Attachment 4

Engineering Department
503-537-1273

City Attorney Office
503-537-1206

City of Newberg

414 E. First Street
Newberg, OR 97132

June 24, 2015

Matthew Garrett, Director
Oregon Department of Transportation
355 Capitol Street NE
Salem, OR 97301

RE: Newberg-Dundee Bypass
Wilsonville Road at Highway 219 Intersection

Dear Mr. Garrett,

ODOT's most current design of the Wilsonville Road at Highway 219 allows for through movements between Wilsonville Road and Phase 1 of the Bypass. The Ladd Hill Neighborhood Association (LHNA) has contacted the Oregon Department of Transportation (ODOT) and the City of Newberg (City) about their concerns for this configuration and future traffic on Wilsonville Road. They have proposed and worked with ODOT on a layout to not allow through movements (east/west) at this intersection as noted in Attachments 1 and 2.

The City met with the LHNA and ODOT on April 23, 2015 to look at the proposed revision and provide some preliminary feedback. The City asked for more detailed traffic information to be able to give the City some certainty on the impacts to our roadway system. The City also identified a concern on emergency vehicle access from Highway 219 onto Wilsonville Road with the proposed LHNA proposal.

This letter is intended to respond to the latest analysis for the re-configured intersection completed by Mackenzie on May 22, 2015. We continue to have concerns about the impacts to our local streets. Although, Mackenzie and the LHNA assert that the impacts are 'minor' there are impacts. On page 5 of their memo (Attachment 3) it shows that in 2016 three intersections that were studied will have a reduced performance standard over the current design. On page 6 the numbers for 2035 are similar in that three intersections (two of them in residential neighborhoods) are worse. Based on these numbers, the City of Newberg has difficulties in going "on the record as supporting the no-through movement design, to mitigate potentially significant impacts on the 12 miles of Wilsonville Road, the City of Wilsonville, four schools, active farms, and I-5 Exit 283." In fact, no documentation has been provided to show 'significant impacts' to Wilsonville Road, classified as a major collector in Yamhill County and minor arterial in Clackamas County.

At the April 23rd meeting the City requested another scenario be modeled but we have not seen that analysis. This scenario would be to leave Wilsonville Road connected to Springbrook Road and instead of a right-in/right-out configuration, install a traffic signal. This signal and the one proposed at Highway 219/Springbrook Road would have to be interconnected and work together to allow for queuing and storage. This analysis may be able to show that there is a solution that can work for all parties involved.

The other major concern raised is whether an amendment to the City's Transportation System Plan (TSP) will be required for a reconfiguration. Ordinance No. 2013-2766 amended the Transportation System Plan to reflect the Phase 1 alignment of the Bypass. This Ordinance and exhibits (Attachment 4) states:

Attachment 4

- Phase 1 of the bypass will reestablish the intersection of Highway 219 and Wilsonville Road.
- Wilsonville Road will be extended west and to connect to Highway 219
- The rerouting and extension of Wilsonville Road will be constructed to minor arterial street standards.
- The purpose of this project is to provide access to Phase 1 of the Bypass at acceptable levels of service and improve safety.
- Exhibit B of the Ordinance shows an intersection in the current through movement (east/west) design configuration.
- Exhibit D Goal 12 states that the Wilsonville Road realignment will improve connectivity between the Bypass, Highway 219 and Wilsonville Road and avoid violating roadway performance standards on Springbrook Road.

Based on the above, our assessment is that this revision will require an amendment to our TSP. This is a land use process that will take between 60-90 days at the local level and is appealable to the Land Use Board of Appeals. If you have specific questions about the process contact our Community Development Director, Doug Rux at 503.537.1212.

It has also been pointed out to the City in the May 22nd Mackenzie analysis that the FEIS that ODOT completed assumed two through lanes on Highway 219 at Springbrook Road. The current plans only show one lane. ODOT should show two lanes on the next set of drawings issued to match the FEIS.

Feel free to contact me with any questions and I look forward to continuing the discussion to obtain a solution that can work for the City of Newberg, ODOT and the Ladd Hill Neighborhood Association.

Sincerely,

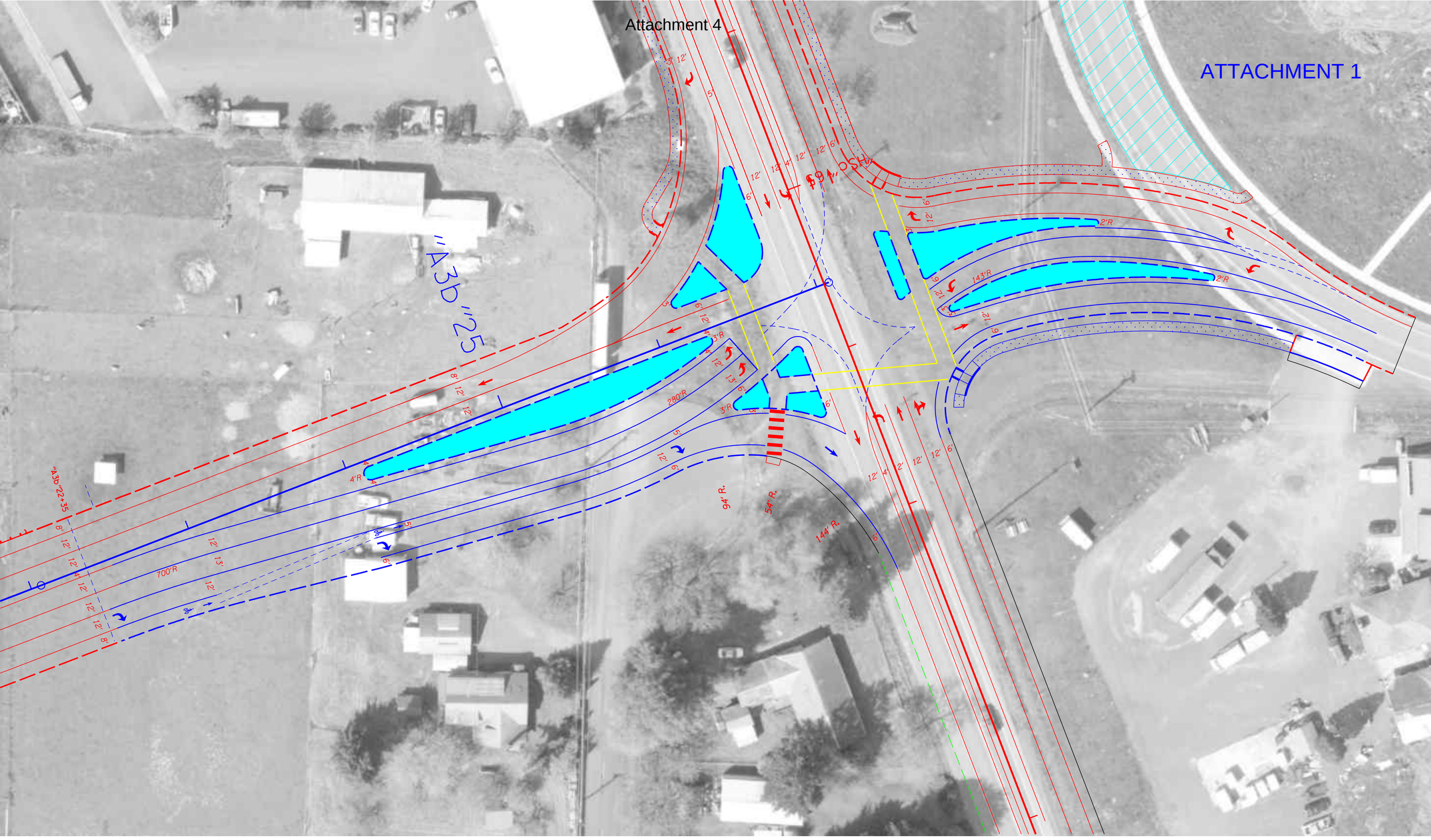
Kaaren Hofmann, PE
City Engineer

Attachments: 1. LHNA Proposed Intersection Configuration (close view)
2. LHNA Proposed Intersection Configuration (wide view)
3. May 22, 2015 Mackenzie Analysis
4. Newberg Ordinance No. 2013-2766

cc Tim Potter, ODOT
Mayor Bob Andrews
Newberg City Council
Jacque Betz, City Manager
Doug Rux, Community Development Director
Stan Halle, Ladd Hill Neighborhood Association, change1@mindspring.com

Attachment 4

ATTACHMENT 1



Attachment 4

ATTACHMENT 2

MACKENZIE.

DESIGN DRIVEN | CLIENT FOCUSED

ATTACHMENT 3

May 22, 2015

City of Newberg
Attention: Kaaren Hofmann
414 E First Street
Newberg, OR 97132

Re: **Newberg-Dundee Bypass**
Wilsonville Road at Highway 219 Analysis
Project Number 2130551.03

Dear Ms. Hofmann:

BACKGROUND

ODOT's most current Newberg-Dundee Bypass plans call for the alignment of Wilsonville Road at Highway 219 with through movements between Wilsonville Road and the Phase 1 Bypass ('Option 1'). As we discussed at our meeting on April 23, ODOT and the Ladd Hill Neighborhood Associate (LHNA) had jointly proposed to not allow through movements between Wilsonville Road and the Phase 1 Bypass through channelization and medians at this new intersection. In our letter dated April 21, 2015, Mackenzie presented six alternatives to the Newberg-Dundee Bypass road network, with the intent of not providing a direct connection between the Phase 1 Bypass and Wilsonville Road. These alternatives include the original alignment of Wilsonville Road at Highway 219 with through movements allowed, the proposed no-through movement configuration, and several other roadway configurations.

City staff had indicated a Transportation System Plan amendment would be needed if the impacts of the proposed no-through movement configuration would result in the need for a change in the classification of a City roadway. The criteria for determining the need are (i) intersection performance and (ii) specific standards as measured by the volume-to-capacity ratio (v/c). Initially, City staff noted volumes on the roadways could trigger the need for a reclassification, but we understand the City has no specific roadway volume thresholds identified for each classification. For State highway intersections, the ODOT specific performance threshold is addressed. For each scenario, we provide the total roadway volume for key segments, and intersection capacity analysis results for impacted locations. All scenarios are addressed for purposes of comparing relative impacts. This letter has been prepared to provide more detail on those aspects for both roadway volumes and intersection level of service, sufficient for determining the need for an amendment to the City's Transportation Plan.

CONCLUSIONS

Based on the analysis provided in this letter, we have reached four important conclusions:

1. Each of the alternatives has only a minor level of impact on streets in the City of Newberg. In the 'worst case,' traffic volume would increase by a maximum of 4% (most likely 1-2.5%).

2. Our analysis used volumes presented in a July 1, 2013, memo from William Ciz, with 2016 and 2035 PM peak hour traffic volumes as presented in the Kittelson & Associates (consultants to ODOT) FEIS analysis. Roadway configuration assumptions were taken from Figure 9 of the January 2012 Newberg Dundee Bypass Tier 2 Final Technical Memorandum, and preliminary construction plans provided by ODOT staff in February 2015. Capacity calculations were prepared using Synchro software, although the original FEIS analysis utilized Traffix software. We had requested copies of the original Traffix output from Kittelson and ODOT, but were not provided with them. Despite not having these original calculations, we were able to closely match the lane configurations, volumes and other parameters and followed ODOT's Analysis Procedures Manual.

3. Based on our analysis, the proposed no-through movement configuration of the intersection of the Phase 1 Bypass at Highway 219 opposite Wilsonville Road **does not result** in any of the intersections to fall below standards at the 2016 opening conditions, and at most would add 50 trips to any City street. Based on these findings, there is **no need** for the City of Newberg to amend the City's Transportation System Plan. An amendment was already approved by the Newberg City Council in December 2013 for the purpose of aligning Wilsonville Road opposite the Phase 1 Bypass at Highway 219. At that time, no specific intersection configuration was provided. We note most intersections in the area do not meet standards or are well over capacity in the 2035 analysis scenarios, as presented in the Final EIS for the project. This result does not change with the various scenarios we have reviewed, including the no-through movement design at Wilsonville Road and the Bypass eastern terminus.

4. During the course of our review, we discovered the FEIS had indicated two southbound through lanes were planned on Highway 219 at the intersection with Springbrook Road, but the current plans only show a single through lane. We verbally notified ODOT staff (Director Matt Garrett, Sonny Chickering. and Tim Potter at the May 15th meeting with LHNA representative, Stan Halle) of this discrepancy and that without a second southbound through lane on Highway 219, the intersection will not meet standards at opening of the Phase 1 Bypass in 2016. For purposes of this analysis we have assumed that two lanes would be provided, consistent with the FEIS.

SCENARIOS

Below is a summary of the six different scenarios discussed in our April 21, 2015, letter and evaluated in this analysis.

1. ODOT's Option 1 – This is the current alignment of Wilsonville Road at the Phase 1 Bypass with allowed through movements in both directions. Design hour traffic volumes from the July 2012 Kittelson figures for 2016 and 2035 Phase 1 scenarios were used as reported in this scenario.
2. Springbrook/Wilsonville Road Right-in/Right-out – Wilsonville Road remains aligned at Springbrook Road but limits turning movements to right-in/right-out.
3. Wynooksi Signal – Wilsonville Road is realigned along Adolf Road, proposed to be aligned across from Wynooksi Road. In this scenario, a traffic signal is assumed at the Wynooski Road/Wilsonville Road/Highway 219 intersection.
4. Springbrook + Wynooski – This scenario is a combination of the current Springbrook alignment scenario with proposed right-in/right-out movements and the Wynooski scenario with the proposed realignment along Adolf Road.

5. No-Throughs-2nd Street– This is another version of the current alignment of Wilsonville Road at the Phase 1 Bypass with prohibited through movements using a channelized configuration. In this scenario, through volumes will be rerouted to 2nd Street.

6. No-Throughs-Fernwood – This assumes the same channelized configuration as the "No-Throughs-2nd" scenario, but with through volumes rerouted to Fernwood Road/Renne Road.

Note: the last two Scenarios are viewed as 'worse case.' In reality, we would expect that traffic would use both options, thereby reducing already minor impacts.

TRAFFIC VOLUMES

A memorandum dated July 1, 2013, was provided to Mackenzie by ODOT staff which included figures reporting 2016 and 2035 Phase 1 design hour volumes for the Option 1 Wilsonville Road alignment at Highway 219. The figures, prepared by Kittelson & Associates, Inc. and dated July 2012, were used to reroute Wilsonville Road traffic onto the surrounding network in the different scenarios. The 2013 memorandum is enclosed with this letter.

At the Phase 1 Bypass, Wilsonville Road traffic was estimated to be 25 vehicles eastbound and westbound in 2016, and 40 vehicles eastbound and 35 vehicles westbound in 2035. At Renne Road, Wilsonville Road traffic was estimated to be 170 vehicles eastbound and 230 vehicles westbound in 2016, and 330 vehicles eastbound and 315 vehicles westbound in 2035.

Figures 1A and 7A show the estimated assignment of only Wilsonville Road traffic onto the surrounding network for 2016 and 2035, respectively, based on the Option 1 traffic volumes. The Wilsonville Road volumes from Figures 1A and 7A were rerouted accordingly in the other five scenarios. The Wilsonville Road volumes were subtracted from the design hour traffic volumes in the Kittelson figures to establish peak hour volumes excluding Wilsonville Road traffic. The Wilsonville Road volumes established for the different scenarios were added back to the base peak hour volumes. Since Phase 1 volumes were only reported for Springbrook Road/Fernwood Road, Highway 219/Springbrook Road/Industrial Parkway, and Highway 219/Wilsonville Road/Bypass, traffic on Highway 219 was carried through to the north and south for the remaining study intersections.

Figures 2A through 6A show the Wilsonville Road volumes for the five alternate scenarios in 2016, and Figures 8A through 12A show the Wilsonville Road volumes for 2035. Figures 2B through 6B show total roadway design hour volumes for 2016, and Figures 8B through 12B show the total design hour volumes for 2035.

The tables below show the difference in estimated traffic volumes for 2nd Street, Fernwood Road and Springbrook Road between the different scenarios and ODOT's current 'Option 1.'

2016 VOLUME COMPARISON							
Road	Volume	Option 1	Springbrook RI-RO	Wynooski Signal	Springbrook + Wynooski	No Throughs-2nd	No Throughs-Fernwood
2nd Street	Total	55	55	55	55	105	55
	Change from Option 1	0	0	0	0	50	0
Fernwood Road	Total	395	565	565	565	395	420
	Change from Option 1	0	170	170	170	0	25
Springbrook Road	Total	1285	1265	1200	1200	1335	1310
	Change from Option 1	0	-20	-85	-85	50	25

2035 VOLUME COMPARISON							
Road	Volume	Option 1	Springbrook RI-RO	Wynooski Signal	Springbrook + Wynooski	No Throughs-2nd	No Throughs-Fernwood
2nd Street	Total	270	270	270	270	345	270
	Change from Option 1	0	0	0	0	75	0
Fernwood Road	Total	945	1230	1230	1230	945	985
	Change from Option 1	0	285	285	285	0	40
Springbrook Road	Total	1600	1515	1430	1430	1675	1635
	Change from Option 1	0	-85	-170	-170	75	35

SYNCHRO ANALYSIS

Synchro 8 was used to model the six scenarios, all of which included the following five key intersections.

1. Highway 219/E 2nd Street
2. Springbrook Road/E Fernwood Road/E 2nd Street
3. Highway 219/Industrial Parkway/ Springbrook Road
4. Highway 219/Wilsonville Road/Bypass
5. Highway 219/Wynooski Road

Volume-to-Capacity (v/c) ratios matched closely to those reported on the Kittelson figures utilizing HCM 2000 methodology. The prior analysis was completed using Traffix, for which the original output sheets were not made

available to Mackenzie. For the three intersections within the study area which had prior v/c ratios reported, the v/c ratios were matched within a 10% margin of error.

The lane configurations within the Synchro model were based on the OR18: Newberg-Dundee Bypass (Phase 1G) (Springbrook Road) plans dated 12/11/2014. Due to differences between the proposed lane configurations at Highway 219/Industrial Parkway/Springbrook Road during the time of the study and now, the lane configuration used in the 2012 analysis was assumed, which includes an extra southbound through lane. An ideal saturated flow rate of 1750 vehicles per hour per lane was used per the ODOT Analysis Procedures Manual for small urban areas. All signals were coded to simulate actuated-coordinated signals with a cycle length of 120 seconds. Right turns-on-red were assumed at all signalized intersections.

The following tables show the performance standard for each intersection, as well as the v/c ratios from the 2016 and 2035 analyses for each scenario. *Note that any v/c ratio that exceeds the stated Performance Standard is highlighted in* ***bold red.***

2016 INTERSECTION ANALYSIS – V/C							
Intersection	Performance Standard	Scenario					
		Option 1	Springbrook RI-RO	Wynooski Signal	Springbrook + Wynooski	No Throughs-2nd	No Throughs-Fernwood
Highway 99/Springbrook Road	0.75	**0.97**	**0.97**	**0.97**	**0.97**	**0.97**	**0.97**
Highway 219/Bypass	0.65	0.65	0.65	**0.68**	0.64	0.65	0.65
Highway 219/Springbrook Road	0.80	0.69	0.66	0.62	0.63	0.73	0.70
Springbrook Road/E Fernwood Road	0.90	0.77	0.81	0.85	0.73	0.80	0.80
Highway 219/E 2nd Street	0.80	0.38	0.61	0.61	0.61	0.39	0.38
Highway 219/Wynooski Road	0.80	0.26	0.26	0.57	0.56	0.26	0.26

2035 INTERSECTION ANALYSIS – V/C							
Intersection	Performance Standard	Scenario					
		Option 1	Springbrook RI-RO	Wynooski Signal	Springbrook + Wynooski	No Throughs-2nd	No Throughs-Fernwood
Highway 99/Springbrook Road	0.75	**1.35**	**1.35**	**1.35**	**1.35**	**1.35**	**1.35**
Highway 219/Bypass	0.65	**0.88**	**0.84**	**0.90**	**0.83**	**0.87**	**0.86**
Highway 219/Springbrook Road	0.80	**0.90**	**0.88**	0.79	**0.85**	**0.96**	**0.92**
Springbrook Road/E Fernwood Road	0.90	**1.46**	**1.79**	**1.95**	**1.67**	**1.55**	**1.54**
Highway 219/E 2nd Street	0.80	0.74	**1.04**	**1.04**	**1.04**	0.78	0.74
Highway 219/Wynooski Road	0.80	0.65	0.65	**0.84**	**0.84**	0.65	0.65

RESULTS

In the 2016 analysis, all of the scenarios show adequate v/c ratios for the five key intersections, with the exception of the Wynooski signal scenario, which exceeds the standard at the Highway 219/Bypass intersection.

The proposed no-through movement scenario shows some intersections operating at up to a 4% higher v/c ratio than in ODOT's 'Option 1,' but still operate at acceptable levels in 2016.

Two intersections are anticipated to be over capacity in 2035 under ODOT's 'Option 1' and no-through movement scenarios, specifically the Springbrook intersections with Highway 99W and Fernwood Road. For the other scenarios, three intersections would be over capacity.

The Highway 219/Springbrook Road intersection was analyzed by modeling, specifically: one shared through-right, one through, and one exclusive left turn lane on the southbound approach, yielding a v/c ratio of 0.69. This configuration is consistent with the original plans for the Highway 219/Springbrook Road intersection in the Newberg Dundee Bypass Tier 2 Final Technical Memorandum. In the Tier 2 memorandum, this intersection resulted in a 0.62 v/c ratio under the Phase 1 – Improved scenario. The latest Newberg-Dundee Bypass (Phase 1G) ODOT plans call for one shared through-right and one exclusive left turn lane on the southbound approach. This configuration results in a v/c ratio of 0.92, which exceeds the performance standard of 0.80. It is suggested that ODOT change their plans to match the original Tier 2 plans for the Highway 219/Springbrook Road intersection in order to meet the capacity standard of 0.80. It is also recommended ODOT change their plan at this intersection to the previous Tier 2 configuration since this has already been approved.

Based on this analysis, it is clear the proposed no-through movement scenario has little impact on the area roads and intersection operation. No intersections will exceed performance standards at opening of the Phase 1 Bypass in 2016. Further, this scenario has less impact than other scenarios (that also have significant added costs), such as the Wynooski signal options with an alignment along Adolf Road. We request the City of Newberg make a finding that no additional

amendment to the City's Transportation System Plan is needed for the ODOT/LHNA proposed no-through movement scenario at the intersection of the Phase 1 Bypass at Highway 219 opposite Wilsonville Road. Furthermore, we request that the Newberg City staff go on record as supporting the no-through movement design to mitigate potentially significant impacts on the 12 miles of Wilsonville Road, the City of Wilsonville, four schools, active farms, and I-5 Exit 283.

If you should have any comments or concerns, please do not hesitate to contact us.

Sincerely,

Brent Ahrend, PE
Senior Associate | Traffic Engineer

Enclosure(s): July 1 20123 Memorandum
Volume Figures
Synchro output sheets
Tier 2 Final Technical Document (excerpts)
OR18 Newberg-Dundee Bypass (Phase 1G) plans

c: Jessica Pelz, Doug Rux – City of Newberg
Stan Halle, Cole Presthus – Ladd Hill Neighborhood Association
Tim Potter, Kelly Amador, Sonny Chickering – ODOT
Ralph Bloemers – Crag Law Center
Janet Jones – Mackenzie

Attachment 4

Newberg-Dundee
BYPASS PROJECT

MEMORANDUM

Date:	July 1, 2013
To:	Kelly Amador
From:	William Ciz
Subject:	Wilsonville Road Traffic Counts
cc:	
Project Number:	274-2395-058
Project Name:	Newberg Dundee Bypass Project

Here is a quick summary of 2011 Traffic Counts, 2016 Traffic Projections (No Build and Build), and 2035 Traffic Projections (No Build and Build) on Wilsonville Road east of Oregon 219, Clackamas and Yamhill County functional classification for Wilsonville Road, a review of Phase 1 E Signing Plans and responses to COP comments. Also attached are the Figures from the Traffic Analysis Reports with the counts and projections referenced in case you would like to forward them.

2011 Peak Hour Traffic Counts (See 2011 Traffic Count pdf, Intersection #21) at the Wilsonville Road/Springbrook Road Intersection were 205 vehicles traveled westbound (70 turned right and 135 turned left onto Springbrook Road). 140 vehicles traveled eastbound (70 turned right and 70 turned left from Springbrook Road onto Wilsonville Road).

2016 No Build Peak Hour Traffic Projections (See Figure 2A, Intersection #21) at the Wilsonville Road/Springbrook Road Intersection were 230 vehicles traveled westbound (80 turned right and 150 turned left onto Springbrook Road). 170 vehicles traveled eastbound (85 turned right and 85 turned left from Springbrook Road onto Wilsonville Road).

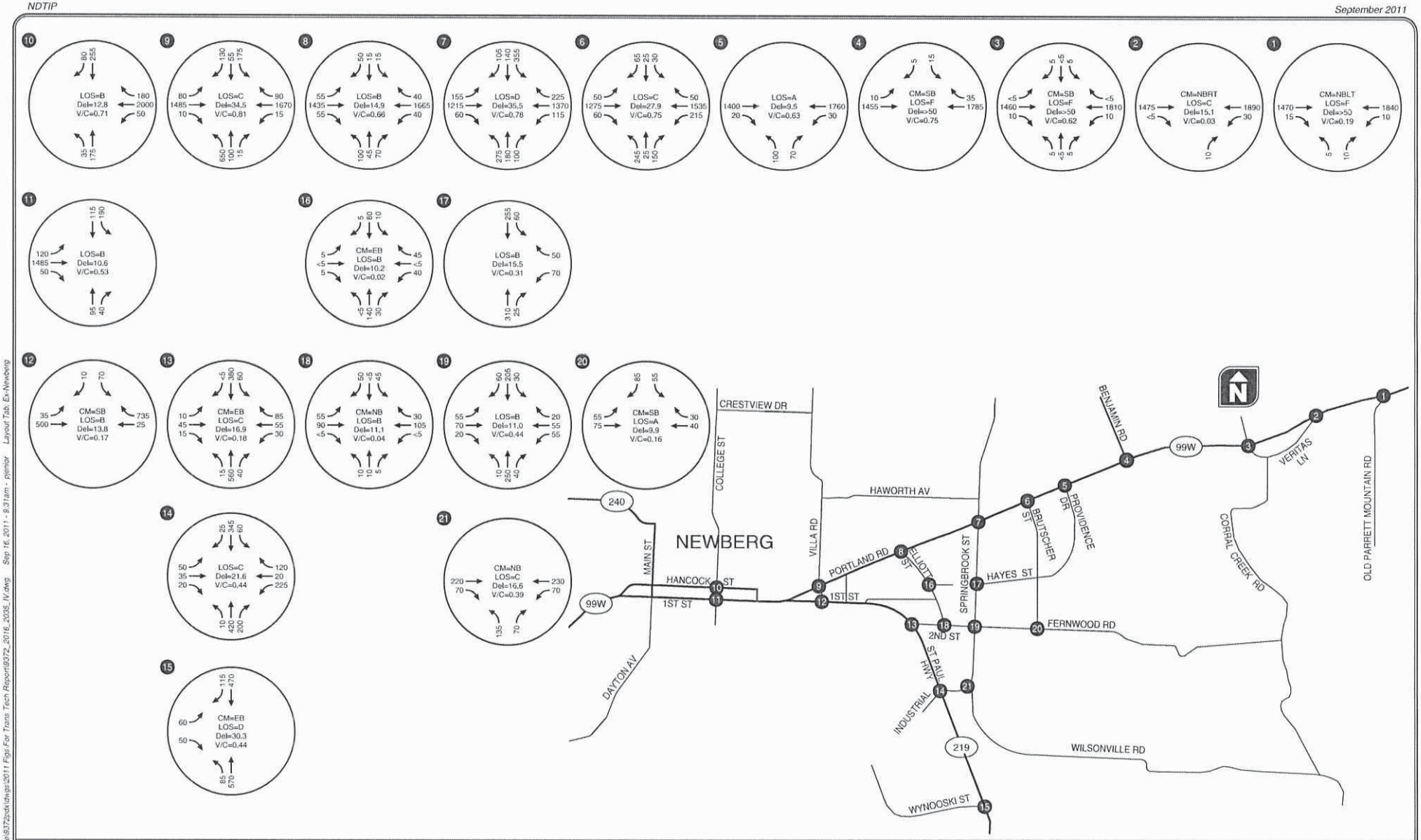
2016 Build Peak Hour Traffic Projection (See Figure 7, Intersection #5) at the new Oregon 219/Wilsonville Road Intersection are 230 vehicles will travel westbound (165 will turn right onto Oregon 219 , 25 will enter the Phase 1 Bypass and 40 will turn left onto Oregon 219). 170 vehicles will travel eastbound (15 will turn right form Oregon 219, 25 will enter from the Phase 1 Bypass and 130 will turn left from Oregon 219).

2035 No Build Peak Hour Traffic Projections (See Figure 4A, Intersection #21) at the Wilsonville Road/Springbrook Road Intersection were 310 vehicles traveled westbound (115 turned right and 195 turned left onto Springbrook Road). 280 vehicles traveled eastbound (140 turned right and 140 turned left from Springbrook Road onto Wilsonville Road).

2035 Peak Hour Traffic Projection (See Figure 8, Intersection #5) at the new Oregon 219/Wilsonville Road Intersection are 315 vehicles will travel westbound (230 will turn right onto Oregon 219 , 35 will entered the Phase 1 Bypass and 50 will turned left onto Oregon 219). 330 vehicles will travel eastbound (25 will turn right from Oregon 219, 40 will enter from the Phase 1 Bypass and 265 will turn left from Oregon 219).

Wilsonville Road is classified as a Major Collector by Yamhill County and as a Major Arterial in Clackamas County.

I also review the current signing plans for Phase 1E. There are no signs at the Oregon 219/Phase 1 Bypass/Wilsonville Road Intersection directing traffic to use Wilsonville Road.

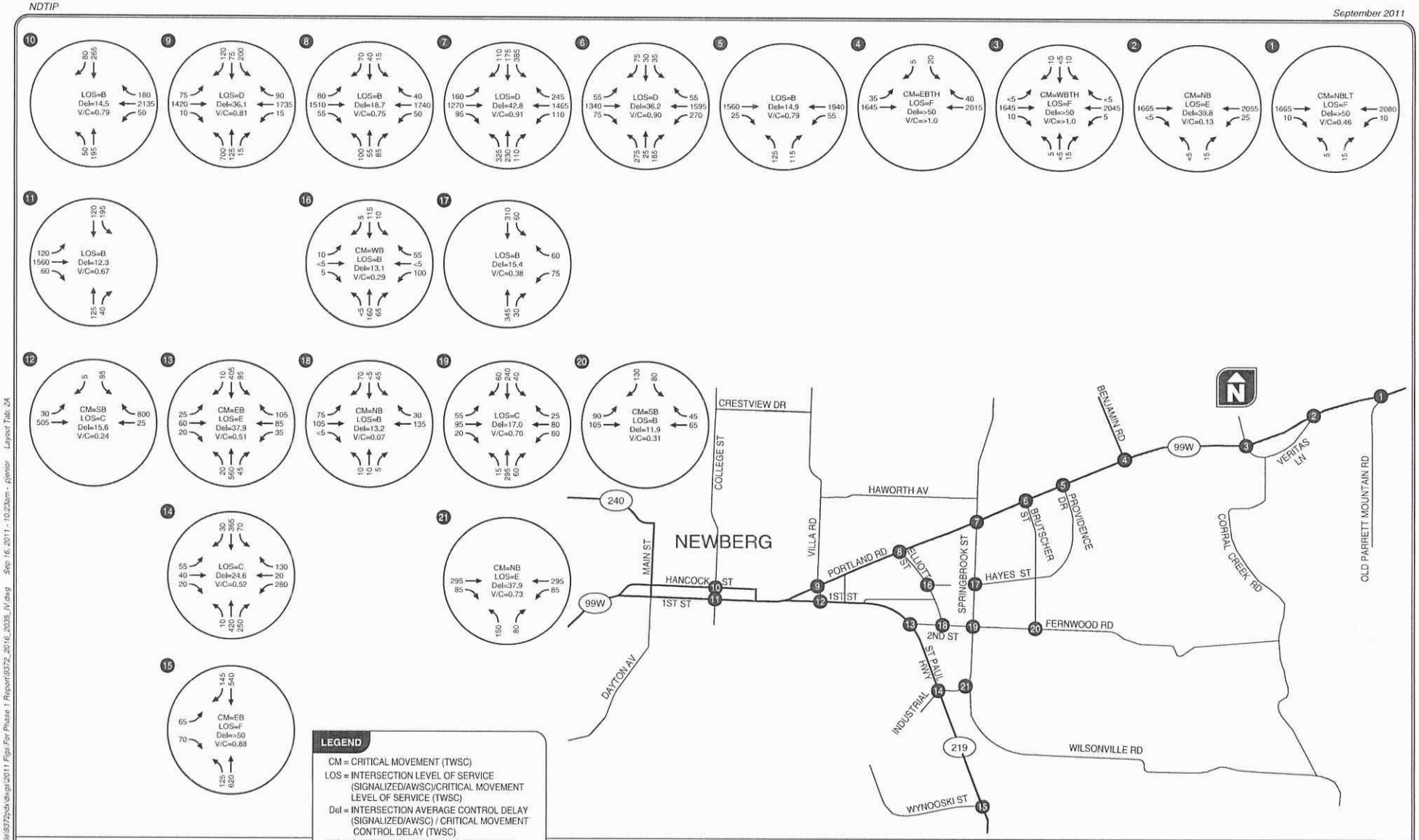


2011 EXISTING TRAFFIC CONDITIONS NEWBERG, OREGON

FIGURE 3A

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING

Attachment 4



2016 NO BUILD TRAFFIC CONDITIONS NEWBERG, OREGON

FIGURE **2A**

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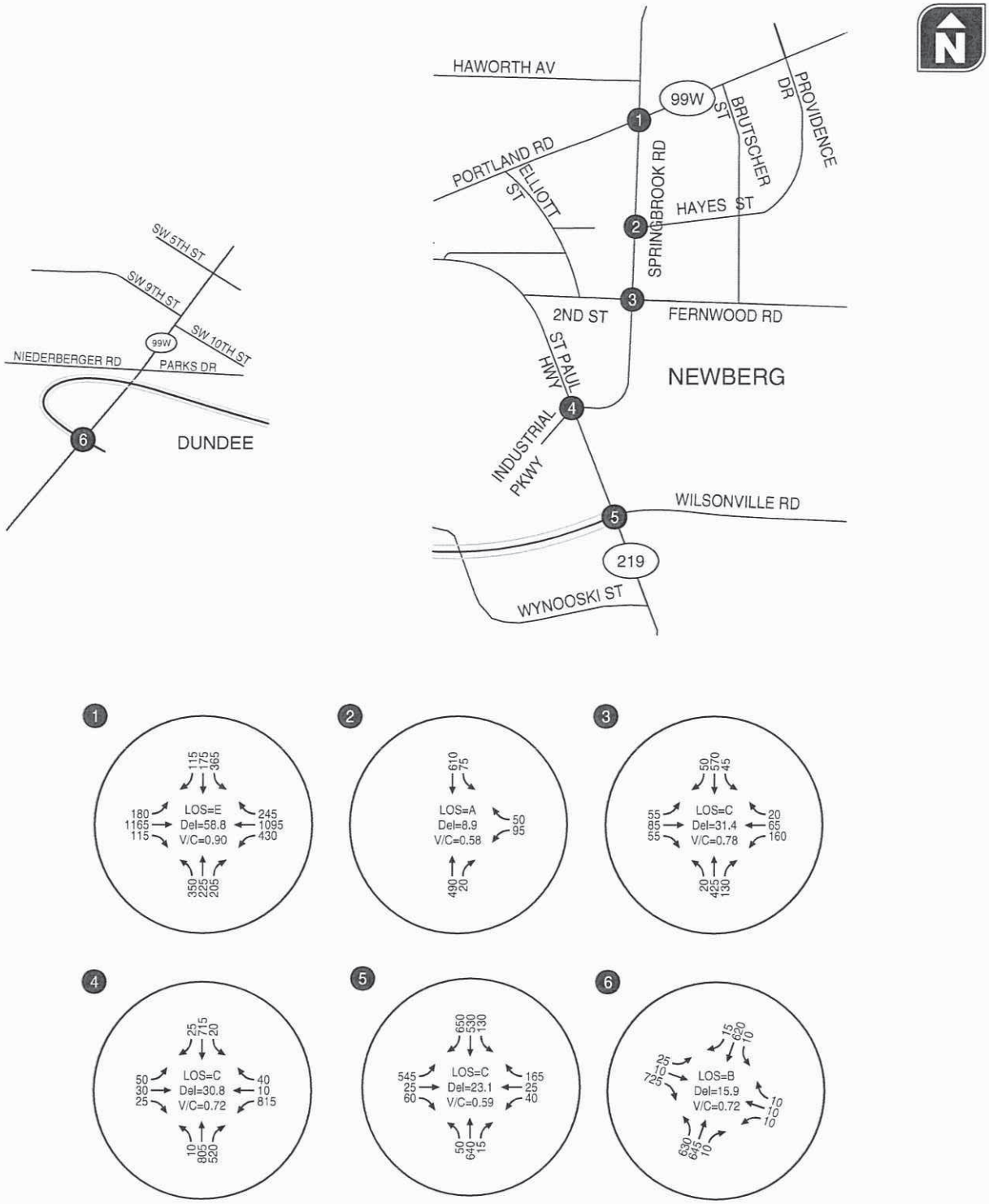


LEGEND

LOS = INTERSECTION LEVEL OF SERVICE

Del = INTERSECTION AVERAGE CONTROL DELAY

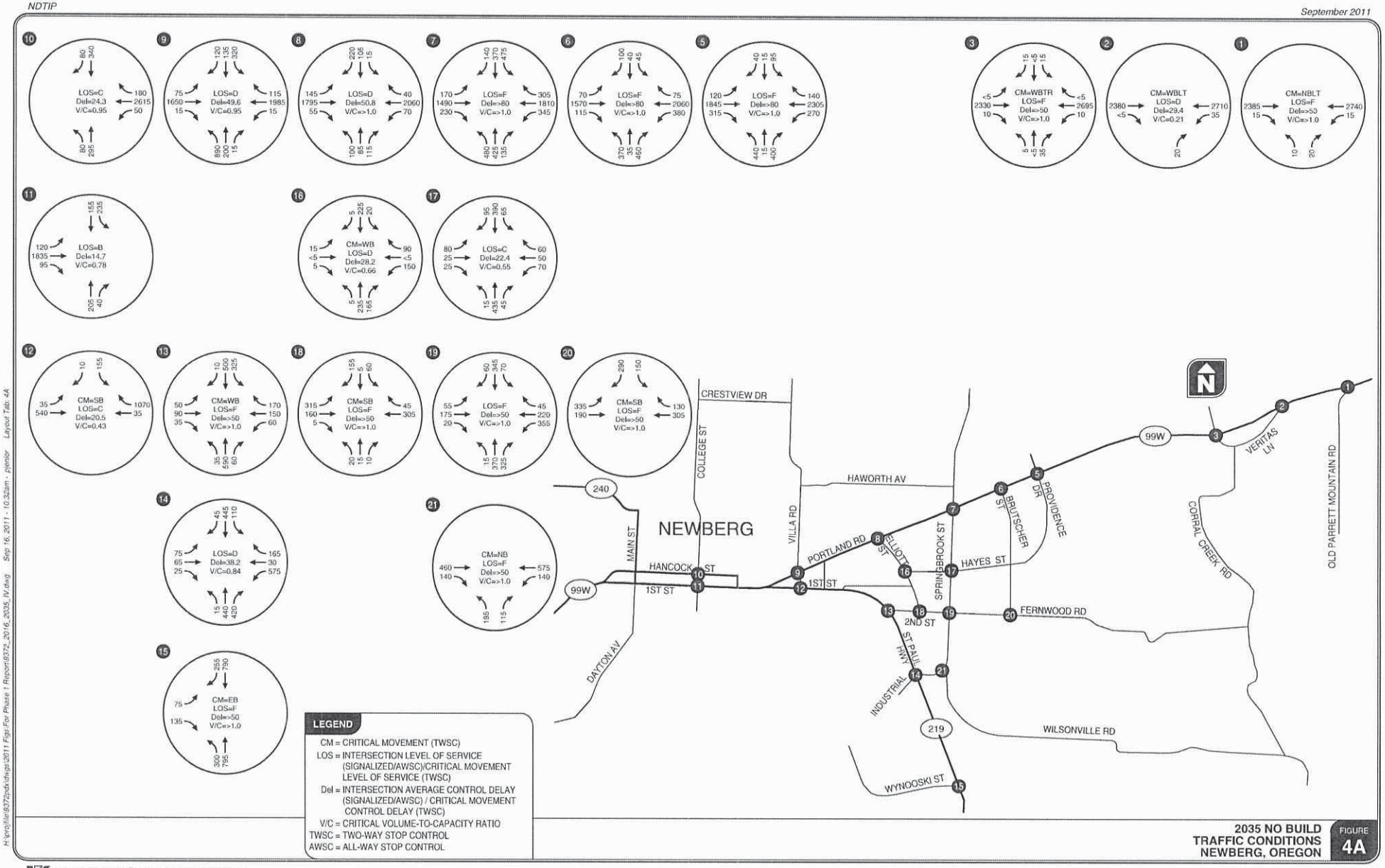
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

YEAR 2016 PHASE 1 SCENARIO
DESIGN HOUR TRAFFIC CONDITIONS
NEWBERG, OREGON

FIGURE 7

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION PLANNING / TRAFFIC ENGINEERING

H:\projfile\9372 - Newberg-Dundee Bypass\2012 July Analysis TST\dwg\9372_Fig_2012_July.dwg Jul 25, 2012 - 11:39am - darguea Layout Tab: 01

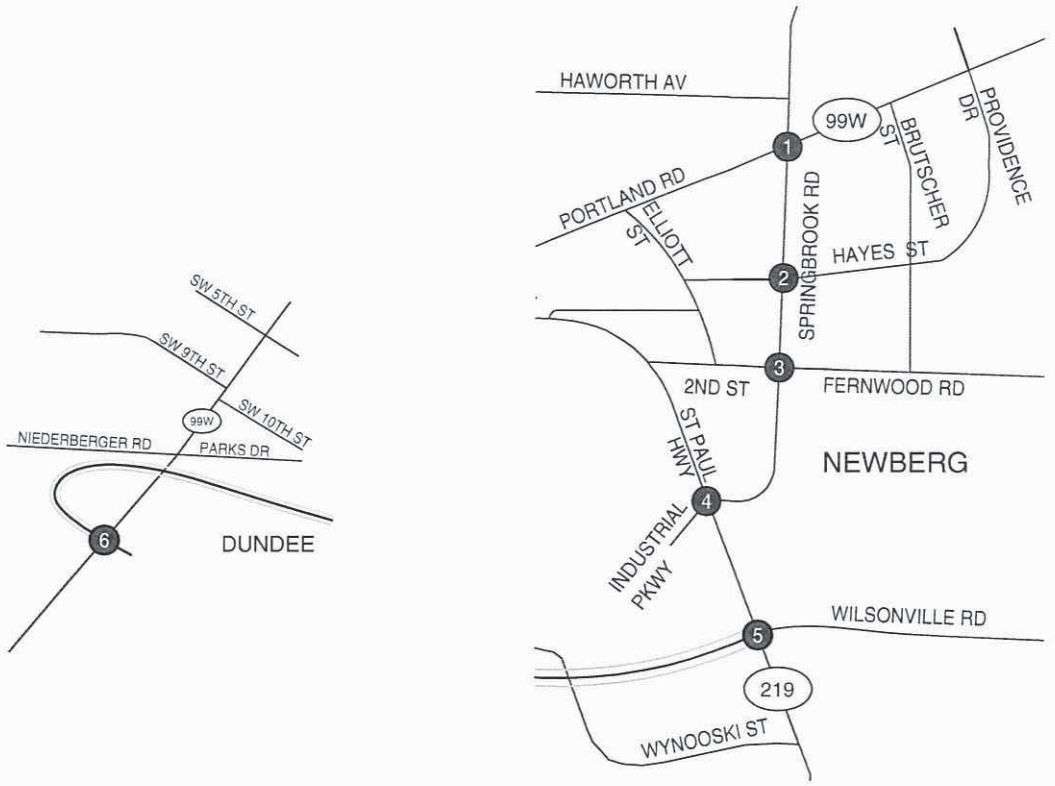


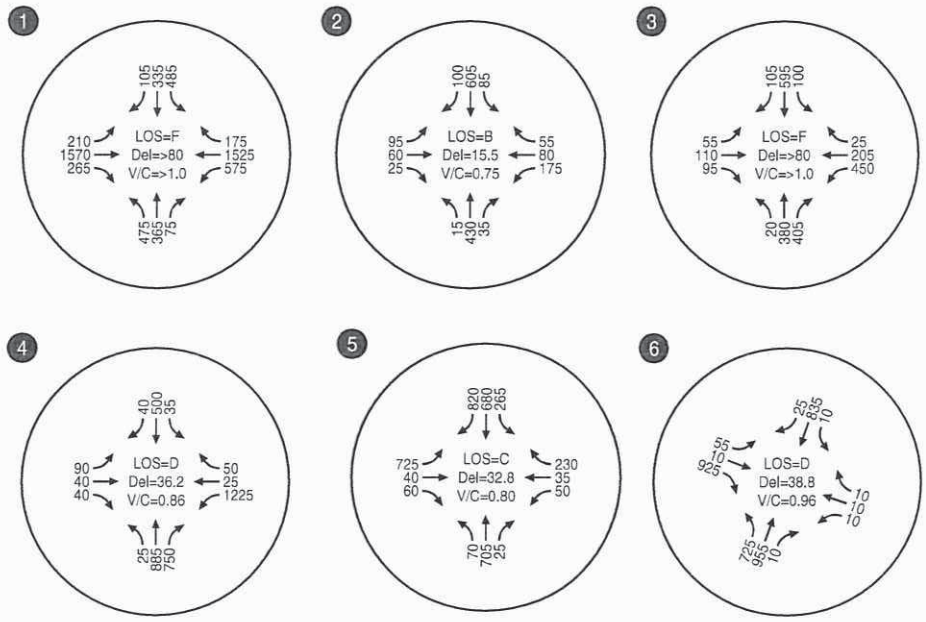
LEGEND

CM = CRITICAL MOVEMENT (TWSC)
LOS = INTERSECTION LEVEL OF SERVICE (SIGNALIZED/AWSC)/CRITICAL MOVEMENT LEVEL OF SERVICE (TWSC)
Del = INTERSECTION AVERAGE CONTROL DELAY (SIGNALIZED/AWSC) / CRITICAL MOVEMENT CONTROL DELAY (TWSC)
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO
TWSC = TWO-WAY STOP CONTROL
AWSC = ALL-WAY STOP CONTROL

2035 NO BUILD TRAFFIC CONDITIONS NEWBERG, OREGON

FIGURE **4A**





LEGEND

LOS = INTERSECTION LEVEL OF SERVICE

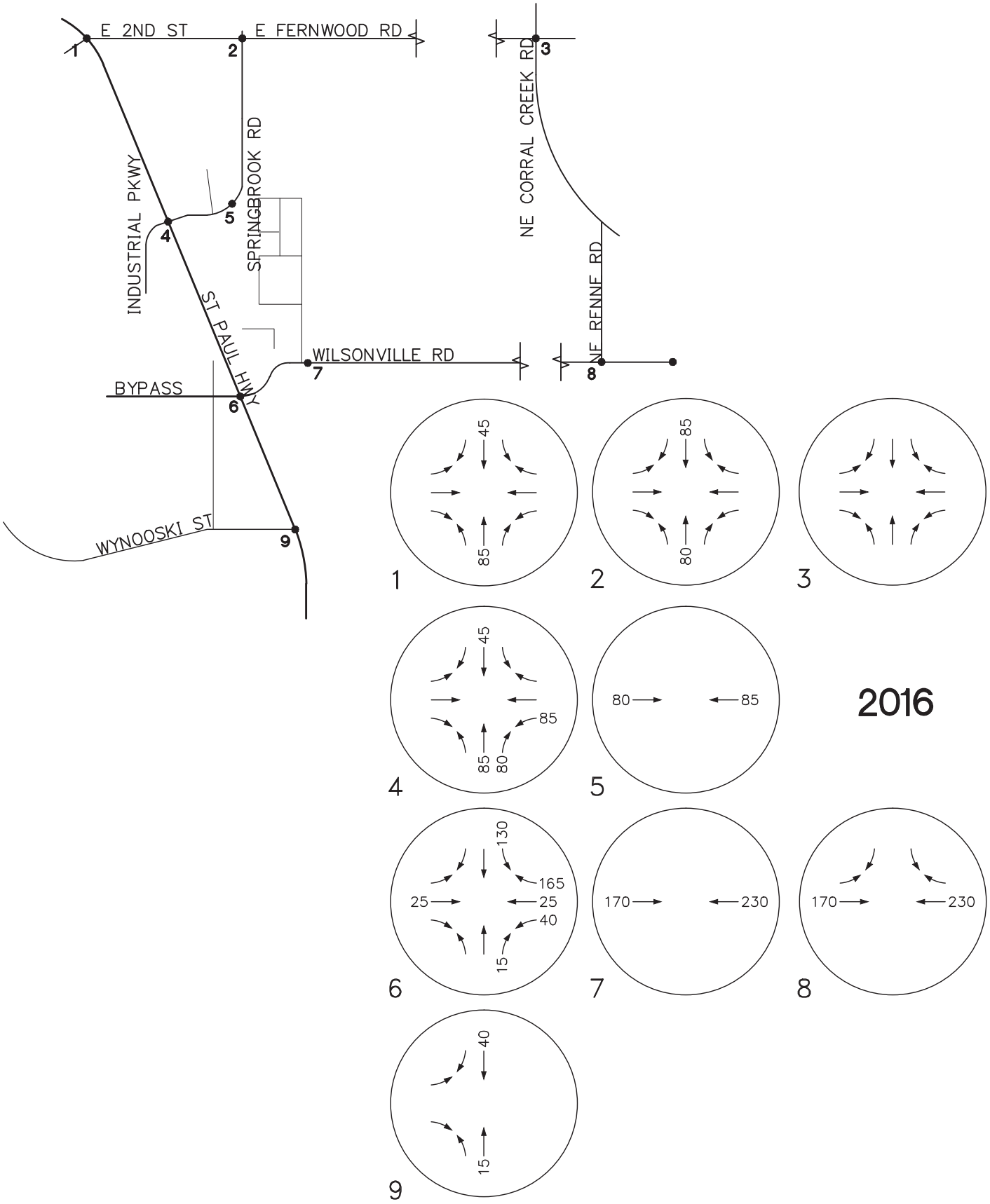
Del = INTERSECTION AVERAGE CONTROL DELAY

V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

YEAR 2035 PHASE 1 SCENARIO
DESIGN HOUR TRAFFIC CONDITIONS
NEWBERG, OREGON

FIGURE **8**

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION PLANNING / TRAFFIC ENGINEERING



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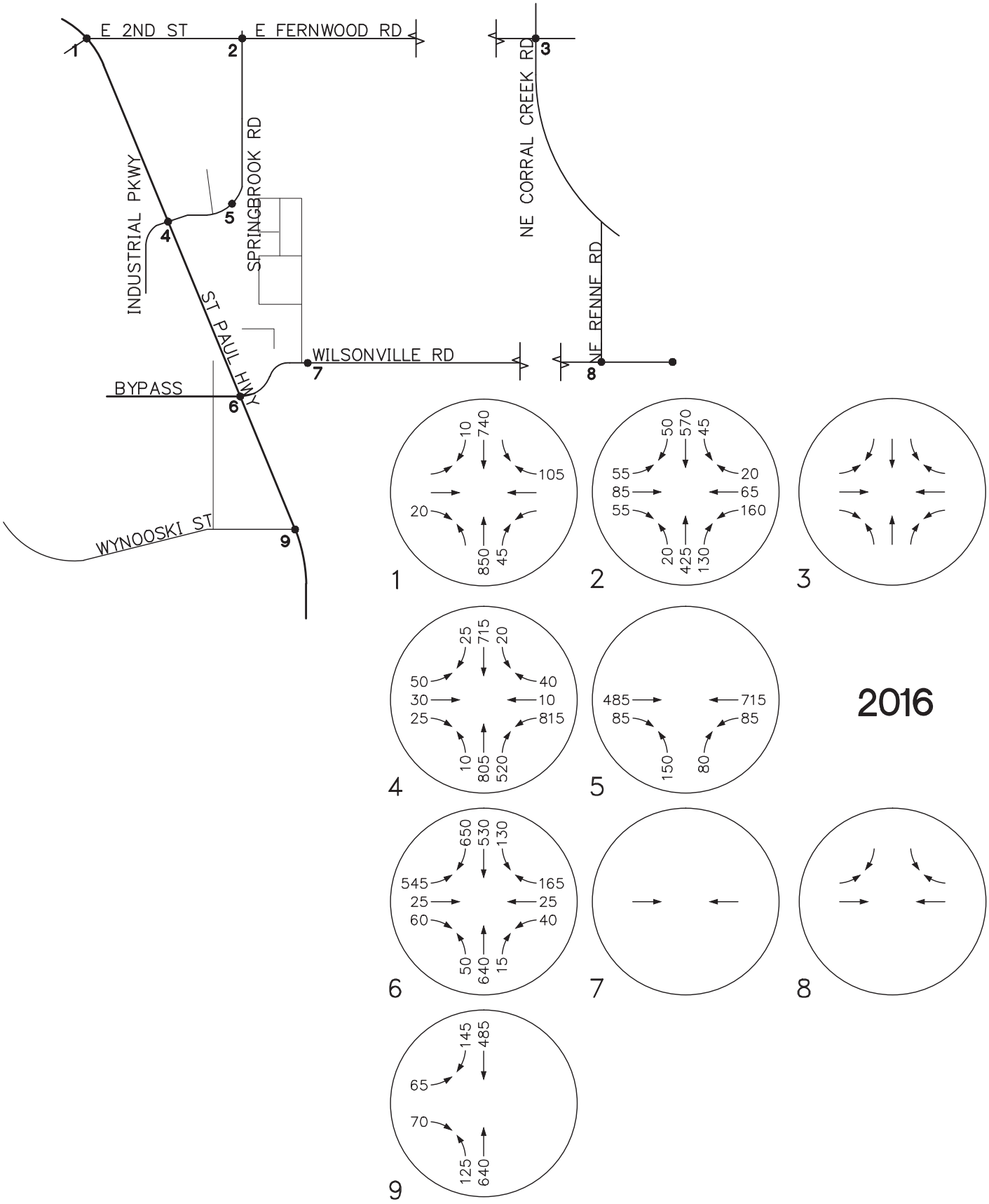
DATE: 04.17.15
DRAWN BY: JTJ
CHECKED BY: BTA
JOB NO: 2130551.03

OPTION 1
PM PEAK HOUR

WILSONVILLE ROAD REVIEW
NEWBERG, OREGON

FIGURE
1A



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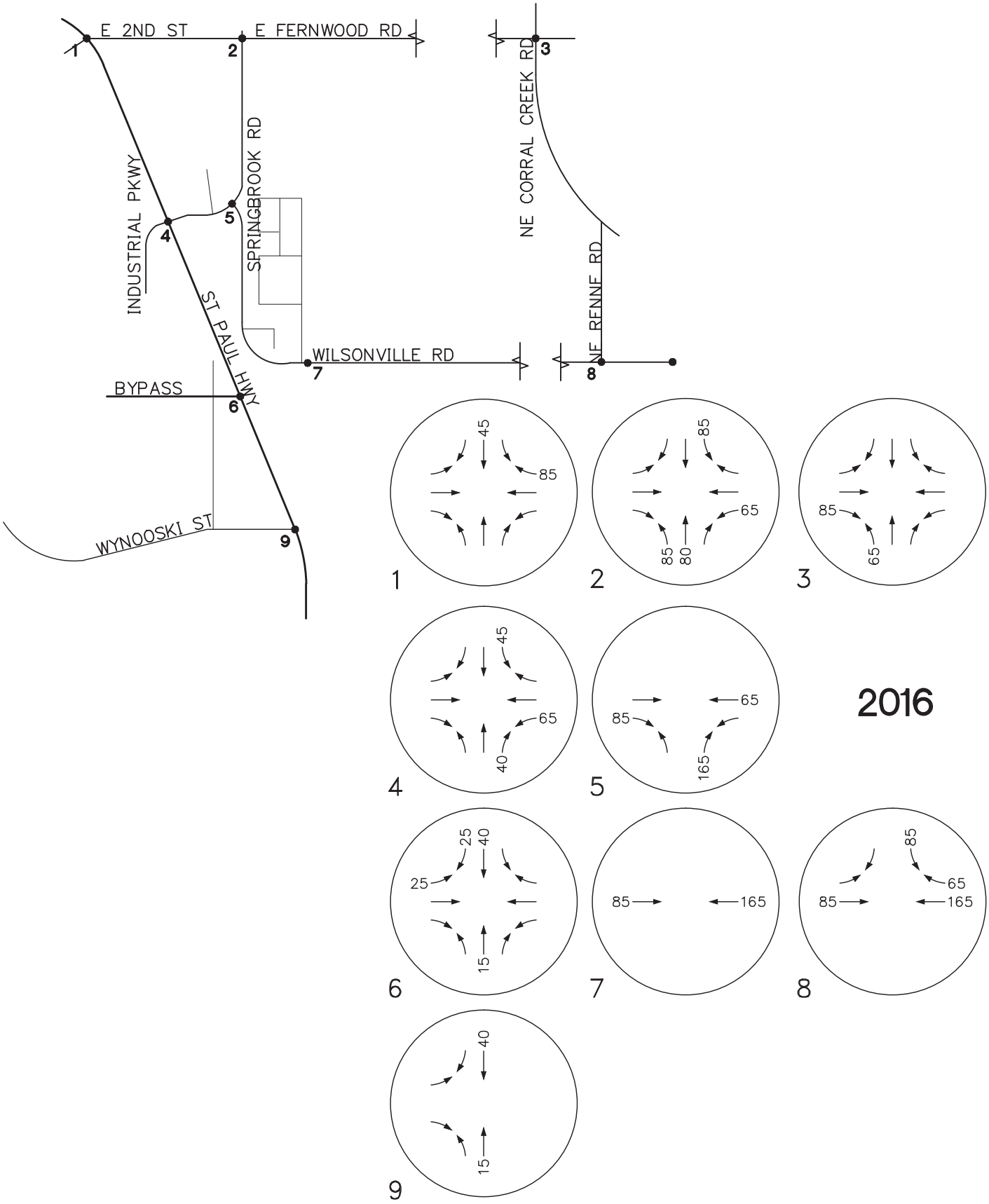
JOB NO: 2130551.03

OPTION 1
PM PEAK HOUR TOTAL

WILSONVILLE ROAD REVIEW
NEWBERG, OREGON

FIGURE
1B



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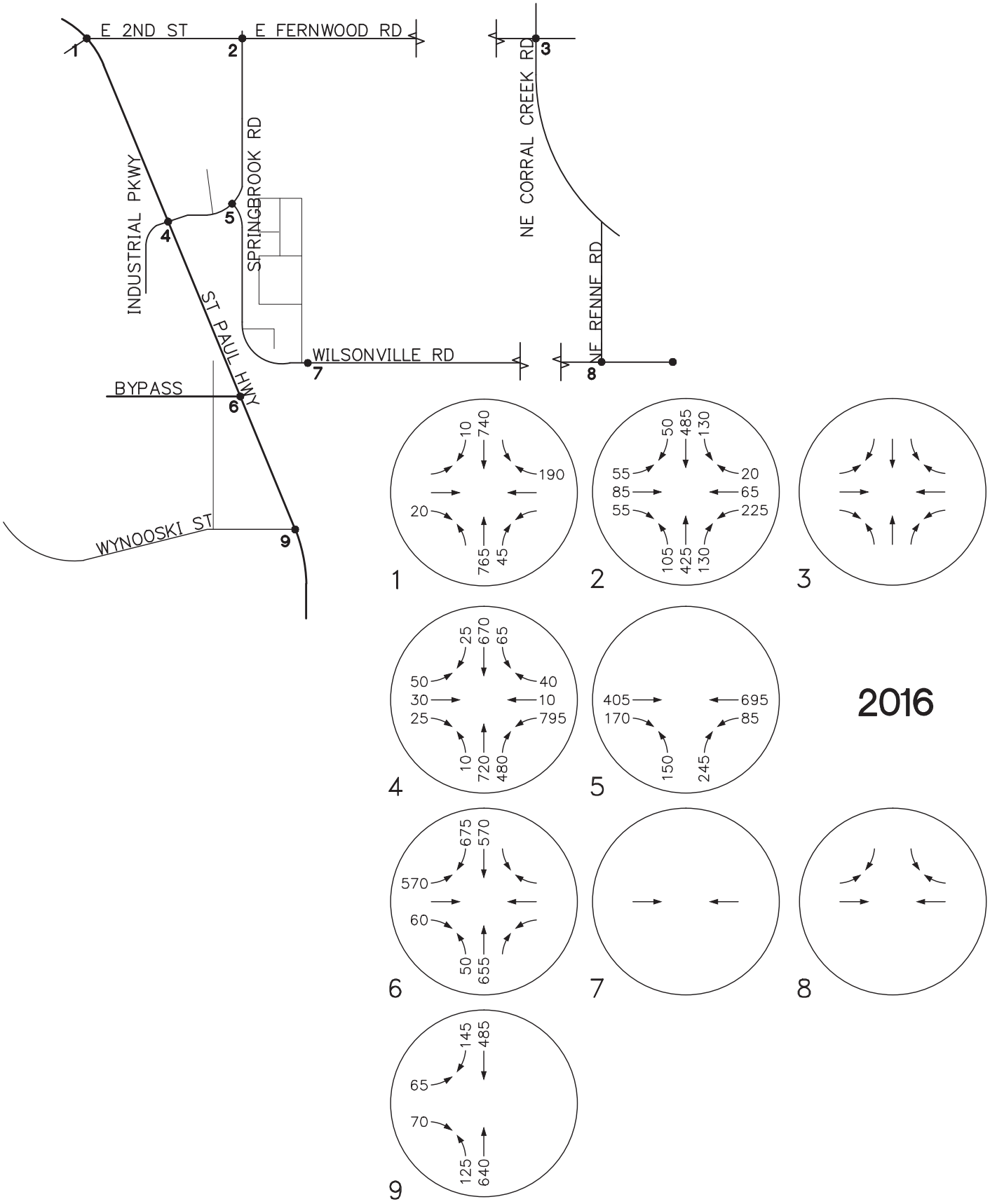
SPRINGBROOK RIGHT IN/OUT
PM PEAK HOUR

WILSONVILLE ROAD REVIEW
NEWBERG, OREGON

FIGURE
2A



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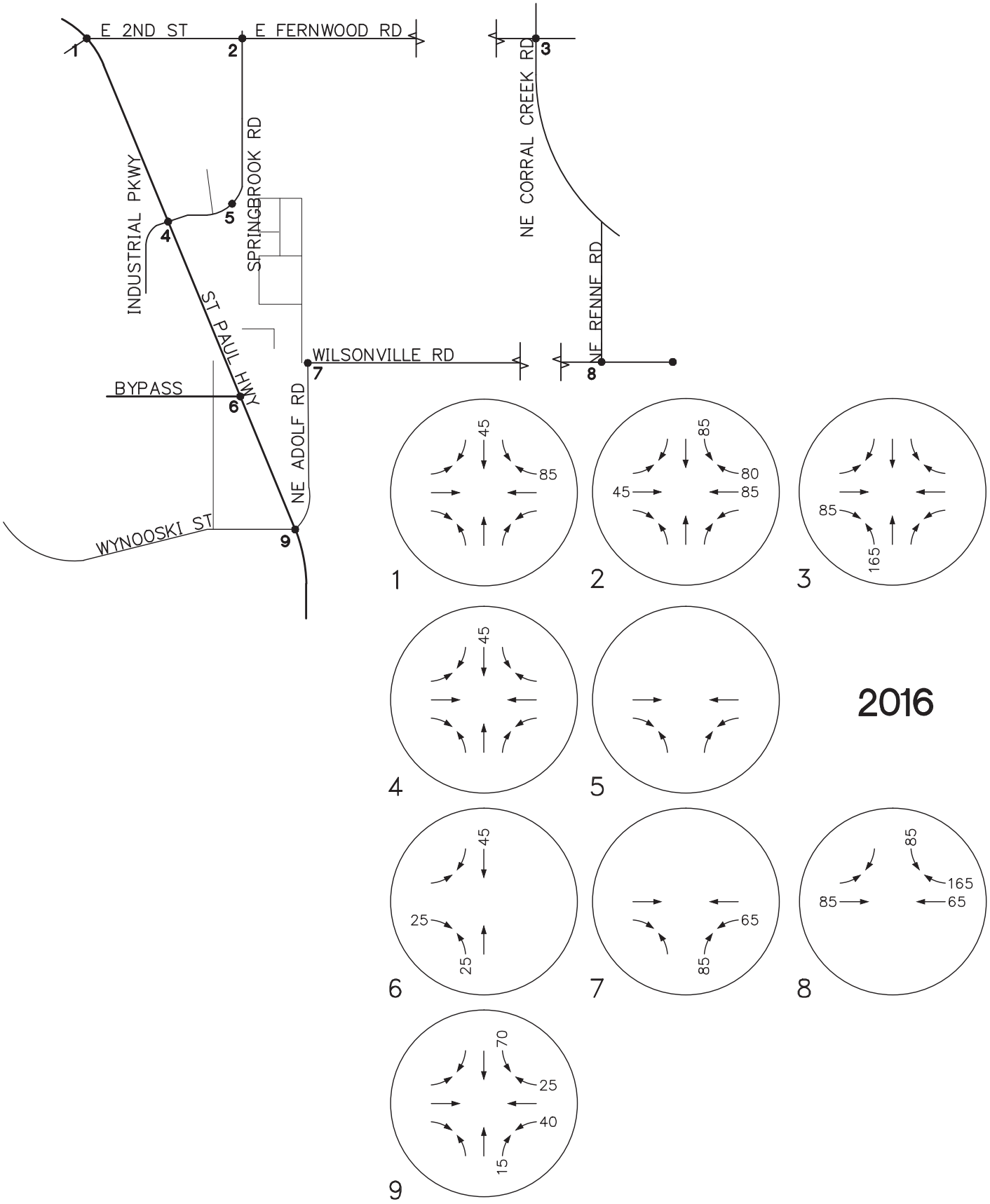
SPRINGBROOK RIGHT IN/OUT
PM PEAK HOUR TOTAL

WILSONVILLE ROAD REVIEW
NEWBERG, OREGON

FIGURE
2B



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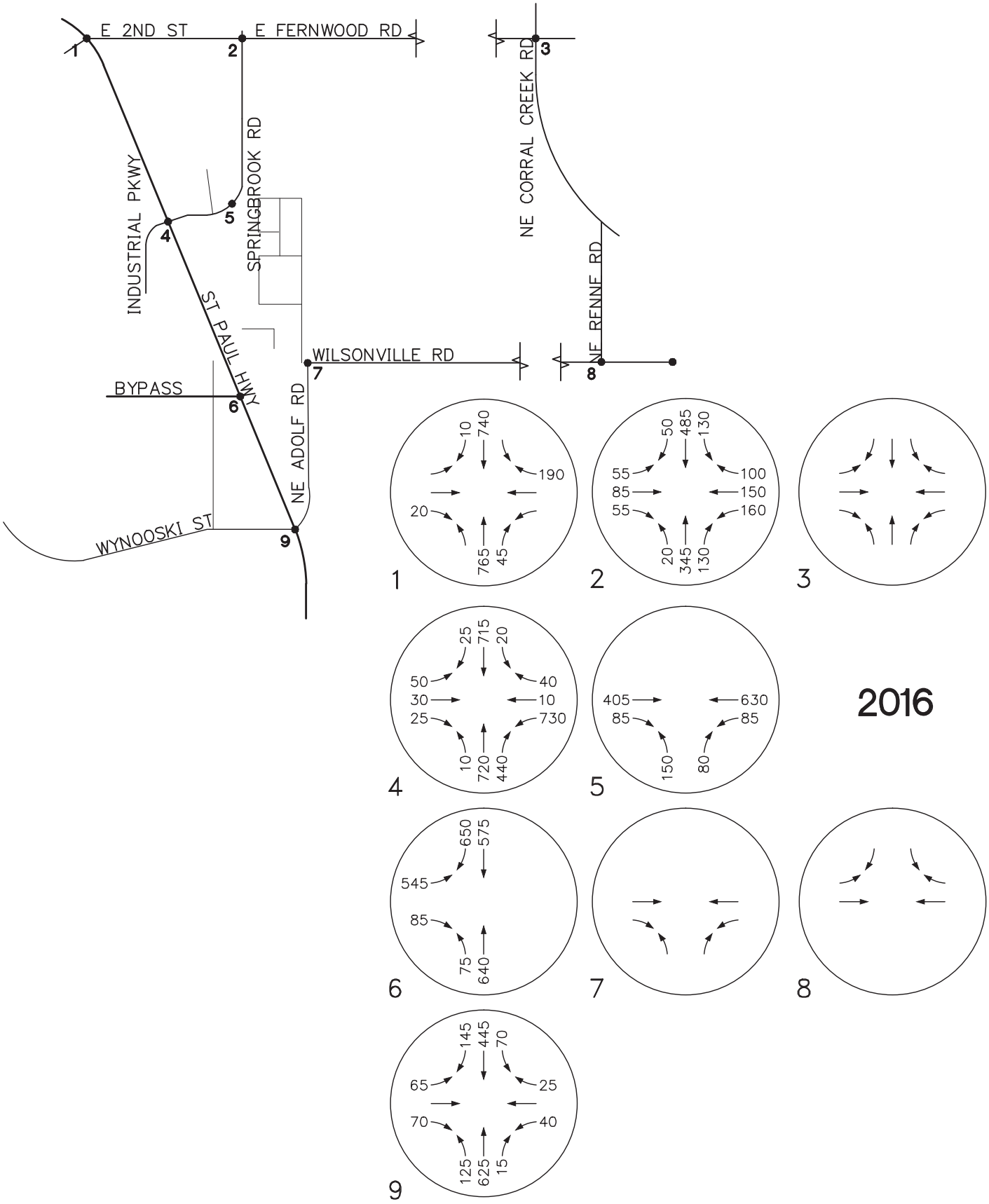
WYNOOSKI SIGNAL
PM PEAK HOUR

WILSONVILLE ROAD REVIEW
NEWBERG, OREGON

FIGURE
3A



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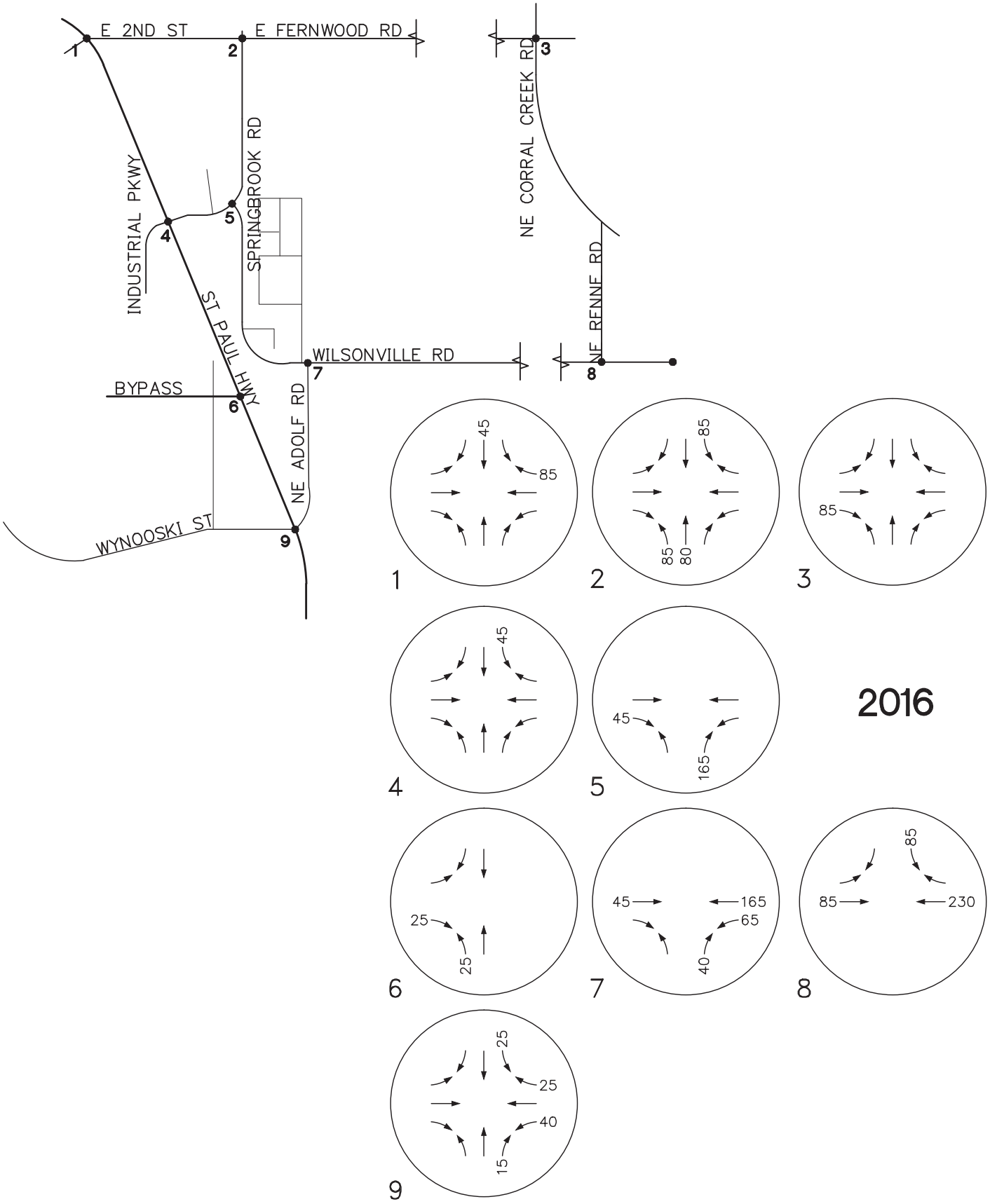
WYNOOSKI SIGNAL
PM PEAK HOUR TOTAL

WILSONVILLE ROAD REVIEW
NEWBERG, OREGON

FIGURE
3B



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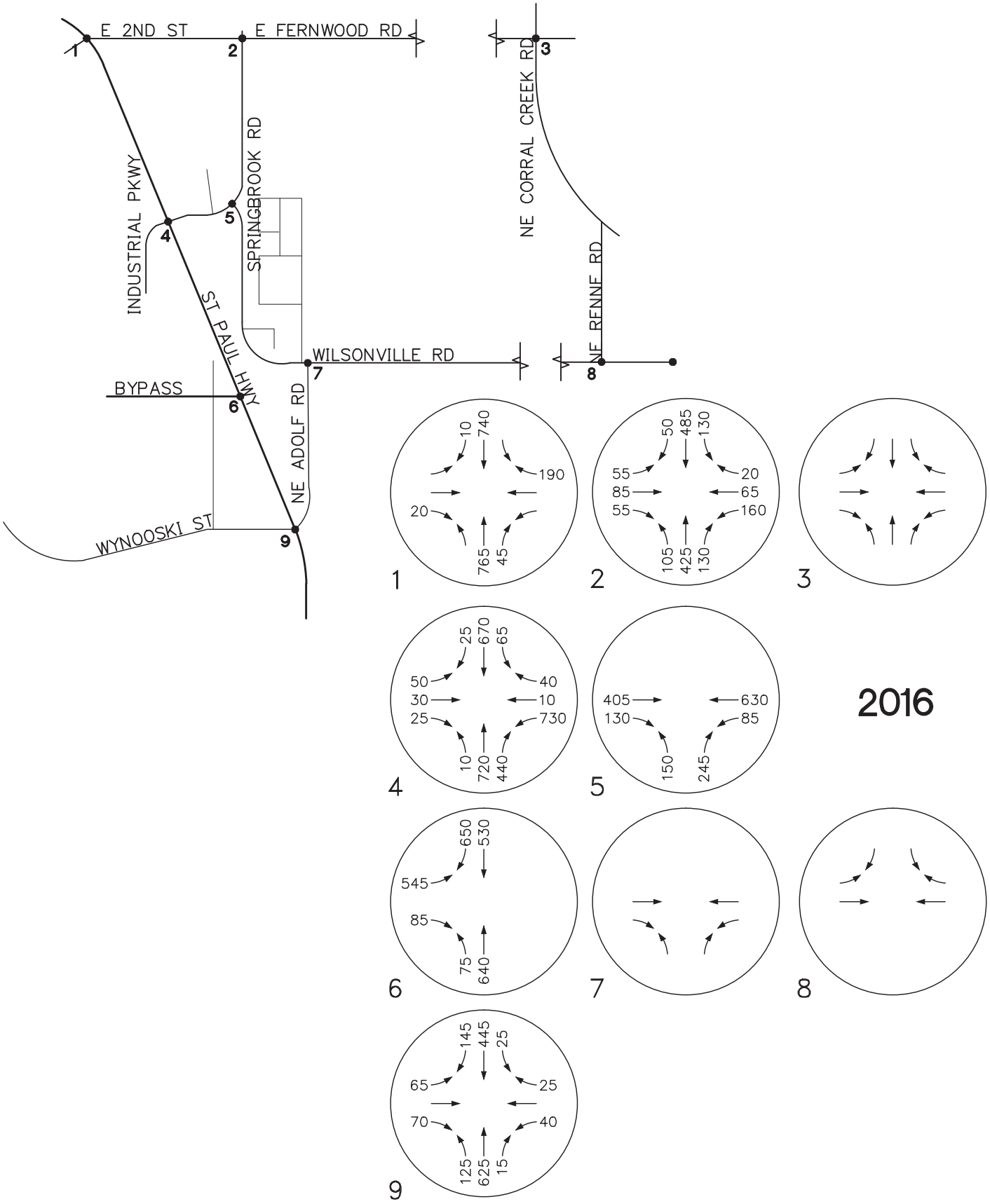
SPRINGBROOK + WYNOOSKI
PM PEAK HOUR

WILSONVILLE ROAD REVIEW
NEWBERG, OREGON

FIGURE
4A



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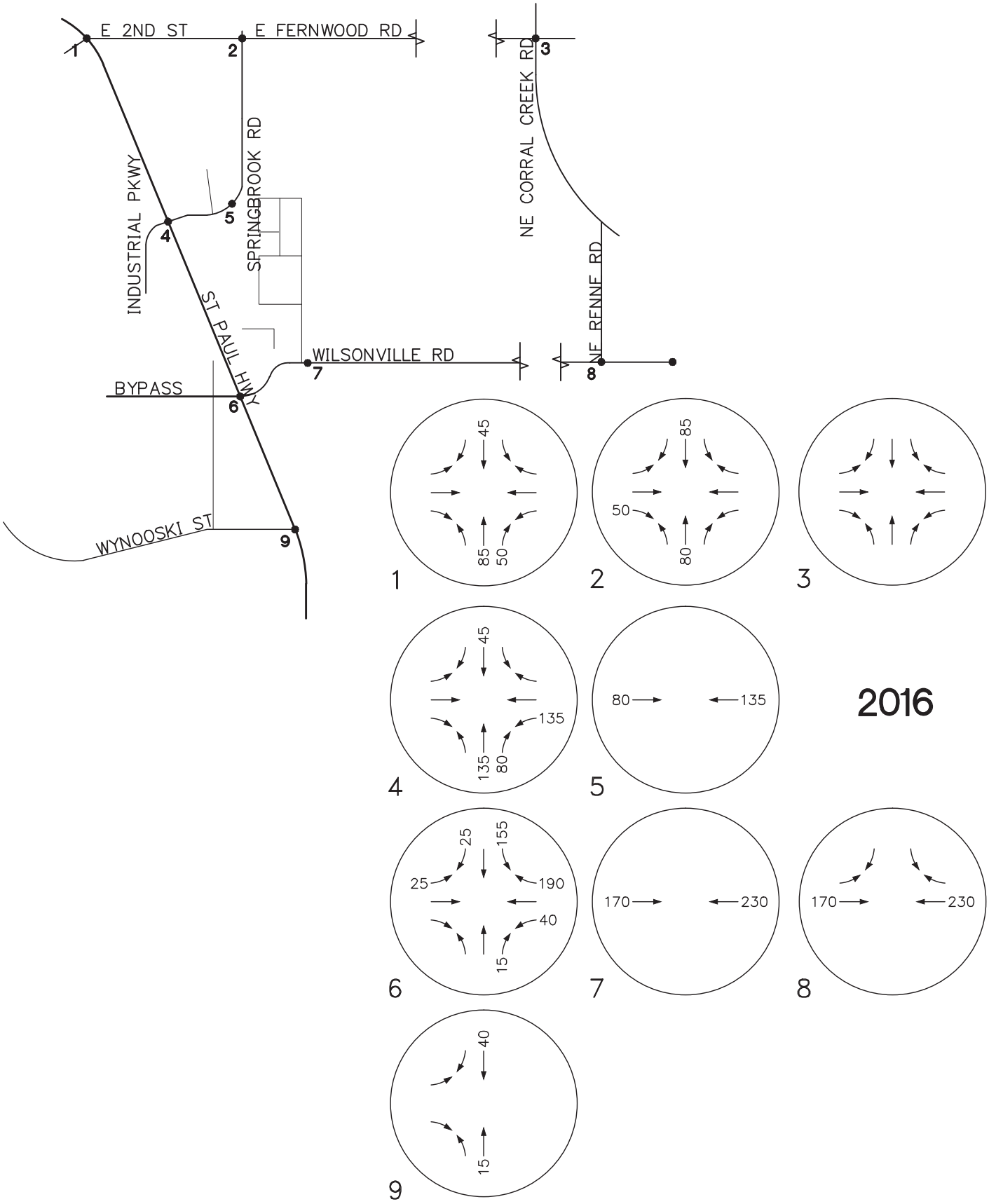
SPRINGBROOK + WYNOOSKI
PM PEAK HOUR TOTAL

WILSONVILLE ROAD REVIEW
NEWBERG, OREGON

FIGURE
4B



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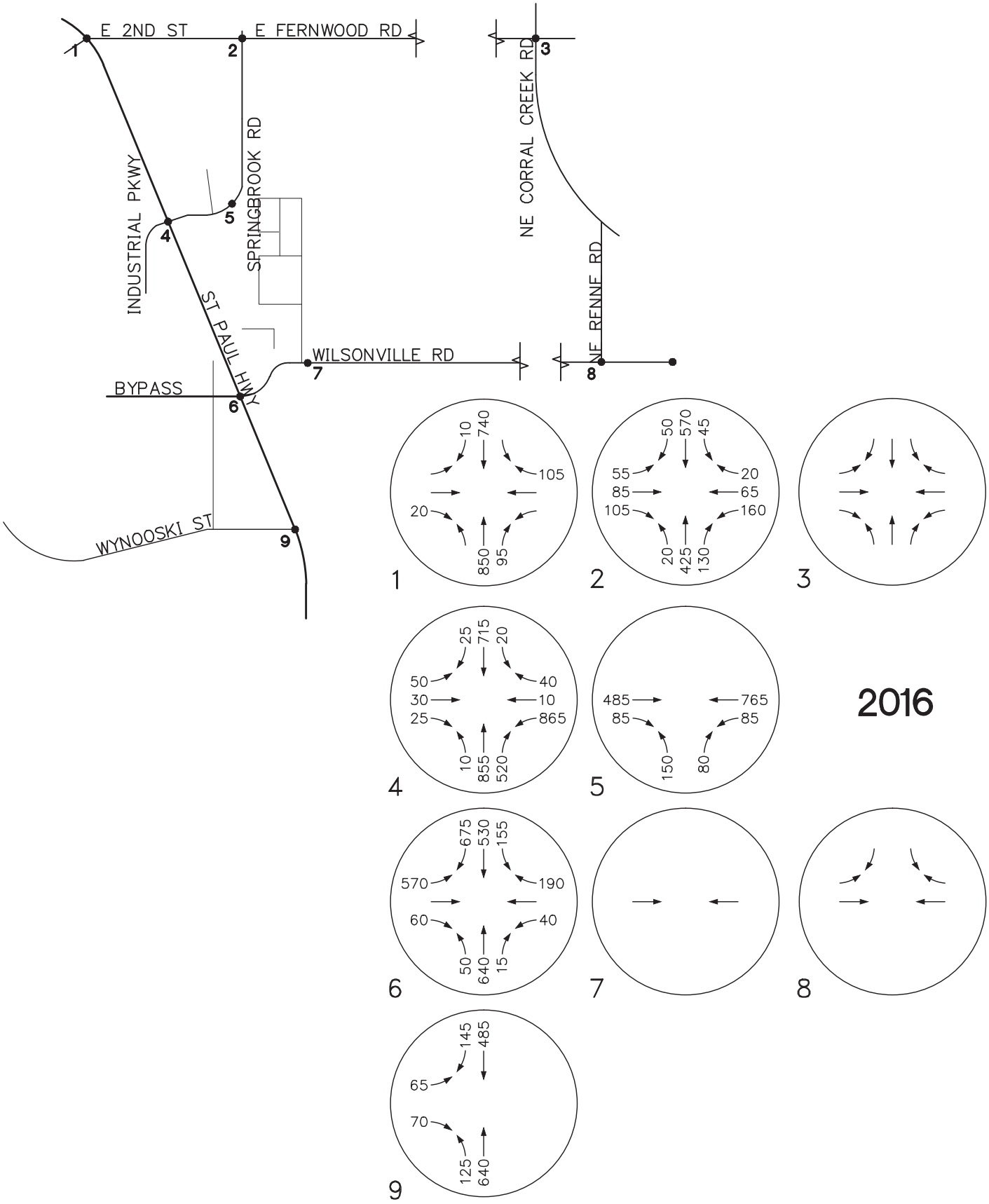
NO THROUGHS-2ND
PM PEAK HOUR

WILSONVILLE ROAD REVIEW
NEWBERG, OREGON

FIGURE
5A



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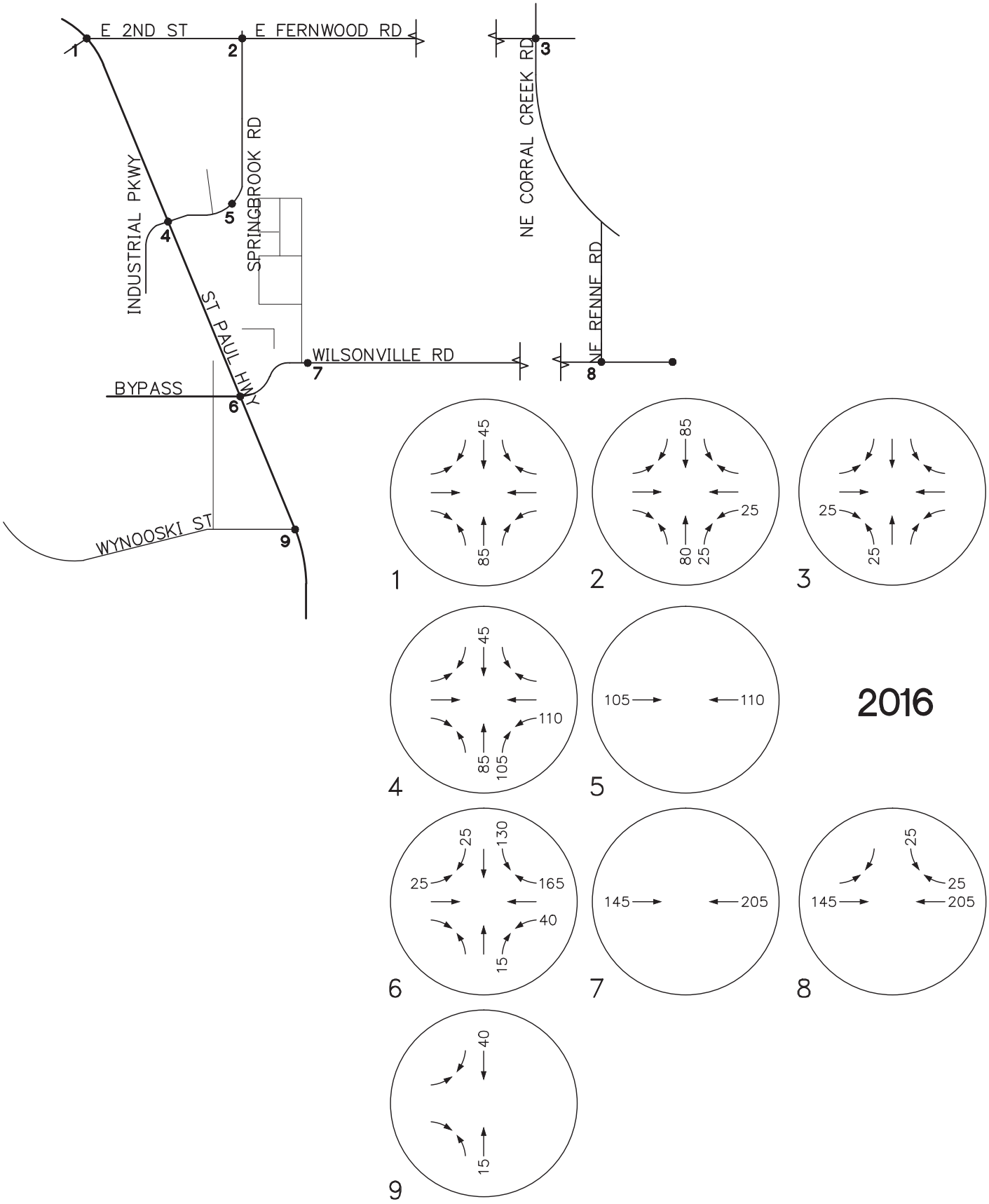
NO THROUGHS-2ND
PM PEAK HOUR TOTAL

WILSONVILLE ROAD REVIEW
NEWBERG, OREGON

FIGURE
5B



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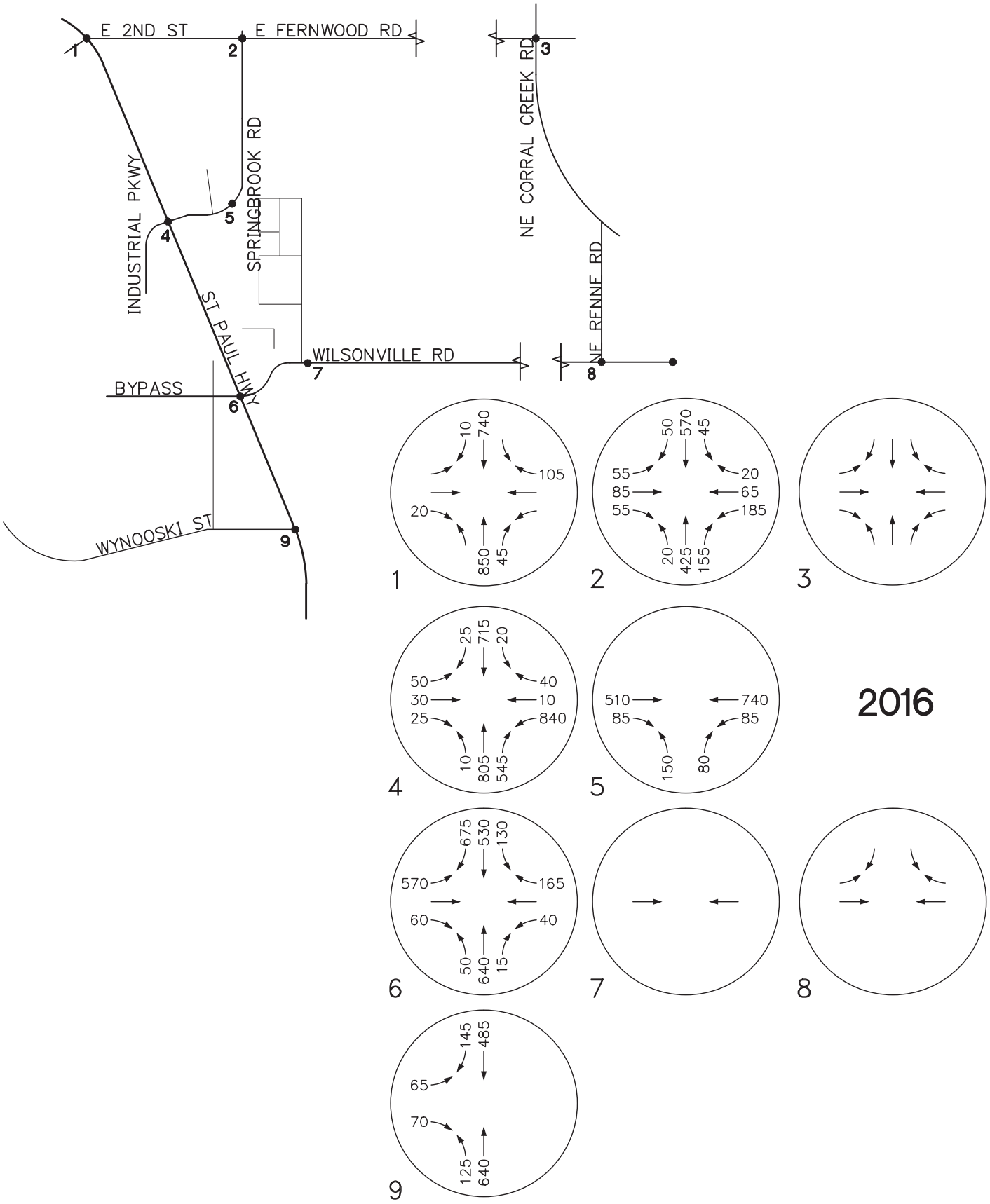
NO THROUGHS-FERNWOOD
PM PEAK HOUR

WILSONVILLE ROAD REVIEW
NEWBERG, OREGON

FIGURE
6A



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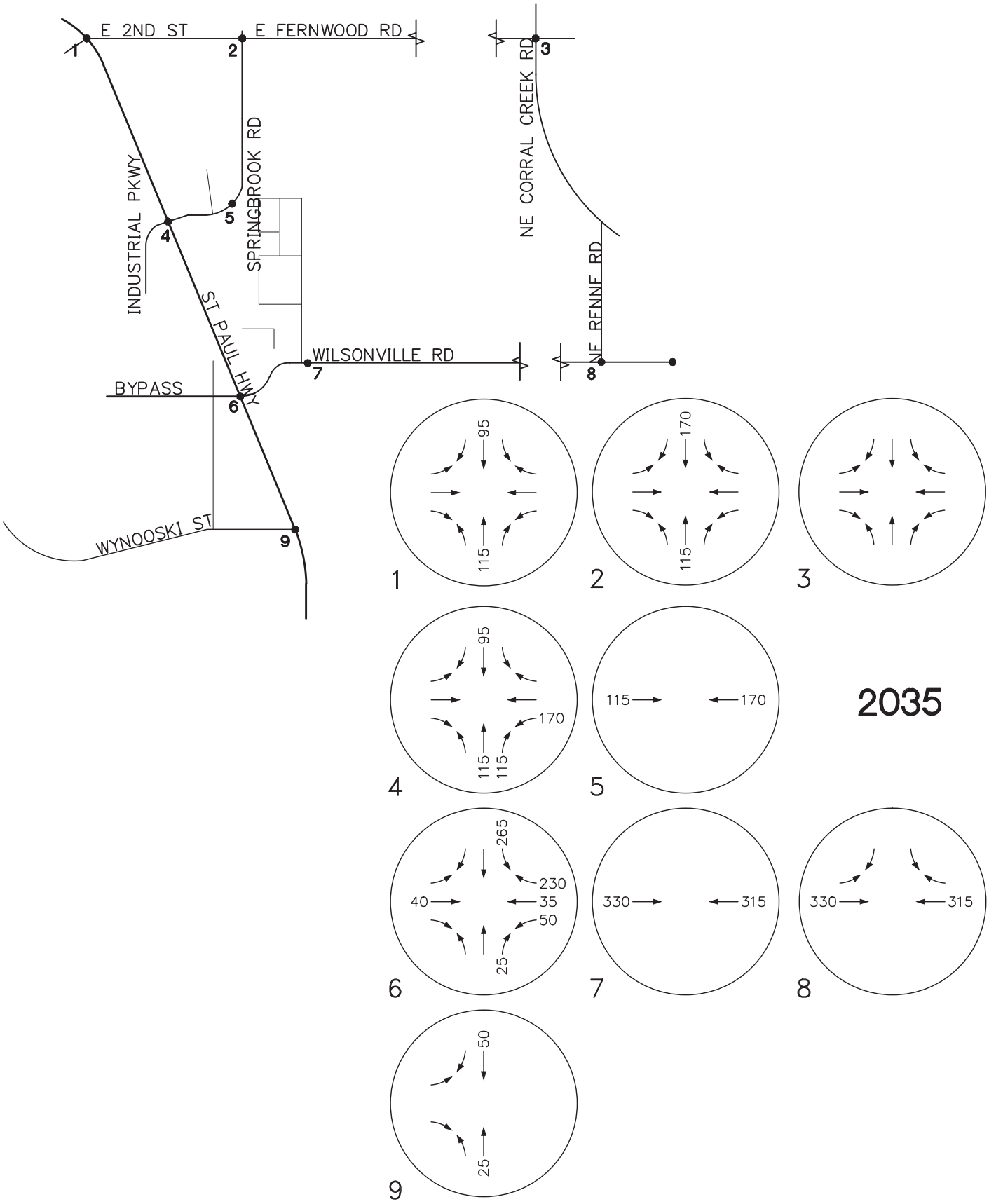
NO THROUGHS-FERNWOOD
PM PEAK HOUR TOTAL

WILSONVILLE ROAD REVIEW
NEWBERG, OREGON

FIGURE
6B



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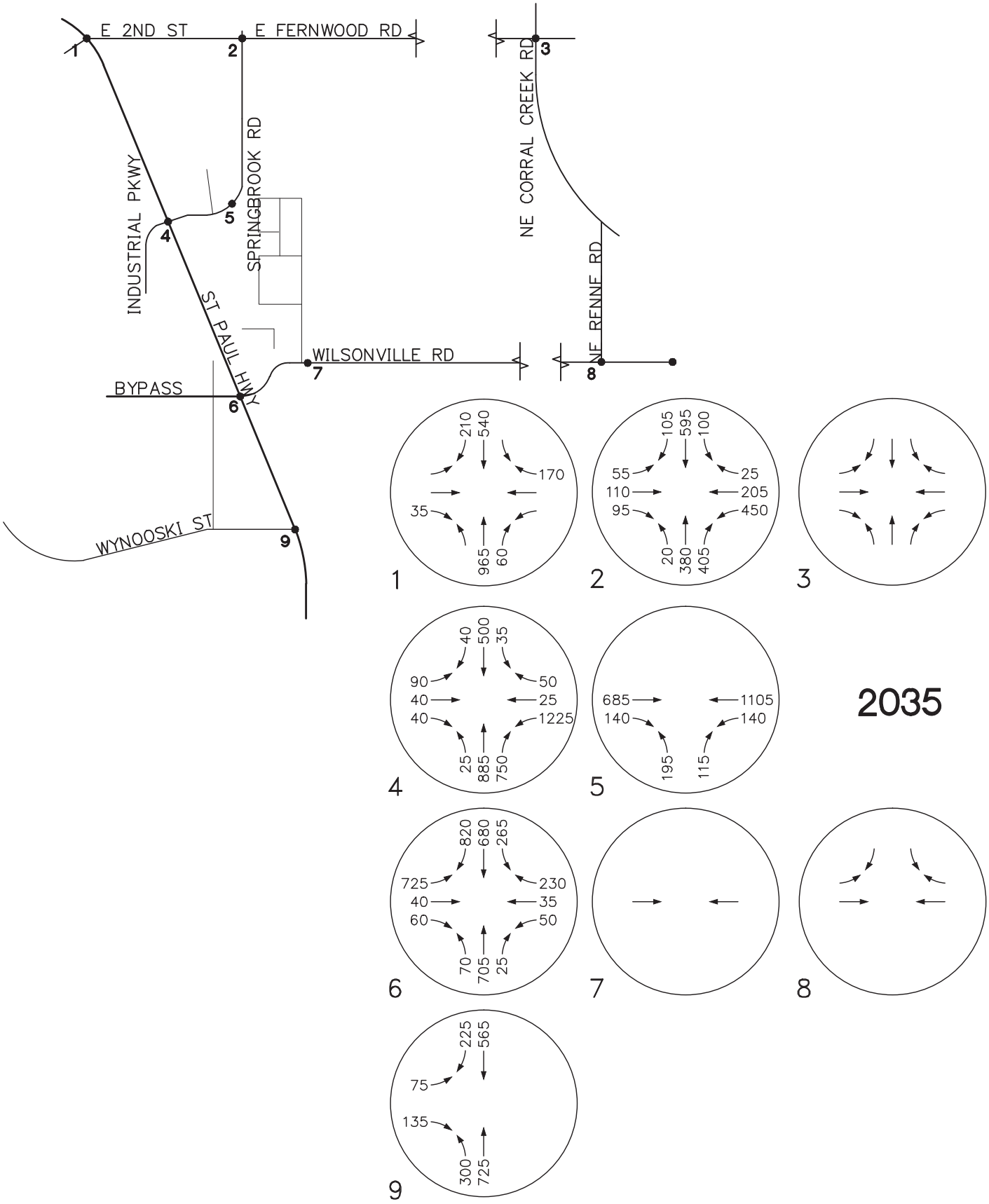
OPTION 1
PM PEAK HOUR

WILSONVILLE ROAD REVIEW
NEWBERG, OREGON

FIGURE
7A



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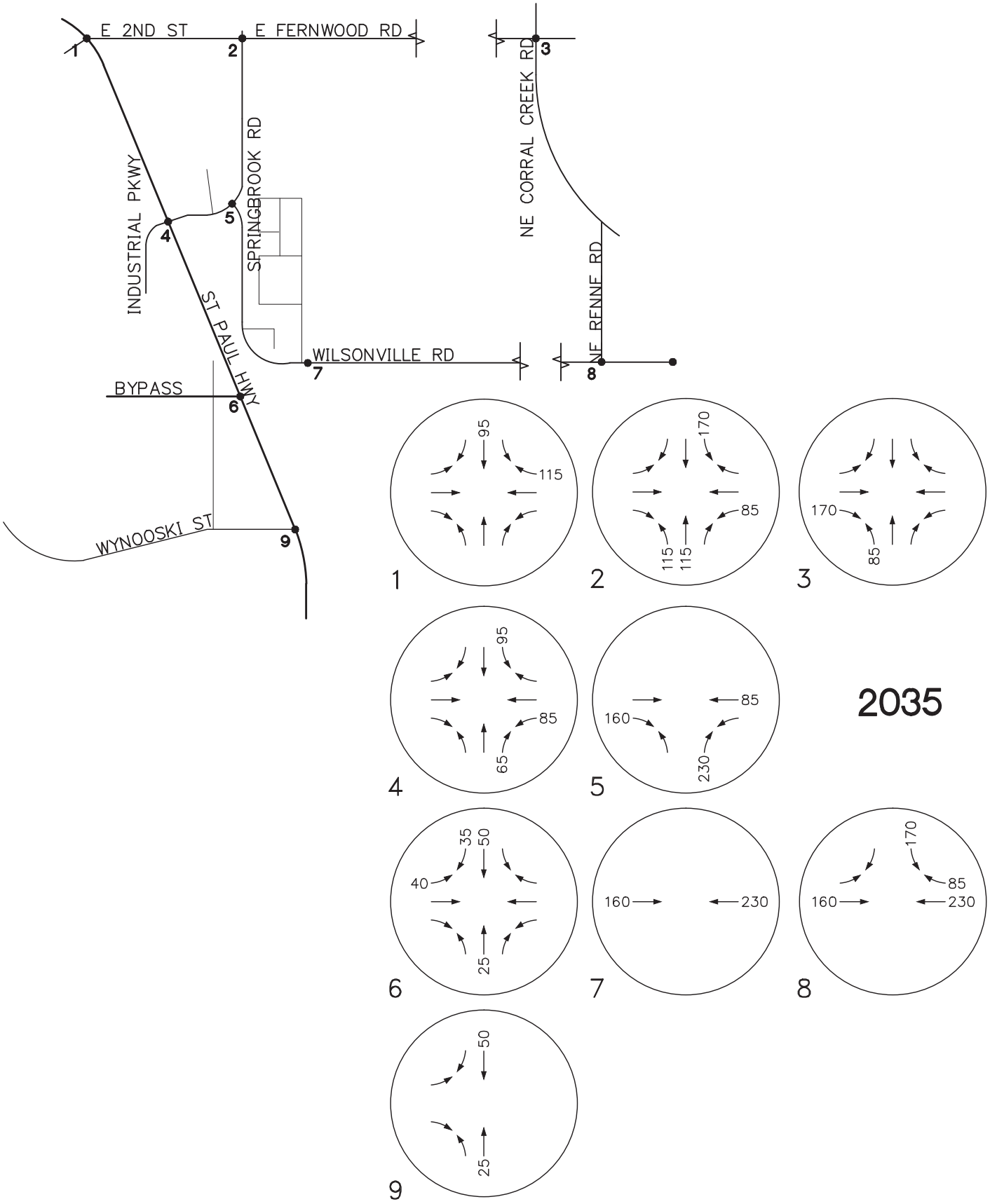
OPTION 1
PM PEAK HOUR TOTAL

WILSONVILLE ROAD REVIEW
NEWBERG, OREGON

FIGURE
7B



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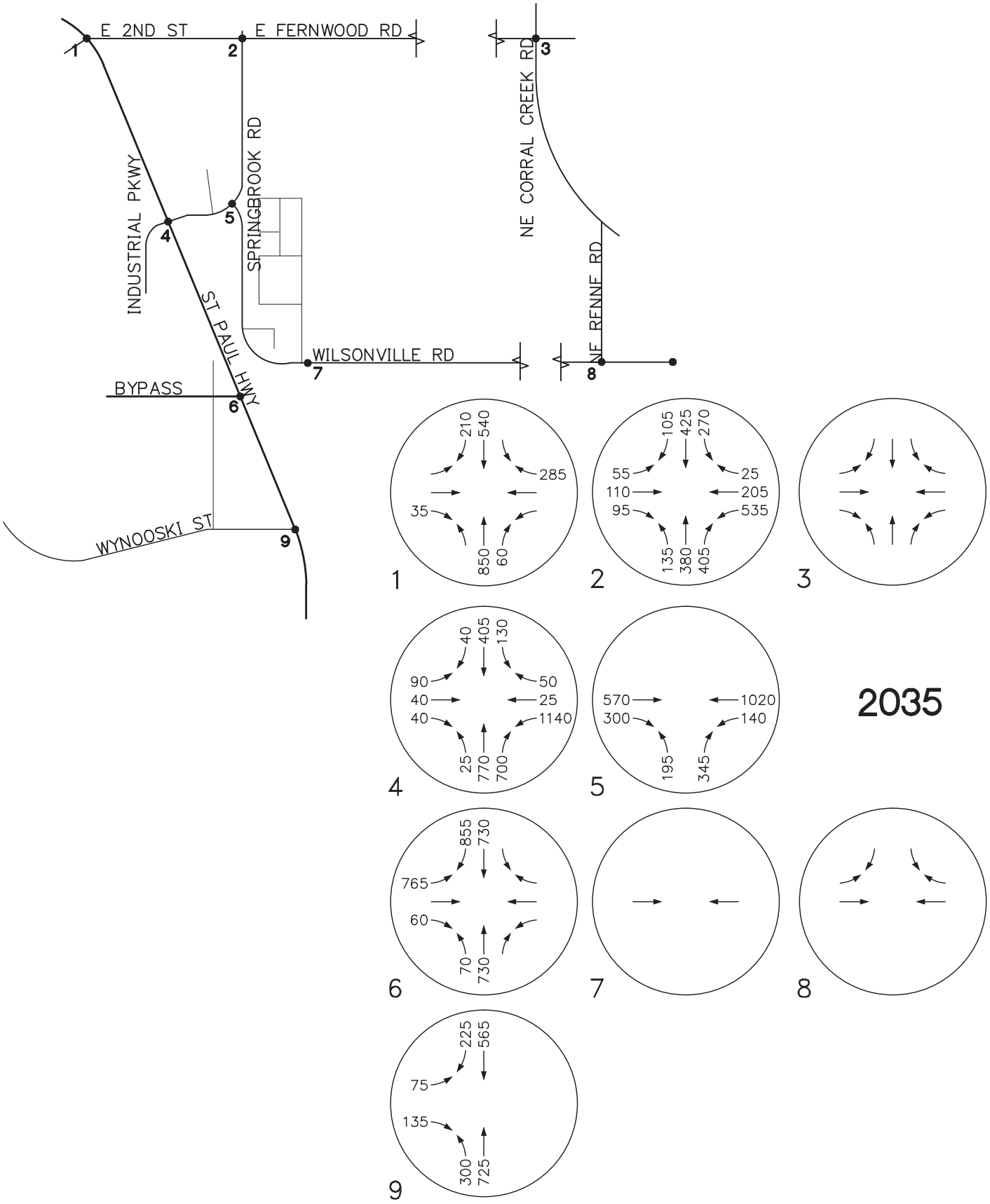
SPRINGBROOK RIGHT IN/OUT
PM PEAK HOUR

WILSONVILLE ROAD REVIEW
NEWBERG, OREGON

FIGURE
8A



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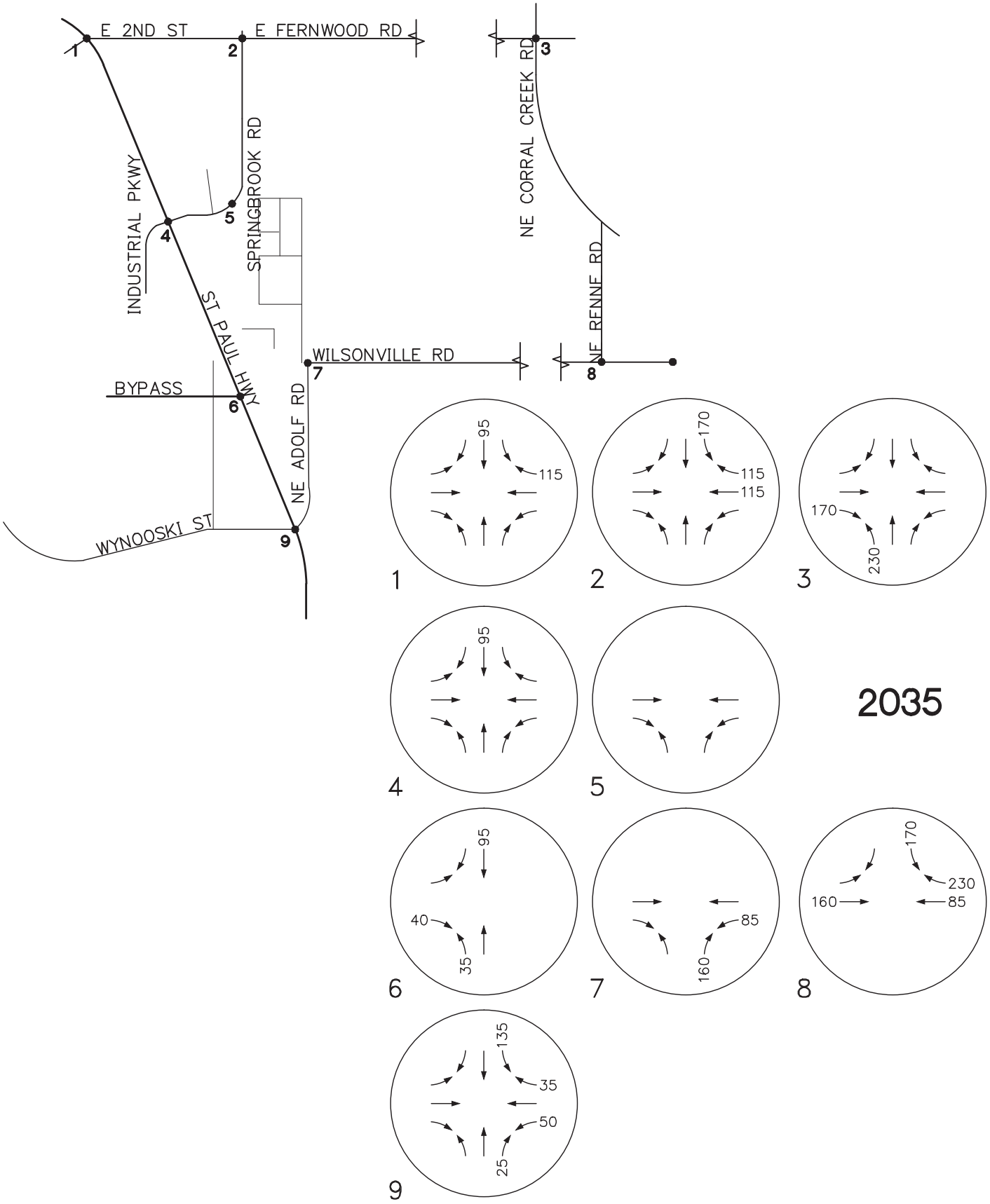
SPRINGBROOK RIGHT IN/OUT
PM PEAK HOUR TOTAL

WILSONVILLE ROAD REVIEW
NEWBERG, OREGON

FIGURE
8B



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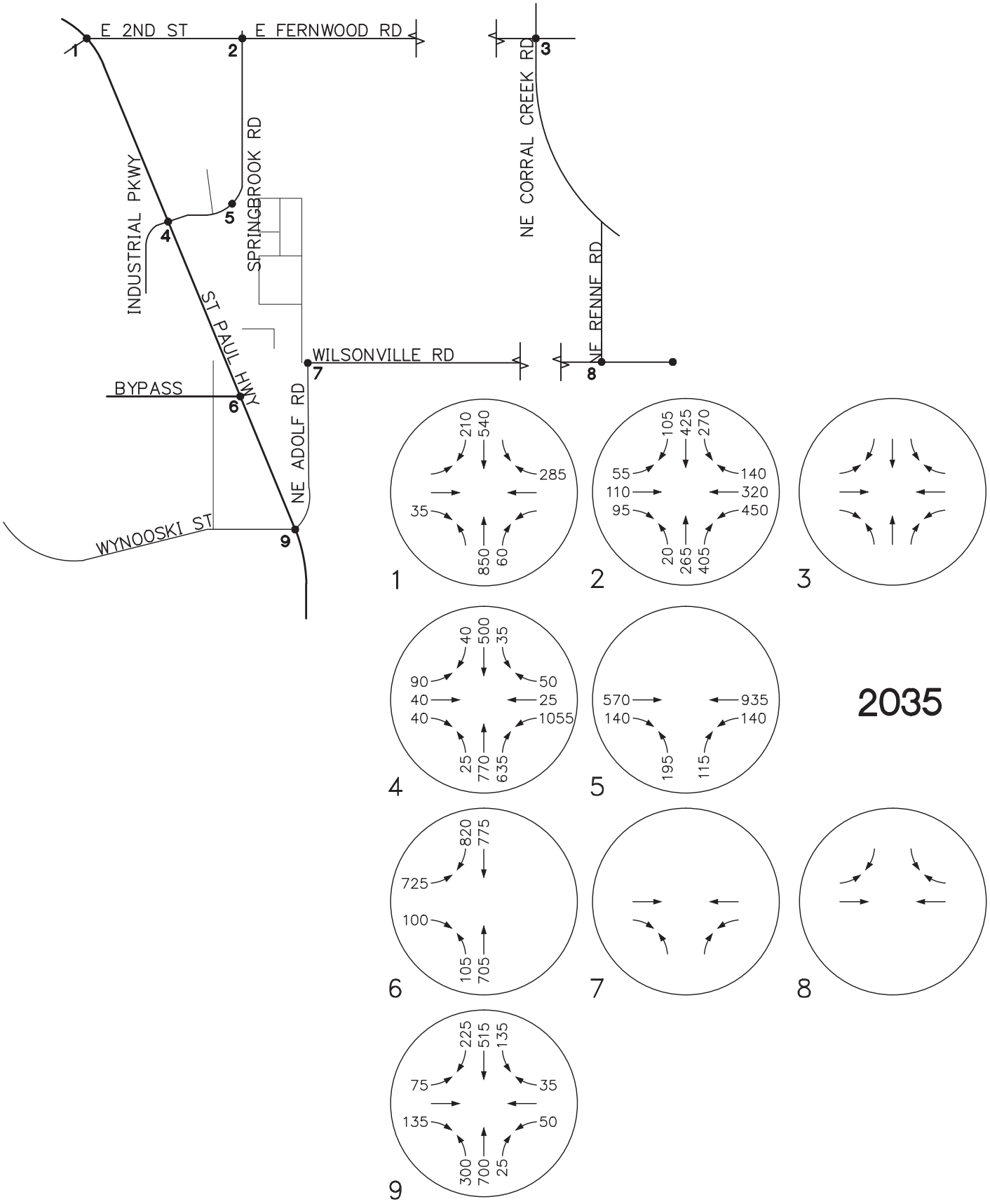
WYNOOSKI SIGNAL
PM PEAK HOUR

WILSONVILLE ROAD REVIEW
NEWBERG, OREGON

FIGURE
9A



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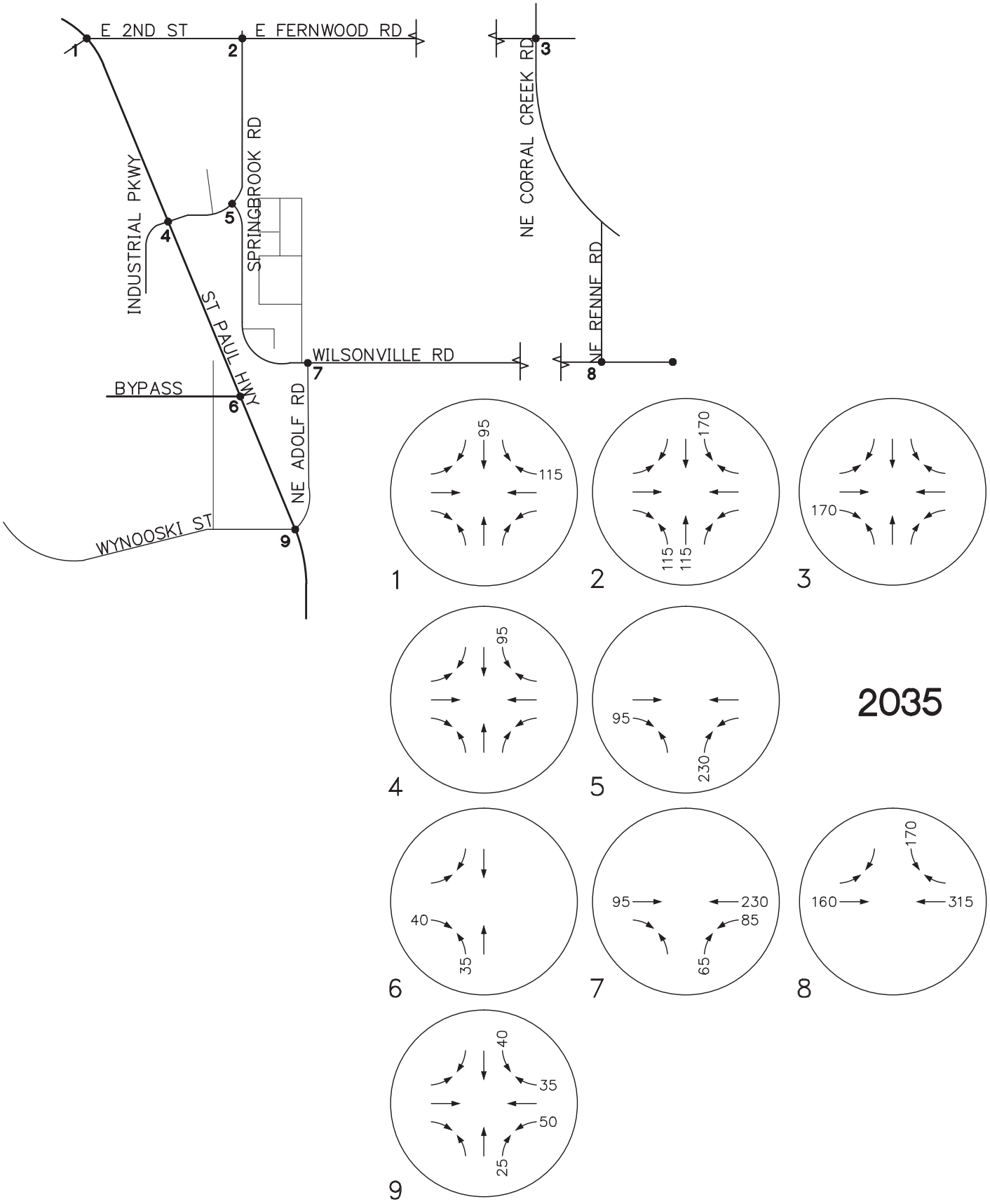
PM PEAK HOUR TOTAL

WILSONVILLE ROAD REVIEW
NEWBERG, OREGON

FIGURE
9B



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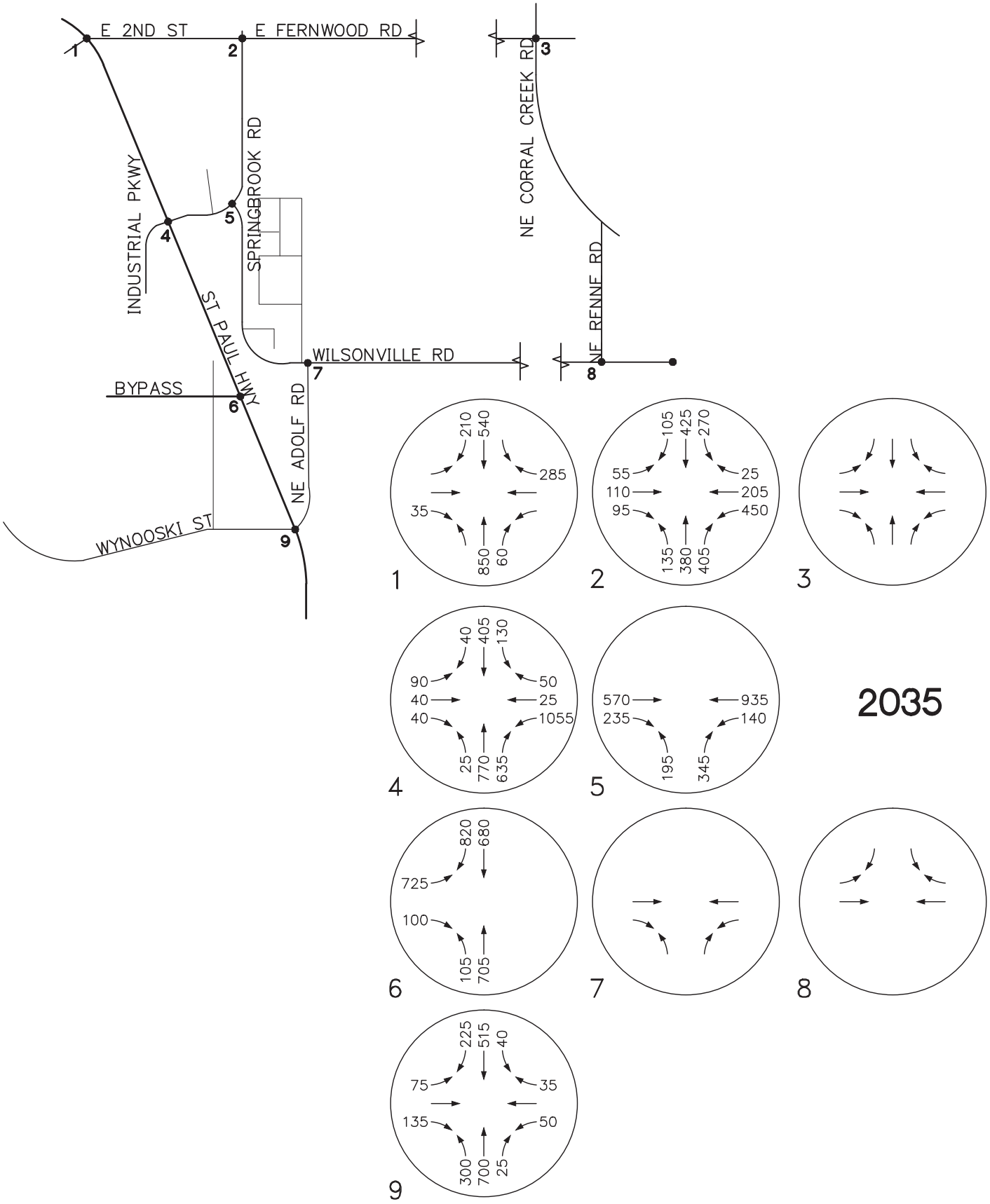
SPRINGBROOK + WYNOOSKI
PM PEAK HOUR

WILSONVILLE ROAD REVIEW
NEWBERG, OREGON

FIGURE
10A



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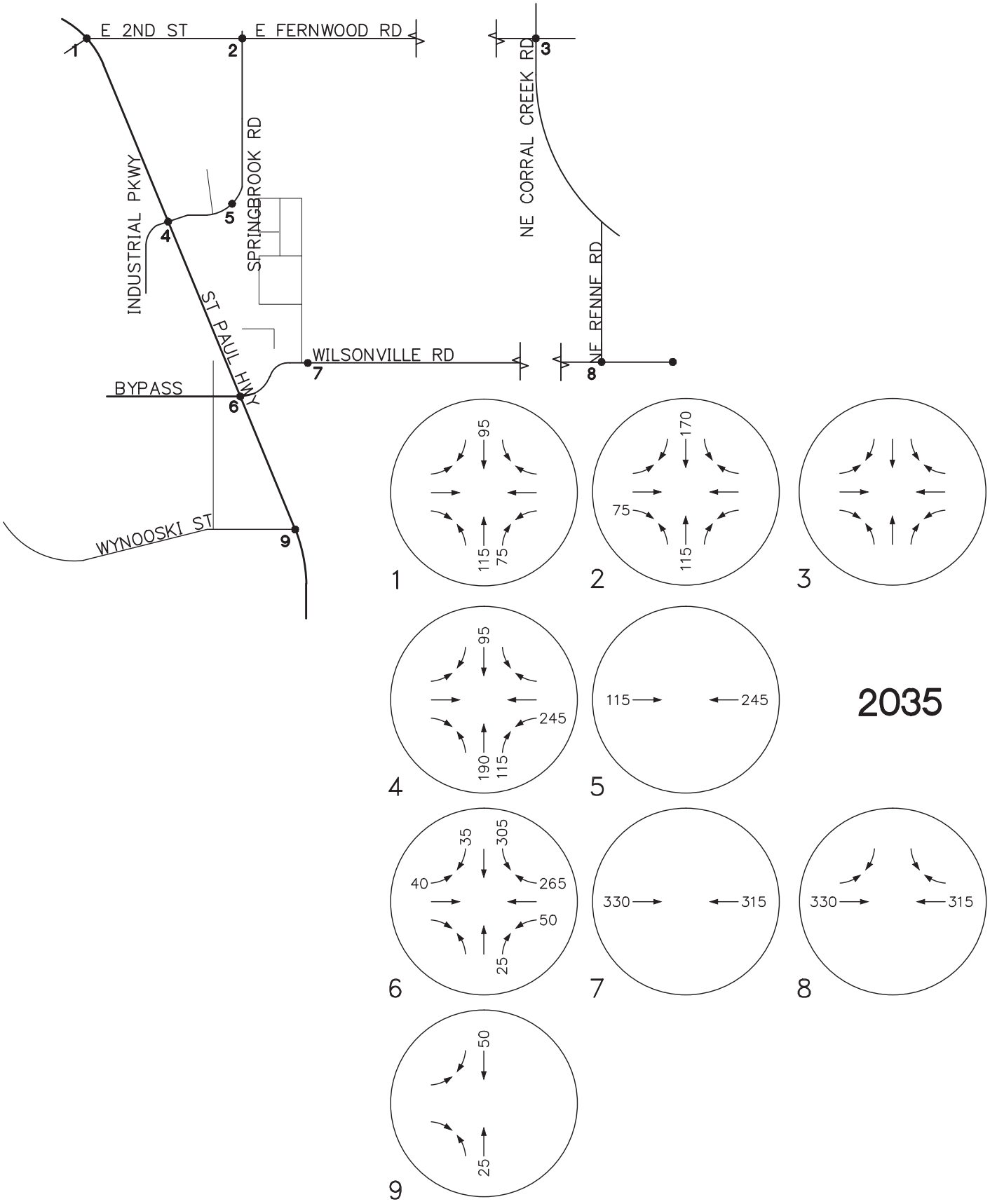
SPRINGBROOK + WYNOOSKI
PM PEAK HOUR TOTAL

WILSONVILLE ROAD REVIEW
NEWBERG, OREGON

FIGURE
10B



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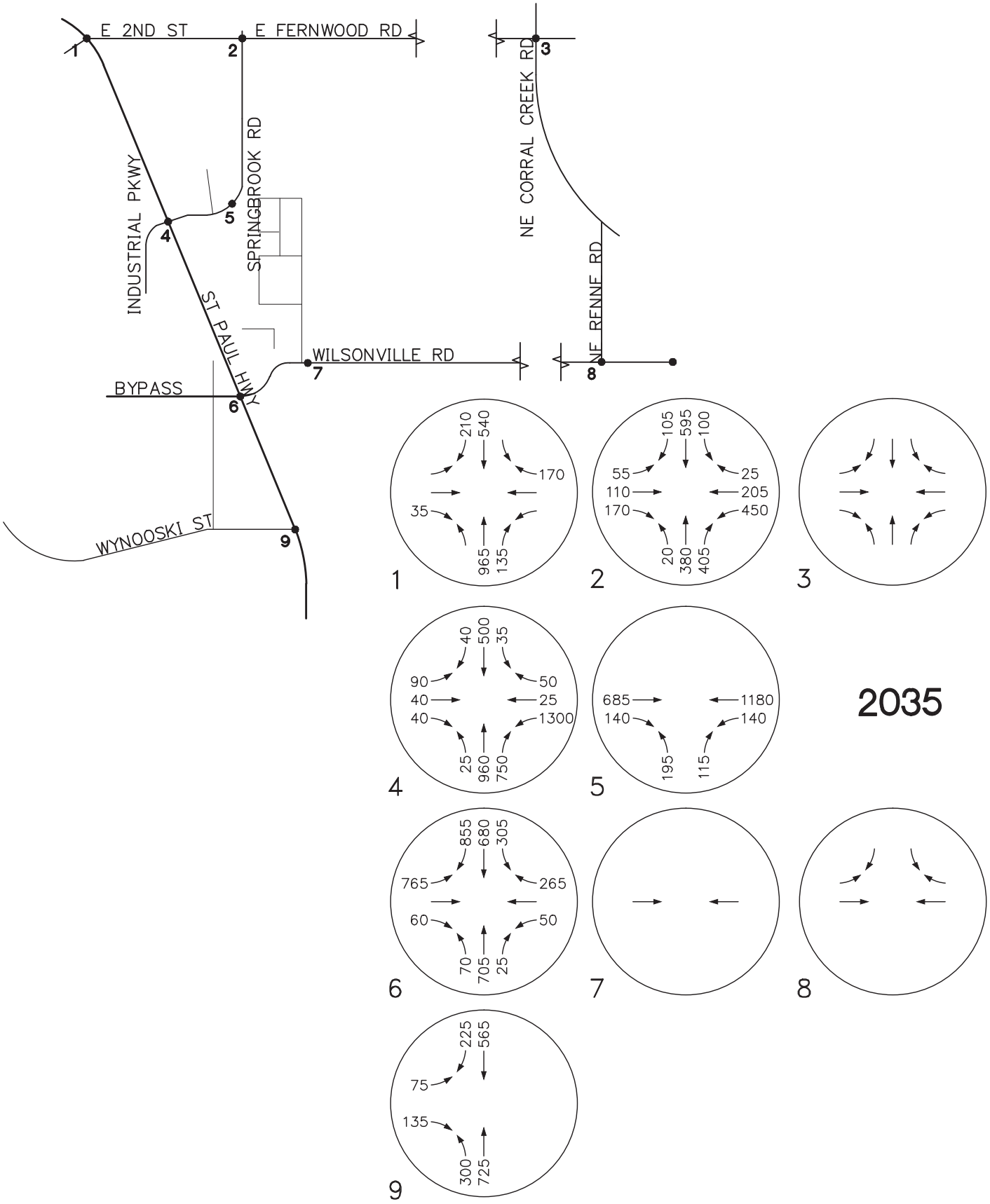
WILSONVILLE ROAD REVIEW
NEWBERG, OREGON

FIGURE
11A



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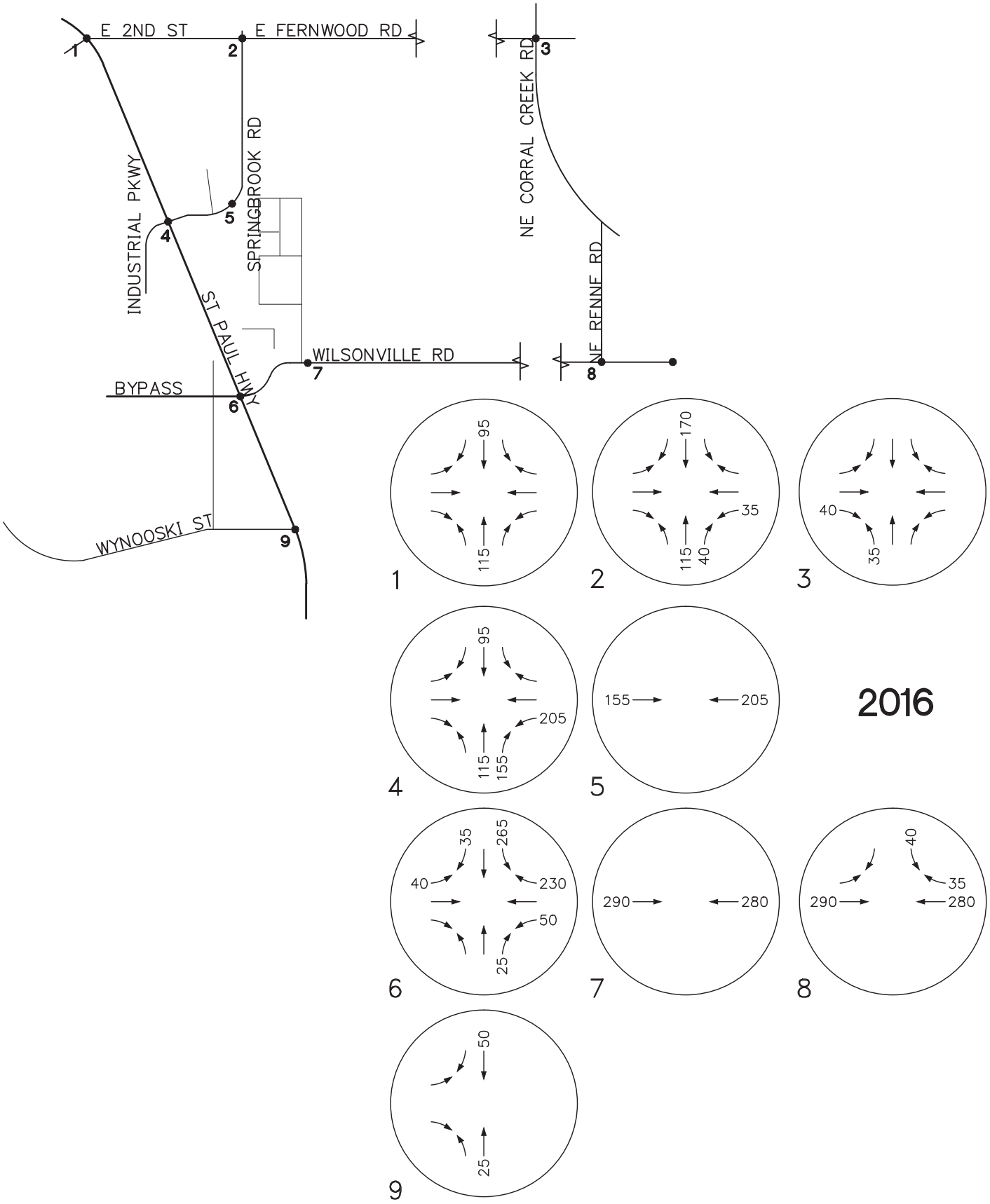
WILSONVILLE ROAD REVIEW
NEWBERG, OREGON

FIGURE
11B



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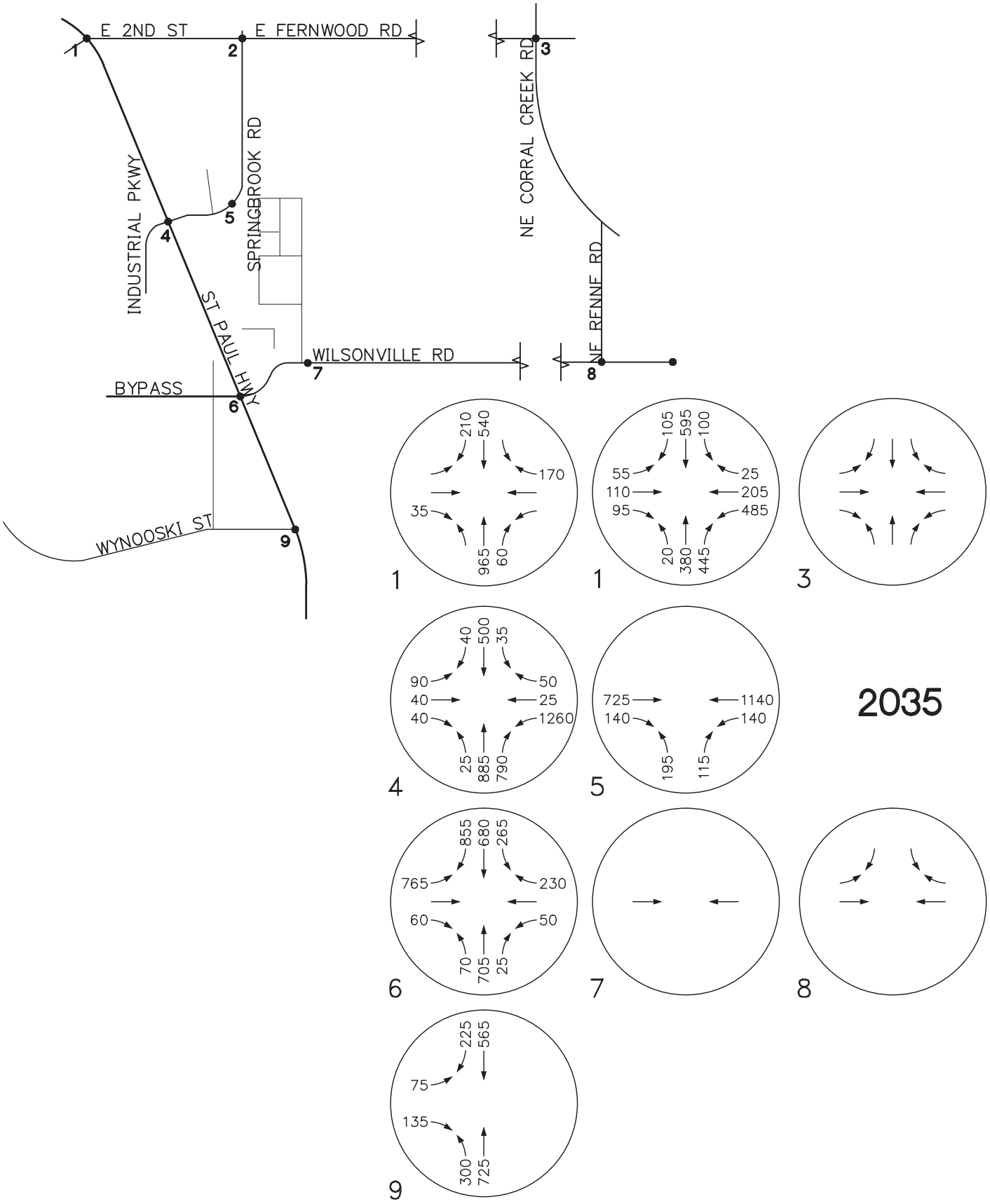
PM PEAK HOUR

WILSONVILLE ROAD REVIEW
NEWBERG, OREGON

FIGURE
12A



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WILSONVILLE ROAD REVIEW
NEWBERG, OREGON

FIGURE
12B

Attachment 4

HCM Unsignalized Intersection Capacity Analysis
1: St Paul Highway & E 2nd Street

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (veh/h)	0	0	20	0	0	105	0	740	10	0	850	45
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	0	0	22	0	0	117	0	822	11	0	944	50
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1914	1822	828	1819	1803	969	994			833		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1914	1822	828	1819	1803	969	994			833		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	94	100	100	62	100			100		
cM capacity (veh/h)	32	77	371	56	79	307	696			800		

Direction, Lane #	EB 1	WB 1	SE 1	NW 1
Volume Total	22	117	833	994
Volume Left	0	0	0	0
Volume Right	22	117	11	50
cSH	371	307	1700	1700
Volume to Capacity	0.06	0.38	0.49	0.58
Queue Length 95th (ft)	5	43	0	0
Control Delay (s)	15.3	23.7	0.0	0.0
Lane LOS	C	C		
Approach Delay (s)	15.3	23.7	0.0	0.0
Approach LOS	C	C		

Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	66.1%	ICU Level of Service	C
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
2: Springbrook Road & E 2nd Street/E Fernwood Road

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	55	85	55	160	65	20	20	425	130	45	570	50
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.5			4.5		4.5	4.5		4.5	4.5	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.96			0.99		1.00	0.96		1.00	0.99	
Flt Protected		0.99			0.97		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1627			1643		1630	1656		1630	1695	
Flt Permitted		0.85			0.60		0.26	1.00		0.29	1.00	
Satd. Flow (perm)		1410			1018		453	1656		497	1695	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	61	94	61	178	72	22	22	472	144	50	633	56
RTOR Reduction (vph)	0	13	0	0	3	0	0	8	0	0	2	0
Lane Group Flow (vph)	0	203	0	0	269	0	22	608	0	50	687	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8			4			6			2		
Actuated Green, G (s)		31.3			31.3		65.9	64.4		69.1	66.0	
Effective Green, g (s)		30.8			30.8		64.9	63.9		68.1	65.5	
Actuated g/C Ratio		0.28			0.28		0.59	0.58		0.61	0.59	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)		2.5			2.5		2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)		391			282		275	955		332	1002	
v/s Ratio Prot							0.00	0.37		c0.00	c0.41	
v/s Ratio Perm		0.14			c0.26		0.05			0.09		
v/c Ratio		0.52			0.95		0.08	0.64		0.15	0.69	
Uniform Delay, d1		33.8			39.3		11.9	15.7		10.7	15.6	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.9			41.0		0.1	3.2		0.2	3.8	
Delay (s)		34.6			80.3		12.0	18.9		10.9	19.4	
Level of Service		C			F		B	B		B	B	
Approach Delay (s)		34.6			80.3			18.7			18.8	
Approach LOS		C			F			B			B	

Intersection Summary			
HCM 2000 Control Delay	29.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	110.8	Sum of lost time (s)	13.5
Intersection Capacity Utilization	78.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: St Paul Highway & Industrial Parkway/Springbrook Road

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	50	30	25	815	10	40	10	805	520	20	715	25
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.4	4.4		4.4	4.4		4.4	4.4	4.4	4.4	4.4	
Lane Util. Factor	1.00	1.00		0.97	1.00		1.00	0.95	1.00	1.00	0.95	
Frt	1.00	0.93		1.00	0.88		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1630	1598		3162	1510		1630	3260	1458	1630	3243	
Flt Permitted	0.72	1.00		0.95	1.00		0.17	1.00	1.00	0.14	1.00	
Satd. Flow (perm)	1237	1598		3162	1510		286	3260	1458	233	3243	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	56	33	28	906	11	44	11	894	578	22	794	28
RTOR Reduction (vph)	0	27	0	0	29	0	0	0	387	0	2	0
Lane Group Flow (vph)	56	34	0	906	26	0	11	894	191	22	820	0
Turn Type	pm+pt	NA		Prot	NA		pm+pt	NA	Prot	pm+pt	NA	
Protected Phases	3	8		7	4		1	6	6	5	2	
Permitted Phases	8						6			2		
Actuated Green, G (s)	25.6	6.8		53.2	41.2		41.6	40.0	40.0	46.4	42.4	
Effective Green, g (s)	24.8	6.4		52.8	40.8		40.8	39.6	39.6	45.6	42.0	
Actuated g/C Ratio	0.21	0.05		0.44	0.34		0.34	0.33	0.33	0.38	0.35	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5	2.5	2.5	2.5	
Lane Grp Cap (vph)	315	85		1391	513		110	1075	481	130	1135	
v/s Ratio Prot	0.03	c0.02		c0.29	0.02		0.00	c0.27	0.13	c0.01	0.25	
v/s Ratio Perm	0.01						0.03			0.06		
v/c Ratio	0.18	0.41		0.65	0.05		0.10	0.83	0.40	0.17	0.72	
Uniform Delay, d1	39.6	55.0		26.4	26.6		42.0	37.1	31.0	42.1	33.9	
Progression Factor	1.00	1.00		1.00	1.00		1.56	1.41	6.90	1.00	1.00	
Incremental Delay, d2	0.2	2.3		2.4	0.2		0.2	6.2	2.0	0.5	4.0	
Delay (s)	39.8	57.3		28.8	26.8		65.7	58.6	215.7	42.5	37.9	
Level of Service	D	E		C	C		E	E	F	D	D	
Approach Delay (s)		48.9			28.6			119.9			38.1	
Approach LOS		D			C			F			D	

Intersection Summary			
HCM 2000 Control Delay	71.4	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	17.6
Intersection Capacity Utilization	63.4%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
6: St Paul Highway & Bypass/NE Wilsonville Road

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	545	25	60	40	25	165	50	640	15	130	530	650
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	1.00		1.00	1.00	1.00	1.00	0.95		1.00	1.00	1.00
Frt	1.00	0.89		1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3162	1534		1630	1716	1458	1630	3248		1630	1716	1458
Flt Permitted	0.95	1.00		0.65	1.00	1.00	0.27	1.00		0.30	1.00	1.00
Satd. Flow (perm)	3162	1534		1107	1716	1458	468	3248		510	1716	1458
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	606	28	67	44	28	183	56	711	17	144	589	722
RTOR Reduction (vph)	0	57	0	0	0	174	0	1	0	0	0	324
Lane Group Flow (vph)	606	38	0	44	28	9	56	727	0	144	589	398
Turn Type	Prot	NA		pm+pt	NA	Prot	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	3	8		7	4	4	1	6		5	2	
Permitted Phases				4			6			2		2
Actuated Green, G (s)	28.5	18.1		22.8	6.2	6.2	61.1	57.9		73.3	66.1	66.1
Effective Green, g (s)	28.5	18.1		22.8	6.2	6.2	61.1	57.9		73.3	66.1	66.1
Actuated g/C Ratio	0.24	0.15		0.19	0.05	0.05	0.51	0.48		0.61	0.55	0.55
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	2.5	2.5		2.5	2.5	2.5	2.5	2.5		2.5	2.5	2.5
Lane Grp Cap (vph)	750	231		282	88	75	269	1567		417	945	803
v/s Ratio Prot	c0.19	0.02		0.02	c0.02	0.01	0.01	0.22		c0.03	c0.34	
v/s Ratio Perm				0.01			0.10			0.18		0.27
v/c Ratio	0.81	0.16		0.16	0.32	0.13	0.21	0.46		0.35	0.62	0.50
Uniform Delay, d1	43.2	44.4		42.0	54.9	54.3	29.6	20.7		19.0	18.4	16.6
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.18	1.02	3.43
Incremental Delay, d2	6.2	0.2		0.2	1.5	0.6	0.3	1.0		1.7	2.3	1.6
Delay (s)	49.4	44.6		42.1	56.4	54.9	29.9	21.7		24.1	21.1	58.7
Level of Service	D	D		D	E	D	C	C		C	C	E
Approach Delay (s)		48.7			52.8			22.3			40.1	
Approach LOS		D			D			C			D	

Intersection Summary			
HCM 2000 Control Delay	38.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	67.2%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
9: St Paul Highway & NE Wynooski Street

5/11/2015

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	65	70	125	640	485	145
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	72	78	139	711	539	161
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		10				
Median type				TWLTL	None	
Median storage veh)				2		
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1608	619	539			
vC1, stage 1 conf vol	619					
vC2, stage 2 conf vol	989					
vCu, unblocked vol	1608	619	539			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)	5.4					
tF (s)	3.5	3.3	2.2			
p0 queue free %	74	84	87			
cM capacity (veh/h)	276	488	1029			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	150	139	711	700
Volume Left	72	139	0	0
Volume Right	78	0	0	161
cSH	573	1029	1700	1700
Volume to Capacity	0.26	0.13	0.42	0.41
Queue Length 95th (ft)	26	12	0	0
Control Delay (s)	18.0	9.0	0.0	0.0
Lane LOS	C	A		
Approach Delay (s)	18.0	1.5		0.0
Approach LOS	C			

Intersection Summary			
Average Delay	2.3		
Intersection Capacity Utilization	60.0%	ICU Level of Service	B
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
10: Springbrook Road & Highway 99W

5/20/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	180	1165	115	430	1095	245	350	225	205	365	175	115
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	0.97	1.00	1.00	0.97	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1630	3260	1458	3162	3260	1458	3162	1716	1458	3162	1716	1458
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1630	3260	1458	3162	3260	1458	3162	1716	1458	3162	1716	1458
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	200	1294	128	478	1217	272	389	250	228	406	194	128
RTOR Reduction (vph)	0	0	59	0	0	71	0	0	56	0	0	58
Lane Group Flow (vph)	200	1294	69	478	1217	201	389	250	172	406	194	70
Turn Type	Prot	NA	pm+ov	Prot	NA	pm+ov	Prot	NA	pm+ov	Prot	NA	pm+ov
Protected Phases	3	8	1	7	4	5	1	6	7	5	2	3
Permitted Phases			8			4			6			2
Actuated Green, G (s)	16.2	48.9	64.6	19.0	51.7	67.8	15.7	20.0	39.0	16.1	20.4	36.6
Effective Green, g (s)	15.7	48.4	63.6	18.5	51.2	66.8	15.2	19.5	38.0	15.6	19.9	35.6
Actuated g/C Ratio	0.13	0.40	0.53	0.15	0.43	0.56	0.13	0.16	0.32	0.13	0.17	0.30
Clearance 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
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Lane Grp Cap (vph)	213	1314	772	487	1390	866	400	278	461	411	284	487
v/s Ratio Prot	0.12	c0.40	0.01	0.15	c0.37	0.03	0.12	c0.15	0.06	c0.13	0.11	0.02
v/s Ratio Perm			0.04			0.11			0.06			0.03
v/c Ratio	0.94	0.98	0.09	0.98	0.88	0.23	0.97	0.90	0.37	0.99	0.68	0.14
Uniform Delay, d1	51.7	35.4	13.9	50.6	31.5	13.5	52.2	49.3	31.8	52.1	47.1	31.0
Progression 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
Incremental Delay, d2	44.2	21.1	0.0	35.8	6.4	0.1	37.6	33.3	0.4	40.8	12.6	0.1
Delay (s)	95.9	56.5	14.0	86.4	37.9	13.6	89.7	82.6	32.1	92.9	59.6	31.1
Level of Service	F	E	B	F	D	B	F	F	C	F	E	C
Approach Delay (s)		58.0			46.3			72.5			73.2	
Approach LOS		E			D			E			E	

Intersection Summary			
HCM 2000 Control Delay	58.1	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	87.4%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Attachment 4

HCM Unsignalized Intersection Capacity Analysis
1: St Paul Highway & E 2nd Street

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (veh/h)	0	0	20	0	0	190	0	740	10	0	765	45
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	0	0	22	0	0	211	0	822	11	0	850	50
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1914	1728	828	1725	1708	875	900			833		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1914	1728	828	1725	1708	875	900			833		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	94	100	100	39	100			100		
cM capacity (veh/h)	20	88	371	66	91	349	755			800		

Direction, Lane #	EB 1	WB 1	SE 1	NW 1
Volume Total	22	211	833	900
Volume Left	0	0	0	0
Volume Right	22	211	11	50
cSH	371	349	1700	1700
Volume to Capacity	0.06	0.61	0.49	0.53
Queue Length 95th (ft)	5	94	0	0
Control Delay (s)	15.3	30.0	0.0	0.0
Lane LOS	C	D		
Approach Delay (s)	15.3	30.0	0.0	0.0
Approach LOS	C	D		

Intersection Summary			
Average Delay	3.4		
Intersection Capacity Utilization	66.9%	ICU Level of Service	C
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
2: Springbrook Road & E 2nd Street/E Fernwood Road

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	55	85	55	225	65	20	105	425	130	130	485	50
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.5			4.5		4.5	4.5		4.5	4.5	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.96			0.99		1.00	0.96		1.00	0.99	
Flt Protected		0.99			0.96		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1627			1641		1630	1656		1630	1691	
Flt Permitted		0.85			0.60		0.27	1.00		0.25	1.00	
Satd. Flow (perm)		1397			1022		460	1656		433	1691	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	61	94	61	250	72	22	117	472	144	144	539	56
RTOR Reduction (vph)	0	12	0	0	2	0	0	9	0	0	3	0
Lane Group Flow (vph)	0	204	0	0	342	0	117	607	0	144	592	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8			4			6			2		
Actuated Green, G (s)		41.2			41.2		66.0	62.0		66.0	62.0	
Effective Green, g (s)		40.7			40.7		65.0	61.5		65.0	61.5	
Actuated g/C Ratio		0.34			0.34		0.55	0.52		0.55	0.52	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)		2.5			2.5		2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)		476			348		285	854		271	872	
v/s Ratio Prot							0.01	c0.37		c0.02	0.35	
v/s Ratio Perm		0.15			c0.33		0.21			0.27		
v/c Ratio		0.43			0.98		0.41	0.71		0.53	0.68	
Uniform Delay, d1		30.3			38.9		18.3	22.0		21.9	21.5	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.5			43.4		0.7	5.0		1.6	4.2	
Delay (s)		30.7			82.3		19.0	27.0		23.5	25.7	
Level of Service		C			F		B	C		C	C	
Approach Delay (s)		30.7			82.3			25.7			25.3	
Approach LOS		C			F			C			C	

Intersection Summary			
HCM 2000 Control Delay	35.7	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	119.2	Sum of lost time (s)	13.5
Intersection Capacity Utilization	86.1%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: St Paul Highway & Industrial Parkway/Springbrook Road

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	50	30	25	795	10	40	10	720	480	65	670	25
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.4	4.4		4.4	4.4		4.4	4.4	4.4	4.4	4.4	
Lane Util. Factor	1.00	1.00		0.97	1.00		1.00	0.95	1.00	1.00	0.95	
Frt	1.00	0.93		1.00	0.88		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1630	1598		3162	1510		1630	3260	1458	1630	3242	
Flt Permitted	0.72	1.00		0.95	1.00		0.20	1.00	1.00	0.19	1.00	
Satd. Flow (perm)	1237	1598		3162	1510		338	3260	1458	322	3242	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	56	33	28	883	11	44	11	800	533	72	744	28
RTOR Reduction (vph)	0	27	0	0	30	0	0	0	357	0	2	0
Lane Group Flow (vph)	56	34	0	883	25	0	11	800	176	72	770	0
Turn Type	pm+pt	NA		Prot	NA		pm+pt	NA	Prot	pm+pt	NA	
Protected Phases	3	8		7	4		1	6	6	5	2	
Permitted Phases	8						6			2		
Actuated Green, G (s)	25.6	6.8		51.6	39.6		41.6	40.0	40.0	49.6	44.0	
Effective Green, g (s)	24.8	6.4		51.2	39.2		40.8	39.6	39.6	48.8	43.6	
Actuated g/C Ratio	0.21	0.05		0.43	0.33		0.34	0.33	0.33	0.41	0.36	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5	2.5	2.5	2.5	
Lane Grp Cap (vph)	315	85		1349	493		127	1075	481	187	1177	
v/s Ratio Prot	0.03	c0.02		c0.28	0.02		0.00	c0.25	0.12	c0.02	0.24	
v/s Ratio Perm	0.01						0.03			0.14		
v/c Ratio	0.18	0.41		0.65	0.05		0.09	0.74	0.37	0.39	0.65	
Uniform Delay, d1	39.6	55.0		27.4	27.7		40.0	35.7	30.6	39.5	31.9	
Progression Factor	1.00	1.00		1.00	1.00		1.38	1.24	5.51	1.00	1.00	
Incremental Delay, d2	0.2	2.3		2.5	0.2		0.2	4.2	1.9	1.0	2.8	
Delay (s)	39.8	57.3		29.9	27.9		55.5	48.5	170.7	40.5	34.7	
Level of Service	D	E		C	C		E	D	F	D	C	
Approach Delay (s)		48.9			29.7			97.0			35.2	
Approach LOS		D			C			F			D	

Intersection Summary			
HCM 2000 Control Delay	59.8	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	17.6
Intersection Capacity Utilization	69.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
6: St Paul Highway & Bypass

5/11/2015

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	570	60	50	655	570	675
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.5	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	1.00	0.95	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	3162	1458	1630	3260	1716	1458
Flt Permitted	0.95	1.00	0.32	1.00	1.00	1.00
Satd. Flow (perm)	3162	1458	557	3260	1716	1458
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	633	67	56	728	633	750
RTOR Reduction (vph)	0	52	0	0	0	267
Lane Group Flow (vph)	633	15	56	728	633	483
Turn Type	Prot	Perm	pm+pt	NA	NA	Perm
Protected Phases	3		1	6	2	
Permitted Phases		3	6			2
Actuated Green, G (s)	27.5	27.5	84.5	84.5	77.3	77.3
Effective Green, g (s)	27.5	27.0	84.5	84.5	77.3	77.3
Actuated g/C Ratio	0.23	0.22	0.70	0.70	0.64	0.64
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5	2.5
Lane Grp Cap (vph)	724	328	420	2295	1105	939
v/s Ratio Prot	c0.20		0.00	c0.22	c0.37	
v/s Ratio Perm		0.01	0.09			0.33
v/c Ratio	0.87	0.05	0.13	0.32	0.57	0.51
Uniform Delay, d1	44.6	36.4	13.5	6.8	12.0	11.4
Progression Factor	1.00	1.00	1.00	1.00	0.97	2.42
Incremental Delay, d2	11.3	0.0	0.1	0.4	1.7	1.6
Delay (s)	55.9	36.5	13.6	7.1	13.4	29.1
Level of Service	E	D	B	A	B	C
Approach Delay (s)	54.0			7.6	21.9	
Approach LOS	D			A	C	

Intersection Summary			
HCM 2000 Control Delay	25.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	63.6%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
9: St Paul Highway & NE Wynooski Street

5/11/2015

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	65	70	125	640	485	145
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	72	78	139	711	539	161
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		10				
Median type				TWLTL	None	
Median storage veh)				2		
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1608	619	539			
vC1, stage 1 conf vol	619					
vC2, stage 2 conf vol	989					
vCu, unblocked vol	1608	619	539			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)	5.4					
tF (s)	3.5	3.3	2.2			
p0 queue free %	74	84	87			
cM capacity (veh/h)	276	488	1029			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	150	139	711	700
Volume Left	72	139	0	0
Volume Right	78	0	0	161
cSH	573	1029	1700	1700
Volume to Capacity	0.26	0.13	0.42	0.41
Queue Length 95th (ft)	26	12	0	0
Control Delay (s)	18.0	9.0	0.0	0.0
Lane LOS	C	A		
Approach Delay (s)	18.0	1.5		0.0
Approach LOS	C			

Intersection Summary			
Average Delay	2.3		
Intersection Capacity Utilization	60.0%	ICU Level of Service	B
Analysis Period (min)	15		

Attachment 4

HCM Unsignalized Intersection Capacity Analysis
1: St Paul Highway & E 2nd Street

5/14/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (veh/h)	0	0	20	0	0	190	0	740	10	0	765	45
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	0	0	22	0	0	211	0	822	11	0	850	50
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1914	1728	828	1725	1708	875	900			833		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1914	1728	828	1725	1708	875	900			833		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	94	100	100	39	100			100		
cM capacity (veh/h)	20	88	371	66	91	349	755			800		

Direction, Lane #	EB 1	WB 1	SE 1	NW 1
Volume Total	22	211	833	900
Volume Left	0	0	0	0
Volume Right	22	211	11	50
cSH	371	349	1700	1700
Volume to Capacity	0.06	0.61	0.49	0.53
Queue Length 95th (ft)	5	94	0	0
Control Delay (s)	15.3	30.0	0.0	0.0
Lane LOS	C	D		
Approach Delay (s)	15.3	30.0	0.0	0.0
Approach LOS	C	D		

Intersection Summary			
Average Delay	3.4		
Intersection Capacity Utilization	66.9%	ICU Level of Service	C
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
2: Springbrook Road & E 2nd Street/E Fernwood Road

5/21/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	55	85	55	160	150	100	20	345	130	130	485	50
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.5			4.5		4.5	4.5		4.5	4.5	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.96			0.97		1.00	0.96		1.00	0.99	
Flt Protected		0.99			0.98		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1627			1628		1630	1645		1630	1691	
Flt Permitted		0.78			0.74		0.29	1.00		0.25	1.00	
Satd. Flow (perm)		1290			1235		491	1645		426	1691	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	61	94	61	178	167	111	22	383	144	144	539	56
RTOR Reduction (vph)	0	13	0	0	11	0	0	11	0	0	3	0
Lane Group Flow (vph)	0	203	0	0	445	0	22	516	0	144	592	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8			4			6			2		
Actuated Green, G (s)		42.6			42.6		52.5	51.0		62.3	56.8	
Effective Green, g (s)		42.1			42.1		51.5	50.5		61.8	56.3	
Actuated g/C Ratio		0.37			0.37		0.46	0.45		0.55	0.50	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)		2.5			2.5		2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)		481			460		234	735		305	843	
v/s Ratio Prot							0.00	0.31		c0.03	c0.35	
v/s Ratio Perm		0.16			c0.36		0.04			0.23		
v/c Ratio		0.42			0.97		0.09	0.70		0.47	0.70	
Uniform Delay, d1		26.3			34.7		18.3	25.1		16.3	21.8	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.4			33.4		0.1	5.6		0.8	4.9	
Delay (s)		26.8			68.2		18.5	30.7		17.1	26.7	
Level of Service		C			E		B	C		B	C	
Approach Delay (s)		26.8			68.2			30.2			24.8	
Approach LOS		C			E			C			C	

Intersection Summary			
HCM 2000 Control Delay	36.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	112.9	Sum of lost time (s)	13.5
Intersection Capacity Utilization	85.1%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: St Paul Highway & Industrial Parkway/Springbrook Road

5/14/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	50	30	25	730	10	40	10	720	440	20	715	25
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.4	4.4		4.4	4.4		4.4	4.4	4.4	4.4	4.4	
Lane Util. Factor	1.00	1.00		0.97	1.00		1.00	0.95	1.00	1.00	0.95	
Frt	1.00	0.93		1.00	0.88		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1630	1598		3162	1510		1630	3260	1458	1630	3243	
Flt Permitted	0.72	1.00		0.95	1.00		0.18	1.00	1.00	0.19	1.00	
Satd. Flow (perm)	1237	1598		3162	1510		310	3260	1458	333	3243	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	56	33	28	811	11	44	11	800	489	22	794	28
RTOR Reduction (vph)	0	27	0	0	30	0	0	0	319	0	2	0
Lane Group Flow (vph)	56	34	0	811	25	0	11	800	170	22	820	0
Turn Type	pm+pt	NA		Prot	NA		pm+pt	NA	Prot	pm+pt	NA	
Protected Phases	3	8		7	4		1	6	6	5	2	
Permitted Phases	8						6			2		
Actuated Green, G (s)	25.6	6.8		51.2	39.2		43.6	42.0	42.0	48.4	44.4	
Effective Green, g (s)	24.8	6.4		50.8	38.8		42.8	41.6	41.6	47.6	44.0	
Actuated g/C Ratio	0.21	0.05		0.42	0.32		0.36	0.35	0.35	0.40	0.37	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5	2.5	2.5	2.5	
Lane Grp Cap (vph)	315	85		1338	488		123	1130	505	171	1189	
v/s Ratio Prot	0.03	c0.02		c0.26	0.02		0.00	0.25	0.12	c0.00	c0.25	
v/s Ratio Perm	0.01						0.03			0.05		
v/c Ratio	0.18	0.41		0.61	0.05		0.09	0.71	0.34	0.13	0.69	
Uniform Delay, d1	39.6	55.0		26.8	27.9		39.8	33.9	29.0	36.6	32.2	
Progression Factor	1.00	1.00		1.00	1.00		1.24	1.14	4.04	1.00	1.00	
Incremental Delay, d2	0.2	2.3		2.0	0.2		0.2	3.3	1.6	0.2	3.3	
Delay (s)	39.8	57.3		28.9	28.1		49.6	41.8	118.6	36.8	35.5	
Level of Service	D	E		C	C		D	D	F	D	D	
Approach Delay (s)		48.9			28.8			70.8			35.5	
Approach LOS		D			C			E			D	

Intersection Summary			
HCM 2000 Control Delay	48.8	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	17.6
Intersection Capacity Utilization	58.9%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
6: St Paul Highway & Bypass

5/14/2015

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	545	85	75	640	575	650
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0		4.0	4.0	4.0	4.0
Lane Util. Factor	0.97		1.00	0.95	1.00	1.00
Frt	0.98		1.00	1.00	1.00	0.85
Flt Protected	0.96		0.95	1.00	1.00	1.00
Satd. Flow (prot)	3126		1630	3260	1716	1458
Flt Permitted	0.96		0.30	1.00	1.00	1.00
Satd. Flow (perm)	3126		516	3260	1716	1458
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	606	94	83	711	639	722
RTOR Reduction (vph)	11	0	0	0	0	285
Lane Group Flow (vph)	689	0	83	711	639	437
Turn Type	Prot		pm+pt	NA	NA	Perm
Protected Phases	3		1	6	2	
Permitted Phases			6			2
Actuated Green, G (s)	30.5		81.5	81.5	72.7	72.7
Effective Green, g (s)	30.5		81.5	81.5	72.7	72.7
Actuated g/C Ratio	0.25		0.68	0.68	0.61	0.61
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	2.5		2.5	2.5	2.5	2.5
Lane Grp Cap (vph)	794		395	2214	1039	883
v/s Ratio Prot	c0.22		0.01	c0.22	c0.37	
v/s Ratio Perm			0.13			0.30
v/c Ratio	0.87		0.21	0.32	0.62	0.50
Uniform Delay, d1	42.8		17.2	7.9	14.9	13.3
Progression Factor	1.00		0.79	0.81	1.08	2.68
Incremental Delay, d2	9.8		0.2	0.3	2.1	1.6
Delay (s)	52.6		13.7	6.7	18.2	37.2
Level of Service	D		B	A	B	D
Approach Delay (s)	52.6			7.4	28.3	
Approach LOS	D			A	C	

Intersection Summary			
HCM 2000 Control Delay	28.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	67.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
9: St Paul Highway & NE Wynooski Street

5/14/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	65	0	70	40	0	25	125	625	15	70	445	145
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.5		4.5	4.5		4.5	4.5	4.5		4.5	4.5	
Lane Util. Factor	1.00		1.00	1.00		1.00	1.00	1.00		1.00	1.00	
Frt	1.00		0.85	1.00		0.85	1.00	1.00		1.00	0.96	
Flt Protected	0.95		1.00	0.95		1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1630		1458	1630		1458	1630	1710		1630	1652	
Flt Permitted	0.95		1.00	0.95		1.00	0.34	1.00		0.33	1.00	
Satd. Flow (perm)	1630		1458	1630		1458	580	1710		563	1652	
Peak-hour factor, PHF	0.90	0.95	0.90	0.95	0.95	0.95	0.90	0.90	0.95	0.95	0.90	0.90
Adj. Flow (vph)	72	0	78	42	0	26	139	694	16	74	494	161
RTOR Reduction (vph)	0	0	73	0	0	26	0	1	0	0	6	0
Lane Group Flow (vph)	72	0	5	42	0	0	139	709	0	74	649	0
Turn Type	Prot		Perm	pm+pt		Perm	pm+pt	NA		pm+pt	NA	
Protected Phases	3			7			1	6		5	2	
Permitted Phases			8	4		4	6			2		
Actuated Green, G (s)	8.6		7.8	5.6		2.4	94.7	88.5		91.3	86.8	
Effective Green, g (s)	8.1		7.3	4.6		1.9	93.7	88.0		90.3	86.3	
Actuated g/C Ratio	0.07		0.06	0.04		0.02	0.78	0.73		0.75	0.72	
Clearance Time (s)	4.0		4.0	4.0		4.0	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	2.5		2.5	2.5		2.5	2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)	110		88	62		23	502	1254		459	1188	
v/s Ratio Prot	c0.04			c0.02			c0.01	c0.41		0.01	0.39	
v/s Ratio Perm			0.00	0.01		0.00	0.20			0.12		
v/c Ratio	0.65		0.05	0.68		0.02	0.28	0.57		0.16	0.55	
Uniform Delay, d1	54.6		53.1	56.8		58.1	4.6	7.3		4.9	7.8	
Progression Factor	1.00		1.00	1.00		1.00	1.00	1.00		0.83	0.55	
Incremental Delay, d2	11.8		0.2	23.4		0.2	0.2	1.9		0.1	1.4	
Delay (s)	66.4		53.3	80.2		58.4	4.8	9.1		4.1	5.7	
Level of Service	E		D	F		E	A	A		A	A	
Approach Delay (s)		59.6			71.8			8.4			5.5	
Approach LOS		E			E			A			A	

Intersection Summary			
HCM 2000 Control Delay	13.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	17.5
Intersection Capacity Utilization	57.7%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Attachment 4

HCM Unsignalized Intersection Capacity Analysis
1: St Paul Highway & E 2nd Street

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (veh/h)	0	0	20	0	0	190	0	740	10	0	765	45
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	0	0	22	0	0	211	0	822	11	0	850	50
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1914	1728	828	1725	1708	875	900			833		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1914	1728	828	1725	1708	875	900			833		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	94	100	100	39	100			100		
cM capacity (veh/h)	20	88	371	66	91	349	755			800		

Direction, Lane #	EB 1	WB 1	SE 1	NW 1
Volume Total	22	211	833	900
Volume Left	0	0	0	0
Volume Right	22	211	11	50
cSH	371	349	1700	1700
Volume to Capacity	0.06	0.61	0.49	0.53
Queue Length 95th (ft)	5	94	0	0
Control Delay (s)	15.3	30.0	0.0	0.0
Lane LOS	C	D		
Approach Delay (s)	15.3	30.0	0.0	0.0
Approach LOS	C	D		

Intersection Summary			
Average Delay	3.4		
Intersection Capacity Utilization	66.9%	ICU Level of Service	C
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
2: Springbrook Road & E 2nd Street/E Fernwood Road

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	55	85	55	160	65	20	105	425	130	130	485	50
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.5			4.5		4.5	4.5		4.5	4.5	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.96			0.99		1.00	0.96		1.00	0.99	
Flt Protected		0.99			0.97		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1627			1643		1630	1656		1630	1691	
Flt Permitted		0.85			0.60		0.30	1.00		0.29	1.00	
Satd. Flow (perm)		1410			1024		519	1656		494	1691	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	61	94	61	178	72	22	117	472	144	144	539	56
RTOR Reduction (vph)	0	13	0	0	3	0	0	8	0	0	3	0
Lane Group Flow (vph)	0	203	0	0	269	0	117	608	0	144	592	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8			4			6			2		
Actuated Green, G (s)		31.7			31.7		66.4	62.4		66.4	62.4	
Effective Green, g (s)		31.2			31.2		65.4	61.9		65.4	61.9	
Actuated g/C Ratio		0.28			0.28		0.59	0.56		0.59	0.56	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)		2.5			2.5		2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)		399			290		343	931		329	950	
v/s Ratio Prot							0.01	c0.37		c0.01	0.35	
v/s Ratio Perm		0.14			c0.26		0.19			0.25		
v/c Ratio		0.51			0.93		0.34	0.65		0.44	0.62	
Uniform Delay, d1		33.0			38.4		11.8	16.7		14.4	16.2	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.7			34.0		0.4	3.6		0.7	3.1	
Delay (s)		33.8			72.4		12.2	20.2		15.1	19.3	
Level of Service		C			E		B	C		B	B	
Approach Delay (s)		33.8			72.4			18.9			18.5	
Approach LOS		C			E			B			B	

Intersection Summary			
HCM 2000 Control Delay	27.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	110.1	Sum of lost time (s)	13.5
Intersection Capacity Utilization	82.1%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: St Paul Highway & Industrial Parkway/Springbrook Road

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	50	30	25	730	10	40	10	720	440	65	670	25
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.4	4.4		4.4	4.4		4.4	4.4	4.4	4.4	4.4	
Lane Util. Factor	1.00	1.00		0.97	1.00		1.00	0.95	1.00	1.00	0.95	
Frt	1.00	0.93		1.00	0.88		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1630	1598		3162	1510		1630	3260	1458	1630	3242	
Flt Permitted	0.72	1.00		0.95	1.00		0.20	1.00	1.00	0.19	1.00	
Satd. Flow (perm)	1237	1598		3162	1510		338	3260	1458	322	3242	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	56	33	28	811	11	44	11	800	489	72	744	28
RTOR Reduction (vph)	0	27	0	0	30	0	0	0	328	0	2	0
Lane Group Flow (vph)	56	34	0	811	25	0	11	800	161	72	770	0
Turn Type	pm+pt	NA		Prot	NA		pm+pt	NA	Prot	pm+pt	NA	
Protected Phases	3	8		7	4		1	6	6	5	2	
Permitted Phases	8						6			2		
Actuated Green, G (s)	25.6	6.8		51.6	39.6		41.6	40.0	40.0	49.6	44.0	
Effective Green, g (s)	24.8	6.4		51.2	39.2		40.8	39.6	39.6	48.8	43.6	
Actuated g/C Ratio	0.21	0.05		0.43	0.33		0.34	0.33	0.33	0.41	0.36	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5	2.5	2.5	2.5	
Lane Grp Cap (vph)	315	85		1349	493		127	1075	481	187	1177	
v/s Ratio Prot	0.03	c0.02		c0.26	0.02		0.00	c0.25	0.11	c0.02	0.24	
v/s Ratio Perm	0.01						0.03			0.14		
v/c Ratio	0.18	0.41		0.60	0.05		0.09	0.74	0.34	0.39	0.65	
Uniform Delay, d1	39.6	55.0		26.5	27.7		40.0	35.7	30.3	39.5	31.9	
Progression Factor	1.00	1.00		1.00	1.00		1.24	1.14	4.06	1.00	1.00	
Incremental Delay, d2	0.2	2.3		2.0	0.2		0.2	4.1	1.6	1.0	2.8	
Delay (s)	39.8	57.3		28.5	27.9		49.8	44.8	124.7	40.5	34.7	
Level of Service	D	E		C	C		D	D	F	D	C	
Approach Delay (s)		48.9			28.5			74.9			35.2	
Approach LOS		D			C			E			D	

Intersection Summary			
HCM 2000 Control Delay	50.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	17.6
Intersection Capacity Utilization	67.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
6: St Paul Highway & Bypass

5/11/2015

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	545	85	75	640	530	650
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0		4.0	4.0	4.0	4.0
Lane Util. Factor	0.97		1.00	0.95	1.00	1.00
Frt	0.98		1.00	1.00	1.00	0.85
Flt Protected	0.96		0.95	1.00	1.00	1.00
Satd. Flow (prot)	3126		1630	3260	1716	1458
Flt Permitted	0.96		0.34	1.00	1.00	1.00
Satd. Flow (perm)	3126		582	3260	1716	1458
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	606	94	83	711	589	722
RTOR Reduction (vph)	11	0	0	0	0	275
Lane Group Flow (vph)	689	0	83	711	589	447
Turn Type	Prot		pm+pt	NA	NA	Perm
Protected Phases	3		1	6	2	
Permitted Phases			6			2
Actuated Green, G (s)	30.5		81.5	81.5	74.3	74.3
Effective Green, g (s)	30.5		81.5	81.5	74.3	74.3
Actuated g/C Ratio	0.25		0.68	0.68	0.62	0.62
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	2.5		2.5	2.5	2.5	2.5
Lane Grp Cap (vph)	794		423	2214	1062	902
v/s Ratio Prot	c0.22		0.01	c0.22	c0.34	
v/s Ratio Perm			0.13			0.31
v/c Ratio	0.87		0.20	0.32	0.55	0.50
Uniform Delay, d1	42.8		15.1	7.9	13.3	12.6
Progression Factor	1.00		0.82	0.82	1.04	2.56
Incremental Delay, d2	9.8		0.1	0.3	1.7	1.6
Delay (s)	52.6		12.5	6.8	15.5	33.7
Level of Service	D		B	A	B	C
Approach Delay (s)	52.6			7.4	25.5	
Approach LOS	D			A	C	

Intersection Summary			
HCM 2000 Control Delay	27.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	64.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
9: St Paul Highway & NE Wynooski Street

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	65	0	70	40	0	25	125	625	15	25	445	145
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.5		4.5	4.5		4.5	4.5	4.5		4.5	4.5	
Lane Util. Factor	1.00		1.00	1.00		1.00	1.00	1.00		1.00	1.00	
Frt	1.00		0.85	1.00		0.85	1.00	1.00		1.00	0.96	
Flt Protected	0.95		1.00	0.95		1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1630		1458	1630		1458	1630	1710		1630	1652	
Flt Permitted	0.95		1.00	0.95		1.00	0.33	1.00		0.34	1.00	
Satd. Flow (perm)	1630		1458	1630		1458	570	1710		584	1652	
Peak-hour factor, PHF	0.90	0.95	0.90	0.95	0.95	0.95	0.90	0.90	0.95	0.95	0.90	0.90
Adj. Flow (vph)	72	0	78	42	0	26	139	694	16	26	494	161
RTOR Reduction (vph)	0	0	73	0	0	26	0	1	0	0	6	0
Lane Group Flow (vph)	72	0	5	42	0	0	139	709	0	26	649	0
Turn Type	Prot		Perm	pm+pt		Perm	pm+pt	NA		pm+pt	NA	
Protected Phases	3			7			1	6		5	2	
Permitted Phases			8	4		4	6			2		
Actuated Green, G (s)	8.6		7.8	5.6		2.4	96.3	90.1		89.7	86.8	
Effective Green, g (s)	8.1		7.3	4.6		1.9	95.3	89.6		88.7	86.3	
Actuated g/C Ratio	0.07		0.06	0.04		0.02	0.79	0.75		0.74	0.72	
Clearance Time (s)	4.0		4.0	4.0		4.0	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	2.5		2.5	2.5		2.5	2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)	110		88	62		23	503	1276		452	1188	
v/s Ratio Prot	c0.04			c0.02			c0.01	c0.41		0.00	0.39	
v/s Ratio Perm			0.00	0.01		0.00	0.21			0.04		
v/c Ratio	0.65		0.05	0.68		0.02	0.28	0.56		0.06	0.55	
Uniform Delay, d1	54.6		53.1	56.8		58.1	4.5	6.6		4.8	7.8	
Progression Factor	1.00		1.00	1.00		1.00	1.00	1.00		0.63	0.44	
Incremental Delay, d2	11.8		0.2	23.4		0.2	0.2	1.8		0.0	1.5	
Delay (s)	66.4		53.3	80.2		58.4	4.7	8.3		3.1	5.0	
Level of Service	E		D	F		E	A	A		A	A	
Approach Delay (s)		59.6			71.8			7.7			4.9	
Approach LOS		E			E			A			A	

Intersection Summary			
HCM 2000 Control Delay	13.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	17.5
Intersection Capacity Utilization	57.7%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Attachment 4

HCM Unsignalized Intersection Capacity Analysis
1: St Paul Highway & E 2nd Street

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (veh/h)	0	0	20	0	0	105	0	740	10	0	850	95
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	0	0	22	0	0	117	0	822	11	0	944	106
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1942	1878	828	1847	1831	997	1050			833		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1942	1878	828	1847	1831	997	1050			833		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	94	100	100	61	100			100		
cM capacity (veh/h)	30	71	371	54	76	296	663			800		

Direction, Lane #	EB 1	WB 1	SE 1	NW 1
Volume Total	22	117	833	1050
Volume Left	0	0	0	0
Volume Right	22	117	11	106
cSH	371	296	1700	1700
Volume to Capacity	0.06	0.39	0.49	0.62
Queue Length 95th (ft)	5	45	0	0
Control Delay (s)	15.3	24.8	0.0	0.0
Lane LOS	C	C		
Approach Delay (s)	15.3	24.8	0.0	0.0
Approach LOS	C	C		

Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	69.4%	ICU Level of Service	C
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
2: Springbrook Road & E 2nd Street/E Fernwood Road

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	55	85	105	160	65	20	20	425	130	45	570	50
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.5			4.5		4.5	4.5		4.5	4.5	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.94			0.99		1.00	0.96		1.00	0.99	
Flt Protected		0.99			0.97		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1598			1643		1630	1656		1630	1695	
Flt Permitted		0.88			0.54		0.25	1.00		0.28	1.00	
Satd. Flow (perm)		1421			923		428	1656		474	1695	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	61	94	117	178	72	22	22	472	144	50	633	56
RTOR Reduction (vph)	0	25	0	0	3	0	0	8	0	0	2	0
Lane Group Flow (vph)	0	247	0	0	269	0	22	608	0	50	687	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8			4			6			2		
Actuated Green, G (s)		33.9			33.9		64.0	62.5		67.2	64.1	
Effective Green, g (s)		33.4			33.4		63.0	62.0		66.2	63.6	
Actuated g/C Ratio		0.30			0.30		0.57	0.56		0.59	0.57	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)		2.5			2.5		2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)		425			276		252	920		308	966	
v/s Ratio Prot							0.00	0.37		c0.00	c0.41	
v/s Ratio Perm		0.17			c0.29		0.05			0.09		
v/c Ratio		0.58			0.98		0.09	0.66		0.16	0.71	
Uniform Delay, d1		33.1			38.6		13.3	17.4		12.0	17.3	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		1.7			47.0		0.1	3.7		0.2	4.4	
Delay (s)		34.8			85.6		13.4	21.1		12.2	21.7	
Level of Service		C			F		B	C		B	C	
Approach Delay (s)		34.8			85.6			20.8			21.1	
Approach LOS		C			F			C			C	

Intersection Summary			
HCM 2000 Control Delay	32.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	111.5	Sum of lost time (s)	13.5
Intersection Capacity Utilization	81.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: St Paul Highway & Industrial Parkway/Springbrook Road

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	50	30	25	865	10	40	10	855	520	20	715	25
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.4	4.4		4.4	4.4		4.4	4.4	4.4	4.4	4.4	
Lane Util. Factor	1.00	1.00		0.97	1.00		1.00	0.95	1.00	1.00	0.95	
Frt	1.00	0.93		1.00	0.88		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1630	1598		3162	1510		1630	3260	1458	1630	3243	
Flt Permitted	0.72	1.00		0.95	1.00		0.17	1.00	1.00	0.11	1.00	
Satd. Flow (perm)	1237	1598		3162	1510		286	3260	1458	190	3243	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	56	33	28	961	11	44	11	950	578	22	794	28
RTOR Reduction (vph)	0	27	0	0	29	0	0	0	387	0	2	0
Lane Group Flow (vph)	56	34	0	961	26	0	11	950	191	22	820	0
Turn Type	pm+pt	NA		Prot	NA		pm+pt	NA	Prot	pm+pt	NA	
Protected Phases	3	8		7	4		1	6	6	5	2	
Permitted Phases	8						6			2		
Actuated Green, G (s)	25.6	6.8		53.2	41.2		41.6	40.0	40.0	46.4	42.4	
Effective Green, g (s)	24.8	6.4		52.8	40.8		40.8	39.6	39.6	45.6	42.0	
Actuated g/C Ratio	0.21	0.05		0.44	0.34		0.34	0.33	0.33	0.38	0.35	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5	2.5	2.5	2.5	
Lane Grp Cap (vph)	315	85		1391	513		110	1075	481	115	1135	
v/s Ratio Prot	0.03	c0.02		c0.30	0.02		0.00	c0.29	0.13	c0.01	0.25	
v/s Ratio Perm	0.01						0.03			0.07		
v/c Ratio	0.18	0.41		0.69	0.05		0.10	0.88	0.40	0.19	0.72	
Uniform Delay, d1	39.6	55.0		27.0	26.6		42.0	38.0	31.0	44.3	33.9	
Progression Factor	1.00	1.00		1.00	1.00		1.45	1.27	5.98	1.00	1.00	
Incremental Delay, d2	0.2	2.3		2.8	0.2		0.2	9.0	2.0	0.6	4.0	
Delay (s)	39.8	57.3		29.9	26.8		61.4	57.3	187.5	44.9	37.9	
Level of Service	D	E		C	C		E	E	F	D	D	
Approach Delay (s)		48.9			29.7			106.2			38.1	
Approach LOS		D			C			F			D	

Intersection Summary			
HCM 2000 Control Delay	65.8	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	17.6
Intersection Capacity Utilization	66.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
6: St Paul Highway & Bypass/NE Wilsonville Road

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	570	0	60	40	0	190	50	640	15	155	530	675
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0		4.5	4.0		4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97		1.00	1.00		1.00	1.00	0.95		1.00	1.00	1.00
Frt	1.00		0.85	1.00		0.85	1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95		1.00	0.95		1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3162		1458	1630		1458	1630	3248		1630	1716	1458
Flt Permitted	0.95		1.00	0.95		1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3162		1458	1630		1458	1630	3248		1630	1716	1458
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	633	0	67	44	0	211	56	711	17	172	589	750
RTOR Reduction (vph)	0	0	63	0	0	63	0	1	0	0	0	67
Lane Group Flow (vph)	633	0	4	44	0	148	56	727	0	172	589	683
Turn Type	Prot		Over	Prot		Over	Prot	NA		Prot	NA	pm+ov
Protected Phases	3		1	7		5	1	6		5	2	3
Permitted Phases												2
Actuated Green, G (s)	28.1		7.2	28.1		26.0	7.2	53.9		26.0	72.7	100.8
Effective Green, g (s)	28.1		6.7	28.1		26.0	7.2	53.9		26.0	72.7	100.8
Actuated g/C Ratio	0.23		0.06	0.23		0.22	0.06	0.45		0.22	0.61	0.84
Clearance Time (s)	4.0		4.0	4.0		4.0	4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	2.5		2.5	2.5		2.5	2.5	2.5		2.5	2.5	2.5
Lane Grp Cap (vph)	740		81	381		315	97	1458		353	1039	1273
v/s Ratio Prot	c0.20		0.00	0.03		0.10	0.03	0.22		c0.11	c0.34	0.13
v/s Ratio Perm												0.34
v/c Ratio	0.86		0.05	0.12		0.47	0.58	0.50		0.49	0.57	0.54
Uniform Delay, d1	44.0		53.6	36.2		41.0	54.9	23.5		41.2	14.2	2.8
Progression Factor	1.00		1.00	1.00		1.00	1.00	1.00		1.03	1.06	3.13
Incremental Delay, d2	9.4		0.2	0.1		5.0	6.7	1.2		3.5	1.6	0.2
Delay (s)	53.4		53.8	36.3		46.0	61.6	24.7		45.8	16.7	9.0
Level of Service	D		D	D		D	E	C		D	B	A
Approach Delay (s)		53.5			44.3			27.3			16.2	
Approach LOS		D			D			C			B	

Intersection Summary			
HCM 2000 Control Delay	29.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	61.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
9: St Paul Highway & NE Wynooski Street

5/11/2015

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	65	70	125	640	485	145
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	72	78	139	711	539	161
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		10				
Median type				TWLTL	None	
Median storage veh)				2		
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1608	619	539			
vC1, stage 1 conf vol	619					
vC2, stage 2 conf vol	989					
vCu, unblocked vol	1608	619	539			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)	5.4					
tF (s)	3.5	3.3	2.2			
p0 queue free %	74	84	87			
cM capacity (veh/h)	276	488	1029			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	150	139	711	700
Volume Left	72	139	0	0
Volume Right	78	0	0	161
cSH	573	1029	1700	1700
Volume to Capacity	0.26	0.13	0.42	0.41
Queue Length 95th (ft)	26	12	0	0
Control Delay (s)	18.0	9.0	0.0	0.0
Lane LOS	C	A		
Approach Delay (s)	18.0	1.5		0.0
Approach LOS	C			

Intersection Summary			
Average Delay	2.3		
Intersection Capacity Utilization	60.0%	ICU Level of Service	B
Analysis Period (min)	15		

Attachment 4

HCM Unsignalized Intersection Capacity Analysis
1: St Paul Highway & E 2nd Street

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (veh/h)	0	0	20	0	0	105	0	740	10	0	850	45
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	0	0	22	0	0	117	0	822	11	0	944	50
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1914	1822	828	1819	1803	969	994			833		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1914	1822	828	1819	1803	969	994			833		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	94	100	100	62	100			100		
cM capacity (veh/h)	32	77	371	56	79	307	696			800		

Direction, Lane #	EB 1	WB 1	SE 1	NW 1
Volume Total	22	117	833	994
Volume Left	0	0	0	0
Volume Right	22	117	11	50
cSH	371	307	1700	1700
Volume to Capacity	0.06	0.38	0.49	0.58
Queue Length 95th (ft)	5	43	0	0
Control Delay (s)	15.3	23.7	0.0	0.0
Lane LOS	C	C		
Approach Delay (s)	15.3	23.7	0.0	0.0
Approach LOS	C	C		

Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	66.1%	ICU Level of Service	C
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
2: Springbrook Road & E 2nd Street/E Fernwood Road

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	55	85	55	185	65	20	20	425	155	45	570	50
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.5			4.5		4.5	4.5		4.5	4.5	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.96			0.99		1.00	0.96		1.00	0.99	
Flt Protected		0.99			0.97		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1627			1642		1630	1647		1630	1695	
Flt Permitted		0.85			0.60		0.25	1.00		0.25	1.00	
Satd. Flow (perm)		1408			1021		424	1647		437	1695	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	61	94	61	206	72	22	22	472	172	50	633	56
RTOR Reduction (vph)	0	13	0	0	3	0	0	10	0	0	2	0
Lane Group Flow (vph)	0	203	0	0	297	0	22	634	0	50	687	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8			4			6			2		
Actuated Green, G (s)		34.5			34.5		63.9	62.4		67.1	64.0	
Effective Green, g (s)		34.0			34.0		62.9	61.9		66.1	63.5	
Actuated g/C Ratio		0.30			0.30		0.56	0.55		0.59	0.57	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)		2.5			2.5		2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)		427			309		248	910		285	961	
v/s Ratio Prot							0.00	0.39		c0.00	c0.41	
v/s Ratio Perm		0.14			c0.29		0.05			0.10		
v/c Ratio		0.47			0.96		0.09	0.70		0.18	0.71	
Uniform Delay, d1		31.7			38.4		13.6	18.2		12.7	17.7	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.6			40.8		0.1	4.4		0.2	4.5	
Delay (s)		32.3			79.1		13.7	22.6		12.9	22.2	
Level of Service		C			E		B	C		B	C	
Approach Delay (s)		32.3			79.1			22.3			21.6	
Approach LOS		C			E			C			C	

Intersection Summary			
HCM 2000 Control Delay	32.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	112.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	79.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: St Paul Highway & Industrial Parkway/Springbrook Road

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	50	30	25	840	10	40	10	805	545	20	715	25
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.4	4.4		4.4	4.4		4.4	4.4	4.4	4.4	4.4	
Lane Util. Factor	1.00	1.00		0.97	1.00		1.00	0.95	1.00	1.00	0.95	
Frt	1.00	0.93		1.00	0.88		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1630	1598		3162	1510		1630	3260	1458	1630	3243	
Flt Permitted	0.72	1.00		0.95	1.00		0.16	1.00	1.00	0.13	1.00	
Satd. Flow (perm)	1237	1598		3162	1510		274	3260	1458	221	3243	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	56	33	28	933	11	44	11	894	606	22	794	28
RTOR Reduction (vph)	0	27	0	0	29	0	0	0	411	0	2	0
Lane Group Flow (vph)	56	34	0	933	26	0	11	894	195	22	820	0
Turn Type	pm+pt	NA		Prot	NA		pm+pt	NA	Prot	pm+pt	NA	
Protected Phases	3	8		7	4		1	6	6	5	2	
Permitted Phases	8						6			2		
Actuated Green, G (s)	25.6	6.8		54.2	42.2		40.6	39.0	39.0	45.4	41.4	
Effective Green, g (s)	24.8	6.4		53.8	41.8		39.8	38.6	38.6	44.6	41.0	
Actuated g/C Ratio	0.21	0.05		0.45	0.35		0.33	0.32	0.32	0.37	0.34	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5	2.5	2.5	2.5	
Lane Grp Cap (vph)	315	85		1417	525		104	1048	468	124	1108	
v/s Ratio Prot	0.03	c0.02		c0.30	0.02		0.00	c0.27	0.13	c0.01	0.25	
v/s Ratio Perm	0.01						0.03			0.06		
v/c Ratio	0.18	0.41		0.66	0.05		0.11	0.85	0.42	0.18	0.74	
Uniform Delay, d1	39.6	55.0		25.9	25.9		43.1	38.0	31.9	43.2	34.8	
Progression Factor	1.00	1.00		1.00	1.00		1.44	1.26	6.19	1.00	1.00	
Incremental Delay, d2	0.2	2.3		2.4	0.2		0.3	7.6	2.3	0.5	4.5	
Delay (s)	39.8	57.3		28.3	26.1		62.5	55.6	199.7	43.7	39.3	
Level of Service	D	E		C	C		E	E	F	D	D	
Approach Delay (s)		48.9			28.2			113.5			39.4	
Approach LOS		D			C			F			D	

Intersection Summary			
HCM 2000 Control Delay	68.9	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	17.6
Intersection Capacity Utilization	64.2%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
6: St Paul Highway & Bypass/NE Wilsonville Road

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	570	0	60	40	0	165	50	640	15	130	530	675
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0		4.5	4.0		4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97		1.00	1.00		1.00	1.00	0.95		1.00	1.00	1.00
Frt	1.00		0.85	1.00		0.85	1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95		1.00	0.95		1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3162		1458	1630		1458	1630	3248		1630	1716	1458
Flt Permitted	0.95		1.00	0.95		1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3162		1458	1630		1458	1630	3248		1630	1716	1458
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	633	0	67	44	0	183	56	711	17	144	589	750
RTOR Reduction (vph)	0	0	63	0	0	75	0	1	0	0	0	67
Lane Group Flow (vph)	633	0	4	44	0	108	56	727	0	144	589	683
Turn Type	Prot		Over	Prot		Over	Prot	NA		Prot	NA	pm+ov
Protected Phases	3		1	7		5	1	6		5	2	3
Permitted Phases												2
Actuated Green, G (s)	28.1		7.2	28.1		22.0	7.2	57.9		22.0	72.7	100.8
Effective Green, g (s)	28.1		6.7	28.1		22.0	7.2	57.9		22.0	72.7	100.8
Actuated g/C Ratio	0.23		0.06	0.23		0.18	0.06	0.48		0.18	0.61	0.84
Clearance Time (s)	4.0		4.0	4.0		4.0	4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	2.5		2.5	2.5		2.5	2.5	2.5		2.5	2.5	2.5
Lane Grp Cap (vph)	740		81	381		267	97	1567		298	1039	1273
v/s Ratio Prot	c0.20		0.00	0.03		0.07	0.03	0.22		c0.09	c0.34	0.13
v/s Ratio Perm												0.34
v/c Ratio	0.86		0.05	0.12		0.40	0.58	0.46		0.48	0.57	0.54
Uniform Delay, d1	44.0		53.6	36.2		43.2	54.9	20.7		43.9	14.2	2.8
Progression Factor	1.00		1.00	1.00		1.00	1.00	1.00		1.05	1.10	3.39
Incremental Delay, d2	9.4		0.2	0.1		4.5	6.7	1.0		4.1	1.7	0.3
Delay (s)	53.4		53.8	36.3		47.7	61.6	21.7		50.1	17.4	9.7
Level of Service	D		D	D		D	E	C		D	B	A
Approach Delay (s)		53.5			45.5			24.5			16.7	
Approach LOS		D			D			C			B	

Intersection Summary			
HCM 2000 Control Delay	28.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	61.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
9: St Paul Highway & NE Wynooski Street

5/11/2015

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	65	70	125	640	485	145
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	72	78	139	711	539	161
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		10				
Median type				TWLTL	None	
Median storage veh)				2		
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1608	619	539			
vC1, stage 1 conf vol	619					
vC2, stage 2 conf vol	989					
vCu, unblocked vol	1608	619	539			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)	5.4					
tF (s)	3.5	3.3	2.2			
p0 queue free %	74	84	87			
cM capacity (veh/h)	276	488	1029			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	150	139	711	700
Volume Left	72	139	0	0
Volume Right	78	0	0	161
cSH	573	1029	1700	1700
Volume to Capacity	0.26	0.13	0.42	0.41
Queue Length 95th (ft)	26	12	0	0
Control Delay (s)	18.0	9.0	0.0	0.0
Lane LOS	C	A		
Approach Delay (s)	18.0	1.5		0.0
Approach LOS	C			

Intersection Summary			
Average Delay	2.3		
Intersection Capacity Utilization	60.0%	ICU Level of Service	B
Analysis Period (min)	15		

Attachment 4

HCM Unsignalized Intersection Capacity Analysis
1: St Paul Highway & E 2nd Street

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (veh/h)	0	0	35	0	0	170	0	540	210	0	965	60
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	0	0	39	0	0	189	0	600	233	0	1072	67
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	2011	1856	717	1861	1939	1106	1139			833		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2011	1856	717	1861	1939	1106	1139			833		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	91	100	100	26	100			100		
cM capacity (veh/h)	12	74	430	51	65	256	613			800		

Direction, Lane #	EB 1	WB 1	SE 1	NW 1
Volume Total	39	189	833	1139
Volume Left	0	0	0	0
Volume Right	39	189	233	67
cSH	430	256	1700	1700
Volume to Capacity	0.09	0.74	0.49	0.67
Queue Length 95th (ft)	7	130	0	0
Control Delay (s)	14.2	50.3	0.0	0.0
Lane LOS	B	F		
Approach Delay (s)	14.2	50.3	0.0	0.0
Approach LOS	B	F		

Intersection Summary			
Average Delay	4.6		
Intersection Capacity Utilization	78.0%	ICU Level of Service	D
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
2: Springbrook Road & E 2nd Street/E Fernwood Road

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	55	110	95	450	205	25	20	380	405	100	595	105
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.5			4.5		4.5	4.5		4.5	4.5	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.95			0.99		1.00	0.92		1.00	0.98	
Flt Protected		0.99			0.97		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1614			1652		1630	1583		1630	1677	
Flt Permitted		0.81			0.60		0.08	1.00		0.08	1.00	
Satd. Flow (perm)		1322			1020		146	1583		141	1677	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	61	122	106	500	228	28	22	422	450	111	661	117
RTOR Reduction (vph)	0	17	0	0	1	0	0	32	0	0	5	0
Lane Group Flow (vph)	0	272	0	0	755	0	22	840	0	111	773	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8			4			6			2		
Actuated Green, G (s)		58.0			58.0		50.0	47.6		53.2	49.2	
Effective Green, g (s)		57.5			57.5		49.0	47.1		52.2	48.7	
Actuated g/C Ratio		0.47			0.47		0.40	0.39		0.43	0.40	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)		2.5			2.5		2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)		625			482		82	613		103	671	
v/s Ratio Prot							0.00	c0.53		c0.03	0.46	
v/s Ratio Perm		0.21			c0.74		0.10			0.43		
v/c Ratio		0.43			1.57		0.27	1.37		1.08	1.15	
Uniform Delay, d1		21.3			32.0		29.7	37.2		36.7	36.4	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.4			264.8		1.3	177.0		111.2	84.6	
Delay (s)		21.6			296.8		31.0	214.2		147.9	121.0	
Level of Service		C			F		C	F		F	F	
Approach Delay (s)		21.6			296.8			209.7			124.4	
Approach LOS		C			F			F			F	

Intersection Summary			
HCM 2000 Control Delay	187.0	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.46		
Actuated Cycle Length (s)	121.6	Sum of lost time (s)	13.5
Intersection Capacity Utilization	125.9%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: St Paul Highway & Industrial Parkway/Springbrook Road

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	90	40	40	1225	25	50	25	885	750	35	500	40
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.4	4.4		4.4	4.4		4.4	4.4	4.4	4.4	4.4	
Lane Util. Factor	1.00	1.00		0.97	1.00		1.00	0.95	1.00	1.00	0.95	
Frt	1.00	0.93		1.00	0.90		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1630	1587		3162	1544		1630	3260	1458	1630	3224	
Flt Permitted	0.70	1.00		0.95	1.00		0.28	1.00	1.00	0.11	1.00	
Satd. Flow (perm)	1205	1587		3162	1544		486	3260	1458	184	3224	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	100	44	44	1361	28	56	28	983	833	39	556	44
RTOR Reduction (vph)	0	32	0	0	36	0	0	0	558	0	5	0
Lane Group Flow (vph)	100	56	0	1361	48	0	28	983	275	39	595	0
Turn Type	pm+pt	NA		Prot	NA		pm+pt	NA	Prot	pm+pt	NA	
Protected Phases	3	8		7	4		1	6	6	5	2	
Permitted Phases	8						6			2		
Actuated Green, G (s)	27.2	9.2		52.4	43.6		44.8	40.0	40.0	40.0	37.6	
Effective Green, g (s)	26.4	8.8		52.0	43.2		44.0	39.6	39.6	39.2	37.2	
Actuated g/C Ratio	0.22	0.07		0.43	0.36		0.37	0.33	0.33	0.33	0.31	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5	2.5	2.5	2.5	
Lane Grp Cap (vph)	327	116		1370	555		220	1075	481	84	999	
v/s Ratio Prot	0.04	c0.04		c0.43	0.03		c0.00	c0.30	0.19	c0.01	0.18	
v/s Ratio Perm	0.02						0.04			0.14		
v/c Ratio	0.31	0.48		0.99	0.09		0.13	0.91	0.57	0.46	0.60	
Uniform Delay, d1	39.8	53.4		33.8	25.4		34.5	38.6	33.2	52.1	35.0	
Progression Factor	1.00	1.00		1.00	1.00		1.41	1.31	6.52	1.00	1.00	
Incremental Delay, d2	0.4	2.3		22.8	0.3		0.1	9.0	3.0	2.9	2.6	
Delay (s)	40.2	55.7		56.6	25.7		48.8	59.4	219.4	55.0	37.7	
Level of Service	D	E		E	C		D	E	F	D	D	
Approach Delay (s)		47.4			54.8			131.5			38.7	
Approach LOS		D			D			F			D	

Intersection Summary			
HCM 2000 Control Delay	86.3	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	17.6
Intersection Capacity Utilization	83.5%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
6: St Paul Highway & Bypass/NE Wilsonville Road

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	725	40	60	50	35	230	70	705	25	265	680	820
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	1.00		1.00	1.00	1.00	1.00	0.95		1.00	1.00	1.00
Frt	1.00	0.91		1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3162	1560		1630	1716	1458	1630	3243		1630	1716	1458
Flt Permitted	0.95	1.00		0.53	1.00	1.00	0.10	1.00		0.18	1.00	1.00
Satd. Flow (perm)	3162	1560		903	1716	1458	172	3243		312	1716	1458
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	806	44	67	56	39	256	78	783	28	294	756	911
RTOR Reduction (vph)	0	58	0	0	0	228	0	2	0	0	0	379
Lane Group Flow (vph)	806	53	0	56	39	28	78	809	0	294	756	532
Turn Type	Prot	NA		pm+pt	NA	Prot	pm+pt	NA		pm+pt	NA	Perm
Protected Phases	3	8		7	4	4	1	6		5	2	
Permitted Phases				4			6			2		2
Actuated Green, G (s)	37.2	16.8		35.6	7.6	7.6	44.0	40.0		63.2	55.2	55.2
Effective Green, g (s)	37.2	16.8		35.6	7.6	7.6	44.0	40.0		63.2	55.2	55.2
Actuated g/C Ratio	0.31	0.14		0.30	0.06	0.06	0.37	0.33		0.53	0.46	0.46
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	2.5	2.5		2.5	2.5	2.5	2.5	2.5		2.5	2.5	2.5
Lane Grp Cap (vph)	980	218		437	108	92	111	1081		375	789	670
v/s Ratio Prot	c0.25	0.03		0.03	c0.02	0.02	0.02	0.25		c0.13	c0.44	
v/s Ratio Perm				0.01			0.23			0.29		0.36
v/c Ratio	0.82	0.24		0.13	0.36	0.31	0.70	0.75		0.78	0.96	0.79
Uniform Delay, d1	38.3	46.0		33.0	53.9	53.7	54.3	35.5		35.4	31.3	27.6
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		0.75	0.75	1.35
Incremental Delay, d2	5.5	0.4		0.1	1.5	1.4	17.0	4.8		8.1	14.8	5.0
Delay (s)	43.9	46.4		33.1	55.4	55.1	71.3	40.3		34.5	38.3	42.2
Level of Service	D	D		C	E	E	E	D		C	D	D
Approach Delay (s)		44.2			51.6			43.0			39.6	
Approach LOS		D			D			D			D	

Intersection Summary			
HCM 2000 Control Delay	42.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	82.2%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
9: St Paul Highway & NE Wynooski Street

5/21/2015

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	75	135	300	725	565	225
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	83	150	333	806	628	250
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		10				
Median type				TWLTL	None	
Median storage veh)				2		
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2225	753	628			
vC1, stage 1 conf vol	753					
vC2, stage 2 conf vol	1472					
vCu, unblocked vol	2225	753	628			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)	5.4					
tF (s)	3.5	3.3	2.2			
p0 queue free %	35	63	65			
cM capacity (veh/h)	129	410	954			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	233	333	806	878
Volume Left	83	333	0	0
Volume Right	150	0	0	250
cSH	361	954	1700	1700
Volume to Capacity	0.65	0.35	0.47	0.52
Queue Length 95th (ft)	108	39	0	0
Control Delay (s)	38.4	10.8	0.0	0.0
Lane LOS	E	B		
Approach Delay (s)	38.4	3.2		0.0
Approach LOS	E			

Intersection Summary			
Average Delay	5.6		
Intersection Capacity Utilization	81.0%	ICU Level of Service	D
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
10: Springbrook Road & Highway 99W

5/21/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	210	1570	265	575	1525	175	475	365	75	485	335	105
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	0.97	1.00	1.00	0.97	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1630	3260	1458	3162	3260	1458	3162	1716	1458	3162	1716	1458
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1630	3260	1458	3162	3260	1458	3162	1716	1458	3162	1716	1458
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	233	1744	294	639	1694	194	528	406	83	539	372	117
RTOR Reduction (vph)	0	0	33	0	0	33	0	0	53	0	0	57
Lane Group Flow (vph)	233	1744	262	639	1694	161	528	406	30	539	372	60
Turn Type	Prot	NA	pm+ov	Prot	NA	pm+ov	Prot	NA	pm+ov	Prot	NA	pm+ov
Protected Phases	3	8	1	7	4	5	1	6	7	5	2	3
Permitted Phases			8			4			6			2
Actuated Green, G (s)	12.0	47.0	61.0	17.0	52.0	66.0	14.0	26.0	43.0	14.0	26.0	38.0
Effective Green, g (s)	11.5	46.5	60.0	16.5	51.5	65.0	13.5	25.5	42.0	13.5	25.5	37.0
Actuated g/C Ratio	0.10	0.39	0.50	0.14	0.43	0.54	0.11	0.21	0.35	0.11	0.21	0.31
Clearance 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
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Lane Grp Cap (vph)	156	1263	729	434	1399	844	355	364	510	355	364	504
v/s Ratio Prot	0.14	c0.54	0.04	c0.20	0.52	0.02	0.17	c0.24	0.01	c0.17	0.22	0.01
v/s Ratio Perm			0.14			0.09			0.01			0.03
v/c Ratio	1.49	1.38	0.36	1.47	1.21	0.19	1.49	1.12	0.06	1.52	1.02	0.12
Uniform Delay, d1	54.2	36.8	18.3	51.8	34.2	14.1	53.2	47.2	25.9	53.2	47.2	29.8
Progression 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
Incremental Delay, d2	252.8	176.4	0.2	224.8	101.8	0.1	233.8	82.1	0.0	247.3	52.9	0.1
Delay (s)	307.0	213.1	18.5	276.5	136.0	14.1	287.1	129.4	25.9	300.5	100.1	29.9
Level of Service	F	F	B	F	F	B	F	F	C	F	F	C
Approach Delay (s)		197.6			162.2			202.8			197.2	
Approach LOS		F			F			F			F	

Intersection Summary			
HCM 2000 Control Delay	185.2	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.35		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	115.8%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Attachment 4

HCM Unsignalized Intersection Capacity Analysis
1: St Paul Highway & E 2nd Street

5/21/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (veh/h)	0	0	35	0	0	285	0	540	210	0	850	60
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	0	0	39	0	0	317	0	600	233	0	944	67
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	2011	1728	717	1733	1811	978	1011			833		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2011	1728	717	1733	1811	978	1011			833		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	100	91	100	100	0	100			100		
cM capacity (veh/h)	0	88	430	63	79	304	686			800		

Direction, Lane #	EB 1	WB 1	SE 1	NW 1
Volume Total	39	317	833	1011
Volume Left	0	0	0	0
Volume Right	39	317	233	67
cSH	430	304	1700	1700
Volume to Capacity	0.09	1.04	0.49	0.59
Queue Length 95th (ft)	7	293	0	0
Control Delay (s)	14.2	101.3	0.0	0.0
Lane LOS	B	F		
Approach Delay (s)	14.2	101.3	0.0	0.0
Approach LOS	B	F		

Intersection Summary			
Average Delay	14.8		
Intersection Capacity Utilization	79.2%	ICU Level of Service	D
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
2: Springbrook Road & E 2nd Street/E Fernwood Road

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	55	110	95	535	205	25	135	380	405	270	425	105
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.5			4.5		4.5	4.5		4.5	4.5	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.95			1.00		1.00	0.92		1.00	0.97	
Flt Protected		0.99			0.97		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1614			1650		1630	1583		1630	1665	
Flt Permitted		0.81			0.59		0.10	1.00		0.09	1.00	
Satd. Flow (perm)		1316			1003		174	1583		161	1665	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	61	122	106	594	228	28	150	422	450	300	472	117
RTOR Reduction (vph)	0	17	0	0	1	0	0	32	0	0	8	0
Lane Group Flow (vph)	0	272	0	0	849	0	150	840	0	300	581	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8			4			6			2		
Actuated Green, G (s)		58.0			58.0		48.0	41.0		52.0	43.0	
Effective Green, g (s)		57.5			57.5		47.0	40.5		51.0	42.5	
Actuated g/C Ratio		0.48			0.48		0.39	0.34		0.42	0.35	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)		2.5			2.5		2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)		630			480		147	534		172	589	
v/s Ratio Prot							0.06	0.53		c0.12	0.35	
v/s Ratio Perm		0.21			c0.85		0.34			c0.61		
v/c Ratio		0.43			1.77		1.02	1.57		1.74	0.99	
Uniform Delay, d1		20.5			31.2		31.9	39.8		30.7	38.5	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.3			354.3		79.7	267.0		357.8	34.0	
Delay (s)		20.9			385.6		111.6	306.7		388.6	72.5	
Level of Service		C			F		F	F		F	E	
Approach Delay (s)		20.9			385.6			278.1			179.1	
Approach LOS		C			F			F			F	

Intersection Summary			
HCM 2000 Control Delay	254.8	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.79		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	141.3%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: St Paul Highway & Industrial Parkway/Springbrook Road

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	90	40	40	1140	25	50	25	770	700	130	405	40
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.4	4.4		4.4	4.4		4.4	4.4	4.4	4.4	4.4	
Lane Util. Factor	1.00	1.00		0.97	1.00		1.00	0.95	1.00	1.00	0.95	
Frt	1.00	0.93		1.00	0.90		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1630	1587		3162	1544		1630	3260	1458	1630	3216	
Flt Permitted	0.70	1.00		0.95	1.00		0.32	1.00	1.00	0.12	1.00	
Satd. Flow (perm)	1205	1587		3162	1544		551	3260	1458	199	3216	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	100	44	44	1267	28	56	28	856	778	144	450	44
RTOR Reduction (vph)	0	32	0	0	35	0	0	0	573	0	6	0
Lane Group Flow (vph)	100	56	0	1267	49	0	28	856	205	144	488	0
Turn Type	pm+pt	NA		Prot	NA		pm+pt	NA	Prot	pm+pt	NA	
Protected Phases	3	8		7	4		1	6	6	5	2	
Permitted Phases	8						6			2		
Actuated Green, G (s)	27.2	9.2		55.2	46.4		36.8	32.0	32.0	42.4	34.8	
Effective Green, g (s)	26.4	8.8		54.8	46.0		36.0	31.6	31.6	41.6	34.4	
Actuated g/C Ratio	0.22	0.07		0.46	0.38		0.30	0.26	0.26	0.35	0.29	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5	2.5	2.5	2.5	
Lane Grp Cap (vph)	327	116		1443	591		204	858	383	154	921	
v/s Ratio Prot	0.04	c0.04		c0.40	0.03		0.01	c0.26	0.14	c0.06	0.15	
v/s Ratio Perm	0.02						0.04			0.27		
v/c Ratio	0.31	0.48		0.88	0.08		0.14	1.00	0.53	0.94	0.53	
Uniform Delay, d1	39.8	53.4		29.6	23.6		38.2	44.2	37.9	50.4	36.0	
Progression Factor	1.00	1.00		1.00	1.00		1.18	1.08	5.40	1.00	1.00	
Incremental Delay, d2	0.4	2.3		7.9	0.3		0.2	26.2	4.0	53.1	2.2	
Delay (s)	40.2	55.7		37.4	23.9		45.4	73.9	208.5	103.5	38.2	
Level of Service	D	E		D	C		D	E	F	F	D	
Approach Delay (s)		47.4			36.6			136.4			52.9	
Approach LOS		D			D			F			D	

Intersection Summary			
HCM 2000 Control Delay	83.1	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	17.6
Intersection Capacity Utilization	83.9%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
6: St Paul Highway & Bypass

5/11/2015

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	765	60	70	730	730	855
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.5	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	1.00	0.95	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	3162	1458	1630	3260	1716	1458
Flt Permitted	0.95	1.00	0.18	1.00	1.00	1.00
Satd. Flow (perm)	3162	1458	315	3260	1716	1458
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	850	67	78	811	811	950
RTOR Reduction (vph)	0	48	0	0	0	367
Lane Group Flow (vph)	850	19	78	811	811	583
Turn Type	Prot	Perm	pm+pt	NA	NA	Perm
Protected Phases	3		1	6	2	
Permitted Phases		3	6			2
Actuated Green, G (s)	34.2	34.2	77.8	77.8	70.6	70.6
Effective Green, g (s)	34.2	33.7	77.8	77.8	70.6	70.6
Actuated g/C Ratio	0.29	0.28	0.65	0.65	0.59	0.59
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5	2.5
Lane Grp Cap (vph)	901	409	239	2113	1009	857
v/s Ratio Prot	c0.27		0.01	c0.25	c0.47	
v/s Ratio Perm		0.01	0.20			0.40
v/c Ratio	0.94	0.05	0.33	0.38	0.80	0.68
Uniform Delay, d1	42.0	31.4	29.5	9.9	19.3	16.9
Progression Factor	1.00	1.00	1.00	1.00	0.53	2.90
Incremental Delay, d2	17.7	0.0	0.6	0.5	4.4	2.8
Delay (s)	59.7	31.5	30.1	10.4	14.6	52.0
Level of Service	E	C	C	B	B	D
Approach Delay (s)	57.6			12.1	34.8	
Approach LOS	E			B	C	

Intersection Summary			
HCM 2000 Control Delay	35.0	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	79.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
9: St Paul Highway & NE Wynooski Street

5/11/2015

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	75	135	300	725	565	225
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	83	150	333	806	628	250
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		10				
Median type				TWLTL	None	
Median storage veh)				2		
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2225	753	628			
vC1, stage 1 conf vol	753					
vC2, stage 2 conf vol	1472					
vCu, unblocked vol	2225	753	628			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)	5.4					
tF (s)	3.5	3.3	2.2			
p0 queue free %	35	63	65			
cM capacity (veh/h)	129	410	954			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	233	333	806	878
Volume Left	83	333	0	0
Volume Right	150	0	0	250
cSH	361	954	1700	1700
Volume to Capacity	0.65	0.35	0.47	0.52
Queue Length 95th (ft)	108	39	0	0
Control Delay (s)	38.4	10.8	0.0	0.0
Lane LOS	E	B		
Approach Delay (s)	38.4	3.2		0.0
Approach LOS	E			

Intersection Summary			
Average Delay	5.6		
Intersection Capacity Utilization	81.0%	ICU Level of Service	D
Analysis Period (min)	15		

Attachment 4

HCM Unsignalized Intersection Capacity Analysis
1: St Paul Highway & E 2nd Street

5/14/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (veh/h)	0	0	35	0	0	285	0	540	210	0	850	60
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	0	0	39	0	0	317	0	600	233	0	944	67
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	2011	1728	717	1733	1811	978	1011			833		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2011	1728	717	1733	1811	978	1011			833		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	100	91	100	100	0	100			100		
cM capacity (veh/h)	0	88	430	63	79	304	686			800		

Direction, Lane #	EB 1	WB 1	SE 1	NW 1
Volume Total	39	317	833	1011
Volume Left	0	0	0	0
Volume Right	39	317	233	67
cSH	430	304	1700	1700
Volume to Capacity	0.09	1.04	0.49	0.59
Queue Length 95th (ft)	7	293	0	0
Control Delay (s)	14.2	101.3	0.0	0.0
Lane LOS	B	F		
Approach Delay (s)	14.2	101.3	0.0	0.0
Approach LOS	B	F		

Intersection Summary			
Average Delay	14.8		
Intersection Capacity Utilization	79.2%	ICU Level of Service	D
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
2: Springbrook Road & E 2nd Street/E Fernwood Road

5/21/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	55	110	95	450	320	140	20	265	405	270	425	105
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.5			4.5		4.5	4.5		4.5	4.5	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.95			0.98		1.00	0.91		1.00	0.97	
Flt Protected		0.99			0.98		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1614			1639		1630	1560		1630	1665	
Flt Permitted		0.76			0.67		0.14	1.00		0.09	1.00	
Satd. Flow (perm)		1235			1129		235	1560		161	1665	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	61	122	106	500	356	156	22	294	450	300	472	117
RTOR Reduction (vph)	0	18	0	0	5	0	0	45	0	0	7	0
Lane Group Flow (vph)	0	271	0	0	1007	0	22	699	0	300	582	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8			4			6			2		
Actuated Green, G (s)		62.0			62.0		41.0	38.6		51.6	45.2	
Effective Green, g (s)		61.5			61.5		40.0	38.1		51.1	44.7	
Actuated g/C Ratio		0.51			0.51		0.33	0.31		0.42	0.37	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)		2.5			2.5		2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)		624			570		99	488		170	612	
v/s Ratio Prot							0.00	0.45		c0.12	0.35	
v/s Ratio Perm		0.22			c0.89		0.07			c0.62		
v/c Ratio		0.43			1.77		0.22	1.43		1.76	0.95	
Uniform Delay, d1		19.0			30.0		30.7	41.8		31.1	37.4	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.4			351.8		0.8	205.8		367.0	26.1	
Delay (s)		19.4			381.8		31.5	247.6		398.1	63.5	
Level of Service		B			F		C	F		F	E	
Approach Delay (s)		19.4			381.8			241.4			176.4	
Approach LOS		B			F			F			F	

Intersection Summary			
HCM 2000 Control Delay	248.2	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.81		
Actuated Cycle Length (s)	121.6	Sum of lost time (s)	13.5
Intersection Capacity Utilization	143.8%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: St Paul Highway & Industrial Parkway/Springbrook Road

5/14/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	90	40	40	1055	25	50	25	770	635	35	500	40
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.4	4.4		4.4	4.4		4.4	4.4	4.4	4.4	4.4	
Lane Util. Factor	1.00	1.00		0.97	1.00		1.00	0.95	1.00	1.00	0.95	
Frt	1.00	0.93		1.00	0.90		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1630	1587		3162	1544		1630	3260	1458	1630	3224	
Flt Permitted	0.70	1.00		0.95	1.00		0.24	1.00	1.00	0.13	1.00	
Satd. Flow (perm)	1205	1587		3162	1544		415	3260	1458	220	3224	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	100	44	44	1172	28	56	28	856	706	39	556	44
RTOR Reduction (vph)	0	32	0	0	33	0	0	0	508	0	4	0
Lane Group Flow (vph)	100	56	0	1172	51	0	28	856	198	39	596	0
Turn Type	pm+pt	NA		Prot	NA		pm+pt	NA	Prot	pm+pt	NA	
Protected Phases	3	8		7	4		1	6	6	5	2	
Permitted Phases	8						6			2		
Actuated Green, G (s)	27.2	9.2		58.4	49.6		38.8	34.0	34.0	34.0	31.6	
Effective Green, g (s)	26.4	8.8		58.0	49.2		38.0	33.6	33.6	33.2	31.2	
Actuated g/C Ratio	0.22	0.07		0.48	0.41		0.32	0.28	0.28	0.28	0.26	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5	2.5	2.5	2.5	
Lane Grp Cap (vph)	327	116		1528	633		175	912	408	84	838	
v/s Ratio Prot	0.04	c0.04		c0.37	0.03		c0.01	c0.26	0.14	c0.01	0.18	
v/s Ratio Perm	0.02						0.04			0.12		
v/c Ratio	0.31	0.48		0.77	0.08		0.16	0.94	0.48	0.46	0.71	
Uniform Delay, d1	39.8	53.4		25.5	21.6		40.3	42.2	36.0	53.6	40.3	
Progression Factor	1.00	1.00		1.00	1.00		1.16	1.06	4.02	1.00	1.00	
Incremental Delay, d2	0.4	2.3		3.7	0.2		0.2	14.4	3.0	2.9	5.1	
Delay (s)	40.2	55.7		29.2	21.8		47.1	59.0	147.5	56.6	45.4	
Level of Service	D	E		C	C		D	E	F	E	D	
Approach Delay (s)		47.4			28.7			98.1			46.1	
Approach LOS		D			C			F			D	

Intersection Summary			
HCM 2000 Control Delay	62.7	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	17.6
Intersection Capacity Utilization	76.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
6: St Paul Highway & Bypass

5/14/2015

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	725	100	105	705	775	820
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0		4.0	4.0	4.0	4.0
Lane Util. Factor	0.97		1.00	0.95	1.00	1.00
Frt	0.98		1.00	1.00	1.00	0.85
Flt Protected	0.96		0.95	1.00	1.00	1.00
Satd. Flow (prot)	3130		1630	3260	1716	1458
Flt Permitted	0.96		0.14	1.00	1.00	1.00
Satd. Flow (perm)	3130		235	3260	1716	1458
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	806	111	117	783	861	911
RTOR Reduction (vph)	9	0	0	0	0	347
Lane Group Flow (vph)	908	0	117	783	861	564
Turn Type	Prot		pm+pt	NA	NA	Perm
Protected Phases	3		1	6	2	
Permitted Phases			6			2
Actuated Green, G (s)	35.7		76.3	76.3	68.3	68.3
Effective Green, g (s)	35.7		76.3	76.3	68.3	68.3
Actuated g/C Ratio	0.30		0.64	0.64	0.57	0.57
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	2.5		2.5	2.5	2.5	2.5
Lane Grp Cap (vph)	931		195	2072	976	829
v/s Ratio Prot	c0.29		c0.02	0.24	c0.50	
v/s Ratio Perm			0.36			0.39
v/c Ratio	0.98		0.60	0.38	0.88	0.68
Uniform Delay, d1	41.7		39.5	10.5	22.4	18.2
Progression Factor	1.00		0.68	0.80	0.80	1.69
Incremental Delay, d2	23.4		3.2	0.4	8.1	3.0
Delay (s)	65.1		30.2	8.8	25.9	33.7
Level of Service	E		C	A	C	C
Approach Delay (s)	65.1			11.6	29.9	
Approach LOS	E			B	C	

Intersection Summary			
HCM 2000 Control Delay	34.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	86.5%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
9: St Paul Highway & NE Wynooski Street

5/14/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	75	0	135	50	0	35	300	700	25	135	515	225
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.5		4.5	4.5		4.5	4.5	4.5		4.5	4.5	
Lane Util. Factor	1.00		1.00	1.00		1.00	1.00	1.00		1.00	1.00	
Frt	1.00		0.85	1.00		0.85	1.00	1.00		1.00	0.95	
Flt Protected	0.95		1.00	0.95		1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1630		1458	1630		1458	1630	1707		1630	1637	
Flt Permitted	0.95		1.00	0.95		1.00	0.11	1.00		0.36	1.00	
Satd. Flow (perm)	1630		1458	1630		1458	192	1707		611	1637	
Peak-hour factor, PHF	0.90	0.95	0.90	0.95	0.95	0.95	0.90	0.90	0.95	0.95	0.90	0.90
Adj. Flow (vph)	83	0	150	53	0	37	333	778	26	142	572	250
RTOR Reduction (vph)	0	0	141	0	0	36	0	1	0	0	12	0
Lane Group Flow (vph)	83	0	9	53	0	1	333	803	0	142	810	0
Turn Type	Prot		Perm	pm+pt		Perm	pm+pt	NA		pm+pt	NA	
Protected Phases	3			7			1	6		5	2	
Permitted Phases			8	4		4	6			2		
Actuated Green, G (s)	8.0		8.0	6.4		3.2	96.8	86.5		70.9	64.6	
Effective Green, g (s)	7.5		7.5	5.4		2.7	96.3	86.0		69.9	64.1	
Actuated g/C Ratio	0.06		0.06	0.05		0.02	0.80	0.72		0.58	0.53	
Clearance Time (s)	4.0		4.0	4.0		4.0	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	2.5		2.5	2.5		2.5	2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)	101		91	73		32	486	1223		405	874	
v/s Ratio Prot	c0.05			c0.02			c0.16	0.47		0.02	c0.49	
v/s Ratio Perm			0.01	0.02		0.00	0.39			0.19		
v/c Ratio	0.82		0.10	0.73		0.03	0.69	0.66		0.35	0.93	
Uniform Delay, d1	55.6		53.1	56.3		57.4	27.1	9.1		14.1	25.8	
Progression Factor	1.00		1.00	1.00		1.00	1.00	1.00		0.70	0.66	
Incremental Delay, d2	38.6		0.4	28.3		0.2	3.6	2.8		0.2	8.8	
Delay (s)	94.2		53.4	84.5		57.6	30.7	11.9		10.0	25.9	
Level of Service	F		D	F		E	C	B		B	C	
Approach Delay (s)		68.0			73.5			17.4			23.5	
Approach LOS		E			E			B			C	

Intersection Summary			
HCM 2000 Control Delay	26.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	17.5
Intersection Capacity Utilization	78.1%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Attachment 4

HCM Unsignalized Intersection Capacity Analysis
1: St Paul Highway & E 2nd Street

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (veh/h)	0	0	35	0	0	285	0	540	210	0	850	60
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	0	0	39	0	0	317	0	600	233	0	944	67
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	2011	1728	717	1733	1811	978	1011			833		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2011	1728	717	1733	1811	978	1011			833		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	100	91	100	100	0	100			100		
cM capacity (veh/h)	0	88	430	63	79	304	686			800		

Direction, Lane #	EB 1	WB 1	SE 1	NW 1
Volume Total	39	317	833	1011
Volume Left	0	0	0	0
Volume Right	39	317	233	67
cSH	430	304	1700	1700
Volume to Capacity	0.09	1.04	0.49	0.59
Queue Length 95th (ft)	7	293	0	0
Control Delay (s)	14.2	101.3	0.0	0.0
Lane LOS	B	F		
Approach Delay (s)	14.2	101.3	0.0	0.0
Approach LOS	B	F		

Intersection Summary			
Average Delay	14.8		
Intersection Capacity Utilization	79.2%	ICU Level of Service	D
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
2: Springbrook Road & E 2nd Street/E Fernwood Road

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	55	110	95	450	205	25	135	380	405	270	425	105
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.5			4.5		4.5	4.5		4.5	4.5	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.95			0.99		1.00	0.92		1.00	0.97	
Flt Protected		0.99			0.97		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1614			1652		1630	1583		1630	1665	
Flt Permitted		0.82			0.59		0.14	1.00		0.09	1.00	
Satd. Flow (perm)		1334			1011		246	1583		151	1665	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	61	122	106	500	228	28	150	422	450	300	472	117
RTOR Reduction (vph)	0	17	0	0	1	0	0	32	0	0	7	0
Lane Group Flow (vph)	0	272	0	0	755	0	150	840	0	300	582	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8			4			6			2		
Actuated Green, G (s)		55.0			55.0		50.0	43.0		56.0	46.0	
Effective Green, g (s)		54.5			54.5		49.0	42.5		55.0	45.5	
Actuated g/C Ratio		0.45			0.45		0.41	0.35		0.46	0.38	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)		2.5			2.5		2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)		605			459		175	560		186	631	
v/s Ratio Prot							0.05	0.53		c0.13	0.35	
v/s Ratio Perm		0.20			c0.75		0.30			c0.61		
v/c Ratio		0.45			1.64		0.86	1.50		1.61	0.92	
Uniform Delay, d1		22.5			32.8		29.5	38.8		33.2	35.5	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.4			299.8		31.2	234.0		299.3	21.0	
Delay (s)		22.8			332.5		60.7	272.8		332.5	56.6	
Level of Service		C			F		E	F		F	E	
Approach Delay (s)		22.8			332.5			241.7			149.7	
Approach LOS		C			F			F			F	

Intersection Summary			
HCM 2000 Control Delay	215.8	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.67		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	136.2%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: St Paul Highway & Industrial Parkway/Springbrook Road

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	90	40	40	1055	25	50	25	770	635	130	405	40
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.4	4.4		4.4	4.4		4.4	4.4	4.4	4.4	4.4	
Lane Util. Factor	1.00	1.00		0.97	1.00		1.00	0.95	1.00	1.00	0.95	
Frt	1.00	0.93		1.00	0.90		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1630	1587		3162	1544		1630	3260	1458	1630	3216	
Flt Permitted	0.70	1.00		0.95	1.00		0.33	1.00	1.00	0.11	1.00	
Satd. Flow (perm)	1205	1587		3162	1544		564	3260	1458	194	3216	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	100	44	44	1172	28	56	28	856	706	144	450	44
RTOR Reduction (vph)	0	32	0	0	35	0	0	0	514	0	6	0
Lane Group Flow (vph)	100	56	0	1172	49	0	28	856	192	144	488	0
Turn Type	pm+pt	NA		Prot	NA		pm+pt	NA	Prot	pm+pt	NA	
Protected Phases	3	8		7	4		1	6	6	5	2	
Permitted Phases	8						6			2		
Actuated Green, G (s)	27.2	9.2		54.2	45.4		37.8	33.0	33.0	43.4	35.8	
Effective Green, g (s)	26.4	8.8		53.8	45.0		37.0	32.6	32.6	42.6	35.4	
Actuated g/C Ratio	0.22	0.07		0.45	0.38		0.31	0.27	0.27	0.36	0.29	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5	2.5	2.5	2.5	
Lane Grp Cap (vph)	327	116		1417	579		212	885	396	155	948	
v/s Ratio Prot	0.04	c0.04		c0.37	0.03		0.00	0.26	0.13	c0.06	0.15	
v/s Ratio Perm	0.02						0.04			c0.27		
v/c Ratio	0.31	0.48		0.83	0.08		0.13	0.97	0.48	0.93	0.52	
Uniform Delay, d1	39.8	53.4		29.0	24.2		37.2	43.2	36.7	49.8	35.2	
Progression Factor	1.00	1.00		1.00	1.00		1.13	1.03	3.90	1.00	1.00	
Incremental Delay, d2	0.4	2.3		5.7	0.3		0.2	19.6	3.2	51.0	2.0	
Delay (s)	40.2	55.7		34.7	24.5		42.2	64.3	146.0	100.8	37.2	
Level of Service	D	E		C	C		D	E	F	F	D	
Approach Delay (s)		47.4			34.0			100.2			51.5	
Approach LOS		D			C			F			D	

Intersection Summary			
HCM 2000 Control Delay	66.4	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	17.6
Intersection Capacity Utilization	81.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
6: St Paul Highway & Bypass

5/11/2015

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	725	100	105	705	680	820
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0		4.0	4.0	4.0	4.0
Lane Util. Factor	0.97		1.00	0.95	1.00	1.00
Frt	0.98		1.00	1.00	1.00	0.85
Flt Protected	0.96		0.95	1.00	1.00	1.00
Satd. Flow (prot)	3130		1630	3260	1716	1458
Flt Permitted	0.96		0.19	1.00	1.00	1.00
Satd. Flow (perm)	3130		334	3260	1716	1458
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	806	111	117	783	756	911
RTOR Reduction (vph)	10	0	0	0	0	384
Lane Group Flow (vph)	907	0	117	783	756	527
Turn Type	Prot		pm+pt	NA	NA	Perm
Protected Phases	3		1	6	2	
Permitted Phases			6			2
Actuated Green, G (s)	37.1		74.9	74.9	66.9	66.9
Effective Green, g (s)	37.1		74.9	74.9	66.9	66.9
Actuated g/C Ratio	0.31		0.62	0.62	0.56	0.56
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	2.5		2.5	2.5	2.5	2.5
Lane Grp Cap (vph)	967		251	2034	956	812
v/s Ratio Prot	c0.29		0.02	c0.24	c0.44	
v/s Ratio Perm			0.27			0.36
v/c Ratio	0.94		0.47	0.38	0.79	0.65
Uniform Delay, d1	40.3		32.2	11.2	21.0	18.4
Progression Factor	1.00		0.65	0.78	0.56	2.79
Incremental Delay, d2	16.0		0.8	0.4	4.7	2.8
Delay (s)	56.3		21.7	9.1	16.5	54.1
Level of Service	E		C	A	B	D
Approach Delay (s)	56.3			10.7	37.0	
Approach LOS	E			B	D	

Intersection Summary			
HCM 2000 Control Delay	35.3	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	81.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
9: St Paul Highway & NE Wynooski Street

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	75	0	135	50	0	35	300	700	25	40	515	225
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.5		4.5	4.5		4.5	4.5	4.5		4.5	4.5	
Lane Util. Factor	1.00		1.00	1.00		1.00	1.00	1.00		1.00	1.00	
Frt	1.00		0.85	1.00		0.85	1.00	1.00		1.00	0.95	
Flt Protected	0.95		1.00	0.95		1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1630		1458	1630		1458	1630	1707		1630	1637	
Flt Permitted	0.95		1.00	0.95		1.00	0.11	1.00		0.36	1.00	
Satd. Flow (perm)	1630		1458	1630		1458	194	1707		621	1637	
Peak-hour factor, PHF	0.90	0.95	0.90	0.95	0.95	0.95	0.90	0.90	0.95	0.95	0.90	0.90
Adj. Flow (vph)	83	0	150	53	0	37	333	778	26	42	572	250
RTOR Reduction (vph)	0	0	141	0	0	36	0	1	0	0	12	0
Lane Group Flow (vph)	83	0	9	53	0	1	333	803	0	42	810	0
Turn Type	Prot		Perm	pm+pt		Perm	pm+pt	NA		pm+pt	NA	
Protected Phases	3			7			1	6		5	2	
Permitted Phases			8	4		4	6			2		
Actuated Green, G (s)	8.0		8.0	6.4		3.2	96.8	88.9		68.6	64.7	
Effective Green, g (s)	7.5		7.5	5.4		2.7	96.3	88.4		67.6	64.2	
Actuated g/C Ratio	0.06		0.06	0.05		0.02	0.80	0.74		0.56	0.54	
Clearance Time (s)	4.0		4.0	4.0		4.0	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	2.5		2.5	2.5		2.5	2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)	101		91	73		32	485	1257		378	875	
v/s Ratio Prot	c0.05			c0.02			c0.16	0.47		0.00	c0.49	
v/s Ratio Perm			0.01	0.02		0.00	0.39			0.06		
v/c Ratio	0.82		0.10	0.73		0.03	0.69	0.64		0.11	0.93	
Uniform Delay, d1	55.6		53.1	56.3		57.4	27.0	7.9		12.3	25.7	
Progression Factor	1.00		1.00	1.00		1.00	1.00	1.00		0.71	0.62	
Incremental Delay, d2	38.6		0.4	28.3		0.2	3.7	2.5		0.1	11.0	
Delay (s)	94.2		53.4	84.5		57.6	30.7	10.4		8.8	26.9	
Level of Service	F		D	F		E	C	B		A	C	
Approach Delay (s)		68.0			73.5			16.3			26.0	
Approach LOS		E			E			B			C	

Intersection Summary			
HCM 2000 Control Delay	27.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	17.5
Intersection Capacity Utilization	78.1%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Attachment 4

HCM Unsignalized Intersection Capacity Analysis
1: St Paul Highway & E 2nd Street

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (veh/h)	0	0	35	0	0	170	0	540	210	0	965	135
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	0	0	39	0	0	189	0	600	233	0	1072	150
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	2053	1939	717	1903	1981	1147	1222			833		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2053	1939	717	1903	1981	1147	1222			833		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	91	100	100	22	100			100		
cM capacity (veh/h)	9	65	430	48	62	242	570			800		

Direction, Lane #	EB 1	WB 1	SE 1	NW 1
Volume Total	39	189	833	1222
Volume Left	0	0	0	0
Volume Right	39	189	233	150
cSH	430	242	1700	1700
Volume to Capacity	0.09	0.78	0.49	0.72
Queue Length 95th (ft)	7	143	0	0
Control Delay (s)	14.2	57.9	0.0	0.0
Lane LOS	B	F		
Approach Delay (s)	14.2	57.9	0.0	0.0
Approach LOS	B	F		

Intersection Summary			
Average Delay	5.0		
Intersection Capacity Utilization	83.0%	ICU Level of Service	E
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
2: Springbrook Road & E 2nd Street/E Fernwood Road

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	55	110	170	450	205	25	20	380	405	100	595	105
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.5			4.5		4.5	4.5		4.5	4.5	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.93			0.99		1.00	0.92		1.00	0.98	
Flt Protected		0.99			0.97		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1585			1652		1630	1583		1630	1677	
Flt Permitted		0.84			0.55		0.09	1.00		0.09	1.00	
Satd. Flow (perm)		1337			930		156	1583		150	1677	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	61	122	189	500	228	28	22	422	450	111	661	117
RTOR Reduction (vph)	0	31	0	0	1	0	0	32	0	0	5	0
Lane Group Flow (vph)	0	341	0	0	755	0	22	840	0	111	773	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8			4			6			2		
Actuated Green, G (s)		61.0			61.0		47.0	44.6		50.2	46.2	
Effective Green, g (s)		60.5			60.5		46.0	44.1		49.2	45.7	
Actuated g/C Ratio		0.50			0.50		0.38	0.36		0.40	0.38	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)		2.5			2.5		2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)		665			462		82	574		103	630	
v/s Ratio Prot							0.00	c0.53		c0.03	0.46	
v/s Ratio Perm		0.26			c0.81		0.10			0.40		
v/c Ratio		0.51			1.63		0.27	1.46		1.08	1.23	
Uniform Delay, d1		20.6			30.5		30.5	38.8		38.1	37.9	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.5			295.1		1.3	218.1		111.2	115.8	
Delay (s)		21.1			325.6		31.8	256.9		149.3	153.7	
Level of Service		C			F		C	F		F	F	
Approach Delay (s)		21.1			325.6			251.3			153.2	
Approach LOS		C			F			F			F	

Intersection Summary			
HCM 2000 Control Delay	211.2	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.55		
Actuated Cycle Length (s)	121.6	Sum of lost time (s)	13.5
Intersection Capacity Utilization	130.9%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: St Paul Highway & Industrial Parkway/Springbrook Road

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	90	40	40	1300	25	50	25	960	750	35	500	40
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.4	4.4		4.4	4.4		4.4	4.4	4.4	4.4	4.4	
Lane Util. Factor	1.00	1.00		0.97	1.00		1.00	0.95	1.00	1.00	0.95	
Frt	1.00	0.93		1.00	0.90		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1630	1587		3162	1544		1630	3260	1458	1630	3224	
Flt Permitted	0.70	1.00		0.95	1.00		0.28	1.00	1.00	0.11	1.00	
Satd. Flow (perm)	1205	1587		3162	1544		486	3260	1458	184	3224	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	100	44	44	1444	28	56	28	1067	833	39	556	44
RTOR Reduction (vph)	0	32	0	0	36	0	0	0	558	0	5	0
Lane Group Flow (vph)	100	56	0	1444	48	0	28	1067	275	39	595	0
Turn Type	pm+pt	NA		Prot	NA		pm+pt	NA	Prot	pm+pt	NA	
Protected Phases	3	8		7	4		1	6	6	5	2	
Permitted Phases	8						6			2		
Actuated Green, G (s)	27.2	9.2		52.4	43.6		44.8	40.0	40.0	40.0	37.6	
Effective Green, g (s)	26.4	8.8		52.0	43.2		44.0	39.6	39.6	39.2	37.2	
Actuated g/C Ratio	0.22	0.07		0.43	0.36		0.37	0.33	0.33	0.33	0.31	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5	2.5	2.5	2.5	
Lane Grp Cap (vph)	327	116		1370	555		220	1075	481	84	999	
v/s Ratio Prot	0.04	c0.04		c0.46	0.03		c0.00	c0.33	0.19	c0.01	0.18	
v/s Ratio Perm	0.02						0.04			0.14		
v/c Ratio	0.31	0.48		1.05	0.09		0.13	0.99	0.57	0.46	0.60	
Uniform Delay, d1	39.8	53.4		34.0	25.4		34.5	40.1	33.2	54.7	35.0	
Progression Factor	1.00	1.00		1.00	1.00		1.33	1.18	5.24	1.00	1.00	
Incremental Delay, d2	0.4	2.3		39.9	0.3		0.1	19.4	2.9	2.9	2.6	
Delay (s)	40.2	55.7		73.9	25.7		46.0	66.5	176.7	57.6	37.7	
Level of Service	D	E		E	C		D	E	F	E	D	
Approach Delay (s)		47.4			71.3			113.9			38.9	
Approach LOS		D			E			F			D	

Intersection Summary			
HCM 2000 Control Delay	84.6	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	17.6
Intersection Capacity Utilization	85.8%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
6: St Paul Highway & Bypass/NE Wilsonville Road

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	765	0	60	50	0	265	70	705	25	305	680	855
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0		4.5	4.0		4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97		1.00	1.00		1.00	1.00	0.95		1.00	1.00	1.00
Frt	1.00		0.85	1.00		0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95		1.00	0.95		1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3162		1458	1630		1458	1630	3243		1630	1716	1458
Flt Permitted	0.95		1.00	0.95		1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3162		1458	1630		1458	1630	3243		1630	1716	1458
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	850	0	67	56	0	294	78	783	28	339	756	950
RTOR Reduction (vph)	0	0	63	0	0	33	0	2	0	0	0	39
Lane Group Flow (vph)	850	0	4	56	0	261	78	809	0	339	756	911
Turn Type	Prot		Over	Prot		Over	Prot	NA		Prot	NA	pm+ov
Protected Phases	3		1	7		5	1	6		5	2	3
Permitted Phases												2
Actuated Green, G (s)	34.8		8.0	34.8		32.0	8.0	41.2		32.0	65.2	100.0
Effective Green, g (s)	34.8		7.5	34.8		32.0	8.0	41.2		32.0	65.2	100.0
Actuated g/C Ratio	0.29		0.06	0.29		0.27	0.07	0.34		0.27	0.54	0.83
Clearance Time (s)	4.0		4.0	4.0		4.0	4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	2.5		2.5	2.5		2.5	2.5	2.5		2.5	2.5	2.5
Lane Grp Cap (vph)	916		91	472		388	108	1113		434	932	1263
v/s Ratio Prot	c0.27		0.00	0.03		0.18	0.05	0.25		c0.21	c0.44	0.21
v/s Ratio Perm												0.42
v/c Ratio	0.93		0.05	0.12		0.67	0.72	0.73		0.78	0.81	0.72
Uniform Delay, d1	41.4		52.9	31.3		39.3	54.9	34.5		40.8	22.4	4.2
Progression Factor	1.00		1.00	1.00		1.00	1.00	1.00		0.74	0.59	3.67
Incremental Delay, d2	15.1		0.2	0.1		9.0	19.9	4.2		6.0	3.4	0.8
Delay (s)	56.4		53.0	31.4		48.3	74.8	38.6		36.2	16.7	16.2
Level of Service	E		D	C		D	E	D		D	B	B
Approach Delay (s)		56.2			45.6			41.8			19.7	
Approach LOS		E			D			D			B	

Intersection Summary			
HCM 2000 Control Delay	34.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	76.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
9: St Paul Highway & NE Wynooski Street

5/21/2015

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	75	135	300	725	565	225
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	83	150	333	806	628	250
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		10				
Median type				TWLTL	None	
Median storage veh)				2		
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2225	753	628			
vC1, stage 1 conf vol	753					
vC2, stage 2 conf vol	1472					
vCu, unblocked vol	2225	753	628			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)	5.4					
tF (s)	3.5	3.3	2.2			
p0 queue free %	35	63	65			
cM capacity (veh/h)	129	410	954			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	233	333	806	878
Volume Left	83	333	0	0
Volume Right	150	0	0	250
cSH	361	954	1700	1700
Volume to Capacity	0.65	0.35	0.47	0.52
Queue Length 95th (ft)	108	39	0	0
Control Delay (s)	38.4	10.8	0.0	0.0
Lane LOS	E	B		
Approach Delay (s)	38.4	3.2		0.0
Approach LOS	E			

Intersection Summary			
Average Delay	5.6		
Intersection Capacity Utilization	81.0%	ICU Level of Service	D
Analysis Period (min)	15		

Attachment 4

HCM Unsignalized Intersection Capacity Analysis
1: St Paul Highway & E 2nd Street

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (veh/h)	0	0	35	0	0	170	0	540	210	0	965	60
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	0	0	39	0	0	189	0	600	233	0	1072	67
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	2011	1856	717	1861	1939	1106	1139			833		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2011	1856	717	1861	1939	1106	1139			833		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	91	100	100	26	100			100		
cM capacity (veh/h)	12	74	430	51	65	256	613			800		

Direction, Lane #	EB 1	WB 1	SE 1	NW 1
Volume Total	39	189	833	1139
Volume Left	0	0	0	0
Volume Right	39	189	233	67
cSH	430	256	1700	1700
Volume to Capacity	0.09	0.74	0.49	0.67
Queue Length 95th (ft)	7	130	0	0
Control Delay (s)	14.2	50.3	0.0	0.0
Lane LOS	B	F		
Approach Delay (s)	14.2	50.3	0.0	0.0
Approach LOS	B	F		

Intersection Summary			
Average Delay	4.6		
Intersection Capacity Utilization	78.0%	ICU Level of Service	D
Analysis Period (min)	15		

Attachment 4

HCM Signalized Intersection Capacity Analysis
2: Springbrook Road & E 2nd Street/E Fernwood Road

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	55	110	95	485	205	25	20	380	445	100	595	105
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.5			4.5		4.5	4.5		4.5	4.5	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.95			1.00		1.00	0.92		1.00	0.98	
Flt Protected		0.99			0.97		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1614			1652		1630	1577		1630	1677	
Flt Permitted		0.81			0.59		0.09	1.00		0.08	1.00	
Satd. Flow (perm)		1315			1015		149	1577		144	1677	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	61	122	106	539	228	28	22	422	494	111	661	117
RTOR Reduction (vph)	0	18	0	0	1	0	0	35	0	0	5	0
Lane Group Flow (vph)	0	271	0	0	794	0	22	881	0	111	773	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8			4			6			2		
Actuated Green, G (s)		59.0			59.0		49.0	46.6		52.2	48.2	
Effective Green, g (s)		58.5			58.5		48.0	46.1		51.2	47.7	
Actuated g/C Ratio		0.48			0.48		0.39	0.38		0.42	0.39	
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)		2.5			2.5		2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)		632			488		81	597		103	657	
v/s Ratio Prot							0.00	c0.56		c0.03	0.46	
v/s Ratio Perm		0.21			c0.78		0.10			0.42		
v/c Ratio		0.43			1.63		0.27	1.48		1.08	1.18	
Uniform Delay, d1		20.6			31.5		30.0	37.8		37.2	36.9	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.3			291.4		1.3	223.2		111.2	94.8	
Delay (s)		21.0			323.0		31.3	261.0		148.4	131.8	
Level of Service		C			F		C	F		F	F	
Approach Delay (s)		21.0			323.0			255.6			133.9	
Approach LOS		C			F			F			F	

Intersection Summary			
HCM 2000 Control Delay	213.5	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.54		
Actuated Cycle Length (s)	121.6	Sum of lost time (s)	13.5
Intersection Capacity Utilization	130.7%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Attachment 4

HCM Signalized Intersection Capacity Analysis
4: St Paul Highway & Industrial Parkway/Springbrook Road

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	90	40	40	1260	25	50	25	885	790	35	500	40
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.4	4.4		4.4	4.4		4.4	4.4	4.4	4.4	4.4	
Lane Util. Factor	1.00	1.00		0.97	1.00		1.00	0.95	1.00	1.00	0.95	
Frt	1.00	0.93		1.00	0.90		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1630	1587		3162	1544		1630	3260	1458	1630	3224	
Flt Permitted	0.70	1.00		0.95	1.00		0.28	1.00	1.00	0.11	1.00	
Satd. Flow (perm)	1205	1587		3162	1544		476	3260	1458	190	3224	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	100	44	44	1400	28	56	28	983	878	39	556	44
RTOR Reduction (vph)	0	32	0	0	35	0	0	0	596	0	5	0
Lane Group Flow (vph)	100	56	0	1400	49	0	28	983	282	39	595	0
Turn Type	pm+pt	NA		Prot	NA		pm+pt	NA	Prot	pm+pt	NA	
Protected Phases	3	8		7	4		1	6	6	5	2	
Permitted Phases	8						6			2		
Actuated Green, G (s)	27.2	9.2		53.4	44.6		43.8	39.0	39.0	39.0	36.6	
Effective Green, g (s)	26.4	8.8		53.0	44.2		43.0	38.6	38.6	38.2	36.2	
Actuated g/C Ratio	0.22	0.07		0.44	0.37		0.36	0.32	0.32	0.32	0.30	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5	2.5	2.5	2.5	
Lane Grp Cap (vph)	327	116		1396	568		212	1048	468	84	972	
v/s Ratio Prot	0.04	c0.04		c0.44	0.03		c0.00	c0.30	0.19	c0.01	0.18	
v/s Ratio Perm	0.02						0.04			0.14		
v/c Ratio	0.31	0.48		1.00	0.09		0.13	0.94	0.60	0.46	0.61	
Uniform Delay, d1	39.8	53.4		33.5	24.7		35.4	39.5	34.3	53.0	35.9	
Progression Factor	1.00	1.00		1.00	1.00		1.32	1.17	6.00	1.00	1.00	
Incremental Delay, d2	0.4	2.3		24.8	0.3		0.1	11.5	3.6	2.9	2.9	
Delay (s)	40.2	55.7		58.3	25.0		46.8	57.6	209.2	55.9	38.8	
Level of Service	D	E		E	C		D	E	F	E	D	
Approach Delay (s)		47.4			56.4			127.9			39.8	
Approach LOS		D			E			F			D	

Intersection Summary			
HCM 2000 Control Delay	85.6	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	17.6
Intersection Capacity Utilization	84.6%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
6: St Paul Highway & Bypass/NE Wilsonville Road

5/11/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	765	0	60	50	0	230	70	705	25	265	680	855
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0		4.5	4.0		4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97		1.00	1.00		1.00	1.00	0.95		1.00	1.00	1.00
Frt	1.00		0.85	1.00		0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95		1.00	0.95		1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3162		1458	1630		1458	1630	3243		1630	1716	1458
Flt Permitted	0.95		1.00	0.95		1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3162		1458	1630		1458	1630	3243		1630	1716	1458
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	850	0	67	56	0	256	78	783	28	294	756	950
RTOR Reduction (vph)	0	0	63	0	0	34	0	2	0	0	0	39
Lane Group Flow (vph)	850	0	4	56	0	222	78	809	0	294	756	911
Turn Type	Prot		Over	Prot		Over	Prot	NA		Prot	NA	pm+ov
Protected Phases	3		1	7		5	1	6		5	2	3
Permitted Phases												2
Actuated Green, G (s)	34.8		8.0	34.8		29.0	8.0	44.2		29.0	65.2	100.0
Effective Green, g (s)	34.8		7.5	34.8		29.0	8.0	44.2		29.0	65.2	100.0
Actuated g/C Ratio	0.29		0.06	0.29		0.24	0.07	0.37		0.24	0.54	0.83
Clearance Time (s)	4.0		4.0	4.0		4.0	4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	2.5		2.5	2.5		2.5	2.5	2.5		2.5	2.5	2.5
Lane Grp Cap (vph)	916		91	472		352	108	1194		393	932	1263
v/s Ratio Prot	c0.27		0.00	0.03		0.15	0.05	0.25		c0.18	c0.44	0.21
v/s Ratio Perm												0.42
v/c Ratio	0.93		0.05	0.12		0.63	0.72	0.68		0.75	0.81	0.72
Uniform Delay, d1	41.4		52.9	31.3		40.7	54.9	31.9		42.1	22.4	4.2
Progression Factor	1.00		1.00	1.00		1.00	1.00	1.00		0.77	0.63	3.41
Incremental Delay, d2	15.1		0.2	0.1		8.3	19.9	3.1		6.2	3.8	0.9
Delay (s)	56.4		53.0	31.4		49.0	74.8	35.0		38.6	17.9	15.2
Level of Service	E		D	C		D	E	D		D	B	B
Approach Delay (s)		56.2			45.8			38.5			19.6	
Approach LOS		E			D			D			B	

Intersection Summary			
HCM 2000 Control Delay	33.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	76.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
9: St Paul Highway & NE Wynooski Street

5/11/2015

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	75	135	300	725	565	225
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	83	150	333	806	628	250
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		10				
Median type				TWLTL	None	
Median storage veh)				2		
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2225	753	628			
vC1, stage 1 conf vol	753					
vC2, stage 2 conf vol	1472					
vCu, unblocked vol	2225	753	628			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)	5.4					
tF (s)	3.5	3.3	2.2			
p0 queue free %	35	63	65			
cM capacity (veh/h)	129	410	954			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	233	333	806	878
Volume Left	83	333	0	0
Volume Right	150	0	0	250
cSH	361	954	1700	1700
Volume to Capacity	0.65	0.35	0.47	0.52
Queue Length 95th (ft)	108	39	0	0
Control Delay (s)	38.4	10.8	0.0	0.0
Lane LOS	E	B		
Approach Delay (s)	38.4	3.2		0.0
Approach LOS	E			

Intersection Summary			
Average Delay	5.6		
Intersection Capacity Utilization	81.0%	ICU Level of Service	D
Analysis Period (min)	15		

Attachment 4

Newberg Dundee Bypass Tier 2 Final Technical Memorandum

Transportation

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Oregon Department of Transportation

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Attachment 4

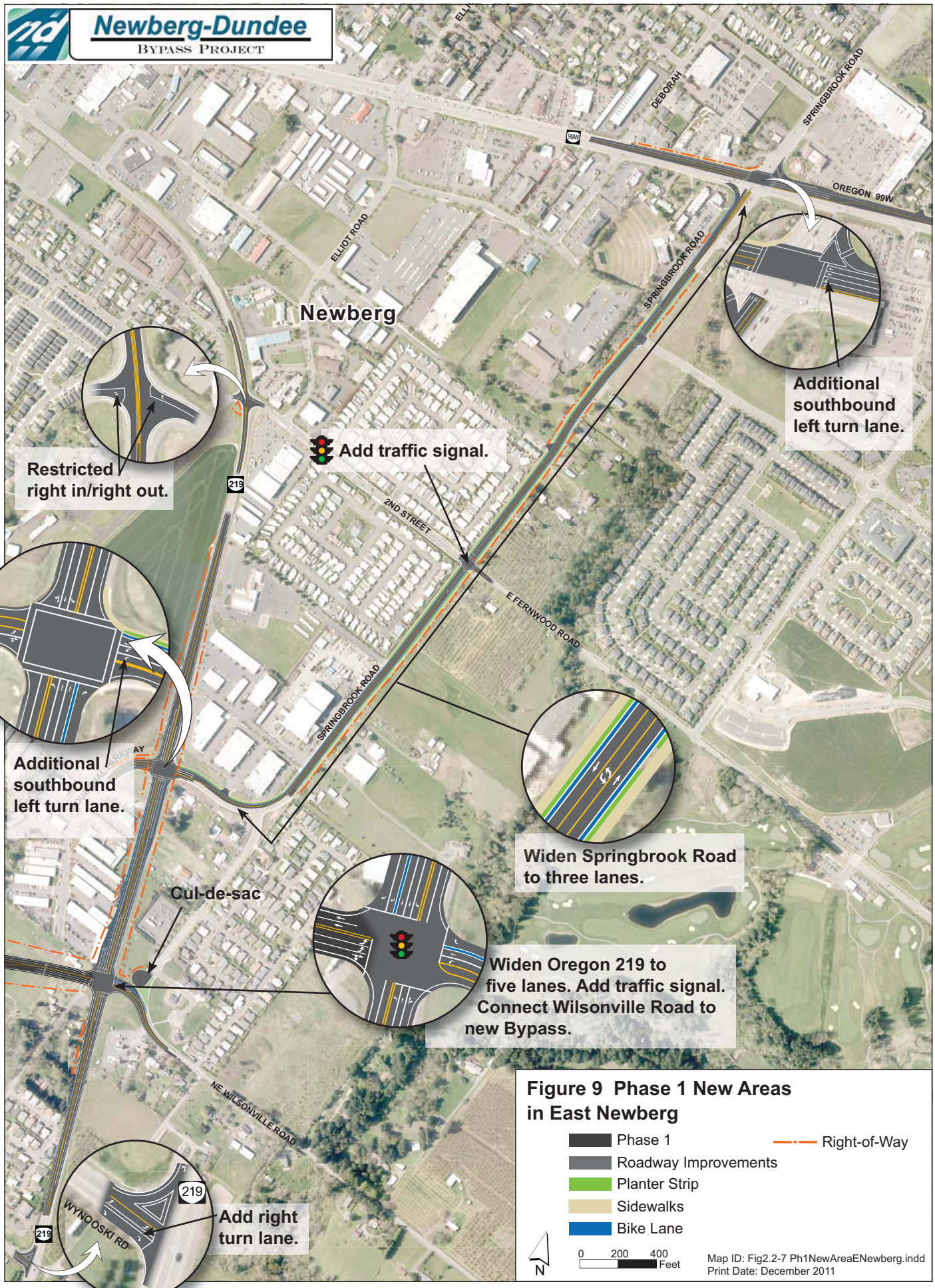


Figure 9 Phase 1 New Areas in East Newberg

Average Daily Traffic Forecast

The ADT forecasts for 2016 at key locations along Oregon 99W, Oregon 219, and Phase 1 are shown in Table 12.

Table 12. Summary of 2011, 2016 and 2035 ADT Forecasts

	ADT (In thousands of vehicles per day)						
Location	**Existing Volume (2011)**	**2016 No Build**	**2016 Phase 1**	**% Change in 2016 with Phase 1**	**2035 No Build**	**2035 with Phase 1**	**% Change in 2035 with Phase 1**
Oregon 99W							
East of Rex Hill	39	43	44	0	60	60	0
East of Springbrook Road	39	41	40	-4	53	50.0	-5
East of College Street	46	48	39	-20	57	51	-10
North of Fox Farm Road	23	29	18	-37	38	27	-28
East of 5th Street in Dundee	26	32	19	-41	46	29	-36
South of Bypass Ramp Terminal	24	30	30	0	40	40	0
Oregon 219							
South of Springbrook Road	14.1	16	28	+82	22	35	+55
Bypass							
Phase 1	N/A	N/A	16	N/A	N/A	20	N/A

Source: Phase 1 Technical Report Addendum (Appendix B).

N/A = Not Applicable.

Under the No Build Alternative, 2016 ADT within the project area is forecast to range from 29,000 to 48,000 vehicles on Oregon 99W, and about 16,000 on Oregon 219. Without Phase 1, ADT is projected to increase by 5 to 25 percent on Oregon 99W and by about 10 percent on Oregon 219 as compared to 2011. In many locations, the demand on Oregon 99W would exceed its capacity. As a result, more traffic will use the local street system for alternate routes, adversely affecting traffic mobility on local streets.

Phase 1 is forecast to have 2016 ADT of 16,000 vehicles. Compared to the No Build Alternative, Phase 1 is forecast to reduce traffic levels on Oregon 99W between Providence Drive in Newberg to south of Dundee. In 2016, these reductions will range from 1,500 to 13,000 vehicles per day. Traffic levels for Phase 1 will increase over the No Build Alternative in 2016 on Oregon 219 north of Wynooski Road. This is due to the additional travel demand

by motorists desiring to access Phase 1 at the Oregon 219 intersection (the east end of Phase 1).

Phase 1 will decrease ADT in downtown Dundee (East of 5th Street) by about 40 percent and in downtown Newberg (East of College Street) by 20 percent in the opening year (see Table 12). This decrease will reduce vehicle congestion, ease access to properties along Oregon 99W, and allow for more vibrant and pedestrian-friendly redevelopment in the downtowns.

In 2035, Phase 1 is forecast to have an ADT of 20,000 vehicles (see Table 12). Phase 1 is predicted to reduce traffic levels on Oregon 99W between Providence Drive in Newberg and south of Dundee by 3,000 to 17,000 vehicles per day as compared to the No Build Alternative in 2035. Traffic levels for Phase 1 will increase on Oregon 219 north of Wynooski Road due to motorists desiring to access Phase 1 at the Oregon 219 Intersection. In 2035, Phase 1 will decrease ADT in downtown Dundee by about 35 percent and in downtown Newberg by 10 percent in 2035 as compared to the No Build Alternative (see Table 12).

Intersection Operations in 2016

The performance of study intersections was assessed based on whether the intersection will be “project impacted” or “non-project impacted” by Phase 1. The project-impacted intersections include the Phase 1 intersections on Oregon 219 in Newberg, on Oregon 99W south of Dundee, and the Springbrook Road/Oregon 219 intersection in Newberg. Widening Oregon 219 between the new intersection and Springbrook Road will be part of Phase 1. Because it will be substantially reconstructed as part of the widening and was included in the Tier 2 DEIS footprint, ODOT considers the Springbrook Road/Oregon 219 intersection to be project impacted. The project-impacted intersections are subject to the mobility standards outlined in ODOT’s HDM based on demand in 2016. See Appendix B for more detail.

ODOT commits to implementing traffic improvement measures associated with Phase 1 based on forecast 2016 opening-year demand. These measures will bring non-project-impacted intersections up to or better than the level of operational performance expected with the No Build Alternative.

The weekday p.m. peak-hour intersection operations for all study intersections were evaluated under Phase 1 and the No Build Alternative for 2016 and 2035. The forecast operations were compared with relevant standards depending on whether the intersection will be project- or non-project-impacted by Phase 1 (see Table 13).

The 2016 results (termed *Phase 1 – Unimproved* in Table 13) were used by ODOT to determine traffic improvement measures to be included with Phase 1.

Table 13. Intersections Not Meeting Standards with Phase 1 in 2016

		2016		
Intersection	**Performance Standard**	**No Build**	**Phase 1 – Unimproved**	**Phase 1 – Improved**
Project-Impacted Locations				
Bypass/Oregon 219	0.65	-	0.64	0.60
Oregon 219/ Springbrook Road	0.80	0.52	0.96	0.62
Non-Project-Impacted Locations				
Oregon 99W				
Providence Drive	0.70	0.79	0.79	0.79

Table 13. Intersections Not Meeting Standards with Phase 1 in 2016

Intersection	Performance Standard	2016 No Build	2016 Phase 1 – Unimproved	2016 Phase 1 – Improved
Brutscher Street	0.75	0.90	0.82	0.82
Springbrook Street	0.75	0.90	0.86	0.84
Elliott Street	0.80	0.75	0.82[a]	0.76
Villa Road	0.80	0.81	0.73	0.77
College Street (north)	0.90	0.79	0.72	0.72
Oregon 219				
2nd Street	0.80	0.51	>2.0[a]	0.19
Wynooski Road	0.80	0.88	0.98*	0.74
Key Local Intersections				
Springbrook Street/ Fernwood Road	0.90	0.70	>2.0*	0.63
Wilsonville Road/ Springbrook Street	0.90	0.73	1.4[a]	Removed
Elliott Street/Hayes Street	0.90	0.29	0.47	0.09
Elliott Street/2nd Street	0.90	0.07	1.1[a]	0.52
Brutscher Street/Fernwood Road	0.90	0.31	0.32	0.31
Oregon 219				
2nd Street	0.80	0.51	>2.0[a]	0.19
Wynooski Road	0.80	0.88	0.98[a]	0.74

Source: Phase 1 Technical Report Addendum (Appendix B).

a With Phase 1 in place without mitigation, intersection operates worse than for the No Build Alternative and does not meet relevant standard.

In 2016, if left unimproved, the following non-project-impacted intersections will operate at a level worse than the No Build Alternative (see Table 13). The improvement measures that ODOT will implement with Phase 1 to achieve No Build or better conditions are discussed in detail under Phase 1 of the Mitigation Measures section. A brief summary is provided below.

- Oregon 99W/Springbrook Road – Construct second westbound left turn and second southbound receiving lane on Springbrook Road.
- Oregon 219/Springbrook Road – Construct second westbound left turn lane, second southbound through lane, and second northbound through lane.
- Springbrook Road/Fernwood Road – Signalize intersection.
- 2nd Street/Oregon 219 – Convert 2nd Street to right-in/right-out.
- Oregon 219/Wynooski Road – Construct eastbound right-turn lane.
- Wilsonville Road/Springbrook Road – Construct a cul-de-sac on Wilsonville Road south of Springbrook Road.

The Elliott Street/2nd Street and Elliott Street/Oregon 99W intersections will operate better than they would have for the No Build Alternative following the conversion of the 2nd Street/Oregon 219 intersection to right-in/right-out. With the 2nd Street/Oregon 219 intersection restricted to right-in/right-out, traffic will travel between Oregon 99W and Phase 1 via Springbrook Road, rather than on Elliott Street. As a result, these two intersections on Elliott Street will meet OHP and city standards and will not require improvement measures in 2016 with Phase 1. At the same time, the Springbrook/Oregon 99W intersection will operate worse than it would have for the No Build Alternative if the Bypass-oriented traffic primarily uses the Springbrook Road corridor. As a result, traffic improvement measures are needed at the Springbrook Road/Oregon 99W intersection as a result of Phase 1.

Table 13 shows two non-project-impacted intersections that are forecast to not meet performance standards in 2016 with Phase 1 that will operate at or better than they would have under No Build Alternative conditions. These include Oregon 99W at Providence Drive and Oregon 99W at Brutscher Street. Because the two intersections will operate better than they would have for the No Build Alternative in 2016, they will not require improvement measures.

The improvement measures for intersections not meeting Phase 1 standards in the opening year (i.e., not meeting performance standards and operating worse than they would have for the No Build Alternative) are described under Phase 1 of the Mitigation Measures section.

Intersection Operations in 2035

The No Build and Preferred Alternatives section at the beginning of the Environmental Consequences section provides a summary of traffic conditions in 2035 under the No Build Alternative and under the Preferred Alternative. In contrast, this section provides a summary of the sensitivity analysis that ODOT performed to document what traffic conditions would be like in 2035 if only Phase 1 is constructed by 2035, compared to the No Build Alternative. This sensitivity analysis should be understood within the context that ODOT is continuing to propose that the full build-out of the Preferred Alternative will be completed by 2035.

In 2035, with only Phase 1 in place, Oregon 219 and other East Newberg roadways (south of Oregon 99W) will experience high levels of congestion, and many study intersections will exceed a v/c ratio of 1.0. This will make it much more difficult for travelers to reach the east end of Phase 1, thereby reducing the number of travelers over time.

In 2035, many of the East Newberg intersections will operate over capacity with just Phase 1 in place (see Table 14).

Completion of the full build-out of the Preferred Alternative will avoid these impacts. However, if only Phase 1 were to be constructed by 2035, the following improvement measures could be needed for the project-impacted intersections to meet HDM standards in 2035:

- Phase 1/Oregon 219 intersection – Add a third eastbound left turn lane off of Phase 1 and a third northbound through lane on Oregon 219.
- Oregon 219/Springbrook Road intersection – Add a third northbound through lane on Oregon 219 and a third westbound left turn lane on Springbrook Road.
- Oregon 219 – Widen to three through lanes in each direction between Springbrook Road and the Phase 1 intersection.
- Oregon 99W intersection south of Dundee – Convert to an interchange.

Rather than implementing these improvement measures, ODOT intends to construct the Preferred Alternative, in part because these measures are not feasible or appropriate. For example, the addition of triple left turn lanes at the Phase 1 intersection on Oregon 219, and

the Springbrook Road intersection on Oregon 219 is neither feasible nor appropriate given the context of the community. To date, no triple left turns have been constructed in Oregon. Further, as shown in Table 14, both intersections are anticipated to operate below capacity. Completion of the Preferred Alternative will eliminate the need for these improvements. Therefore, ODOT will not implement further improvement measures beyond those identified for opening year 2016.

Table 14. Intersections Not Meeting Standards with Phase 1 in 2035

Intersection	Performance Standard	2035	
		No Build	Phase 1
Project-Impacted Locations			
Bypass/Oregon 219	0.65	-	0.78
Oregon 219/ Springbrook Road	0.80	0.84	0.82
Non-Project-Impacted Locations			
Oregon 99W			
Providence Drive	0.70	1.4	1.6[a]
Brutscher Street	0.75	1.2	1.1
Springbrook Street	0.75	1.2	1.2
Elliott Street	0.80	1.04	1.1[a]
Villa Road	0.80	0.95	0.96[a]
College Street (north)	0.90	0.95	0.97[a]
Oregon 219			
2nd Street	0.80	>2.0	0.28
Wynooski Road	0.80	>2.0	>2.0[a]
Key Local Intersections			
Springbrook Street/ Fernwood Road	0.90	1.4	1.3
Wilsonville Road/ Springbrook Street	0.90	>2.0	Removed
Elliott Street/2nd Street	0.90	1.03	1.1[a]
Brutscher Street/Fernwood Road	0.90	1.6	>2.0[a]

Source: Phase 1 Technical Report Addendum (Appendix B).

a With Phase 1 in place without mitigation, intersection operates worse than for the No Build Alternative and does not meet relevant standard.

Construction Impacts

There are no construction traffic impacts with Phase 1 that will be different from those described for the Preferred Alternative, with the exception of the amount of excavation and soil disposal that will be required. Construction of Phase 1 will generate less than 181,700 cy of soil that will require off-site disposal, and it will result in fewer than 18,000 truck trips on local roads and arterials.

Attachment 4

INDEX OF SHEETS	
SHEET NO.	DESCRIPTION
1	Title Sheet
1A, 1A-2, 1A-3	Index Of Sheets Cont. & Std. Drg. Nos.
1B	Sheet Layout

STATE OF OREGON
DEPARTMENT OF TRANSPORTATION

PLANS FOR PROPOSED PROJECT

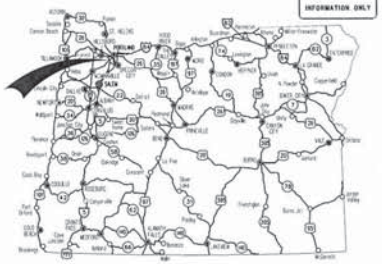
GRADING, PAVING, SIGNING, SIGNALS

OR18: NEWBERG-DUNDEE BYPASS (PHASE 1G) (SPRINGBROOK RD)

HILLSBORO-SILVERTON, PACIFIC HIGHWAY WEST, & SALMON RIVER HWYS.

YAMHILL COUNTY
DECEMBER 2015

PRELIMINARY COPY
INFORMATION ONLY



Overall Length Of Project - XX.XX Miles

ATTENTION:
Oregon Law Requires You To Follow Rules Adopted By The Oregon Utility Notification Center. Those Rules Are Set Forth In OAR 952-001-0010 Through OAR 952-001-0090. You May Obtain Copies Of The Rules By Calling The Center. (Note: The Telephone Number For The Oregon Utility Center Is (503) 232-1987.)

LET'S ALL WORK TOGETHER TO MAKE THIS JOB SAFE

BEGINNING OF PROJECT
STA. "N" 769+95 (M.P. 21.84)

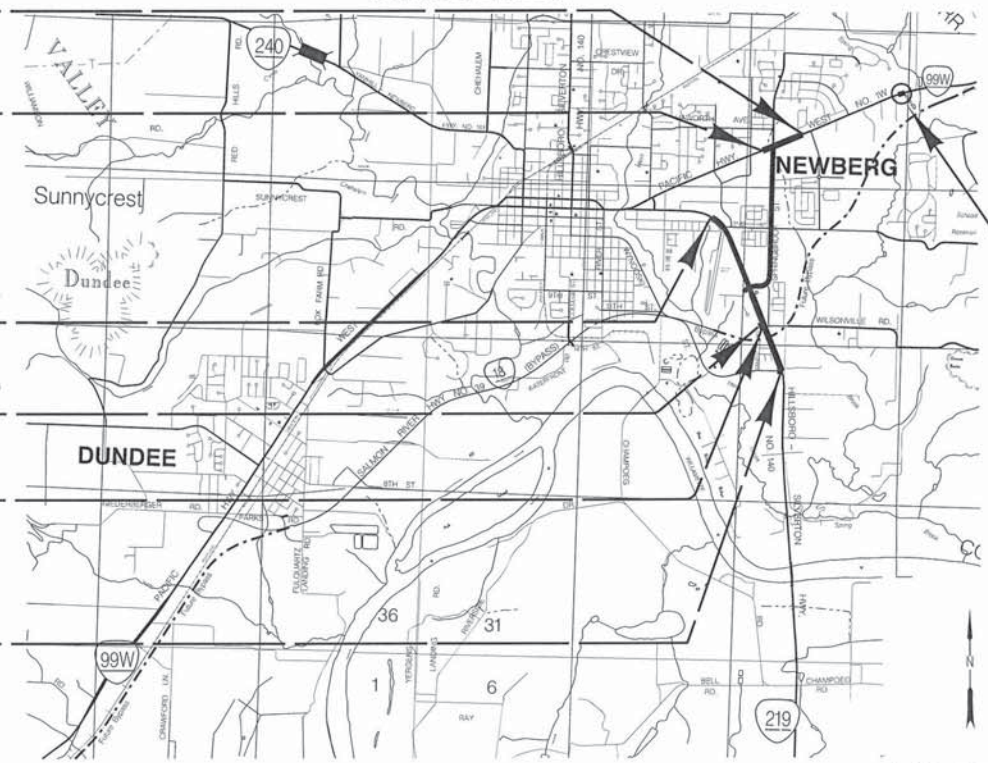
END OF PROJECT
STA. "N"786+54 (M.P. 22.16)

BEGINNING OF PROJECT
STA. "B" 30+38 (M.P. 21.14)

BEGINNING OF PROJECT
STA. "A3b" 24+82.4 (M.P. 59.63)

END OF PROJECT
STA. "A3b"26+80.70 (M.P. 59.67)

END OF PROJECT
STA. "B"85+72 (M.P. 22.19)



PROJECT SITE
STA. "LS" 720+30 (M.P. 21.20)

T. 3 S., R. 2 W., W.M.

OREGON TRANSPORTATION COMMISSION

Pat Egan	CHAIR
David Lohman	COMMISSIONER
Mary F. Olson	COMMISSIONER
Mark Frohnmayer	COMMISSIONER
Tommy Boney	COMMISSIONER
Matthew L. Garrett	DIRECTOR OF TRANSPORTATION

These plans were developed using ODOT design standards. Exceptions to these standards, if any, have been submitted and approved by the ODOT Chief Engineer or their delegated authority.

By: _____
Signature & date

Michael T. Long - R2 Tech Center Manager
Print name and title

_____
Concurrence by ODOT Chief Engineer

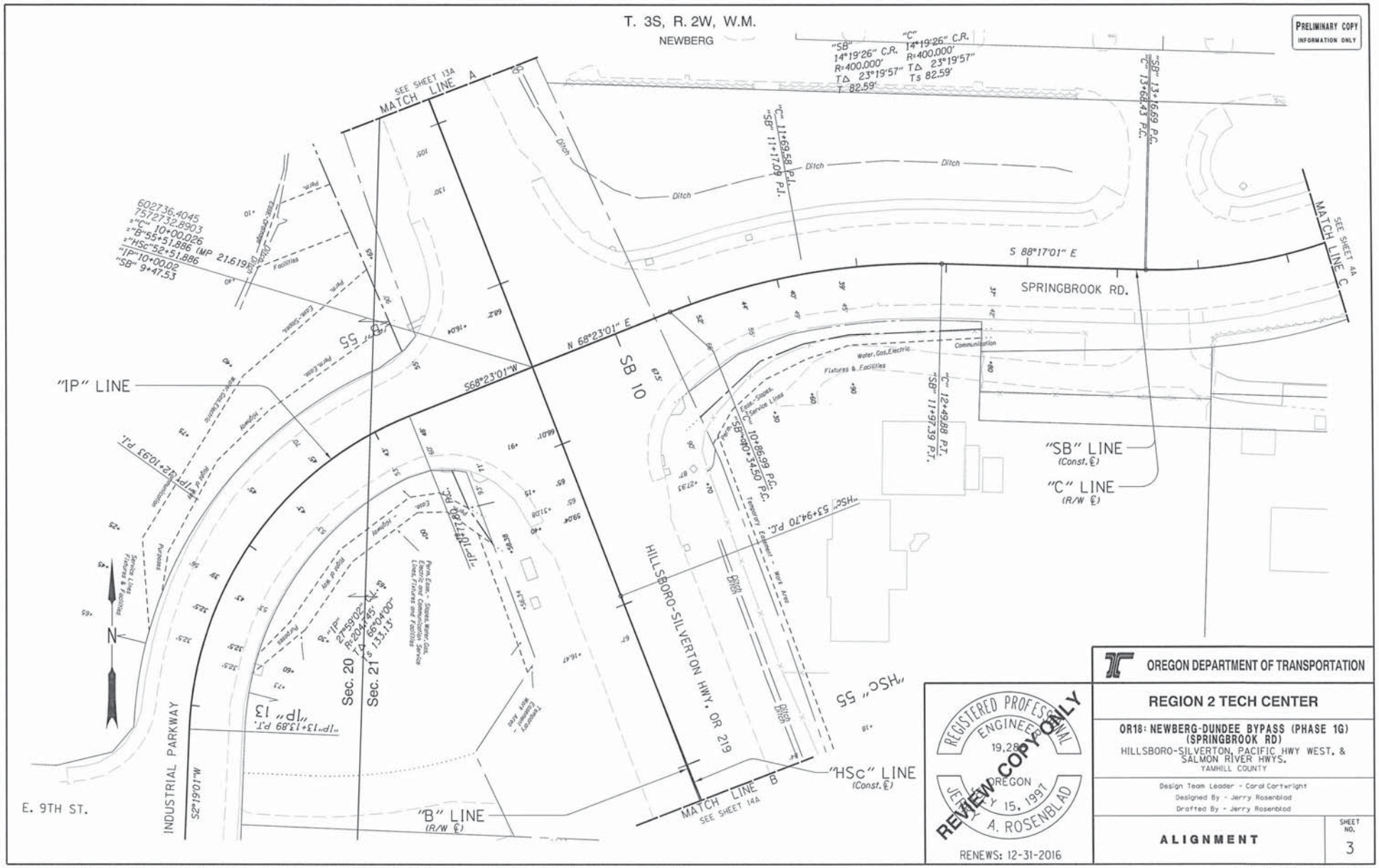
OR18: NEWBERG-DUNDEE BYPASS (PHASE 1G) (SPRINGBROOK RD)
HILLSBORO-SILVERTON, PACIFIC HWY WEST, & SALMON RIVER HWYS.
YAMHILL COUNTY

FEDERAL HIGHWAY ADMINISTRATION	PROJECT NUMBER	SHEET NO.
OREGON DIVISION	STATE	1

\\scdcto2\2650_nd-bypass_17099\Plans\16901_phlg\sheets\16901f_G.tsl :: Default 1/15/2015 1:26:02 PM hwye22e

1:1200 - 001

Attachment 4



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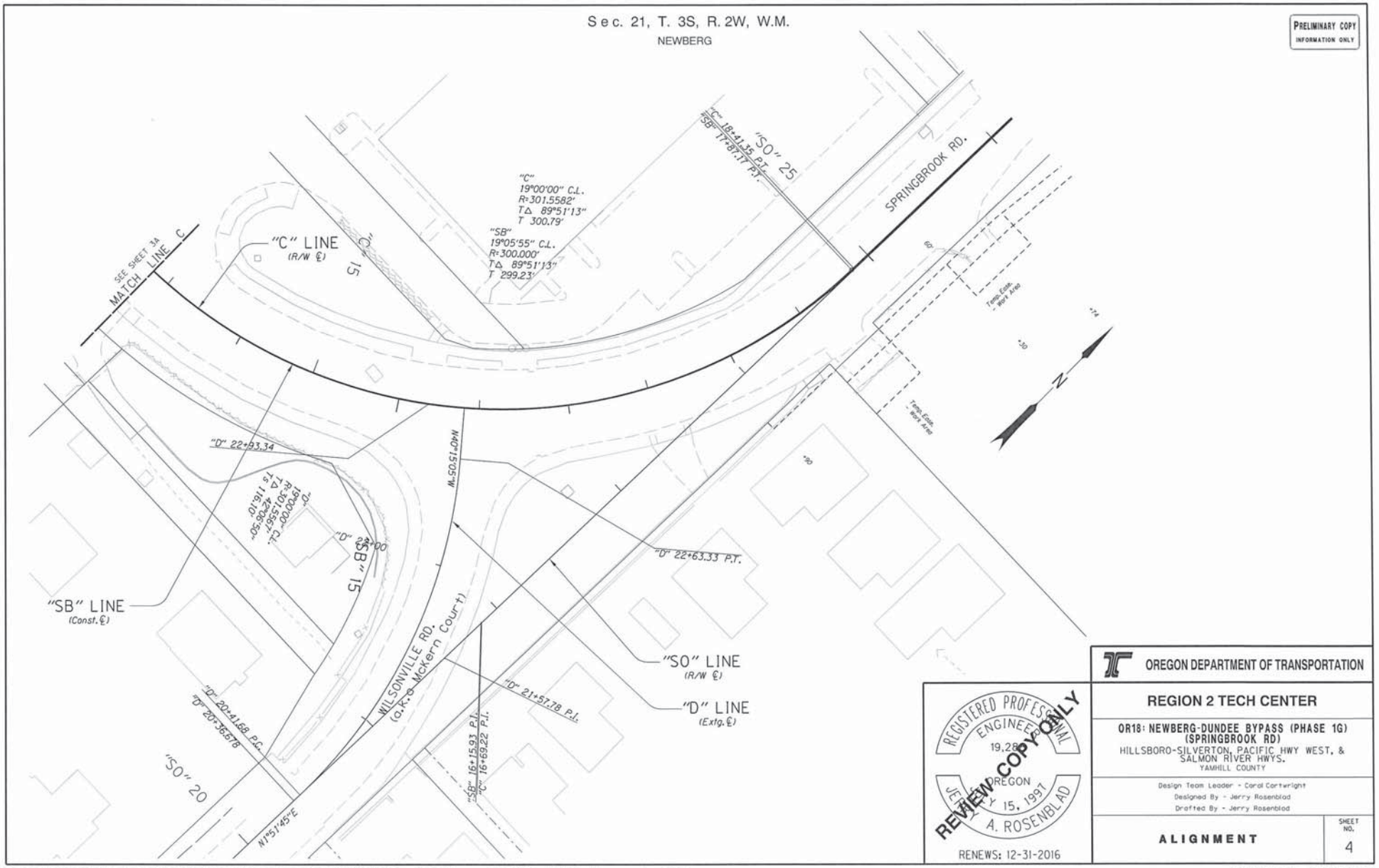

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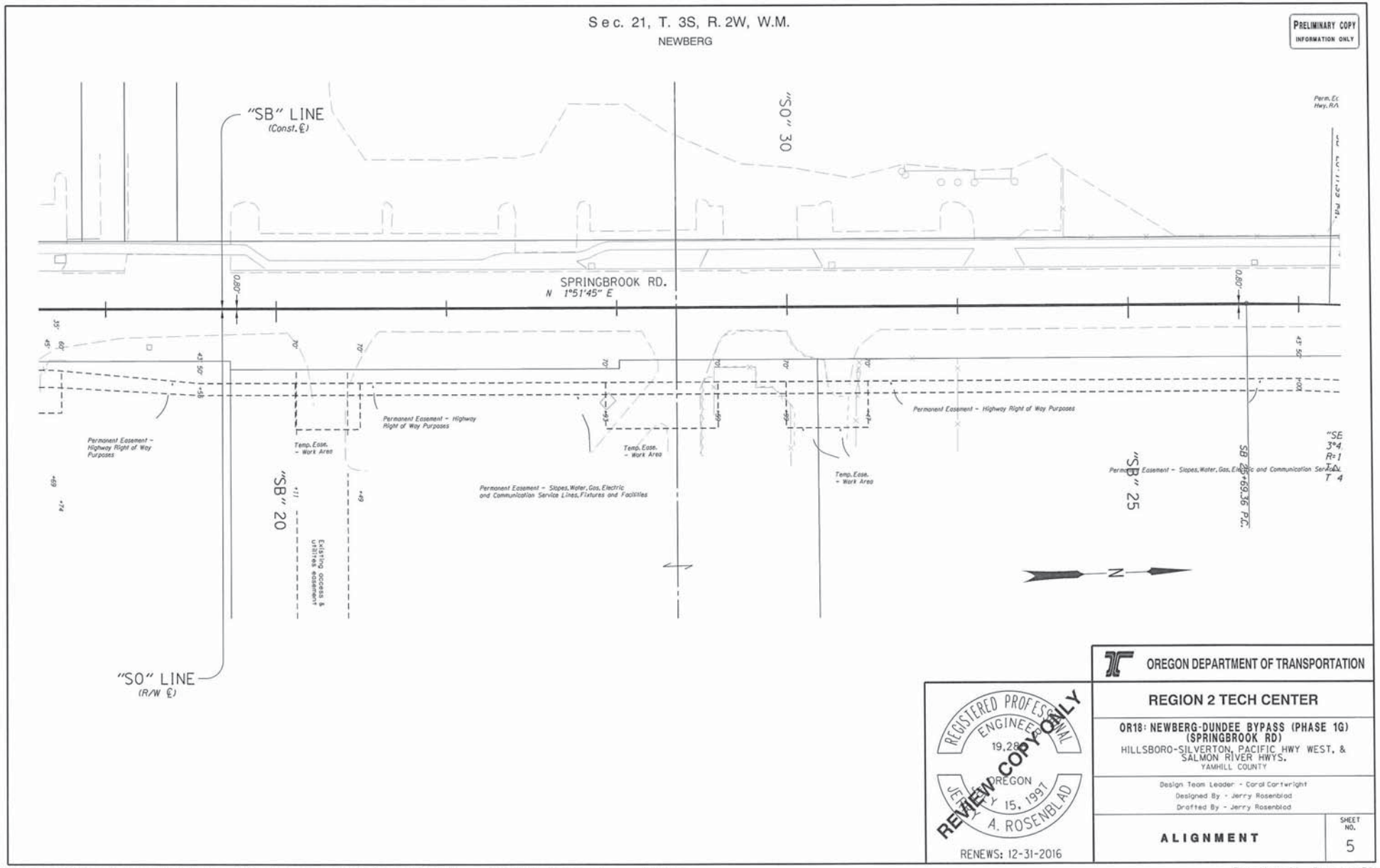

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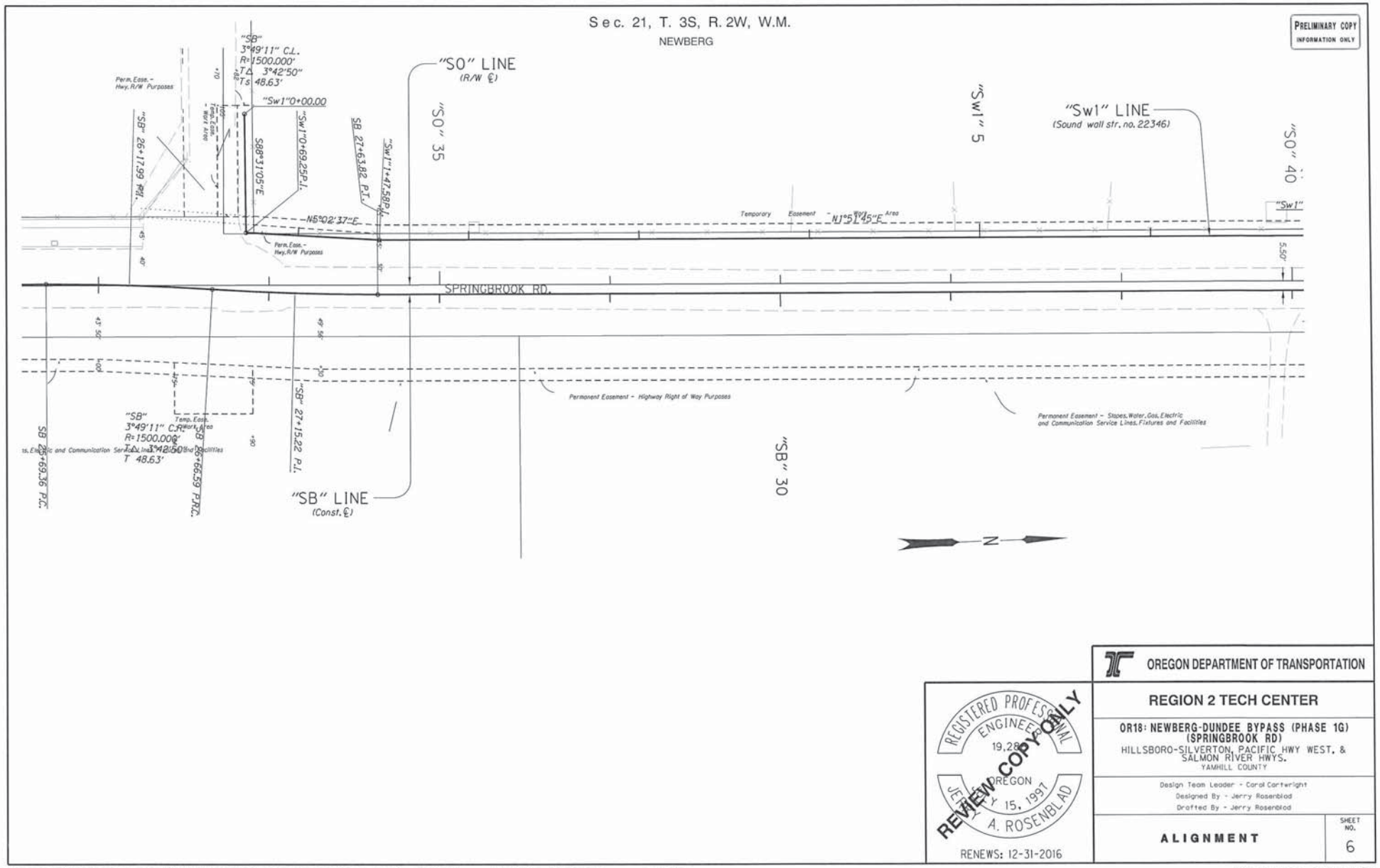

OREGON DEPARTMENT OF TRANSPORTATION

REGION 2 TECH CENTER

OR18: NEWBERG-DUNDEE BYPASS (PHASE 1G)
(SPRINGBROOK RD)
HILLSBORO-SILVERTON, PACIFIC HWY WEST, & SALMON RIVER HWYS.
YAMHILL COUNTY

Design Team Leader - Carol Cartwright
Designed By - Jerry Rosenblad
Drafted By - Jerry Rosenblad

REGISTERED PROFESSIONAL ENGINEER
19,28
OREGON
JANUARY 15, 1997
JERRY A. ROSENBLAD
RENEWS: 12-31-2016
REVIEW COPY ONLY

ALIGNMENT

SHEET NO. 6

\\scdata2\2650_nd-bypass_17099\Plans\16901_phlg\sheets\16901F_G_AL4 :: Default 1/15/2015 1:27:03 PM hwye22e

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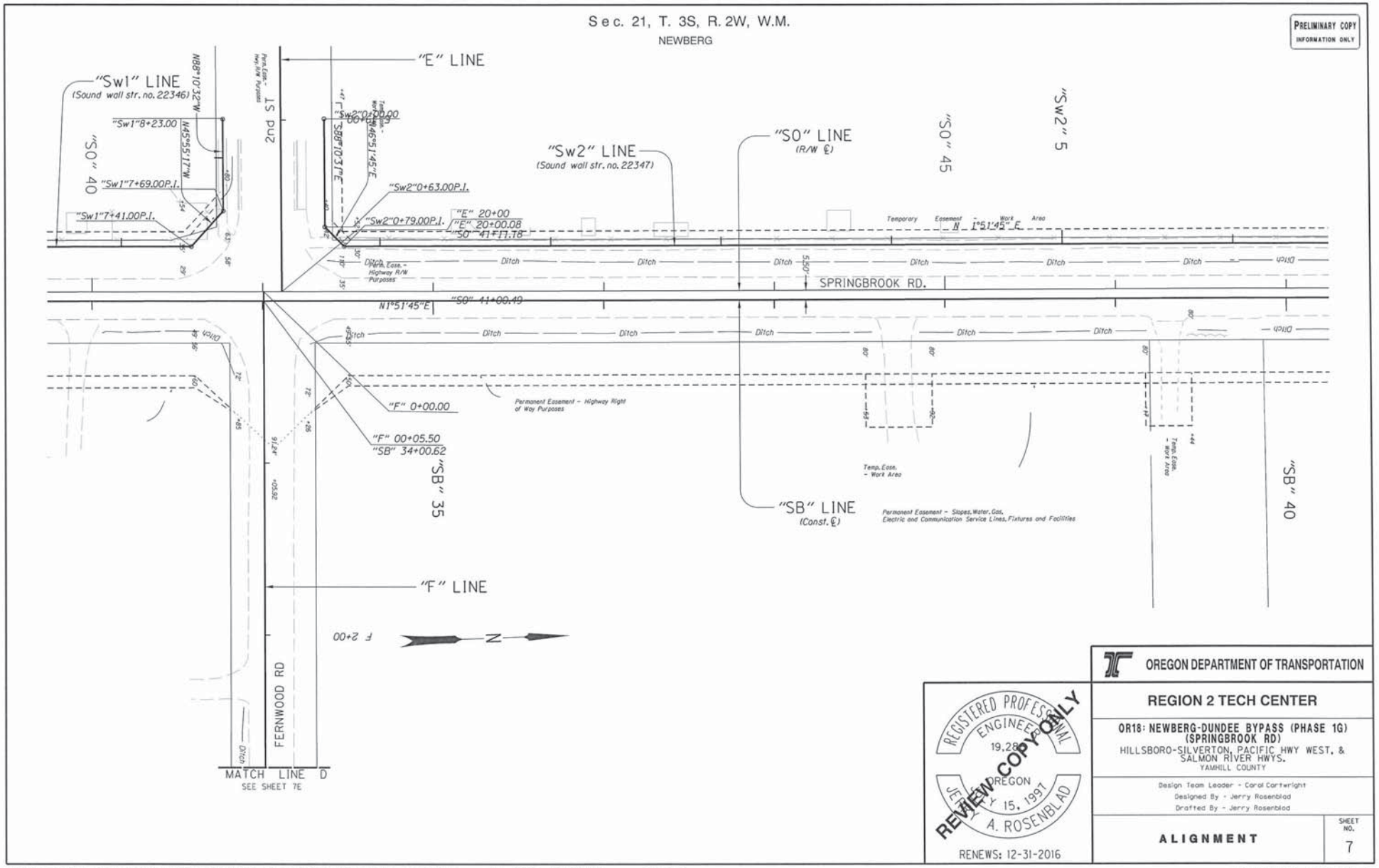
Attachment 4



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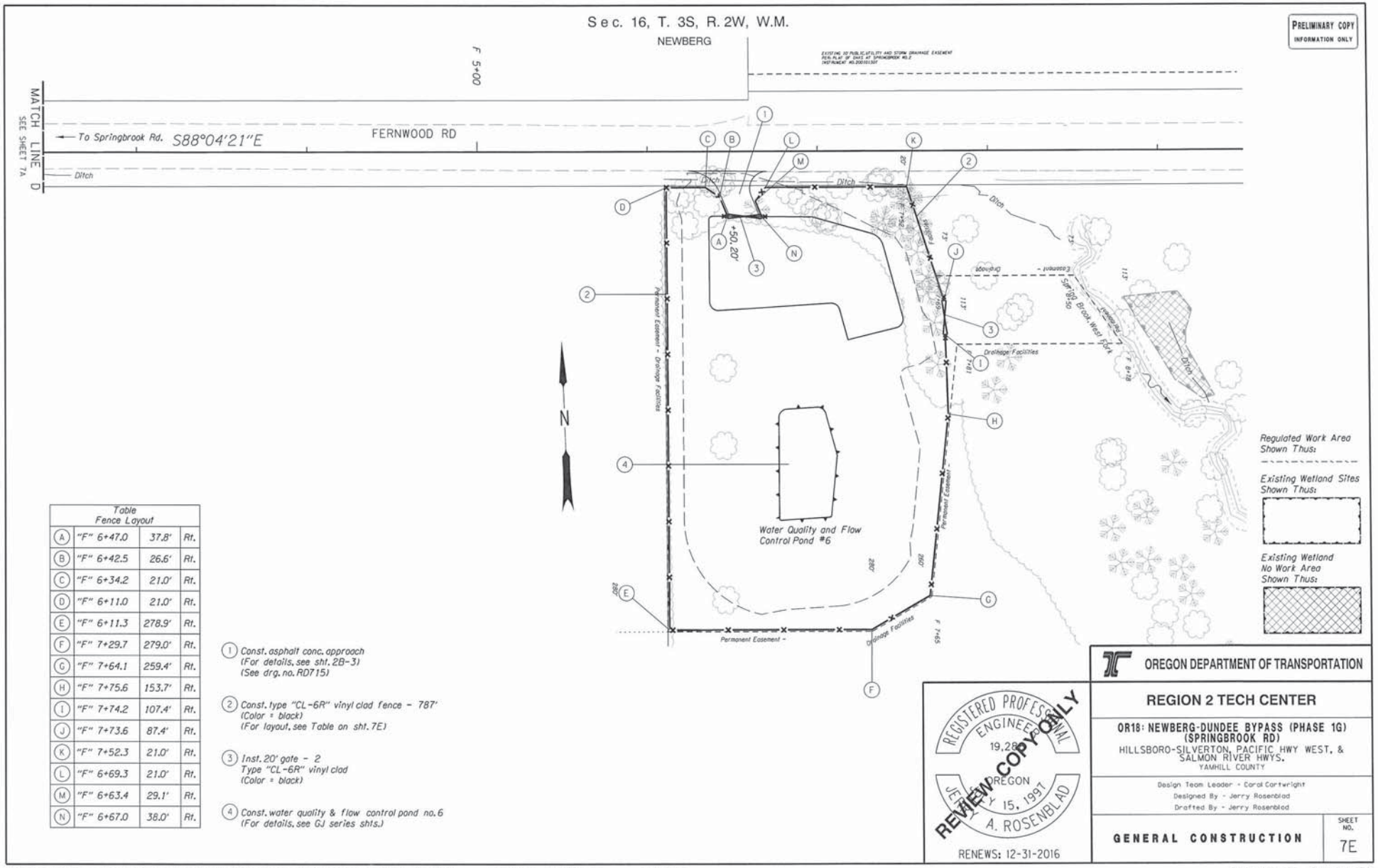

Table Fence Layout			
A	"F" 6+47.0	37.8'	Rt.
B	"F" 6+42.5	26.6'	Rt.
C	"F" 6+34.2	21.0'	Rt.
D	"F" 6+11.0	21.0'	Rt.
E	"F" 6+11.3	278.9'	Rt.
F	"F" 7+29.7	279.0'	Rt.
G	"F" 7+64.1	259.4'	Rt.
H	"F" 7+75.6	153.7'	Rt.
I	"F" 7+74.2	107.4'	Rt.
J	"F" 7+73.6	87.4'	Rt.
K	"F" 7+52.3	21.0'	Rt.
L	"F" 6+69.3	21.0'	Rt.
M	"F" 6+63.4	29.1'	Rt.
N	"F" 6+67.0	38.0'	Rt.

1. Const. asphalt conc. approach (For details, see sht. 2B-3) (See drg. no. RD715)
2. Const. type "CL-6R" vinyl clad fence - 787' (Color = black) (For layout, see Table on sht. 7E)
3. Inst. 20' gate - 2 Type "CL-6R" vinyl clad (Color = black)
4. Const. water quality & flow control pond no. 6 (For details, see GJ series shts.)

REGISTERED PROFESSIONAL ENGINEER 19,280 OREGON JULY 15, 1997 JERRY A. ROSENBLAD
RENEWS: 12-31-2016
REVIEW COPY ONLY

OREGON DEPARTMENT OF TRANSPORTATION

REGION 2 TECH CENTER

OR18: NEWBERG-DUNDEE BYPASS (PHASE 1G) (SPRINGBROOK RD)
HILLSBORO-SILVERTON, PACIFIC HWY WEST, & SALMON RIVER HWYS.
YAMHILL COUNTY

Design Team Leader - Carol Cartwright
Designed By - Jerry Rosenblad
Drafted By - Jerry Rosenblad

GENERAL CONSTRUCTION

SHEET NO. 7E

\\scdata2\2650_ND-Bypass_17099\Plans\16901_phig\sheets\16901F_G.PLS :: Default 1/15/2015 2:27:09 PM hwye22e

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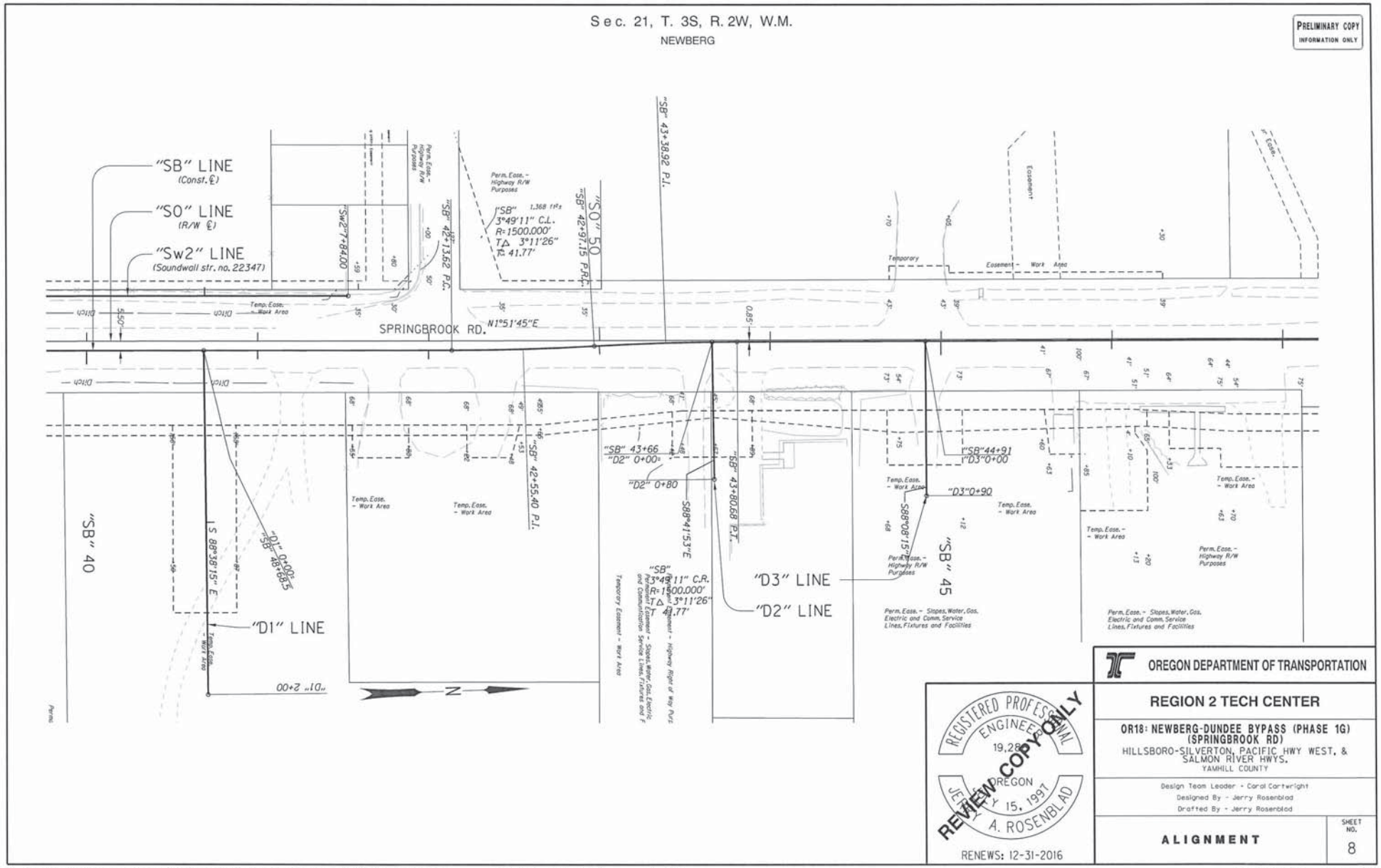
Attachment 4



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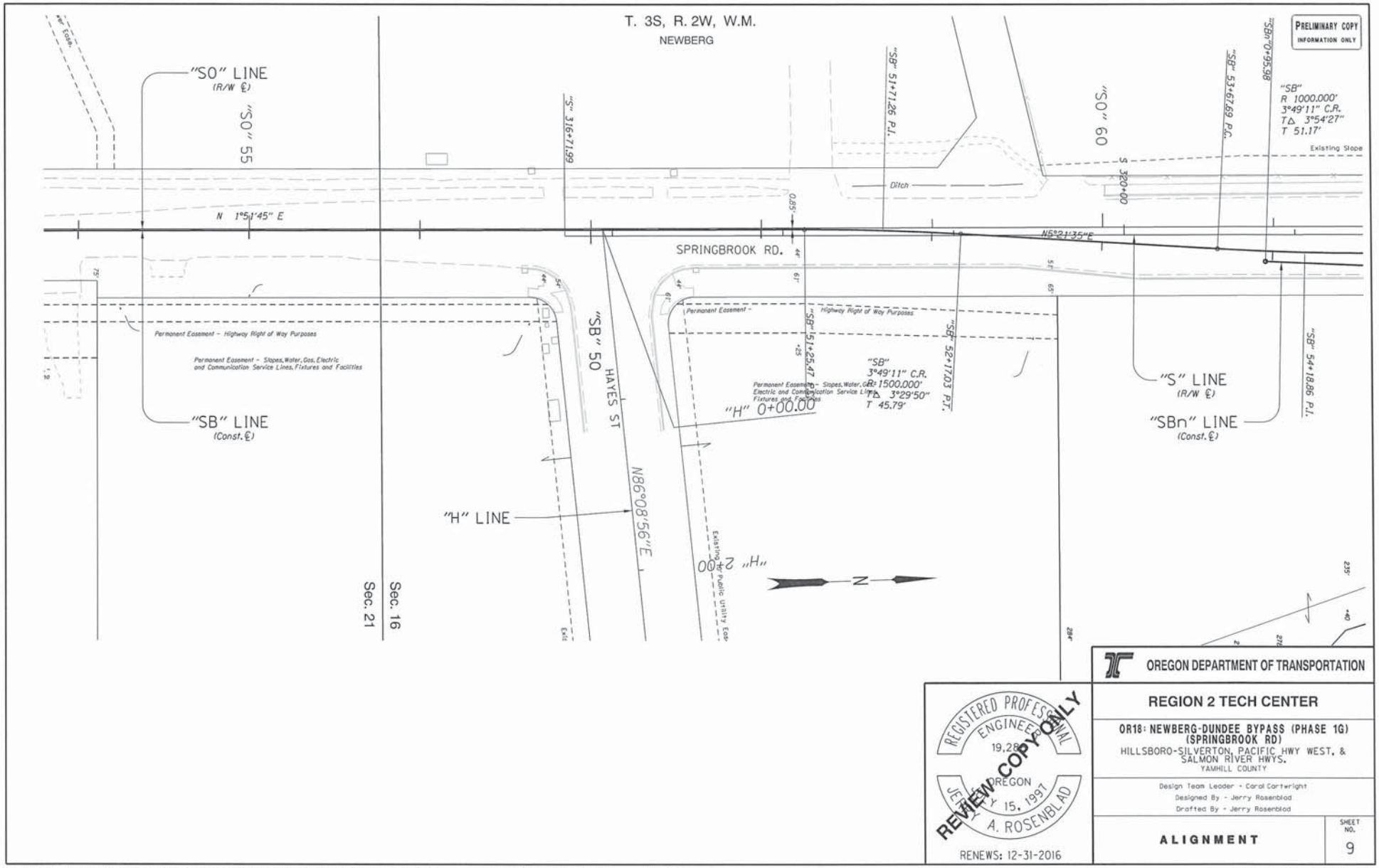

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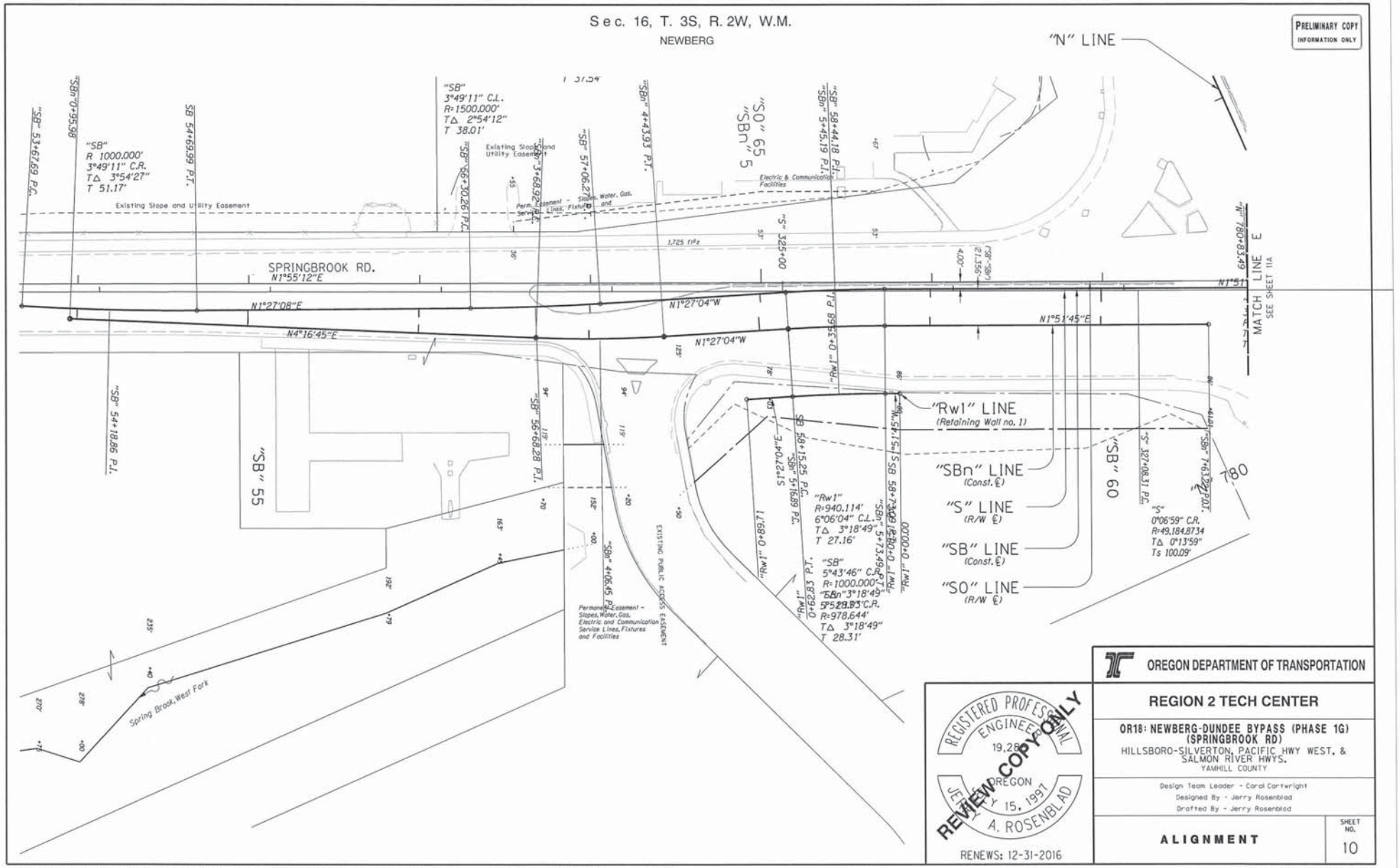

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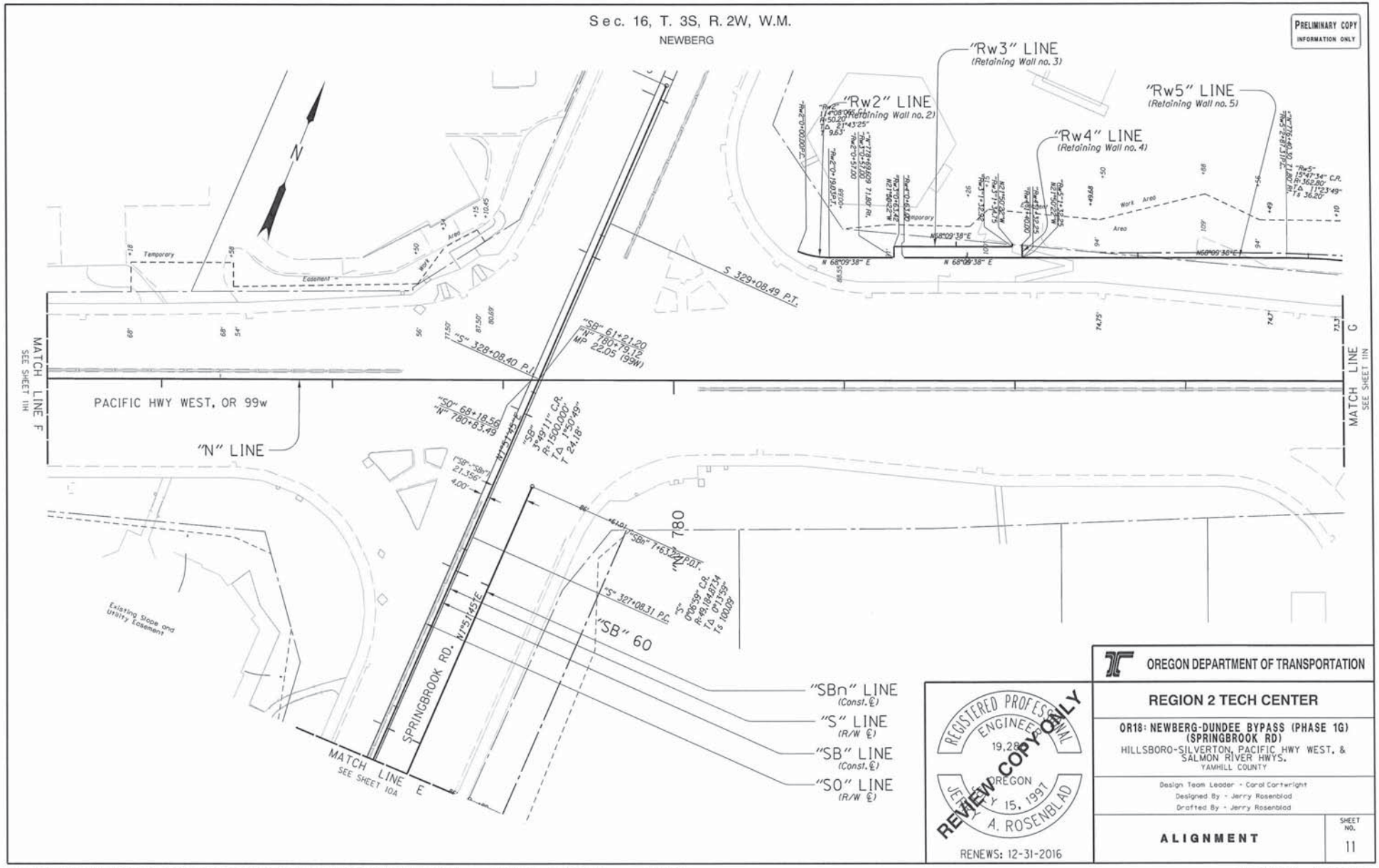

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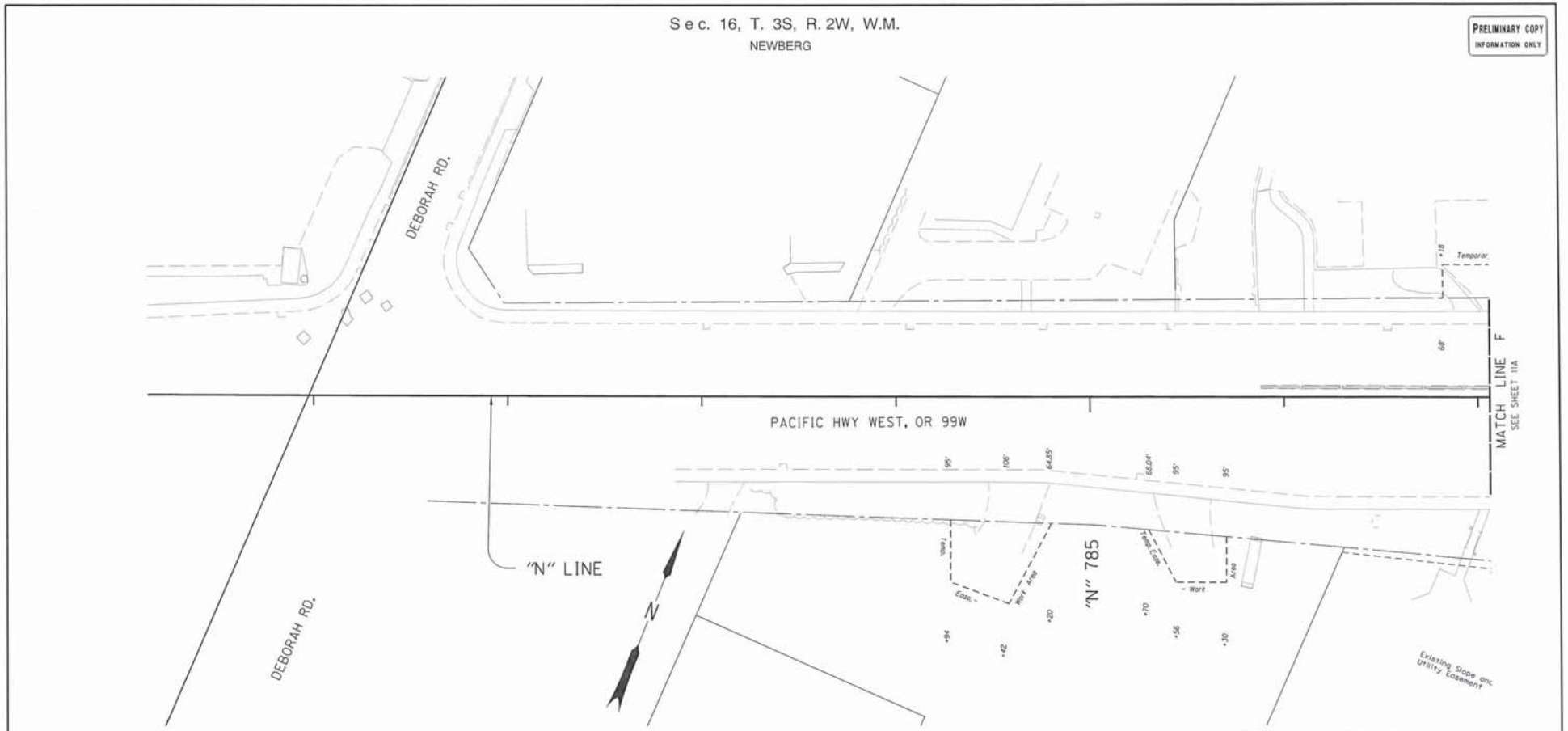

OREGON DEPARTMENT OF TRANSPORTATION

REGION 2 TECH CENTER

OR18: NEWBERG-DUNDEE BYPASS (PHASE 1G)
(SPRINGBROOK RD)
HILLSBORO-SILVERTON, PACIFIC HWY WEST, & SALMON RIVER HWYS.
YAMHILL COUNTY

Design Team Leader - Carol Cartwright
Designed By - Jerry Rosenblad
Drafted By - Jerry Rosenblad

ALIGNMENT

SHEET NO. 11G

REGISTERED PROFESSIONAL ENGINEER 19,28 OREGON JULY 15, 1997 JERRY A. ROSENBLAD
RENEWS: 12-31-2016

REVIEW COPY ONLY

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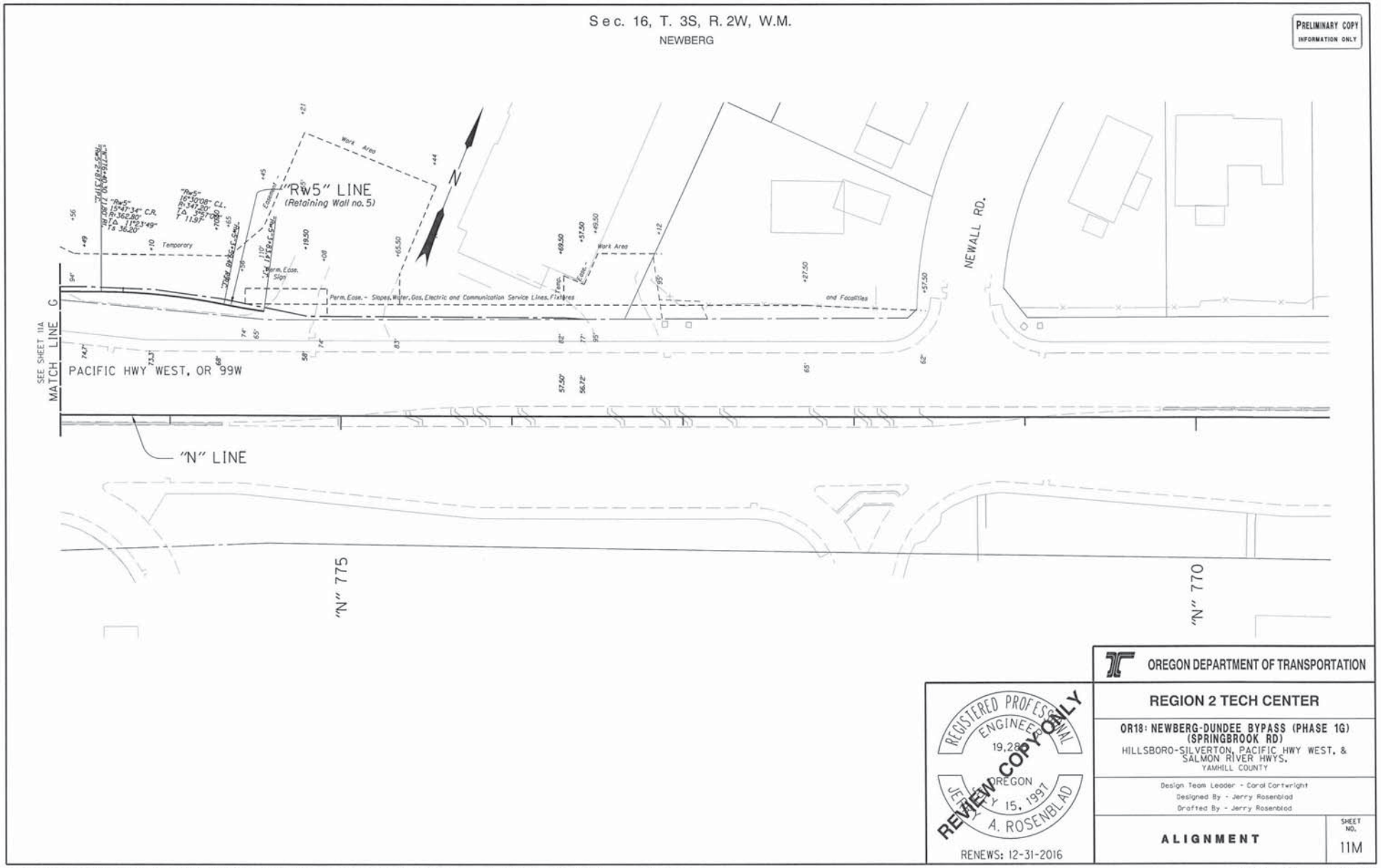
Attachment 4



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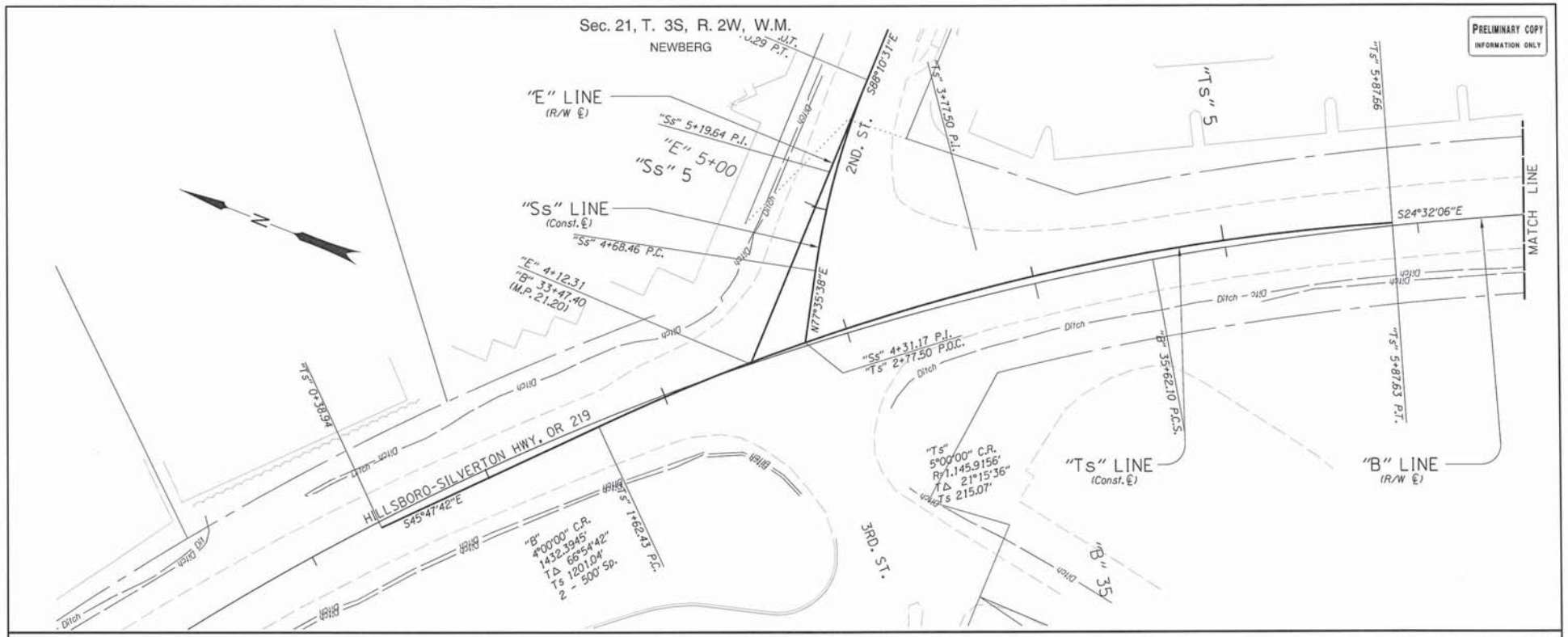

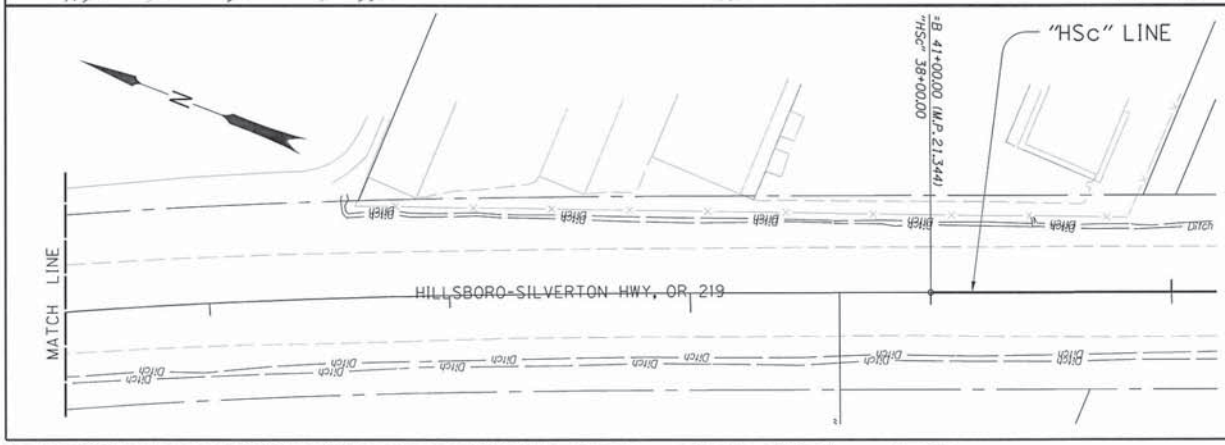

REGISTERED PROFESSIONAL ENGINEER
19,280
OREGON
JULY 15, 1997
JERRY A. ROSENBLAD
RENEWS: 12-31-2016
REVIEW COPY ONLY

OREGON DEPARTMENT OF TRANSPORTATION

REGION 2 TECH CENTER

OR18: NEWBERG-DUNDEE BYPASS (PHASE 1G) (SPRINGBROOK RD)
HILLSBORO-SILVERTON, PACIFIC HWY WEST, & SALMON RIVER HWYS.
YAMHILL COUNTY

Design Team Leader - Carol Cartwright
Designed By - Jerry Rosenblad
Drafted By - Jerry Rosenblad

ALIGNMENT

SHEET NO. 12

\\scdata2\2650_nd-bypass_17099\Plans\16901_phlg\sheets\16901f_G.ALI :: Default 1/15/2015 1:28:25 PM hwye22e

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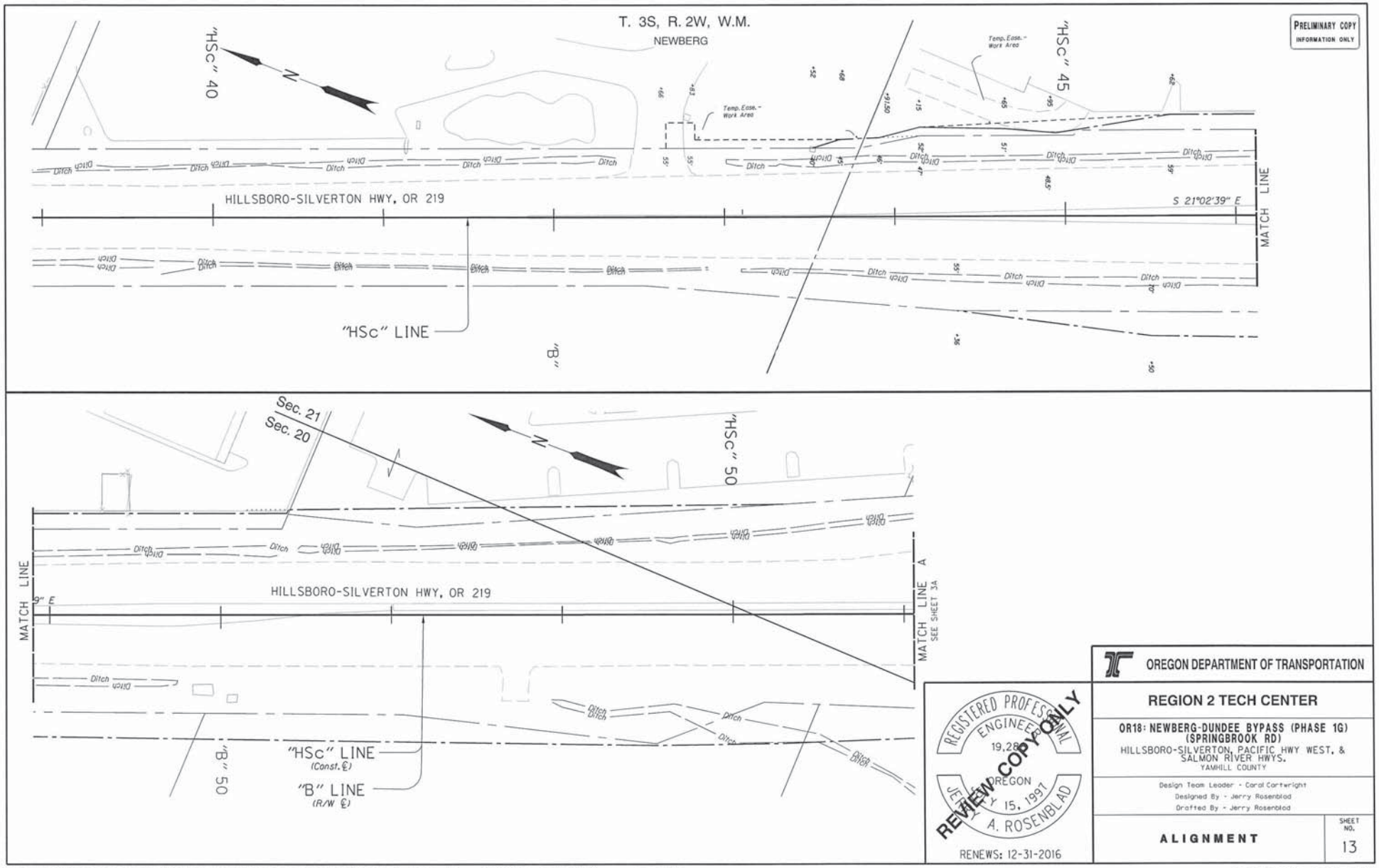

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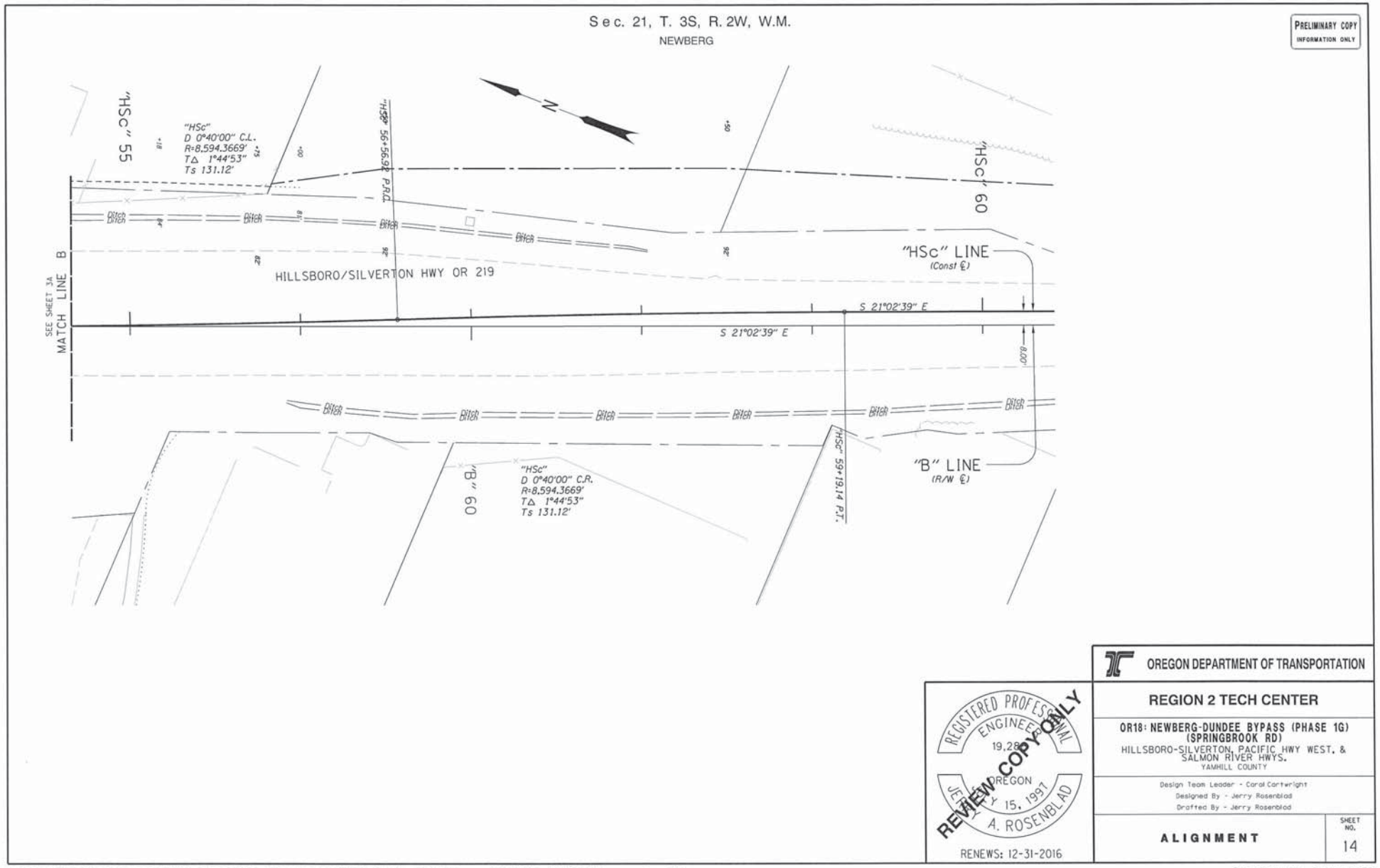
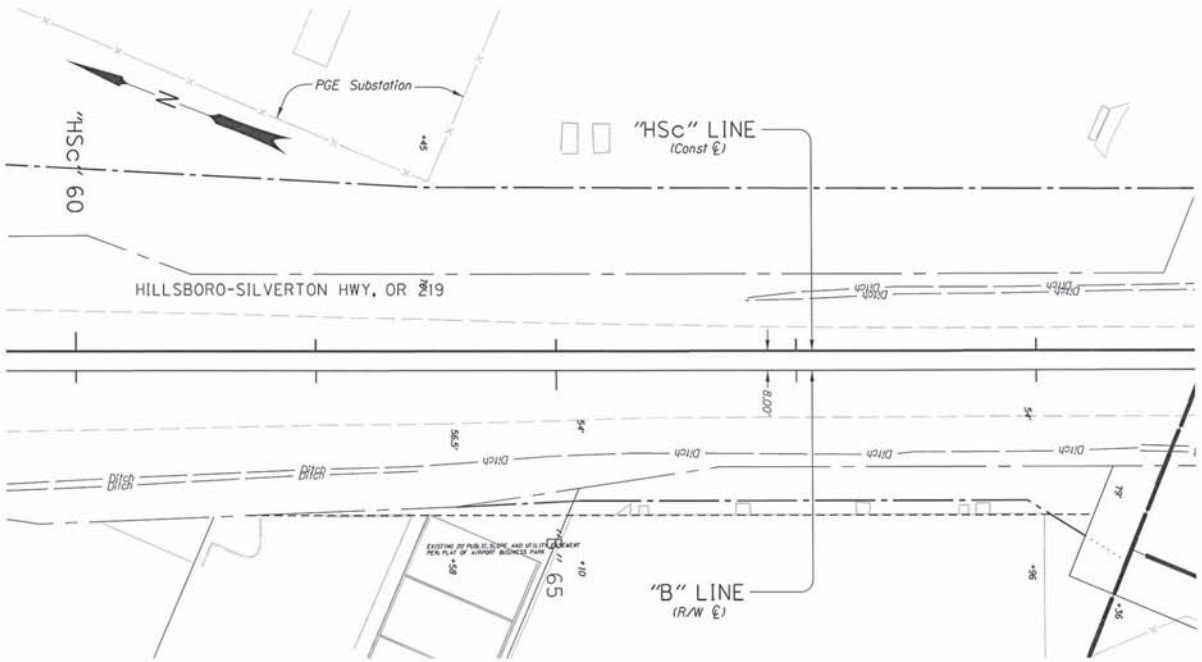


Attachment 4

Sec. 21, T. 3S, R. 2W, W.M.
NEWBERG

PRELIMINARY COPY
INFORMATION ONLY



OREGON DEPARTMENT OF TRANSPORTATION

REGION 2 TECH CENTER

OR18: NEWBERG-DUNDEE BYPASS (PHASE 1G)
(SPRINGBROOK RD)
HILLSBORO-SILVERTON, PACIFIC HWY WEST, &
SALMON RIVER HWYS.
YAMHILL COUNTY

Design Team Leader - Carol Cartwright
Designed By - Jerry Rosenblad
Drafted By - Jerry Rosenblad

ALIGNMENT

SHEET NO. 15

REGISTERED PROFESSIONAL ENGINEER
19,28
OREGON
JULY 15, 1997
JERRY A. ROSENBLAD
RENEWS: 12-31-2016

REVIEW COPY ONLY

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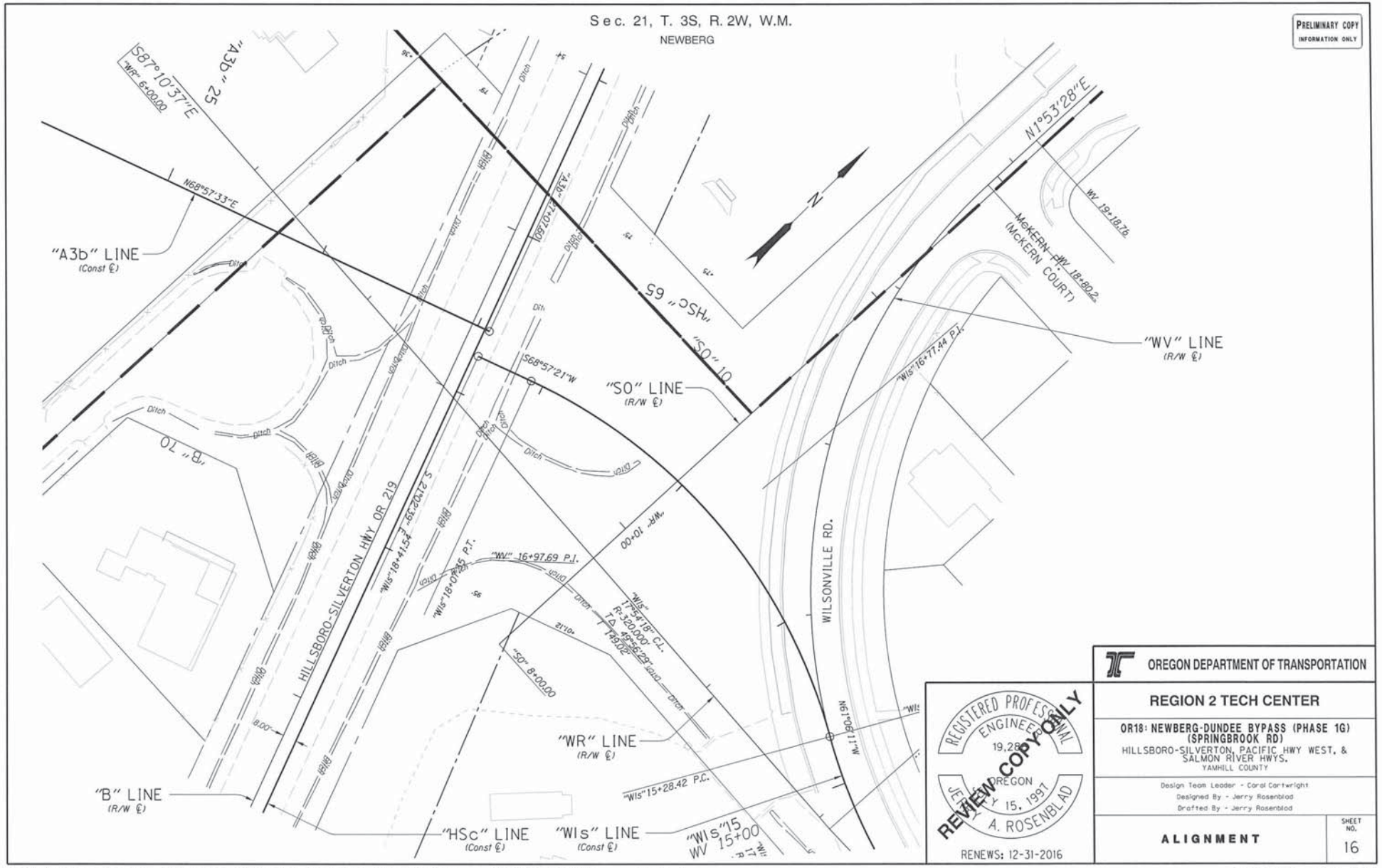
Attachment 4



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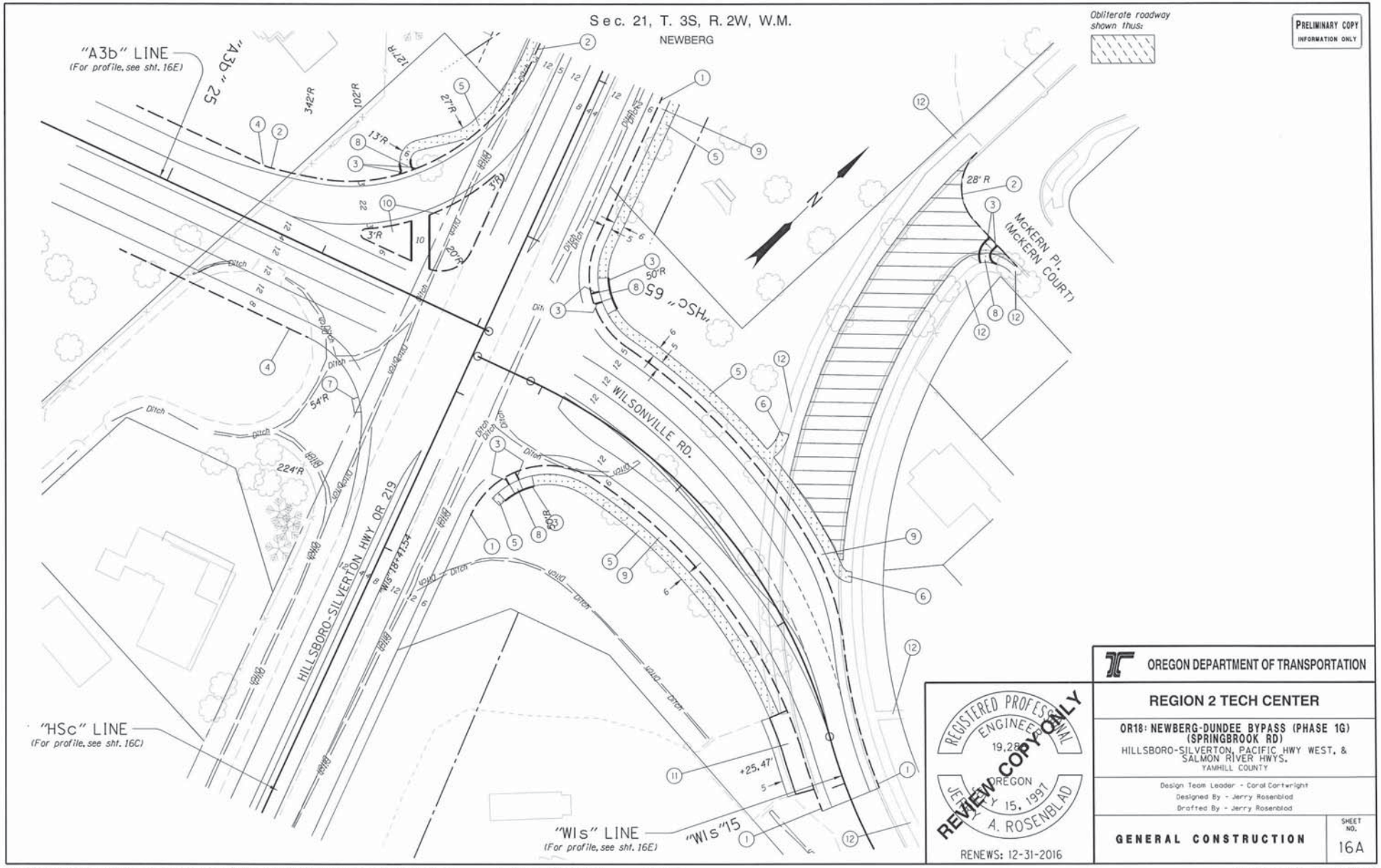

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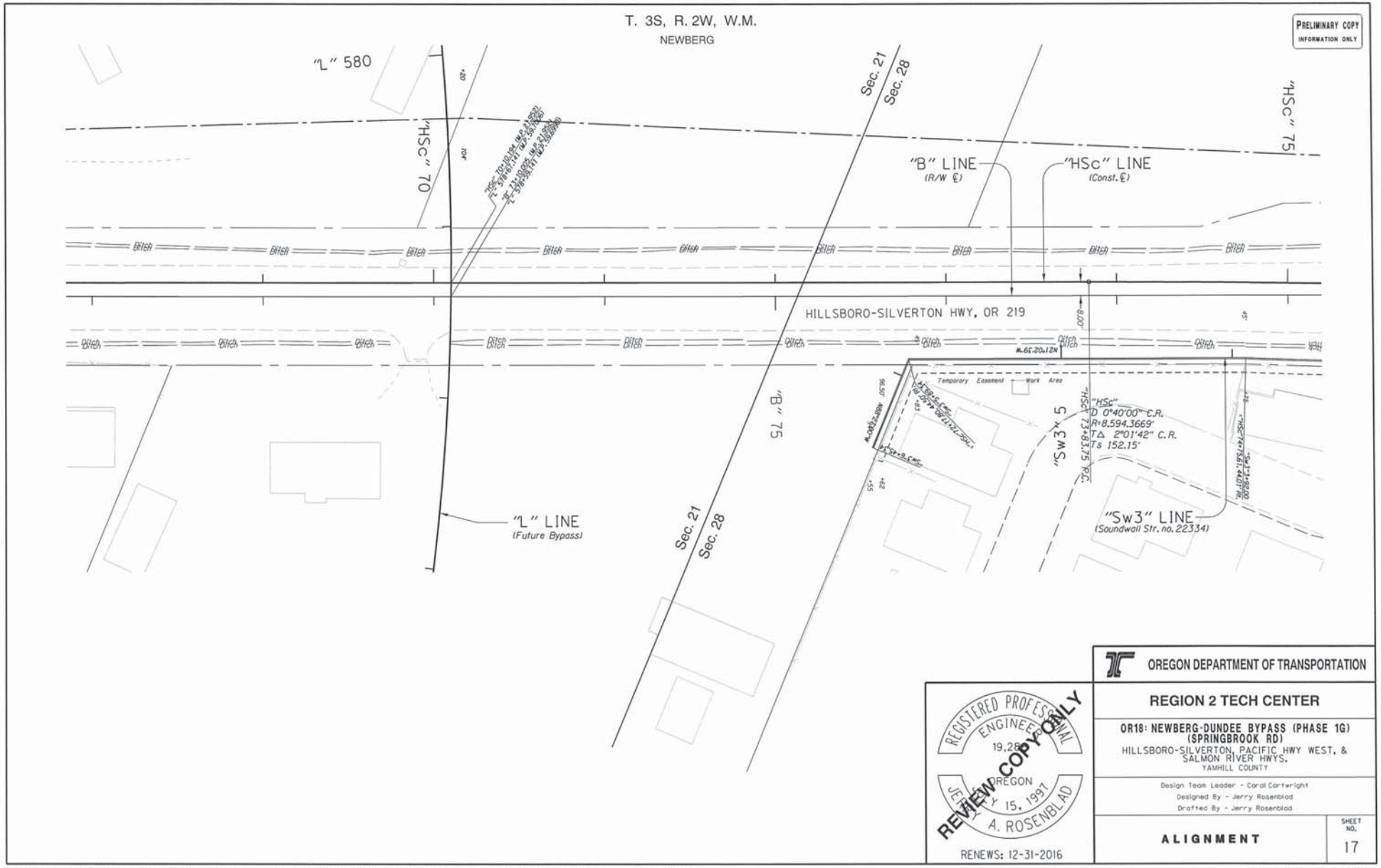

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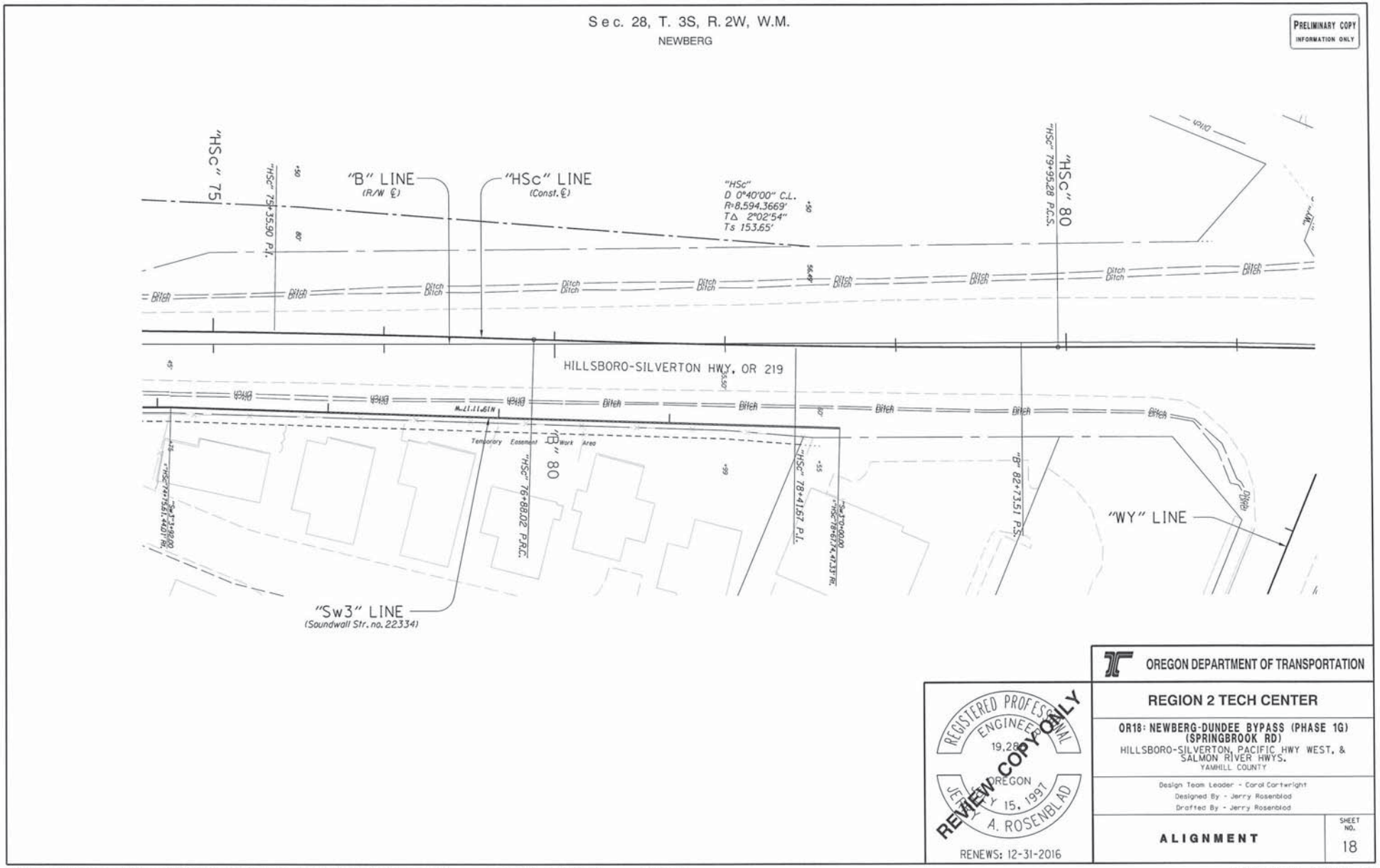

OREGON DEPARTMENT OF TRANSPORTATION

REGION 2 TECH CENTER

OR18: NEWBERG-DUNDEE BYPASS (PHASE 1G)
(SPRINGBROOK RD)
HILLSBORO-SILVERTON, PACIFIC HWY WEST, & SALMON RIVER HWYS.
YAMHILL COUNTY

Design Team Leader - Carol Cartwright
Designed By - Jerry Rosenblad
Drafted By - Jerry Rosenblad

ALIGNMENT

SHEET NO. 18

REGISTERED PROFESSIONAL ENGINEER 19,28 OREGON JULY 15, 1997 JERRY A. ROSENBLAD
RENEWS: 12-31-2016

REVIEW COPY ONLY

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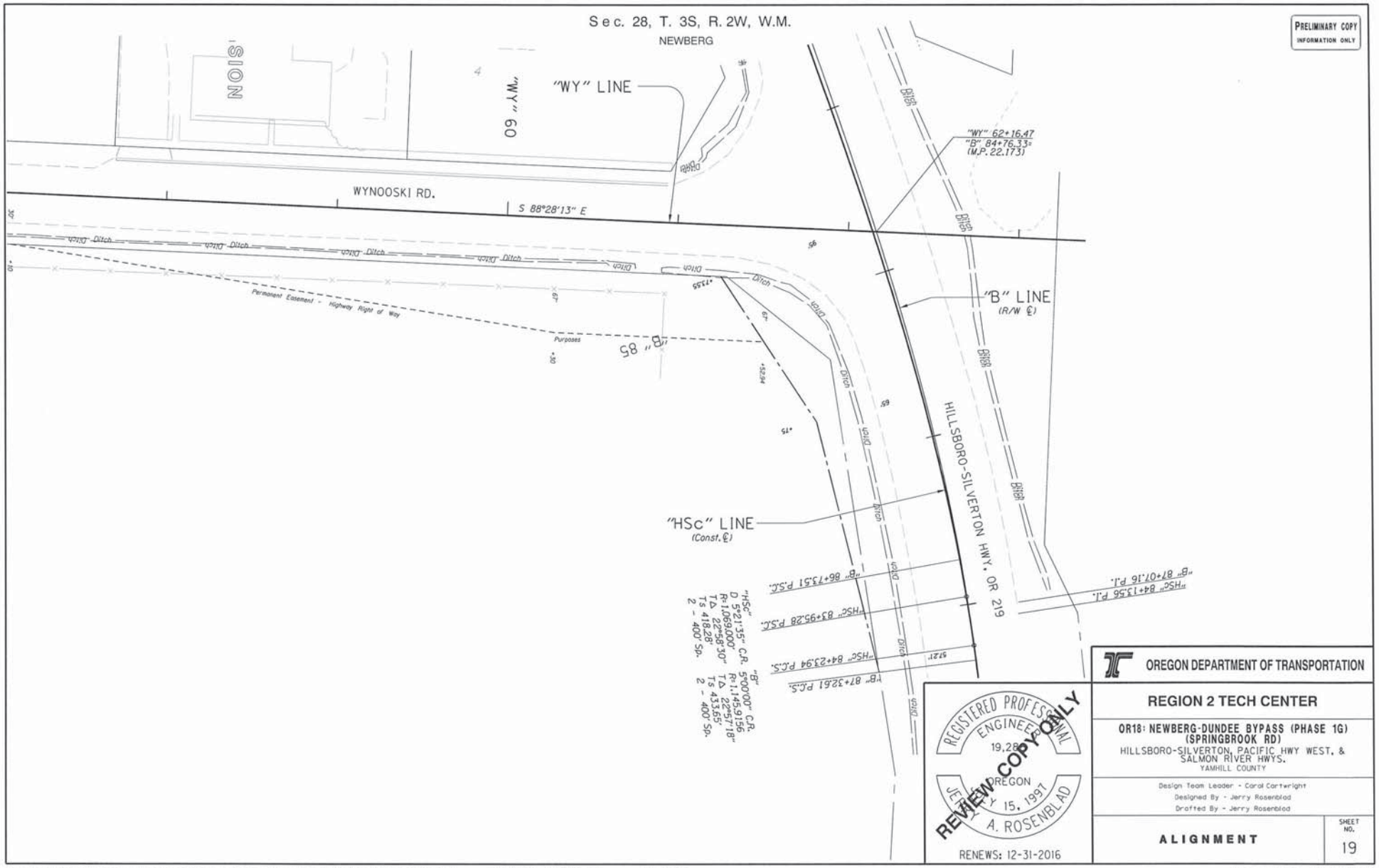

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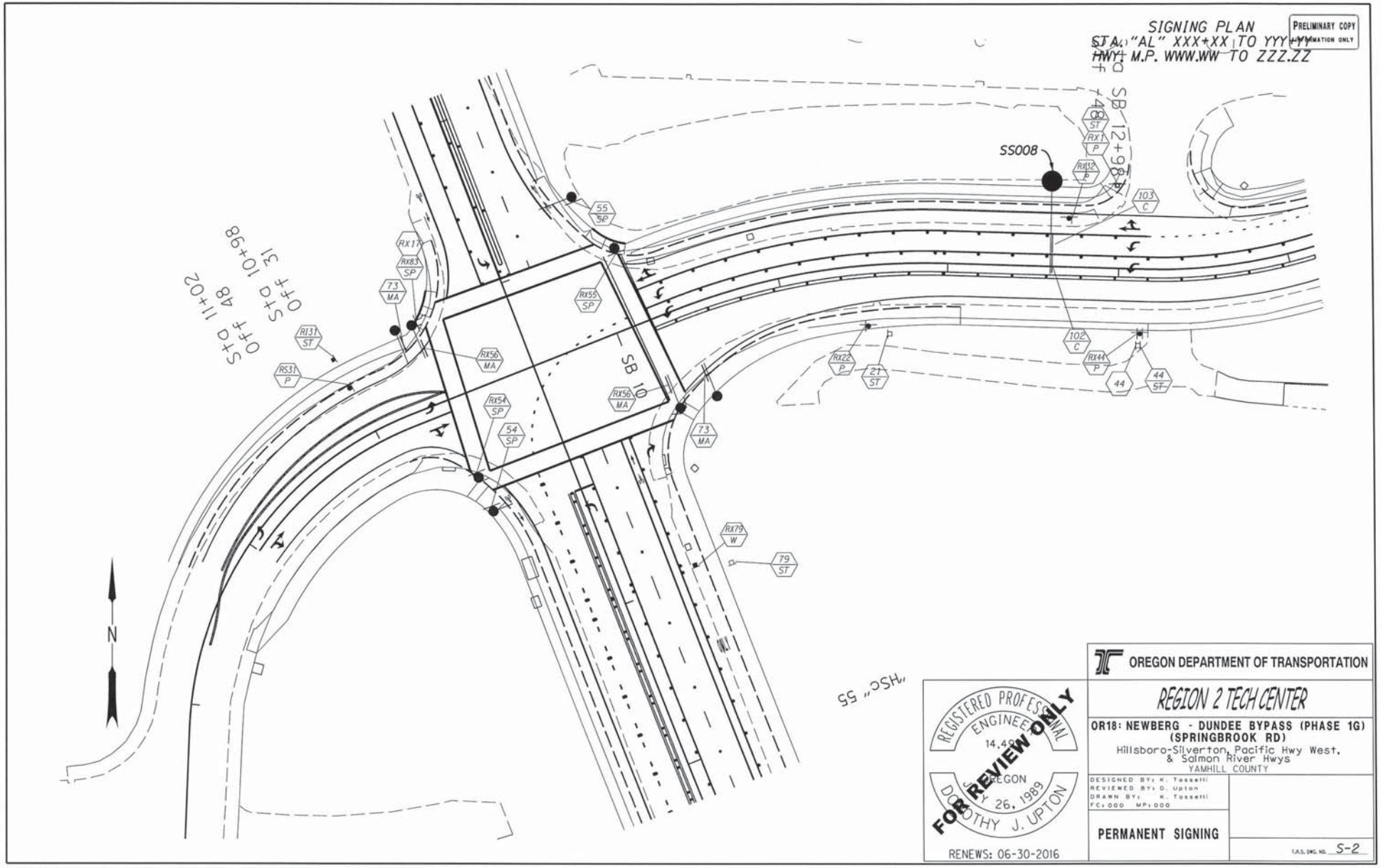

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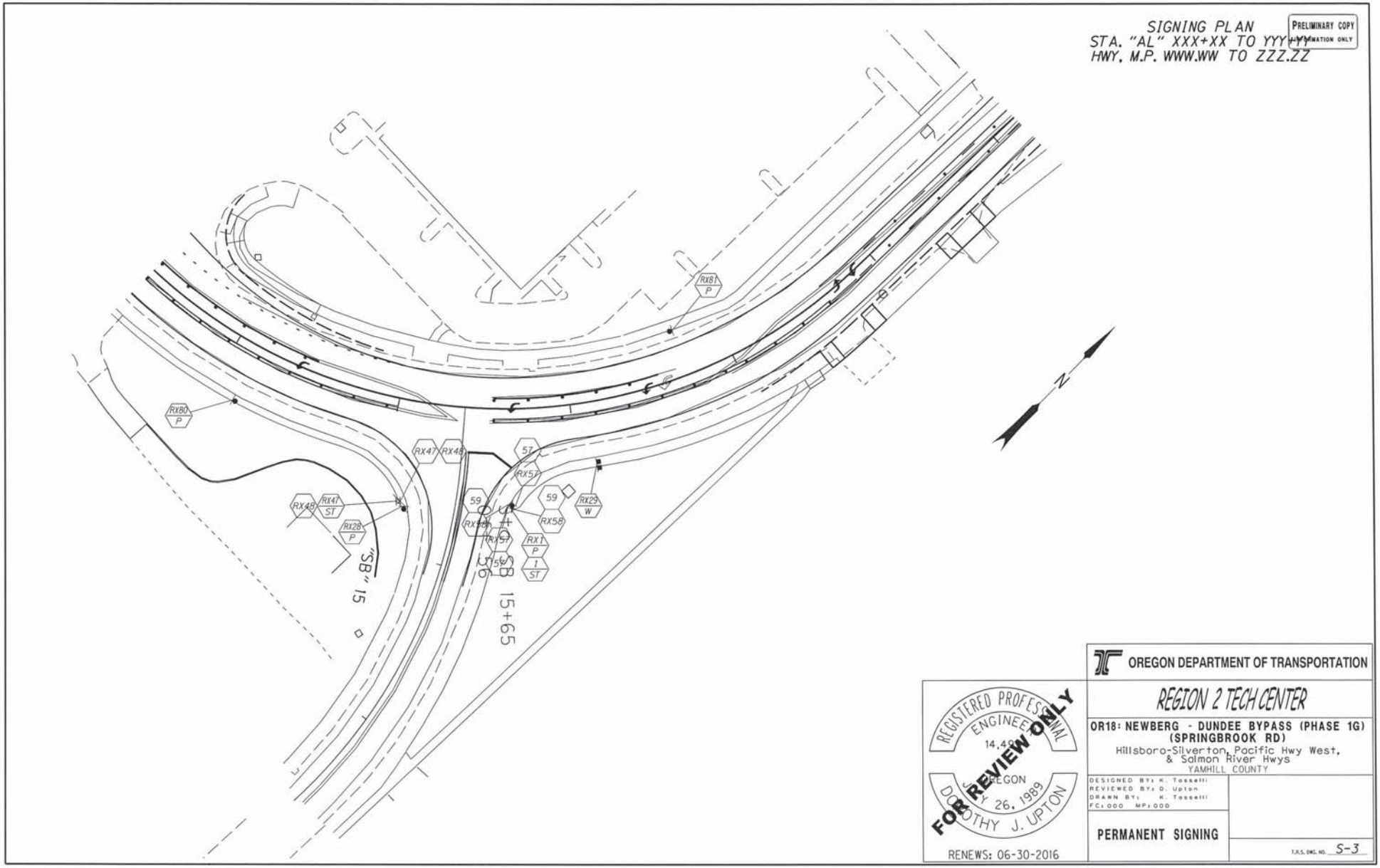

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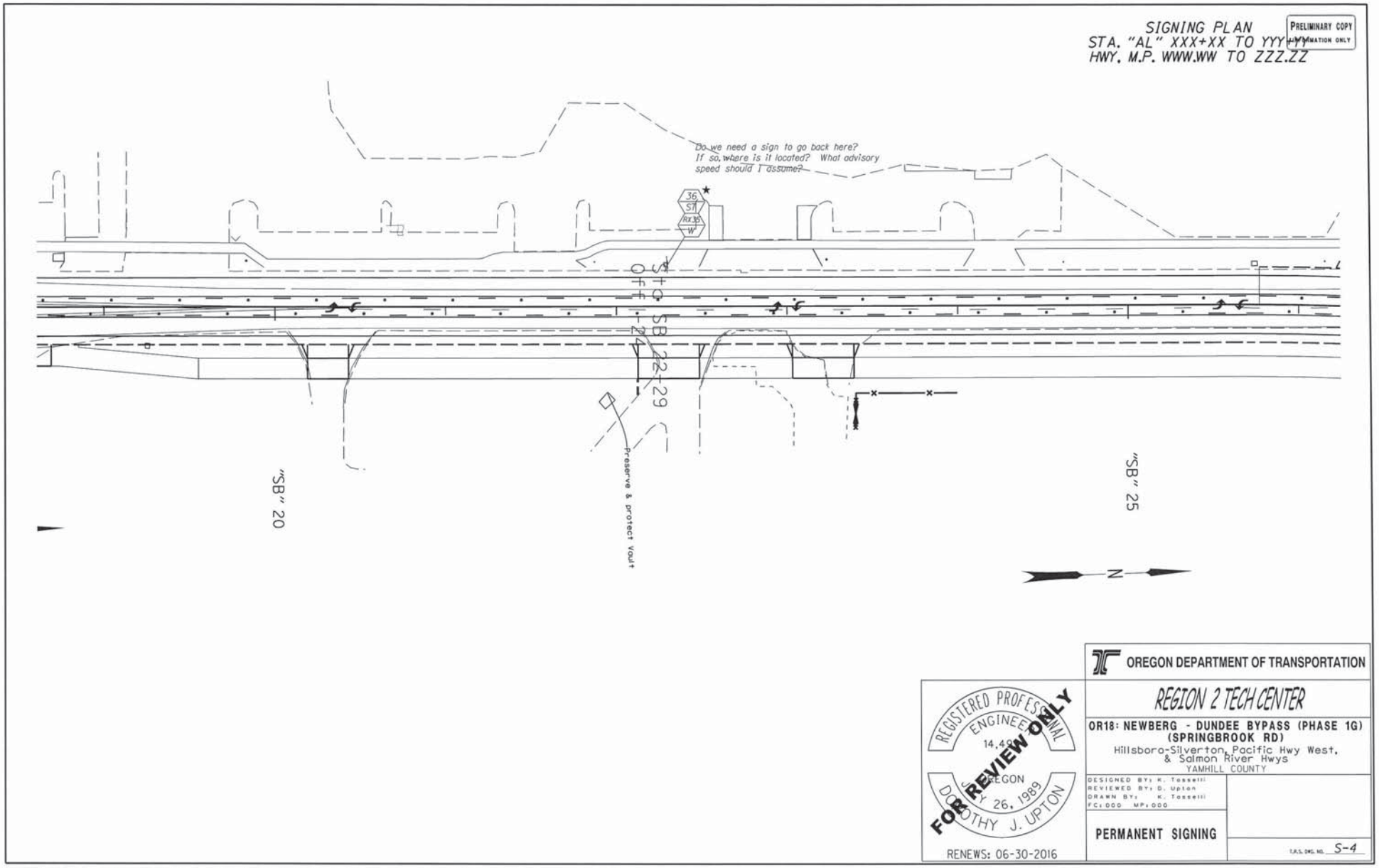

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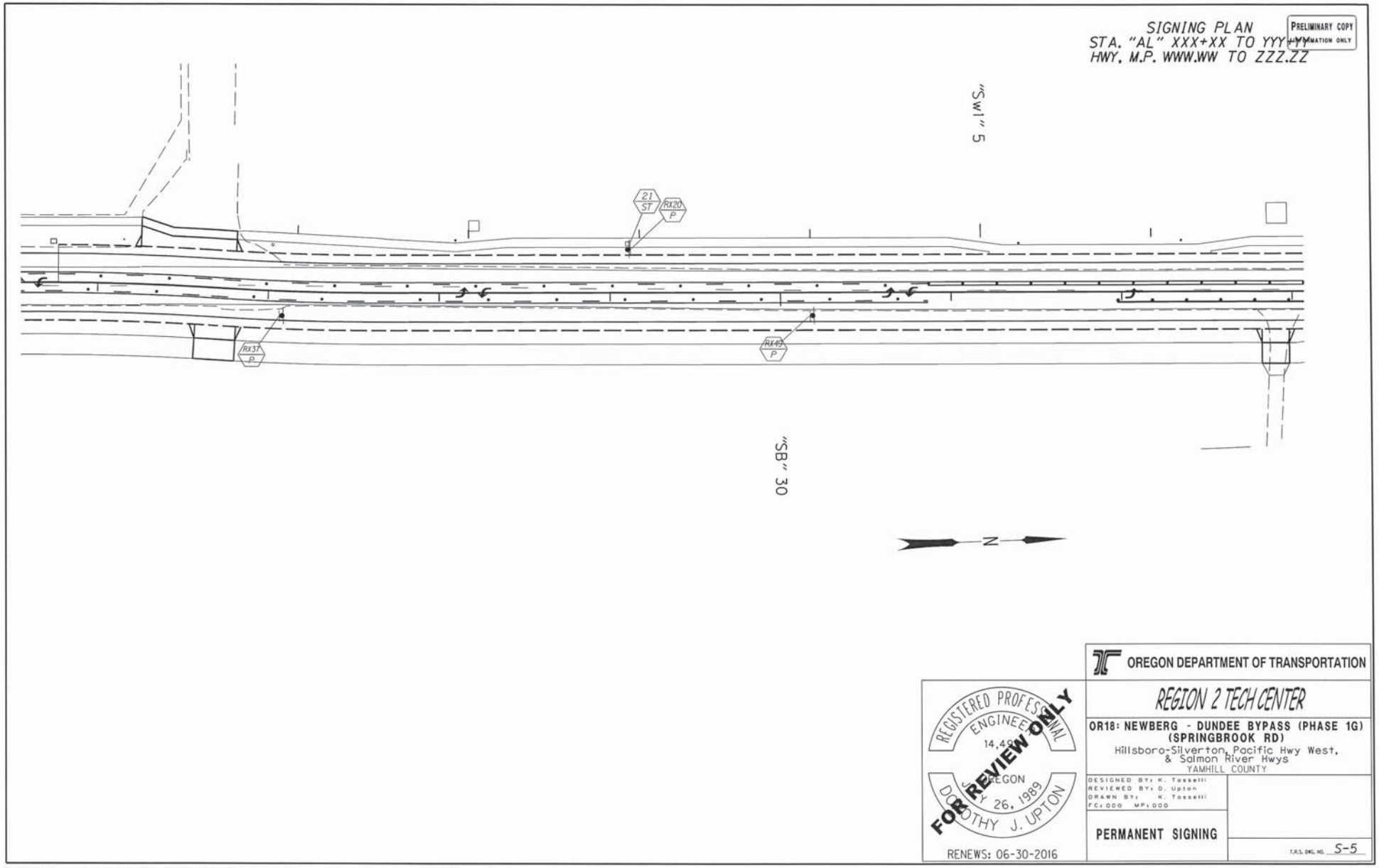

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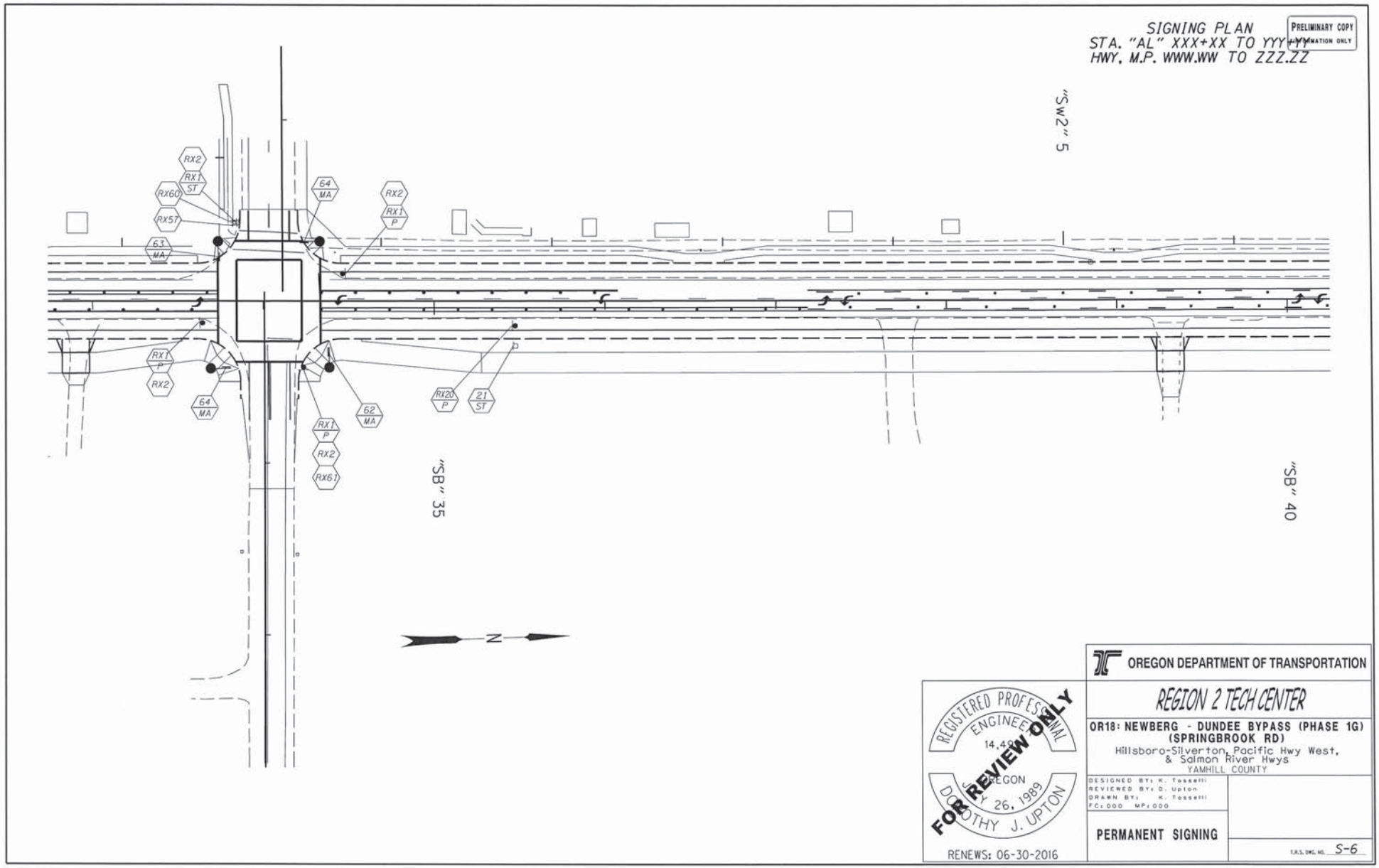

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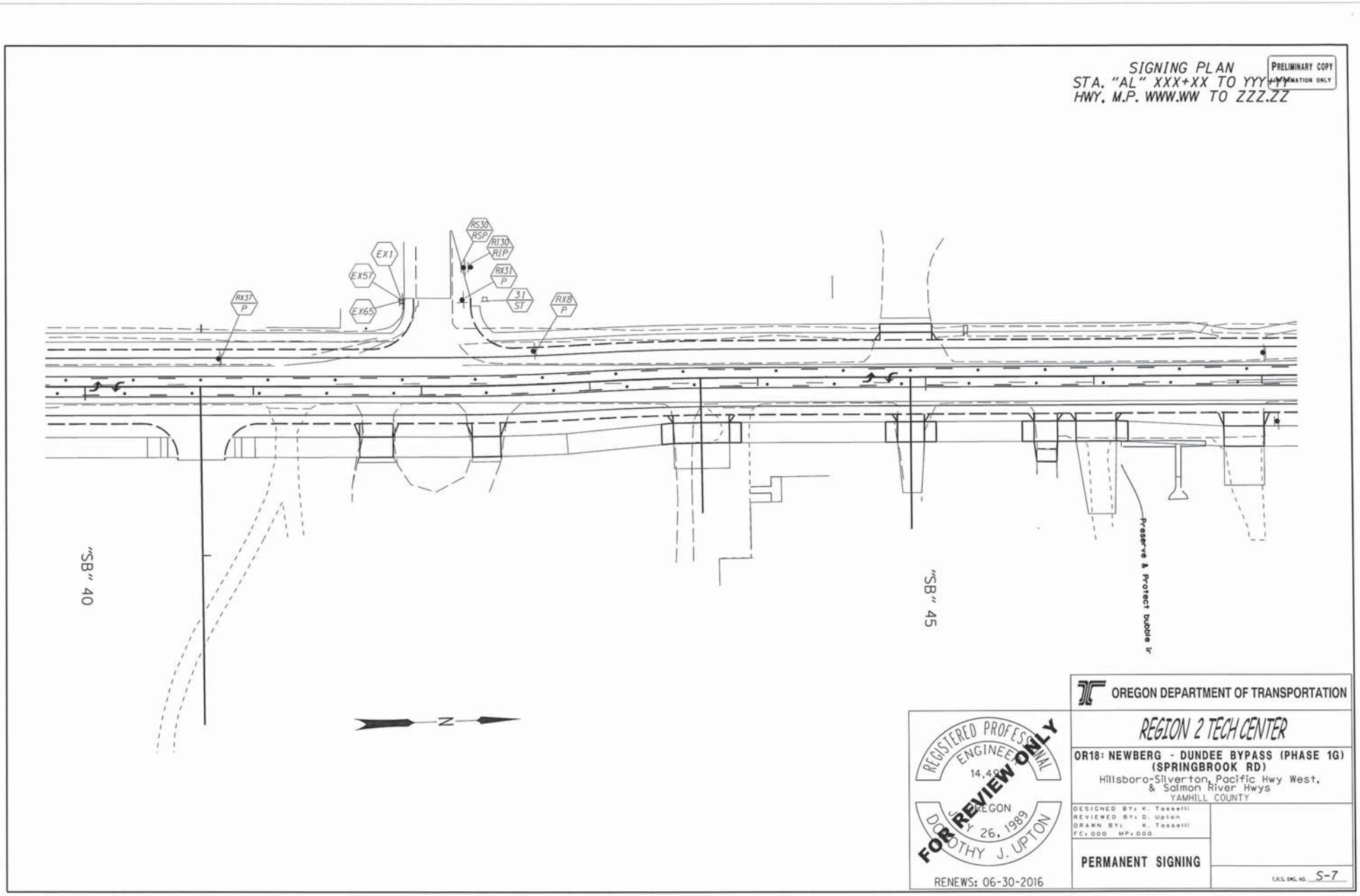

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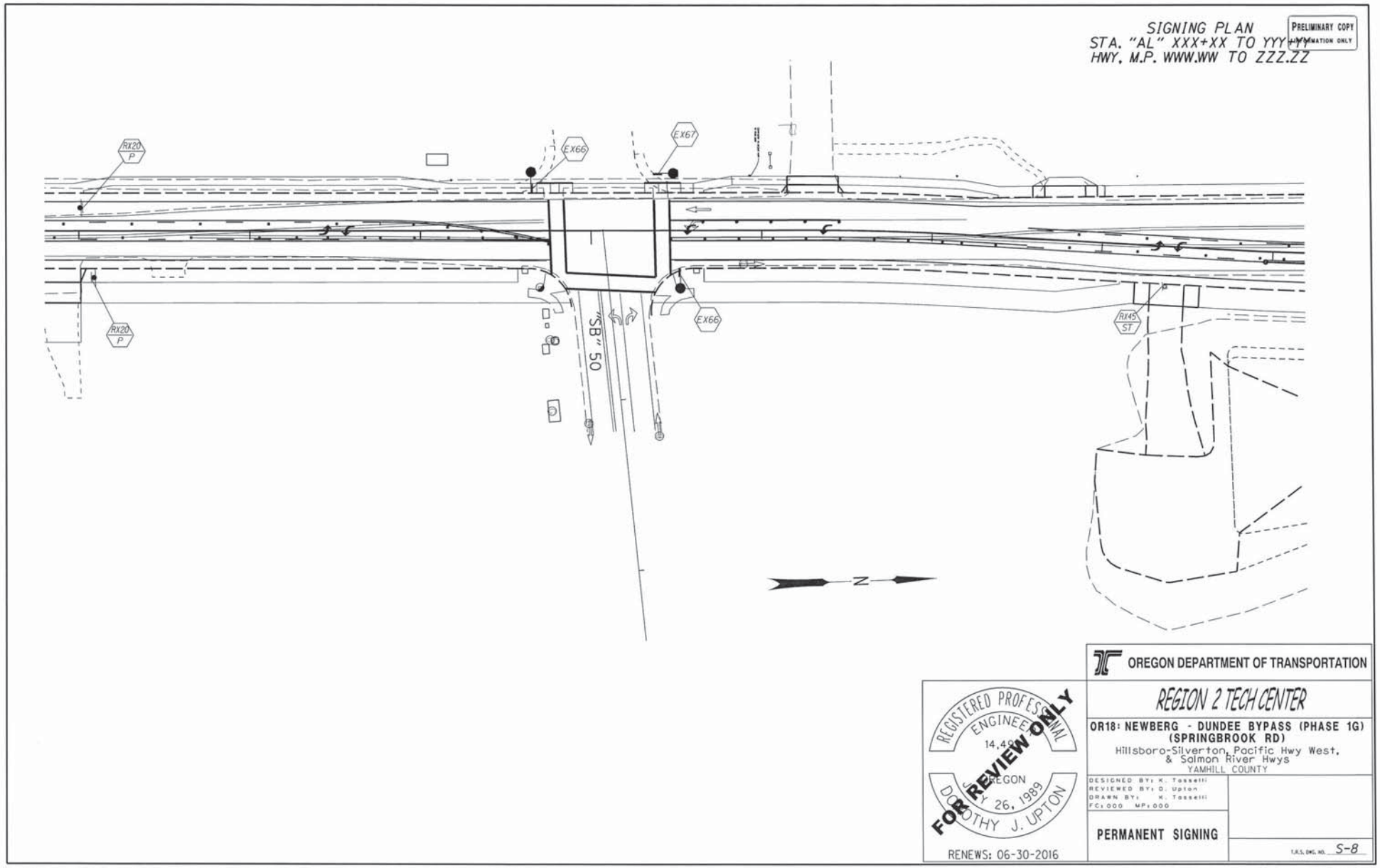

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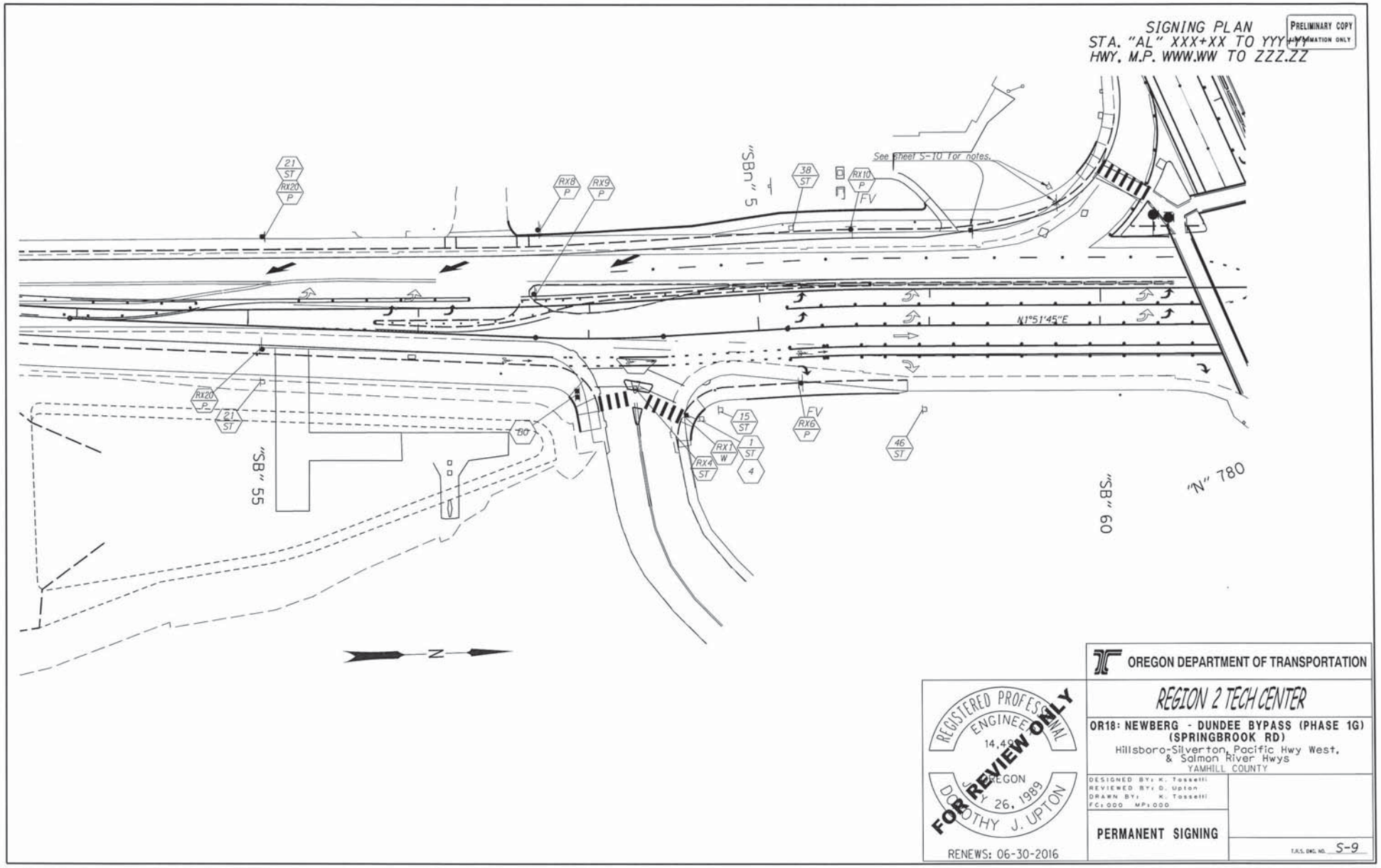

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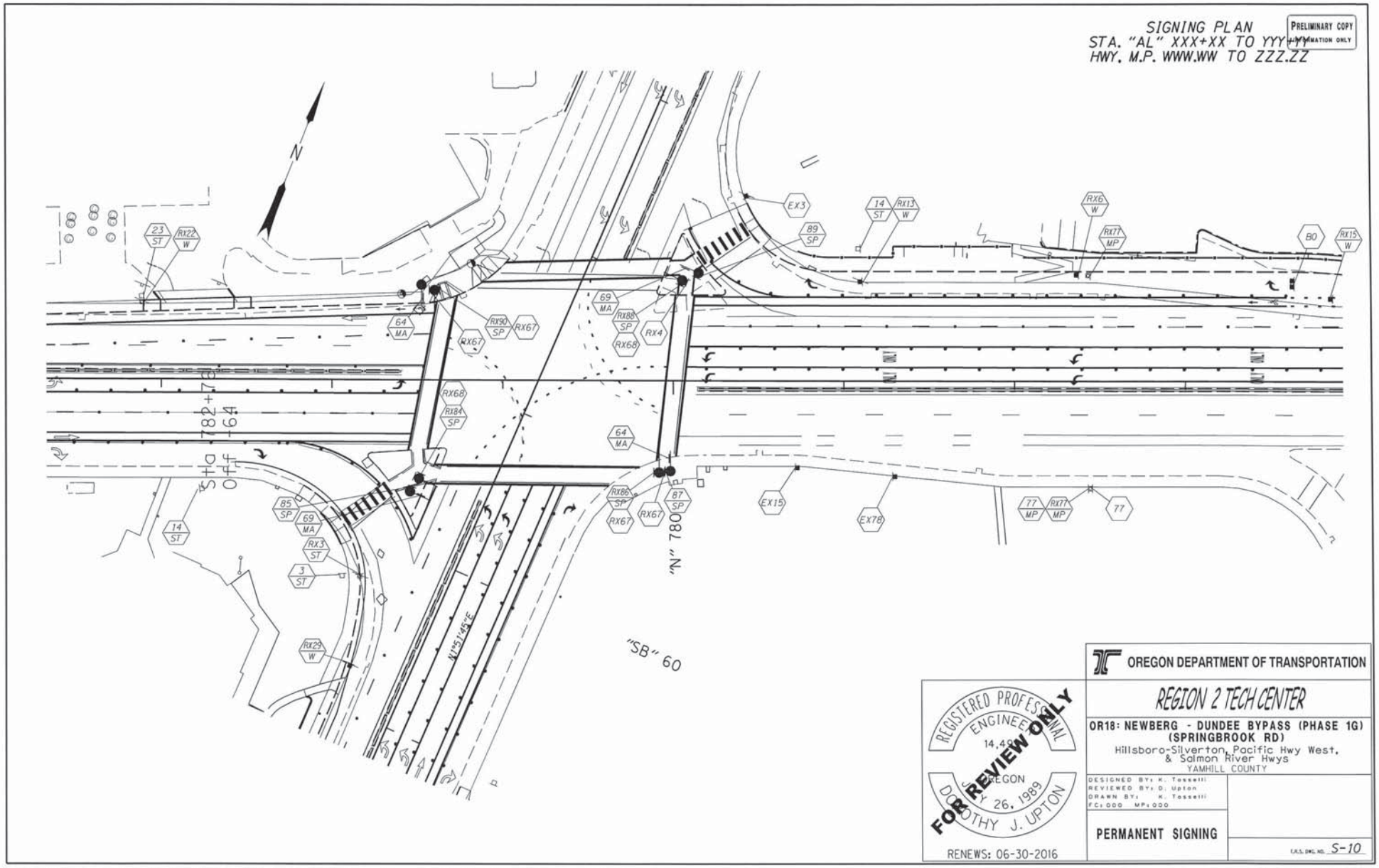

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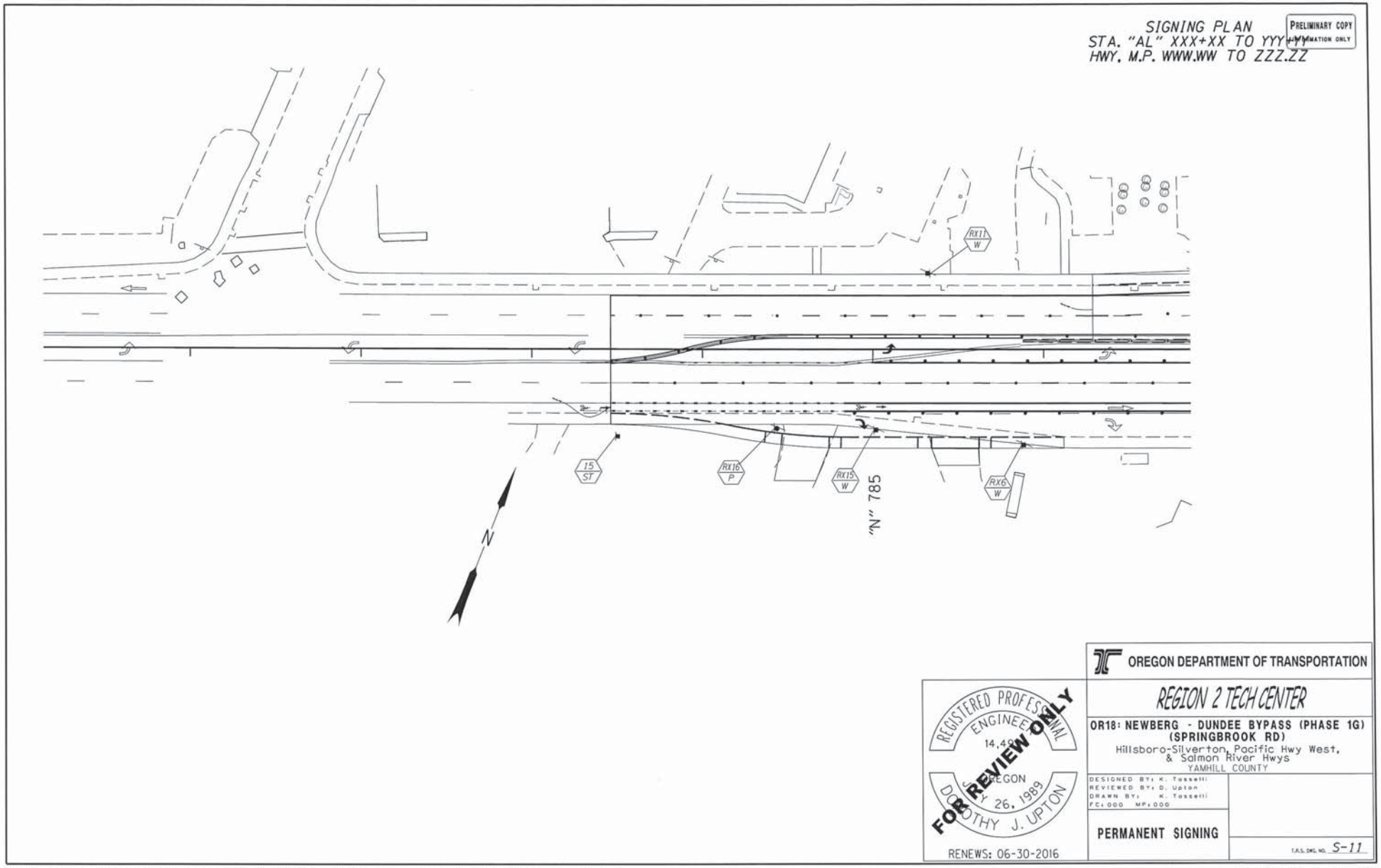
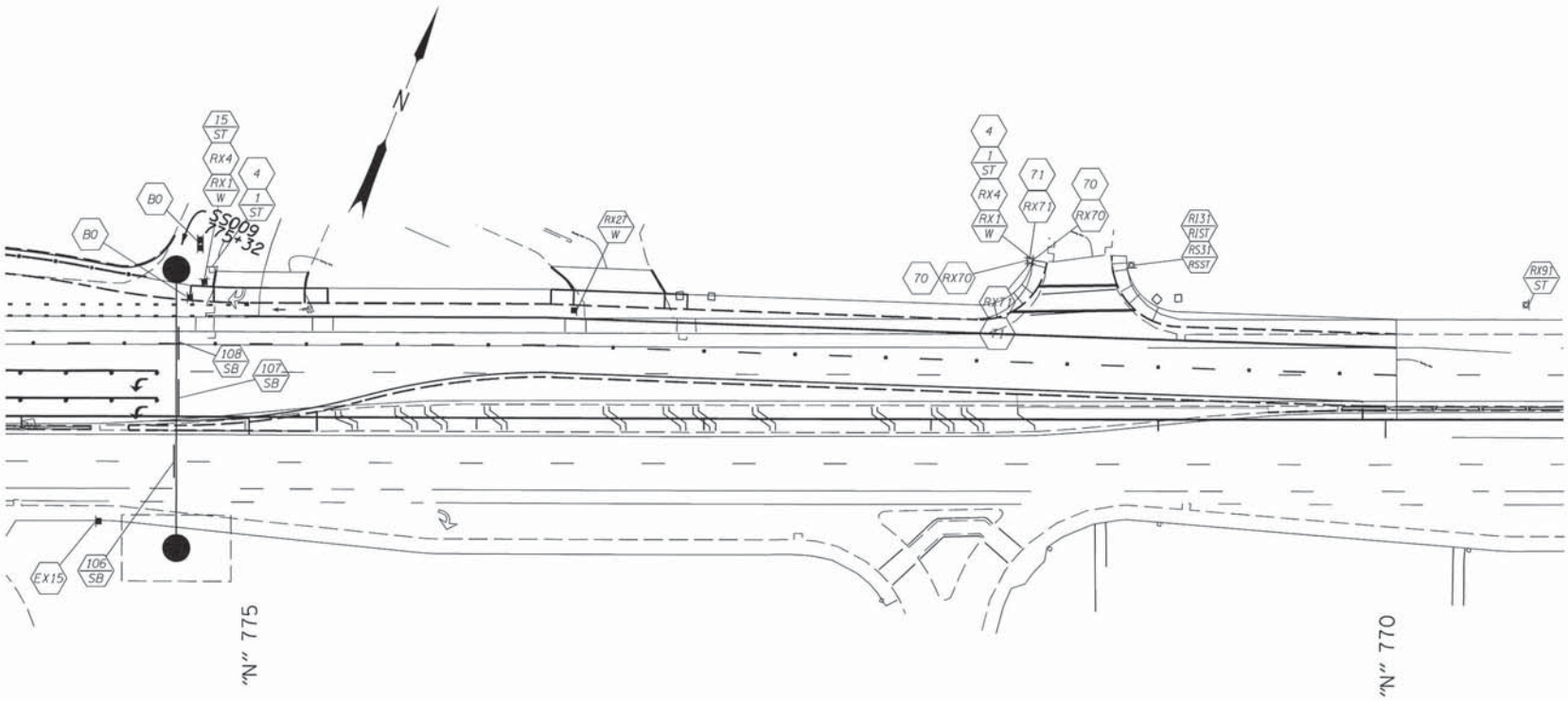


Attachment 4

SIGNING PLAN
STA. "AL" XXX+XX TO YYY+YY
HWY. M.P. WWW.WW TO ZZZ.ZZ

PRELIMINARY COPY
FOR INFORMATION ONLY



OREGON DEPARTMENT OF TRANSPORTATION

REGISTERED PROFESSIONAL ENGINEER
14,489
OREGON
JULY 26, 1989
DOROTHY J. UPTON
FOR REVIEW ONLY
RENEWS: 06-30-2016

REGION 2 TECH CENTER

OR18: NEWBERG - DUNDEE BYPASS (PHASE 1G)
(SPRINGBROOK RD)
Hillsboro-Silverton, Pacific Hwy West,
& Salmon River Hwys
YAMHILL COUNTY

DESIGNED BY: K. Tossell
REVIEWED BY: D. Upton
DRAWN BY: K. Tossell
FC: 000 MP: 000

PERMANENT SIGNING

T.R.S. DWG. NO. S-12

F:\ODOT_DATA\Projects\2014\17099_NDB\1G\SIGNS\16901F_G.snl :: Default 12/11/2014 2:32:34 PM hwye2'q

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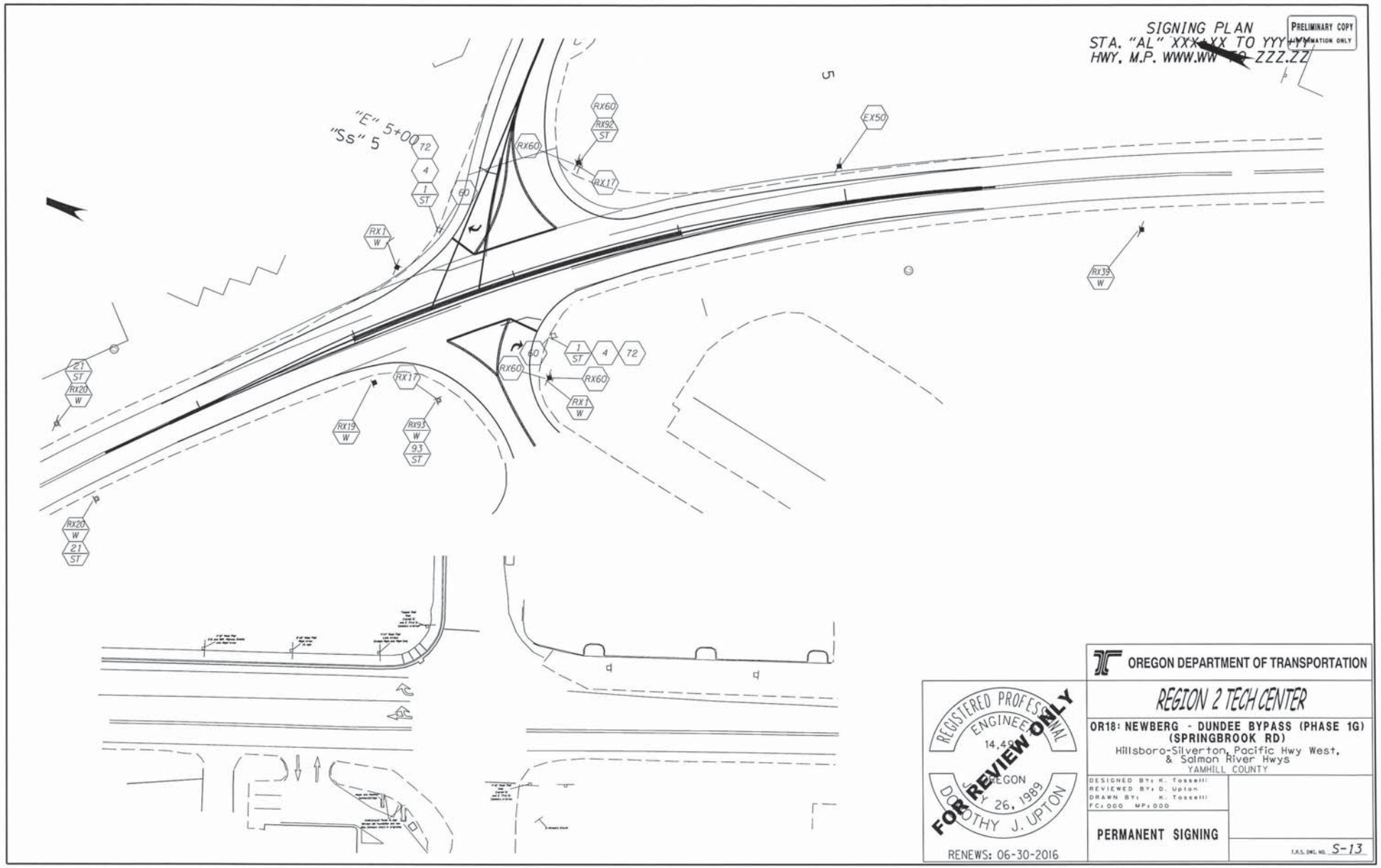
Attachment 4



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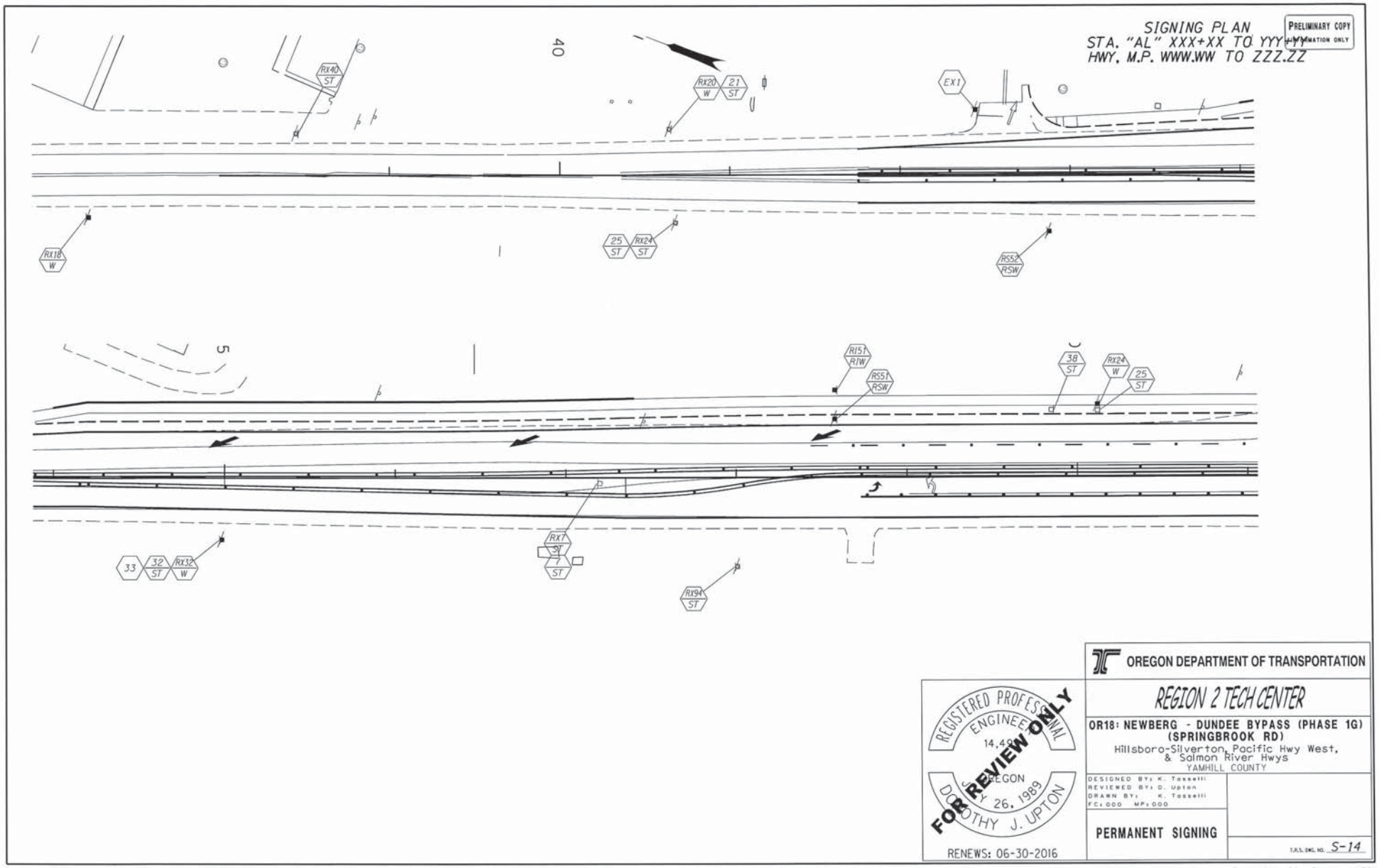
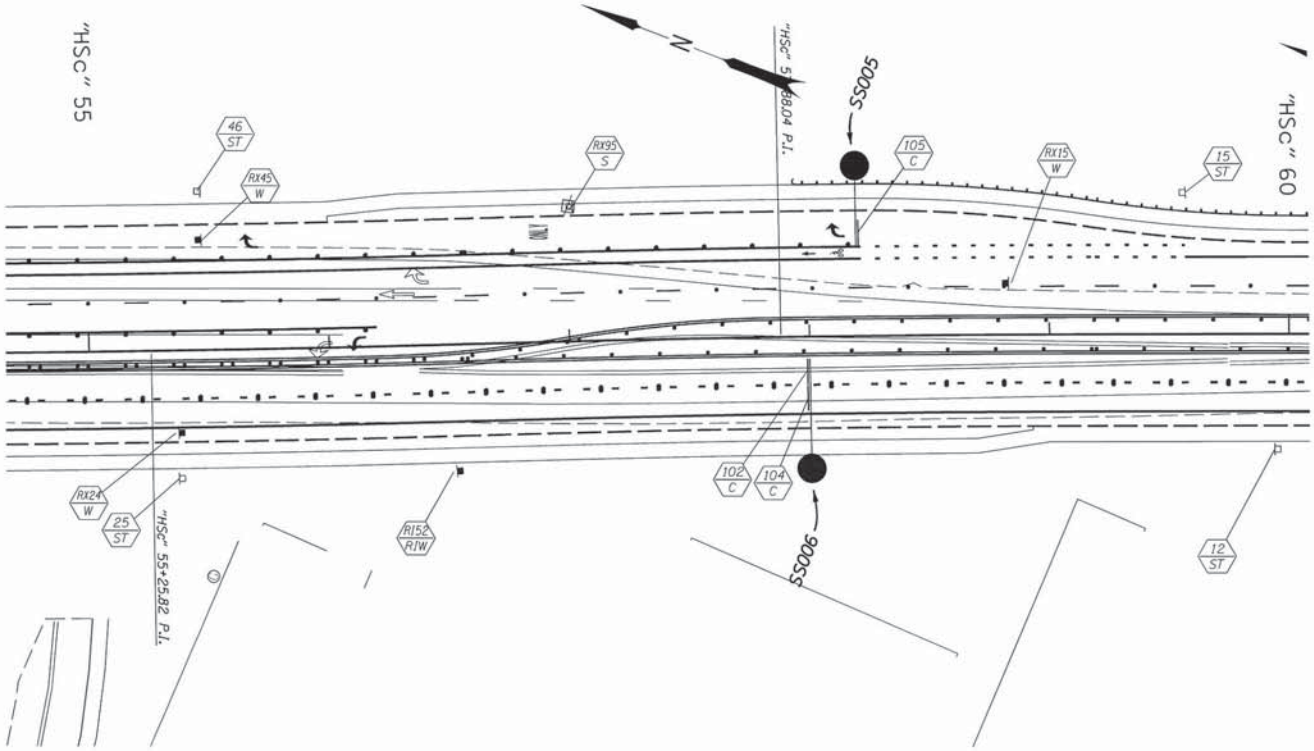


Attachment 4

SIGNING PLAN
STA. "AL" XXX+XX TO YYY+YY
HWY. M.P. WWW.WW TO ZZZ.ZZ

PRELIMINARY COPY
FOR INFORMATION ONLY



OREGON DEPARTMENT OF TRANSPORTATION

REGION 2 TECH CENTER

OR18: NEWBERG - DUNDEE BYPASS (PHASE 1G)
(SPRINGBROOK RD)
Hillsboro-Silverton, Pacific Hwy West,
& Salmon River Hwys
YAMHILL COUNTY

REGISTERED PROFESSIONAL ENGINEER
14,489
OREGON
JULY 26, 1989
DOROTHY J. UPTON
RENEWS: 06-30-2016

FOR REVIEW ONLY

DESIGNED BY: K. Tosselli
REVIEWED BY: D. Upton
DRAWN BY: K. Tosselli
FC: 000 MP: 000

PERMANENT SIGNING

T.R.S. DWG. NO. S-15

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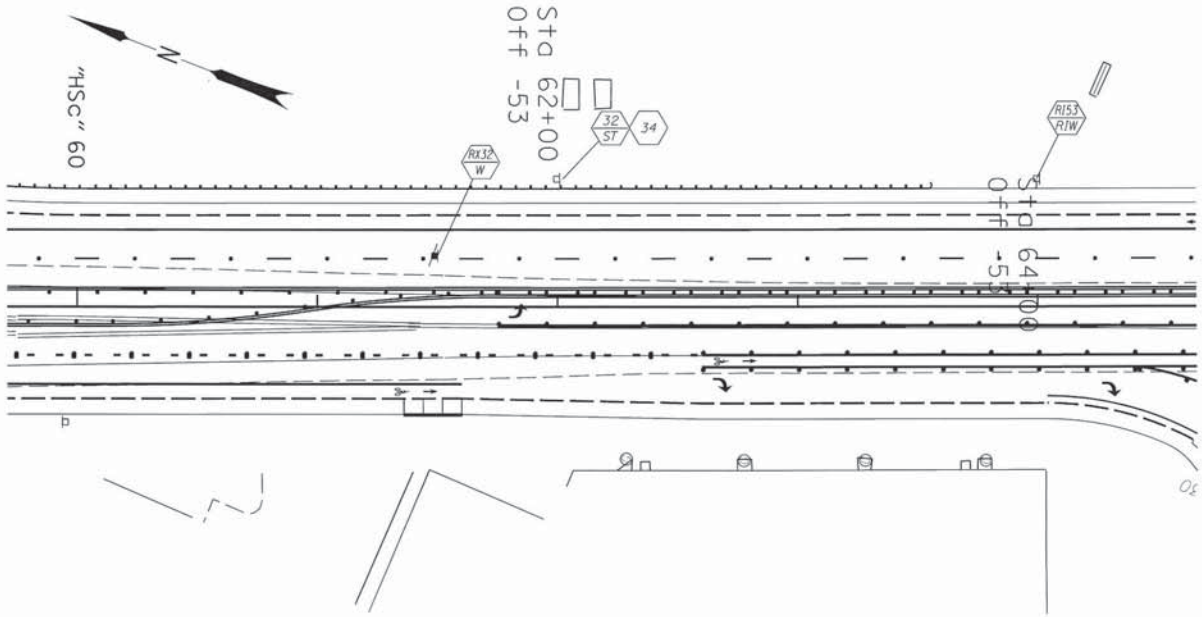
Attachment 4

SIGNING PLAN
STA. "AL" XXX+XX TO YYY+YY
HWY. M.P. WWW.WW TO ZZZ.ZZ

PRELIMINARY COPY
FOR INFORMATION ONLY



OREGON DEPARTMENT OF TRANSPORTATION

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(SPRINGBROOK RD)
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YAMHILL COUNTY

DESIGNED BY: K. Tosselli
REVIEWED BY: D. Upton
DRAWN BY: K. Tosselli
FC: 000 MP: 000

PERMANENT SIGNING

T.R.S. DWG. NO. S-16

REGISTERED PROFESSIONAL ENGINEER
14,49
OREGON
JULY 26, 1989
DOROTHY J. UPTON
RENEWS: 06-30-2016

FOR REVIEW ONLY

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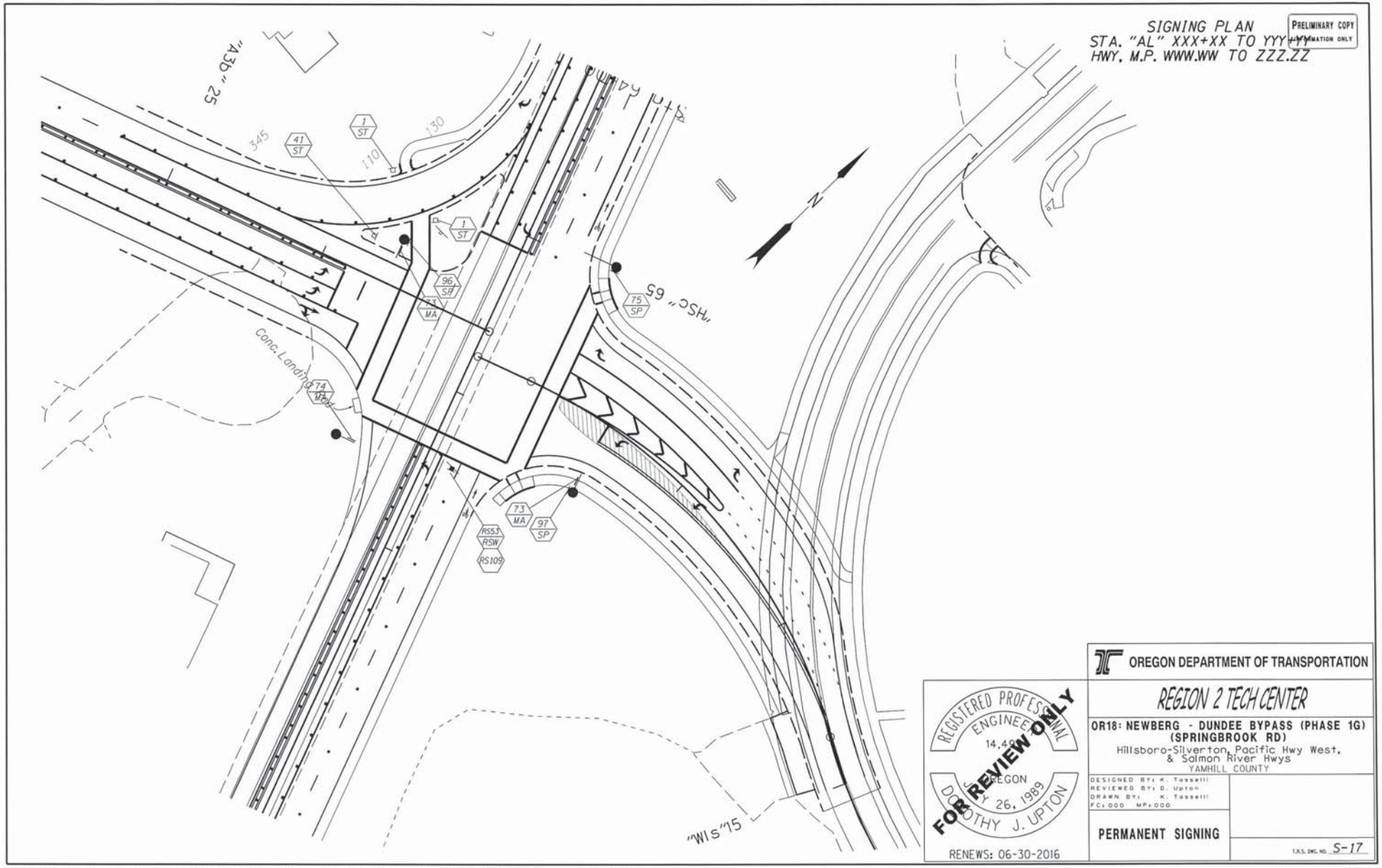

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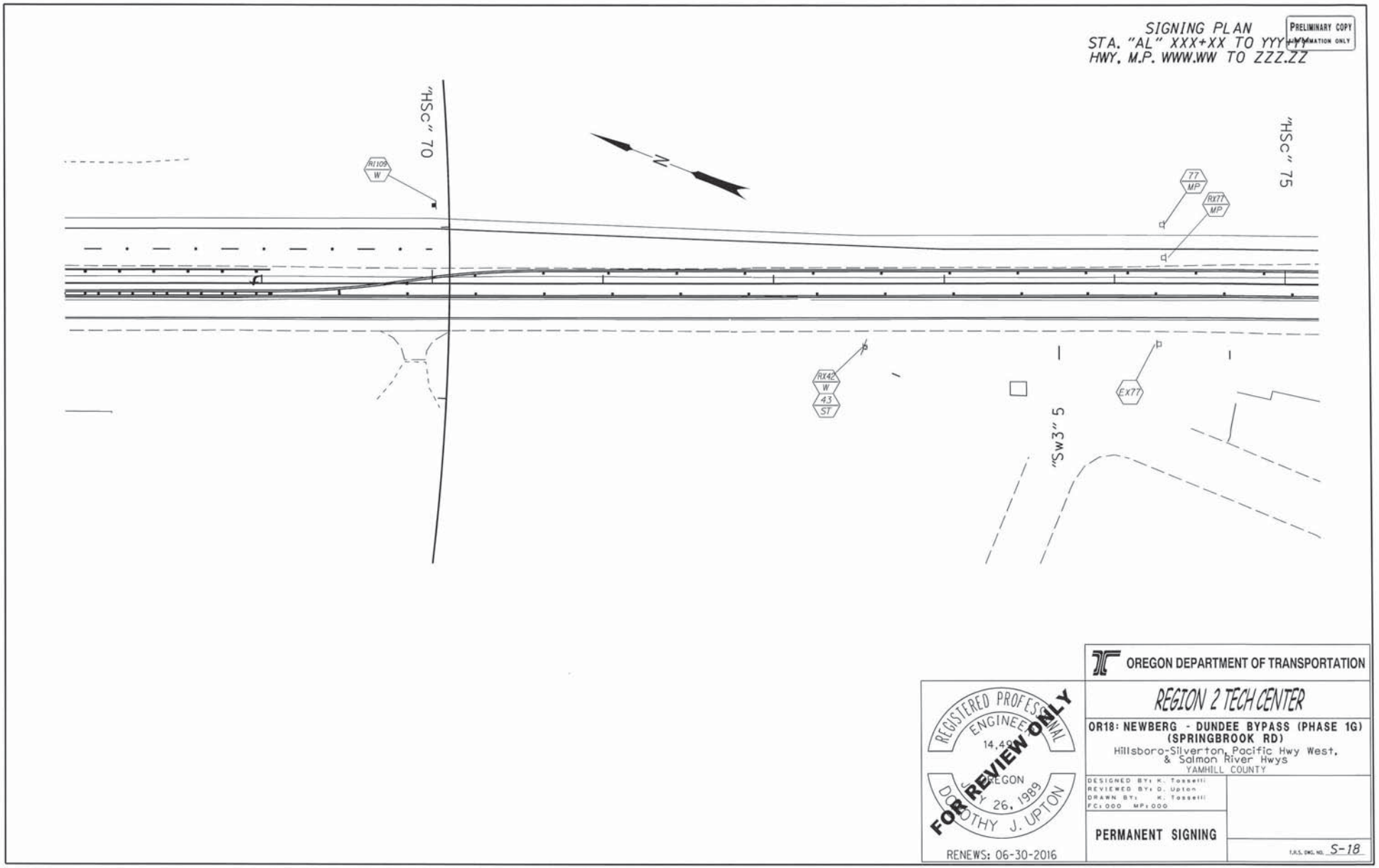

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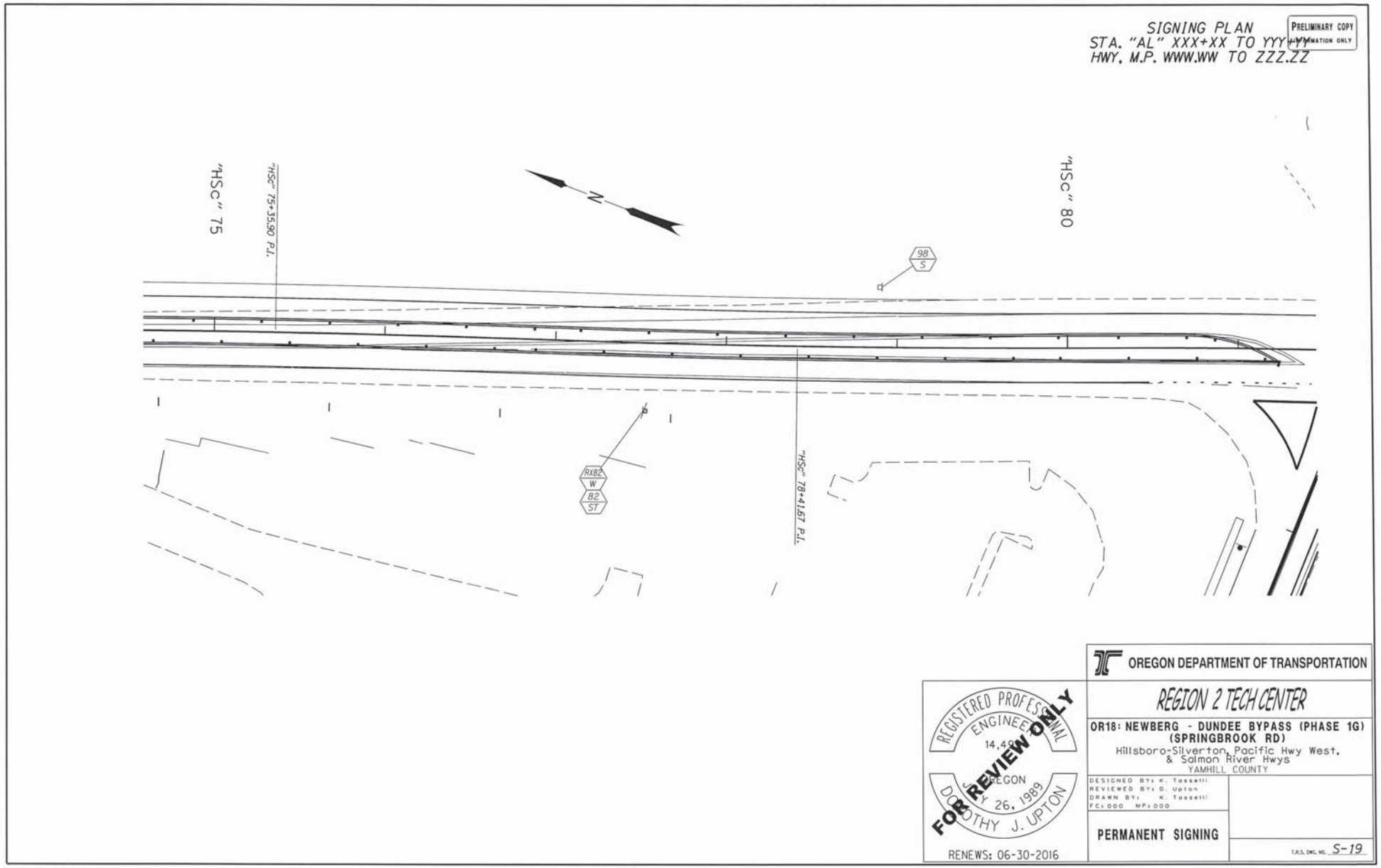

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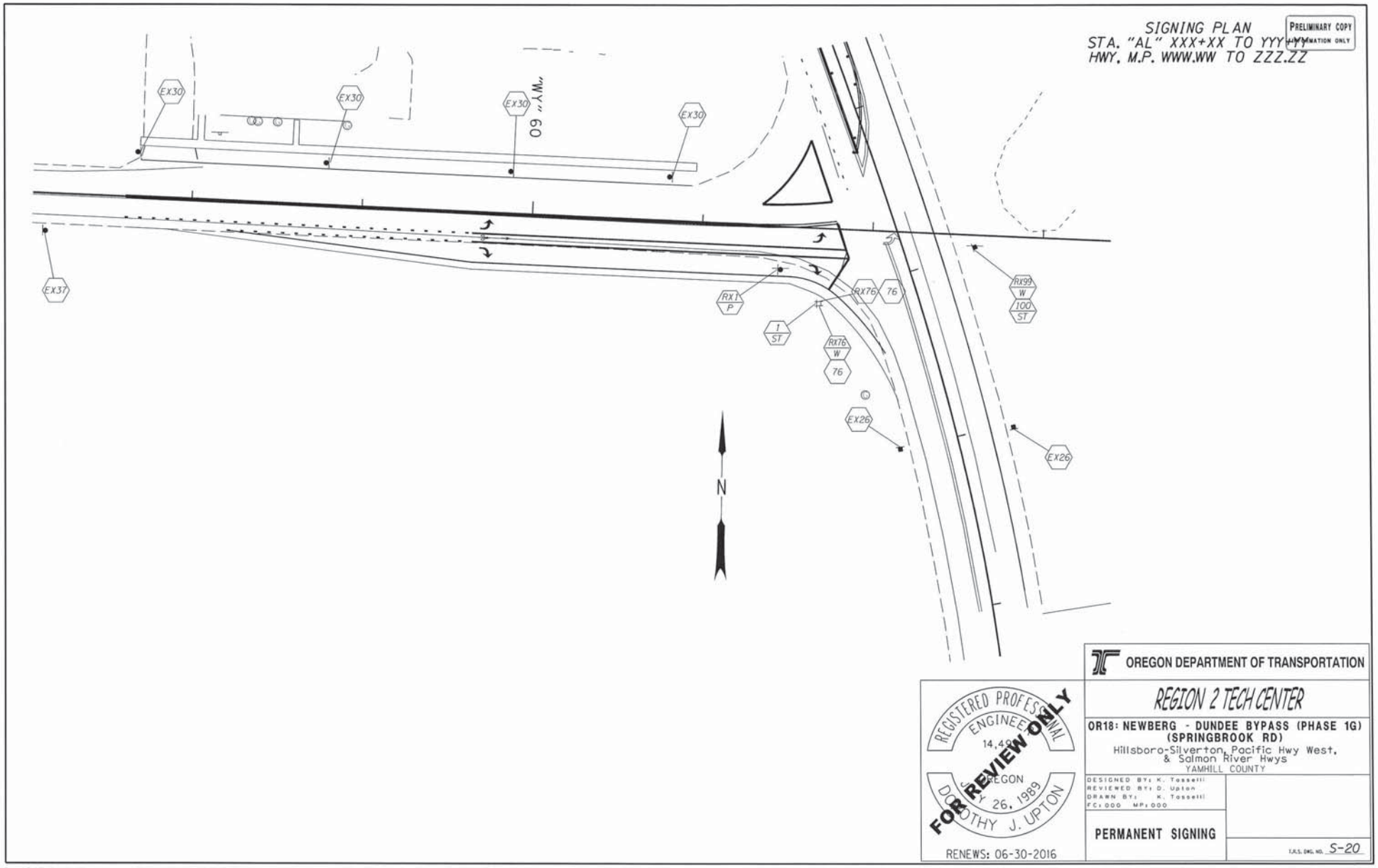

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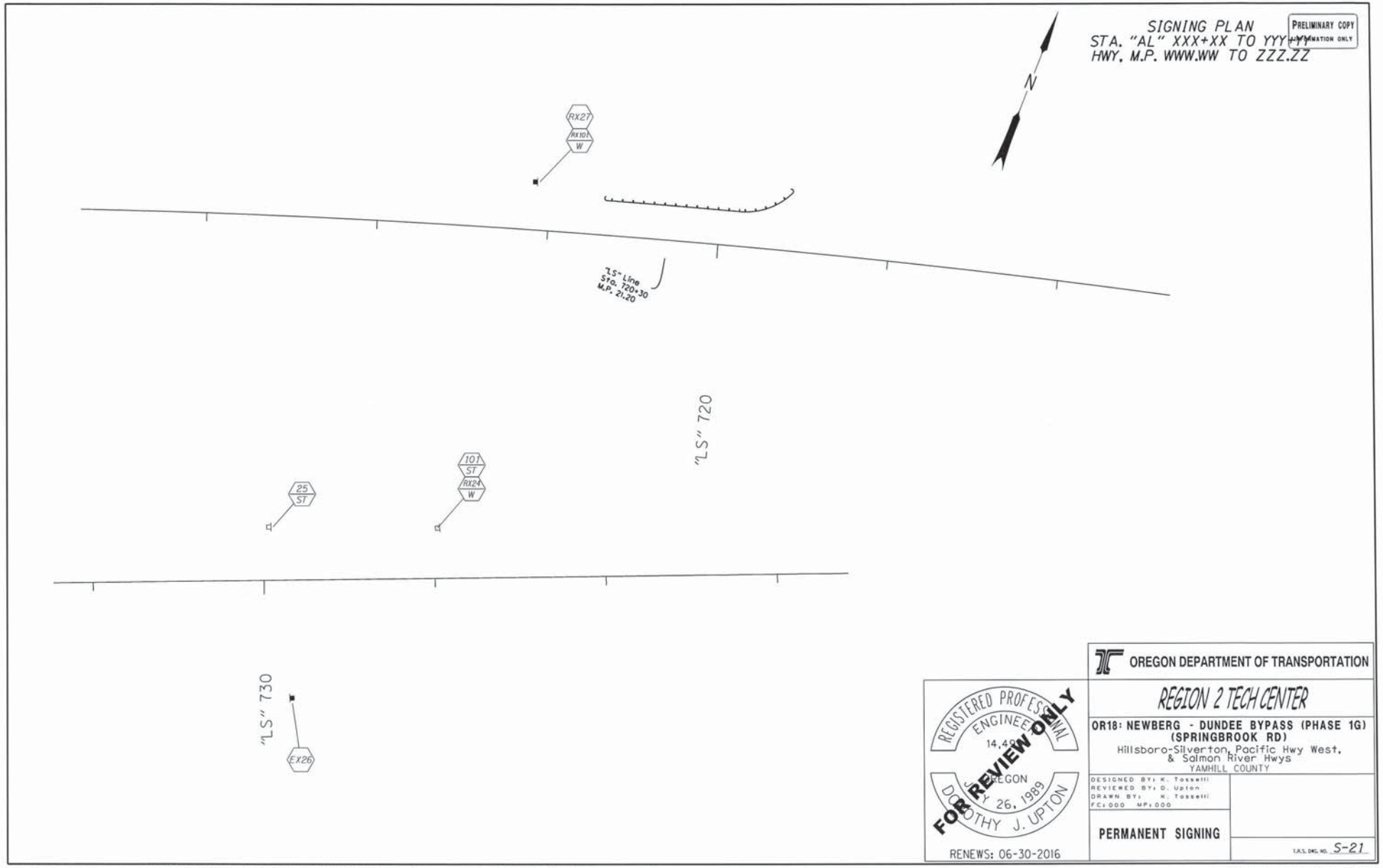

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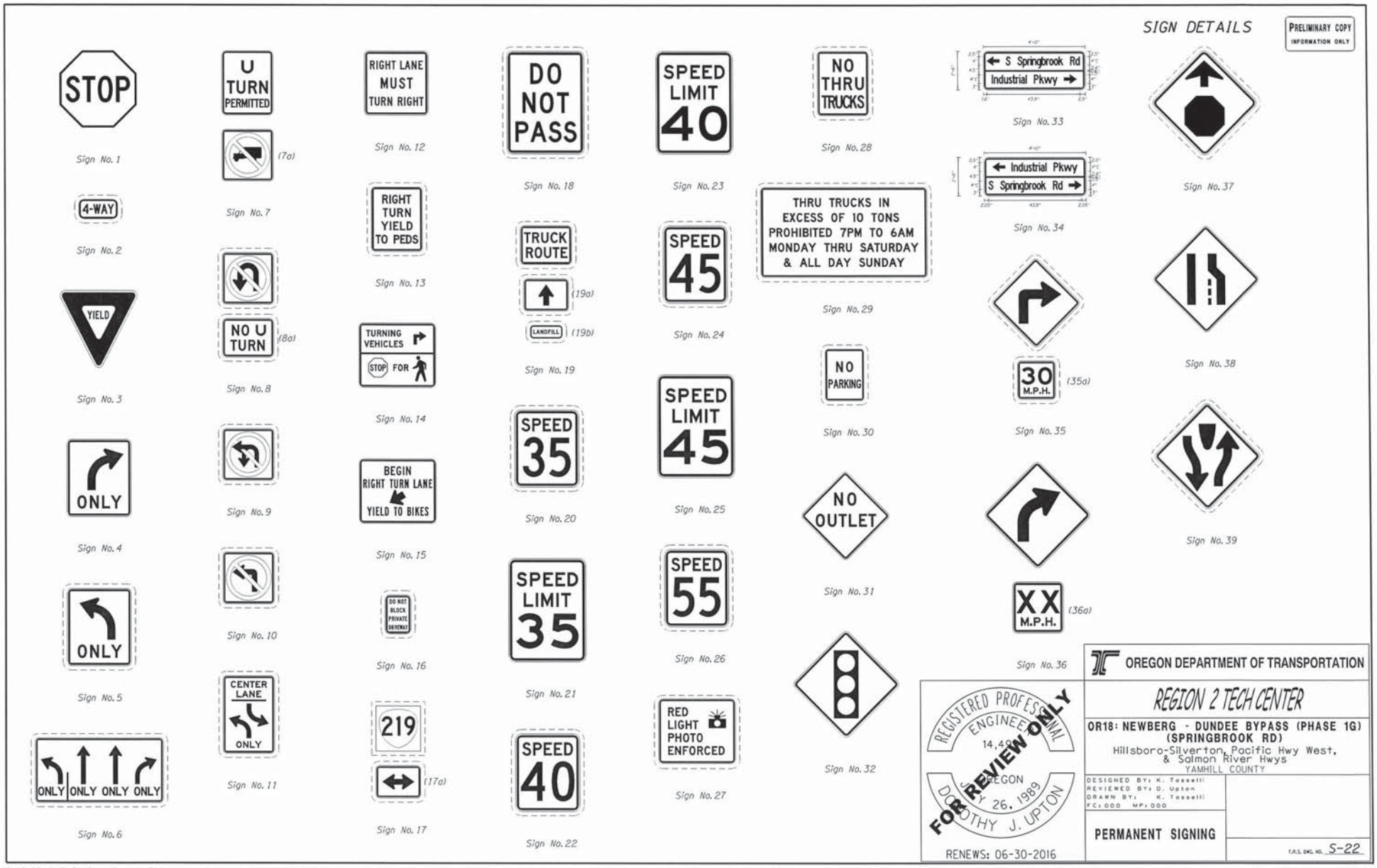

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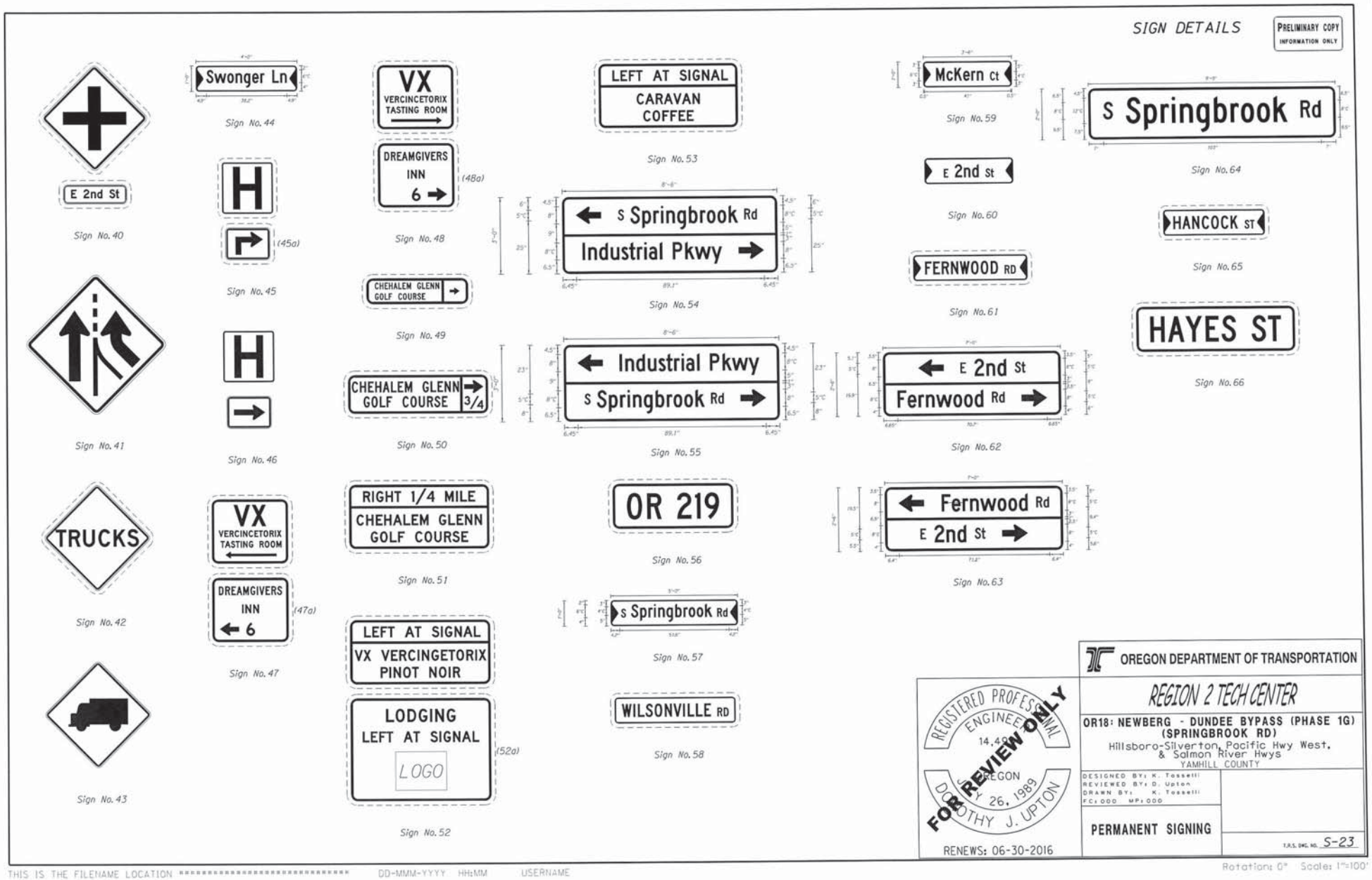

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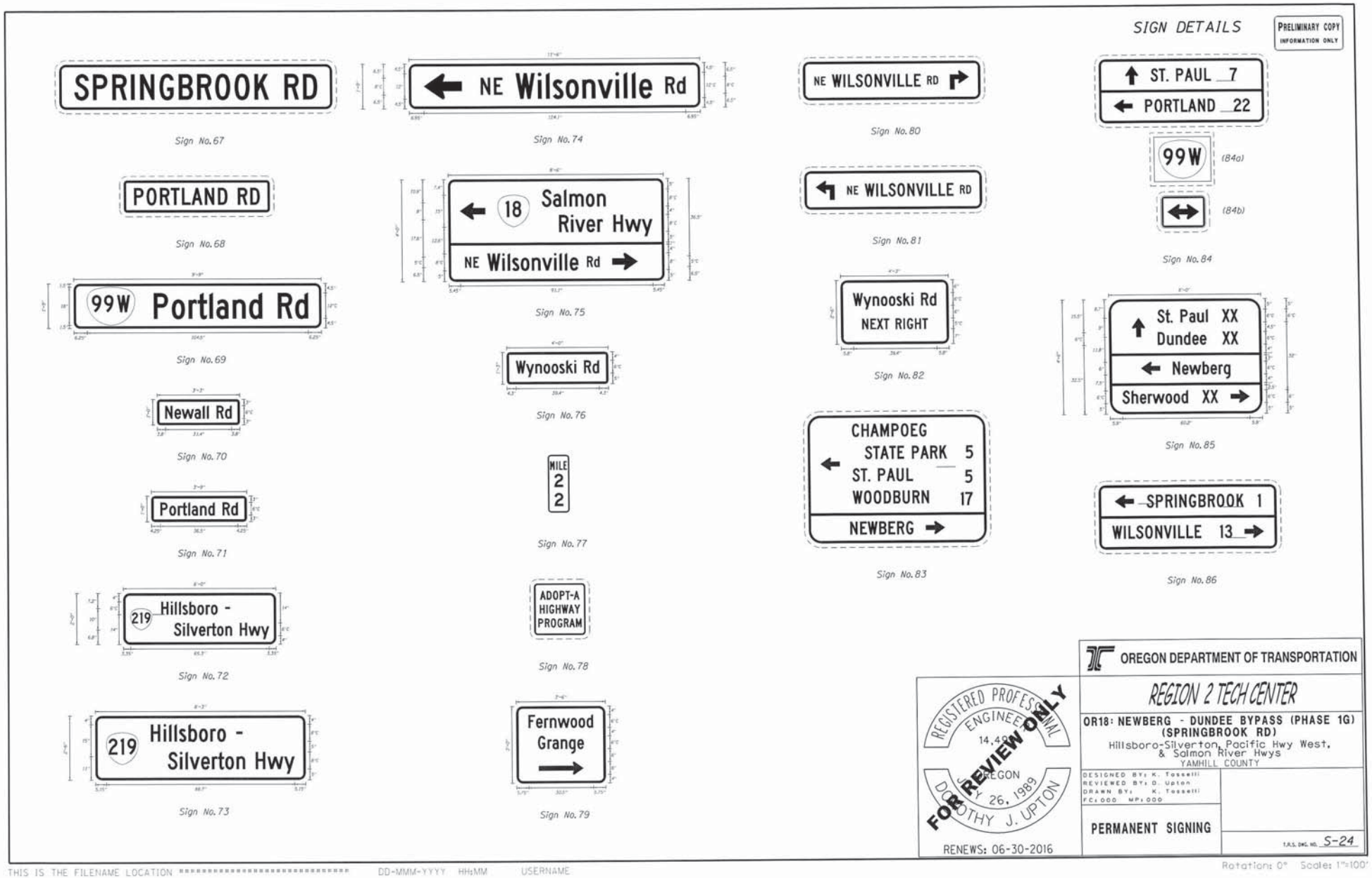


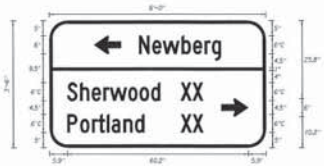
Attachment 4

SIGN DETAILS

PRELIMINARY COPY
INFORMATION ONLY

Sign No. 87

Sign No. 88



Sign No. 89

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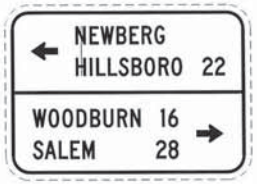

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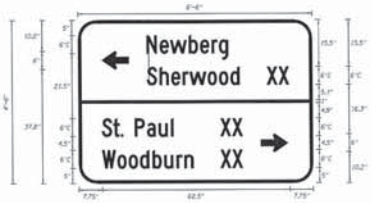

Sign No. 100

Sign No. 101

REGISTERED PROFESSIONAL ENGINEER
14,489
OREGON
JULY 26, 1989
DOROTHY J. UPTON
RENEWS: 06-30-2016

FOR REVIEW ONLY

OREGON DEPARTMENT OF TRANSPORTATION

REGION 2 TECH CENTER

OR18: NEWBERG - DUNDEE BYPASS (PHASE 1G)
(SPRINGBROOK RD)
Hillsboro-Silverton, Pacific Hwy West,
& Salmon River Hwys
YAMHILL COUNTY

DESIGNED BY: K. Tossell
REVIEWED BY: D. Upton
DRAWN BY: K. Tossell
FC: 000 MP: 000

PERMANENT SIGNING

T.R.S. DWG. NO. S-25

THIS IS THE FILENAME LOCATION ********** DD-MMM-YYYY HH:MM USERNAME

Rotation: 0° Scale: 1"=100'

Attachment 4

SIGN DETAILS

PRELIMINARY COPY
INFORMATION ONLY

Sign No. 102

Sign No. 104

Sign No. 106

Sign No. 103

Sign No. 105

REGISTERED PROFESSIONAL ENGINEER
14,49
OREGON
JULY 26, 1989
DOROTHY J. UPTON
RENEWS: 06-30-2016

FOR REVIEW ONLY

OREGON DEPARTMENT OF TRANSPORTATION

REGION 2 TECH CENTER

OR18: NEWBERG - DUNDEE BYPASS (PHASE 1G)
(SPRINGBROOK RD)
Hillsboro-Silverton, Pacific Hwy West,
& Salmon River Hwys
YAMHILL COUNTY

DESIGNED BY: K. Tosselli
REVIEWED BY: D. Upton
DRAWN BY: K. Tosselli
FC: 000 MP: 000

PERMANENT SIGNING

T.R.S. DWG. NO. S-26

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ATTCHMENT 4

ORDINANCE NO. 2013-2766

AN ORDINANCE AMENDING THE TRANSPORTATION SYSTEM PLAN TO REFLECT THE PHASE I ALIGNMENT OF THE NEWBERG DUNDEE BYPASS

RECITALS:

1. Oregon Department of Transportation submitted an application to amend Newberg's transportation system plan (TSP) to reflect the phase 1 alignment of the Newberg Dundee Bypass project (bypass).

2. The TSP includes the full bypass alignment, which will be an 11-mile, four-lane highway around the cities of Newberg and Dundee from Highway 99W northeast of Newberg to the Highway 18 interchange south of Dundee. However, the bypass will be a phased development due to funding constraints. Phase 1 of the bypass will include construction of one lane of the bypass in each direction between Highway 219 and Highway 99W south of Dundee, and will reestablish the intersection of Wilsonville Road and Highway 219. Phase 1 will add a traffic signal to the Wilsonville Road and Highway 219 intersection and remove the current connection between Wilsonville Road and Springbrook Road. The current north-south section of Wilsonville Road between the new Highway 219 intersection and Springbrook Road will end in a cul-de-sac at the southern end. The planning commission recommended renaming that section to McKern Court.

3. The Newberg planning commission adopted Resolution No. 2013-301 on September 12, 2013, recommending city council adopt the proposed TSP amendments as shown in Exhibit "A" and based on the findings in Exhibit "D". Exhibit "B" shows details of the new road configurations, and Exhibit "C" shows the full layout of the phase 1 bypass.

THE CITY OF NEWBERG ORDAINS AS FOLLOWS:

1. The Newberg transportation system plan is hereby amended as shown in Exhibit "A", based on the findings in Exhibit "D", and as shown on the maps in Exhibits "B" and "C". Exhibits "A", "B", "C", and "D" are hereby attached and by this reference incorporated.

2. The remaining portion of Wilsonville Road between the new cul-de-sac and Springbrook Road will be renamed to McKern Court.

- **EFFECTIVE DATE** of this ordinance is 30 days after the adoption date, which is: January 2, 2014.

ADOPTED by the City Council of the City of Newberg, Oregon, this 2nd day of December, 2013, by the following votes: **AYE: 6** **NAY: 1 [HOWARD]** **ABSENT: 0** **ABSTAIN: 0**

Norma I. Alley

Norma I. Alley, MMC, City Recorder

ATTEST by the Mayor this 5th day of December, 2013.

Bob Andrews, Mayor

TSP Text Amendment

The following text amendment should be made to section 6.2.2(6) of the Newberg Transportation System Plan (2005). Deletions are shown as ~~strikethrough~~; additions are shown as double underline:

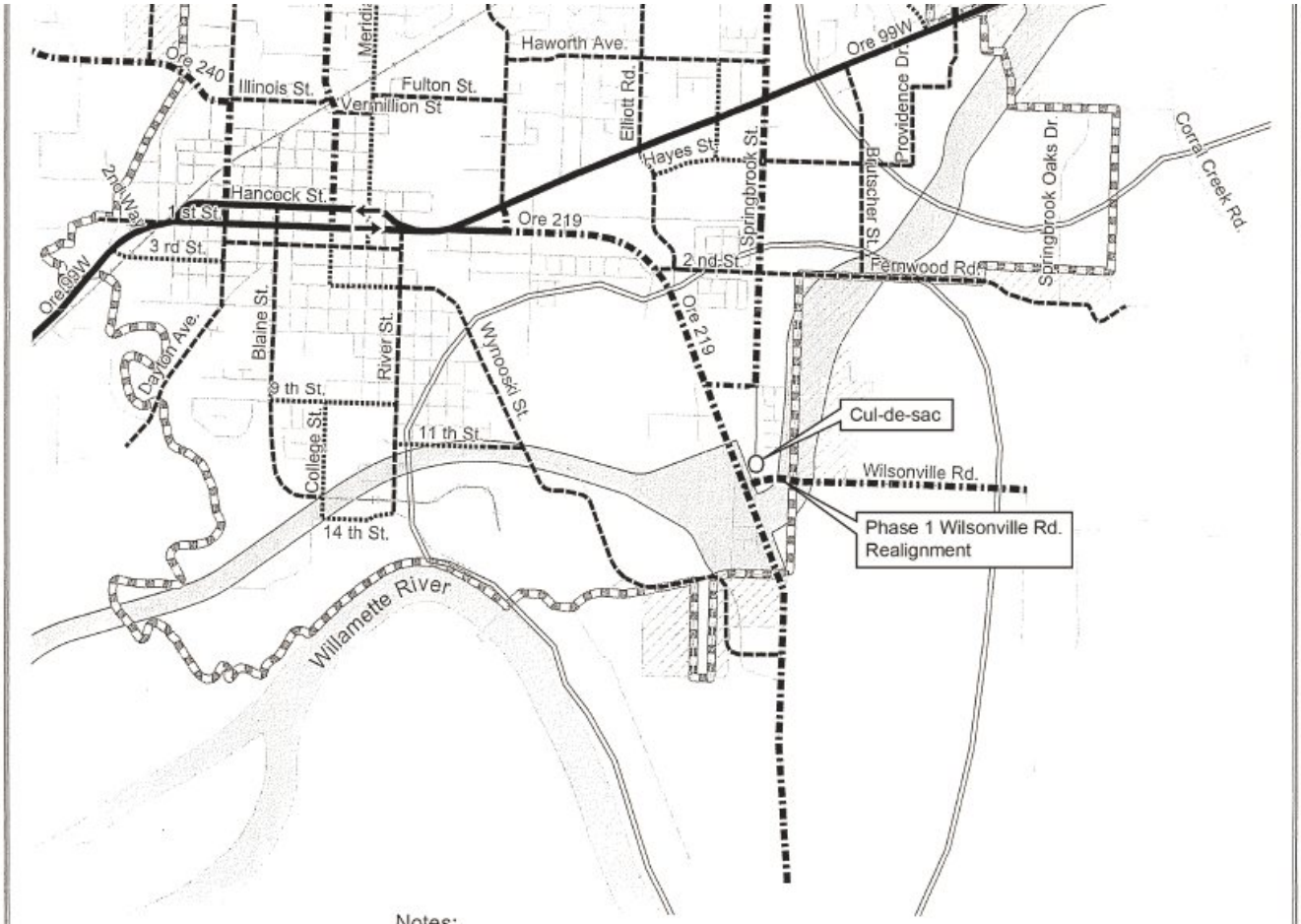
(From page 123 of 2005 TSP.)
6. *Wilsonville Road*: ~~Wilsonville Road is to be rerouted to the north to cross the Bypass (without an interchange) and to intersect with Springbrook Street. Wilsonville Road will then extend westward from its intersection with Springbrook Street to a new signalized intersection with Ore 219 at about 8th Street. The reroute and extension of Wilsonville Road will be constructed to minor arterial street standards. The purpose of this project is to provide adequate spacing of intersections on Ore 219 from the proposed interchange with the bypass. The cost of this project is estimated at about $2.0 million, and will be funded by ODOT as a safety improvement project. The improvement will comply with spacing standards as defined in the NDTIP bypass project. Moreover, this project will be full considered and potentially modified under the context of the NDTIP Bypass/Ore 219 Interchange Area Management Plan. This project is included as a Safety Project in the Statewide Transportation Improvement Program, 2002-2005, Key#09274. See Appendix "N" for a conceptual plan of this project.~~ Wilsonville Road is to be extended to the west to connect to Oregon 219. A cul-de-sac will be placed on Wilsonville Road between the new extension to Oregon 219 and Springbrook Road. The rerouting and extension of Wilsonville Road will be constructed to minor arterial street standards. The purpose of this project is to provide access to Phase 1 of the Bypass at acceptable levels of service and improve safety. The improvement will comply with ODOT spacing standards for a District Highway. The future Phase 2 of the Bypass will disconnect the new intersection of Wilsonville Road and Oregon 219. During Phase 2 construction, Wilsonville Road will be rerouted further south to a new intersection with Oregon 219.

Attachment 4

Exhibit "A"
To Ordinance No. 2013-2766

Revised Figure 6-1

Excerpt from Figure 6-1, Functional Classification Plan, Newberg TSP (2005)



Notes:

(A) The configuration and alignment of Mountainview Drive in this area is subject to the major street alignment location review process as outlined in the development code.

- Street located outside of Urban Growth Boundary are outside of Newberg's jurisdiction. If a proposed roadway alignment extends outside the UGB, than a plan amendment is required. Improvements recommended would need to be coordinated with Yamhill County.

LEGEND

- Statewide Highway
- Major Arterial
- Minor Arterial
- Major Collector
- Minor Collector
- Interchange Area Management Plan Boundary
- Urban Growth Boundary
- Urban Reserve Area
- Railroad
- Streets
- River

FUNCTIONAL CLASSIFICATION PLAN
NEWBERG, OR.

FIGURE **6-1**

H:\projfile\5193\GIS\Newberg TSP\6-1.mxd

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION PLANNING / TRAFFIC ENGINEERING

Attachment 4

Exhibit "B"
To Ordinance No. 2013-2766

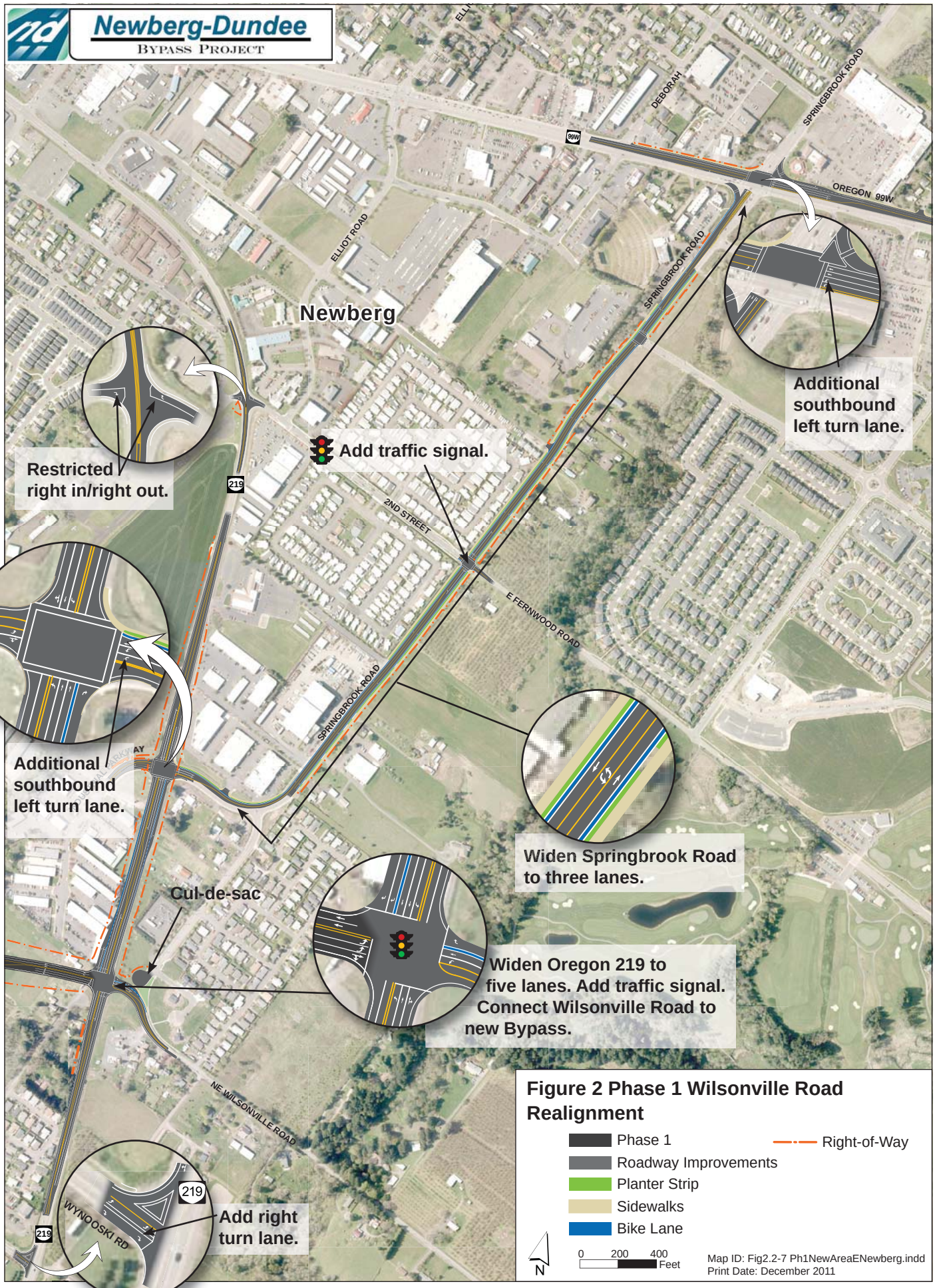


Figure 2 Phase 1 Wilsonville Road Realignment

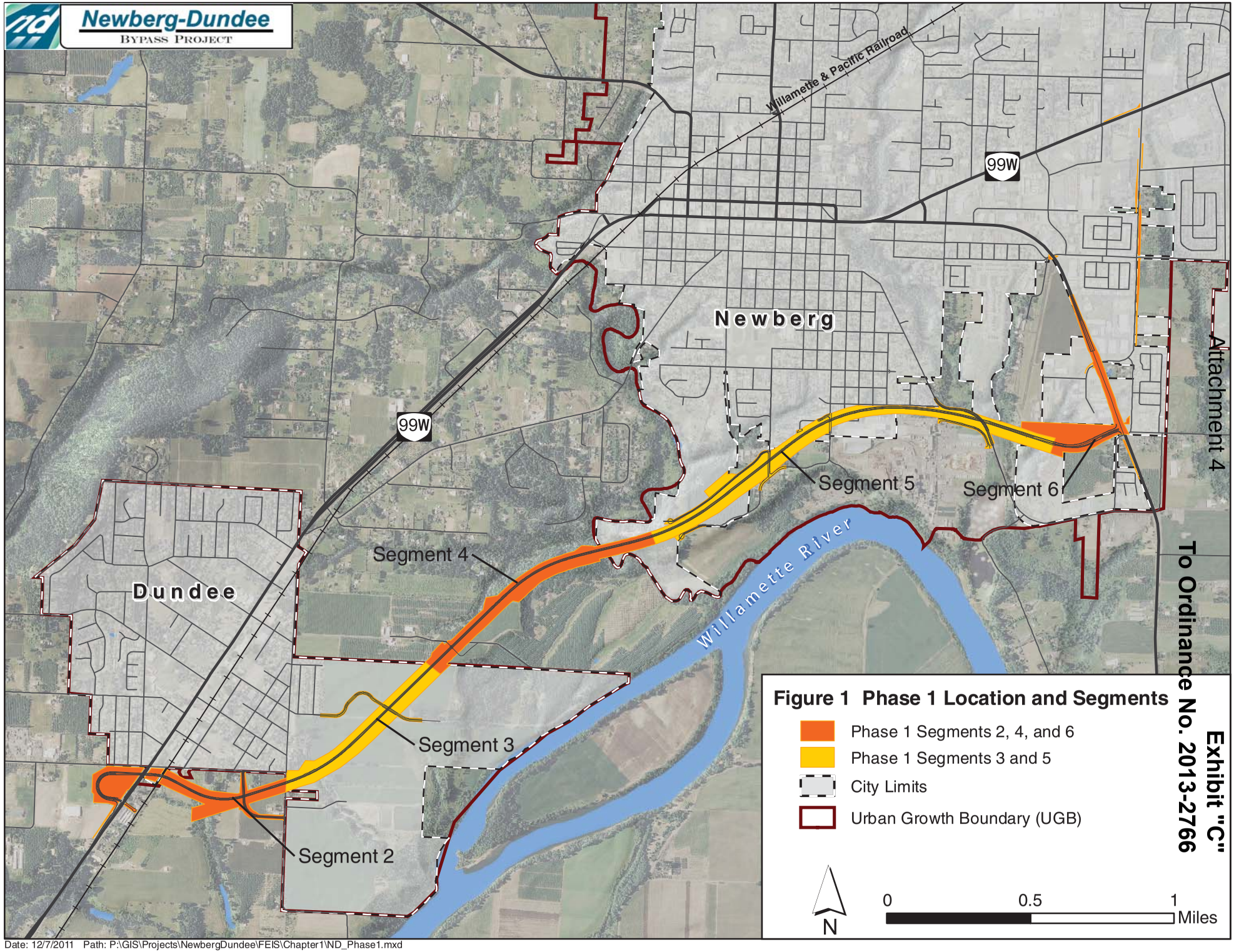


Exhibit "C"
To Ordinance No. 2013-2766
Attachment 4

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Findings

Transportation System Plan (TSP) amendments must be consistent with the Newberg Comprehensive Plan and the applicable statewide planning goals.

Newberg Comprehensive Plan – applicable goals and policies

A. Citizen Involvement

GOAL: To maintain a Citizen Involvement Program that offers citizens the opportunity for involvement in all phases of the planning process.

Section A, Citizen Involvement, notes that the city will continue to implement an ongoing citizen involvement program that provides residents opportunity to be involved in all phases of the planning process. For the Wilsonville Road realignment, the city will provide public notice to affected property owners, opportunities for testimony at public hearings, and opportunities for appeal of local decisions.

B. Land Use Planning

GOAL: To maintain an ongoing land use planning program to implement statewide and local goals. The program shall be consistent with natural and cultural resources and needs.

The proposed TSP amendments are consistent with the land use planning goal because they will help implement Phase 1 of the Bypass which is an approved project in the Newberg TSP and Comprehensive Plan.

H. The Economy

GOAL: To develop a diverse and stable economic base.
Policy 1.o. The City shall collaborate with other public and private entities and project developers to construct and maintain the best surface transportation infrastructure possible (e.g. roads, airpark, railroad).

The Phase 1 Bypass Project, including the Wilsonville Road realignment, will improve mobility and accessibility in general, and freight movement in particular, throughout the Newberg Dundee urban area, thus resulting in substantially reduced congestion and hours of delay when compared to a No Build Alternative. This supports the goal of developing a diverse and stable economic base.

K. Transportation

Policy1.f. The City shall coordinate with Yamhill County and the State on the development of the Newberg Dundee Bypass.

The city is directly coordinating with ODOT and Yamhill County on the development of the Bypass. The TSP currently contains the full Bypass alignment, which will be an 11-mile, four-lane highway around the

cities of Newberg and Dundee from Highway 99W northeast of Newberg to the Highway 18 interchange south of Dundee. However, funding constraints preclude full construction of the Bypass at this time, and the Bypass will be a phased development. The proposed TSP amendments are necessary to implement Phase 1 of the Bypass.

M. Energy

GOAL: To conserve energy through efficient land use patterns and energy-related policies and ordinances.

The Bypass project, including Phase 1 and the Wilsonville Road realignment, is intended to improve statewide and regional mobility through the area and to make existing Highway 99W more accessible for local and regional traffic. The project will help relieve much of the substantial traffic congestion that currently exists along Highway 99W. Facilitating the smooth flow of traffic at acceptable levels of service also helps conserve fuel by avoiding the wasteful burning of fuel at intersections already above capacity or expected to exceed capacity during the planning period.

<u>Oregon Statewide Planning Goals – applicable goals</u>

Goal 1 (Citizen Involvement)
Goal 1 requires the opportunity for citizens to be involved in all phases of the planning process. Generally, Goal 1 is satisfied when a local government follows the public involvement procedures set out in its acknowledged comprehensive plan and land use regulations.
The City of Newberg Comprehensive Plan requires the city maintain a Citizen Involvement Program that offers citizens the opportunity for involvement in all phases of the planning process. Compliance with these regulations results in compliance with Goal 1.

Goal 2 (Land Use Planning), Part I
Goal 2, Part I requires that actions related to land use be consistent with acknowledged comprehensive plans of cities and counties. It is specifically noted that the City of Newberg updated the Comprehensive Plan to include the Newberg Dundee Bypass.

Goal 2, Part I also requires coordination with affected governments and agencies, evaluation of alternatives, and an adequate factual base. In developing the Wilsonville Road realignment, ODOT engaged in coordination efforts with planners, officials, and other representatives of Newberg. The amendment also is consistent with the Phase 1 Bypass as authorized by the Oregon Legislature and approved by Yamhill County.

Goal 5 (Open Spaces, Scenic and Historic Areas, and Natural Resources)
Goal 5 requires local governments to adopt programs to protect natural resources and conserve scenic, historic, and open space resources for present and future generations as provided in the Oregon Department of Land Conservation and Development's Goal 5 administrative rule, OAR 660, Division 23. Under OAR 660-023-0250(3)(b), local governments are not required to apply Goal 5 in post-acknowledgment plan amendment proceedings unless the amendment affects a Goal 5 resource to allow new uses that could be conflicting uses with a particular significant Goal 5 resource site. The Wilsonville

Road realignment does not impact any resource sites inventoried and designated as significant under Goal 5. Therefore, Goal 5 does not apply.

Goal 6 (Air, Water and Land Resources Quality)
Goal 6 addresses the quality of air, water, and land resources. In the context of a comprehensive plan amendment, a local government complies with Goal 6 by explaining why it is reasonable to expect that the proposed uses authorized by the plan amendment will be able to satisfy applicable federal and state environmental standards, including air and water quality standards. Because the Wilsonville Road realignment is part of Phase 1, which provides the first step in implementing the Bypass project, and because the Bypass project is an approved project in the City of Newberg's acknowledged TSP and Comprehensive Plan, the Wilsonville Road realignment is consistent with the City's TSP and Comprehensive Plan findings of compliance with Goal 6.

By substantially relieving congestion in the region, the Bypass project will improve air quality. This 2013 amendment will help substantially relieve congestion in the region by facilitating implementation of Phase 1. Like the Bypass project in its entirety, the Wilsonville Road realignment will impact water resources by adding a small amount of impervious surface to the watershed area. Where areas are paved, water cannot penetrate the soils, so it rushes over the surface. This can increase erosion, increase the movement of fine sediments, and increase pollutant loads in watercourses. However, these impacts can adequately be mitigated through the use of effective land-based stormwater treatment systems that include measures to preserve and restore mature vegetation and maximize infiltration. The use of construction techniques that include temporary and permanent best management practices (BMPs) for erosion and sediment control and spill control and prevention also can achieve compliance with clean water standards. OHP 5A.1 directs ODOT to implement BMPs. These BMPs will apply to development of JTA Phase 1. Mitigation strategies have been identified and agreed to in the Newberg Dundee Tier 2 Final EIS.

Stormwater is also subject to statewide permits that are issued to ODOT. For construction activities, ODOT will comply with the terms and conditions of its statewide National Pollution Discharge Elimination System (NPDES) permit: 1200-CA. ODOT will also comply with the terms and conditions of its statewide MS4 permit for ongoing maintenance and operation of the highway. To comply with the terms of the permits, ODOT follows BMPs set out in the *Routine Road Maintenance Water Quality and Habitat Guide*, or Blue Book, which details the standard maintenance activities and describes how to perform them in the most environmentally sensitive way. The Blue Book, first published in 1999, is the basis for Endangered Species Act compliance with the National Marine Fisheries Service under the Clean Water Act's 4(d) exemption for maintenance activities. Goal 6 is met.

Goal 8 (Recreational Needs)
Goal 8 provides for local governments to meet the recreational needs of the citizens of Oregon. The Bypass project, including the Wilsonville Road realignment, will further Goal 8's objectives by improving access to recreational destination areas such as the Oregon coast, Yamhill County wineries, and the Spirit Mountain Casino. The proposed road realignment will not impact existing park or recreational lands.

Goal 9 (Economic Development)
Goal 9 requires local governments to adopt comprehensive plans and policies that "contribute to a stable and healthy economy in all regions of the state." The City of Newberg's Comprehensive Plan has been acknowledged to comply with Goal 9. The Bypass project, including the Wilsonville Road realignment to

implement Phase 1, will improve mobility and accessibility generally, and freight movement in particular, throughout the Newberg Dundee urban area, thus resulting in substantially reduced congestion and hours of delay when compared to a No Build Alternative.

Goal 10 (Housing)
Goal 10 applies inside urban growth boundaries. While the Wilsonville Road realignment is within land zoned as medium-density residential, there are no impacts to housing, because the road will be placed on land that was previously roadway. Wilsonville Road will be reconnected to Highway 219 in its previous location. Therefore, this action is consistent with Goal 10.

Goal 12 (Transportation)
Goal 12 requires local governments to "provide and encourage a safe, convenient, and economic transportation system." Goal 12 is implemented through the Transportation Planning Rule (TPR), OAR 660, Division 12. Because the Newberg Dundee Bypass Project is an approved project in the City of Newberg's acknowledged TSP, and the Wilsonville Road realignment is necessary to implement Phase 1 of the project, it is consistent with Goal 12 and with the TPR planning and coordination requirements. The Wilsonville Road realignment will improve connectivity between the Bypass, Highway 219 and Wilsonville Road and avoid violating roadway performance standards on Springbrook Road by severing the connection between the two roads. The new intersection of Wilsonville Road and Highway 219 will operate within ODOT's performance standards.

Goal 13 (Energy Conservation)
Goal 13 directs cities and counties to manage and control land and uses developed on the land to maximize the conservation of all forms of energy, based on sound economic principles. The Bypass project, including JTA Phase 1 and the Wilsonville Road realignment, is intended to improve statewide and regional mobility through the area and to make existing Highway 99W more accessible for local and regional traffic. The project will help relieve much of the substantial traffic congestion that already exists along Highway 99W and that will only deteriorate further in its absence. Providing safe and convenient travel through an area and facilitating the efficient movement of people, goods, and services in that area serves the growth needs and objectives of the region and the state, and follows sound economic principles. Facilitating the smooth flow of traffic at acceptable levels of service also helps conserve fuel by avoiding the wasteful burning of fuel at intersections already above capacity or expected to exceed capacity during the planning period.