Oregon
Theodore R. Kulongoski, Governor

Department of Land Conservation and Development
635 Capitol Street, Suite 150
Salem, OR 97301-2540
(503) 373-0050
Fax (503) 378-5518
www.lcd.state.or.us

NOTICE OF ADOPTED AMENDMENT

December 26, 2006

TO: Subscribers to Notice of Adopted Plan or Land Use Regulation Amendments

FROM: Mara Ulloa, Plan Amendment Program Specialist

SUBJECT: City of Madras Plan Amendment
DLCD File Number 014-06

The Department of Land Conservation and Development (DLCD) received the attached notice of adoption. Due to the size of amended material submitted, a complete copy has not been attached. Copies of the adopted plan amendment are available for review at DLCD offices in Salem, the applicable field office, and at the local government office.

Appeal Procedures*

DLCD ACKNOWLEDGMENT or DEADLINE TO APPEAL: January 8, 2007

This amendment was submitted to DLCD for review with less than the required 45-day notice because the jurisdiction determined that emergency circumstances required expedited review. Pursuant to ORS 197.830 (2)(b) only persons who participated in the local government proceedings leading to adoption of the amendment are eligible to appeal this decision to the Land Use Board of Appeals (LUBA).

If you wish to appeal, you must file a notice of intent to appeal with the Land Use Board of Appeals (LUBA) no later than 21 days from the date the decision was mailed to you by the local government. If you have questions, check with the local government to determine the appeal deadline. Copies of the notice of intent to appeal must be served upon the local government and others who received written notice of the final decision from the local government. The notice of intent to appeal must be served and filed in the form and manner prescribed by LUBA, (OAR Chapter 661, Division 10). Please call LUBA at 503-373-1265, if you have questions about appeal procedures.

***NOTE: THE APPEAL DEADLINE IS BASED UPON THE DATE THE DECISION WAS MAILED BY LOCAL GOVERNMENT. A DECISION MAY HAVE BEEN MAILED TO YOU ON A DIFFERENT DATE THAN IT WAS MAILED TO DLCD. AS A RESULT YOUR APPEAL DEADLINE MAY BE EARLIER THAN THE DATE SPECIFIED ABOVE.**

cc: Gloria Gardiner, DLCD Urban Planning Specialist
Mark Radabaugh, DLCD Regional Representative
Matthew Crall, DLCD Transportation Planner
Chuck McGraw, City of Madras

<paa> ya/

FORM 2 Notice of Adoption

THIS FORM **MUST BE MAILED** TO DLCD
WITHIN 5 WORKING DAYS AFTER THE FINAL DECISION
PER ORS 197.610, OAR CHAPTER 660 - DIVISION 18

DEPT OF
DEC 20 2006
LAND CONSERVATION AND DEVELOPMENT
For DLCD Use Only

Jurisdiction: **City of Madras** Local file number: **PA-06-2**

Date of Adoption: **12/12/2006** Date Mailed: **12/13/2006**

Date original Notice of Proposed Amendment was mailed to DLCD: **9/6/2006**

☒ Comprehensive Plan Text Amendment
☐ Comprehensive Plan Map Amendment
☐ Land Use Regulation Amendment
☐ Zoning Map Amendment
☐ New Land Use Regulation
☐ Other:

Summarize the adopted amendment. Do not use technical terms. Do not write "See Attached".

Refining thes City of Madras Transportation System Plan to refine the location of the Truck Reroute, add new Collector Streets and refine the J Street/Hwy 97 intersection improvements.

Describe how the adopted amendment differs from the proposed amendment. If it is the same, write "SAME". If you did not give Notice for the Proposed Amendment, write "N/A".

Same

Plan Map Changed from: **N/A** to: **N/A**

Zone Map Changed from: **N/A** to: **N/A**

Location: Acres Involved:

Specify Density: Previous: New:

Applicable Statewide Planning Goals: **12**

Was and Exception Adopted? ☐ YES ☒ NO

DLCD File No.: 014-06 (15531)

Did the Department of Land Conservation and Development receive a Notice of Proposed Amendment......

Forty-five (45) days prior to first evidentiary hearing?	☐ **Yes**	☐ **No**
If no, do the statewide planning goals apply?	☐ **Yes**	☐ **No**
If no, did Emergency Circumstances require immediate adoption?	☐ **Yes**	☐ **No**

Affected State or Federal Agencies, Local Governments or Special Districts:

DLCD; ODOT and Jefferson County

Local Contact: **Chuck McGraw** Phone: **(541) 475-3388** Extension:

Address: **71 SE D Street** City: **Madras**

Zip Code + 4: **97741-** Email Address: **cmcgraw@ci.madras.or.us**

ADOPTION SUBMITTAL REQUIREMENTS

This form **must be mailed** to DLCD **within 5 working days after the final decision**
per ORS 197.610, OAR Chapter 660 - Division 18.

1. Send this Form and **TWO (2) Copies** of the Adopted Amendment to:

ATTENTION: PLAN AMENDMENT SPECIALIST
DEPARTMENT OF LAND CONSERVATION AND DEVELOPMENT
635 CAPITOL STREET NE, SUITE 150
SALEM, OREGON 97301-2540

2. Submit **TWO (2) copies** the adopted material, if copies are bounded please submit **TWO (2) complete copies** of documents and maps.

3. Please Note: Adopted materials must be sent to DLCD not later than **FIVE (5) working days** following the date of the final decision on the amendment.

4. Submittal of this Notice of Adoption must include the text of the amendment plus adopted findings and supplementary information.

5. The deadline to appeal will not be extended if you submit this notice of adoption within five working days of the final decision. Appeals to LUBA may be filed within **TWENTY-ONE (21) days** of the date, the Notice of Adoption is sent to DLCD.

6. In addition to sending the Notice of Adoption to DLCD, you must notify persons who participated in the local hearing and requested notice of the final decision.

7. **Need More Copies?** You can copy this form on to 8-1/2x11 green paper only; or call the DLCD Office at (503) 373-0050; or Fax your request to:(503) 378-5518; or Email your request to **mara.ulloa@state.or.us** - ATTENTION: PLAN AMENDMENT SPECIALIST.

ORDINANCE NO. 785

AN ORDINANCE AMENDING THE MADRAS COMPREHENSIVE PLAN BY ADOPTING THE CITY OF MADRAS TRANSPORATION SYSTEM REFINEMENT PLAN AND AMENDMENTS, AND DECLARING AN EMERGENCY.

WHEREAS, Statewide Planning Goal 12 – Transportation and Oregon Administrative Rules (OAR 660-12-000) require that the City of Madras adopt a Transportation Systems Plan (TSP); and

WHEREAS, the City of Madras prepared its TSP in 1994 and adopted the Plan in 1998; and

WHEREAS, OAR 660-12-0025 specifically provides for TSP Refinement Plans; and

WHEREAS, the impact of the recently approved Deer Ridge Correctional Facility was not incorporated into the original TSP; and

WHEREAS, in 2005, Jefferson County began preparing their TSP, and that TSP included the preparation of refinements plans for the Madras Truck Route and the 'J' Street improvements; and

WHEREAS, the City of Madras also desired to update the list of City projects to reflect the impact of the County TSP list in an effort to coordinate the City's TSP project list with the new County TSP project list; and

WHEREAS, the City of Madras recognized the need to include additional amendments to address the growing development trends in the City; and

WHEREAS, the City of Madras Planning Commission held public hearings on October 18, 2006 and November 1, 2006, and the City Council heard public testimony on December 12, 2006 ; and

NOW, THEREFORE, the City of Madras ordains as follows:

SECTION 1: The City of Madras Transportation System Plan Map, Refinement Plan and Amendments, as identified in Exhibit 'A' are adopted, and incorporated by reference herein.

SECTION 2: **SEVERABILITY**: The provisions of this ordinance are severable. If any section, sentence, clause, or phrase of this ordinance is adjudged by a court of competent jurisdiction to be invalid, the decision shall not effect the validity of the remaining portions of the ordinance.

SECTION 3: **CORRECTIONS:** This ordinance may be corrected by order of the City Council to cure editorial and clerical errors.

SECTION 4: **EMERGENCY CLAUSE**

The City Council of the City of Madras, having reviewed the Comprehensive Plan of the City of Madras, and the need for enactment of ordinances to regulate land use within the City does hereby determine that this ordinance is necessary for the immediate preservation of the public peace, health and safety of the citizens of the City of Madras and an emergency is hereby declared to exist, and this Ordinance shall become in full force and effect from and after the date it is enacted and signed by the Mayor.

ADOPTED by the City Council of the City of Madras this 12th day of December, 2006.

Ayes:	5
Nays:	0
Abstentions:	0
Absent:	1
Vacancies:	0

Frank E. Morton

Frank E. Morton, Mayor

ATTEST:

Karen J. Coleman

Karen J. Coleman, City Recorder

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION PLANNING/TRAFFIC ENGINEERING
610 SW ALDER, SUITE 700 • PORTLAND, OR 97205 • (503) 228-5230 • FAX (503) 273-8169

October 10, 2006 Project #: 7976

Chuck McGraw
City of Madras
Community Development Department
71 SE "D" Street
Madras, Oregon 97741

RE: City of Madras TSP Refinement Plans and Amendments

Dear Chuck:

This report provides additional information to update the City of Madras's Transportation System Plan (TSP). The information provided in this report has been divided into three areas: Refinement Plans, Updated Project List, and Additional Amendments. The following sections provide the background and details of these areas.

Background

Per Oregon Administrative Rule (OAR) Division 12, "Transportation Planning" 660-012-000, the City of Madras initiated the process to prepare its long-range transportation plan in 1994 with the help of a grant from the Oregon Department of Transportation (ODOT). A consultant team prepared the Transportation System Plan (TSP), which was published in 1995. After the City and ODOT staff's extensive review, the document was modified and republished in 1998. The City adopted the modified TSP in August 1998.

The impact of the, then newly proposed, Department of Correction's facility located to the east of the City was not included in the original TSP. In order to incorporate the impact of the proposed facility, the City decided to update its Comprehensive Plan and TSP through the Transportation Growth Management (TGM) grant from ODOT and Department of Land Conservation and Development (DLCD) in 2000. The plan was completed and adopted by the City in 2001.

In 2005, Jefferson County began preparing their TSP with the help of a grant from ODOT. The county TSP project included the preparation of refinement plans for the Madras Truck Route and J Street improvements. This report summarizes the results of those refinement plans. In addition, this report updates the list of City projects to reflect the impact of the County TSP project list in an effort to coordinate the City's TSP project list with the new County's TSP project list. Furthermore, during the County TSP process, City staff recognized the need to include additional amendments to address the growing development trends in the City. These amendments are also included in this report.

Madras Truck Route Refinement Plan

Determination of Need

Technical Memoranda "A" and "B" of the Jefferson County TSP project provide detailed information needed to determine the needs of the proposed Madras Truck Route. The information provided in this section is a summary of the memoranda.

US 97 and US 26, in Central Oregon, are critical elements of Oregon's Statewide Highway Freight System. The *1999 Oregon Highway Plan* classifies these roadways as Statewide Highways and designated Freight Routes. According to the 2004 Automatic Traffic Recorder (ATR) data obtained from ODOT, US 97 carries around 6,300 average daily traffic (ADT) and US 26 carries around 11,900 ADT, just north of City of Madras downtown. Through downtown Madras US 97/US 26 carries around 19,700 ADT, while south of downtown Madras, US 97/US 26 carries around 13,100 ADT. The ATR data also show that 14%–18% of the traffic on the highway is truck traffic. These high traffic volumes and truck percentages indicate the importance of the truck mobility through downtown Madras.

Technical Memoranda "A" provided the near-term operational and safety analysis of US 97/US 26 through downtown Madras. The US97/US26 North intersection was recently realigned and upgraded as part of ODOT's 2004–2007 Statewide Transportation Improvement Program (STIP) project. With the upgrade, the intersection is anticipated to operate at level-of-service (LOS) "C" and at a volume-to-capacity (v/c) ratio of 0.73 during the 30th highest hour. This level of operation meets the ODOT mobility standard of 0.75 for the intersection.

While the operation of the US 97/US 26 North intersection will meet the operational standards in the near term, the proposed intersection modification will not eliminate operational concerns related to truck traffic traveling through downtown Madras. Downtown Madras will continue to have numerous traffic signals and low travel speeds that do not facilitate the mobility of freight traffic on US 97/US 26. As such, in spite of the recent upgrade to the US 97/US 26 North intersection, a truck route bypassing downtown Madras is anticipated to reduce the volume of downtown truck traffic, improve the operation of the intersections in downtown, and facilitate truck mobility around Madras.

A safety analysis was also conducted on US 97/US 26 around Madras as part of the needs analysis. The crash data (for a three year period) obtained from the ODOT Crash Unit revealed that US 97/US 26 through the Madras City Limit experienced annual crash rates of 1.34, 1.86, and 1.46 crashes per million vehicle miles traveled, respectively. These crash rates are higher than the statewide average for similar facilities, which were reported at 1.16, 1.28 and 0.99 for the same three year period, respectively.

Long-Term Transportation Need

Technical Memorandum "B" analyzed various traffic volume forecast scenarios to determine the most realistic estimate of future traffic volume in the area. The analysis reviewed three traffic volume forecasting methodologies, namely, historic traffic growth, ODOT future volume forecast and updated population forecast. Based on extensive discussions with City, ODOT and County staff, the updated population forecast methodology that included the impact of the Department of Correction facilities that is currently under construction on the east side of the city, was determined to most closely approximate the future traffic volume forecast in and around the city. As such, the traffic volume on US 97/US 26 through downtown Madras and south of downtown were forecasted to grow annually at 3.37% and 2.37%, respectively.

Based on the forecasted traffic volume, US 97/US 26 North and South intersection are anticipated to operate at LOS "F" in year 2025 if no improvements are made to the facilities through downtown Madras.

The existing and future operational and safety analysis indicates that, at the current pace of traffic growth, US 97/US 26 is anticipated to carry a high volume of traffic through downtown Madras by 2025. The increase in traffic volume in downtown Madras will deteriorate the operation and safety of the roadway. As US 97 and US 26 are classified as highways of statewide significance, the mobility of vehicles on the highway is important to the economic viability of the state.

Alternative Analysis

Concerns with Approved Alternative

Figure 1 shows the approved alignment of the Madras Truck Route as recommended in the 2001 City of Madras TSP Update. Several new developments have occurred in Madras since the adoption of the TSP. Some of the new commercial developments that were approved have impacted the feasibility of the approved truck route alignment. One of the major developments is a new hotel and mixed-use retail development planned and approved for construction to the west of the existing US 97/US 26 North intersection in downtown. The location of this development eliminates the ability to create the northern connection of the truck route as previously planned in the TSP update.

A second concern relates to access management along Culver Highway 361. The route is anticipated to have a high volume of truck traffic and relatively high travel speed. Access from adjacent properties will likely be limited to facilitate the mobility of truck traffic and enhance safety. However, the section of existing Culver Highway 361 that the planned truck route is to follow is lined with single- and multi-family homes that have direct access to the highway. Access management to facilitate the truck route along this section of highway would be challenging.

Given these concerns and the high cost of the planned alignment, this refinement plan evaluates the feasibility of an alternative alignment taking right-of-way impact, in-process developments, and current and future transportation operation and safety concerns into account.

Refinement Plan Alternatives

The Madras Truck Route will provide alternate access for regional traffic passing through Madras, thus reducing traffic volume and the percentage of truck traffic traveling through downtown Madras. The alternate access can be provided on existing roadways or on a new roadway that bypasses the downtown area. After considering the existing roadway network, impact on existing businesses, and physical constraints, past studies recommended that a feasible alternative is to provide a truck bypass that generally follows the existing Culver Highway 361 alignment. Taking those recommendations into account, this refinement plan developed additional alternative based on the information received from two sources: 1) comments received from the public and input from

County, ODOT, and City staff; and 2) the technical analysis of traffic operations and safety on the roadway. Three new alignment options were proposed for the northern connection of the bypass and four new alignment options were proposed for the southern connection. Figure 2 shows the alternative alignments and provides the advantages and disadvantages of each.

The Madras Truck Route is anticipated to be a limited-access expressway with a median barrier to improve the mobility of vehicles. It is planned to have four 12-foot travel lanes and a 12-foot raised median, with four-foot shy distance, two eight-foot bike lanes, an eight-foot planer strip and a six-foot sidewalk on both sides for a total of 114-foot right-of-way (See Figure 2 for detail cross-section). Access to the expressway will be provided via right-in/right-out driveways and full-access traffic signals at the intersections with Fairground Road, Belmont Street, and C Street.

The Madras Truck Route has various advantages and disadvantages, highlighted below.

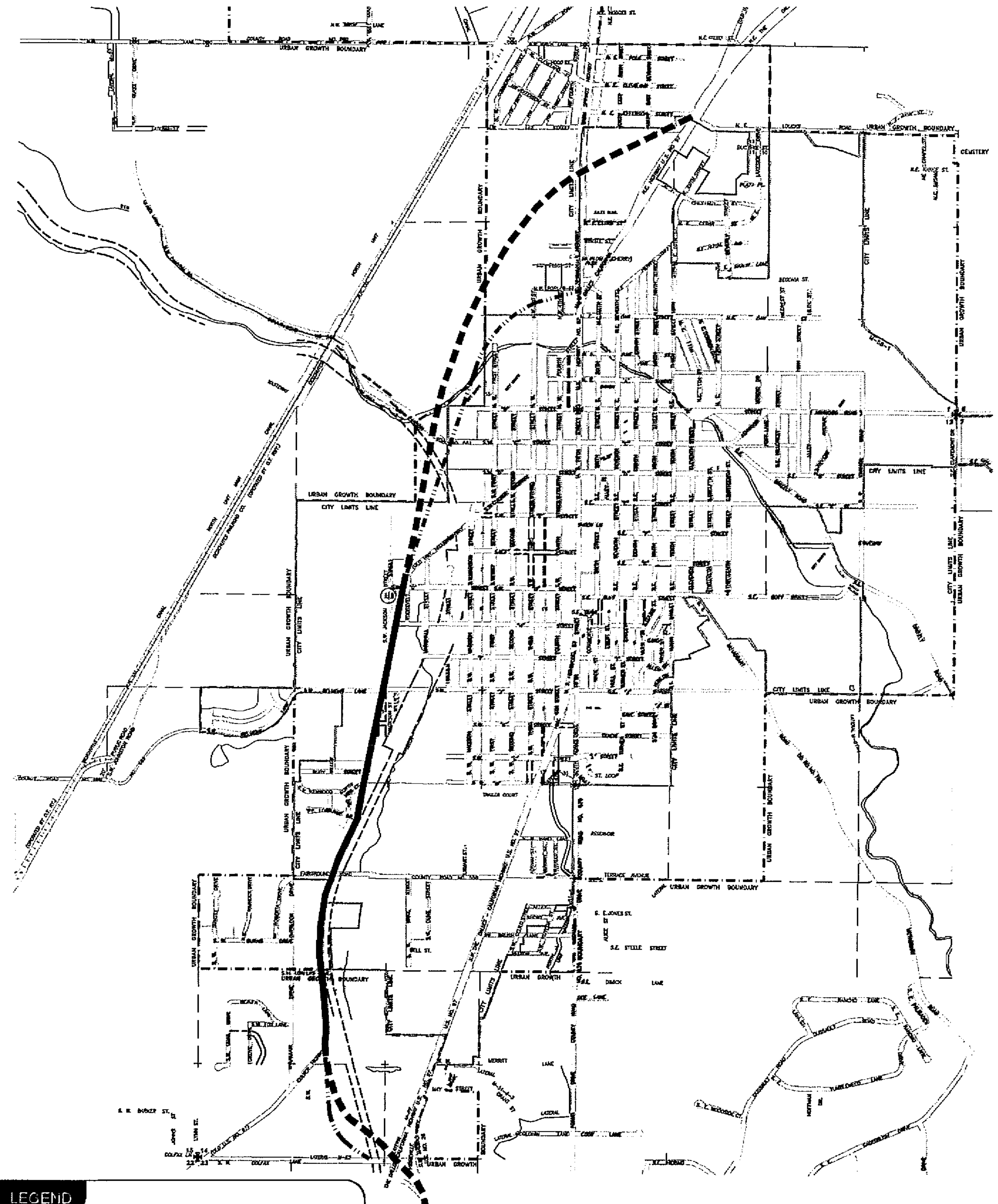
Advantages

- Reduces regular and truck traffic through downtown Madras, thus improving safety and mobility for local traffic and pedestrians in downtown Madras.
- Increases the mobility of regional truck traffic by providing an access-controlled facility.
- Utilizes existing right-of-way of Culver Highway 361 for majority of the alignment.
- Minimal impact on land outside the urban growth boundary, which will require a goal exception from Department of Land Conservation and Development (DLCD).

Disadvantage

- Impacts access to and from existing properties along Culver Highway. Alternate access, such as a frontage road, should be provided to the affected properties.
- Changes the characteristic of portions of Culver Highway from a rural/semi-urban highway to a higher speed, limited-access expressway.
- Requires acquisition of significant right-of-way along Culver Highway.

According to the City staff, the Alternative 1C and Alternative 2 concepts appear to have the most advantages. Alternative 1C begin at the US 97/US 26 North intersection as a west approach of the intersection. It then follows 1st Street and the existing Culver Highway alignment. The alignment does not impact the proposed hotel development and preserves the area for further development. In addition, the alignment stays to the east of the railroad track and the bluff on the west side of the city, which will reduce the cost of the project considerably. However, the alignment will have a right-of-way and access impact on the properties on 1st Street and portions of the Culver Highway alignment.



LEGEND

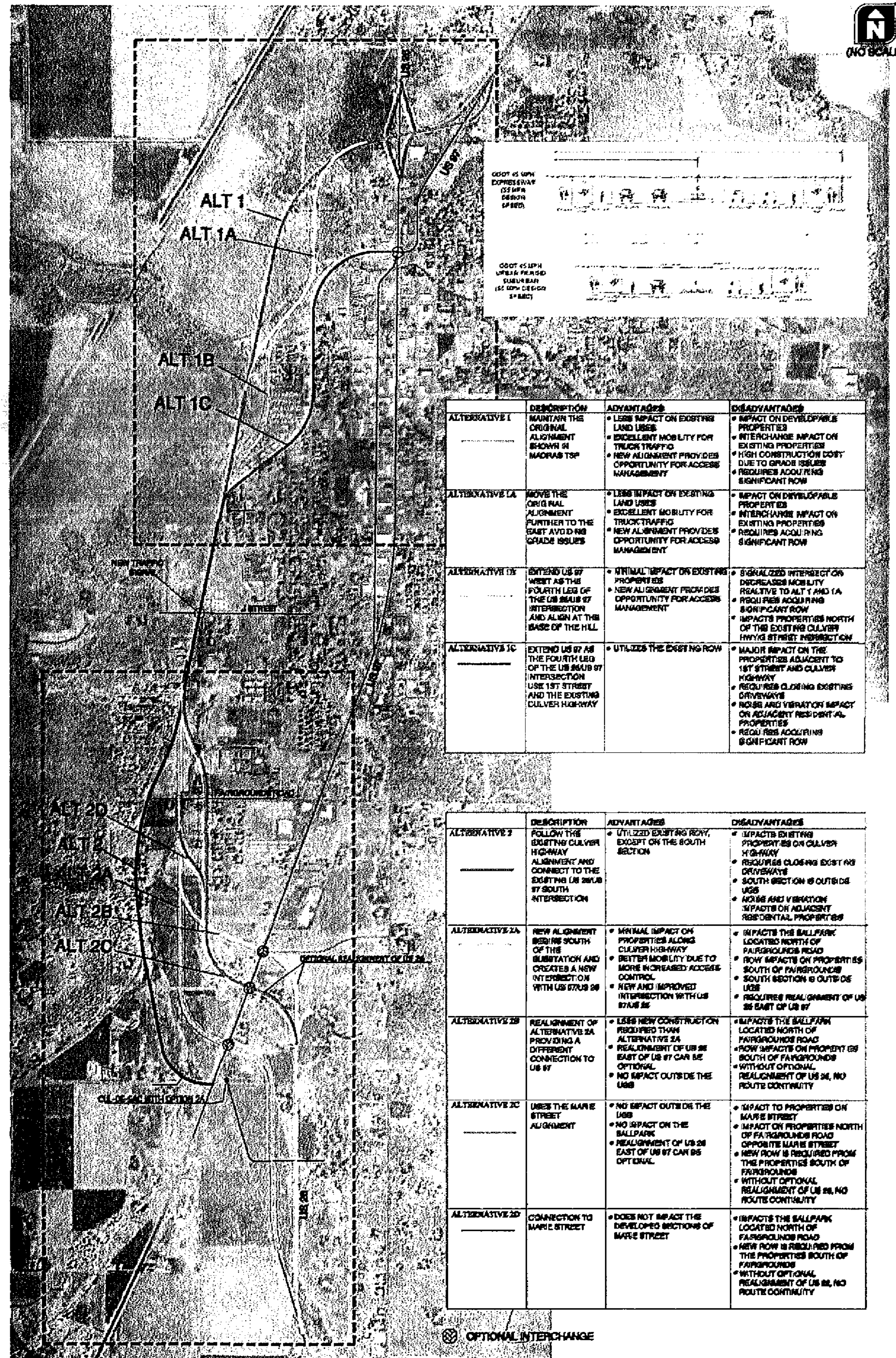
- Existing Infrastructure
- 2001 Madras TSP Udpate Alignment
- 1998 Madras TSP Alignment
- Madras UGB

APPROVED MADRAS TRUCK ROUTE
2001 CITY OF MADRAS TSP UPDATE
MADRAS, OREGON

FIGURE 1

K:\H_Portland\projfile\7976 - Madras TSP Amendment\dwgs\figs\FIGS.dwg Oct 10, 2006 - 11:49am - sonta Layout Tab: FIG 01

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION PLANNING / TRAFFIC ENGINEERING



	DESCRIPTION	ADVANTAGES	DISADVANTAGES
ALTERNATIVE 1	MAINTAIN THE ORIGINAL ALIGNMENT SHOWN IN MADRAS TSP	• LESS IMPACT ON EXISTING LAND USES • EXCELLENT MOBILITY FOR TRUCK TRAFFIC • NEW ALIGNMENT PROVIDES OPPORTUNITY FOR ACCESS MANAGEMENT	• IMPACT ON DEVELOPABLE PROPERTIES • INTERCHANGE IMPACT ON EXISTING PROPERTIES • HIGH CONSTRUCTION COST DUE TO GRADE ISSUES • REQUIRES ACQUIRING SIGNIFICANT ROW
ALTERNATIVE 1A	MOVE THE ORIGINAL ALIGNMENT FURTHER TO THE EAST AVOIDING GRADE ISSUES	• LESS IMPACT ON EXISTING LAND USES • EXCELLENT MOBILITY FOR TRUCK TRAFFIC • NEW ALIGNMENT PROVIDES OPPORTUNITY FOR ACCESS MANAGEMENT	• IMPACT ON DEVELOPABLE PROPERTIES • INTERCHANGE IMPACT ON EXISTING PROPERTIES • REQUIRES ACQUIRING SIGNIFICANT ROW
ALTERNATIVE 1B	EXTEND US 97 WEST AS THE FOURTH LEG OF THE US 26/US 97 INTERSECTION AND ALIGN AT THE BASE OF THE HILL	• MINIMAL IMPACT ON EXISTING PROPERTIES • NEW ALIGNMENT PROVIDES OPPORTUNITY FOR ACCESS MANAGEMENT	• SIGNALIZED INTERSECTION DECREASES MOBILITY REALTIVE TO ALT 1 AND 1A • REQUIRES ACQUIRING SIGNIFICANT ROW • IMPACTS PROPERTIES NORTH OF THE EXISTING CULVER HWY/G STREET INTERSECTION
ALTERNATIVE 1C	EXTEND US 97 AS THE FOURTH LEG OF THE US 26/US 97 INTERSECTION USE 1ST STREET AND THE EXISTING CULVER HIGHWAY	• UTILIZES THE EXISTING ROW	• MAJOR IMPACT ON THE PROPERTIES ADJACENT TO 1ST STREET AND CULVER HIGHWAY • REQUIRES CLOSING EXISTING DRIVEWAYS • NOISE AND VIBRATION IMPACT ON ADJACENT RESIDENTIAL PROPERTIES • REQUIRES ACQUIRING SIGNIFICANT ROW

	DESCRIPTION	ADVANTAGES	DISADVANTAGES
ALTERNATIVE 2	FOLLOW THE EXISTING CULVER HIGHWAY ALIGNMENT AND CONNECT TO THE EXISTING US 26/US 97 SOUTH INTERSECTION	• UTILIZED EXISTING ROW, EXCEPT ON THE SOUTH SECTION	• IMPACTS EXISTING PROPERTIES ON CULVER HIGHWAY • REQUIRES CLOSING EXISTING DRIVEWAYS • SOUTH SECTION IS OUTSIDE UGB • NOISE AND VIBRATION IMPACTS ON ADJACENT RESIDENTIAL PROPERTIES
ALTERNATIVE 2A	NEW ALIGNMENT BEGINS SOUTH OF THE SUBSTATION AND CREATES A NEW INTERSECTION WITH US 97/US 26	• MINIMAL IMPACT ON PROPERTIES ALONG CULVER HIGHWAY • BETTER MOBILITY DUE TO MORE INCREASED ACCESS CONTROL • NEW AND IMPROVED INTERSECTION WITH US 97/US 26	• IMPACTS THE BALLPARK LOCATED NORTH OF FAIRGROUNDS ROAD • ROW IMPACTS ON PROPERTIES SOUTH OF FAIRGROUNDS • SOUTH SECTION IS OUTSIDE UGB • REQUIRES REALIGNMENT OF US 26 EAST OF US 97
ALTERNATIVE 2B	REALIGNMENT OF ALTERNATIVE 2A PROVIDING A DIFFERENT CONNECTION TO US 97	• LESS NEW CONSTRUCTION REQUIRED THAN ALTERNATIVE 2A • REALIGNMENT OF US 26 EAST OF US 97 CAN BE OPTIONAL • NO IMPACT OUTSIDE THE UGB	• IMPACTS THE BALLPARK LOCATED NORTH OF FAIRGROUNDS ROAD • ROW IMPACTS ON PROPERTIES SOUTH OF FAIRGROUNDS • WITHOUT OPTIONAL REALIGNMENT OF US 26, NO ROUTE CONTINUITY
ALTERNATIVE 2C	USES THE MARIE STREET ALIGNMENT	• NO IMPACT OUTSIDE THE UGB • NO IMPACT ON THE BALLPARK • REALIGNMENT OF US 26 EAST OF US 97 CAN BE OPTIONAL	• IMPACT TO PROPERTIES ON MARIE STREET • IMPACT ON PROPERTIES NORTH OF FAIRGROUNDS ROAD OPPOSITE MARIE STREET • NEW ROW IS REQUIRED FROM THE PROPERTIES SOUTH OF FAIRGROUNDS • WITHOUT OPTIONAL REALIGNMENT OF US 26, NO ROUTE CONTINUITY
ALTERNATIVE 2D	CONNECTION TO MARIE STREET	• DOES NOT IMPACT THE DEVELOPED SECTIONS OF MARIE STREET	• IMPACTS THE BALLPARK LOCATED NORTH OF FAIRGROUNDS ROAD • NEW ROW IS REQUIRED FROM THE PROPERTIES SOUTH OF FAIRGROUNDS • WITHOUT OPTIONAL REALIGNMENT OF US 26, NO ROUTE CONTINUITY

MADRAS TRUCK ROUTE REFINEMENT PLAN ALTERNATIVES
PROJECT 18
MADRAS, OREGON

FIGURE 2

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION PLANNING/TRAFFIC ENGINEERING

Alternative 2 follows the existing alignment of Culver Highway to SW Loafers Lane, where it diverts to intersect with US 97 near the existing US 97/US 26 South intersection. This new intersection with US 97 will most likely be a grade-separated interchange in the long run. As shown in Figure 2, various other alignments were analyzed for advantages and disadvantages. However, based on discussion with City staff, it was determined that Alternative 2, which follows the approved alignment of the Madras Truck Route, is the most feasible.

The planning-level cost estimate for Alternative 1C, improvement to the existing alignment of Culver Highway 361, and Alternative 2, is approximately $7.5 million, $8.75 million, and $3 million, respectively. The total estimated cost is $19.25 million, without consideration for right of way acquisition, impacts to adjacent properties, or the cost of interchanges.

Evaluation of the Madras Truck Route/US 97/US 26 North Intersection

Alternative 1C connects to the existing US 97/US 26 North intersection as the fourth leg of the intersection, which currently serves a small retail development. The impact of the truck route on the turning movements at the intersection was determined after reviewing the existing turning movement patterns. In order to estimate traffic volume on the Madras Truck Route, approximately 55 percent of the existing westbound left-turning traffic and 30 percent of the southbound through traffic was assigned to the new truck route. Similarly, 55 percent of the northbound right-turning traffic and 30 percent of the northbound through traffic is estimated to use the new truck route. With these turning movement estimates, the intersection is anticipated to operate at volume to capacity ratio of 0.70 in 2025 traffic condition with the lane configuration listed below.

- Northbound: left-turn, through, and through-right lanes
- Southbound: left-turn, dual through, and right-turn lanes
- Eastbound: dual left-turn, through, and through right-turn lanes
- Westbound: dual left-turn, through, and through right-turn lanes

Even with the lanes recommended above, the total delay incurred at a traffic signal will increase as traffic volume increases. Therefore, it is recommended to preserve the option to provide an interchange at the Madras Truck Route/US 97/US 26 North intersection in the future. An interchange will provide the highest degree of mobility and route continuity for US 97 and US 26. By reducing delay in transporting goods and services, the interchange is anticipated to enhance the economic benefit to the region

Evaluation of the Madras Truck Route/US 97/US 26 South Intersection

The growth in traffic on US 97 and US 26 south of Madras is anticipated to deteriorate the operation of the existing US 97/US 26 South intersection. Without the Madras Truck Route, the intersection will require a traffic signal to meet the ODOT mobility standard in 2025. The intersection is anticipated to operate at a volume-to-capacity ratio of 0.67 under 2025 traffic conditions with a traffic signal installed. With the Madras Truck Route, which is anticipated to connect to US 97 in the vicinity of the intersection, the intersection area would need to be redesigned to an interchange to provide adequate mobility for truck traffic.

Recommendation

The next steps required to formalize the Madras Truck Route include conducting a further detail analysis and a feasibility study to determine the full impact of the proposed truck by-pass on adjacent properties and finalizing the preferred alternative. The analysis should consider other potential solutions to mitigate the operation and safety of US 97/US 26 through downtown. Options include optimizing the operation of US 97/US 26 through downtown Madras and/or adding capacity to the existing roadway. The study would likely need to include a National Environmental Policy Act (NEPA) analysis and appropriate environmental assessments of the alternative alignments of the future US 97 Truck Bypass before a final preferred alternative alignment is chosen.

J Street Improvement Refinement Plan

Background and Determination of Need

J Street is the main east-west connection in the south end of downtown Madras and provides access to the Palisades State Park to the west and new residential developments to the east. On the westside of Madras, J Street is known as Belmont Street and is mostly a two-lane rural roadway with minimal shoulder widths and shallow drainage ditches on both sides of the roadway. To the east of US 97, J Street is a two-lane roadway with urban features, (e.g. bike lanes and sidewalks), and provides access to new residential developments on the east end of the roadway, near McTaggart Road.

Past studies have identified the need to improve the operation of the intersections of J Street and US 97/US 26 Northbound and Southbound. In order to determine that the J Street improvements are still needed, analyses were conducted at three study intersections, namely J Street/US 97/US 26 Northbound, J Street/US 97/ US 26 Southbound, J Street/Adams Drive, to evaluate the existing operation of the intersections. The following section is a summary to technical analysis provided in Technical Memoranda "A", "B" and "C" of the Jefferson County TSP.

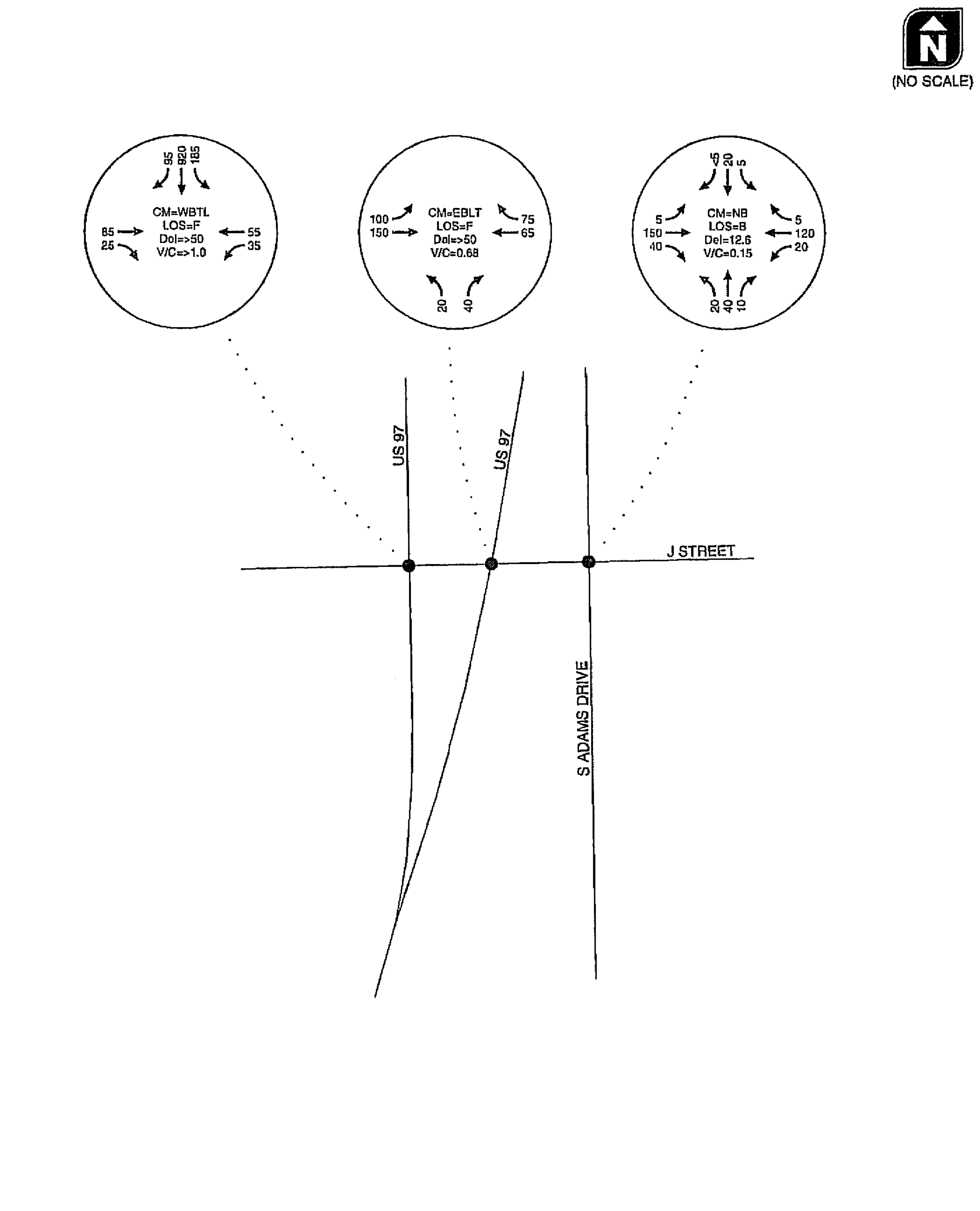
The operation analysis was based on the 30th highest traffic volume and latest analysis guidelines provided by ODOT. Figure 3 shows the results of the operational analysis at the intersections. As shown in the figure, all the intersections meet the OHP standard, except the J Street/US 97/US 26 Southbound intersection. The westbound left-turn movement at the J Street/US 97/US 26 Southbound intersection operates at volume-to-capacity ratio greater than 1.0 during the 30th highest hour.

As mentioned in the Madras Truck Route Refinement Plan section, the traffic volume in downtown Madras is anticipated to grow at the rate of 3.37% annually. Using this growth rate, a 20-year analysis was conducted to the study intersection. Based on the analysis, the J Street/US 97/US 26 Northbound and Southbound intersections are anticipated to operation over capacity in year 2025 if no improvements are made at the intersections.

Similarly, a review of the five year crash history (from 2000–2004) revealed that there were six and seven crashes reported at the J Street/US 97/US 26 Southbound and J Street/US 97/US 26 Northbound intersections, respectively. The majority of the crashes were angle-type collisions. One of the potential causes of the high number of crashes is the close proximity of the two intersections which makes it an unsafe environment for motorists in the area. With the anticipated 70-percent increase in traffic volume over the next 20 years, the number and severity of crashes at the intersections are likely to increase in the future if no improvements are made at the intersection.

In addition, field observation revealed several other factors impacting the capacity and safety of the intersection:

- When looking north, the sight distance for the westbound movement at the J Street/US 97/US 26 Southbound intersection is not adequate for safe turning movements. The existing on-street parking on US 97/US 26 southbound blocks the view of oncoming southbound traffic.



H:\proj\file\7976 - Madras TSP Amendment\dwgs\figs\7976Figs2.dwg Oct 10, 2006 - 1:33pm - mdowell Layout Tab: FIG 03

2005 EXISTING TRAFFIC CONDITIONS
30th HIGHEST HOUR
MADRAS, OREGON

FIGURE 3

Kittelson & Associates, Inc.
Transportation Engineering / Planning

- The westbound through movement at the J Street/US 97/US 26 Southbound intersection is not aligned with the corresponding receiving lane.
- US 97/US 26 Southbound traffic merges from two lanes to one lane through the J Street intersection.
- US 97/ US 26 Northbound traffic diverges from one lane to two lanes through the J Street intersection.

In summary, J Street forms two closely spaced (60 feet apart) intersections with the US 97/US 26 couplet. The close proximity of these intersections presents traffic operation problems on J Street including high vehicle delay for east-west traffic, queuing problems, and safety concerns. In addition, the US 97/US 26 couplet is two lanes in each direction to the north of J Street and one lane in each direction to the south. The lane transition occurs through J Street exacerbating the operation and safety concerns at the intersection. As a result, it was determined that the intersections of J Street and US 97/US 26 Northbound and Southbound continue to need improvements to provide a safe operational environment in both the short and long term.

Alternative Analysis

The 1998 City of Madras TSP proposed two design alternatives at the J Street/US 97/US 26 intersections. The design alternatives provided more distance between the US 97/US 26 southbound and northbound intersections with J Street. The first alternative realigned US 97/US 26 northbound (or 5th Street) to 7th Street, while the second alternative realigned it to 10th Street. The TSP recommends realigning US 97/US 26 northbound to 10th Street as 7th Street is found to have "inadequate geometry to function as a good north-south route."

Subsequently, the 2001 City of Madras TSP Update reviewed the alternatives presented in the 1998 TSP and recommended two additional design alternatives. These alternatives are show in Figure 4 and discussed below.

Design Option 1

Design Option 1 shortens the existing one-way couplet by shifting the couplet transition north of J Street and signalizing the J Street/US 97/US 26 intersection. With this option, there will be only one intersection between J Street and US 97/US 26, which eliminates the operational hazards of having two closely spaced intersections. However, this design option will impact existing businesses located between the US 97/US 26 couplet, north of J Street.

Design Option 2

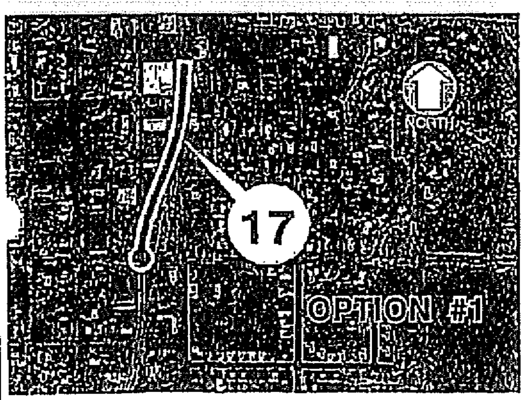
Design Option 2 extends the existing one-way US 97/US 26 couplet through downtown by shifting the couplet transition south of J Street and signalizing both the southbound and northbound J Street intersections. With this option, the current alignment of Adams Drive will be used for the realigned section of US 97/26. While this option will increase the distance between the existing closely spaced intersections, the new signalized intersections will still be within 200 feet of one another and will require signal coordination to reduce queues.

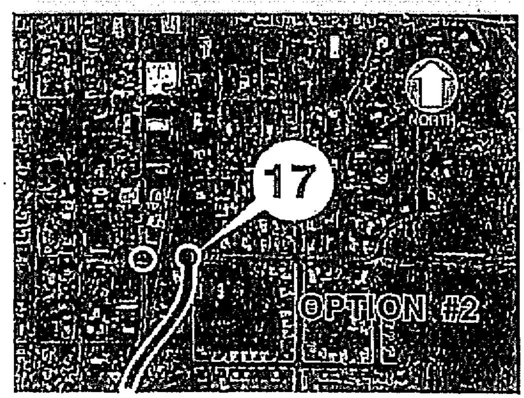
#17	"J" Street/US 97 Intersection Realignment

PURPOSE:
Provides a safe "J" Street crossing of the US 26/US 97 couplet and improves the east-west connectivity within Madras.

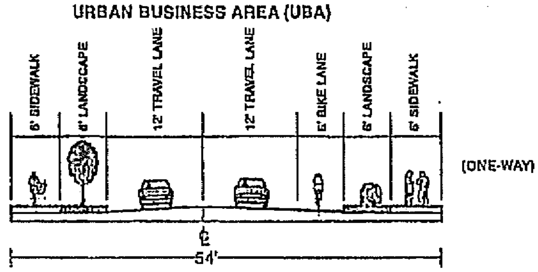
PROJECT DESCRIPTION:
This project has two design options that both require significant right-of-way and will likely impact existing businesses. Design Option #1 shortens the existing one-way couplet by shifting the couplet transition north of "J" Street and signalizing the "J" Street/US 26/US 97 intersection. Design Option #2 lengthens the existing one-way couplet by shifting the couplet transition south of "J" street and signalizing both the 4th Street and 5th Street intersections. Both of these design options will require Adams Drive to be reconfigured.

TIME FRAME: 10-20 years





TYPICAL CROSS-SECTION:



2001 MADRAS TSP UPDATE DESIGN OPTIONS
MADRAS, OREGON

FIGURE 4

Based on qualitative review of the design options, the 2001 TSP update recommended Design Option 2 as a preferred alternative. The main advantage of Design Option 2 over Design Option 1 is that it "allows for future 5-lane section" of the highway.

Refinement Plan Alternatives

Alternative Solution A: Install Traffic Signal at the Current Intersection Location

One of the options to improve the operation of the J Street/US 97/US 26 intersections is to install traffic signals at the current location of the northbound and southbound intersections. Due to the proximity of these intersections (there is approximately 60 feet of storage between the intersections), a Synchro analysis was conducted at the intersections to take the progression of traffic between the intersections into consideration. The northbound and southbound intersections are anticipated to operate at volume to capacity ratio of 0.48 and 0.41, respectively, during the weekday p.m. peak hour periods with the traffic signals in place under 2005 traffic conditions.

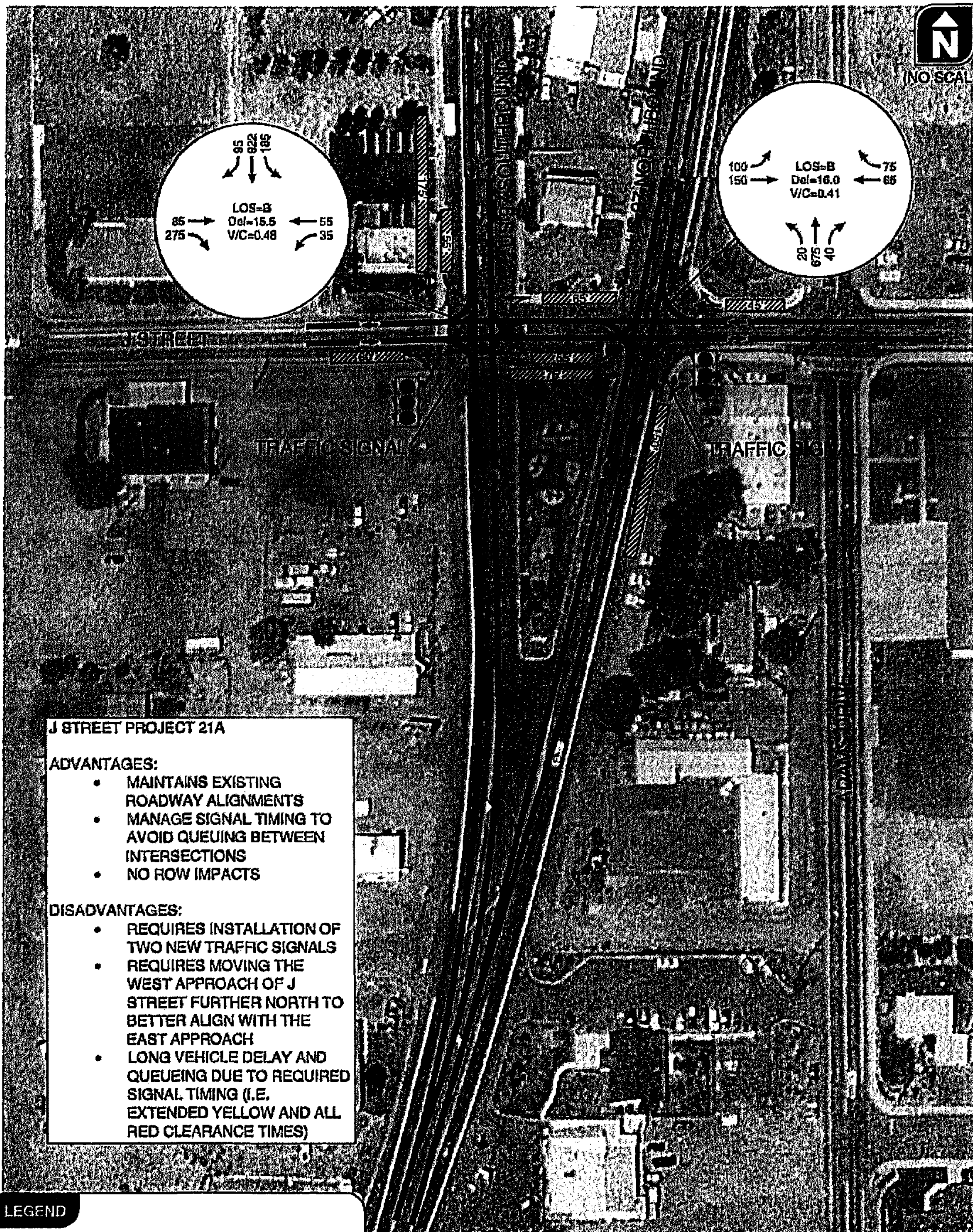
A review of the 95th percentile queues between the intersections showed that the eastbound and westbound queues at the intersections will exceed the 60 feet of available storage between the intersections. Subsequently, the queues are anticipated to spill back through the upstream signals. Even with east-west coordination between the intersections, the queues between the intersections are anticipated to exceed available storage. Furthermore, with anticipated growth in traffic on US 97/26, the coordination of the signals in the east-west direction will adversely impact the operation and queue for the north-south traffic at both the intersections. Consequently, it was determined that installing traffic signals at the current intersection location is not a viable solution. Figure 5 shows the general layout of this solution.

Alternative Solution B: Single Point Urban Intersection

One option to eliminate the issue of queues between the intersections is to redesign the two intersections into a one signal-point urban intersection. The intersection is anticipated to operate at a volume-to-capacity ratio of 0.59 as a single intersection under 2005 traffic condition. The intersection needs to be improved to the lane configuration listed below to meet the ODOT mobility standard of volume to capacity ratio 0.70 under 2025 traffic condition.

- Northbound: left-turn, dual through, and right-turn lanes
- Southbound: dual left-turn, dual through, and right-turn lanes
- Eastbound and Westbound: dual left-turn, through, and through-right turn lanes

This lane configuration will widen the intersection considerably and have adverse impact on the properties adjacent to the intersection. In addition, pedestrian and bicycle mobility through the intersection will be challenging, especially for children and the elderly. Hence, this solution was not determined to address all the operational and safety needs of the area. Figure 6 shows the single-line drawing of alternative solution B.



LEGEND

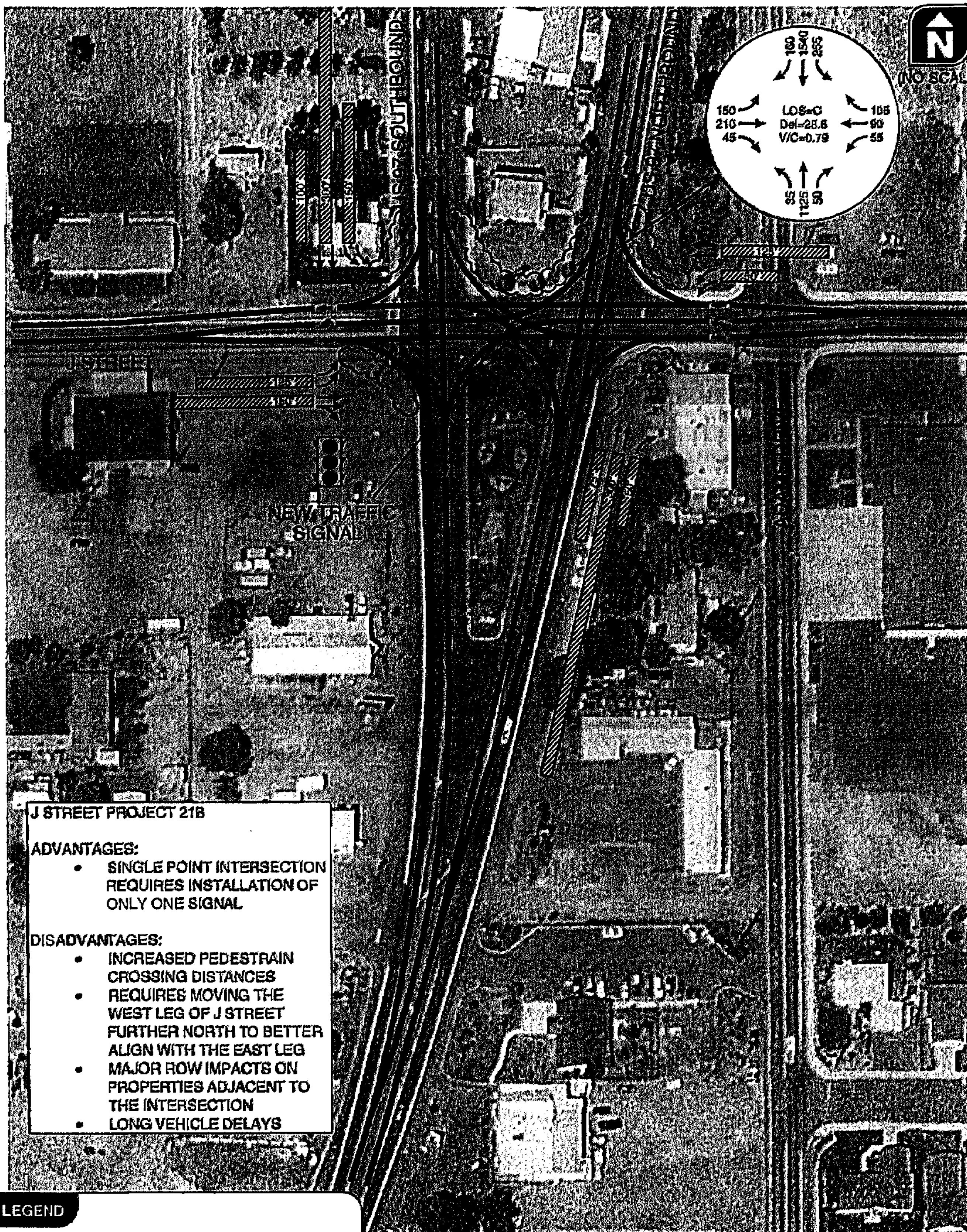
- 95TH PERCENTILE QUEUE

* - QUEUE LONGER THAN 60' OF AVAILABLE STORAGE

POTENTIAL J STREET ALTERNATIVE SOLUTION A
INSTALL TRAFFIC SIGNAL AT CURRENT LOCATION
2005 30TH HIGHEST HOUR TRAFFIC CONDITIONS

FIGURE 5

H:\projfile\7976 - Madras TSP Amendment\dwgs\figs\7976Figs3.dwg Oct 10, 2006 - 1:34pm - mdowell Layout Tab: FIG 05



J STREET PROJECT 21B

ADVANTAGES:

- SINGLE POINT INTERSECTION REQUIRES INSTALLATION OF ONLY ONE SIGNAL

DISADVANTAGES:

- INCREASED PEDESTRAIN CROSSING DISTANCES
- REQUIRES MOVING THE WEST LEG OF J STREET FURTHER NORTH TO BETTER ALIGN WITH THE EAST LEG
- MAJOR ROW IMPACTS ON PROPERTIES ADJACENT TO THE INTERSECTION
- LONG VEHICLE DELAYS

LEGEND

- 95TH PERCENTILE QUEUE
- RIGHT-OF-WAY IMPACT

POTENTIAL J STREET ALTERNATIVE SOLUTION B
SINGLE POINT URBAN INTERSECTION
2025 30TH HIGHEST HOUR TRAFFIC CONDITIONS

FIGURE 6

H:\projfile\7976 - Madras TSP Amendment\dwgs\figs\7976Figs3.dwg Oct 10, 2006 - 1:35pm - mdowell Layout Tab: FIG 06

Kittelson & Associates, Inc.
Transportation Engineering / Planning

Alternative Solution C: US 97/US 26 Realignment

As discussed previously, the 2001 Madras TSP Update evaluated realigning the highway north and south of J Street. The report recommended realigning the highway to the south of J Street based on the impact to current businesses and other concerns.

The current refinement plan evaluated two options for realigning the US 97/US 26 northbound approach south of J Street. The southern of the two alignments was determined to have lesser impact of the properties, based on discussions with City and County staff. A Synchro analysis was conducted to ensure that the traffic signal at the new realigned intersection would operate acceptably. The analysis showed that the J Street/US 97/US 26 Southbound intersection would operate at a volume-to-capacity ratio of 0.73 and the J Street/US 97/US 26 Northbound intersection would operate at a volume-to-capacity ratio of 0.67 during the 2025 30^{th} highest hour conditions. Figure 7 shows the single-line drawing of alternative alignment C. Figure 8 shows the double-line drawing of the southern alignment option.

The US 97/US 26 realignment project has several advantages and disadvantages, which are highlighted below.

Advantages

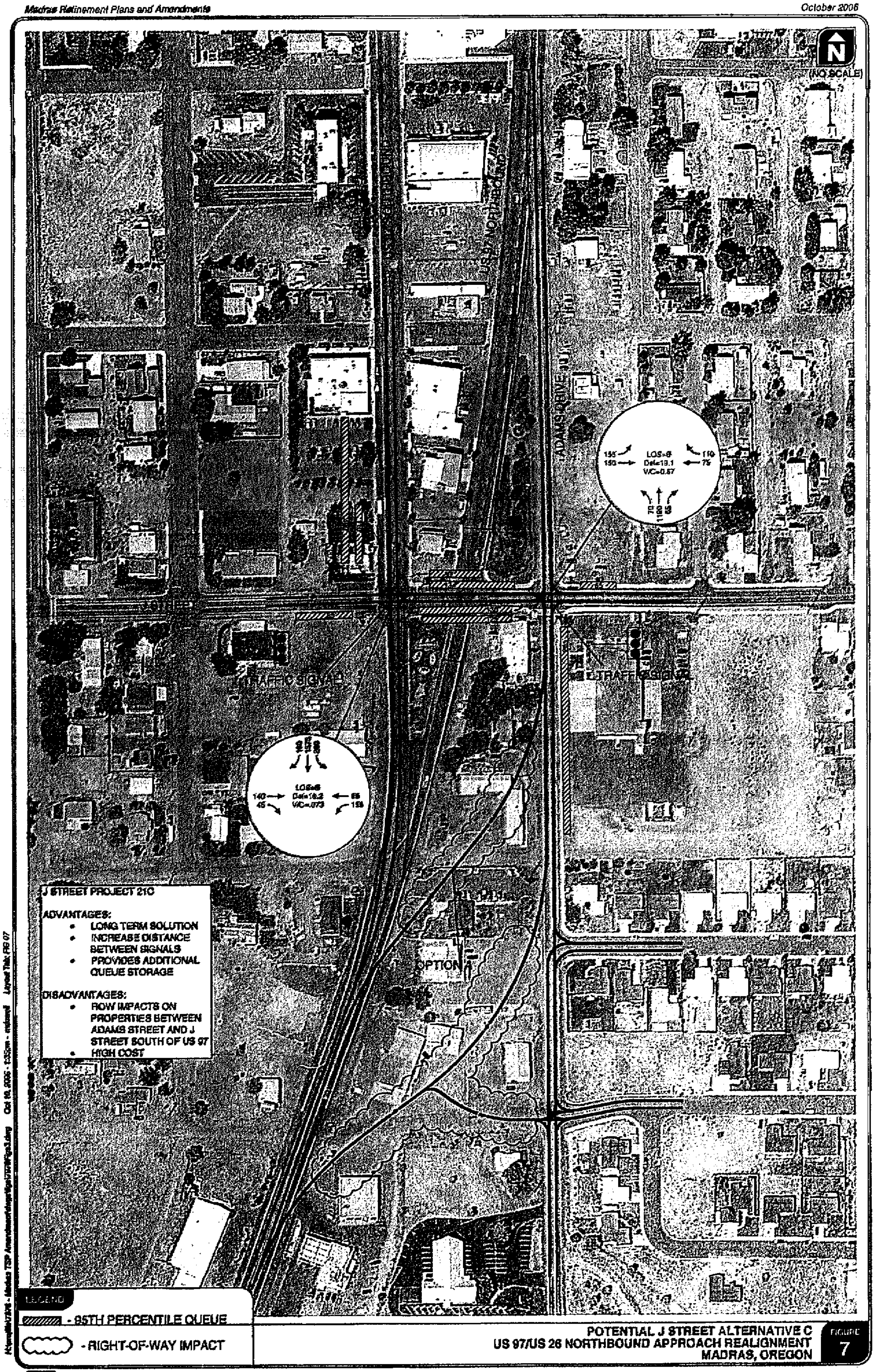
- Provides enough queuing distance between the northbound and southbound approaches of the highway, to store the vehicles on J Street.
- Reduces the speed for the northbound approach by using a low-speed design for the realignment.
- Extends the couplet south and provides access to additional properties for development.

Disadvantages

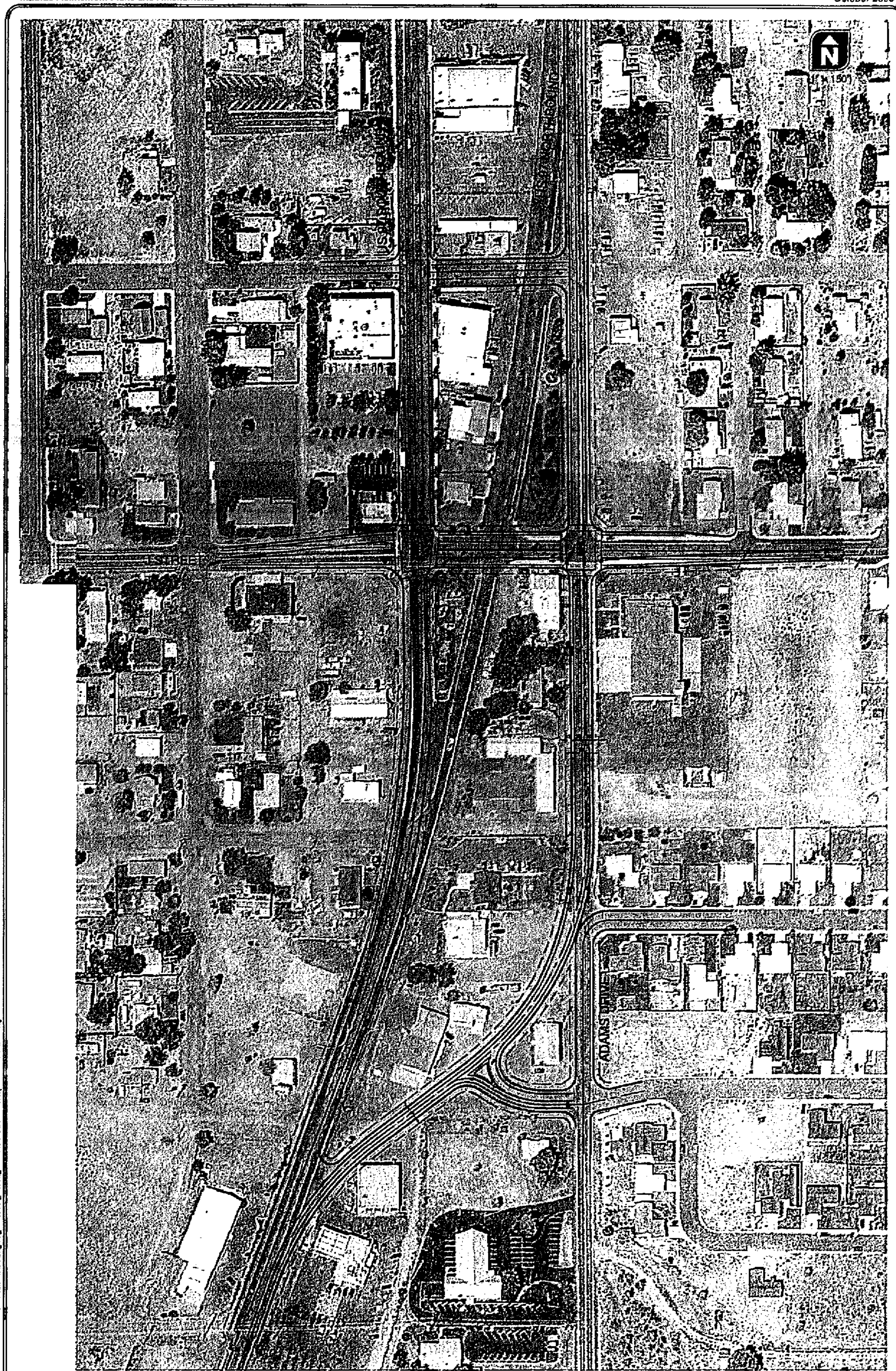
- Adversely impacts properties south of J Street between Adams Street and US 97/US 26.
- Substantial construction and right-of-way cost. ODOT cost estimate for the project is approximately $9 million.

Recommendation

The transportation alternatives presented above were discussed in detail in the technical advisory committee meetings and presented to the public in an open house. Based on the discussion and review comments received, Alternative C, the realignment of the US 97/US 26 northbound approach to Adams Street, was found to be most feasible and provides a long-term solution.



Kittelson & Associates, Inc.
Transportation Engineering / Planning



J STREET ALTERNATIVE SOLUTION C - DOUBLE-LINE DRAWING OF US 97/US 26 NORTHBOUND APPROACH REALIGNMENT
MADRAS, OREGON

FIGURE 8

Kittelson & Associates, Inc.
Transportation Engineering / Planning

City of Madras TSP Project List Update

Several projects were identified in and around the City of Madras city limits during the course of preparing Jefferson County TSP. These projects addressed the long-term transportation needs of the County and City. The projects were reviewed by the technical advisory committee for the Jefferson County TSP, which included staff from City of Madras planning division, engineering division, school district as well as the police department. Some of these projects impacted the list of projects approved in the 2001 City of Madras TSP Update. In addition, the updated project list takes into consideration the recent residential developments in the east side of town.

In an effort to coordinate the two project lists (County and City), this section updates the City of Madras TSP project list to match the ones recommended in the County TSP. The following section identifies the projects that are impacted. The project number listed below refers to the City's TSP project list. Figure 9 provides the updated Figure B6 of the 2001 City of Madras TSP Update.

#6 Fairgrounds Road Extension (US 26/US 97 to ~~Adams Drive~~ Grizzly Road)

Extend Fairground Road future east to Grizzly Road. This extension represents anticipated future growth in the area.

#7 ~~Oak Street~~ Maple Street Extension (~~3rd~~-1st Street to US 26/US 97)

In order to coordinate with the newly constructed US 26/US 97 North intersection, and preserving the option of extending the fourth leg of the intersection as the Madras Truck Route, change Oak Street extension to Maple Street extension.

#8 ~~3rd~~ 1st Street Extension (~~Oak Street~~ Maple Street to B Street)

In order to coordinate with the Madras Truck Route option, change the project to 1st Street extension from Maple Street to B Street.

#10 ~~Claremont Street~~ Bean Drive Extension (~~US 97~~ Meadow Lark to ~~Grizzly Road~~ B Street)

Change project #10 Claremont Street extension from US 97 to Grizzly Road to Bean Drive extension from Meadow Lark to B Street to coordinate with Jefferson County TSP. The future intersection of Bean Drive/Kinkade Road is planned to be a modern roundabout.

#14 Oak Street Extension (16th Street to ~~Claremont~~ City View Street)

The alignment of the Oak Street extension is altered to form a curvilinear roadway and intersection opposite the City View Street/B Street intersection. A modern roundabout is planned at the intersection of Kinkade Avenue and Oak Street.

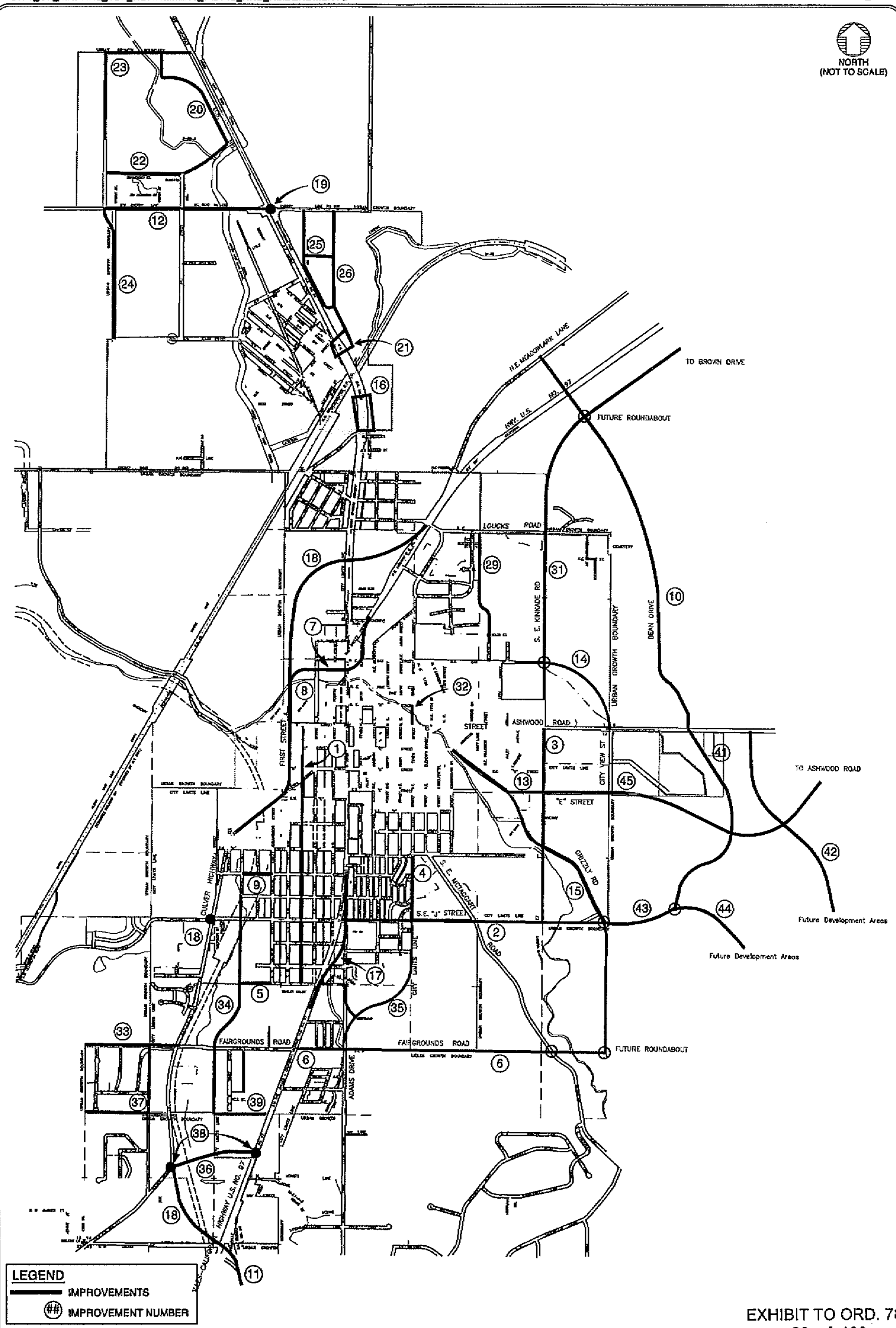


EXHIBIT TO ORD. 785
20 of 100

UPDATED SUMMARY OF PROPOSED TRANSPORTATION SYSTEM IMPROVEMENTS

CITY OF MADRAS COMPREHENSIVE PLAN AND TRANSPORTATION SYSTEM PLAN UPDATE

OCTOBER 2006

FIGURE B6

4139\DWGS\TECHMEMO#28\4139F0B6

FIGURE 9

#17 J Street/US 97 Intersection Realignment

Based on the refinement plan presented in previous section of this report, update the J Street/US 97 intersection realignment design to the double-line design shown in Figure 8. The project is estimated to cost approximately $9 million dollars including right-of-way acquisition, engineering and construction cost, according to the ODOT cost estimate.

#18A - D Madras Truck By-Pass Alignments

The Madras Truck Route refinement plan analyzed various alternative alignments, as described in the previous section. Based on the discussion on those alignments, the alignment that extends the truck route as the fourth leg of the US 97/US 26 North intersection and follows 1st Street to the current alignment of Culver Highway was identified as the most feasible alignment. The alignment is named as Alternative 1C and Alternative 2 in Figure 2. Even though the alignment addresses some of the concerns, such as the impact on the hotel development and cost of construction, it is anticipated to continue to have major right-of-way and access impacts on the properties adjacent to Culver Highway. As such, it is recommended that a detailed quantitative impact analysis be conducted in accordance with NEPA process before a final preferred alternative is selected.

#27 ~~Alder Street Improvements (Glass Drive to Mill Street)~~

This project is recommended to be removed from the list as it has already been built and is not identified in Jefferson County TSP.

#28 ~~Lakeside Drive Extension (Loucks Road to Kinkade Avenue)~~

This project is replaced by the Kinkade Avenue extension and is not included in the Jefferson County TSP.

#PM ~~Cedar Street Extension (Lakeside Drive to Claremont Extension)~~

This project is recommended to be removed from the list as Marigold Street, which runs parallel to Cedar Street, is proposed to extended to Bean Drive.

#P1 Kinkade Avenue Extension (~~US 97~~ Brown Drive to ~~"A"~~ B Street)

The alignment of this project is modified to be extended north from B Street to the future extension of Bean Drive and continue to the northeast to Brown Drive. This project is anticipated to provide residential developments around Brown Drive with alternative access to downtown Madras without relying on US 97. The intersections of Kinkade Avenue/Bean Drive and Kinkade Avenue/Oak Street are planned to be modern roundabouts.

#P5 Adams Drive/10th Street Connection

The alignment of this project is modified to illustrate a road connection on 10th Street from J Street to Fairgrounds Road and on Fairgrounds Road from 10th Street to Adams Drive (rearrange alignment to an "L" shape).

#41 Bean Drive Extension (Ashwood Road to J Street Extension)

The alignment of Bean Drive extension has been modified to accommodate current development pattern in the area. The final alignment of this project will need to accommodate topographical constraints and final developmental activity in the area.

#42 North-South UGB Road #1 (~~"("~~ B Street to J Street)

The final alignment of this project will need to accommodate topographical constraints and development activity in the area.

#43 J Street Extenstion (Grizzly Road to Bean Drive Extension)

The alignment of the extension has been modified to accommodate current development pattern in the area. The final alignment of this project will need to accommodate topographical constraints and developmental activity in the area.

#44 East-West UGB Road #1 (~~Kinkade Avenue to Claremont~~ City View Street to Future Growth Area)

The final alignment of this project will need to accommodate topographical constraints and development activity in the area.

#45 ~~East-West UGB Road #1~~ E Street Extension (Kinkade Avenue to ~~"-" SW~~ ~~Extension~~ Ashwood Road)

Extend E Street east to Ashwood Road to accommodate future development in the area. The final alignment of this project will need to accommodate topographical constraints and development plan.

Additional Amendments

In recent years, City of Madras has witnessed a high pace of growth. The rate of growth is primarily attributed to the construction of the Department of Correction facility on the east side of the city and to the general population growth in Central Oregon, especially around the cities of Bend and Redmond. As such, large areas that were previously uninhabited are now being developed into residential sub-divisions, especially on the east side of the city. The updated list of projects provided in the previous section addressed some of the long-term transportation needs of these areas to accommodate the growth.

Furthermore, City of Madras is recommending to amend the City's TSP to include additional engineering standards and guidelines. These standards and guidelines will assist city officials in requiring new construction to follow standard engineering practices. It will also ensure that basic operational and safety features are provided in the design of the transportation system in and around the city.

Modern Roundabout Design and Operation Consideration

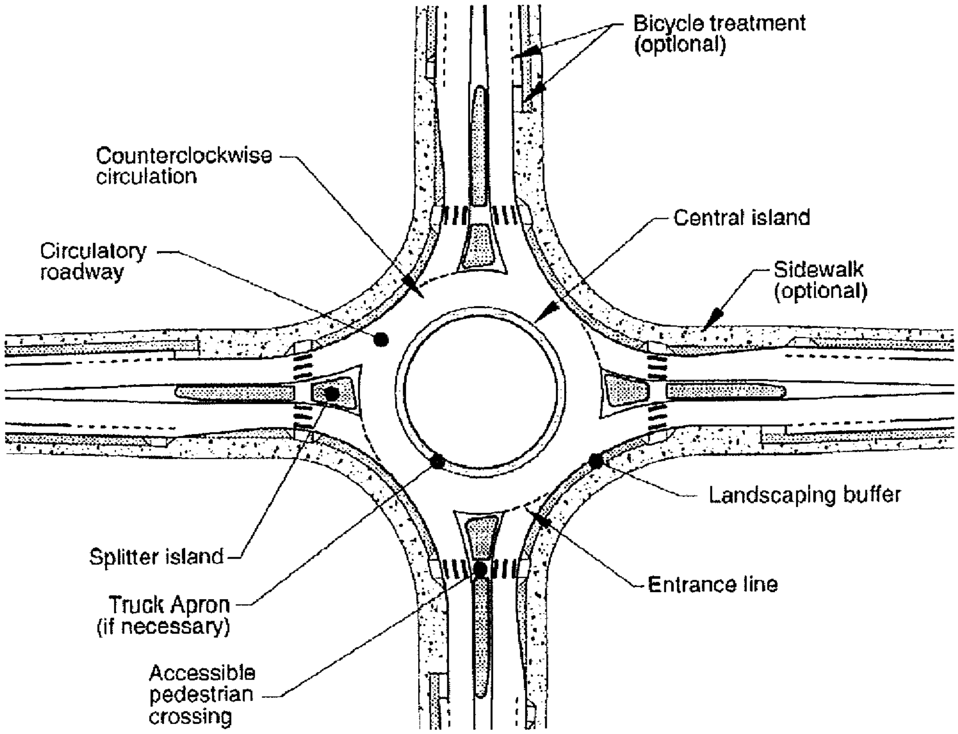
Modern roundabouts are a form of intersection design that provide safe and efficient flow of traffic within a certain range of traffic volume. Numerous research studies in the U.S. and abroad have shown that the operation of roundabouts is highly dependent on its geometric design and the characteristic of the traffic volume it serves. The detailed information on the safety, operations, and design of roundabout is provided in *Roundabouts: An Informational Guide*, published by the Federal Highway Administration (FHWA). The document stipulates that before the details of the geometry are defined, three fundamental elements must be determined in the preliminary design stage:

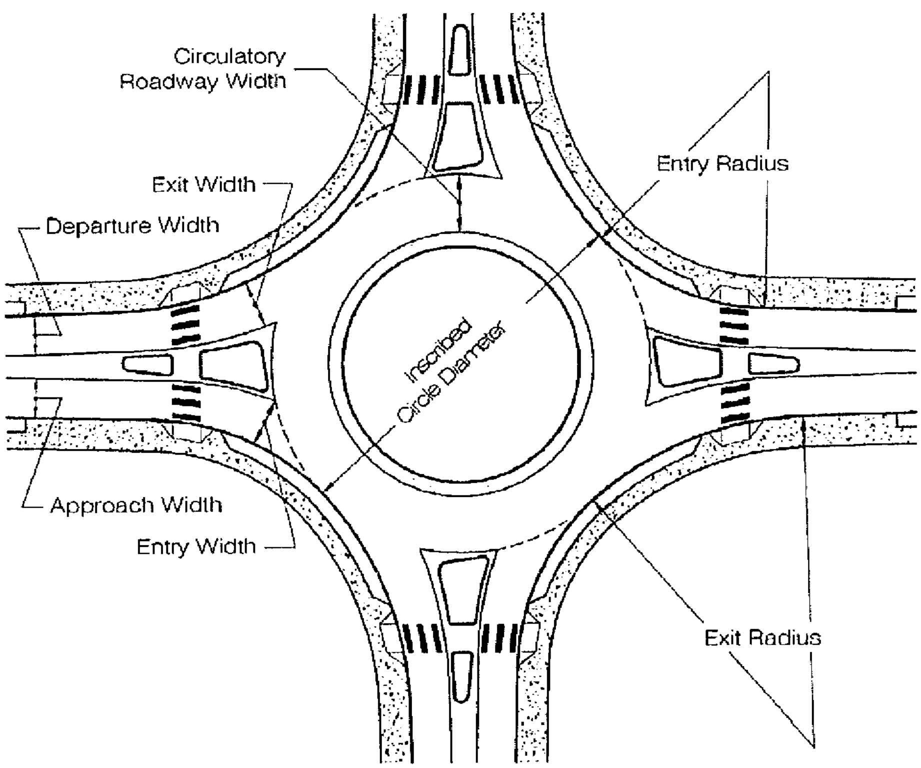
1. The optimal roundabout size;
2. The optimal position; and
3. The optimal alignment and arrangement of approach legs.

The document also highlights following critical design principals for roundabouts:

- Speed Profiles
- Design Speed
- Vehicle Paths
- Speed-Curve Relationship
- Speed Consistency

Other design considerations like design vehicle and non-motorized design users, among others, are also discussed in detail in the document. A volume-to-capacity (v/c) ratio of 0.85 is recommended as the operational standard of a roundabout. Exception to the v/c ratio standard is recommended when long-term analysis is conducted. Figure 10 shows key features and dimensions of modern roundabout.





K:\H_Portland\projfile\7976 - Madras TSP Amendment\dwgs\figs\Fig 11.dwg Oct 10, 2006 - 1:29pm - sonia Layout Tab: Fig 10

KEY ROUNDABOUT FEATURES AND DIMENSIONS
MADRAS, OREGON

FIGURE **10**

City of Madras Roundabout Standard

City of Madras and Jefferson County are planning to build several modern roundabouts around the city. In an effort to ensure that proper engineering standards are used when constructing roundabouts in and around the city, following design guidelines are recommended to be followed:

1. *Roundabouts: An Informational Guide* published by FHWA
2. *A Policy on Geometric Design of Highways and Streets* (Green Book), published by AASHTO
3. *Manual of Uniform Traffic Control Devices,* published by FHWA

Table 1 shows the recommended inscribed circle diameter ranges that is provided in Exhibit 6-19 of the roundabout guide.

Table 1 Recommended Inscribed Circle Diameter Ranges from Exhibit 6-19 of the *Roundabouts: An Informational Guide*

Site Category	Typical Design Vehicle	Inscribed Circle Diameter Range *
Mini-Roundabout	Single-Unit Truck	45 – 80 feet
Urban Compact	Single-Unit Truck/Bus	80 – 100 feet
Urban Single Lane	t B-50	100 – 130 feet
Urban Double Lane	t B-50	150 – 180 feet
Rural Single Lane	t B-67	115 – 130 feet
Rural Double Lane	t B-67	180 – 200 feet

* Assumes 90 degree angles between entries and no more then four legs.

Intersections of roadway facility types should consider all forms on intersection to ensure safe operating environment. Subject to a discretionary analysis by the Public Works Department, a modern roundabout is the initially preferred form of intersection between two major collectors or higher facilities. Based on City of Madras staff review of roundabouts in the region, a modern roundabout with an inscribed circle diameter of 190 feet and right-of-way of 252 feet diameter shall be dedicated as default, if no safety and operational analysis is presented to justify a smaller inscribed circle diameter. A roundabout with smaller inscribed diameter might be approved at certain location if a 20-year traffic safety and operation analysis determines that a smaller roundabout will operate adequately in the long-term. It is recommended that such a safety and operational analysis be conducted at all proposed/planned roundabouts before a final design is approved.

Planned Roundabouts

City of Madras and Jefferson County are planning to construct modern roundabouts at the following intersections:

- Kinkade Avenue/Oak Street/City View Street

- Kinkade Avenue extension/Bean Drive extension
- J Street extension/Bean Drive extension
- J Street extension/Grizzly Road
- Fairground Road extension/Grizzly Road
- Fairground Road extension/McTaggart Road

US 97/US 26 Highway Upgrade: K Street to Colfax Road

City of Madras and ODOT are planning to upgrade US 97/US 26 south of downtown Madras, from K Street to Colfax Road. The highway upgrade is anticipated to improve the operation and safety of motorist on the highway by reducing speed and adding urban features on the highway. Within a 100-foot right-of-way, the cross-section of the highway will include:

- Two 12-foot travel lanes
- One 16-foot center two-way left-turn lane
- Two 8-foot bike lanes
- 15-foot planter strip/drainage ditch on each side
- 6-foot sidewalk on each side

Figure 11 shows the cross-section of the US 97/US 26 highway upgrade. It should be noted that the above cross-section was included at the request of City staff. No specific reviews of the cross-section were conducted as part of the TSP amendment process.

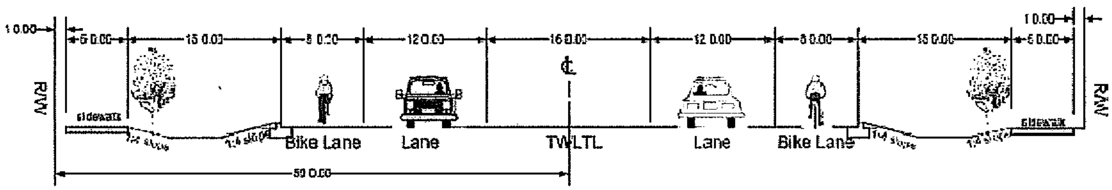
Culver Highway Upgrade: 1st Street to Colfax Road

Culver Highway is planned to be upgraded from 1st Street to Colfax Road as part of the Madras Truck Route. The design will include urban features and a posted speed of 45 mph.

- Two 12-foot travel lanes
- One 13-foot raised median with 3-foot shy distance on each side
- Two 8-foot bike lanes
- 4-8-foot planter strip on each side
- 6-foot sidewalk on each side

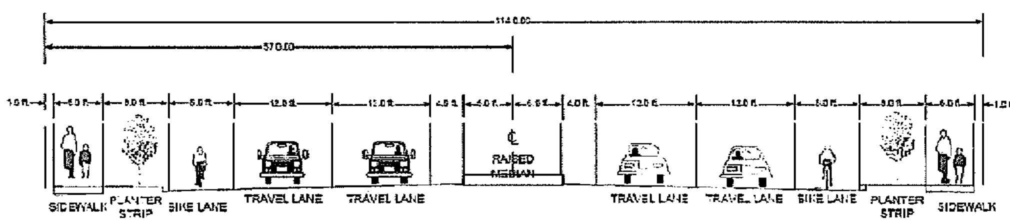
Figure 11 also shows the planned cross-section of Culver Highway/Madras Truck Route upgrade. Similar to US 97/US 26 cross-section, it should be noted that the cross-section for Culver Highway was included at the request of City staff. No specific reviews or impact analysis of the cross-section were conducted as part of the TSP amendment process.

TYPICAL SECTION US 97 – "K" STREET TO COLFAX RD.

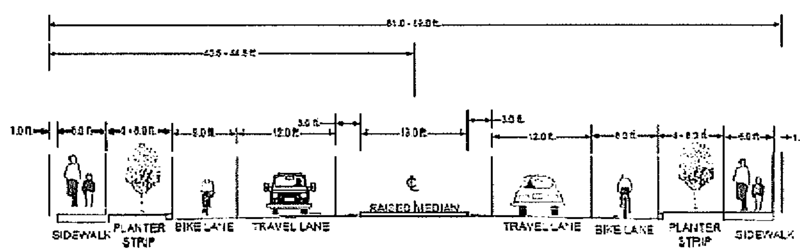


TYPICAL SECTION CULVER HIGHWAY - 1ST STREET TO COLFAX RD.

ODOT 45 MPH EXPRESSWAY (55 MPH DESIGN SPEED)



ODOT 45 MPH URBAN FRINGE/ SUBURBAN (55 MPH DESIGN SPEED)



US 97/US 26 AND CULVER HIGHWAY PLANNED CROSS-SECTION MADRAS, OREGON

FIGURE 11

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION PLANNING/TRAFFIC ENGINEERING
610 SW ALDER, SUITE 700 · PORTLAND, OR 97205 · (503) 228-5230 · FAX (503) 273-8169

TECHNICAL MEMORANDUM A

Jefferson County Transportation System Plan

EXISTING CONDITIONS INVENTORY
Madras Truck Route Refinement Plan
J Street/US 97/US 26 Intersection Refinement Plan

Date: December 13, 2005 **Project #:** 7475.04

To: Technical Advisory Committee

From: Sagar Onta, P.E, Elizabeth Wemple, P.E., Julia Knudsen & Dave Daly

Project: Jefferson County TSP and Madras Refinement Plans

Subject: Existing Condition Inventory of Madras Truck Route and J Street Refinement Plan

---

The Kittelson & Associates, Inc. (KAI) contract for the Jefferson County TSP also includes two tasks not specifically related to the TSP. These tasks are: an alternatives analysis and refinement plan for the Madras Truck Route, and an alternatives analysis and refinement plan for the intersection of J Street/US 97/US 26. The initial analyses conducted for the Madras Truck Route Refinement Plan includes a review of background material and an initial review of alternative alignment options. For the J Street Refinement Plan, this initial analysis includes an assessment of previous studies, traffic operation and safety at the J Street/US 97/US 26 intersections. The following presents the details of these assessments.

Madras Truck Route Refinement Plan

Background

The City of Madras, in conjunction with the Oregon Department of Transportation (ODOT), initiated the Madras Truck Route refinement plan. The purpose of the refinement plan is to reevaluate and update the existing planned Madras Truck Route, taking into account the past and future growth of Madras.

The Madras Truck Route addresses the portions of US 97 and US 26 that run through the City of Madras. US 97 and US 26 are critical elements of Oregon's Statewide Highway Freight System in Central Oregon. These roadways are classified as Statewide Highways and designated Freight Routes in the *1999 Oregon Highway Plan* (Reference 1). These highways serve a high volume of traffic, a large percentage of which is truck traffic. Table 1 shows the average daily traffic and truck percentages on these highways. The data is based on ODOT permanent Automatic Traffic Recorder (ATR) stations located on the highways. The ATR collects various types of data including traffic volume and vehicle classification. ATR Station 16-002 is located on US 26/US 97 at mile post 95.92 between J Street and the City of Madras south city limit. ATR Station 16-006 is located on US 26 at mile post 113.29, just north of NW Elm Lane.

Table 1 Truck Percentage of ADT

Year	Warm Springs US 26 (Station 16-006)		Madras US 26/US 97 (Station 16-002)	
	ADT	Truck Percentage (%)	ADT	Truck Percentage (%)
1999	6,840	13.9	12,484	18.4
2000	6,863	14.1	12,685	18.1
2001	6,838	14.1	12,611	18.1
2002	7,022	14.1	12,811	18.1
2003	7,193	15.9	12,726	14.3
2004	7,125	15.9	13,143	14.3

The data in Table 1 shows that US 26/US 97 serves a high volume of traffic with a particularly high percentage of truck traffic south of downtown Madras (station 16.002). This traffic adversely impacts the safety and congestion in downtown Madras. The Madras Truck Route Refinement Plan will consider a truck by-pass route around downtown Madras to improve traffic operation, truck traffic mobility and safety in downtown the downtown area.

The following sections of the technical memorandum provide a summary of past studies conducted for the truck route and a summary of the operational and safety analyses conducted at key locations on the route.

Past Studies

The Madras Truck Route has been planned and studied in studies performed previously for the City of Madras. In 1998, David Evans & Associates completed the City of Madras TSP. This study identified a new truck route as one of the recommended projects. The proposed route started at the new US 97/US 26 signalized intersection, extended west to connect with Culver Highway 361 at the vicinity of G Street. The route then followed the exiting Culver Highway 361 alignment south beyond the southwest Madras Urban Growth Boundary (UGB). As the Highway 361 veers southwest to Metolius, the truck route would veer southeast on a new alignment and intersected with Colfax Lane, just west of the Colfax Lane/US 97 intersection. At the time of the TSP, the cost estimate of the project was high at around $10.5 million.

Subsequently in 2001, Kittelson & Associates, Inc. (KAI) updated this work in the *City of Madras Comprehensive Plan and Transportation System Plan Update*. In this study, the proposed route was modified to connect with US 97, just north of the Madras UGB, travel southwest through a grade separated interchange with US 26 and tie into Culver Highway 361 on the west side of the Madras downtown core. The route would then continue south on Culver Highway 361 until re-connecting with US 97 at the US 97/US 26-Colfax Lane intersection, south of Madras. A map showing the planned truck route is shown in Figure 1.

Current Concerns

In the time that has passed since the Madras Truck Route alternative alignment was documented in the 2001 Madras TSP update, several issues have come to light that have necessitate a review of the planned alignment. This section highlights some of the major concerns with the alignment.

Since 2001, several new developments have occurred in Madras. Some of the new developments that were approved have impacted the feasibility of the approved truck route alignment. One of the major developments is the new hotel and mixed-use retail development planned and approved for construction at the southwest quadrant of the existing US 97/US 26 North intersection in downtown. The location of this development eliminates the ability to create the northern connection of the truck route as previously planned in the TSP update.

A second concern relates to access management along Culver Highway 361. The route is anticipated to have high volume of truck traffic and relatively high travel speed. It would likely have limited access from adjacent properties to facilitate mobility of the truck traffic and improve safety. However, the section of existing Culver Highway 361 that the planned truck route is to follow is lined with single and multi family homes that have direct access to the highway. Access management along this section of highway to facilitate the truck route would be challenging.

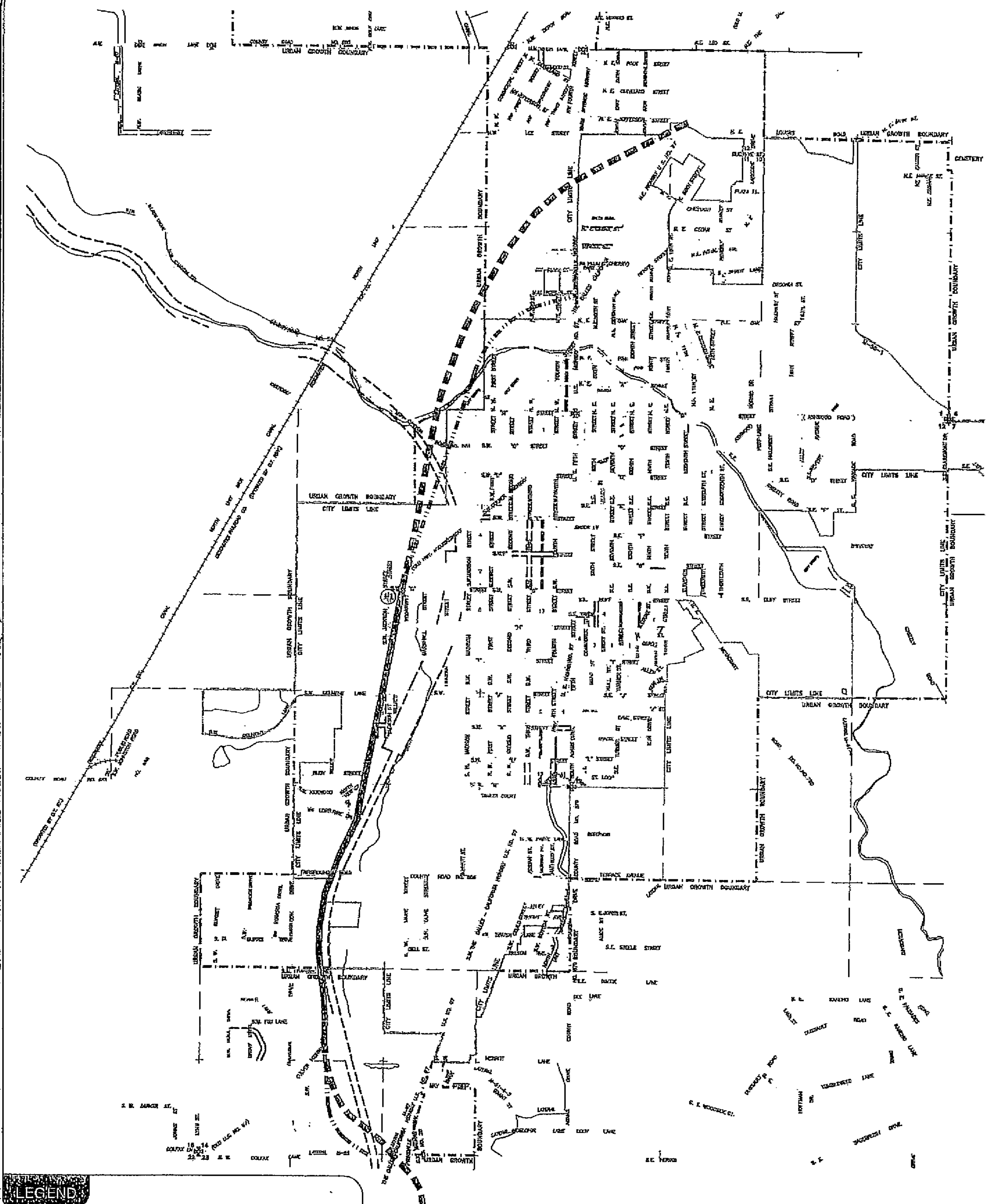
Given these concerns and the high cost of the planned alignment, the purpose of this Refinement Plan is to develop a feasible alternative alignment of the planned truck route that takes into account right-of-way impacts, in-process developments, and current and future transportation operation and safety concerns.

Traffic Operation

Along the planned truck route, there are few key intersections whose traffic operation is critical. With the future grade-separated interchange at the US 97/US 26 North intersection in question due the approved developments in the area, the operation of the signalized intersection at the current US 97/US 26 North intersection becomes critical to the planned truck route.

Currently, as part of ODOT's 2004-2007 Statewide Transportation Improvement Program (STIP) modernization program, the intersection of US 97/US 26 at the north end of downtown Madras is under construction. The intersection improvements identified include realignment of US 97, installing a traffic signal, and modifying access to/from the various businesses in the area.

As part of the planning and development of this concept, David Evans & Associates, Inc. (DEA) conducted a traffic operational analysis for the project in June 2003. To estimate 2025 traffic volumes, DEA applied a 1.66% annual traffic volume growth rate and re-assigned traffic based on the proposed realignment of the highway.



LEGEND

- Existing Infrastructure
- 2001 Madras TSP Udpate Alignment
- 1998 Madras TSP Alignment
- Madras UGB

PLANNED MADRAS TRUCK ROUTE
2001 CITY OF MADRAS TSP UPDATE
MADRAS, OREGON

FIGURE 1

Based on the 2003 traffic counts and the 2025 future traffic volume in the previous DEA work, KAI interpolated the 2025 volume to arrive at 2005 traffic volumes that represent the estimated volume at the intersection of US 97/US 26 North after the completion of the construction. In addition, KAI included the trips that will be generated by three residential developments that have not been constructed but have been approved by the City of Madras in the estimated "after-construction" operational analysis. These developments are; Morning Crest Estates (80 lots remaining in Phases 3, 4 and 5), The Pines at Madras (62 lots remaining in Phases 2, 3 and 4) and Strawberry Heights (122 lots in Phases 4, 5 and 6). Figure 2 shows 2003 and 2025 lane configuration and traffic control from the 2003 DEA study at the various intersections in the area.

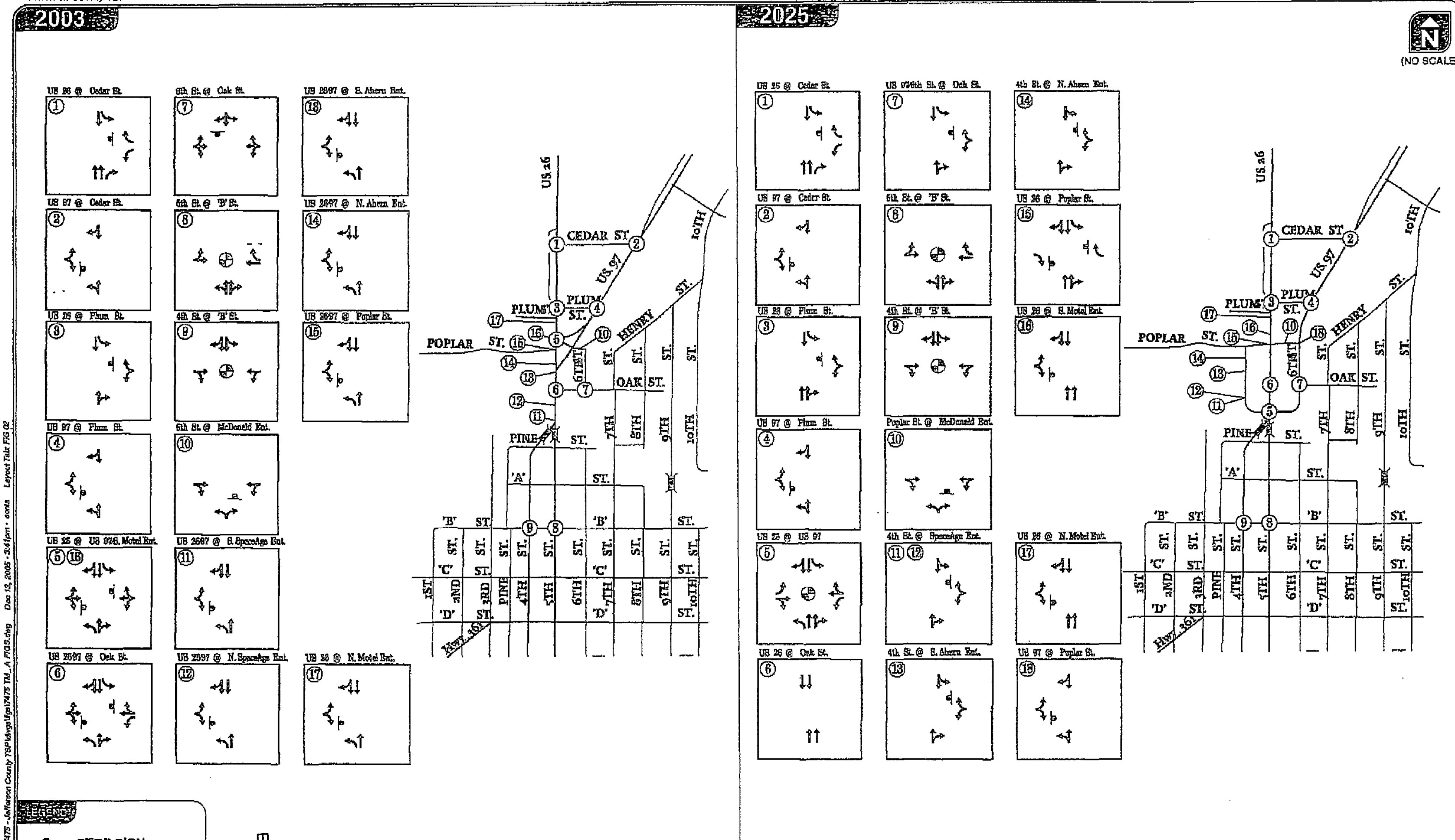
The methodology described in the *2000 Highway Capacity Manual* was used to evaluate the operation of the intersection. The operational guidelines provided by ODOT were incorporated in the analysis, which included factoring the traffic volume to arrive at the 30th highest hour and maintaining the saturation flow rate at 1,800 vehicles/hour. Based on these assumptions, it is estimated that with reconstruction the on opening day intersection will operate at LOS "C" with a volume-to-capacity ratio of 0.73 during the 30th highest hour as a signalized intersection. This level of operation meets the ODOT mobility standard of 0.75 for the intersection, as outlined in the 1999 Oregon Highway Plan.

While the operation of the US 97/US 26 North intersection will meet the operational standard after the realignment project, the proposed intersection modification will not eliminate operation and safety concerns related to truck traffic traveling through downtown Madras on US 26/US 97. Downtown Madras will continue to have numerous traffic signals and low travel speeds that do not facilitate the mobility of freight traffic on US 97/US 26. As such, a truck by-pass around downtown Madras is still needed to reduce the volume of truck traffic and improve the operation of the intersections in downtown, as well as to facilitate truck travel through Madras.

Safety

ODOT conducts safety crash rate analyses on segments of state highways. The analysis compares the incidence of crashes to traffic volumes and highway mileage to estimate the number crashes per million vehicles miles traveled (VMT). Based on three year data from 2002, 2003 and 2004, US 97/US 26 through Madras city limit experienced 1.34 1.86 and 1.46 crashes/million VMT, respectively. This crash rate is higher than the statewide average for similar facilities, which is reported at 1.16, 1.28 and 0.99 for the same three year period, respectively.

A detail review of the crash rate revealed that higher crash rates were reported on the downtown couplet, especially in the southbound direction. The high crash rates begin at the US 97/US 26 North intersection. Based on the ODOT Crash Unit data, there were five crashes reported at the US 97/US 26 North intersection during the five year period from 2000 to 2004. Of the five crashes, four crashes were rear-end collision with property damage only. Of the four rear-end crashes, two crashes each occurred on the southbound and westbound approaches. One of the factors contributing to the crash could be the down-grade on the southbound approach and the high westbound traffic volume. In addition, the intersection of US 97/US 26 is the first traffic control on US 97 as it approaches Madras. This could be one of the factors in the crashes.



Legend

- STOP SIGN
- TRAFFIC SIGNAL

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION PLANNING / TRAFFIC ENGINEERING

2003 AND 2025 LANE CONFIGURATIONS & TRAFFIC CONTROL DEVICES
2003 DEA STUDY
MADRAS, OREGON

FIGURE 2

EXHIBIT TO ORD. 785
33 of 100

Conclusion

US 97/US 26 through downtown Madras continues to carry high volume of traffic with a high truck percentage. The highways are classified as Statewide Highways, which implies that they are highways with statewide significance. The highways, which serve as the main truck route through Central Oregon, are also designated as Freight Routes.

The 1998 City of Madras TSP and the subsequent 2001 TSP Update recommended an alignment for the Madras Truck Route to move truck traffic away from downtown Madras. Based on the current traffic operation analysis and safety review, it can be concluded that the Madras Truck Route is still needed to improve the operation and safety of the US 97/US 26 couplet through downtown Madras.

The north intersection of US 97/US 26 is under construction that will enhance the operation of the intersection and the immediate surrounding area. However, the project will have negligible impact on traffic operation and safety in downtown Madras. The highway through downtown Madras will continue to carry high volumes of truck traffic. As such, a truck route that by-passes downtown area continues to be needed to improve the operation and safety of the transportation system through downtown Madras.

However, the feasibility of the planned alignment of the Madras Truck Route has come into question in recent times. One of the reasons for the concern is the approval of a new development on a parcel that was intended as part of the proposed truck route alignment that eliminated the ability to build the Madras Truck Route, as planned. The other concern with the alignment is access to the truck route from adjacent properties along Culver Highway 361. Currently, there is a high degree of access to and fro this facility. With development of the truck route, it is desirable for access to and from Culver Highway 361 to decrease. These concerns will be addressed in the future technical memorandum as feasibility of various alternatives is evaluated.

In the next steps of this task, KAI will review options to connect to the truck route to US 97 and US 26, north of the downtown couplet. The next steps will also include evaluating alternative alignments of the truck route to minimize impacts on the properties along Culver Highway 361. As part of the review of the alternatives, comments and concerns will be sought from the TAC and the public to help identify future alignment of the Madras Truck Route that meets the needs of the community.

J Street/US 97 Intersection Refinement Plan

Background

J Street is the main east-west connection in the south end of downtown Madras and provides access to the Palisades State Park to the west and new residential developments to the east. On the westside of Madras, J Street is known as Belmont Street and is mostly a two-lane rural roadway with minimal shoulders widths and shallow drainage ditches on both sides of the roadway. To the east of US 97, J Street is a two-lane roadway with urban features, (e.g. bike lanes and sidewalks), and provides access to new residential developments on the east end of the roadway, near McTaggart Road. Figure 3 shows the vicinity of the J Street/US 97/US 26 intersection and lane configuration at key intersections.

In 1998 David Evans & Associates, Inc. prepared the *City of Madras Transportation System Plan (TSP)*. The TSP identified the J Street/US 97/US 26 intersections as one of the areas that would need improvements in the City. Two design alternatives were proposed to provide more distance between the US 97/US 26 southbound and northbound intersections with J Street. The first alternative realigned US 97/US 26 northbound (or 5th Street) to 7th Street, while the second alternative realigned it to 10th Street. The TSP recommends realigning US 97/US 26 northbound to 10th Street as 7th Street is found to have "inadequate geometry to function as a good north-south route".

Subsequently, in 2001, Kittelson & Associates, Inc. (KAI) prepared the *City of Madras Comprehensive Plan and Transportation System Plan Update (TSP update)* to the *1998 Madras TSP*. As part of the update, KAI reviewed the alternatives presented in the 1998 TSP and recommended two additional design alternatives. These alternatives are discussed in the following section.

US 97/US26/J Street Intersection Improvements

J Street forms two closely spaced intersections with the US 97/US 26 couplet. The distance between the southbound and northbound directions of the couplet at this location is approximately 60 feet. The close proximity of these intersections presents traffic operation problems on J Street including high vehicle delay for east-west traffic, queuing problems, and safety concerns. In addition, the US 97/US 26 couplet is two lanes in each direction to the north of J Street and is one lane in each direction to the south. The lane transition occurs through J Street exacerbating the operation and safety concerns at the intersection (see Figure 3).

The 2001 TSP update evaluated two design options for the intersection of J Street/US 97/US 26. Both options involved realignment of the US 97/US 26 couplet (shown in Figure 4). The recommended realignments observed the following design objectives:

- Provide a safe J Street crossing of the US 97 couplet;
- Improve the east-west connectivity within Madras;
- Minimize impacts to local businesses;

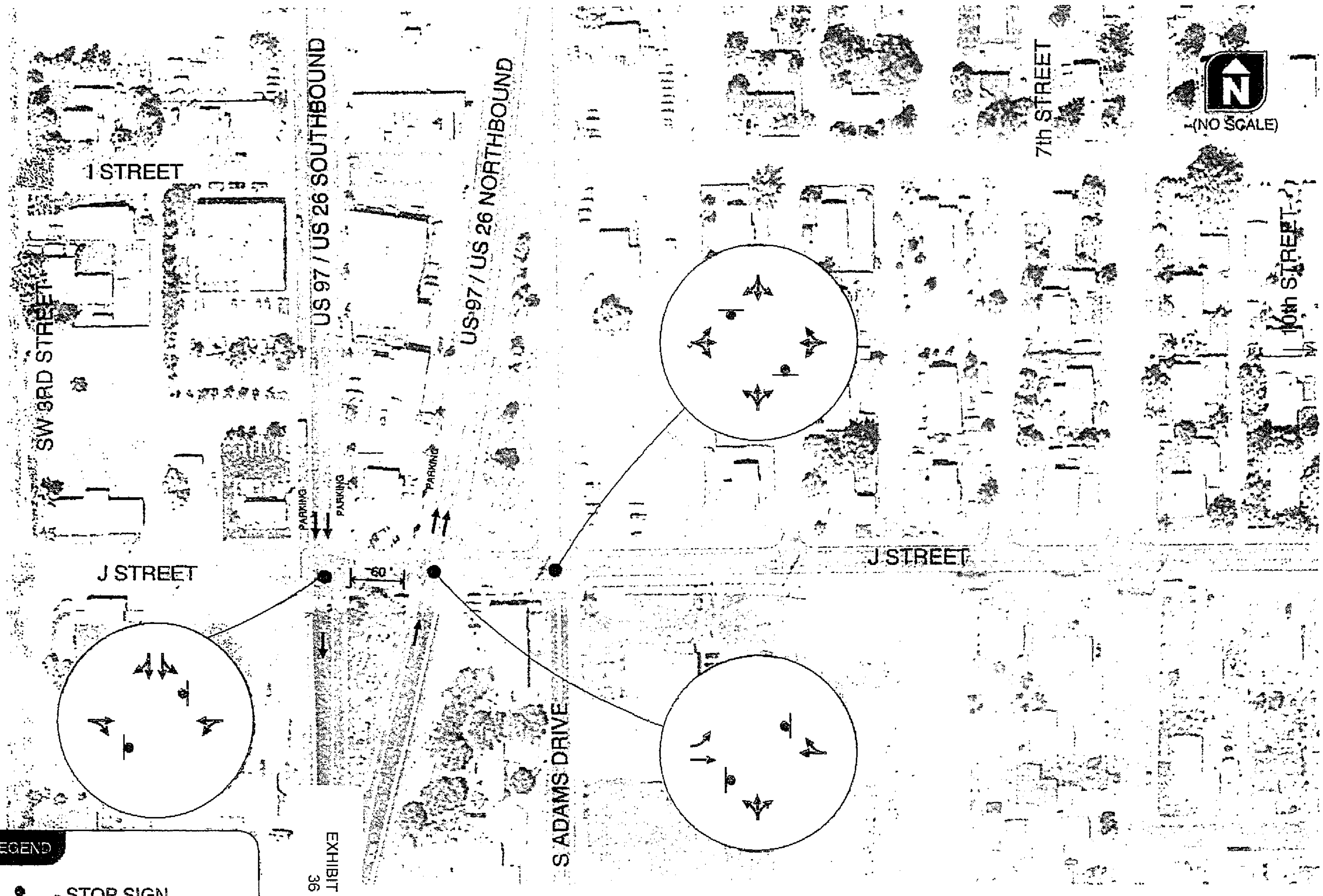


EXHIBIT TO ORD. 785
36 of 100

J STREET / US 97 / US 26 VICINITY MAP & LANE CONFIGURATION
MADRAS, OREGON

FIGURE 3

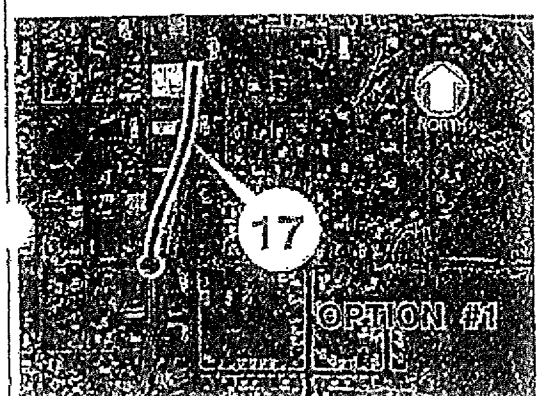
KITTELSON & ASSOCIATES, INC.
TRANSPORTATION PLANNING / TRAFFIC ENGINEERING

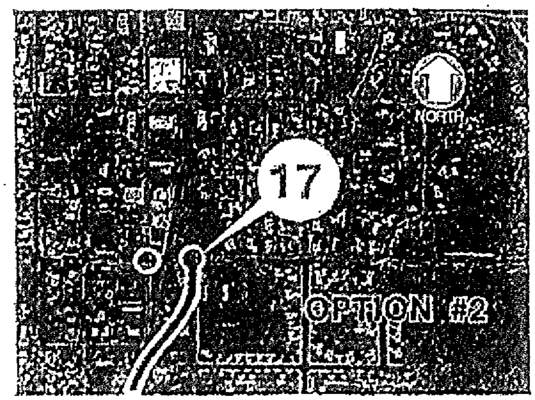
#17	"J" Street/US 97 Intersection Realignment

PURPOSE:
Provides a safe "J" Street crossing of the US 26/US 97 couplet and improves the east-west connectivity within Madras.

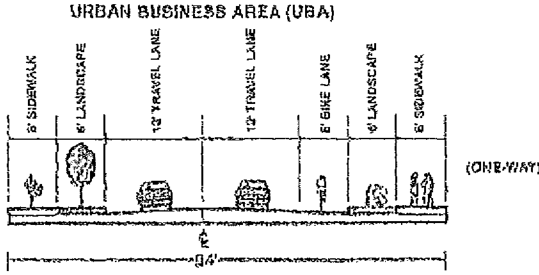
PROJECT DESCRIPTION:
This project has two design options that both require significant right-of-way and will likely impact existing businesses. Design Option #1 shortens the existing one-way couplet by shifting the couplet transition north of "J" Street and signalizing the "J" Street/US 26/US 97 intersection. Design Option #2 lengthens the existing one-way couplet by shifting the couplet transition south of "J" street and signalizing both the 4th Street and 5th Street intersections. Both of these design options will require Adams Drive to be reconfigured.

TIME FRAME: 10-20 years





TYPICAL CROSS-SECTION:



2001 MADRAS TSP UPDATE DESIGN OPTIONS
MADRAS, OREGON

FIGURE 4

- Minimize right-of-way impacts; and
- Create a design that will be compatible with the potential US 97 widening to five lanes south of J Street.

Design Option 1

Design Option 1 shortens the existing one-way couplet by shifting the couplet transition north of J Street and signalizing the J Street/US 97 intersection. With this option, there will be only one intersection of J Street with US 97/US 26, which eliminates the operational hazards of having two closely spaced intersections. However, this design option will impact existing businesses located between the US 97/US 26 couplet just north of J Street.

Design Option 2

Design Option 2 lengthens the existing one-way couplet by shifting the couplet transition south of J Street and signalizing both the southbound and northbound J Street intersections. With this option, the current alignment of Adams Drive will be used for the realigned section of US 97/26. While this option will increase the distance between the existing closely spaced intersections, the new signalized intersections will still be within 200 feet of each other and will require coordination between the signals to reduce queues between them.

Based on qualitative review of the design options, the 2001 TSP update recommends Design Option 2 as a preferred alternative. The main advantage of Design Option 2 over Design Option 1 is that it "allows for future 5-lane section" of the highway.

2005 J Street Refinement Plan

The purpose of the 2005 J Street Refinement Plan is to evaluate the current operational and safety concerns at the J Street/US 97/US 26 intersections, and study the feasibility of the proposed design options. The technical memorandum will focus the evaluation of the operation and safety analysis.

Existing Condition Traffic Operations

Analyses were conducted at three study intersections in the vicinity to evaluate the existing operation of the intersections around the J Street/US 97/US 26 couplet junction. The intersections, selected based on direction provided by the City of Madras and Oregon Department of Transportation (ODOT) staff, are listed below:

- J Street/ Adams Drive,
- J Street/ US 97 Southbound, and
- J Street/ US 97 Northbound

ODOT provided the 24-hour turning movement counts at the study intersections on a mid-week day in October 2005. The weekday p.m. peak hour traffic volume between 4:00 p.m. - 6:00 p.m. was calibrated for the 30th highest hour using the seasonal factor methodology described in the ODOT *Development Review Guideline*.

Based on the *1999 Oregon Highway Plan* (OHP), at signalized intersections on statewide freight highway system, where the speed limit is less than 45 MPH, a volume-to-capacity ratio greater than 0.75 is considered unacceptable. At unsignalized intersections, a volume-to-capacity ratio greater than 0.85 is considered to be unacceptable. The study intersections were evaluated against these standards using the methodology described in the *2000 Highway Capacity Manual.*

Figure 5 shows the results of the operational analysis at the intersections. As shown in the figure, all the intersections meet the OHP standard, except the J Street/US 97/US 26 Southbound intersection. The westbound left-turn movement at the J Street/US 97/US 26 Southbound intersection operates at volume-to-capacity ratio greater than 1.0 during the 30th highest hour.

This is primarily due to a high level of southbound through traffic at the intersection and the lack of adequate gaps for the westbound left-turning vehicles.

Traffic Safety

The traffic safety at J Street's closely-spaced intersections with US 97/US is one of the main concerns in the area. As stated previously, the intersections are 60 feet apart with a high volume of turning traffic, which reduces the capacity of the intersections. The reduction in capacity results in longer queues between the intersections which cannot be accommodated between the closely spaced intersections. This results in an unsafe condition at both intersections, as shown by the crash data presented below.

The most recently five year crash histories of the respective study intersections were reviewed in an effort to identify potential intersection safety issues. Crash records were obtained from the ODOT Crash Unit. Table 2 shows the summary of the crashes.

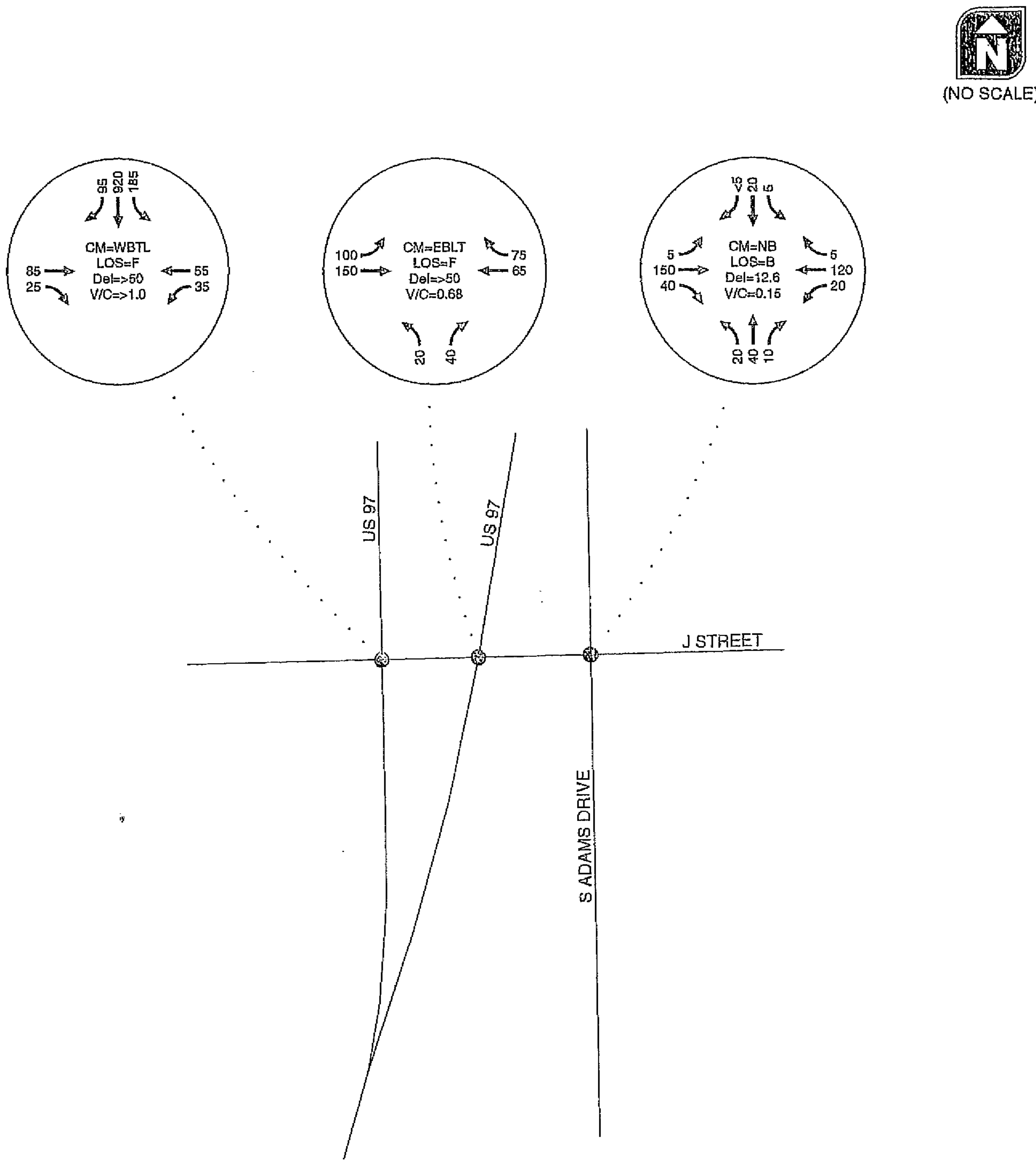
Table 2 Study Intersection Crash Type Summary (2000-2004)

Intersection	Number of Crashes	Collision Type				Severity		
		Rear End	Turning/ Side Swipe	Angle	Other	PDO	Injury	Fatal
J Street/ Adams Drive	4	0	0	4	0	2	2	0
J Street/ US 97 Southbound	6	0	2	3	1	4	2	0
J Street/ US 97 Northbound	7	0	2	4	1	5	2	0

PDO: Property Damage Only

As illustrated in Table 2, of the 17 total crashes at the three intersections, 11 were "angle" crashes. This type of crash occur when vehicles collide while traveling on crossing paths (i.e. one vehicle on a roadway (i.e. north/south) and another vehicle from another roadway (i.e. east/west)). This crash type occurs frequently at intersections where poor alignment or poor sight distance is present, particularly for minor street approaches like the eastbound or westbound approaches at the J Street intersections. These deficiencies were identified in the site visit.

Field observation revealed several other factors impacting the capacity and safety of the intersection:



2005 EXISTING TRAFFIC CONDITIONS
30th HIGHEST HOUR
MADRAS, OREGON

FIGURE 5

- When looking north, the sight distance for the westbound movement at the J Street/US 97/US 26 Southbound intersection is not adequate for safe turning movements. The existing on-street parking on US 97/US 26 southbound blocks the view of oncoming southbound traffic.
- The westbound through movement at the J Street/US 97/US 26 Southbound intersection is not aligned with the opposite receiving lane.
- US 97/US 26 Southbound traffic merges from two lanes to one lane through the J Street intersection.
- US 97/ US 26 Northbound traffic diverges from one lane to two lanes through the J Street intersection.

Planned Improvements

The 2001 TSP update recommends couple of additional improvement projects on J Street. These projects improve the accessibility of J Street to and from different parts of the city. This improved accessibility is anticipated to have additional impact on the operation and safety of the J Street/US 97/US 26 intersections.

J Street – Belmont Street/Culver Highway 361 Intersection

Highlighting the significance of J Street-Belmont Street and Culver Highway 361 in Madras and Jefferson County, the 2001 TSP update recommends signalizing the intersection in the 10-20 year time frame. The signal is also anticipated to provide safe and efficient access to the Madras Truck Route which is planned to follow the existing Culver Highway 361 alignment in this section.

J Street Extension from 10th Street to Grizzly Road

The 2001 TSP update recommends extending J Street east from 10th Street to Grizzly Road as a three-lane roadway with bike lanes and sidewalk. The purpose of the extension is to provide additional accessibility to and from Grizzly Road and an alternate access downtown Madras from the south.

Future Plans of J Street

The City of Madras plans to continue relying on J Street for major east-west connectivity at the south end of downtown Madras. The future plan includes extending J Street to the east to Ashwood Road, beyond its current plan to extend to Grizzly Road. This future extension will provide a direct connection to the Deer Creek Correctional Facility. It will eliminate the need for traffic generated by the development to travel through downtown Madras. To the west, J Street will continue to provide access from downtown Madras to Palisades State Park and future attractions in the area.

Conclusion

J Street serves as the main east-west route in Madras and, in the future, will continue to link the downtown core with future development on the east and west sides of town. It is also intended to serve as a connection between the Deer Creek Correctional Facility and Madras. Subsequently, the traffic volume on J Street is anticipated to increase in the future.

The existing operational and safety analyses show that the intersections of J Street with the US 97/US 26 couplet and Adams Drive continue to be a concern. The westbound left-turn movement at the J Street/US 97/US 26 Southbound intersection is currently operating over capacity. In addition, field observation revealed that the close proximity of the two intersections of J Street with US 97/US 26 is inadequate to accommodate queue storage between the intersections. The crash data and field observations revealed that the intersection alignment and sight distance are deficient and need to be addressed in the future.

The next steps for the project will be to obtain comments from the TAC and public on additional issues with the area. These comments will be taken into consideration as KAI evaluates future mitigation alternatives. The mitigation alternatives analysis will determine ways to improve east-west mobility and safety at the J Street/US 97/US 26 junction in Madras.

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION PLANNING/TRAFFIC ENGINEERING
610 SW ALDER, SUITE 700 • PORTLAND, OR 97205 • (503) 228-5230 • FAX (503) 273-8169

TECHNICAL MEMORANDUM #B and #C

Jefferson County Transportation System Plan

DETERMINATION OF TRANSPORTATION NEEDS AND ALTERNATIVES ANALYSIS
Madras Truck Route Refinement Plan
"J" Street/US 97/US 26 Intersection Realignment Plan

Date: April 25, 2006 **Project #:** 7475

To: Technical Advisory Committee
From: Sagar Onta, P.E.
Elizabeth Wemple, P.E.
Julia Knudsen
Dave Daly

cc:

The Jefferson County Transportation System Plan (TSP) project contract for Kittelson & Associates, Inc. (KAI) includes the development of refinement plans for the Madras Truck Route and the "J" Street/US 97/US 26 intersection improvement. KAI conducted an existing condition analysis as part of the refinement plan development and presented the results in Technical Memorandum "A." This technical memorandum evaluates the future needs of the project as well as the transportation alternatives available to address those needs. The analysis is based on the forecasted traffic volumes and input received from the public and City, County and ODOT staff.

It should be noted that most of the information provided in this memorandum was also presented in Technical Memoranda #4 and #5 of the Jefferson County TSP project. The information is duplicated in this document to provide context for the analysis.

Determination of Transportation Needs

FORECAST FUTURE TRAFFIC VOLUME

The first step in both the long-term transportation analysis of the Madras Truck Route and the "J" Street/US 97/US 26 intersection analysis is to forecast the 20-year traffic volume growth in the area. Two types of traffic volume are developed for this purpose: average daily traffic (ADT) volume and 30th highest hour traffic volume. The ADT forecast provides traffic volumes for US

97, US 26 through downtown Madras and on Highway 361. It is a planning-level methodology that gauges the operation of the roadways on a broad-level. The 30th highest hour forecast provides a detailed intersection level analysis at the "J" Street/US 97/US 26 intersection.

The 20-year traffic volume forecast was based on the comparison of the forecasts obtained from three methodologies. The following sections describe the methodologies used and compare the results for different highway sections. The methodologies are:

1. Historical Traffic Growth
2. ODOT Future Volume Forecast
3. Updated Population Forecast

Historical Traffic Growth

ODOT's Transportation Planning Analysis Unit (TPAU) uses several models and methodologies to forecast traffic volume, depending on the characteristics of the roadway, the surrounding land-uses, and several socio-economic aspects of the community. TPAU recommends using the historical traffic growth as the methodology to forecast traffic in rural areas of the state. Therefore, historical ADT volumes were obtained from ODOT volume tables for years 1993 and 2004. Annual growth rates based on this data were calculated on US 97 and US 26 through downtown Madras and on Highway 361 and applied to year 2004 ADT to estimate the year 2025 ADT. The comparison section of this document evaluates the historic growth in traffic against other methodologies described below.

ODOT Future Volume Forecast

The second methodology considered ODOT's Future Volume forecasts. TPAU develops the future volumes forecast by reviewing historical volume trends, local and regional land-use and development trends, and projecting future volumes by assuming similar growth patterns will continue in the future. At the time this memorandum was prepared, ODOT had projected ADT volumes to year 2024 on the state highways within Jefferson County. The yearly average growth rate for US 97 and US 26 through downtown Madras and on Highway 361 was applied to the year 2004 ADT to estimate the year 2025 ADT for the state highways.

Updated Population Forecast

The third methodology used population growth as the surrogate for traffic growth. The 1990 and 2000 population census data and the ADT volume recorded for those years at the two permanent Automatic Traffic Recorder (ATR) stations in the County were analyzed to verify the relation between population and traffic volume growth. The ATR collects various types of data, including traffic volume and vehicle classification. ATR Station 16-002 is located on US 26/US 97 at mile post 95.92 between "J" Street and the Madras south city limit. ATR Station 16-006 is located on US 26 at milepost 113.29, just north of NW Elm Lane. Table 1 shows the historic growth in population and ADT.

Table 1 Historic Population and Traffic Volume Growth

Year	City of Madras Population Census	ADT Volumes	
		ATR 16-002	ATR 16-005
1990	3,443	9,197	4,878
2000	5,078	12,685	6,863
Annual Growth Rate	4.7%	3.8%	4.1%

As shown in Table 1, the traffic growth rate on state highways is slightly lower than the City of Madras population growth rate. It can be concluded that the population growth is a relatively conservative surrogate for traffic growth in the City.

The Office of Economic Analysis (OEA) (Reference 1) provides population forecasts on the state and county, but not for cities. The majority of county populations live in cities, which tend to grow at a faster rate than the rest of the county. Consequently, it is important to forecast the population of the cities as accurately as possible.

Developing accurate population forecasts for the cities requires a detailed review of recent trends and the potential for future growth in the area. Due to limited resources, a detailed forecast was not conducted for this project. However, in an effort to account for local development trends, the OEA population forecast was updated based on the impact of the Deer Creek Correctional Facility and certified population counts for the Cities provided by Portland State University.

The Deer Creek Correctional Facility is currently under construction and expected to be fully operational and occupied by 2015. Based on discussions with Jefferson County and City of Madras staff, this facility is forecasted to generate approximately 620 jobs in the area and is anticipated to increase the population by approximately 1,550 people. To account for this impact in population, 775 people each were added to the OEA forecast for 2010 and 2015 to arrive at updated 2010 and 2015 population estimates for the county.

The updated county population forecast was allocated to various incorporated cities and rural areas based on data obtained from the Population Research Center at Portland State University (PSU) (Reference 2). PSU maintains the population data for all the counties and cities in Oregon. It provides yearly certified population estimates for all cities and counties, but does not forecast the population for the jurisdictions. The updated county population forecast was proportionally distributed to the cities and unincorporated areas based on the PSU population data. The portion of the Jefferson County population allocated to the City of Madras was increased by one percentage point every five years to account for higher growth in the City than the rest of the County. The portion for other incorporated and un-incorporated cities were maintained at the current levels. Table 2 shows the updated population forecasts from 1990 to 2025 for Jefferson County, City of Madras, City of Culver, City of Metolius, and the unincorporated areas.

As shown in Table 2, the Jefferson County population is anticipated to grow at 2.37 percent annually to reach approximately 30,198 people in 2025. In addition, the City of Madras is anticipated to grow at a higher annual growth rate of 3.37 percent to reach approximately 9,361 people in 2025. The updated population growth rates identified used to forecast traffic growth on US 97/US 26 through downtown Madras and on Highway 361. The City's growth rates were used for locations inside the City UGB and the County's growth rates were used for locations outside the City UGB.

Table 2 Year 1990 to 2025 Updated Population Forecasts

Year	Jefferson County	Madras	Culver	Metolius	Unincorporated[1]		
					Warm Springs	Crooked River Ranch	Rest of County
1990	13,676	3,443	570	450	2,764	3,409	3,040
2000	19,009	5,078	802	729	3,720	4,588	4,092
2005	20,491	5,592	1,019	804	3,956	4,878	4,351
2010	22,943	6,424	1,147	918	4,359	5,506	4,589
2015	25,686	7,452	1,285	1,028	4,882	6,167	4,882
2020	27,815	8,345	1,391	1,113	5,285	6,676	5,007
2025	30,198	9,361	1,510	1,208	5,738	7,248	5,134
Annual Growth Rate	2.37%	3.37%	2.41%	2.51%	2.25%	2.43%	0.90%

NOTE: The population forecast for the City of Madras does not take into consideration the relatively high number of building permits issued by the City in the last year or so.

FORECASTED TRAFFIC GROWTH COMPARISONS

The three methodologies described above were used on the 2004 State Highway ADT (obtained from ODOT) to arrive at the 2025 forecasted traffic volume. Table 3 shows the forecasted growth in traffic volume at major locations on US 97 and US 26 through downtown Madras and on Highway 361 in the Madras area.

As shown in Table 3, the forecasted traffic volume resulting from the three methodologies varies significantly at some locations. In general, the historical growth rate and ODOT future volume methodologies produced comparable future traffic volumes, but neither methodology was consistently higher or lower than the other. On the other hand, the updated population forecast methodology consistently produced relatively high forecasts for most of the locations analyzed. This is the result of using a higher growth rate for locations inside the City of Madras UGB. The updated population forecast at MP 97.19 on US 97 and MP 2.26 on Culver Highway 361 results in a lower traffic volume forecast than the other methodologies, as it uses lower population growth rate of the County.

After discussions with City, Jefferson County, and ODOT staff, it was concluded that traffic within the City of Madras UGB, US 97/US 26 and Culver Highway 361 through Madras serve a higher portion of local trips than regional trips. It is anticipated that the traffic growth in the City will closely follow the rapid population growth. Hence, the updated population growth rate for Madras (3.37 – percent) is assumed to provide better estimate of traffic growth within the City's UGB as compared to other methodologies.

US 97 south of Madras serves traffic from Madras and the surrounding areas, as well as regional traffic to and from Deschutes County. Of the three methodologies, the updated population forecast for Jefferson County (2.37 percent) provides an annual growth rate that is anticipated to represent the future traffic volume growth on the corridor.

Table 3 2025 Forecasted Traffic Volumes

Highway	Location	Mile Post	2004 ADT	2025 Forecasted ADT: Historic Growth	2025 Forecasted ADT: ODOT Future Volume	2025 Forecasted ADT: Updated Population Forecast
US97 (US 26)	North City Limit of Madras	91.44	6300	7,700	7,800	10,800
	0.10 mile south of US 26	92.04	20,800	31,300	29,700	35,500
	0.10 mile north of G Street	92.77S	11,600	17,500	14,400	19,800
	0.10 mile north of Buff Street	92.75N	11,900	11,700	17,400	20,200
	0.01 mile south of J Street	93.05 S/N	9600/ 8500	13,200/ 12,200	11,300 / 10,700	16,400/ 14,500
	Madras ATR, 0.028 mile north of US 26	96.9	13,100	19,900	18,200	22,400
	0.01 mile south of US 26	97.19	12,000	21,500	16,500	18,000*
Culver Highway 361	0.01 mile west of US 26 and US 97 (eastbound)	0.06	4000	5,500	5,800	6,800
	0.01 mile south of Belmont Lane	0.89	3,900	6,700	6,400	6,700
	0.01 mile northeast of Colfax Lane	2.26	3,400	3,800	5,700	5,400*

* used County population growth rate

YEAR 2025 30TH HIGHEST HOUR TRAFFIC

The year 2025 30th highest hour traffic volumes were also based on the growth rates described above. The growth rates were applied to the year 2005 30th highest hour turning movement volumes at the "J" Street/US 97/US 26 intersection, US 97/US 26 North and South intersections that were developed using the ODOT seasonal trend methodology. This resulted in the estimated year 2025 30th highest hour turning movement volumes, which were used to conduct year 2025 future intersection operations analysis.

FUTURE TRAFFIC OPERATIONS

Roadway Operations

Roadway capacity is described in terms of vehicles per hour. Several parameters influence the capacity calculation, including roadway design speed, lane width, type of terrain, shoulder width, percent of heavy vehicles on the roadway, density of access points (number of accesses/mile), traffic volume on minor streets. Default assumptions of the roadway characteristics were applied to develop a planning level estimate of future roadway traffic operations, as noted in Table 4, thereby yielding thresholds for individual levels of service according to ADT (also shown in Table 4).

Generalized LOS was estimated for the various roadway segments using the forecast 2025 ADT and the LOS thresholds shown in Table 4. The results show that US 97/US 26 is forecasted to operate at LOS "F" through downtown Madras, while Culver Highway 361 is forecasted to operate at LOS "C," if no improvements are made to the current facilities. This is mainly due to the anticipated high traffic volume growth on these sections of the state highway. *Appendix "A" provides the growth rate worksheet and planning level operation for the roadways.*

Table 4 Typical[1] Two-Lane Highway Level-Of-Service Thresholds

Level-of-Service	ADT Threshold
	City of Madras
A	Less than 7,650
B	7,651 to 12,510
C	12,511 to 18,060
D	18,061 to 23,980
E	23,981 to 29,310
F	Greater than 29,310

[1]Assumptions: Lane width = 12 ft., shoulder width = 4 ft., Directional split = 50/50, PHF = 0.85, HV% = 18%, Recreational Vehicles = 6%, Terrain = Level, Free Flow Speed = 45 mph.

Intersection Operations

Year 2025 intersection traffic operation analyses were conducted at the "J" Street/US 97/US 26 intersections using forecasted 30th highest hour turning movement volumes. All the operational analyses described in this report were performed in accordance with the procedures stated in the *2000 Highway Capacity Manual* (Reference 3). These analyses used a saturation flow rate of 1,800 vehicles/hour and the peak hour factors of 0.85 for local/ collector minor street approaches and 0.95 for major arterial approaches. *Appendix "B" provides the description of level-of-service and its criteria.*

Per the *2003 Highway Design Manual* (Reference 4), the mobility standard for the critical movement at an unsignalized intersection is 0.80 volume-to-capacity ratio for intersections inside of the urban growth boundary. For signalized intersection on a statewide freight route within the urban growth boundary, with speed limit less than 45 mph, the volume-to-capacity ratio standard is 0.70. Table 5 shows the 30th highest hour level of service and volume-to-capacity ratio calculated for each study intersection.

Table 5 2025 Operational Analysis Results Under Existing Geometry

Intersection	Juridiction	Mobility Standard (volume to capacity)	Level-of-Service	Volume - to - capacity
US-26/US 97-North	State	0.70	F	**>1.0**
Culver Hwy-SR 361/US 97	State	0.70	C	0.10
J Street/US 97 Northbound	City	0.80	F	**>1.0**
J Street/US 97 Southbound	City	0.80	F	**>1.0**
J Street/Adams Drive	City	0.80	C	0.17
US-26/US 97-South	State	0.80	F	**>1.0**

As shown in Table 5, all of the study intersections are forecast operate acceptably during the 30th highest hour, except at the four locations discussed below.

- The US 26/US 97 North intersection is estimated to operate at LOS "F" under year 2025 traffic conditions. This is due to high turning movement volumes, such as the northbound right-turn and westbound left-turn. The eastbound approach at this intersection experiences high delay as a result of the low percentage of green-time allocated to the approach. Other approaches of the intersection are allocated higher percentages of green time to accommodate their high traffic volumes.
- "J" Street/US 97 Southbound and J Street/US 97 Northbound are forecast to operate at LOS "F," due to high turning movement volumes and the close proximity of these intersections. These intersections serve a high number of residential traffic traveling to the old and new residential areas on the southeast and southwest areas of Madras. Alternative designs and configurations for these intersections will be studied in the next stages of this project.
- The US 97/US 26 South intersection is also anticipated to operate at LOS "F" and over capacity during the 30th highest hour period in the year 2025, if no improvements are made to the intersection. The intersection serves a high level of turning movements between the two highways. The high traffic volume on US 97 at the intersection does not provide adequate gaps in traffic for the eastbound left-turn movement to make its maneuvers. This will result in poor traffic operation for the movement.

Mitigations to improve traffic operations at these intersections will be identified in the next stage of this project. *Appendix "C" provides the level-of-service worksheets for the 30th highest hour for the year 2025 traffic conditions operational analysis.*

FUTURE SAFETY NEEDS

The safety of the roadway will continue to be a major concern in the future as the traffic volumes through downtown Madras continue to increase. Under 2005 existing conditions, US 97/US 26 in Madras were identified as having high crash rates in comparison to statewide averages for similar type of facility, based on the review of ODOT crash rates on state highways. The high crash rate in downtown Madras could be attributed to the high number of driveways and truck traffic on US 97/US 26. Because of the increase traffic volume, the roadway is expected to continue to have high crash rates under future conditions.

Similarly, a review of the five year crash history (from 2000-2004) at the "J" Street/US 97 Southbound and "J" Street/US 97 Northbound intersections revealed that there were six and seven crashes reported, respectively. The majority of the crashes were angle-type collisions. With the anticipated 70 percent increase in traffic volume over the next 20 years, the number and severity of crashes at the intersections is likely to increase in the future if no improvements are conducted at the intersection.

CONCLUSION

Based on the analysis presented above, it can be determined that US 97/US 26 through downtown Madras is anticipated to operate unacceptably in 20 years if no improvements are made to the roadways. The traffic volume on the highway is estimated to increase by approximately 70 percent at the current pace of population growth in the area. This increase in traffic volume will adversely impact the operation and safety of the roadway. In addition, the analysis also revealed that Culver Highway 361 is anticipated to operate under capacity in 20 years even after applying the annual growth rate assumed on US 97/US 26.

The next section of this memorandum provides evaluates the transportation alternatives that provide solutions to the needs identified above.

Development of Transportation Alternatives

Kittelson & Associates, Inc (KAI) is contracted to conduct evaluation of transportation alternatives for the Madras Truck Route and the "J" Street/US 97/US 26 intersection improvements. The following section provides the summary of the evaluation.

Madras Truck Route Alternatives

Based on the existing and future operational and safety analysis, it was determined that at the current pace of traffic growth, US 97/US 26 through downtown Madras is anticipated to carry a high volume of traffic by 2025. The increase in traffic volume in downtown Madras will deteriorate the operation and safety of the roadway. As US 97 and US 26 are classified as highways of statewide significance, the mobility of the vehicles on the highway is important to the economic viability of the state.

Transportation alternatives for the Madras Truck Route were developed and evaluated to address transportation needs based on the information received from two sources: 1) comments received from the public and input from County, ODOT and City staff; and 2) the technical analysis of traffic operations and safety on the roadway.

The Madras Truck Route provides alternate access for regional traffic passing through Madras, thus reducing traffic volume and the percentage of truck traffic through downtown. The alternate access can be provided on existing roadways or on a new roadway that by-passes the downtown area. Past studies conducted on a truck by-pass alternative, upon considering the existing roadway network, proposed development impact, and physical constraints, indicate that a feasible alternative is to provide a truck by-pass that generally follow the existing Culver Highway 361 alignment.

The Madras Truck Route is anticipated to be limited-access expressway with a median barrier to improve the mobility of vehicles. It is planned to have four 12-foot travel lanes and a 14-foot median, as well as 10 feet of landscaping on both sides and a 12-foot multi-use path on one side (See Figure 1 for detail cross-section). Access to the expressway will be provided via right-in/right-out driveways and full-access traffic signals at the intersections with Fairground Road, Belmont Street and C Street.

The Madras Truck Route, as it is proposed at this time, has various advantages and disadvantages, which are highlighted below.

Advantages

- Reduces regular and truck traffic through downtown Madras, thus improving safety and mobility for local traffic and pedestrians in downtown Madras;
- Increases the mobility of regional truck traffic by providing an access-controlled facility
- Utilizes existing right-of-way of Culver Highway 361 for majority of the alignment
- Minimal impact on land outside the urban growth boundary, which will require a goal exception from Department of Land Conservation and Development (DLCD)

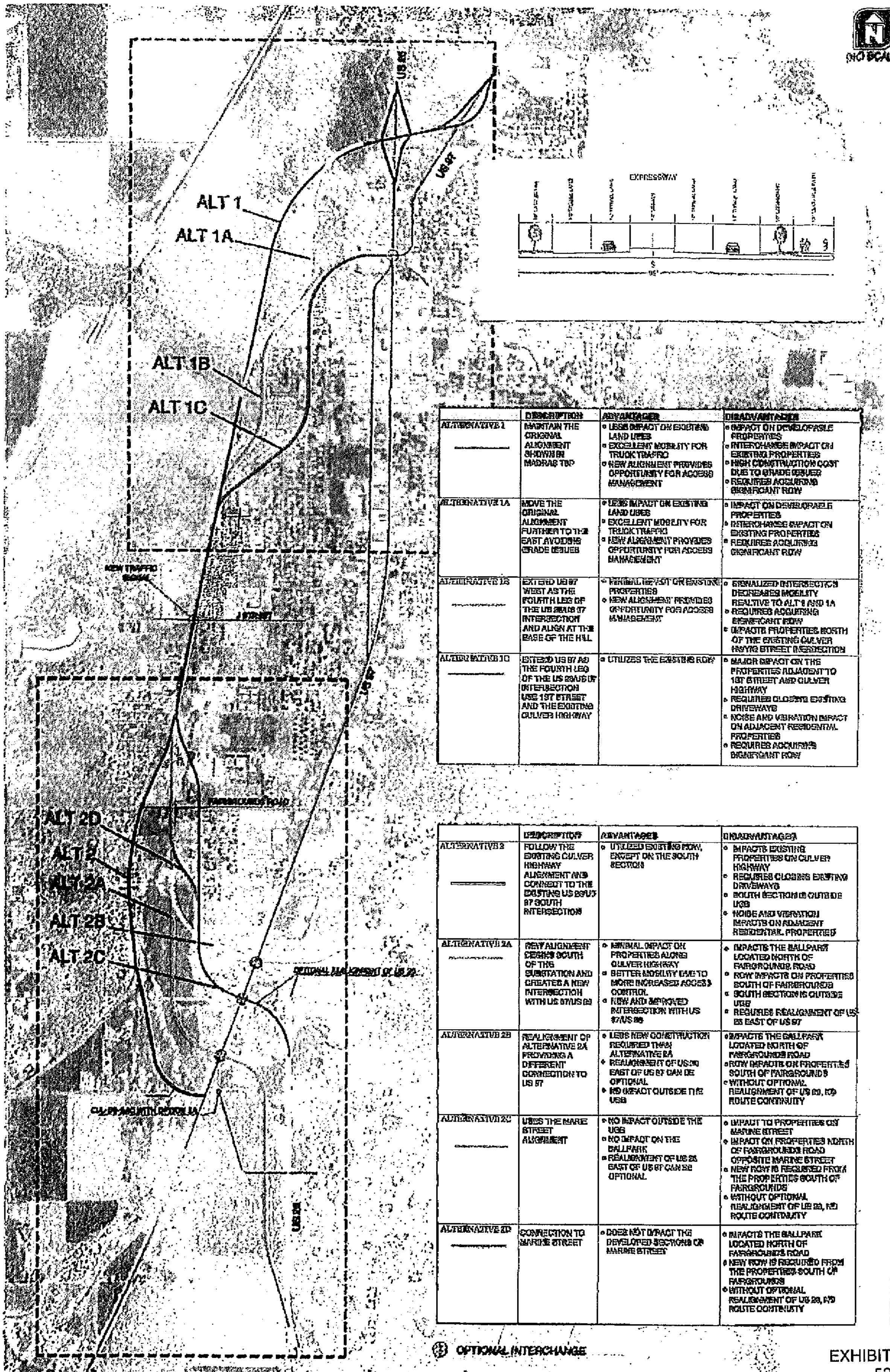
Disadvantage

- Impacts access to and from existing properties along Culver Highway. Alternate access, such as a frontage road, should be provided to the affected properties
- Changes the characteristic of Culver Highway from rural/semi-urban highway to higher speed, limited-access expressway
- Requires acquisition of significant right-of-way along Culver Highway

The *1998 Madras Transportation System Plan* (Reference 5) and the 2001 update of the plan (Reference 6) included alignment options for the potential truck route. The proposed alignment was reviewed for its impact on adjacent land-uses and approved developments. Three new alignment options were proposed for the northern connection of the by-pass and four new alignment options were proposed for the southern connection. Figure 1 shows the alternative alignments and provides the advantages and disadvantages of each.

According to the City staff, the Alternative 1C and Alternative 2 concepts appear to have the most advantages. Alternative 1C connects to the US 97/US 26 North intersection as a west approach of the existing intersection. It then follows 1st Street and the existing Culver Highway alignment. Alternative 2 follows the existing alignment of Culver Highway until SW Loafers Lane, after which it diverts to intersect with US 97 near the existing US 97/US 26 South intersection. The new intersection with US 97 would be a grade-separated interchange.

The planning-level cost estimate for Alternative 1C, improvement to the existing alignment of Culver Highway 361 and Alternative 2, is approximately \$7.5 million, \$8.75 million and \$3 million respectively. Total estimated cost is \$19.25 million, without consideration for right of way acquisition, impacts to adjacent properties, or the cost of interchanges.



	DESCRIPTION	ADVANTAGES	DISADVANTAGES
ALTERNATIVE 1	MAINTAIN THE ORIGINAL ALIGNMENT SHOWN IN MADRAS TSP	• LESS IMPACT ON EXISTING LAND USES • EXCELLENT MOBILITY FOR TRUCK TRAFFIC • NEW ALIGNMENT PROVIDES OPPORTUNITY FOR ACCESS MANAGEMENT	• IMPACT ON DEVELOPABLE PROPERTIES • INTERCHANGE IMPACT ON EXISTING PROPERTIES • HIGH CONSTRUCTION COST DUE TO GRADE ISSUES • REQUIRES ACQUIRING SIGNIFICANT ROW
ALTERNATIVE 1A	MOVE THE ORIGINAL ALIGNMENT FURTHER TO THE EAST AVOIDING GRADE ISSUES	• LESS IMPACT ON EXISTING LAND USES • EXCELLENT MOBILITY FOR TRUCK TRAFFIC • NEW ALIGNMENT PROVIDES OPPORTUNITY FOR ACCESS MANAGEMENT	• IMPACT ON DEVELOPABLE PROPERTIES • INTERCHANGE IMPACT ON EXISTING PROPERTIES • REQUIRES ACQUIRING SIGNIFICANT ROW
ALTERNATIVE 1B	EXTEND US 97 WEST AS THE FOURTH LEG OF THE US 26/US 97 INTERSECTION AND ALIGN AT THE BASE OF THE HILL	• MINIMAL IMPACT ON EXISTING PROPERTIES • NEW ALIGNMENT PROVIDES OPPORTUNITY FOR ACCESS MANAGEMENT	• SIGNALIZED INTERSECTION DECREASES MOBILITY REALTIVE TO ALT 1 AND 1A • REQUIRES ACQUIRING SIGNIFICANT ROW • IMPACTS PROPERTIES NORTH OF THE EXISTING CULVER HWY/1ST STREET INTERSECTION
ALTERNATIVE 1C	EXTEND US 97 AS THE FOURTH LEG OF THE US 26/US 97 INTERSECTION USE 1ST STREET AND THE EXISTING CULVER HIGHWAY	• UTILIZES THE EXISTING ROW	• MAJOR IMPACT ON THE PROPERTIES ADJACENT TO 1ST STREET AND CULVER HIGHWAY • REQUIRES CLOSING EXISTING DRIVEWAYS • NOISE AND VIBRATION IMPACT ON ADJACENT RESIDENTIAL PROPERTIES • REQUIRES ACQUIRING SIGNIFICANT ROW

	DESCRIPTION	ADVANTAGES	DISADVANTAGES
ALTERNATIVE 2	FOLLOW THE EXISTING CULVER HIGHWAY ALIGNMENT AND CONNECT TO THE EXISTING US 26/US 97 SOUTH INTERSECTION	• UTILIZED EXISTING ROW, EXCEPT ON THE SOUTH SECTION	• IMPACTS EXISTING PROPERTIES ON CULVER HIGHWAY • REQUIRES CLOSING EXISTING DRIVEWAYS • SOUTH SECTION IS OUTSIDE UGB • NOISE AND VIBRATION IMPACTS ON ADJACENT RESIDENTIAL PROPERTIES
ALTERNATIVE 2A	NEW ALIGNMENT BEGINS SOUTH OF THE SUBSTATION AND CREATES A NEW INTERSECTION WITH US 97/US 26	• MINIMAL IMPACT ON PROPERTIES ALONG CULVER HIGHWAY • BETTER MOBILITY DUE TO MORE INCREASED ACCESS CONTROL • NEW AND IMPROVED INTERSECTION WITH US 97/US 26	• IMPACTS THE BALLPARK LOCATED NORTH OF FAIRGROUNDS ROAD • ROW IMPACTS ON PROPERTIES SOUTH OF FAIRGROUNDS • SOUTH SECTION IS OUTSIDE UGB • REQUIRES REALIGNMENT OF US 26 EAST OF US 97
ALTERNATIVE 2B	REALIGNMENT OF ALTERNATIVE 2A PROVIDING A DIFFERENT CONNECTION TO US 97	• LESS NEW CONSTRUCTION REQUIRED THAN ALTERNATIVE 2A • REALIGNMENT OF US 26 EAST OF US 97 CAN BE OPTIONAL • NO IMPACT OUTSIDE THE UGB	• IMPACTS THE BALLPARK LOCATED NORTH OF FAIRGROUNDS ROAD • ROW IMPACTS ON PROPERTIES SOUTH OF FAIRGROUNDS • WITHOUT OPTIONAL REALIGNMENT OF US 26, NO ROUTE CONTINUITY
ALTERNATIVE 2C	USES THE MARINE STREET ALIGNMENT	• NO IMPACT OUTSIDE THE UGB • NO IMPACT ON THE BALLPARK • REALIGNMENT OF US 26 EAST OF US 97 CAN BE OPTIONAL	• IMPACT TO PROPERTIES ON MARINE STREET • IMPACT ON PROPERTIES NORTH OF FAIRGROUNDS ROAD OPPOSITE MARINE STREET • NEW ROW IS REQUIRED FROM THE PROPERTIES SOUTH OF FAIRGROUNDS • WITHOUT OPTIONAL REALIGNMENT OF US 26, NO ROUTE CONTINUITY
ALTERNATIVE 2D	CONNECTION TO MARINE STREET	• DOES NOT IMPACT THE DEVELOPED SECTIONS OF MARINE STREET	• IMPACTS THE BALLPARK LOCATED NORTH OF FAIRGROUNDS ROAD • NEW ROW IS REQUIRED FROM THE PROPERTIES SOUTH OF FAIRGROUNDS • WITHOUT OPTIONAL REALIGNMENT OF US 26, NO ROUTE CONTINUITY

OPTIONAL INTERCHANGE

EXHIBIT TO ORD. 785
52 of 100

MADRAS TRUCK ROUTE ALTERNATIVES
MADRAS, OREGON

FIGURE 1

Evaluation of the Madras Truck Route/US 97/US 26 North Intersection

Alternative 1C connects to the existing US 97/US 26 North intersection as the fourth leg of the intersection, which currently serves a small retail development. The impact of the truck route on the turning movements at the intersection was determined after reviewing the existing turning movement patterns. From the north, approximately 55 percent of the existing westbound left-turning traffic and 30 percent of the southbound through traffic was assigned to the new truck route. From the south, 55 percent of the northbound right-turn volume and 30 percent of the northbound through volume is estimated to use the new truck route. With the lane configuration listed below, the intersection is anticipated to operate at volume to capacity ratio of 0.70 in 2025 traffic condition.

- Northbound: left-turn, through, and through-right lanes
- Southbound: left-turn, dual through, and right-turn lanes
- Eastbound: dual left-turn, through, and through right-turn lanes
- Westbound: dual left-turn, through, and through right-turn lanes

The delay incurred at a traffic signal will increase as traffic volume increases. Therefore, it is recommended to keep the option open to provide an interchange at the Madras Truck Route/US 97/US 26 North intersection in the future. An interchange will provide the highest degree of mobility and route continuity; it is anticipated to enhance the economic benefit to the region by reducing delay in transporting goods and services. *Appendix "D" provides the level-of-service worksheets showing the operation of the intersection.*

Evaluation of the Madras Truck Route/US 97/US 26 South Intersection

The growth in traffic on US 97 and US 26 south of Madras is anticipated to deteriorate the operation of the existing US 97/US 26 South intersection. Without the Madras Truck Route, the intersection will require a traffic signal to meet the ODOT mobility standard in 2025. The intersection is anticipated to operate at a volume-to-capacity ratio of 0.67 in 2025 traffic condition with a traffic signal installed. In addition, the Madras Truck Route is anticipated to connect to US 97 in the vicinity of the intersection. With the connection, the intersection area would need to be redesigned to an interchange to provide the mobility for truck traffic. *Appendix "D" also provides the level-of-service worksheet showing the operation of the intersection.*

Next Steps

The next steps required to formalize the Madras Truck Route include conducting a further detail analysis and a feasibility study to determine the full impact of the proposed truck by-pass on adjacent properties and identify the preferred alternative. The analysis should consider other potential solutions to mitigate the operation and safety of US 97/US 26 through downtown. Options include optimizing the operation of US 97/US 26 through downtown Madras and/or adding capacity to the existing roadway. The study should include a National Environmental Policy Act (NEPA) analysis and appropriate environmental assessments of the alternative alignments of the future US 97 Truck Bypass before a final preferred alternative alignment is chosen.

"J" Street/US 97/US 26 Intersection Improvement Alternatives

The "J" Street/US 97/US 26 intersections (both northbound and southbound) currently serve approximately 22,000 ADT. During the weekday p.m. peak hour the intersections are currently operating with volume-to-capacity ratios of 0.68 and greater than 1.0 at the northbound and southbound intersections, respectively. The intersections are anticipated to serve approximately 36,000 ADT in 2025 and operate at volume-to-capacity ratios greater than 1.0 if no improvements are made to the intersections. Various alternatives were analyzed to improve the operation and safety of the intersection. The following sections describe the alternatives in detail.

Alternative Solution A: Install Traffic Signal at the Current Intersection Location

One option available to improve the operation of the "J" Street/US 97/US 26 intersections is to install traffic signals at the northbound and southbound intersections. A signal warrant analysis conducted based on the guidelines provided in the Manual of Uniform Traffic Control Device (MUTCD) (Reference 7) showed that both the intersections meet the three major signal warrants; Warrant #1 Eighth-Highest Hour, Warrant #2 Fourth-Highest Hour and Warrant #3 Peak Hour. *Appendix "E" provides the signal warrant worksheets.*

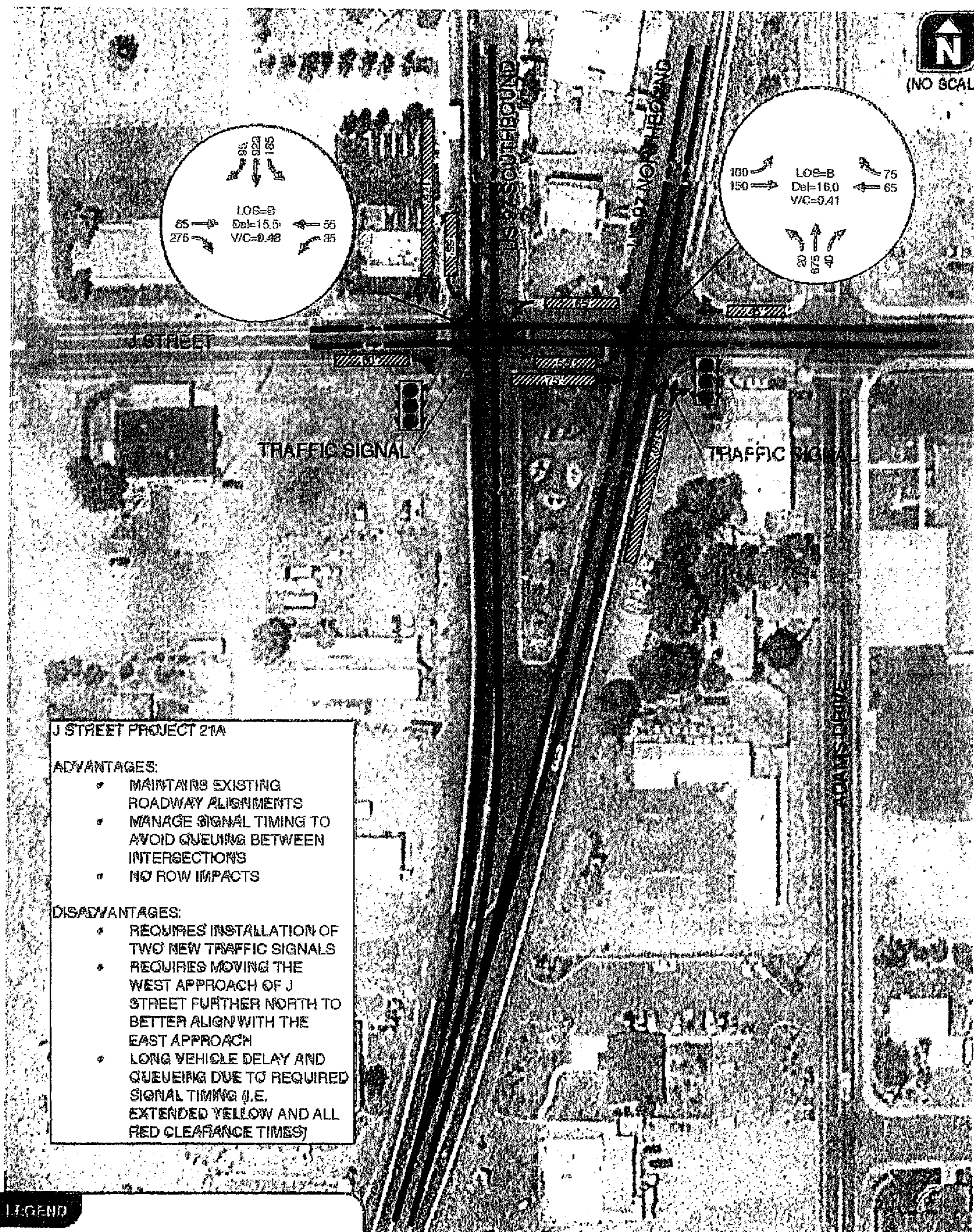
Due to the proximity of the intersection, (there is approximately 60 feet of storage between the intersections), a Synchro analysis was conducted at the intersections in order to take into consideration the progression of traffic between the intersections. During the 2005 traffic conditions, the northbound and southbound intersections are anticipated to operate at volume to capacity ratio of 0.48 and 0.41, respectively, during the weekday p.m. peak hour periods with the traffic signals in place. *Appendix "F" provides the level-of-service worksheet of the existing intersection as signalzed intersection.*

A review of the 95th percentile queues between the intersections showed that the eastbound and westbound queues at the intersections will exceed the 60 feet of available storage. Subsequently, the queues are anticipated to spill back through the upstream signals. Even with east-west coordination between the intersections, the queues between the intersections are anticipated to exceed available storage. Furthermore, with anticipated growth in traffic on US 97/26, the coordination of the signals in the east-west direction will adversely impact the operation and queue for the north-south traffic at both the intersections. Figure 2 shows the general layout of this solution.

Alternative Solution B: Single Point Urban Intersection

To eliminate the issue of queues between the intersections, one option is to redesign the two intersections into one signal point urban intersection. The intersection is anticipated to operate at volume-to-capacity ratio of 0.59 under 2005 traffic condition analyzed as a single intersection. Under 2025 traffic condition, the intersection needs to be improved to lane configuration listed below to meet the ODOT mobility standard of volume to capacity ratio 0.70.

- Northbound – left-turn, dual through, and right-turn lanes
- Southbound - dual left-turn, dual through, and right-turn lanes



J STREET PROJECT 21A

ADVANTAGES:

- MAINTAINS EXISTING ROADWAY ALIGNMENTS
- MANAGE SIGNAL TIMING TO AVOID QUEUING BETWEEN INTERSECTIONS
- NO ROW IMPACTS

DISADVANTAGES:

- REQUIRES INSTALLATION OF TWO NEW TRAFFIC SIGNALS
- REQUIRES MOVING THE WEST APPROACH OF J STREET FURTHER NORTH TO BETTER ALIGN WITH THE EAST APPROACH
- LONG VEHICLE DELAY AND QUEUEING DUE TO REQUIRED SIGNAL TIMING (I.E. EXTENDED YELLOW AND ALL RED CLEARANCE TIMES)

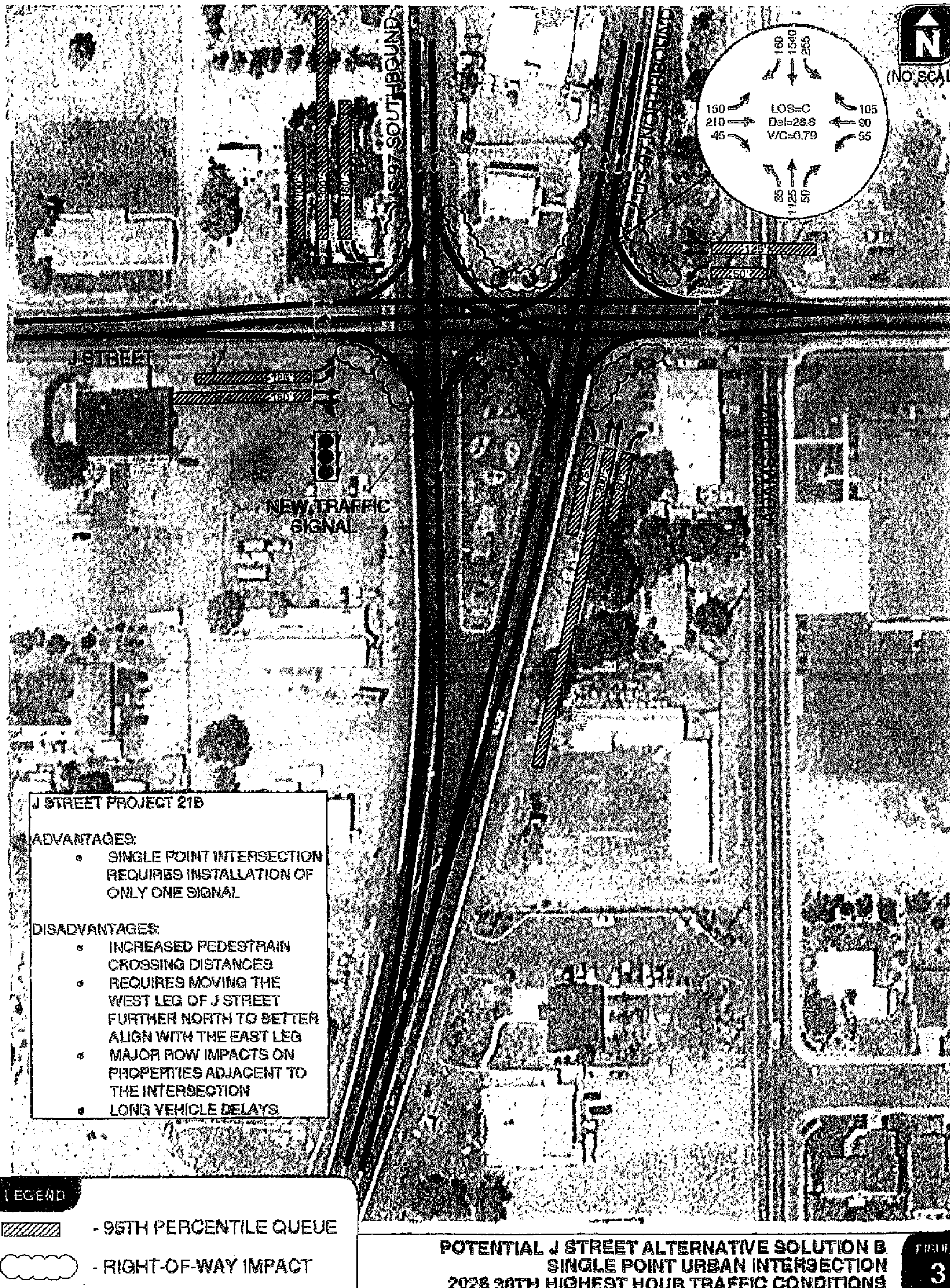
LEGEND

- 95TH PERCENTILE QUEUE

* - QUEUE LONGER THAN 60' OF AVAILABLE STORAGE

POTENTIAL J STREET ALTERNATIVE SOLUTION A
INSTALL TRAFFIC SIGNAL AT CURRENT LOCATION
2005 30TH HIGHEST HOUR TRAFFIC CONDITIONS

FIGURE 2



J STREET PROJECT 21B

ADVANTAGES:
- SINGLE POINT INTERSECTION REQUIRES INSTALLATION OF ONLY ONE SIGNAL

DISADVANTAGES:
- INCREASED PEDESTRAIN CROSSING DISTANCES
- REQUIRES MOVING THE WEST LEG OF J STREET FURTHER NORTH TO BETTER ALIGN WITH THE EAST LEG
- MAJOR ROW IMPACTS ON PROPERTIES ADJACENT TO THE INTERSECTION
- LONG VEHICLE DELAYS

LEGEND
- 95TH PERCENTILE QUEUE
- RIGHT-OF-WAY IMPACT

**POTENTIAL J STREET ALTERNATIVE SOLUTION B
SINGLE POINT URBAN INTERSECTION
2026 30TH HIGHEST HOUR TRAFFIC CONDITIONS**

FIGURE 3

H:\projfile\... Jefferson County TSP\Tech Memos\TM B and CJ_SI_Concepts(single line).dwg May 03, 2006 - 11:3.. mdowell Layout Tab: FIG 03

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION PLANNING / TRAFFIC ENGINEERING

- Eastbound: dual left-turn, through, and through-right turn lanes
- Westbound: dual left-turn, through, and through-right turn lanes

This lane configuration will widen the intersection considerably and have adverse impact on the properties adjacent to the intersection. In addition, pedestrian and bicycle mobility through the intersection will be challenging, especially for children and the elderly. Figure 3 shows the single-line drawing of alternative solution B. *Appendix "G" provides the level-of-service worksheets of the intersection operation as single point urban intersection.*

Alternative Solution C: US 97/US 26 Realignment

Previous studies have evaluated the option of realigning the US 97/US 26 highways in the vicinity of "J" Street to mitigate the operation and safety at the "J" Street/US 97/US 26 intersections. The 2001 Madras TSP Update looked at realigning the highway north and south of "J" Street. The report recommended realigning the highway to the south of "J" Street based on the impact to current businesses and other concerns.

KAI evaluated two options of realigning US 97/US 26 northbound approach south of "J" Street. Based on discussion with City and County staff, a southern of the two alignments was determined to have minimal impact of the properties. A Synchro analysis was conducted to ensure that the traffic signal at the new realigned intersection would operate acceptably. The analysis showed that the "J" Street/US 97/US 26 Southbound intersection would operate at a volume-to-capacity ratio of 0.73 and the "J" Street/US 97/US 26 Northbound intersection would operate at a volume-to-capacity ratio of 0.67 in 2025 weekday p.m. peak hour conditions. Figure 4 shows the single-line drawing of alternative alignment C and Figure 5 shows the double-line drawing of the southern alignment option. *Appendix "H" provides the level-of-service worksheet of the operational analysis.*

The US 97/US 26 realignment project has several advantages and disadvantages, which are highlighted below.

Advantages

- Provides the queuing distance between the northbound and southbound approaches of the highway, thus providing enough storage for vehicles on "J" Street
- Reduces the speed for the northbound approach by using low-speed design for the realignment
- Extends the couplet and provides access to additional properties for development

Disadvantages

- Adversely impacts properties south of "J" Street between Adams Street and US 97/US 26
- Substantial construction and right-of-way cost

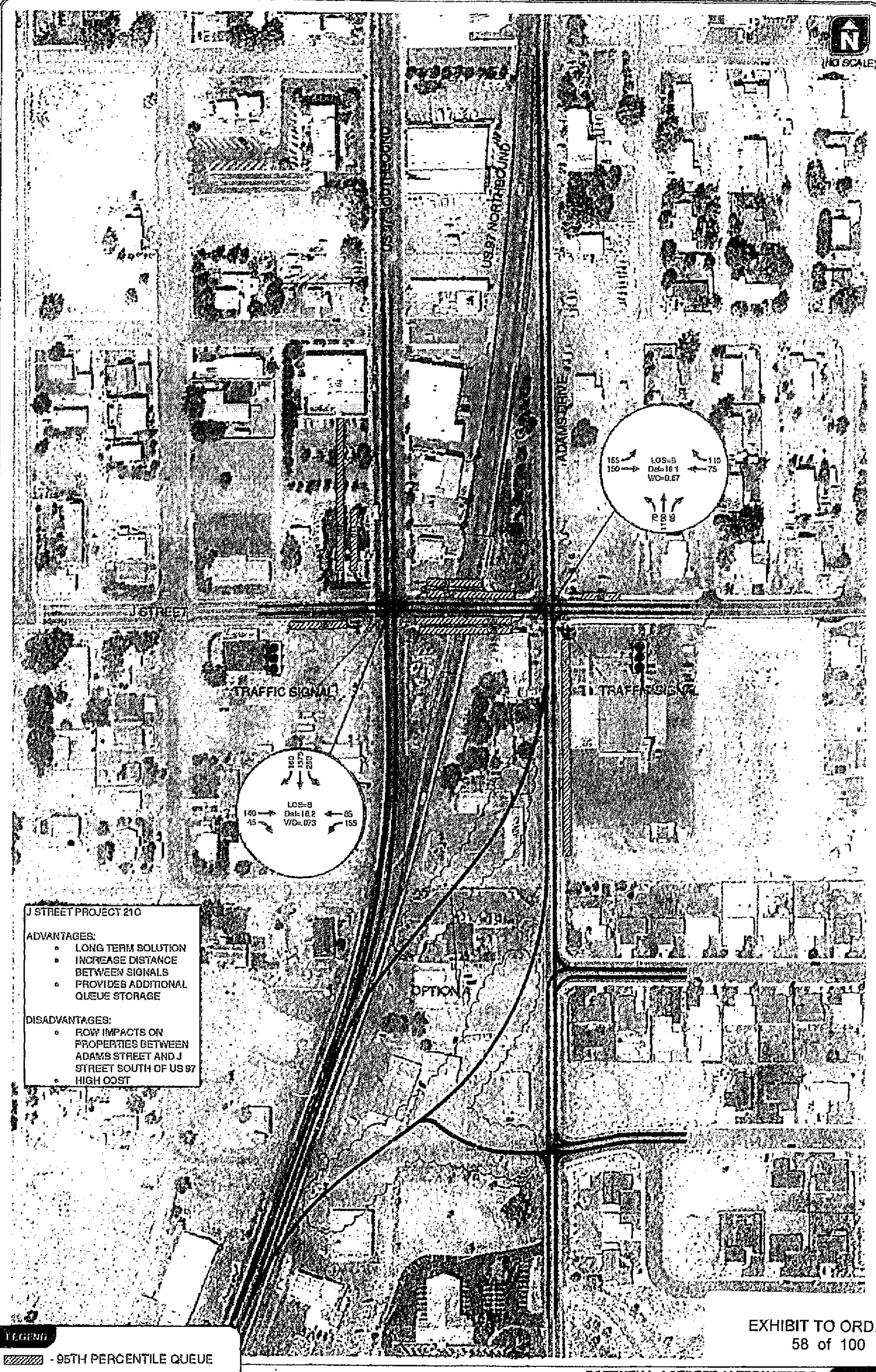
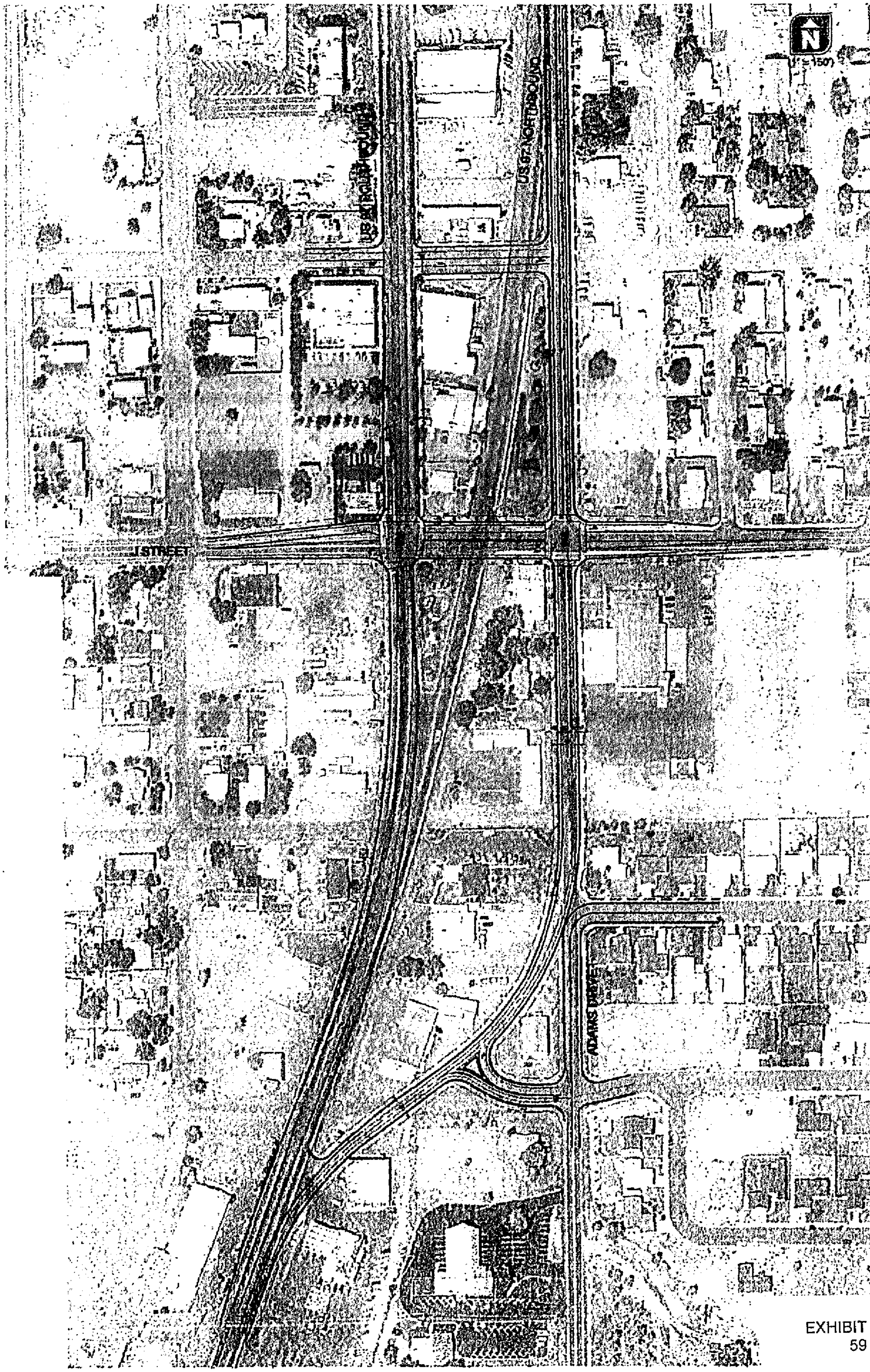


EXHIBIT TO ORD. 785
58 of 100

POTENTIAL J STREET ALTERNATIVE C
US 97/US 26 NORTHBOUND APPROACH REALIGNMENT
MADRAS, OREGON

FIGURE 4

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION PLANNING / TRAFFIC ENGINEERING



J STREET ALTERNATIVE SOLUTION C - DOUBLE-LINE DRAWING OF
US 97/US 26 NORTHBOUND APPROACH REALIGNMENT
MADRAS, OREGON

FIGURE 5

EXHIBIT TO ORD. 785
59 of 100

Conclusion

The transportation alternatives presented in this memorandum were discussed in detail in the technical advisory committee meetings and presented to the public in an open house. Based on the discussion and review comments received, the Madras Truck Route with Alternative 1C and Alternative 2 were found to have the most advantages and relatively less impact on the environment. However, it should be noted that a further detail NEPA analysis should be conducted to quantify the environmental and land-use impact of the proposed solution.

Similarly, the operation and safety of the "J" Street/US 97/US 26 intersection can be improved through various alternative solutions. Alternative C, the realignment of the US 97/US 26 northbound approach to Adams Street, appears most feasible and provides a long-term solution.

References

1. The Office of Economic Analysis, *Long-Term County Forecast*, 2004
2. Portland State University, *Population Research Center*, 2000
3. Transportation Research Board, *2000 Highway Capacity Manual*, 2000
4. Oregon Department of Transportation, *2003 Oregon Highway Design Manual*, 2003
5. City of Madras, *Transportation System Plan*, 1998
6. City of Madras, *Comprehensive Plan and Transportation System Plan Update*, 2001
7. Federal Highway Administration, *Manual of Uniform Traffic Control Devices*, 2003.

Appendix A

Forecast Traffic Volume and Growth Rate Worksheet

Jefferson County State Highway Forecast Volumes

State Facility	Mile Post	Description	ODOT 1993 ADT	ODOT 2004 ADT	ODOT Historic Growth Rate (1993 to 2004)	2025 ADT (ODOT Historic Traffic Volume Data)	Growth Rate for ODOT Future Volume Table	ODOT Future Volume Table 2024 ADT	2025 ADT (Based on ODOT Future Volume Table)	Updated Pop Forecast Year 2004 to 2015 Growth Rate	Updated Pop Forecast Year 2015 Traffic Volumes	Updated Pop Forecast Year 2015 to 2025 Growth Rate	Updated Pop Forecast Year 2025 Traffic Volumes	2025 ADT Census Population Data (1.35%/yr)
US 26 (Warm Springs)	96.40	Wasco-Jefferson County Line	2800	4300	3.95%	7900	2.33%	6300	6400	2.15%	5320	2.15%	6200	6100
	102.28	0.01 mile northwest of Agency Hot Springs Road	3400	5100	3.75%	9100	1.80%	7000	7100	2.15%	6310	2.15%	7400	7200
	103.30	0.01 mile southeast of Agency Hot Springs Road	4200	7500	5.38%	18400	2.24%	11000	11200	2.15%	9400	2.15%	11000	10700
	110.88	0.12 miles west of Quinwood Lane	5800	6100	0.30%	6500	0.33%	6500	6590	2.15%	7540	2.15%	8900	8600
	111.77	0.01 miles northwest of NW Columbia Drive	5100	7000	2.92%	11300	1.43%	9000	9100	2.15%	8650	2.15%	10200	9900
	113.25	0.32 mile northwest of NW Elm Lane		7100			3.84%	10000	10200	2.15%	8780	2.15%	10300	10000
	113.94	0.01 mile northwest of Boise Drive	5200	7100	2.87%	11400	1.55%	9300	9400	2.15%	8780	2.15%	10300	10000
	113.99	0.01 mile southeast of Boise Drive	5300	7400	3.08%	12300	1.35%	8400	8500	2.15%	9150	2.15%	10700	10400
	115.87	0.01 miles southeast of NW Cherry Lane	8200	8500	0.33%	9100	1.12%	10400	10500	2.15%	10510	2.15%	12300	12000
	116.41	0.01 southeast of Earl Street	8500	11300	2.62%	17500	2.48%	16900	17300	2.15%	13970	2.15%	16400	15900
	117.11	0.01 mile north of NE Jefferson Street	9300	12400	2.65%	19300	2.14%	17700	18100	2.15%	15330	2.15%	18000	17500
	117.16	0.01 mile south of Lee St, north city limits of Madras	10800	11900	1.59%	15900	1.87%	16500	16800	3.37%	16810	3.37%	20300	18500
	117.57	0.01 north of US 97	11800	13300	1.74%	16200	2.33%	14900	20000	3.37%	18920	3.37%	22700	18700
US 20 (Madras-Prineville)	0.01	0.01 mile southeast of US 97	1700	1800	0.52%	2000	1.38%	2300	2300	2.15%	2230	2.15%	2300	2500
	1.10	0.01 mile south of Devor Lane	1400	1700	1.78%	2300	2.35%	2500	2600	2.15%	2100	2.15%	2500	2400
	1.59	0.01 mile south of Adams Drive	1700	1800	0.52%	2000	3.81%	3100	3200	2.15%	2230	2.15%	2900	2500
	9.85	0.01 mile north of Ramms Road	1600	1900	1.57%	2500	2.03%	2900	3000	2.15%	2350	2.15%	2700	2700
	9.91	0.01 mile south of Ramms Road	1600	1900	1.57%	2500	2.37%	2800	2900	2.15%	2350	2.15%	2600	2700
	18.3	Jefferson-Crook County Line	1700	2000	1.48%	2800	2.25%	2900	3000	2.15%	2470	2.15%	2900	2800
US 97	74.26	Wasco-Jefferson County Line	2100											
	81	0.02 mile south of Old Highway	2700	3300	1.04%	4600	1.97%	4600	4700	2.00%	4030	2.00%	4700	4700
	85.2	0.12 mile south of NE Fern Lane	2800											
	87.78	0.50 mile south of NE Elm Lane	2800					4600	4800	2.00%		2.00%		
	88.48	0.01 mile south of NE Dogwood Ln	2600											
	89.64	0.01 mile north of NE Cherry Lane	3200	3600	1.00%	4400	1.53%	4700	4800	2.00%	4390	2.00%	5100	5100
	91.21	0.08 mile north of NE Meadowlark Ln	3700	4100	0.94%	4900	1.46%	5300	5400	2.00%	5000	2.00%	5800	5600
	91.44	North City limits of Madras	5600	6300	1.08%	7700	1.11%	7700	7800	3.37%	8040	3.37%	10600	8900
	91.73	0.01 mile south of NE Cedar St	4700											
	91.84	0.10 mile north of US 26	4800	11300	8.08%	30500	0.34%	13300	13300	3.37%	15400	3.37%	19200	15900
	92.04	0.10 mile south of US 26	16800	20800	2.41%	31300	2.80%	29100	29700	3.37%	28510	3.37%	35580	29300
	92.14 S	0.01 mile north of Fine Street	8800	10500	1.83%	14500	1.76%	14200	14500	3.37%	14300	3.37%	17200	14800
	92.45 S	0.01 mile north of Culver Highway	9700	11900	1.99%	18600	0.80%	14002	14100	3.37%	16310	3.37%	20300	16600
	92.47 S	0.01 mile south of Culver Highway	5300	9300	0.00%	9300	0.48%	10200	10200	3.37%	12650	3.37%	15900	13100
	92.77 S	0.01 mile north of G Street	8900	11600	2.44%	17500	1.12%	14300	14400	3.37%	15800	3.37%	16800	16400
	93.05 S	0.01 mile south of J Street	7900	9600	1.79%	15200	0.63%	11200	11300	3.37%	13160	3.37%	16400	13500
	92.13 N	0.01 mile north of Fine Street	7800	10500	2.82%	16300	0.50%	12300	12400	3.37%	14380	3.37%	17600	14800
	92.45 N	0.01 mile north of Culver Highway	8800	10400	1.74%	14200	0.38%	11200	11200	3.37%	14260	3.37%	17600	14700
	92.47 N	0.01 mile south of Culver Highway	8405	10400	1.96%	14100	0.56%	11600	11700	3.37%	14260	3.37%	17800	14700
	92.75 N	0.01 mile north of Earl Street	12800	11900	-0.00%	11700	2.14%	17000	17400	3.37%	16310	3.37%	20300	16200
	93.05 N	0.01 mile south of J Street	6900	8500	2.05%	12200	1.24%	10600	10700	3.37%	11650	3.37%	14500	12000
	96.45	0.02 mile north of SW Fairgrounds Rd	12000	16100	2.71%	28300	1.21%	21800	22000	3.37%	22070	3.37%	27500	22700
	98.9	Madras ATR, 0.020 mile north of US 26	10080	13100	2.49%	18000	1.83%	17800	18200	3.37%	17960	3.37%	22400	18500
	97.19	0.01 mile south of US 26	8800	12800	3.75%	21500	1.75%	16200	16500	2.37%	15130	2.37%	18000	18900
	103.62	0.01 mile north of SW Iris Lane	8000	9100	1.19%	11400	2.38%	13400	13700	2.37%	11476	2.37%	13000	12800
	105.72	0.01 mile north of Culver Highway	7500	8700	1.36%	11300	2.07%	12300	12600	2.37%	10970	2.37%	13000	12300
	105.74	0.01 mile south of Culver Highway	7700	10100	2.50%	15400	2.20%	14700	15000	2.37%	12738	2.37%	15100	14200
	113.44	0.20 mile north of Crooked River Gorge	8000										0	
	112.86	Jefferson-Deschutes County Line	8000	10700	2.68%	16700	2.40%	16000	16400	2.37%	13499	2.37%	16000	15100
Culver Highway	0.01	0.01 mile west of US 97 and US 26 (Northbound)	3800	3000	-0.00%	3000	1.32%	3500	3500	3.37%	4110	3.37%	5100	4200
	0.05	0.01 mile west of US 26 and US 97 (Eastbound)	3300	4000	1.76%	5500	2.12%	5100	5200	3.37%	5480	3.37%	6800	5600
	0.14	0.01 mile southwest of SW 3rd Street	3200											
	0.34	0.01 mile southwest of Madison Street	2800	3500	2.24%	5600	2.06%	5600	5700	3.37%	4800	3.37%	6000	4900
	0.49	0.01 mile north of SW Belmont Lane	2700	3900	3.40%	6100	2.46%	6200	6400	3.37%	5300	3.37%	6700	5500
	2.26	0.01 mile northeast of SW Culler Lane	3200	3400	0.55%	3800	3.06%	5500	5700	2.75%	4438	2.75%	5400	4800
	2.9	0.01 mile north of SW Bear Drive	3200	3600	1.08%	4400	2.92%	5700	5900	2.75%	4890	2.75%	5700	5100
	2.92	0.01 mile southwest of SW Bear Drive	3200	3500	0.82%	4100	2.08%	5500	5700	2.75%	4560	2.75%	5500	4000
	3.91	0.01 mile south of SW Dover Lane	3100	3400	0.84%	4000	2.21%	4800	5000	2.75%	4430	2.75%	5400	4800
	4.34	0.01 mile north of 7th St	3100	3300	1.28%	3400	2.03%	4500	4800	3.00%	4300	3.00%	5200	4500
	4.36	0.01 mile south of 7th St	2800	3100	0.61%	3550	1.84%	4300	4400	3.00%	4120	3.00%	5100	4400
	4.57	0.01 mile south of 4th St	2900	3000	0.31%	3300	3.33%	4400	4500	3.00%	3800	3.00%	4900	4200
	5.07	0.01 mile southwest of SW Eureka Lane	2000	2700	2.77%	4300	1.85%	3700	3800	2.40%	3410	2.40%	4100	3800
	7.02	0.01 mile northeast of SW Ford Lane	2100	2700	2.31%	4000	2.78%	4200	4300	2.40%	3410	2.40%	4100	3800
	7.04	0.01 mile south of SW Ford Lane	2200	3100	3.17%	5200	2.50%	4700	4800	2.40%	3820	2.40%	4700	4400
	8.82	North City limits of Culver	1900	2700	3.75%	4800	2.41%	4000	4100	2.50%	3440	2.50%	4100	3000
	8.97	0.01 mile north of C St	1800											
	8.99	0.01 mile south of C St	2400											
	0.31	0.01 mile north of SW Iris Drive	1800	2300	2.25%	3400	2.17%	3300	3400	2.50%	3930	2.50%	3500	3200
	9.33	0.01 mile south of SW Iris Lane	1200	1800	3.75%	3200	2.22%	2600	2700	2.00%	2200	2.00%	2600	2500
	10.82	0.01 mile north of Jerico Lane	1200	1800	3.75%	3200	1.04%	2500	2500	2.00%	2200	2.00%	2600	2500
	11.51	0.01 mile west of US 97	1100	1900	5.08%	3900	1.54%	2600	2600	2.00%	2320	2.00%	2700	2700
US 20	98.9	0.01 miles west of Camp Sherman Road	5000	4600	-0.76%	3900	1.85%	6300	6400	1.70%	5460	1.70%	6200	6500
	90.92	0.01 miles east of Camp Sherman Road	5400	5100	-0.52%	4500	1.47%	6600	6700	1.70%	6050	1.70%	6000	7300

Jefferson County
Madras
Culver
Metolius

EXHIBIT TO ORD. 785
63 of 100

Appendix B

Description of Level-of-Service Methods and Criteria

Appendix B

Level of Service Concept

Level of service (LOS) is a concept developed to quantify the degree of comfort (including such elements as travel time, number of stops, total amount of stopped delay, and impediments caused by other vehicles) afforded to drivers as they travel through an intersection or roadway segment. Six grades are used to denote the various level of service from A to F.[1]

Signalized Intersections

The six level of service grades are described qualitatively for signalized intersections in Table B1. Additionally, Table B2 identifies the relationship between level of service and average control delay per vehicle. Control delay is defined to include initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay. Using this definition, level of service D is generally considered to represent the minimum acceptable design standard.

Table B1
Level of Service Definitions (Signalized Intersections)

Level of Service	Average Delay per Vehicle
A	Very low average control delay, less than 10 seconds per vehicle. This occurs when progression is extremely favorable, and most vehicles arrive during the green phase. Most vehicles do not stop at all. Short cycle lengths may also contribute to low delay.
B	Average control delay is greater than 10 seconds per vehicle and less than or equal to 20 seconds per vehicle. This generally occurs with good progression and/or short cycle lengths. More vehicles stop than for a level of service A, causing higher levels of average delay.
C	Average control delay is greater than 20 seconds per vehicle and less than or equal to 35 seconds per vehicle. These higher delays may result from fair progression and/or longer cycle lengths. Individual cycle failures may begin to appear at this level. The number of vehicles stopping is significant at this level, although many still pass through the intersection without stopping.
D	Average control delay is greater than 35 seconds per vehicle and less than or equal to 55 seconds per vehicle. The influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavorable progression, long cycle length, or high volume/capacity ratios. Many vehicles stop, and the proportion of vehicles not stopping declines. Individual cycle failures are noticeable.
E	Average control delay is greater than 55 seconds per vehicle and less than or equal to 80 seconds per vehicle. This is usually considered to be the limit of acceptable delay. These high delay values generally (but not always) indicate poor progression, long cycle lengths, and high volume/capacity ratios. Individual cycle failures are frequent occurrences.
F	Average control delay is in excess of 80 seconds per vehicle. This is considered to be unacceptable to most drivers. This condition often occurs with oversaturation. It may also occur at high volume/capacity ratios below 1.0 with many individual cycle failures. Poor progression and long cycle lengths may also contribute to such high delay values.

1 Most of the material in this appendix is adapted from the Transportation Research Board, *Highway Capacity Manual*, (2000).

Table B2
Level of Service Criteria for Signalized Intersections

Level of Service	Average Control Delay per Vehicle (Seconds)
A	<10.0
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

Unsignalized Intersections

Unsignalized intersections include two way stop controlled (TWSC) and all way stop controlled (AWSC) intersections. The 2000 Highway Capacity Manual provides models for estimating control delay at both TWSC and AWSC intersections. A qualitative description of the various service levels associated with an unsignalized intersection is presented in Table B3. A quantitative definition of level of service for unsignalized intersections is presented in Table B4. Using this definition, level of service E is generally considered to represent the minimum acceptable design standard.

Table B3
Level of Service Criteria for Unsignalized Intersections

Level of Service	Average Delay per Vehicle to Minor Street
A	• Nearly all drivers find freedom of operation. • Very seldom is there more than one vehicle in queue.
B	• Some drivers begin to consider the delay an inconvenience. • Occasionally there is more than one vehicle in queue.
C	• Many times there is more than one vehicle in queue. • Most drivers feel restricted, but not objectionably so.
D	• Often there is more than one vehicle in queue. • Drivers feel quite restricted.
E	• Represents a condition in which the demand is near or equal to the probable maximum number of vehicles that can be accommodated by the movement. • There is almost always more than one vehicle in queue. • Drivers find the delays approaching intolerable levels.
F	• Forced flow. • Represents an intersection failure condition that is caused by geometric and/or operational constraints external to the intersection.

Table B4
Level of Service Criteria for Unsignalized Intersections

Level of Service	Average Control Delay per Vehicle (Seconds)
A	<10.0
B	>10.0 and ≤ 15.0
C	>15.0 and ≤ 25.0
D	>25.0 and ≤ 35.0
E	>35.0 and ≤ 50.0
F	>50.0

It should be noted that the level of service criteria for unsignalized intersections are somewhat different than the criteria used for signalized intersections. The primary reason for this difference is that drivers expect different levels of performance from different kinds of transportation facilities. The expectation is that a signalized intersection is designed to carry higher traffic volumes than an unsignalized intersection. Additionally, there are a number of driver behavior considerations that combine to make delays at signalized intersections less onerous than at unsignalized intersections. For example, drivers at signalized intersections are able to relax during the red interval, while drivers on the minor street approaches to TWSC intersections must remain attentive to the task of identifying acceptable gaps and vehicle conflicts. Also, there is often much more variability in the amount of delay experienced by individual drivers at unsignalized intersections than signalized intersections. For these reasons, it is considered that the control delay threshold for any given level of service is less for an unsignalized intersection than for a signalized intersection. While overall intersection level of service is calculated for AWSC intersections, level of service is only calculated for the minor approaches and the major street left turn movements at TWSC intersections. No delay is assumed to the major street through movements. For TWSC intersections, the overall intersection level of service remains undefined: level-of-service is only calculated for each minor street lane.

In the performance evaluation of TWSC intersections, it is important to consider other measures of effectiveness (MOE's) in addition to delay, such as v/c ratios for individual movements, average queue lengths, and 95th-percentile queue lengths. By focusing on a single MOE for the worst movement only, such as delay for the minor-street left turn, users may make inappropriate traffic control decisions. The potential for making such inappropriate decisions is likely to be particularly pronounced when the HCM level-of-service thresholds are adopted as legal standards, as is the case in many public agencies.

Appendix C

2025 Traffic Conditions, Level-of-Service Worksheet

Kittelson & Associates, Inc. Project # (7475.4)
Jefferson County TSP
2025 Total Traffic Conditions, PM Peak Hour

Scenario Report

Scenario:	Default Scenario
Command:	Default Command
Volume:	Default Volume
Geometry:	Default Geometry
Impact Fee:	Default Impact Fee
Trip Generation:	Default Trip Generation
Trip Distribution:	Default Trip Distribution
Paths:	Default Paths
Routes:	Default Routes
Configuration:	Default Configuration

Kittelson & Associates, Inc. Project # (7475.4)
Jefferson County TSP
2025 Total Traffic Conditions, PM Peak Hour

Impact Analysis Report
Level Of Service

Intersection	Base LOS	Base Del/ Veh	Base V/C	Future LOS	Future Del/ Veh	Future V/C	Change in
# 10 US 97/US 26 - North of Madras	E	78.6	1.138	F	92.3	1.189	+13.685 D/V
# 15 US 97 SB/J Street	F	OVRFL	0.000	F	OVRFL	0.000	+37778931862
# 16 US 97 NB/J Street	F	559.6	0.000	F	OVRFL	0.000	+703.105 D/V
# 23 US 97/US 26 - South of Madras	F	484.4	0.000	F	484.4	0.000	+ 0.000 D/V
# 34 US 97/Culver Highway - SR 361	E	46.0	0.000	E	46.0	0.000	+ 0.000 D/V
# 62 Adams Dr/J Street	B	13.8	0.000	C	16.6	0.000	+ 2.822 D/V

EXHIBIT TO ORD. 785
69 of 100

```
Traffix 7.7.0515 (c) 2005 Dowling Assoc. Licensed to KITTELSON, PORTLAND

Default Scenario          Wed Feb 1, 2006 10:43:39                  Page 5-1
--------------------------------------------------------------------------------
                Kittelson & Associates, Inc. Project # (7475.4)
                           Jefferson County TSP
                 2025 Total Traffic Conditions, PM Peak Hour
--------------------------------------------------------------------------------
                    Level Of Service Computation Report
          2000 HCM Operations Method (Future Volume Alternative)
********************************************************************************
Intersection #10 US 97/US 26 - North of Madras
********************************************************************************
Cycle (sec):        100               Critical Vol./Cap. (X):        1.189
Loss Time (sec):     16 (Y+R =  4 sec) Average Delay (sec/veh):       92.3
Optimal Cycle:      180               Level Of Service:                 F
********************************************************************************
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Protected        Protected        Protected        Protected
Rights:          Include          Include          Include          Include
Min. Green:    0    0    0     0    0    0     0    0    0     0    0    0
Lanes:        1  0  1  1  0   1  0  1  1  0   1  0  0  1  0   1  0  0  1  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:      25  588  356    31  811    1    18    1   43   236    1   12
Growth Adj:  1.67 1.67 1.67  1.67 1.67 1.67  1.67 1.67 1.67  1.67 1.67 1.67
Initial Bse:   42  982  595    52 1354    2    30    2   72   394    2   20
Added Vol:      0    5   29    11    9    0     0    0    0    25    0    7
PasserByVol:    0    0    0     0    0    0     0    0    0     0    0    0
Initial Fut:   42  987  624    63 1363    2    30    2   72   419    2   27
User Adj:    1.00 1.00 1.00  1.00 1.00 1.00  1.00 1.00 1.00  1.00 1.00 1.00
PHF Adj:     0.95 0.95 0.95  0.95 0.95 0.95  0.85 0.85 0.85  0.95 0.95 0.95
PHF Volume:    44 1039  667    66 1435    2    35    2   84   441    2   28
Reduct Vol:     0    0    0     0    0    0     0    0    0     0    0    0
Reduced Vol:   44 1039  667    66 1435    2    35    2   84   441    2   28
PCE Adj:     1.00 1.00 1.00  1.00 1.00 1.00  1.00 1.00 1.00  1.00 1.00 1.00
MLF Adj:     1.00 1.00 1.00  1.00 1.00 1.00  1.00 1.00 1.00  1.00 1.00 1.00
Final Vol.:    44 1039  667    66 1435    2    35    2   84   441    2   28
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1800 1800 1800  1800 1800 1800  1800 1800 1800  1800 1800 1800
Adjustment:  0.83 0.78 0.78  0.83 0.83 0.83  0.95 0.85 0.85  0.83 0.75 0.75
Lanes:       1.00 1.22 0.78  1.00 1.99 0.01  1.00 0.02 0.98  1.00 0.06 0.94
Final Sat.:  1500 1719 1103  1500 2996    4  1710   35 1501  1500   79 1277
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.03 0.60 0.60  0.04 0.48 0.48  0.02 0.06 0.06  0.29 0.02 0.02
Crit Moves:       ****       ****                  ****      ****
Green/Cycle: 0.03 0.51 0.51  0.04 0.51 0.51  0.14 0.05 0.05  0.25 0.15 0.15
Volume/Cap:  0.93 1.19 1.19  1.19 0.93 0.93  0.15 1.19 1.19  1.19 0.15 0.15
Delay/Veh:  153.6  117 117.0 229.1 33.3 33.3  37.9  213 212.9 146.6 37.0 37.0
User DelAdj: 1.00 1.00 1.00  1.00 1.00 1.00  1.00 1.00 1.00  1.00 1.00 1.00
AdjDel/Veh: 153.6  117 117.0 229.1 33.3 33.3  37.9  213 212.9 146.6 37.0 37.0
HCM2kAvg:       3   46   46     6   25   25     1    7    7    26    1    1
********************************************************************************
```

```
Traffix 7.7.0515 (c) 2005 Dowling Assoc. Licensed to KITTELSON, PORTLAND

Default Scenario          Wed Feb 1, 2006 10:43:39                  Page 6-1
--------------------------------------------------------------------------------
                Kittelson & Associates, Inc. Project # (7475.4)
                           Jefferson County TSP
                 2025 Total Traffic Conditions, PM Peak Hour
--------------------------------------------------------------------------------
                    Level Of Service Computation Report
          2000 HCM Unsignalized Method (Future Volume Alternative)
********************************************************************************
Intersection #15 US 97 SB/J Street
********************************************************************************
Average Delay (sec/veh): OVERFLOW   Worst Case Level Of Service:     F[ xxxxx]
********************************************************************************
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:      Uncontrolled     Uncontrolled      Stop Sign        Stop Sign
Rights:          Include          Include          Include          Include
Lanes:        0  0  0  0  0   0  1  0  1  0   0  0  0  1  0   0  1  0  0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0    0    0    91  820   85     0   72   24    24   47    0
Growth Adj:  1.79 1.79 1.79  1.79 1.79 1.79  1.79 1.79 1.79  1.79 1.79 1.79
Initial Bse:    0    0    0   163 1471  152     0  129   43    43   84    0
Added Vol:      0    0    0    83    4    0     0    5    0    10    3    0
PasserByVol:    0    0    0     0    0    0     0    0    0     0    0    0
Initial Fut:    0    0    0   246 1475  152     0  134   43    53   87    0
User Adj:    1.00 1.00 1.00  1.00 1.00 1.00  1.00 1.00 1.00  1.00 1.00 1.00
PHF Adj:     1.00 1.00 1.00  0.95 0.95 0.95  1.00 0.85 0.85  0.85 0.85 1.00
PHF Volume:     0    0    0   259 1553  161     0  158   51    62  103    0
Reduct Vol:     0    0    0     0    0    0     0    0    0     0    0    0
Final Vol.:     0    0    0   259 1553  161     0  158   51    62  103    0
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx   4.2 xxxx xxxxx xxxxx  6.5  6.2   7.1  6.5 xxxxx
FollowUpTim:xxxxx xxxx xxxxx   2.3 xxxx xxxxx xxxxx  4.0  3.3   3.5  4.0 xxxxx
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx     0 xxxx xxxxx  xxxx 2151  857  1374 2232 xxxxx
Potent Cap.: xxxx xxxx xxxxx   900 xxxx xxxxx  xxxx   48  357   123   43 xxxxx
Move Cap.:   xxxx xxxx xxxxx   900 xxxx xxxxx  xxxx   30  357     0   27 xxxxx
Volume/Cap:  xxxx xxxx  xxxx  0.29 xxxx  xxxx  xxxx 5.26 0.14  xxxx 3.85  xxxx
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
Queue:       xxxxx xxxx xxxxx   1.2 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Stopped Del:xxxxx xxxx xxxxx  10.6 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:    *    *    *     B    *    *     *    *    *     *    *    *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx   39     0 xxxx xxxxx
SharedQueue:xxxxx xxxx xxxxx   1.2 xxxx xxxxx xxxxx xxxx 24.4 xxxxx xxxx xxxxx
Shrd StpDel:xxxxx xxxx xxxxx  10.6 xxxx xxxxx xxxxx xxxx 2188 xxxxx xxxx xxxxx
Shared LOS:     *    *    *     B    *    *     *    *    F     *    *    *
ApproachDel:      xxxxxx           xxxxxx           2187.7           xxxxxx
ApproachLOS:        *                *                F                F
```

S:\PROGRAMS\TIA Tools\traffix output.doc

EXHIBIT TO ORD. 785
70 of 100

```
Traffix 7.7.0515 (c) 2005 Dowling Assoc. Licensed to KITTELSON, PORTLAND

Default Scenario            Wed Feb 1, 2006 10:43:39                  Page 7-1
-------------------------------------------------------------------------------
                 Kittelson & Associates, Inc. Project # (7475.4)
                            Jefferson County TSP
                 2025 Total Traffic Conditions, PM Peak Hour
-------------------------------------------------------------------------------
                    Level Of Service Computation Report
          2000 HCM Unsignalized Method (Future Volume Alternative)
*******************************************************************************
Intersection #16 US 97 NB/J Street
*******************************************************************************
Average Delay (sec/veh):   300.8   Worst Case Level Of Service:      F[ 1262.7]
*******************************************************************************
Approach:     North Bound      South Bound      East Bound       West Bound
Movement:    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|----------------||----------------||----------------||----------------|
Control:      Uncontrolled     Uncontrolled      Stop Sign        Stop Sign
Rights:          Include          Include          Include          Include
Lanes:        0  0  1! 0  0    0  0  0  0  0    1  0  1  0  0    0  0  0  1  0
------------|----------------||----------------||----------------||----------------|
Volume Module:
Base Vol:      18  598    18     0    0     0    68   79     0     0   48    38
Growth Adj:  1.79 1.79  1.79  1.79 1.79  1.79  1.79 1.79  1.79  1.79 1.79  1.79
Initial Bse:   32 1072    32     0    0     0   122  142     0     0   86    68
Added Vol:      0    6    18     0    0     0    25   63     0     0   13    33
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:   32 1079    50     0    0     0   147  205     0     0   99   101
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.95 0.95  0.95  1.00 1.00  1.00  0.85 0.85  1.00  1.00 0.85  0.85
PHF Volume:    34 1136    53     0    0     0   173  241     0     0  117   119
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Final Vol.:    34 1136    53     0    0     0   173  241     0     0  117   119
Critical Gap Module:
Critical Gp:  4.2 xxxx xxxxx xxxxx xxxx xxxxx   7.1  6.5 xxxxx xxxxx  6.5   6.2
FollowUpTim:  2.3 xxxx xxxxx xxxxx xxxx xxxxx   3.5  4.0 xxxxx xxxxx  4.0   3.3
------------|----------------||----------------||----------------||----------------|
Capacity Module:
Cnflict Vol:    0 xxxx xxxxx  xxxx xxxx xxxxx  1348 1257 xxxxx  xxxx 1230  1162
Potent Cap.:  900 xxxx xxxxx  xxxx xxxx xxxxx   128  171 xxxxx  xxxx  178   237
Move Cap.:    900 xxxx xxxxx  xxxx xxxx xxxxx    28  165 xxxxx  xxxx  171   237
Volume/Cap:  0.04 xxxx  xxxx  xxxx xxxx  xxxx  6.20 1.46  xxxx  xxxx 0.68  0.50
------------|----------------||----------------||----------------||----------------|
Level Of Service Module:
Queue:        0.1 xxxx xxxxx xxxxx xxxx xxxxx  21.2 15.4 xxxxx xxxxx xxxx xxxxx
Stopped Del:  9.2 xxxx xxxxx xxxxx xxxx xxxxx  2617  290 xxxxx xxxxx xxxx xxxxx
LOS by Move:    A    *     *     *    *     *     F    F     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx   199
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx  12.0
Shrd StpDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx 171.2
Shared LOS:     *    *     *     *    *     *     *    *     *     *    *     F
ApproachDel:      xxxxxx           xxxxxx           1262.7           171.2
ApproachLOS:         *                *                F                F
```

```
Traffix 7.7.0515 (c) 2005 Dowling Assoc. Licensed to KITTELSON, PORTLAND

Default Scenario            Wed Feb 1, 2006 10:43:39                  Page 8-1
-------------------------------------------------------------------------------
                 Kittelson & Associates, Inc. Project # (7475.4)
                            Jefferson County TSP
                 2025 Total Traffic Conditions, PM Peak Hour
-------------------------------------------------------------------------------
                    Level Of Service Computation Report
          2000 HCM Unsignalized Method (Future Volume Alternative)
*******************************************************************************
Intersection #23 US 97/US 26 - South of Madras
*******************************************************************************
Average Delay (sec/veh):    17.5   Worst Case Level Of Service:       F[ 484.4]
*******************************************************************************
Approach:     North Bound      South Bound      East Bound       West Bound
Movement:    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|----------------||----------------||----------------||----------------|
Control:      Uncontrolled     Uncontrolled      Stop Sign        Stop Sign
Rights:          Include          Include          Include          Include
Lanes:        1  0  1  0  1    1  0  1  0  1    0  1  0  0  1    0  1  0  0  1
------------|----------------||----------------||----------------||----------------|
Volume Module:
Base Vol:       6  410     4   102  486    36    25    1    10     2    3    77
Growth Adj:  1.58 1.58  1.58  1.58 1.58  1.58  1.58 1.58  1.58  1.58 1.58  1.58
Initial Bse:   10  649     6   162  770    57    40    2    16     3    5   122
Added Vol:      0    0     0     0    0     0     0    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:   10  649     6   162  770    57    40    2    16     3    5   122
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.95  0.95 0.95  0.95
PHF Volume:    10  684     7   170  810    60    42    2    17     3    5   128
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Final Vol.:    10  684     7   170  810    60    42    2    17     3    5   128
Critical Gap Module:
Critical Gp:  4.2 xxxx xxxxx   4.2 xxxx xxxxx   7.3  6.7   6.4   7.3  6.7   6.4
FollowUpTim:  2.3 xxxx xxxxx   2.3 xxxx xxxxx   3.6  4.1   3.4   3.6  4.1   3.4
------------|----------------||----------------||----------------||----------------|
Capacity Module:
Cnflict Vol:  870 xxxx xxxxx   690 xxxx xxxxx  1924 1861   810  1893 1914   684
Potent Cap.:  726 xxxx xxxxx   851 xxxx xxxxx    46   67   359    49   62   426
Move Cap.:    726 xxxx xxxxx   851 xxxx xxxxx    25   53   359    38   49   426
Volume/Cap:  0.01 xxxx  xxxx  0.20 xxxx  xxxx  1.66 0.03  0.05  0.09 0.10  0.30
------------|----------------||----------------||----------------||----------------|
Level Of Service Module:
Queue:        0.0 xxxx xxxxx   0.7 xxxx xxxxx xxxxx xxxx   0.1 xxxxx xxxx   1.3
Stopped Del: 10.0 xxxx xxxxx  10.3 xxxx xxxxx xxxxx xxxx  15.5 xxxxx xxxx  17.1
LOS by Move:    B    *     *     B    *     *     *    *     C     *    *     C
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx    26 xxxx xxxxx    44 xxxx xxxxx
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx   5.3 xxxx xxxxx   0.6 xxxx xxxxx
Shrd StpDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx 664.7 xxxx xxxxx 104.9 xxxx xxxxx
Shared LOS:     *    *     *     *    *     *     F    *     *     F    *     *
ApproachDel:      xxxxxx           xxxxxx            484.4            22.4
ApproachLOS:         *                *                F                C
```

```
Kittelson & Associates, Inc. Project # (7475.4)
Jefferson County TSP
2025 Total Traffic Conditions, PM Peak Hour
-----------------------------------------------------------------------------
Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)
*****************************************************************************
Intersection #34 US 97/Culver Highway - SR 361
*****************************************************************************
Average Delay (sec/veh):      3.1    Worst Case Level Of Service:     E[ 46.0]
*****************************************************************************
Approach:     North Bound     South Bound      East Bound      West Bound
Movement:    L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:      Uncontrolled    Uncontrolled     Stop Sign       Stop Sign
Rights:          Include         Include        Include         Include
Lanes:       1  0  0  1  0   0  1  0  0  1   0  0  1! 0  0   0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:      86  314    1     5  413    1     1    3   70     1    1    1
Growth Adj:  1.59 1.59 1.59  1.59 1.59 1.59  1.59 1.59 1.59  1.59 1.59 1.59
Initial Bse:  137  501    2     8  658    2     2    5  112     2    2    2
Added Vol:      0    0    0     0    0    0     0    0    0     0    0    0
PasserByVol:    0    0    0     0    0    0     0    0    0     0    0    0
Initial Fut:  137  501    2     8  658    2     2    5  112     2    2    2
User Adj:    1.00 1.00 1.00  1.00 1.00 1.00  1.00 1.00 1.00  1.00 1.00 1.00
PHF Adj:     0.95 0.95 0.95  0.95 0.95 0.95  0.85 0.85 0.85  0.85 0.85 0.85
PHF Volume:   144  527    2     8  693    2     2    6  131     2    2    2
Reduct Vol:     0    0    0     0    0    0     0    0    0     0    0    0
Final Vol.:   144  527    2     8  693    2     2    6  131     2    2    2
Critical Gap Module:
Critical Gp:  4.2 xxxx xxxxx   4.2 xxxx xxxxx   7.1  6.5  6.2   7.1  6.5  6.2
FollowUpTim:  2.3 xxxx xxxxx   2.3 xxxx xxxxx   3.5  4.0  3.3   3.5  4.0  3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol:  695 xxxx xxxxx   529 xxxx xxxxx  1528 1527  693  1595 1528  528
Potent Cap.:  848 xxxx xxxxx   980 xxxx xxxxx    96  117  443    86  117  551
Move Cap.:    848 xxxx xxxxx   980 xxxx xxxxx    81   97  443    50   97  551
Volume/Cap:  0.17 xxxx  xxxx  0.01 xxxx  xxxx  0.02 0.06 0.30  0.04 0.02 0.00
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
Queue:        0.6 xxxx xxxxx   0.0 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Stopped Del: 10.1 xxxx xxxxx   8.7 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:    B    *    *     A    *    *     *    *    *     *    *    *
Movement:    LT - LTR - RT   LT - LTR - RT   LT - LTR - RT   LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx xxxx xxxx xxxxx  xxxx  368 xxxxx  xxxx   93 xxxxx
SharedQueue:xxxxx xxxx xxxxx   0.0 xxxx xxxxx xxxxx  1.7 xxxxx xxxxx  0.2 xxxxx
Shrd StpDel:xxxxx xxxx xxxxx   8.7 xxxx xxxxx xxxxx 20.6 xxxxx xxxxx 46.0 xxxxx
Shared LOS:     *    *    *     A    *    *     *    C    *     *    E    *
ApproachDel:     xxxxxx          xxxxxx           20.6            46.0
ApproachLOS:        *               *               C               E
```



```
Kittelson & Associates, Inc. Project # (7475.4)
Jefferson County TSP
2025 Total Traffic Conditions, PM Peak Hour
-----------------------------------------------------------------------------
Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)
*****************************************************************************
Intersection #62 Adams Dr/J Street
*****************************************************************************
Average Delay (sec/veh):      4.4    Worst Case Level Of Service:     C[ 16.6]
*****************************************************************************
Approach:     North Bound     South Bound      East Bound      West Bound
Movement:    L  -  T  -  R   L  -  T  -  R   L  -  T  -  R   L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Stop Sign       Stop Sign      Uncontrolled    Uncontrolled
Rights:          Include         Include        Include         Include
Lanes:       0  0  1! 0  0   0  0  1! 0  0   0  0  1! 0  0   0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:      19   34    8     3   19    2     3   61   37    17   68    4
Growth Adj:  1.79 1.79 1.79  1.79 1.79 1.79  1.79 1.79 1.79  1.79 1.79 1.79
Initial Bse:   34   61   14     5   34    4     5  109   66    30  122    7
Added Vol:      0    0    0     0    0    0     0   81    0     0   45    0
PasserByVol:    0    0    0     0    0    0     0    0    0     0    0    0
Initial Fut:   34   61   14     5   34    4     5  190   66    30  167    7
User Adj:    1.00 1.00 1.00  1.00 1.00 1.00  1.00 1.00 1.00  1.00 1.00 1.00
PHF Adj:     0.85 0.85 0.85  0.85 0.85 0.85  0.85 0.85 0.85  0.85 0.85 0.85
PHF Volume:    40   72   17     6   40    4     6  224   78    36  196    8
Reduct Vol:     0    0    0     0    0    0     0    0    0     0    0    0
Final Vol.:    40   72   17     6   40    4     6  224   78    36  196    8
Critical Gap Module:
Critical Gp:  7.1  6.5  6.2   7.1  6.5  6.2   4.1 xxxx xxxxx   4.1 xxxx xxxxx
FollowUpTim:  3.5  4.0  3.3   3.5  4.0  3.3   2.2 xxxx xxxxx   2.2 xxxx xxxxx
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol:  570  552  263   593  587  201   205 xxxx xxxxx   302 xxxx xxxxx
Potent Cap.:  432  441  776   418  422  840  1367 xxxx xxxxx  1259 xxxx xxxxx
Move Cap.:    397  427  776   347  408  840  1367 xxxx xxxxx  1259 xxxx xxxxx
Volume/Cap:  0.10 0.17 0.02  0.02 0.10 0.01  0.00 xxxx  xxxx  0.03 xxxx  xxxx
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
Queue:      xxxxx xxxx xxxxx xxxxx xxxx xxxxx   0.0 xxxx xxxxx   0.1 xxxx xxxxx
Stopped Del:xxxxx xxxx xxxxx xxxxx xxxx xxxxx   7.6 xxxx xxxxx   7.9 xxxx xxxxx
LOS by Move:    *    *    *     *    *    *     A    *    *     A    *    *
Movement:    LT - LTR - RT   LT - LTR - RT   LT - LTR - RT   LT - LTR - RT
Shared Cap.: xxxx  439 xxxxx  xxxx  416 xxxxx xxxx xxxx xxxxx xxxx xxxx xxxxx
SharedQueue:xxxxx  1.2 xxxxx xxxxx  0.4 xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shrd StpDel:xxxxx 16.6 xxxxx xxxxx 14.8 xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:     *    C    *     *    B    *     *    *    *     *    *    *
ApproachDel:       16.6            14.8          xxxxxx          xxxxxx
```

ApproachLOS:	C	B	*	*

Traffix 7.7.0515 (c) 2005 Dowling Assoc. Licensed to KITTELSON, PORTLAND

Appendix D

2025 Traffic Conditions, Level-of-Service Worksheet for the Madras Truck Route/US 97/US 26 North and South Intersection

Kittelson & Associates, Inc. Project # (7475.4)
Jefferson County TSP
2025 Total Traffic Conditions, PM Peak Hour

Level Of Service Detailed Computation Report (HCM2000 Queue Method)
2000 HCM Operations Method
Future Volume Alternative

Intersection #67 Madras Truck Route/US 97/US 26

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Green/Cycle:	0.06	0.49	0.49	0.06	0.50	0.50	0.17	0.21	0.21	0.10	0.14	0.14
ArrivalType:		3			3			3			3	
ProgFactor:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1:	1.9	14.0	14.0	2.2	13.1	10.5	5.6	7.7	7.7	3.7	5.1	5.1
UpstreamVC:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
UpstreamAdj:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EarlyArrAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q2:	1.4	2.2	2.2	1.6	1.8	1.6	1.7	2.0	2.0	1.8	1.7	1.7
HCM2KQueue:	3.3	16.2	16.2	3.9	14.8	12.0	7.3	9.7	9.7	5.5	6.8	6.8
70th%Factor:	1.19	1.17	1.17	1.19	1.17	1.17	1.18	1.18	1.18	1.19	1.18	1.18
70th%HCM2kQ:	3.9	18.9	18.9	4.6	17.3	14.1	8.6	11.4	11.4	6.6	8.0	8.0
85th%Factor:	1.57	1.47	1.47	1.56	1.48	1.50	1.54	1.52	1.52	1.55	1.54	1.54
85th%HCM2kQ:	5.1	23.9	23.9	6.0	22.0	18.0	11.2	14.7	14.7	8.6	10.4	10.4
90th%Factor:	1.74	1.58	1.58	1.73	1.59	1.62	1.68	1.65	1.65	1.70	1.69	1.69
90th%HCM2kQ:	5.7	25.6	25.6	6.7	23.6	19.5	12.2	16.0	16.0	9.4	11.4	11.4
95th%Factor:	2.00	1.74	1.74	1.98	1.76	1.81	1.90	1.85	1.85	1.94	1.91	1.91
95th%HCM2kQ:	6.5	28.3	28.3	7.7	26.1	21.7	13.9	17.9	17.9	10.8	12.9	12.9
98th%Factor:	2.48	1.99	1.99	2.44	2.02	2.10	2.27	2.17	2.17	2.35	2.29	2.29
98th%HCM2kQ:	8.1	32.2	32.2	9.4	29.9	25.2	16.6	21.1	21.1	13.0	15.5	15.5

Kittelson & Associates, Inc. Project # (7475.4)
Jefferson County TSP
2025 Total Traffic Conditions, PM Peak Hour

Fuel Consumption and Emissions
2000 HCM Operations Method
Future Volume Alternative

Intersection #67 Madras Truck Route/US 97/US 26

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Run Speed:		30 MPH			30 MPH			30 MPH			30 MPH	
NumOfStops:	14.2	142	58.2	16.8	186	78.4	81.3	95.4	13.6	54.1	64.0	8.3

Name: year 1995 composite fleet

Fuel Consumption:	144.776 pounds
	23.454 gallons
Carbon Dioxide:	451.702 pounds
Carbon Monoxide:	36.513 pounds
Hydrocarbons:	7.009 pounds
Nitrogen Oxides:	1.198 pounds

Name: year 2000 composite fleet

Fuel Consumption:	137.524 pounds
	22.279 gallons
Carbon Dioxide:	429.076 pounds
Carbon Monoxide:	35.942 pounds
Hydrocarbons:	6.894 pounds
Nitrogen Oxides:	1.083 pounds

DISCLAIMER
The fuel consumption and emissions measures should be used with caution and only for comparisons of different signal timings, geometric design alternatives or for general planning applications, as these calculations are applied to the analysis of a single intersection within the CCG and TRAFFIX. Network models are more appropriate since they can account for the influence of the adjacent control measures and other system elements.

Appendix E

Signal Warrant Analysis for the "J" Street/US 97/US 26 Intersection

Appendix F

2005 Traffic Conditions, Level-of-Service Worksheet of "J" Street/US 97/US 26 Intersection Operation as Signalized Intersections

Project #:	7475.6 1
Project Name:	Jefferson County TSP
Analyst:	DDD
Date:	10/17/2006
Intersection:	US 97 NB/J Street
Scenario:	2005 Total Conditions

Volume Adjustment Factor =	1.0
North-South Approach =	Major
East-West Approach =	Minor
Major Street Thru Lanes =	2
Minor Street Thru Lanes =	1
Speed > 40 mph?	Yes
Population < 10,000?	Yes
Warrant Factor	70%
Peak Hour or Daily Count?	Peak Hour

Note: Add'l data input on sheet "Warrant 3".

Warrant Summary

Warrant	Name	Analyzed?	Met?
#1	Eight-Highest	Yes	Yes
#2	Four-Hour	Yes	Yes
#3	Peak Hour	Yes	Yes

Traffic Volumes

Hour		Major Street		Minor Street		Major St.	Minor St.
Begin	End	NB	SB	EB	WB	Adj. Factor	Adj. Factor
5:00 PM	6:00 PM	734	0	252	143	1.00	1.00
2nd	Highest Hour	705	0	242	137	0.96	0.96
3rd	Highest Hour	690	0	237	134	0.94	0.94
4th	Highest Hour	587	0	202	114	0.80	0.80
5th	Highest Hour	558	0	192	109	0.76	0.76
6th	Highest Hour	499	0	171	97	0.68	0.68
7th	Highest Hour	462	0	159	90	0.63	0.63
8th	Highest Hour	440	0	151	86	0.60	0.60
9th	Highest Hour	352	0	121	69	0.48	0.48
10th	Highest Hour	330	0	113	64	0.45	0.45
11th	Highest Hour	330	0	113	64	0.45	0.45
12th	Highest Hour	316	0	108	61	0.43	0.43
13th	Highest Hour	286	0	98	56	0.39	0.39
14th	Highest Hour	264	0	91	51	0.36	0.36
15th	Highest Hour	264	0	91	51	0.36	0.36
16th	Highest Hour	257	0	88	50	0.35	0.35
17th	Highest Hour	147	0	50	29	0.20	0.20
18th	Highest Hour	81	0	28	16	0.11	0.11
19th	Highest Hour	73	0	25	14	0.10	0.10
20th	Highest Hour	29	0	10	6	0.04	0.04
21st	Highest Hour	22	0	8	4	0.03	0.03
22nd	Highest Hour	22	0	8	4	0.03	0.03
23rd	Highest Hour	15	0	5	3	0.02	0.02
24th	Highest Hour	15	0	5	3	0.02	0.02

Project #:	7475.6.1
Project Name:	Jefferson County TSP
Analyst:	DDD
Date:	10/17/2006
Intersection:	US 97 SB/J Street
Scenario:	2025 Total Conditions

Volume Adjustment Factor =	1.0
North-South Approach =	Major
East-West Approach =	Minor
Major Street Thru Lanes =	2
Minor Street Thru Lanes =	1
Speed > 40 mph?	No
Population < 10,000?	Yes
Warrant Factor	70%
Peak Hour or Daily Count?	Peak Hour

Note: Add'l data input on sheet "Warrant 3".

Warrant Summary

Warrant	Name	Analyzed?	Met?
#1	Eight-Highest	Yes	Yes
#2	Four-Hour	Yes	Yes
#3	Peak Hour	Yes	Yes

Traffic Volumes

Hour		Major Street		Minor Street		Major St.	Minor St.
Begin	End	NB	SB	EB	WB	Adj. Factor	Adj. Factor
5:00 PM	6:00 PM	0	1973	191	165	1.00	1.00
2nd	Highest Hour	0	1894	183	158	0.96	0.96
3rd	Highest Hour	0	1855	180	155	0.94	0.94
4th	Highest Hour	0	1578	153	132	0.80	0.80
5th	Highest Hour	0	1499	145	125	0.76	0.76
6th	Highest Hour	0	1342	130	112	0.68	0.68
7th	Highest Hour	0	1243	120	104	0.63	0.63
8th	Highest Hour	0	1184	115	99	0.60	0.60
9th	Highest Hour	0	947	92	79	0.48	0.48
10th	Highest Hour	0	888	86	74	0.45	0.45
11th	Highest Hour	0	888	86	74	0.45	0.45
12th	Highest Hour	0	848	82	71	0.43	0.43
13th	Highest Hour	0	769	74	64	0.39	0.39
14th	Highest Hour	0	710	69	59	0.36	0.36
15th	Highest Hour	0	710	69	59	0.36	0.36
16th	Highest Hour	0	691	67	56	0.35	0.35
17th	Highest Hour	0	395	38	33	0.20	0.20
18th	Highest Hour	0	217	21	18	0.11	0.11
19th	Highest Hour	0	197	19	17	0.10	0.10
20th	Highest Hour	0	79	8	7	0.04	0.04
21st	Highest Hour	0	59	6	5	0.03	0.03
22nd	Highest Hour	0	59	6	5	0.03	0.03
23rd	Highest Hour	0	39	4	3	0.02	0.02
24th	Highest Hour	0	39	4	3	0.02	0.02

Data Input

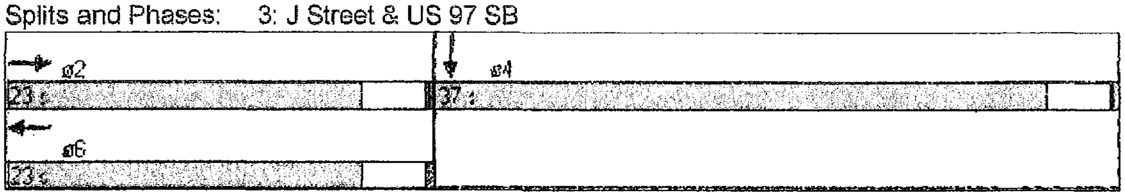
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)		50		50	50					50	50	
Trailing Detector (ft)		0		0	0					0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95
Ped Bike Factor		1.00			1.00					0.99	1.00	
Frt		0.968									0.986	
Flt Protected					0.980					0.950		
Satd. Flow (prot)	0	1701	0	0	1649	0	0	0	0	1676	3078	0
Flt Permitted					0.864					0.950		
Satd. Flow (perm)	0	1701	0	0	1451	0	0	0	0	1666	3078	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		28									29	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		25			25			35			35	
Link Distance (ft)		244			120			440			1205	
Travel Time (s)		6.7			3.3			8.6			23.5	
Volume (vph)	0	86	27	37	56	0	0	0	0	185	922	95
Confl. Peds. (#/hr)			5	5						5		5
Peak Hour Factor	1.00	0.85	0.85	0.85	0.85	1.00	1.00	1.00	1.00	0.95	0.95	0.95
Heavy Vehicles (%)	0%	2%	2%	7%	7%	0%	0%	0%	0%	2%	10%	2%
Adj. Flow (vph)	0	101	32	44	66	0	0	0	0	195	971	100
Lane Group Flow (vph)	0	133	0	0	110	0	0	0	0	195	1071	0
Turn Type				Perm						Perm		
Protected Phases		2			6						4	
Permitted Phases				6						4		
Detector Phases		2		6	6					4	4	
Minimum Initial (s)		4.0		4.0	4.0					4.0	4.0	
Minimum Split (s)		21.0		21.0	21.0					20.0	20.0	
Total Split (s)	0.0	23.0	0.0	23.0	23.0	0.0	0.0	0.0	0.0	37.0	37.0	0.0
Total Split (%)	0.0%	38.3%	0.0%	38.3%	38.3%	0.0%	0.0%	0.0%	0.0%	61.7%	61.7%	0.0%
Maximum Green (s)		19.0		19.0	19.0					33.0	33.0	
Yellow Time (s)		3.5		3.5	3.5					3.5	3.5	
All-Red Time (s)		0.5		0.5	0.5					0.5	0.5	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)		3.0		3.0	3.0					3.0	3.0	
Recall Mode		C-Max		C-Min	C-Min					None	None	
Walk Time (s)		5.0		5.0	5.0					5.0	5.0	
Flash Dont Walk (s)		12.0		12.0	12.0					10.0	10.0	
Pedestrian Calls (#/hr)		5		5	5					5	5	
Act Effct Green (s)		25.6			25.6					26.4	26.4	
Actuated g/C Ratio		0.43			0.43					0.44	0.44	
v/c Ratio		0.18			0.18					0.27	0.78	
Control Delay		11.4			15.1					10.4	17.9	
Queue Delay		0.0			3.0					0.1	0.0	
Total Delay		11.4			18.1					10.4	17.9	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
LOS		B			B					B	B	
Approach Delay		11.4			18.1						16.7	
Approach LOS		B			B						B	
Queue Length 50th (ft)		22			28					42	157	
Queue Length 95th (ft)		58			m63					62	177	
Internal Link Dist (ft)		164			40			360			1125	
Turn Bay Length (ft)												
Base Capacity (vph)		742			619					916	1706	
Starvation Cap Reductn		0			418					0	0	
Spillback Cap Reductn		2			0					165	0	
Storage Cap Reductn		0			0					0	0	
Reduced v/c Ratio		0.18			0.55					0.26	0.63	

Intersection Summary

Area Type: Other
Cycle Length: 60
Actuated Cycle Length: 60
Offset: 10 (17%), Referenced to phase 2:EBT and 6:WBTL, Start of Yellow
Natural Cycle: 45
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.78
Intersection Signal Delay: 16.4 Intersection LOS: B
Intersection Capacity Utilization 51.0% ICU Level of Service A
Analysis Period (min) 15
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 3: J Street & US 97 SB



Lane Group	EBT	WBT	SBL	SBT
Lane Group Flow (vph)	133	110	195	1071
v/c Ratio	0.18	0.18	0.27	0.78
Control Delay	11.4	15.1	10.4	17.9
Queue Delay	0.0	3.0	0.1	0.0
Total Delay	11.4	18.1	10.4	17.9
Queue Length 50th (ft)	22	28	42	157
Queue Length 95th (ft)	58	m63	62	177
Internal Link Dist (ft)	164	40		1125
Turn Bay Length (ft)				
Base Capacity (vph)	742	619	916	1706
Starvation Cap Reductn	0	418	0	0
Spillback Cap Reductn	2	0	165	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.18	0.55	0.26	0.63

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)		4.0			4.0					4.0	4.0	
Lane Util. Factor		1.00			1.00					1.00	0.95	
Frpb, ped/bikes		1.00			1.00					1.00	1.00	
Flpb, ped/bikes		1.00			1.00					0.99	1.00	
Frt		0.97			1.00					1.00	0.99	
Flt Protected		1.00			0.98					0.95	1.00	
Satd. Flow (prot)		1700			1646					1666	3078	
Flt Permitted		1.00			0.87					0.95	1.00	
Satd. Flow (perm)		1700			1468					1666	3078	
Volume (vph)	0	86	27	37	56	0	0	0	0	185	922	95
Peak-hour factor, PHF	1.00	0.85	0.85	0.85	0.85	1.00	1.00	1.00	1.00	0.95	0.95	0.95
Adj. Flow (vph)	0	101	32	44	66	0	0	0	0	195	971	100
RTOR Reduction (vph)	0	16	0	0	0	0	0	0	0	0	16	0
Lane Group Flow (vph)	0	117	0	0	110	0	0	0	0	195	1055	0
Confl. Peds. (#/hr)			5	5						5		5
Heavy Vehicles (%)	0%	2%	2%	7%	7%	0%	0%	0%	0%	2%	10%	2%
Turn Type				Perm						Perm		
Protected Phases		2			6						4	
Permitted Phases				6						4		
Actuated Green, G (s)		25.6			25.6					26.4	26.4	
Effective Green, g (s)		25.6			25.6					26.4	26.4	
Actuated g/C Ratio		0.43			0.43					0.44	0.44	
Clearance Time (s)		4.0			4.0					4.0	4.0	
Vehicle Extension (s)		3.0			3.0					3.0	3.0	
Lane Grp Cap (vph)		725			626					733	1354	
v/s Ratio Prot		0.07									c0.34	
v/s Ratio Perm					c0.07					0.12		
v/c Ratio		0.16			0.18					0.27	0.78	
Uniform Delay, d1		10.6			10.7					10.7	14.3	
Progression Factor		1.00			1.07					1.00	1.00	
Incremental Delay, d2		0.5			0.6					0.2	2.9	
Delay (s)		11.1			12.0					10.9	17.2	
Level of Service		B			B					B	B	
Approach Delay (s)		11.1			12.0			0.0			16.2	
Approach LOS		B			B			A			B	

Intersection Summary

HCM Average Control Delay	15.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.48		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	51.0%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

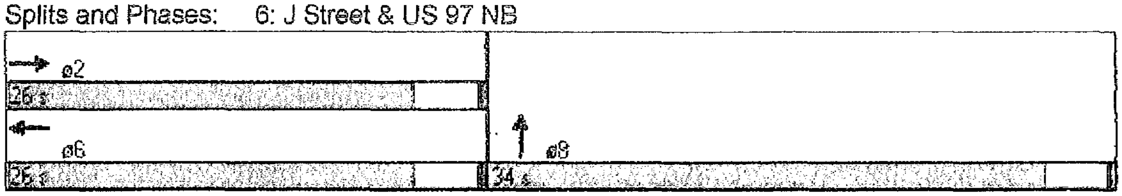
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50			50		50	50				
Trailing Detector (ft)	0	0			0		0	0				
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	0.95	1.00	1.00	1.00
Ped Bike Factor	1.00				0.99			1.00				
Frt					0.928			0.992				
Flt Protected	0.950							0.999				
Satd. Flow (prot)	1629	1714	0	0	1546	0	0	3094	0	0	0	0
Flt Permitted	0.651							0.999				
Satd. Flow (perm)	1111	1714	0	0	1546	0	0	3094	0	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					89			13				
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		25			25			35			35	
Link Distance (ft)		120			124			967			1231	
Travel Time (s)		3.3			3.4			18.8			24.0	
Volume (vph)	101	151	0	0	67	76	20	676	38	0	0	0
Confl. Peds. (#/hr)	5					5	5		5			
Peak Hour Factor	0.85	0.85	1.00	1.00	0.85	0.85	0.95	0.95	0.95	1.00	1.00	1.00
Heavy Vehicles (%)	5%	5%	0%	0%	7%	7%	2%	10%	2%	0%	0%	0%
Adj. Flow (vph)	119	178	0	0	79	89	21	712	40	0	0	0
Lane Group Flow (vph)	119	178	0	0	168	0	0	773	0	0	0	0
Turn Type	Perm						Perm					
Protected Phases		2			6			8				
Permitted Phases	2						8					
Detector Phases	2	2			6		8	8				
Minimum Initial (s)	4.0	4.0			4.0		4.0	4.0				
Minimum Split (s)	20.0	20.0			20.0		21.0	21.0				
Total Split (s)	26.0	26.0	0.0	0.0	26.0	0.0	34.0	34.0	0.0	0.0	0.0	0.0
Total Split (%)	43.3%	43.3%	0.0%	0.0%	43.3%	0.0%	56.7%	56.7%	0.0%	0.0%	0.0%	0.0%
Maximum Green (s)	22.0	22.0			22.0		30.0	30.0				
Yellow Time (s)	3.5	3.5			3.5		3.5	3.5				
All-Red Time (s)	0.5	0.5			0.5		0.5	0.5				
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0				
Recall Mode	C-Min	C-Min			C-Max		Min	Min				
Walk Time (s)	5.0	5.0			5.0		5.0	5.0				
Flash Dont Walk (s)	10.0	10.0			10.0		12.0	12.0				
Pedestrian Calls (#/hr)	5	5			5		5	5				
Act Effct Green (s)	32.4	32.4			32.4			19.6				
Actuated g/C Ratio	0.54	0.54			0.54			0.33				
v/c Ratio	0.20	0.19			0.19			0.76				
Control Delay	8.9	8.2			5.4			22.5				
Queue Delay	3.4	2.9			0.3			0.0				
Total Delay	12.2	11.1			5.7			22.5				

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
LOS	B	B			A			C				
Approach Delay		11.6			5.7			22.5				
Approach LOS		B			A			C				
Queue Length 50th (ft)	26	39			12			128				
Queue Length 95th (ft)	55	73			44			151				
Internal Link Dist (ft)		40			44			887			1151	
Turn Bay Length (ft)												
Base Capacity (vph)	600	926			876			1554				
Starvation Cap Reductn	395	640			0			0				
Spillback Cap Reductn	0	0			323			49				
Storage Cap Reductn	0	0			0			0				
Reduced v/c Ratio	0.58	0.62			0.30			0.51				

Intersection Summary

Area Type: Other
Cycle Length: 60
Actuated Cycle Length: 60
Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBT, Start of Yellow
Natural Cycle: 45
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.76
Intersection Signal Delay: 17.6 Intersection LOS: B
Intersection Capacity Utilization 50.0% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 6: J Street & US 97 NB



Lane Group	EBL	EBT	WBT	NBT
Lane Group Flow (vph)	119	178	168	773
v/c Ratio	0.20	0.19	0.19	0.76
Control Delay	8.9	8.2	5.4	22.5
Queue Delay	3.4	2.9	0.3	0.0
Total Delay	12.2	11.1	5.7	22.5
Queue Length 50th (ft)	26	39	12	128
Queue Length 95th (ft)	55	73	44	151
Internal Link Dist (ft)		40	44	887
Turn Bay Length (ft)				
Base Capacity (vph)	600	926	876	1554
Starvation Cap Reductn	395	640	0	0
Spillback Cap Reductn	0	0	323	49
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.58	0.62	0.30	0.51

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	4.0	4.0			4.0			4.0				
Lane Util. Factor	1.00	1.00			1.00			0.95				
Frpb, ped/bikes	1.00	1.00			0.99			1.00				
Flpb, ped/bikes	1.00	1.00			1.00			1.00				
Frt	1.00	1.00			0.93			0.99				
Flt Protected	0.95	1.00			1.00			1.00				
Satd. Flow (prot)	1621	1714			1547			3093				
Flt Permitted	0.65	1.00			1.00			1.00				
Satd. Flow (perm)	1110	1714			1547			3093				
Volume (vph)	101	151	0	0	67	76	20	676	38	0	0	0
Peak-hour factor, PHF	0.85	0.85	1.00	1.00	0.85	0.85	0.95	0.95	0.95	1.00	1.00	1.00
Adj. Flow (vph)	119	178	0	0	79	89	21	712	40	0	0	0
RTOR Reduction (vph)	0	0	0	0	41	0	0	9	0	0	0	0
Lane Group Flow (vph)	119	178	0	0	127	0	0	764	0	0	0	0
Confl. Peds. (#/hr)	5					5	5		5			
Heavy Vehicles (%)	5%	5%	0%	0%	7%	7%	2%	10%	2%	0%	0%	0%
Turn Type	Perm						Perm					
Protected Phases		2			6			8				
Permitted Phases	2						8					
Actuated Green, G (s)	32.4	32.4			32.4			19.6				
Effective Green, g (s)	32.4	32.4			32.4			19.6				
Actuated g/C Ratio	0.54	0.54			0.54			0.33				
Clearance Time (s)	4.0	4.0			4.0			4.0				
Vehicle Extension (s)	3.0	3.0			3.0			3.0				
Lane Grp Cap (vph)	599	926			835			1010				
v/s Ratio Prot		0.10			0.08							
v/s Ratio Perm	c0.11							0.25				
v/c Ratio	0.20	0.19			0.15			0.76				
Uniform Delay, d1	7.1	7.1			6.9			18.1				
Progression Factor	0.88	0.88			1.00			1.00				
Incremental Delay, d2	0.7	0.5			0.4			3.3				
Delay (s)	7.0	6.7			7.3			21.3				
Level of Service	A	A			A			C				
Approach Delay (s)		6.8			7.3			21.3			0.0	
Approach LOS		A			A			C			A	

Intersection Summary

HCM Average Control Delay	16.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.41		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	50.0%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt		0.971			0.996			0.982			0.991	
Flt Protected		0.999			0.994			0.985			0.994	
Satd. Flow (prot)	0	1767	0	0	1730	0	0	1838	0	0	1872	0
Flt Permitted		0.999			0.994			0.985			0.994	
Satd. Flow (perm)	0	1767	0	0	1730	0	0	1838	0	0	1872	0
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		25			25			30			30	
Link Distance (ft)		124			861			798			980	
Travel Time (s)		3.4			23.5			18.1			22.3	
Volume (vph)	3	149	41	19	121	4	21	38	9	3	21	2
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Heavy Vehicles (%)	2%	5%	2%	2%	10%	2%	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	4	175	48	22	142	5	25	45	11	4	25	2
Lane Group Flow (vph)	0	227	0	0	169	0	0	81	0	0	31	0
Sign Control		Free			Free			Stop			Stop	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 33.4% ICU Level of Service A
Analysis Period (min) 15

Appendix G

2025 Traffic Conditions,
Level-of-Service Worksheet
of "J" Street/US 97/US 26
Intersection Operation as
Single Point Urban
Intersection (SPUI)

Default Scenario Thu Apr 27, 2006 16:01:48 Page 1-1

Kittelson & Associates, Inc. Project #7475
Jefferson County TSP
2025 Total Traffic Condition, 30th Highest Hour

Scenario Report

Scenario:	Default Scenario
Command:	Default Command
Volume:	Default Volume
Geometry:	Default Geometry
Impact Fee:	Default Impact Fee
Trip Generation:	Default Trip Generation
Trip Distribution:	Default Trip Distribution
Paths:	Default Paths
Routes:	Default Routes
Configuration:	Default Configuration

Traffix 7.7.0515 (c) 2005 Dowling Assoc. Licensed to KITTELSON, PORTLAND

Default Scenario Thu Apr 27, 2006 16:01:48 Page 2-1

Kittelson & Associates, Inc. Project #7475
Jefferson County TSP
2025 Total Traffic Condition, 30th Highest Hour

Impact Analysis Report
Level Of Service

Intersection	Base			Future			Change
		Del/	V/		Del/	V/	in
	LOS	Veh	C	LOS	Veh	C	
# 1	C	28.8	0.787	C	28.8	0.787	+ 0.000 D/V

EXHIBIT TO ORD. 785
90 of 100

Kittelson & Associates, Inc. Project #7475
Jefferson County TSP
2025 Total Traffic Condition, 30th Highest Hour

Level Of Service Computation Report
2000 HCM Operations Method (Base Volume Alternative)

Intersection #1 J Street/US 97/US 26 SPUI

Cycle (sec):	120	Critical Vol./Cap. (X):	0.787
Loss Time (sec):	16 (Y+R = 4 sec)	Average Delay (sec/veh):	28.8
Optimal Cycle:	89	Level Of Service:	C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Protected			Protected			Protected			Protected		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	2 0	1	2 0	2 0	1	2 0	1 1	0	2 0	1 1	0
Volume Module:												
Base Vol:	34	1124	52	253	1536	159	152	211	45	55	91	104
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	34	1124	52	253	1538	159	152	211	45	55	91	104
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.85	0.85	0.85	0.85	0.85	0.85
PHF Volume:	36	1183	55	266	1619	167	179	248	53	65	107	122
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	36	1183	55	266	1619	167	179	248	53	65	107	122
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	36	1183	55	266	1619	167	179	248	53	65	107	122
Saturation Flow Module:												
Sat/Lane:	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Adjustment:	0.86	0.86	0.77	0.84	0.86	0.77	0.88	0.88	0.88	0.88	0.83	0.83
Lanes:	1.00	2.00	1.00	2.00	2.00	1.00	2.00	1.65	0.35	2.00	1.00	1.00
Final Sat.:	1554	3109	1391	3016	3109	1391	3158	2614	557	3158	1498	1498
Capacity Analysis Module:												
Vol/Sat:	0.02	0.38	0.04	0.09	0.52	0.12	0.06	0.09	0.09	0.02	0.07	0.08
Crit Moves:	****				****		****					****
Green/Cycle:	0.03	0.56	0.56	0.13	0.66	0.66	0.07	0.14	0.14	0.03	0.10	0.10
Volume/Cap:	0.79	0.68	0.07	0.68	0.79	0.18	0.79	0.66	0.66	0.66	0.69	0.79
Uniform Del:	57.9	18.7	12.0	49.8	14.3	7.8	54.8	48.5	48.5	57.5	51.9	52.5
IncremntDel:	59.7	1.1	0.0	4.7	2.1	0.1	16.5	3.5	3.5	15.0	6.0	13.3
InitQueuDel:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Delay/Veh:	117.5	19.8	12.1	54.5	16.4	7.9	71.3	52.0	52.0	72.5	57.9	65.7
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	117.5	19.8	12.1	54.5	16.4	7.9	71.3	52.0	52.0	72.5	57.9	65.7
HCM2kAvg:	3	16	1	6	22	2	5	6	6	2	5	6

Traffix 7.7.0515 (c) 2005 Dowling Assoc. Licensed to KITTELSON, PORTLAND

Appendix H

2025 Traffic Conditions, Level-of-Service Worksheet of "J" Street/US 97/US 26 Intersection Operation with US 97 Northbound Realignment

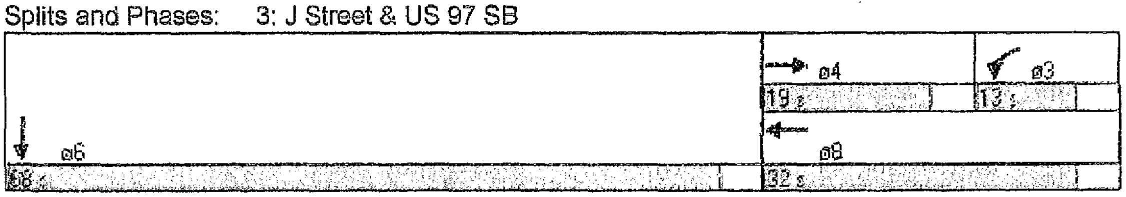
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↱		↰	↑					↰	↑↑	↱
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Storage Length (ft)	0		0	200		0	0		0	0		0
Storage Lanes	0		0	1		0	0		0	1		1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)		50		50	50					50	50	50
Trailing Detector (ft)		0		0	0					0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00
Ped Bike Factor		0.99										0.97
Frt		0.961										0.850
Flt Protected				0.950						0.950		
Satd. Flow (prot)	0	3112	0	1629	1714	0	0	0	0	1629	3109	1457
Flt Permitted				0.577						0.950		
Satd. Flow (perm)	0	3112	0	989	1714	0	0	0	0	1629	3109	1410
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		41										172
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		25			30			35			35	
Link Distance (ft)		244			236			938			1205	
Travel Time (s)		6.7			5.4			18.3			23.5	
Volume (vph)	0	140	45	156	87	0	0	0	0	259	1574	163
Confl. Peds. (#/hr)			5									5
Peak Hour Factor	1.00	0.92	0.85	0.92	0.92	0.92	1.00	1.00	0.92	0.92	0.95	0.95
Heavy Vehicles (%)	2%	5%	5%	5%	5%	2%	2%	2%	2%	5%	10%	5%
Adj. Flow (vph)	0	152	53	170	95	0	0	0	0	282	1657	172
Lane Group Flow (vph)	0	205	0	170	95	0	0	0	0	282	1657	172
Turn Type				pm+pt						Perm		Perm
Protected Phases		4		3	8						6	
Permitted Phases				8						6		6
Detector Phases		4		3	8					6	6	6
Minimum Initial (s)		4.0		4.0	4.0					4.0	4.0	4.0
Minimum Split (s)		19.0		8.0	19.0					24.0	24.0	24.0
Total Split (s)	0.0	19.0	0.0	13.0	32.0	0.0	0.0	0.0	0.0	68.0	68.0	68.0
Total Split (%)	0.0%	19.0%	0.0%	13.0%	32.0%	0.0%	0.0%	0.0%	0.0%	68.0%	68.0%	68.0%
Maximum Green (s)		15.0		9.0	28.0					64.0	64.0	64.0
Yellow Time (s)		4.0		4.0	4.0					4.0	4.0	4.0
All-Red Time (s)		0.0		0.0	0.0					0.0	0.0	0.0
Lead/Lag		Lead		Lag								
Lead-Lag Optimize?		Yes		Yes								
Vehicle Extension (s)		3.0		3.0	3.0					3.0	3.0	3.0
Recall Mode		None		None	None					C-Min	C-Min	C-Min
Walk Time (s)		3.0			3.0					5.0	5.0	5.0
Flash Dont Walk (s)		12.0			12.0					15.0	15.0	15.0
Pedestrian Calls (#/hr)		0			0					0	0	0
Act Effct Green (s)		10.5		21.3	21.3					70.7	70.7	70.7
Actuated g/C Ratio		0.10		0.21	0.21					0.71	0.71	0.71
v/c Ratio		0.56		0.67	0.26					0.24	0.75	0.16
Control Delay		39.6		50.1	34.5					6.4	12.9	1.4

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay		0.2		0.5	0.0					0.0	0.0	0.0
Total Delay		39.9		50.6	34.5					6.4	12.9	1.4
LOS		D		D	C					A	B	A
Approach Delay		39.9			44.8						11.1	
Approach LOS		D			D						B	

Intersection Summary

Area Type: Other
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 0 (0%), Referenced to phase 6:SBTL, Start of Yellow
Natural Cycle: 75
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.75
Intersection Signal Delay: 16.8 Intersection LOS: B
Intersection Capacity Utilization 103.5% ICU Level of Service G
Analysis Period (min) 15

Splits and Phases: 3: J Street & US 97 SB



Lane Group	EBT →	WBL ↙	WBT ←	SBL ↘	SBT ↓	SBR ↙
Lane Group Flow (vph)	205	170	95	282	1657	172
v/c Ratio	0.56	0.67	0.26	0.24	0.75	0.16
Control Delay	39.6	50.1	34.5	6.4	12.9	1.4
Queue Delay	0.2	0.5	0.0	0.0	0.0	0.0
Total Delay	39.9	50.6	34.5	6.4	12.9	1.4
Queue Length 50th (ft)	52	91	49	53	288	0
Queue Length 95th (ft)	86	m134	m78	108	488	22
Internal Link Dist (ft)	164		156		1125	
Turn Bay Length (ft)		200				
Base Capacity (vph)	502	290	480	1152	2199	1047
Starvation Cap Reductn	0	14	0	0	0	0
Spillback Cap Reductn	47	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.45	0.62	0.20	0.24	0.75	0.16

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)		4.0		4.0	4.0					4.0	4.0	4.0
Lane Util. Factor		0.95		1.00	1.00					1.00	0.95	1.00
Frpb, ped/bikes		0.99		1.00	1.00					1.00	1.00	0.97
Flpb, ped/bikes		1.00		1.00	1.00					1.00	1.00	1.00
Frt		0.96		1.00	1.00					1.00	1.00	0.85
Flt Protected		1.00		0.95	1.00					0.95	1.00	1.00
Satd. Flow (prot)		3113		1629	1714					1629	3109	1410
Flt Permitted		1.00		0.55	1.00					0.95	1.00	1.00
Satd. Flow (perm)		3113		943	1714					1629	3109	1410
Volume (vph)	0	140	45	156	87	0	0	0	0	259	1574	163
Peak-hour factor, PHF	1.00	0.92	0.85	0.92	0.92	0.92	1.00	1.00	0.92	0.92	0.95	0.95
Adj. Flow (vph)	0	152	53	170	95	0	0	0	0	282	1657	172
RTOR Reduction (vph)	0	37	0	0	0	0	0	0	0	0	0	50
Lane Group Flow (vph)	0	168	0	170	95	0	0	0	0	282	1657	122
Confl. Peds. (#/hr)			5									5
Heavy Vehicles (%)	2%	5%	5%	5%	5%	2%	2%	2%	2%	5%	10%	5%
Turn Type				pm+pt						Perm		Perm
Protected Phases		4		3	8						6	
Permitted Phases				8						6		6
Actuated Green, G (s)		10.5		21.3	21.3					70.7	70.7	70.7
Effective Green, g (s)		10.5		21.3	21.3					70.7	70.7	70.7
Actuated g/C Ratio		0.10		0.21	0.21					0.71	0.71	0.71
Clearance Time (s)		4.0		4.0	4.0					4.0	4.0	4.0
Vehicle Extension (s)		3.0		3.0	3.0					3.0	3.0	3.0
Lane Grp Cap (vph)		327		248	365					1152	2198	997
v/s Ratio Prot		0.05		c0.05	0.06						c0.53	
v/s Ratio Perm				c0.10						0.17		0.09
v/c Ratio		0.51		0.69	0.26					0.24	0.75	0.12
Uniform Delay, d1		42.3		37.6	32.8					5.2	9.2	4.7
Progression Factor		1.00		1.01	1.04					1.00	1.00	1.00
Incremental Delay, d2		1.4		7.2	0.4					0.5	2.5	0.3
Delay (s)		43.7		45.3	34.4					5.7	11.6	4.9
Level of Service		D		D	C					A	B	A
Approach Delay (s)		43.7			41.4			0.0			10.3	
Approach LOS		D			D			A			B	

Intersection Summary

HCM Average Control Delay	16.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	103.5%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

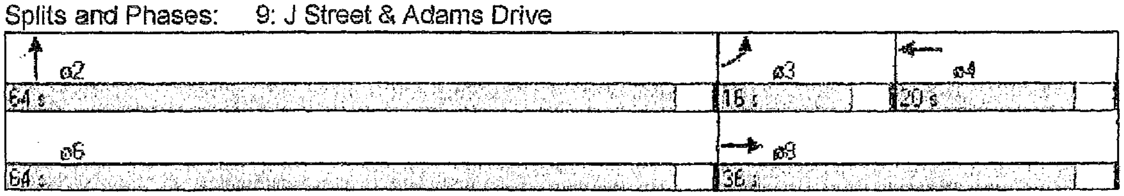
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑			↑↱			↰↑↱				
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Storage Length (ft)	200		0	0		0	0		0	0		0
Storage Lanes	1		0	0		0	0		0	0		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50			50		50	50		50		
Trailing Detector (ft)	0	0			0		0	0		0		
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95	0.95	0.95	0.95	0.95	1.00	1.00	1.00
Ped Bike Factor					0.99							
Frt					0.908			0.992				
Flt Protected	0.950							0.997				
Satd. Flow (prot)	1629	1714	0	0	2971	0	0	3098	0	0	0	0
Flt Permitted	0.446							0.997				
Satd. Flow (perm)	765	1714	0	0	2971	0	0	3098	0	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					116			10				
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			25			30			30	
Link Distance (ft)		236			861			614			980	
Travel Time (s)		5.4			23.5			14.0			22.3	
Volume (vph)	156	149	0	0	75	111	70	1188	67	0	0	0
Confl. Peds. (#/hr)						5				5		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.85	0.92	0.92	0.92	0.85	0.92	0.92
Heavy Vehicles (%)	5%	5%	2%	2%	5%	2%	2%	10%	2%	2%	2%	2%
Adj. Flow (vph)	170	162	0	0	82	131	76	1291	73	0	0	0
Lane Group Flow (vph)	170	162	0	0	213	0	0	1440	0	0	0	0
Turn Type	pm+pt						Perm			custom		
Protected Phases	3	8			4			2				
Permitted Phases	8						2			6		
Detector Phases	3	8			4		2	2		6		
Minimum Initial (s)	4.0	4.0			4.0		4.0	4.0		4.0		
Minimum Split (s)	8.0	20.0			20.0		20.0	20.0		20.0		
Total Split (s)	16.0	36.0	0.0	0.0	20.0	0.0	64.0	64.0	0.0	64.0	0.0	0.0
Total Split (%)	16.0%	36.0%	0.0%	0.0%	20.0%	0.0%	64.0%	64.0%	0.0%	64.0%	0.0%	0.0%
Maximum Green (s)	12.0	32.0			16.0		60.0	60.0		60.0		
Yellow Time (s)	3.5	3.5			3.5		3.5	3.5		3.5		
All-Red Time (s)	0.5	0.5			0.5		0.5	0.5		0.5		
Lead/Lag	Lead				Lag							
Lead-Lag Optimize?	Yes				Yes							
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0		3.0		
Recall Mode	None	None			None		C-Min	C-Min		Min		
Walk Time (s)		5.0			5.0		5.0	5.0		5.0		
Flash Dont Walk (s)		11.0			11.0		11.0	11.0		11.0		
Pedestrian Calls (#/hr)		0			0		0	0		0		
Act Effct Green (s)	24.6	24.6			8.7			67.4				
Actuated g/C Ratio	0.25	0.25			0.09			0.67				
v/c Ratio	0.59	0.38			0.58			0.69				
Control Delay	39.3	33.2			26.5			12.7				

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	1.9	0.7			0.0			0.0				
Total Delay	41.3	33.9			26.5			12.7				
LOS	D	C			C			B				
Approach Delay		37.7			26.5			12.7				
Approach LOS		D			C			B				

Intersection Summary

Area Type: Other
Cycle Length: 100
Actuated Cycle Length: 100
Offset: 0 (0%), Referenced to phase 2:NBTL, Start of Yellow, Master Intersection
Natural Cycle: 65
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.69
Intersection Signal Delay: 18.4 Intersection LOS: B
Intersection Capacity Utilization 103.5% ICU Level of Service G
Analysis Period (min) 15

Splits and Phases: 9: J Street & Adams Drive



Lane Group	EBL	EBT	WBT	NBT
Lane Group Flow (vph)	170	162	213	1440
v/c Ratio	0.59	0.38	0.58	0.69
Control Delay	39.3	33.2	26.5	12.7
Queue Delay	1.9	0.7	0.0	0.0
Total Delay	41.3	33.9	26.5	12.7
Queue Length 50th (ft)	79	74	31	267
Queue Length 95th (ft)	128	123	65	380
Internal Link Dist (ft)		156	781	534
Turn Bay Length (ft)	200			
Base Capacity (vph)	297	548	573	2092
Starvation Cap Reductn	45	170	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.67	0.43	0.37	0.69

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)	4.0	4.0			4.0			4.0				
Lane Util. Factor	1.00	1.00			0.95			0.95				
Frpb, ped/bikes	1.00	1.00			0.99			1.00				
Flpb, ped/bikes	1.00	1.00			1.00			1.00				
Frt	1.00	1.00			0.91			0.99				
Flt Protected	0.95	1.00			1.00			1.00				
Satd. Flow (prot)	1629	1714			2970			3101				
Flt Permitted	0.33	1.00			1.00			1.00				
Satd. Flow (perm)	558	1714			2970			3101				
Volume (vph)	156	149	0	0	75	111	70	1188	67	0	0	0
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.85	0.92	0.92	0.92	0.85	0.92	0.92
Adj. Flow (vph)	170	162	0	0	82	131	76	1291	73	0	0	0
RTOR Reduction (vph)	0	0	0	0	106	0	0	3	0	0	0	0
Lane Group Flow (vph)	170	162	0	0	107	0	0	1437	0	0	0	0
Confl. Peds. (#/hr)						5				5		
Heavy Vehicles (%)	5%	5%	2%	2%	5%	2%	2%	10%	2%	2%	2%	2%
Turn Type	pm+pt						Perm			custom		
Protected Phases	3	8			4			2				
Permitted Phases	8						2			6		
Actuated Green, G (s)	24.6	24.6			8.8			67.4				
Effective Green, g (s)	24.6	24.6			8.8			67.4				
Actuated g/C Ratio	0.25	0.25			0.09			0.67				
Clearance Time (s)	4.0	4.0			4.0			4.0				
Vehicle Extension (s)	3.0	3.0			3.0			3.0				
Lane Grp Cap (vph)	264	422			261			2090				
v/s Ratio Prot	c0.08	0.09			0.04							
v/s Ratio Perm	c0.08							0.46				
v/c Ratio	0.64	0.38			0.41			0.69				
Uniform Delay, d1	32.0	31.4			43.1			9.9				
Progression Factor	1.01	1.00			1.00			1.00				
Incremental Delay, d2	5.0	0.6			1.1			1.9				
Delay (s)	37.2	32.0			44.2			11.8				
Level of Service	D	C			D			B				
Approach Delay (s)		34.7			44.2			11.8			0.0	
Approach LOS		C			D			B			A	

Intersection Summary

HCM Average Control Delay	19.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	103.5%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group