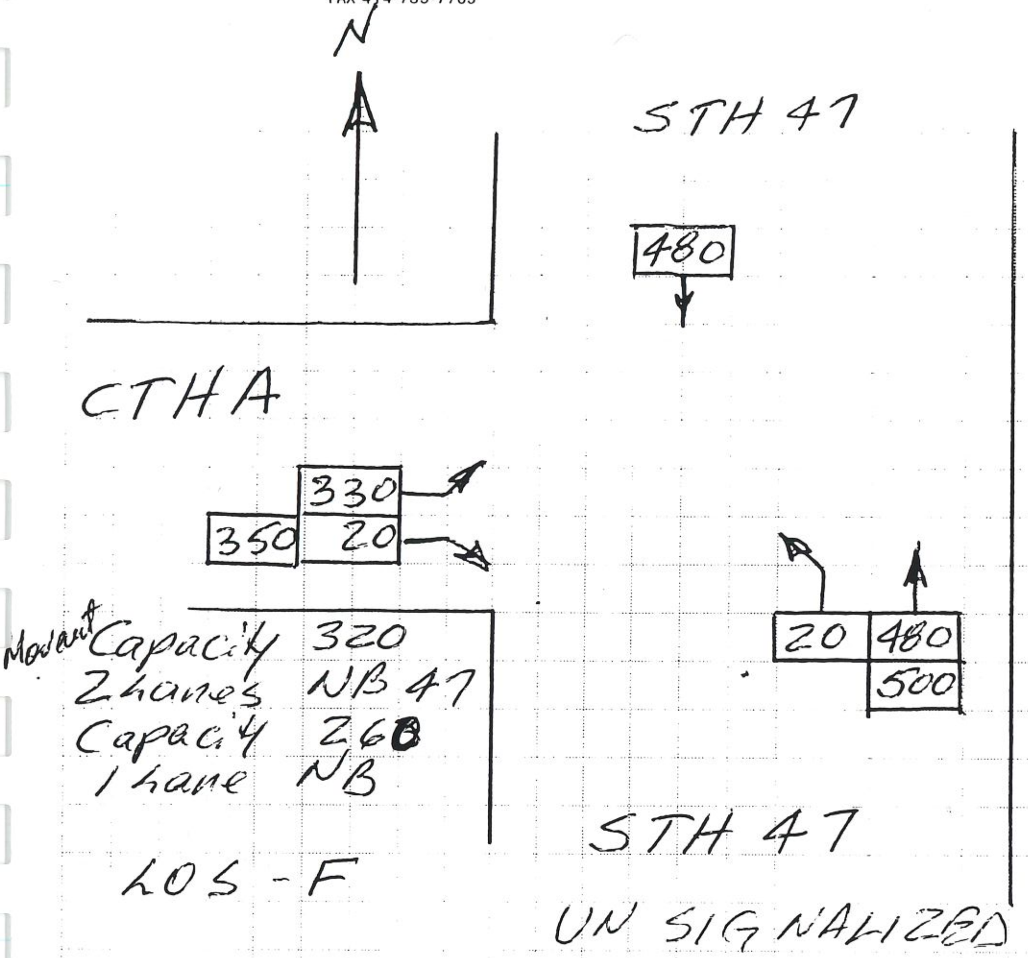
Exhibit H-1



YEAR - 2020

CTHA ALT - NO INT

ALL WAY STOP

ONE LANE NORTH - LOS INTERSECTION D

TWO LANES NB - LOS B

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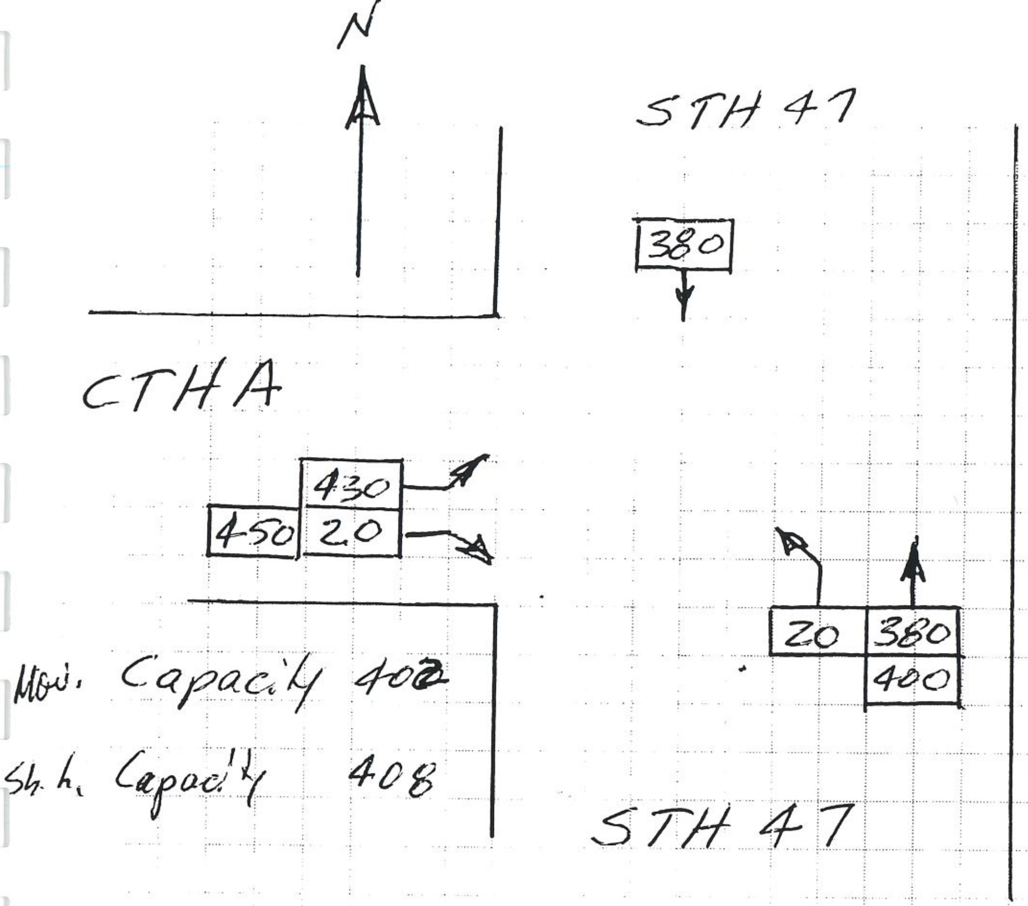
OM ASS

Exhibit H-2

YEAR - 2020

CTH A ALT - PARTIAL INT



ALL WAY STOP

2 LANES NB - LOS - B

1 LANE NB - LOS - D

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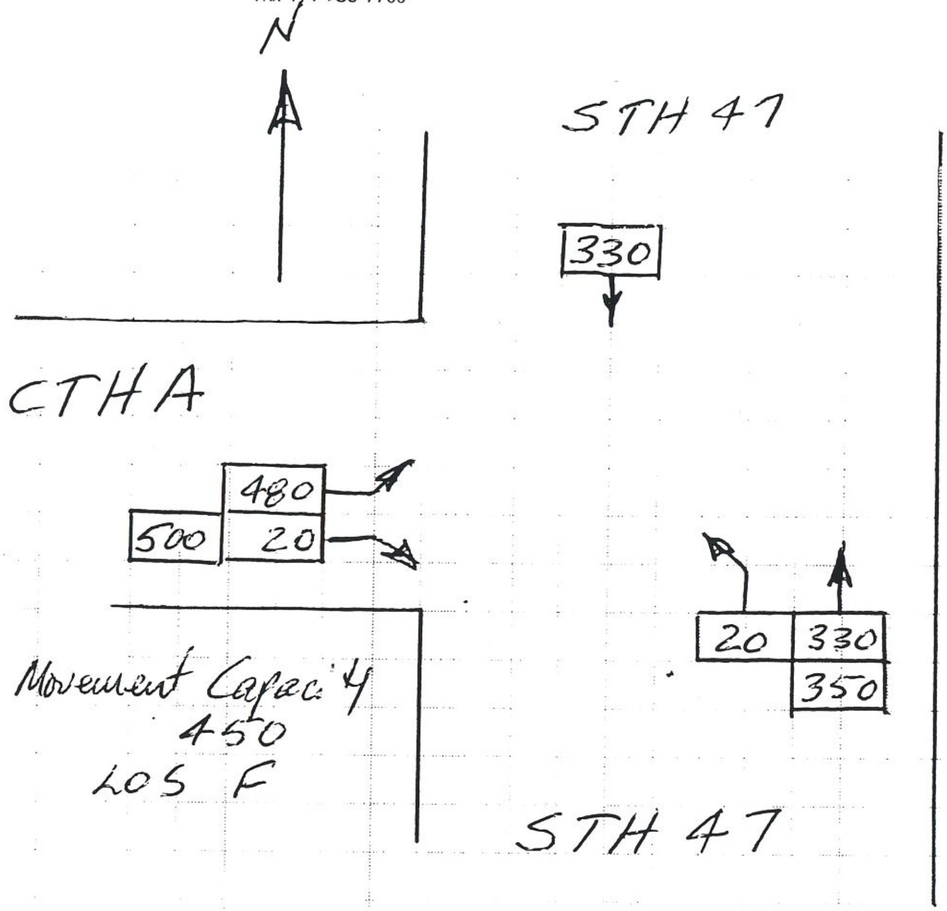
Exhibit H-3



YEAR – 2020

CTHA ALT – FULL INT

ALL WAY STOP

1 LANE NB – LOS – D

2 LANES NB – LOS – B

Exhibit I-1

Chapter 9, Signalized Intersections, or Chapter 10, Unsignalized Intersections, should be applied.

RAMP COMPONENTS

A ramp may consist of up to three geometric elements of interest:

1. The ramp-freeway junction,
2. The ramp roadway, and
3. The ramp-street junction.

A ramp-freeway junction is generally designed to permit high-speed merging or diverging to take place with a minimum of disruption to the adjacent freeway traffic stream. The geometric characteristics of ramp-freeway junctions vary. Elements such as the length and type (taper, parallel) of acceleration or deceleration lane, free-flow speed of the ramp in the immediate vicinity of the junction, and sight distances may all influence ramp operations. The procedures in this chapter are primarily applicable to high-type designs. Nevertheless, some of the models used account explicitly for the effect of acceleration or deceleration lane length and the free-flow speed of the ramp and can therefore be applied to a range of geometric designs, including some that might be considered substandard. Geometric design standards for ramps and ramp junctions are given by AASHTO (*1*).

Geometric characteristics of ramp roadways also vary from location to location. Ramps may vary in terms of number of lanes (usually one or two), design speed, grade, and horizontal curvature. The design of a ramp roadway is seldom a source of operational difficulty unless a traffic incident causes disruption along its length. Ramp-street terminal problems can cause queueing along the length of a ramp, but this queueing is generally not related to the design of the ramp roadway.

Freeway-to-freeway ramps have two ramp-freeway terminals and do not have a ramp-street terminal. Many ramps, however, connect limited-access facilities to local arterials and collectors. For such ramps, the ramp-street terminal is often a critical element in the overall design. Ramp-street junctions can permit uncontrolled merging and diverging movements or take the form of an at-grade intersection.

Procedures in this chapter allow for the identification of likely breakdowns at ramp-freeway terminals [Level-of-Service (LOS) F] and for the analysis of operations at ramp-freeway junctions and on ramp roadways at LOS A through E. For analysis of ramp-street junctions involving an at-grade intersection, consult Chapter 9, Signalized Intersections, or Chapter 10, Unsignalized Intersections.

Sections addressing special applications, including metered ramps, ramps on five-lane (one-direction) freeway sections, two-lane ramps, major merge areas, and major diverge areas, are contained in this chapter.

OPERATIONAL CHARACTERISTICS

A ramp-freeway junction is an area of competing traffic demands for space. Upstream freeway traffic competes for space with entering on-ramp vehicles in merge areas. On-ramp demand is usually generated locally, although arterials and collectors may bring some drivers to the ramp from more distant origins. The [illegible] posite of upstream trip generation patterns from a variety of sources.

In the merge area, individual on-ramp vehicles attempt to find gaps in the traffic stream of the adjacent freeway lane. Since most ramps are on the right side of the freeway, the freeway lane in which on-ramp vehicles seek gaps is the shoulder lane, designated herein as Lane 1. In this chapter, lanes are numbered 1 to N from the shoulder to the median.

The action of individual merging vehicles entering the Lane 1 traffic stream creates turbulence in the traffic stream in the vicinity of the ramp. Approaching freeway vehicles move toward the left to avoid this turbulence. Recent studies (*2*) have shown that the operational effect of merging vehicles is heaviest in freeway Lanes 1 and 2 and the acceleration lane for a distance extending from the physical merge point to 1,500 ft downstream. Figure 5-1 shows the "influence area" for on-ramp junctions. Models presented in this chapter focus on operational characteristics within this defined influence area.

Interactions are dynamic. Approaching freeway vehicles will move left as long as there is capacity to do so. Whereas the intensity of ramp flow generally influences the behavior of freeway vehicles, general freeway congestion can also limit ramp flow, causing diversion to other interchanges or routes.

At off-ramps the basic maneuver is a diverge, that is, a single traffic stream separating into two separate streams. Exiting vehicles *must* occupy the lane adjacent to the off-ramp, Lane 1 for a right-hand off-ramp. Thus, as the off-ramp is approached, exiting vehicles move right. This movement brings about a redistribution of other freeway vehicles, which move left to avoid the turbulence of the immediate diverge area. Again, recent studies (*2*) show that the area of most intense turbulence is the deceleration lane plus Lanes 1 and 2 over 1,500 ft extending upstream from the physical diverge point (Figure 5-1).

Procedures in this chapter treat both ramp and freeway flow rates as inputs to an operational analysis of the merge or diverge influence area. Thus, design and planning applications become trial-and-error computations using the operational analysis techniques as specified. This procedure is logical, because the ramp is a point location on an overall facility for which flows are either known or specified.

The procedures in this chapter assume that the behavior of merging or diverging vehicles is unaffected by downstream or upstream constrictions or disruptions. Downstream problems, for example, can easily propagate upstream through a merge or diverge area. In such cases operations reflect the characteristics of the downstream

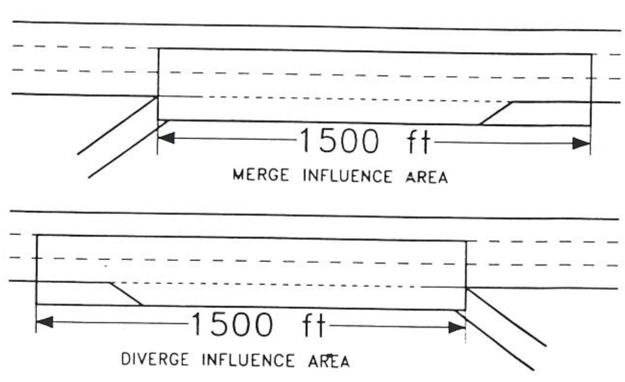
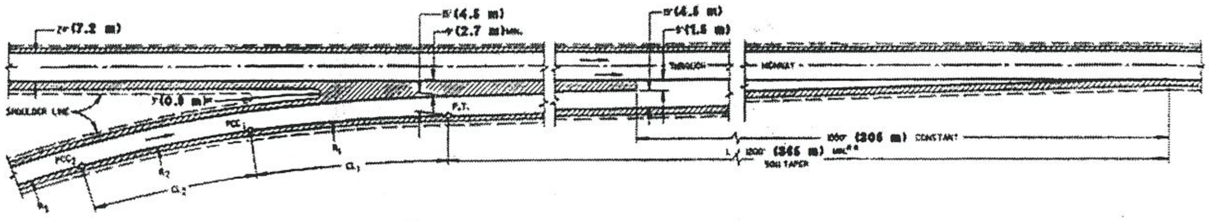


Figure 5-1. On- and off-ramp influence areas.

Exhibit I - 2



SINGLE LANE ENTRANCE TERMINAL

LEGEND

PAVED SHOULDER.

R_3 - RADIUS OF THE MAJOR INTERNAL SEGMENT OF A LOOP.

Ramp Design Speed PCC_2		Radius			Curve Length	
(mph)	(km/h)	R_3	R_2	R_1	CL_2	CL_1
55	90	TANGENT ALIGNMENT		MIN. 1095' (335 m)		MIN.200 (60 m)
50	80			MIN. 850' (260 m)		MIN.200 (60 m)
45	70	560' (195 m)		850' (260 m)		150' (45 m)
40	60	510' (135 m)		850' (260 m)		150' (45 m)
35	60	380' (135 m)	560' (195 m)	850' (260 m)	150 (45 m)	150' (45 m)
30	50	275' (90 m)	510' (135 m)	850' (260 m)	150 (45 m)	150' (45 m)
		*250' (84 m)				

* Minimum Desirable

Minimum Shoulder Treatments

Mainline

Left - 6'(**1.8 m**) total / 3'(**0.9 m**) paved [4'(**1.2 m**) for interstate]

Right - 10'(**3.0 m**) total / 8'(**2.4 m**) paved

Ramps

Left - 4'(**1.2 m**) total / 3'(**0.9 m**) paved

Right - 8'(**2.4 m**) total / 5'(**1.5 m**) paved

NOTES:

Ramp design speeds at PCC_2 are based on governing radii R_3 or R_1. Assuming SE = 6% refer to Table III-6, page 154, GDHS.

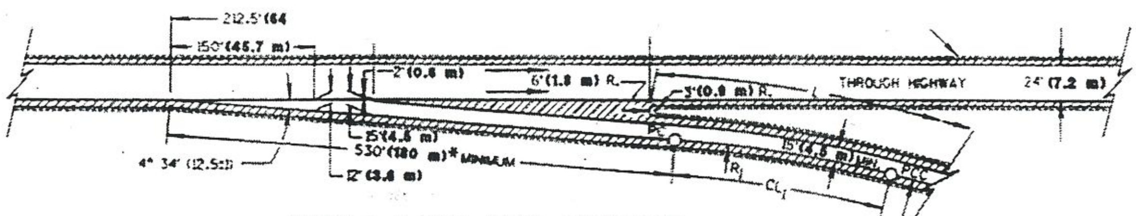
Minimum acceleration lane, taper length (L), based on Table X-4, page 986, GDHS.

For acceleration lanes having grades in excess of $\pm 2\%$ refer to Table X-5, page 990, GDHS, for length adjustment.

When design speed at PCC_2 is 40 MPH (60 km/h**) or less, adjust acceleration length (L) as follows: 1250' (**380 m**) (40 MPH) (**60 km/h**), 1300' (**395 m**) (35 MPH) (**60 km/h**), and 1400' (**425 m**) (30 MPH) (50 km/h).

Ramp geometrics are adequate for mainline design speeds through 65 MPH. (**110 km/h**).

2



SINGLE LANE EXIT TERMINAL

Ramp Design Speed PC	Radius R_1	Radius R_2	Ramp Design Speed PCC	Curve Length CL_1
55 mph (90 km/h)	Tangent Alignment			
50 mph (80 km/h)	[redacted]	[redacted]	40 mph (60 km/h)	150' (50 m)
45 mph (70 km/h)	[redacted]	[redacted]	35 mph (60 km/h)	150' (50 m)
40 mph (60 km/h)	[redacted]	[redacted]	30 mph (50 km/h)	150' (50 m)

L = 900' (280 m)

LEGEND

(hatched box)	Paved Shoulder
L	Minimum ramp distance from gore to the intersection of the ramp with the crossroad.
R_2	Radius of the major internal segment of the loop.

NOTES:

The length of the deceleration lane is based on ramp grades of 0 to 2%. Refer to table X-6, page 991, GDHS, for length adjustment factors to be used when ramp grades exceed ± 2%.

If the ramp speed and radii relationships listed in the table cannot be attained due to area R/W restrictions, consideration should be given to collector-distributor roads. This permits further speed reductions before entering the ramp loop.

The radii of the horizontal curves are rounded and based on a maximum superelevation rate of [redacted] and the speeds shown.

Ramp geometrics are adequate for mainline design speeds through 65 MPH.

* This metric length is based on a mainline design speed of 68 MPH **(110 km/h)** and a minimum ramp design speed at PC of 37 mph **(60 km/h)**

Minimum Shoulder Treatments

Mainline

- Left - 6'**(1.8 m)** total / 3'**(0.9m)** paved [4'**(1.2 m)** for interstate]
- Right- 10'**(3.0 m)** total / 8'**(2.4 m)** paved

Ramps

- Left - 4'**(1.2 m)** total / 3'**(0.9 m)** paved
- Right - 8'**(2.4 m)** total / 5'**(1.5 m)** paved

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