NE 181ST AVENUE TRAFFIC CAPACITY STUDY

NE SANDY BOULEVARD TO NE HALSEY STREET

PUBLICATION DRAFT

January 23, 2009

City of Gresham
Department of Environmental Services
Transportation Engineering

Executive Summary

Background Information

NE 181st Avenue provides the only connection to the Interstate-84 freeway within Gresham city limits. As the areas to the south develop, including Pleasant Valley and Damascus, this corridor will grow more congested because it provides the nearest freeway access. The redevelopment potential of the Wilkes East and North Gresham neighborhoods, including the Industrial portion of the Rockwood Urban Renewal District, will be hampered as the NE 181st Avenue intersections near the freeway reach capacity.

This study is in response to the 2007 Rockwood-West Gresham Urban Renewal Industrial Opportunity Study, which recommended that a traffic study be done for the NE 181st Avenue corridor between NE Sandy Boulevard and NE Halsey Street to determine the existing conditions and to evaluate and prioritize improvement projects. Existing conditions (year 2007) and future conditions (year 2027) were assessed.

Corridor Improvement Alternatives

The study evaluated four main future alternatives:

Alt 0 - No action

Alt 1 - Sydney Coordinated Adaptive Traffic System (SCATS) adaptive signal control at the six study intersections

Alt 2 - Widening NE 181st to three lanes in each direction between the freeway and south of NE Halsey Street

Alt 3 - Installing a reversible center lane between the freeway and south of NE Halsey Street that would operate three lanes northbound during the a.m. peak and three lanes southbound during the rest of the day. Left turns would be prohibited from NE 181st Avenue at the NE San Rafael Street and NE Halsey Street with this alternative.

With additional improvements, all four future alternatives studied in this report were shown to provide acceptable intersection and corridor performance. However, the added capacity brought by the improvements of Alt 2 and Alt 3 would attract additional trips to the corridor, partially negating their performance gains.

Alt 1, which would add SCATS at the six study intersections, would provide performance that would meet City of Gresham standards, assuming its performance improvements are as effective as those on the Burnside Road corridor* and additional intersection improvements are done. Alt 1, with additional intersection improvements, performs as well or better than more expensive corridor widening and reversible-lane projects, partially because the widening projects would attract additional traffic from parallel routes. Added benefits of the SCATS signal system include the ability to adapt to the high-volume shift changes at the Boeing and US Bancorp facilities during all times of the day. Alt 1 was by far the most cost-effective corridor alternative studied.

* Independent analysis has shown that the SCATS system on the Burnside corridor has resulted in a minimum 10% improvement in corridor travel time and a corresponding minimum 10% increase in effective intersection capacity.

Some Intersection TIF Projects Should Proceed as Planned

Two of the City's Transportation Impact Fee (TIF) projects that are planned for the corridor are required for the study intersections to meet City performance standards in 2027. These projects are:

515200 The 181st at Halsey TIF project would add dual northbound and southbound left-turn pockets, as well as eastbound, westbound, and southbound right-turn pockets. This project will likely be necessary by 2018. (Project cost estimate $919,000)

521200 The Sandy Intersection Improvements TIF project would widen the intersection to add dual westbound left-turn lanes and a northbound right-turn pocket. The project should be modified to add dual northbound left-turn lanes. The northbound right-turn pocket is not needed for adequate intersection operation during the corridor a.m. and p.m. peaks, however, although further study of the intersection performance during the period before shift changes at the Boeing facility should be considered before that right-turn pocket is removed from the planned design. This project will be necessary by 2023, although developments in the area may require its construction sooner. (Project cost estimate is $576,000, although that does not include the added northbound dual left turn.)

Changes Are Needed at the San Rafael Intersection for Performance

Signal phase changes at the San Rafael intersection should be constructed immediately to improve corridor throughput and westbound right-turn performance:

- The current, signed prohibition on westbound right turns on red should be removed at the San Rafael intersection. To do this, an electronic "no right turn" sign will be installed in its place. That sign will only be lit during the southbound U turn phase, meaning that right turns on red will be permitted during most of the cycle.
- The curb radius on the northeast corner of the San Rafael intersection will be widened to allow trucks to turn more easily into moving traffic.
- The westbound crosswalk (over the north leg of the intersection) should be closed.
- A median barrier between the southbound left-turn pocket and the northbound lanes should be installed from the planted island near McDonalds south to within 30 feet of the intersection. This island will prevent unsafe and illegal uncontrolled U turns north of the intersection.

Additional Intersection Improvement Project Will Be Needed by 2026

Recommended projects not part of the City's current TIF project list include signal phasing modifications at the US Bank (3000 Block) intersection. This project would add protected-permitted left-turn phasing on the driveway side streets, which will eventually be needed to provide adequate performance during the peak exit times from the businesses these driveways serve.

Several TIF Projects Will Not Be Needed

Several other planned TIF projects for the NE 181st Avenue corridor will not be needed to ensure future performance through to 2027, assuming SCATS is installed and performs as predicted. Not constructing these projects will save close to $13 million in TIF funds. These projects include:

515100 This unfunded TIF project would widen NE 181st Avenue between the I-84 freeway eastbound ramps and Halsey. Its additional capacity would attract new trips, which would partially offset the performance gains on the corridor. The viability of the project is limited by the difficulty in acquiring the right of way on the west side of 181st. (2002 project cost estimate $3,373,000)

516600 The analysis showed that this unfunded TIF, which would reconstruct the eastbound I-84 ramps intersection to eliminate the southbound left-turn phase and replace it with an uncontrolled partial cloverleaf, isn't required within the 2027 time period. (2002 project cost estimate $5,746,000)

521300 This unfunded TIF project would add a southbound lane to NE 181st Avenue between the US Bank driveway intersection and the I-84 westbound ramps intersection. The added capacity it would provide is not needed to ensure adequate corridor performance. (2002 project cost estimate $3,369,000)

Urban Renewal Improvement Projects

Most of the Urban Renewal projects that were reviewed in the report are intended to make the area more attractive to industrial redevelopment but will have minimal impact to the traffic performance on the 181st corridor:

- The new connection between Wilkes and San Rafael, near what would be NE 186th Avenue, would shorten the travel distance from 181st and Wilkes and the former Firestone property on Wilkes by more than half, from 7,300 feet to 3,500 feet. This would make redevelopment of the entire area more likely, but it would not directly impact the performance of the 181st corridor.
- Similarly, the Urban Renewal projects that would rebuild San Rafael and 192nd to collector standards would have little or no impact to the 181st Avenue corridor performance.

A full or improved connection between NE Wilkes Road and NE 181st Avenue would not be permitted by ODOT. The future modeling of another proposed option, an off-ramp to Wilkes from the I-84 eastbound onramp shows that it would attract cut-trough traffic during the p.m. peak commute.

Public Process

The East Wilkes Neighborhood Association and Rockwood Business Coalition were both consulted on the proposed project. These organizations welcomed the likely benefits of the SCATS system installation.

The results of the Traffic Capacity Study were presented to the Gresham Redevelopment Commission in September. The commissioners were concerned about the negative impacts to businesses and employees that were expected with the then-proposed prohibition of southbound U turns at the San Rafael intersection.

Two public meetings were held in mid-September to get input on the proposed SCATS implementation, focusing on the then-proposed changes to the San Rafael intersection and possible mitigation measures to replace or mitigate the southbound U turn. While neither meeting was well attended, those who did attend were very supportive of the proposed SCATS system, but

wanted to see a solution to the San Rafael that would keep the U turn in place. Attendees of the first meeting suggested that the traffic signal should be modified to prohibit right turns on red only when they would be inherently unsafe to make. They also suggested that the turn radius on the northeast corner should be increased to make the turn easier and faster for trucks that could now turn into moving traffic. There were no objections voiced concerning the proposed removal of the crosswalk over the north leg of the intersection.

Recommendations

Recommend proceeding with Alt 1, the SCATS adaptive signal control system installation at the six study intersections (expanded to include a seventh intersection at NE 181st Avenue and NE Glisan Street). Modify the San Rafael signal to install an LED "no right turn" sign that would prohibit westbound right turns only during the southbound U turn phase; widen the curb radius on the northeast corner to ease truck turns to northbound 181st; and close the crosswalk over the north leg of the intersection.

Program 181st at Halsey TIF (515200, which would add dual northbound and southbound left-turn pockets and eastbound, westbound, and southbound right-turn pockets), and the Sandy Intersection Improvements TIF (521200, which would add dual westbound left-turn lanes and a northbound right-turn pocket, but needs to be modified to add dual northbound left-turn lanes) in the Capital Improvement Program within the next 10 years. Add a new project to modify the traffic signal at the US Bancorp driveway intersection to the unfunded TIF list.

Remove 181st Avenue (I-84 to Halsey) TIF (515100), 181st at I-84 TIF (516600), and 181st Avenue (I-84 to US Bancorp) TIF (521300) from the next update of the TIF project list. Dropping these three projects will remove an estimated $12,488,000 in costs from the unfunded TIF list.

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Introduction

NE 181st Avenue provides the only connection to the Interstate-84 freeway within Gresham city limits. The NE 181st Avenue interchange is the first exit from I-84 eastbound after NE 122nd Avenue and the last exit to surface streets on I-84 westbound until NE 43rd Avenue. With the construction of the NE 207th Avenue (now Fairview Parkway) interchange some ¾ of a mile to the east on I-84, traffic volumes on NE 181st Avenue are currently less than those during the late 1990s.

As the areas to the south develop, including Pleasant Valley and Damascus, this corridor will grow more congested because it provides the nearest freeway access. Under current City of Gresham development policy, the Wilkes East and North Gresham neighborhoods will become more expensive to redevelop as the NE 181st Avenue corridor intersections reach capacity.

This study is in response to the 2007 Rockwood-West Gresham Urban Renewal Industrial Opportunity Study, which recommended that a traffic study be done for the NE 181st Avenue corridor between NE Sandy Boulevard and NE Halsey Street to determine the existing conditions and to evaluate and prioritize improvement projects. Existing conditions (year 2007) and future conditions (year 2027) were assessed.

Purpose and Need

This study will evaluate potential intersection and corridor improvements for the NE 181st Avenue corridor to determine which work best to retain or improve the current conditions. City of Gresham, along with the Gresham Redevelopment Commission, will work to implement the recommended projects based on feasibility and cost.

In addition to the corridor improvements, there are individual projects to be evaluated:

- Improving access to NE Wilkes Road by permitting turns from Wilkes to 181st or providing an exit from the eastbound I-84 freeway onramp.
- The construction of a new, collector-class street between NE Wilkes Road and NE San Rafael Street, east of NE 181st Avenue and west of NE 192nd Avenue.
- Prohibiting the southbound U-turn at NE San Rafael Street so that the prohibition on right turns on red from westbound San Rafael can be lifted to improve freight access and improve intersection throughput.

Several businesses east of NE 181st Avenue have listed delays at 181st and NE San Rafael Street as a serious impediment to their operations . The depot manager at John Deere is definitely in favor any improvements that will help traffic move through the area better. The production manager at Imperial Manufacturing calls the right turn from westbound San Rafael to northbound 181st a “nightmare"; he reports that they sometimes send trucks north on NE 201st Avenue to Sandy Boulevard to avoid the intersection. The owner of NW Retreaders points specifically to the U turn at the intersection as the cause of the problems. Trucks end up idling, wasting time and gas, he reports, and then asks if anything can be done to make the intersection more efficient.

Study Area

Figure 1 shows the NE 181st/SE 182nd Avenue corridor with the study area highlighted. NE 181st Ave/SE 182nd Avenue corridor begins north of the I-84 freeway at NE Sandy Boulevard. North

of Sandy it continues as NE Airport Way. The corridor continues south from the study corridor through North Gresham and Rockwood to the Centennial Neighborhood and W Powell Boulevard. From there the corridor continues south as Highland Drive and SE 190th Drive through Southwest Gresham and Pleasant Valley and to the Clackamas County line and Damascus.

This traffic analysis is limited to the ¾-mile segment of NE 181st Avenue between NE Sandy Boulevard and NE Halsey Street, including six signalized intersections: NE Sandy Boulevard, the US Bancorp/Gateway Corporate Center Driveways (3000 Block), the westbound I-84 ramps, the eastbound I-84 ramps, NE San Rafael Street, and NE Halsey Street. Partially because much of the study corridor is within the Oregon Department of Transportation's interchange management area, there are no other full intersections. The one other intersection is with NE Wilkes Road, which permits northbound right turns from 181st only and has no lanes that exit onto 181st.

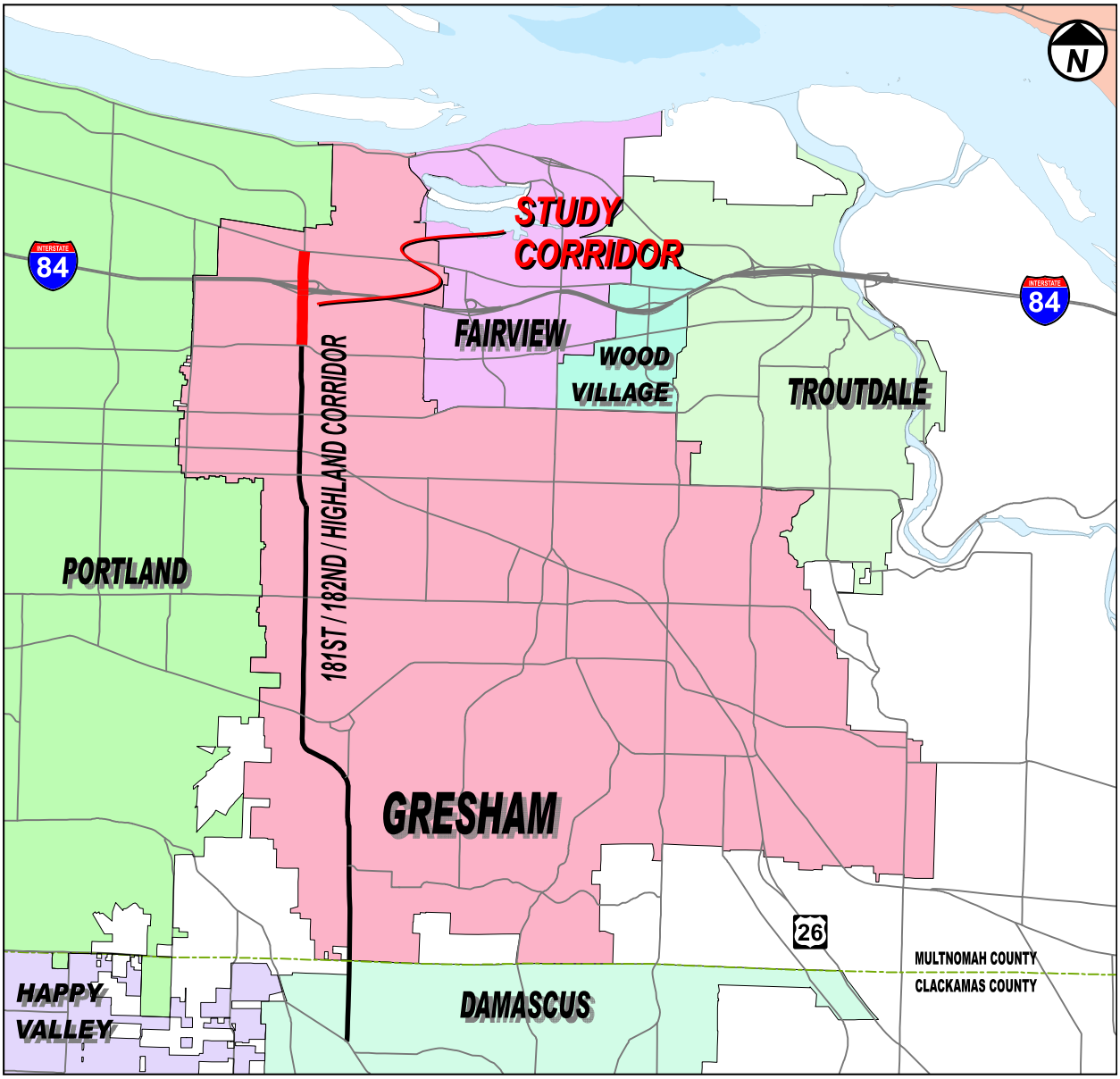

Figure 1: Area Map Showing Study Corridor

Transportation Analysis Methodology

Average Delays and Level of Service

Intersection level of service (LOS) is an evaluation of the operational characteristics of roadway intersections, and because these intersections are typically the points of congestion, it is an evaluation of roadway network operations as a whole. Levels of service are given designations of LOS A through LOS F by the Transportation Research Board's Highway Capacity Manual (Transportation Research Board, Special Report 209, 2000). LOS A represents ideal, free-flow conditions and LOS F represents a breakdown in traffic flow, characterized by excessive delay to motorists. At LOS E, an intersection has reached the physical capacity for which it was designed. The only way for operations to be improved at intersections with LOS F is either to reduce the number of vehicles using the intersection or to increase the intersection capacity by adding lanes, revising lane configurations, or modifying signal timing.

LOS for Signalized and Roundabout Intersections

LOS	Control Delay Per Vehicle (sec)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

City of Gresham performance standards require intersections to operate at an overall LOS D during the peak hour, with no individual movement operating at LOS F.

LOS for Stop Controlled Intersections

LOS	Control Delay Per Vehicle (sec)
A	≤10
B	>10 and ≤15
C	>15 and ≤25
D	>25 and ≤35
E	>35 and ≤50
F	>50

Synchro uses a percentile delay method to calculate delay at signalized intersections. There are five percentile scenarios (90^{th}, 70^{th}, 50^{th}, 30^{th}, and 10^{th}), each of which represent 20% of the cycles predicted to occur at the intersection. The model provides a weighted average of the delay resulting from these percentile scenarios. Synchro 6.0 incorporates a "Queue Delay" term in its total delay calculations in addition to the "Control Delay" that is defined by the Highway Capacity Manual. Queue delay attempts to account for the impact of short links and turn bays, which when combined with poorly coordinated signal timing, tend result in spillback, starvation, or storage blocking.

The measurement of intersection LOS for two-way stop-controlled intersections is done by Synchro using procedures from the 2000 Highway Capacity Manual. The analysis for such intersections is based on gap acceptance and queuing theory. LOS for two-way stop-controlled intersections is measured for individual movements but not for the intersection as a whole. Like LOS for signalized intersections, it is based on control delay. A measure of LOS for the main street left turns onto the minor street and minor street movements can be determined.

95^{th} Percentile Queue Lengths

Another measure of intersection performance is the 95^{th} percentile queue length (Q_{95}). As used in this study, this is the length per lane of queued vehicles in a given movement assuming an arrival rate that represents the maximum traffic volume that can be expected 95 percent of the analyzed hour. The queues along corridors with coordinated signals can be metered by upstream signals, if the upstream intersection is operating over capacity. If each intersection were modeled independently, the queues would be longer than those reported by Synchro within the coordinated signal network. In the queue results tables, metered queues are preceded by "m".

Queue lengths at intersections can point to problems not represented in the delay calculations. Queues that extend beyond the storage capacity of the turn pockets will block through movements. Through-movement queues that extend through the preceding intersection will lead to gridlock on the corridor.

Microscopic Traffic Simulation

The microscopic simulation module of Synchro, SimTraffic, was used to simulate future traffic conditions on the corridor and also to aid in the determination of appropriate turn pocket lengths. The simulation model was calibrated by comparing queue lengths generated in the model to field conditions. Multiple simulations are run and queue and delay results are averaged. In the case of this study, 5 simulations of 60 minutes each were run for every time period and alternative, using random number seeds of 1 through 5. The first 15 minutes are the "peaking" interval, with the peak hour factor applied. The next 45 minutes is set with the peak hour factor inverted (anti-PHF in the settings), during which the queues disperse. This set of intervals and number of simulations is consistent with ODOT simulation methodology for SimTraffic.

Simulations can provide insight into corridor performance in situations where the macroscopic models like Synchro do not, such as spill-back from a downstream intersection or a mid-block location where a 5-lane arterial narrows to 2 lanes. Because each individual vehicle is simulated separately, SimTraffic reports average delay for every lane, not aggregated delay for every movement the way Synchro does. When reporting queuing, however, SimTraffic does determine an average queue for each lane at an intersection, which is the average of the maximum queue lengths recorded for each 2 minute interval. A standard deviation is also calculated using the sum of squares for each 2 minute interval. The 95th percentile queue is equal to the average queue plus 1.65 standard deviations. The 95th percentile queue is not necessarily ever observed, it is simply based on statistical calculations. For this report, however, the SimTraffic queue results are the maximum observed in the simulation.

Volume to Capacity Ratio

The City of Gresham has a performance standard based on the calculated volume to capacity ratio. The intersection average V/C ratio may not exceed 0.90, with no individual movement with V/C of more than 1.00. In many ways this is a better measure of an individual movement's performance than delay, as delay for a turn movement is seen as acceptable to the motoring public, where cycle failure and queue blockage of such movements is not. Overall intersection V/C ratios are calculated by Synchro using Highway Capacity Manual methodology, assuming actuated signal green time. The V/C ratio for individual movements shown in this report are calculated by Synchro using the average of the five percentile scenarios used in calculating intersection and movement delay.

The choice to report the different methods is due to the problems Synchro has with calculating V/C ratios for movements with very small volumes. In implementing the Highway Capacity Manual methodology, Synchro takes several factors into account that are not part of the standard HCM calculations, including the explicit impact of signal coordination, actuated signal times, protected-permitted left-turn phasing, and right turns on red. Synchro will assign an unrealistically short actuated cycle split to a movement with light volumes; the resulting V/C ratio will be extremely high as a result. Using the percentile method to calculate individual movement V/C

ratios avoids this problem, but can lead to a situation where the overall intersection V/C ratio is higher than any individual V/C ratio, which mathematically shouldn't happen in reality.

Network Measures of Effectiveness

Synchro provides a way to measure network-wide statistics quantitatively. These measures of effectiveness can give a summary picture of how well the modeled road network is performing and thus allow a quantitative comparison between two future alternatives in terms of delay, stops, average speed, travel time, distance traveled, fuel consumed, vehicle emissions, and modeled counts of unserved vehicles and dilemma zone vehicles. Synchro also provides a composite rating, called the Performance Index (PI), which is a formula combination of the delays and stops. The PI is what Synchro uses to determine the optimal signal cycle length at an intersection. The formula used to calculate the PI is shown below:

$$PI = \frac{Total\ Delay + 10 \times Stops}{3600}$$

Arterial Level of Service

Arterial level of service is also calculated by Synchro, and is based on the methodology from the Arterials section of the Highway Capacity Manual. The arterial speed shown for an intersection is the travel time on the preceding arterial segment plus the intersection delay for the through movement, divided by the length of the segment. It is a measure of through movement delay at each signalized intersection along the corridor. LOS for arterials is based on the Arterial Class and the calculated arterial speed.

Arterial Classification

Speed (mph)	Segment Distance	Class
1 to 29	any	IV
30 to 35	< 2000 ft	IV
30 to 35	≥ 2000 ft	III
36 to 45	any	II
above 45	any	I

Arterial LOS by Class

Urban Street Class	I	II	III	IV
Free-Flow Speeds	55 to 45 mph	45 to 35 mph	35 to 30 mph	30 to 25 mph
LOS	Average Travel Speed (mph)			
A	> 42	> 35	> 30	> 25
B	> 34–42	> 28–35	> 24–30	> 19–25
C	> 27–34	> 22–28	> 18–24	> 13–19
D	> 21–27	> 17–22	> 14–18	> 9–13
E	> 16–21	> 13–17	> 10–14	> 7–9
F	≤ 16	≤ 13	≤ 10	≤ 7

Modeling Adaptive Signals

The City of Gresham has begun a program of replacing conventional 170E signal controllers running Wapiti IKS software with the Sydney Coordinated Adaptive Traffic System (SCATS) where appropriate. NE 181st Avenue is currently the highest priority for this conversion.

Modeling the affect of SCATS using the analysis tools available is problematic. Analysis conducted by the Portland State University Center for Transportation Studies has shown that the SCATS system on the Burnside Corridor has shown the equivalent of approximately 10% increase in capacity for the mainline corridor movements. To model this effect in Synchro, the ideal saturation flow rate for the mainline through and right-turn movements was increased from 1,900 vehicles per hour per lane to 2,090 vphpl. For SimTraffic simulations to reflect this increase in capacity, the headway factor for these same movements was reduced from 1.00 to 0.92.

Existing Conditions

Roadway Network and Intersection Channelization

Figure 2 shows the existing intersection channelization at the six signalized study intersections. The following are descriptions of the existing channelization at the study intersections.

NE 181st Avenue and NE Sandy Boulevard:

NE Sandy Boulevard in East County is Highway US-30 Bypass. It provides connections to many freight-dependent industries and warehouses north of the I-84 freeway, most notably the Boeing Company. The Boeing manufacturing complex east of the intersection generates high volumes of traffic when its shifts change, although the shift changes are timed to occur well before the normal peak hours.

The eastbound approach has a 200-foot left-turn pocket, a through lane, a right-turn drop lane and an unmarked bike lane. The westbound approach has a left-turn lane, a through lane, and a 125-foot right-turn pocket. Then northbound approach has a 275-foot left-turn pocket, a through lane, a shared through-right lane, and a bike lane. The southbound approach has a 200-foot left-turn pocket, a through lane, a shared through-right lane, and a bike lane.

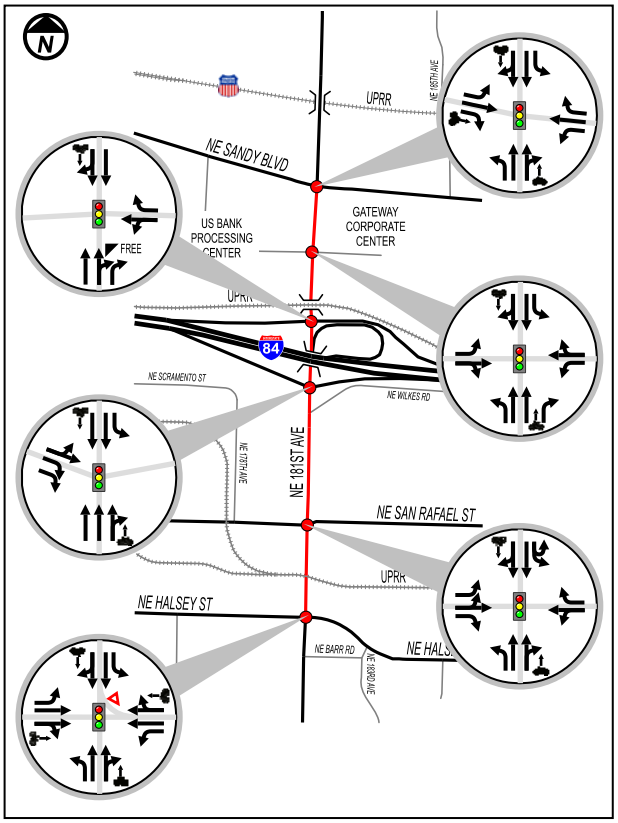

Figure 2: Existing Intersection Channelization

NE 181st Avenue at US Bancorp/ Gateway Corporate Center (3000 Block):

This signal provides the primary access to the US Bank processing facility to the west and the Gateway Corporate Center business park to the east. Like Boeing on Sandy, the bank processing facility has very shift-driven traffic patterns. The US Bank property has room for expansion and the Gateway Corporate Center has completed only the first of its two approved phases.

The eastbound approach has a 125-foot left-turn pocket and a shared through-right lane. The westbound approach has a 150-foot left-turn pocket and a shared through-right lane. The northbound approach has a 275-foot left-turn pocket, a through lane, a shared through-right lane, and a bike lane. The southbound approach has a 200-foot left-turn pocket, a through lane, a shared through-right lane, and a bike lane. Pedestrian crossing over the south leg of the intersection is prohibited.

NE 181st Avenue at I-84 Westbound Ramps:

The westbound approach has a shared left-through lane and a 165-foot channelized right-turn pocket. Then northbound approach has two through lanes. The northbound dual, free right-turn movements onto the freeway cloverleaf onramp split off approximately 140 feet south of the sig-

nalized intersection. Because of the conflict with the dual right-turn, the northbound bike lane on NE 181st Avenue is diverted between the ramps intersections. Cyclists are required to cross to the west side of 181st Avenue at the I-84 eastbound ramps intersection and to use the sidewalk. Once through the westbound ramps intersection, they are then directed to cross back over the north leg crosswalk to continue on the bike lane north of the intersection.

The southbound approach has a through lane, a shared through-right lane, and a bike lane. Pedestrian crossing over the south and west legs of the intersection is prohibited.

NE 181st Avenue at I-84 Eastbound Ramps:

The eastbound approach has a shared through-left lane that begins 550 feet west of the intersection, a right turn lane, and a 400-foot right-turn pocket. Then northbound approach has two through lanes and a shared through-right lane that starts 200 feet south of the intersection at Wilkes Road. The southbound approach has a left-turn lane, two through lanes, and a bike lane.

The northbound approach also has a bike lane, but a sign north of the intersection directs cyclists to cross over the north leg crosswalk to the west side sidewalk to avoid conflicts with the dual right-turn movement to the westbound freeway onramp. Pedestrian crossing over the south leg of the intersection is prohibited.

NE 181st Avenue and NE San Rafael Street:

NE San Rafael Street provides connections to the light and heavy industrial uses east and west of NE 181st Avenue.

The eastbound approach has a 325-foot left-turn pocket, a shared left-through lane, and a 225-foot right-turn pocket. It's notable that the lane utilization for the eastbound left turns is weighted to the outside of the two lanes, as trucks bound for the freeway need to be in the outside lane on northbound 181st.

The westbound approach has a shared left-through lane and a 125-foot right-turn pocket. There is limited connectivity in the street network east of the San Rafael intersection. The next side street from San Rafael is NE 192nd Avenue, which is more than a half mile east of 181st.

The northbound approach has a 300-foot left-turn pocket, a through lane, a shared through-right lane, and a bike lane. The southbound approach has a 300-foot U-and-left-turn pocket, a through lane, a shared through-right lane, and a bike lane.

NE 181st Avenue and NE Halsey Street:

NE Halsey Street is a high-capacity east-west arterial that runs from Northeast Portland to Gresham west of NE 192nd Avenue, and then continues eastward as a lesser arterial to Troutdale. Halsey is a parallel facility to I-84, and is used as an alternative route when there are freeway incidents.

The eastbound approach has a 325-foot left-turn pocket, a through lane, a shared through-right lane, and a bike lane. The westbound approach has a 325-foot left-turn lane, a through lane, a shared through-right lane, and a bike lane. Then northbound approach has a 200-foot left-turn pocket, a through lane, a shared through-right lane, and a bike lane. The southbound approach has a 275-foot left-turn pocket, a through lane, a shared through-right lane, and a bike lane.

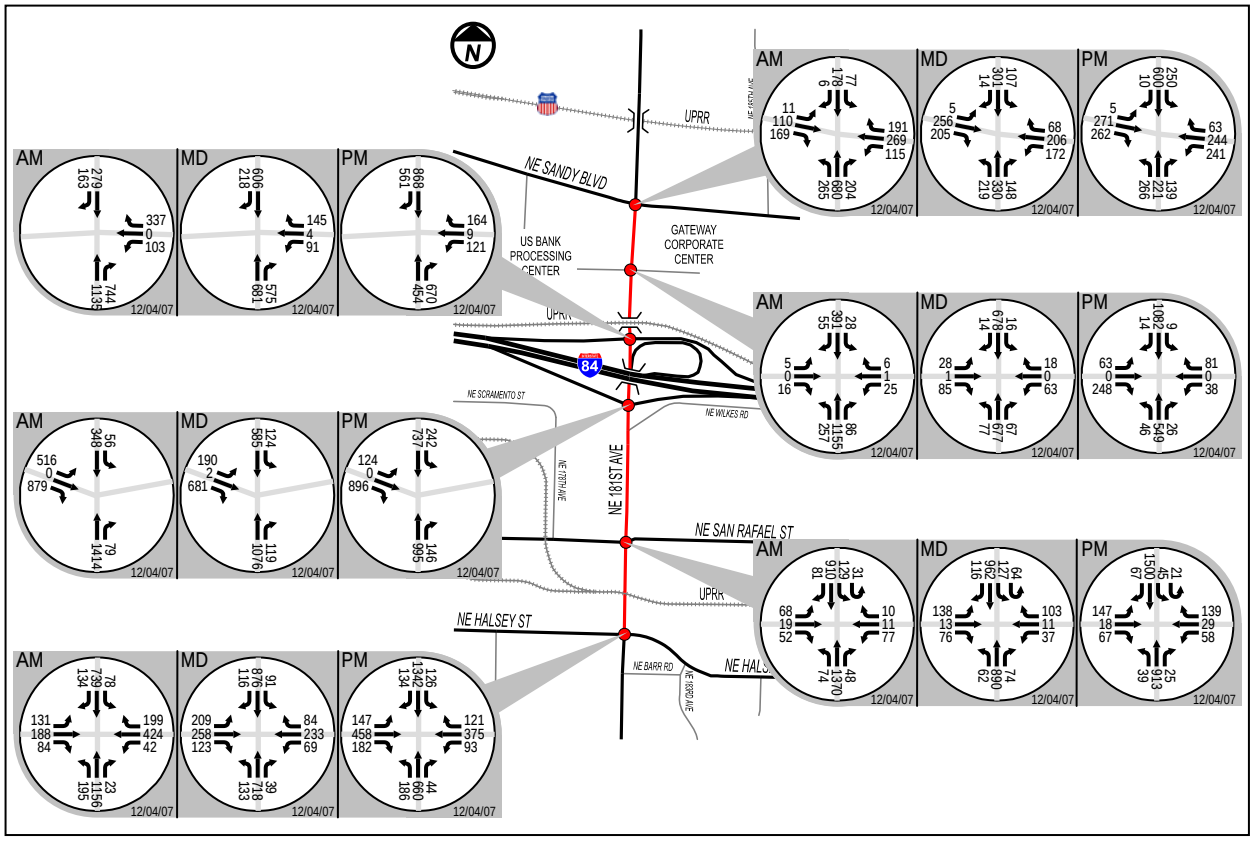

Figure 3: Peak Hour Turning Movement Volumes *

(* Counts collected on 12/04/2007. Volumes shown are annualized at 108.1% of actual counts.)

Existing Traffic Volumes and Travel Patterns

Figure 3 shows the a.m. and p.m. peak hour traffic volumes based on counts collected in December, 2007. As these counts were collected in winter, between the Thanksgiving and Christmas holidays, an annualization factor of 108.1 percent was applied to the counts to compensate. This annualization factor, applied to all movements, may result in some Synchro and SimTraffic results that are not worse than what can be expected in reality.

Transit

TriMet provides peak commute bus service to the entire study corridor, with more frequent service provided on the NE Sandy Boulevard and NE Halsey Street cross streets.

TriMet bus route 87 runs the length of the study corridor, running every half hour each direction between 6:00 a.m. and 9:00 a.m. and again between 2:30 p.m. and 6:00 p.m. It connects the Parkrose/Sumner Transit Center to the Rockwood Transit Center via NE Airport Way, NE 181st Avenue, and NE Burnside Street or NE Stark Street.

Route 12 runs from Gresham Transit Center to Downtown Portland via NE Sandy Boulevard. In the vicinity of NE 181st Avenue it provides service approximately every 30 minutes in each direction throughout the day.

Route 77 runs between Troutdale and Northwest Portland along NE Halsey Street. During the a.m., midday, and p.m. peak hours it provides service in each direction approximately every 15 minutes.

Currently Pella Window and Door Company is the only business within the industrial area that sponsors a van to shuttle employees between the work site and the light rail stations within the Rockwood Town Center. Pella, as one of the larger employers in the City, partnered directly with TriMet to implement the service.

Corridor Safety Analysis

Table 1 shows the crash history for the study corridor during the three years between 2004 and 2006.

Table 1: Corridor Crash History 2004-2006

	Crash Type										Severity				
	Head On	Turning	Rear End	Right Angle	Sideswipe - Overtaking	Sideswipe - Meeting	Pedestrian	Fixed Objects	Backing	Other	Fatal	Injury	Property Damage	TOTAL	EST. CRASH RATE (per million entering veh)
Sandy Blvd		1	3		1							5		5	0.12
Midblock		1										1		1	0.03
US Bank/Gateway Ctr														0	0.00
I-84 WB Ramps		3	3				1					5	2	7	0.15
I-84 EB Ramps		4	8	1				1				7	7	14	0.26
Midblock					1								1	1	0.02
San Rafael St	1	3	15	1	1			1	2			10	14	24	0.46
Halsey St		10	34	7	1	1		3				31	25	56	0.86
Total:	**1**	**22**	**63**	**9**	**4**	**1**	**1**	**5**	**2**	**0**	**0**	**59**	**49**	**108**	
As % of Total Accidents:	1%	20%	58%	8%	4%	1%	1%	5%	2%	0%	0%	55%	45%		

Crashes within 200 feet of an intersection are considered intersection-related crashes.

More than half of all crashes along this corridor occur at or near the Halsey Street intersection, with another quarter near San Rafael Street. The intersection of Halsey and 181st has historically been among the most crash-prone in East Multnomah County. The installation of median barriers at the intersection to limit left turns to and from driveways has reduced the turning-type crashes. Rear end crashes are now the most frequent type of crash at Halsey and throughout the study corridor, making up more than 58% of all crashes. Rear-end type crashes are often caused by congested conditions at signalized intersections.

The crash data for the San Rafael intersection (and 300 feet to the north) shows no evidence of U-turn related crashes. The signalized U turns and illegal U turns taken just north of the signal have not contributed to the overall crash experience in the corridor.

Existing-Condition Corridor Traffic Operations Analysis

The existing intersection channelization, turning movement counts, and signal timing were entered into a.m., midday, and p.m. peak hour Synchro models. The signal timing, especially for

the four southernmost intersections, is coordinated and believed to be nearly optimal as it is the result of extensive modeling and field work in late 2006.

Existing-Condition Intersection Levels of Service, Delays, and Volume to Capacity Ratios

Table 2 contains the existing-condition intersection performance results for the six study intersections for the a.m. and p.m. peak hours. Table 3 is the composite results from the five SimTraffic simulations for the same models and time periods.

Table 2: Existing-Condition Intersection Performance

	A.M. Peak Hour					Midday Peak Hour					P.M. Peak Hour				
	Intersection Average			Movement with Highest V/C		Intersection Average			Movement with Highest V/C		Intersection Average			Movement with Highest V/C	
Intersection	LOS	Delay (sec)	V/C Ratio	Movement	V/C Ratio	LOS	Delay (sec)	V/C Ratio	Movement	V/C Ratio	LOS	Delay (sec)	V/C Ratio	Movement	V/C Ratio
181st & Sandy	**C**	**29.0**	**0.66**	NB Thru	0.73	**D**	**35.7**	**0.65**	NB Left	0.80	**D**	**48.2**	**0.76**	NBL & SBL	0.88
181st @ US Bank	**B**	**12.4**	**0.53**	NB Left	0.59	**A**	**8.6**	**0.42**	NB Left	0.46	**B**	**13.5**	**0.66**	WB Left	0.66
181st & I-84 WB	**A**	**7.9**	**0.61**	WB Right	0.79	**A**	**5.7**	**0.42**	WB Thru	0.52	**A**	**6.7**	**0.58**	WB Thru	0.64
181st & I-84 EB	**B**	**17.6**	**0.70**	EB Left	0.87	**C**	**21.5**	**0.57**	SB Left	0.67	**C**	**30.5**	**0.61**	SB Left	1.07
181st & San Rafael	**C**	**21.5**	**0.75**	SB Left	0.91	**D**	**37.0**	**0.71**	SB Left	1.29	**C**	**25.4**	**0.74**	WB Right	0.82
181st & Halsey	**D**	**37.9**	**0.82**	NB Left	1.00	**D**	**38.1**	**0.72**	EB Left	1.19	**D**	**42.4**	**0.90**	NB Left	0.94

The Synchro models of the existing conditions during all three time periods show acceptable overall delay and intersection LOS at all intersections. There are individual movements that exceed City of Gresham standards. The southbound U- and left-turn movement at San Rafael during the midday is shown to be operating well above capacity, as is the eastbound left-turn movement at Halsey during that time period. The high V/C ratios at San Rafael and Halsey during the midday can also be lessened with revised signal timing (as shown later in this report), but at least for the San Rafael intersection not without seriously impacting the coordinated mainline capacity. The southbound left-turn movement at the eastbound I-84 ramps intersection is modeled as having V/C ratio of 1.07, which, if confirmed, could also be corrected with an adjustment to the signal timing.

Table 3: Existing-Condition Intersection Performance from Simulation

	A.M. Peak Hour					Midday Peak Hour					P.M. Peak Hour				
	Intersection Average		By Movement with Longest Delay			Intersection Average		By Movement with Longest Delay			Intersection Average		By Movement with Longest Delay		
Intersection	LOS	Delay (sec)	Movement	LOS	Delay (sec)	LOS	Delay (sec)	Movement	LOS	Delay (sec)	LOS	Delay (sec)	Movement	LOS	Delay (sec)
181st & Sandy	**C**	**24.8**	EB Left	E	55.3	**C**	**28.2**	EB Left	E	73.9	**E**	**56.5**	SB Left	F	142.4
181st @ US Bank	**B**	**13.4**	NB Left	D	45.8	**A**	**7.7**	SB Left	D	37.8	**B**	**12.0**	SB Left	D	46.0
181st & I-84 WB	**A**	**7.8**	WB Left	C	22.4	**A**	**6.0**	WB Left	D	50.8	**B**	**15.6**	WB Left	F	131.2
181st & I-84 EB	**E**	**60.4**	EB Left	F	156.0	**B**	**17.8**	SB Left	D	53.5	**C**	**34.5**	SB Left	F	178.9
181st & San Rafael	**C**	**25.8**	SBU	E	66.8	**C**	**32.8**	SB Left	F	159.4	**D**	**44.4**	SB Left	F	98.7
181st & Halsey	**C**	**31.3**	NB Left	F	86.2	**D**	**41.6**	EB Left	F	226.1	**D**	**46.7**	NB Left	F	98.2

Simulation can point to problems in the network that aren't apparent in the macro-simulation models like Synchro, like queue blockages caused by downstream congestion. In this model it

shows that the southbound U- and left-turn movements at San Rafael during the p.m. are a problem, which is something that the Synchro model does not predict. It also reflects the Synchro model for San Rafael and Halsey, where the southbound left and eastbound left turns, respectively, are operating below City standards during the midday.

SimTraffic simulations can also magnify the known problems shown in Synchro. In the case of the existing conditions models, it shows a much higher delay for the eastbound left-turn movement at the eastbound I-84 ramps during the a.m. peak hour.

Existing-Condition Queue Lengths

Table 4 contains the existing-condition queue length results for the six study intersections.

Table 4: Existing-Condition 95th Percentile Queue Lengths

A.M. Peak Hour	Eastbound			Westbound			Northbound			Southbound		
Intersection	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)
181st & Sandy	29	130	55	156	260	93	#322	#485	-	116	105	-
181st @ US Bank	13	0	-	38	12	-	#348	384	31	50	146	-
181st & I-84 WB	-	-	-	-	60	#186	-	m123	m185	-	34	-
181st & I-84 EB	-	#504	147	-	-	-	-	m211	-	80	123	-
181st & San Rafael	62	72	37	-	36	101	m65	#216	-	#245	376	-
181st & Halsey	#179	100	-	66	273	-	#296	#595	-	108	275	-
Midday Peak Hour	**Eastbound**			**Westbound**			**Northbound**			**Southbound**		
	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)
181st & Sandy	20	318	65	244	196	33	305	255	-	170	194	-
181st @ US Bank	31	34	-	58	0	-	70	128	16	25	154	-
181st & I-84 WB	-	-	-	-	114	55	-	4	452	-	142	-
181st & I-84 EB	-	210	288	-	-	-	-	m228	-	167	158	-
181st & San Rafael	111	108	44	-	73	#164	m85	m143	-	#354	513	-
181st & Halsey	#351	165	-	100	147	-	#177	305	-	m86	58	-
P.M. Peak Hour	**Eastbound**			**Westbound**			**Northbound**			**Southbound**		
	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)
181st & Sandy	21	365	77	#375	252	41	#456	165	-	#530	391	-
181st @ US Bank	78	47	-	113	0	-	76	152	13	25	397	-
181st & I-84 WB	-	-	-	-	163	60	-	2	10	-	284	-
181st & I-84 EB	-	143	385	-	-	-	-	84	-	#393	192	-
181st & San Rafael	102	115	39	-	119	#218	m61	m419	-	m88	#847	-
181st & Halsey	#214	315	-	130	246	-	#288	271	-	m118	#764	-

m Queue is metered by upstream signal

95th percentile volume exceeds capacity--this is the queue experienced after two cycles

The models point to cycle failure on the mainline northbound at Halsey and San Rafael during the a.m. peak and southbound during the p.m. peak. Additionally, the left-turn queue from Halsey eastbound and northbound and right-turn queue from San Rafael westbound are failing to clear during most modeled periods. The left turn-through lane from the I-84 eastbound ramps is also overloaded during the a.m. peak hour.

Existing-Condition Arterial Level of Service

Table 5 shows the existing-condition arterial level of service for the corridor. With a posted speed of 40 miles per hour, NE 181st Avenue is classified as a Type II arterial. The City of

Gresham has no performance standards for arterial LOS, although a bi-directional corridor average of LOS D is the basis of a performance measure used by the City to track arterial performance.

Overall average arterial speed in the southbound direction results in LOS D during all three peak periods. The arterial's performance at Sandy Boulevard northbound is the worst in the study corridor for all three periods. This can be explained by the fact that the signal timing at Sandy is not biased towards the 181st corridor, unlike all five other study intersections. The maximum green times for all four through movements at the fully-actuated Sandy signal are 40 seconds. By comparison, the Halsey signal during the p.m. peak provides at least 56 seconds of green time to the 181st through movements and only 30-32 seconds of green time for the Halsey through movements.

Table 5: Existing-Condition Arterial Level of Service

		A.M. Peak Hour		Midday Peak Hour		P.M. Peak Hour	
Arterial	Cross Street	Arterial Speed (mph)	LOS	Arterial Speed (mph)	LOS	Arterial Speed (mph)	LOS
NB *NE 181st Avenue*	Halsey	24.0	C	26.8	C	26.9	C
	San Rafael	20.9	D	20.0	D	21.2	D
	I-84 EB	24.8	C	22.2	C	21.5	D
	I-84 WB	23.3	C	29.8	B	30.4	B
	US Bank	20.8	D	23.5	C	20.8	D
	Sandy	10.5	F	9.7	F	10.3	F
	TOTAL -	**21.0**	**D**	**21.6**	**D**	**21.7**	**D**
SB *NE 181st Avenue*	Sandy	25.2	C	23.9	C	21.2	D
	US Bank	16.6	E	19.3	D	15.6	E
	I-84 WB	25.5	C	25.2	C	23.5	C
	I-84 EB	12.1	F	15.9	E	15.2	E
	San Rafael	20.0	D	18.3	D	18.3	D
	Halsey	16.6	E	22.3	C	13.7	E
	TOTAL -	**20.2**	**D**	**21.2**	**D**	**18.4**	**D**

The other failing segment is southbound at the I-84 eastbound ramps, where the southbound through movement split is short, which leads to delay for that movement. It is also a function of the short road segment between the freeway ramps.

Optimized Existing Conditions

The signal timing used in the existing-condition a.m., midday, and p.m. peak hour models are the result of intensive refinement in the field for the four signals from the freeway to Halsey. However, the volumes as collected and annualized have resulted in modeled delays and queues that could be reduced with minor modifications to the signal timing.

To further improve model performance, the two fully actuated signals at US Bank and Sandy were also optimized using Synchro. Sandy was included in the coordinated system for the a.m. and midday peaks but not during the p.m. peak, where Synchro determined it would be detrimental to the corridor performance. The US Bank signal was coordinated with the system to the south in all three time periods.

Optimized Existing-Condition Intersection Levels of Service, Delays, and Volume to Capacity Ratios

Table 6 contains the peak hour LOS, delay and V/C ratios for the six study intersections.

Table 6: Optimized Existing-Condition Intersection Performance

	A.M. Peak Hour					Midday Peak Hour					P.M. Peak Hour				
	Intersection Average			Movement with Highest V/C		Intersection Average			Movement with Highest V/C		Intersection Average			Movement with Highest V/C	
Intersection	LOS	Delay (sec)	V/C Ratio	Movement	V/C Ratio	LOS	Delay (sec)	V/C Ratio	Movement	V/C Ratio	LOS	Delay (sec)	V/C Ratio	Movement	V/C Ratio
181st & Sandy	**C**	**29.1**	**0.68**	NB Left	0.84	**C**	**35.0**	**0.69**	WB Left	0.90	**D**	**41.1**	**0.77**	WB Left	0.92
181st @ US Bank	**A**	**10.0**	**0.49**	NB Left	0.50	**B**	**12.7**	**0.39**	NB Left	0.66	**B**	**14.1**	**0.67**	WB Left	0.76
181st & I-84 WB	**B**	**12.7**	**0.62**	WB Right	0.89	**A**	**5.5**	**0.47**	WB Thru	0.54	**A**	**5.5**	**0.58**	WB Thru	0.62
181st & I-84 EB	**B**	**16.7**	**0.70**	EB Thru	0.82	**B**	**16.4**	**0.55**	SB Left	0.69	**B**	**19.9**	**0.58**	SB Left	0.82
181st & San Rafael	**C**	**20.2**	**0.73**	SB Left	0.91	**C**	**26.3**	**0.70**	SB Left	0.94	**C**	**25.2**	**0.72**	SB Thru	0.83
181st & Halsey	**D**	**39.7**	**0.80**	NB Left	0.90	**C**	**32.3**	**0.72**	EB Left	0.92	**D**	**38.6**	**0.89**	NB Left	0.96

Table 7 shows the 95th percentile queue lengths generated by the optimized models.

Table 7: Optimized Existing-Condition 95th Percentile Queue Lengths

A.M. Peak Hour	Eastbound			Westbound			Northbound			Southbound		
Intersection	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)
181st & Sandy	29	131	55	#165	274	73	#361	328	-	119	97	-
181st @ US Bank	15	0	-	41	13	-	m244	202	m8	m51	92	-
181st & I-84 WB	-	-	-	-	113	312	-	112	226	-	0	-
181st & I-84 EB	-	458	111	-	-	-	-	m120	-	90	110	-
181st & San Rafael	69	81	39	-	40	#116	m0	175	-	#260	357	-
181st & Halsey	#200	114	-	74	#332	-	#265	543	-	#142	295	-

Midday Peak Hour	Eastbound			Westbound			Northbound			Southbound		
	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)
181st & Sandy	17	265	59	#258	183	31	#304	89	-	139	142	-
181st @ US Bank	51	49	-	95	0	-	109	242	29	m23	m207	-
181st & I-84 WB	-	-	-	-	114	55	-	102	538	-	64	-
181st & I-84 EB	-	199	208	-	-	-	-	m110	-	116	197	-
181st & San Rafael	111	108	44	-	73	#164	m91	m175	-	#306	341	-
181st & Halsey	#275	150	-	101	150	-	#199	307	-	m102	186	-

P.M. Peak Hour	Eastbound			Westbound			Northbound			Southbound		
	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)
181st & Sandy	17	278	66	#368	212	30	#391	142	-	266	286	-
181st @ US Bank	81	65	-	112	0	-	m82	161	m9	26	381	-
181st & I-84 WB	-	-	-	-	149	57	-	18	0	-	76	-
181st & I-84 EB	-	135	285	-	-	-	-	59	-	251	282	-
181st & San Rafael	90	103	35	-	101	157	m55	m#461	-	m86	#947	-
181st & Halsey	#234	286	-	#152	224	-	#283	254	-	m88	#235	-

m Queue is metered by upstream signal

95th percentile volume exceeds capacity--this is the queue experienced after two cycles

The movements with failing performance shown for the existing midday and p.m. peak hours in Table 2 would be improved with optimized timing. The substandard V/C ratios for the southbound left turns at San Rafael and the I-84 eastbound ramps during the midday and p.m. peak hours, respectively, are reduced to well below the maximum allowed by City standards.

Compared to the queue results shown Table 4, Table 7 shows fewer instances of cycle failure northbound and southbound during the a.m. and midday peak hours. Some queues for left-turn movements would increase, however, which reflects the bias that the optimized timing places on the mainline NE 181st Avenue movements.

During the a.m. peak hour, the optimized timing reduces the northbound through queues at Halsey and San Rafael and the eastbound shared left-turn and through queue at the I-84 eastbound ramps, which are now shown to clear every cycle. Similar improvements to the queues are shown for the southbound left turns at Sandy and eastbound I-84 ramps.

Table 8 shows the arterial levels of service for the optimized Synchro models.

Table 8: Optimized Existing-Condition Arterial Level of Service

		A.M. Peak Hour		Midday Peak Hour		P.M. Peak Hour	
Arterial	Cross Street	Arterial Speed (mph)	LOS	Arterial Speed (mph)	LOS	Arterial Speed (mph)	LOS
NB *NE 181st Avenue*	Halsey	24.8	C	27.0	C	27.0	C
	San Rafael	23.7	C	20.1	D	20.0	D
	I-84 EB	22.8	C	25.9	C	26.2	C
	I-84 WB	23.5	C	27.5	C	26.2	C
	US Bank	25.1	C	19.8	D	24.1	C
	Sandy	17.0	D	18.7	D	9.3	F
	TOTAL -	**23.3**	**C**	**20.2**	**D**	**21.9**	**D**
SB *NE 181st Avenue*	Sandy	26.9	C	25.8	C	23.0	C
	US Bank	16.9	E	23.1	C	16.9	E
	I-84 WB	24.9	C	28.5	B	26.5	C
	I-84 EB	16.9	E	15.7	E	12.7	F
	San Rafael	20.0	D	20.3	D	17.0	D
	Halsey	15.1	E	21.6	D	15.4	E
	TOTAL -	**21.2**	**D**	**22.9**	**C**	**19.0**	**D**

The optimized models bring the US Bank and Sandy intersections into the coordinated system during the a.m. and midday, greatly reducing the delays at those intersections on the arterial. The arterial speed near San Rafael is reduced with the optimized timing during the p.m. peak hour, reflecting the additional time devoted to the side-street and southbound left-turn movements to improve their performance.

Future Conditions

Four sets of future-condition models were created by Metro, based on their 2005 and 2030 emme/2 models, to evaluate four future improvements scenarios. These alternative scenarios have increasing degrees of improvement, from timing optimization, to controller improvements, to full corridor widening, to technology-based capacity improvements that would not require widening. As the optimized existing-condition a.m. peak performance is not shown to have movements that would be a concern in terms of capacity relative to the midday or p.m. peak, that time period was not modeled for future conditions. The existing conditions analysis shows that the p.m. peak hour is the design hour for the corridor. Additionally, the midday peak does exhibit some sub-standard performance, specifically at the San Rafael intersection, so that time period was also modeled.

The future forecast year for this study is 2027, or 20 years out from the modeled existing conditions. As the Metro models forecast 25-year growth, only 80% of the Metro model growth was applied to the existing conditions, assuming linear growth on the corridor over the 25 years.

Future Corridor Alternatives

Four future corridor improvement scenarios were modeled. Additional fixes at individual intersections (such as the elimination of the southbound U turn at San Rafael or the construction of dual left-turn pockets at Halsey) and added connections (the direct connection from the eastbound I-84 on-ramp to Wilkes Road, new connection between Wilkes Road and San Rafael west of 192nd Avenue), are independent of these alternatives and will be discussed separately. Figure 4 shows the channelization differences between the four future alternatives.

Alt 0 – No Build

No intersection improvements were assumed and the signal timing was optimized and coordinated at the six signalized study intersections by Synchro.

Alt 1 - SCATS Adaptive

The Sydney Coordinated Adaptive Traffic System (SCATS) adaptive signal system would be installed at the six signalized study intersections. Based on the City's experience on the Burnside corridor, the assumption was made that SCATS would provide an additional 10% capacity. A more efficient corridor will attract additional users, so Metro's future forecast modeling assumed a 10% capacity increase on all approaches.

In the Synchro model, the ideal saturated flow rate for all movements was increased from the nominal 1,900 vehicles per hour per lane to 2,090 vphpl. To partially reflect the improvements in the SimTraffic simulations, the Headway Factor in Synchro was reduced from the default 1.00 to 0.92 for all movements. However, adaptive coordinated cycle lengths cannot be modeled fully in Synchro or SimTraffic, so the modeling does not fully reflect the improvements.

In most of the models during both peak periods, Synchro would optimize the cycle lengths at lower than what would be viable at the Sandy Boulevard intersection, so it would leave Sandy running uncoordinated. Because Alt 1 is specifically for SCATS on the corridor, the cycle lengths in this alternative were always kept high enough to allow the Sandy signal to be included in the coordinated system.

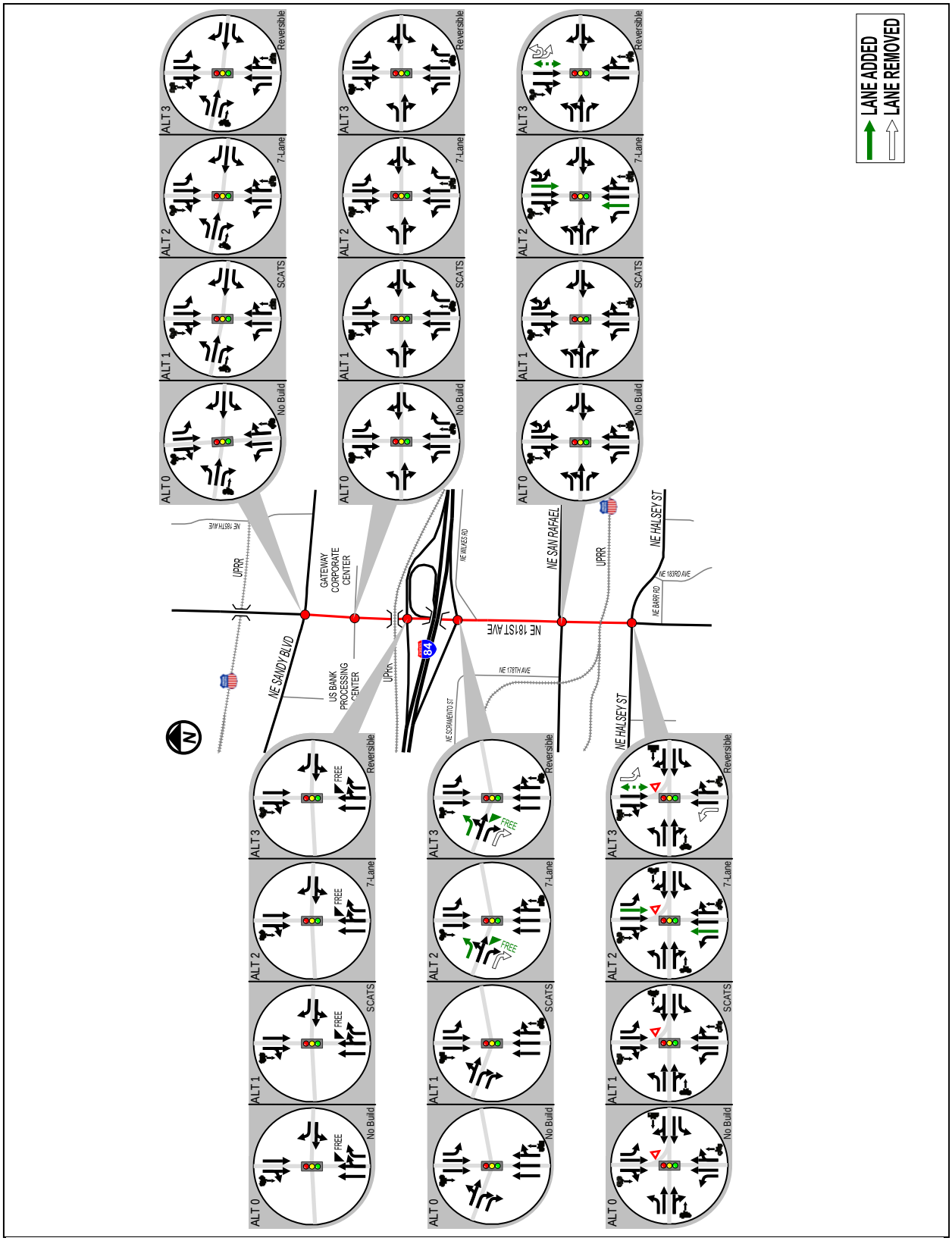

Figure 4: Future Alternatives Intersection Channelization

Alt 2 - 7-Lane

The corridor between the eastbound I-84 ramps and a point 650 feet south of NE Halsey Street (275 feet south of NE Barr Road) would be widened to a 7-lane cross cross-section to increase throughput capacity. All turn movements would be retained. The I-84 eastbound ramps intersection would be modified to create a free-right-turn onto the added southbound through lane. With the added capacity of a single free right lane, the remaining two lanes on the off-ramp would become dual left-turn lanes. Significant additional right-of-way would need to be acquired for this alternative.

To account for the modification in the cross section, the Metro future forecast model capacity for the widened NE 181st Avenue links was increased to 2,750.

SCATS adaptive control was also assumed for Alt 2, with ideal saturated flow increased to 2,090 vphpl and the headway factor reduced to 0.92 for all movements.

Alt 3 - Reversible

The corridor between the eastbound I-84 ramps and a point 650 feet south of NE Halsey Street (275 feet south of NE Barr Road) would be modified within its existing cross-section. The median barriers and two-way left-turn lanes would be removed and left turns from 181st to San Rafael and Halsey would be prohibited. The middle lane in the existing 5-lane section would become a reversible lane, with three lanes northbound during the morning commute until midmorning, and three lanes southbound for the rest of the day until the start of the a.m. commute. Electronic signage and/or a movable upright barrier would be used to designate the current direction of the center lane.

As was the case with Alt 2, the added southbound through lane that would begin at the I-84 eastbound ramps creates the opportunity for a free right turn from the eastbound off-ramp. With the added capacity of a single free right lane, the remaining two lanes on the off-ramp would become dual left-turn lanes. Figure 4 shows only the midday and p.m. peak configuration, with the reversible lane southbound.

This future scenario is the least viable. While it would serve to efficiently carry trips destined for the growing Southwest Gresham neighborhoods, those trips would be at the expense of freight trips in the industrial areas immediately south of the freeway. The prohibition of southbound left-turns at Halsey and San Rafael would significantly reduce freight access to the areas east of NE 181st Avenue.

To account for the modification in the cross section, the Metro midday and p.m. peak future forecast models capacities for the southbound NE 181st Avenue link was increased to 2,750 vehicles.

SCATS adaptive control was also assumed for the mainline movements in Alt 3, with ideal saturated flow increased to 2,090 vphpl and the headway factor reduced to 0.92.

Future Volumes Methodology

Metro, Portland's regional planning organization, provided output from their p.m. peak and midday peak emme/2 models for years 2005 and 2030 for the corridor. The Metro emme/2 models provide p.m. peak-2-hour and midday peak-hour directional link volumes and turning movements at link intersections.

The emme/2 model-generated turning movements were not used directly for this analysis. Instead, the future turning movements were determined from the growth between the two models, using the following method:

1. The link growth between the 2005 and 2030 p.m. peak-2-hour and midday peak hour models was determined by subtracting the link volumes of the 2005 emme/2 output for each alternative from the link volumes from the corresponding 2030 emme/2 output.
2. Assuming linear growth through the 25 years, 80% of this link growth was added to the existing (2007) p.m. peak-2-hour link volumes or midday peak-hour volumes to create 2027 future models.
3. 2027 turning-movement proportions (the percentage of left turns, right turns, or through movements as part of the entire approach) at each intersection are based 50% on those in the future models (to allow for changing travel patterns in the future), and based 50% on the 2007 p.m. peak hour counts (which helps to maintain realism in the final results).
4. The volumes were then adjusted to balance the link volumes along the corridor. The difference between the volumes entering and exiting a link was limited to 5%, with growth rates kept as close to those in the Metro emme/2 model as possible.

US Bancorp/Gateway Corporate Center Driveway Growth

The Metro model does not contain the intersection of NE 181st Avenue at the US Bancorp/ Gateway Corporate Center driveways. However, the model does show a centroid connector intersection[‡] near that location. Consequently, as those driveways are the only ones serving the commercial and light industrial areas between the freeway and Sandy Boulevard, the growth on that centroid connector was used to represent the growth at both driveways. Only the 2007 existing turn proportions were used for the future years at this intersection, which, while a reasonable approximation, is likely not truly representative of where the growth at this intersection will take place.

Future Alternatives Projected Traffic Volumes

Figures 5 and 6 show the 2027 future forecast midday peak-hour volumes and 2027 future forecast p.m. peak-hour volumes used in the analysis, respectively.

For both the peak periods studied, the major differences between the four alternatives are predictable and consistent: the southbound volumes on 181st for Alt 2 and Alt 3 are significantly higher than those for Alt 0 and Alt 1. For Alt 0 and Alt 1 in the p.m. peak hour, the 2027 southbound volume on 181st is nearly identical to the 2007 existing volume. The added capacity of Alt 2 and Alt 3 attract additional southbound trips to the already-congested corridor.

The peak hour factors for both midday and p.m. peak hour future models were set at 0.96 to account for the future spreading of the peaks.

[‡] A centroid connector is used in the Metro model to move model trips to and from the center of an analysis area onto the network. A centroid connector intersection is a node in the model that represents multiple driveways and non-arterial streets that are not included in the model network.

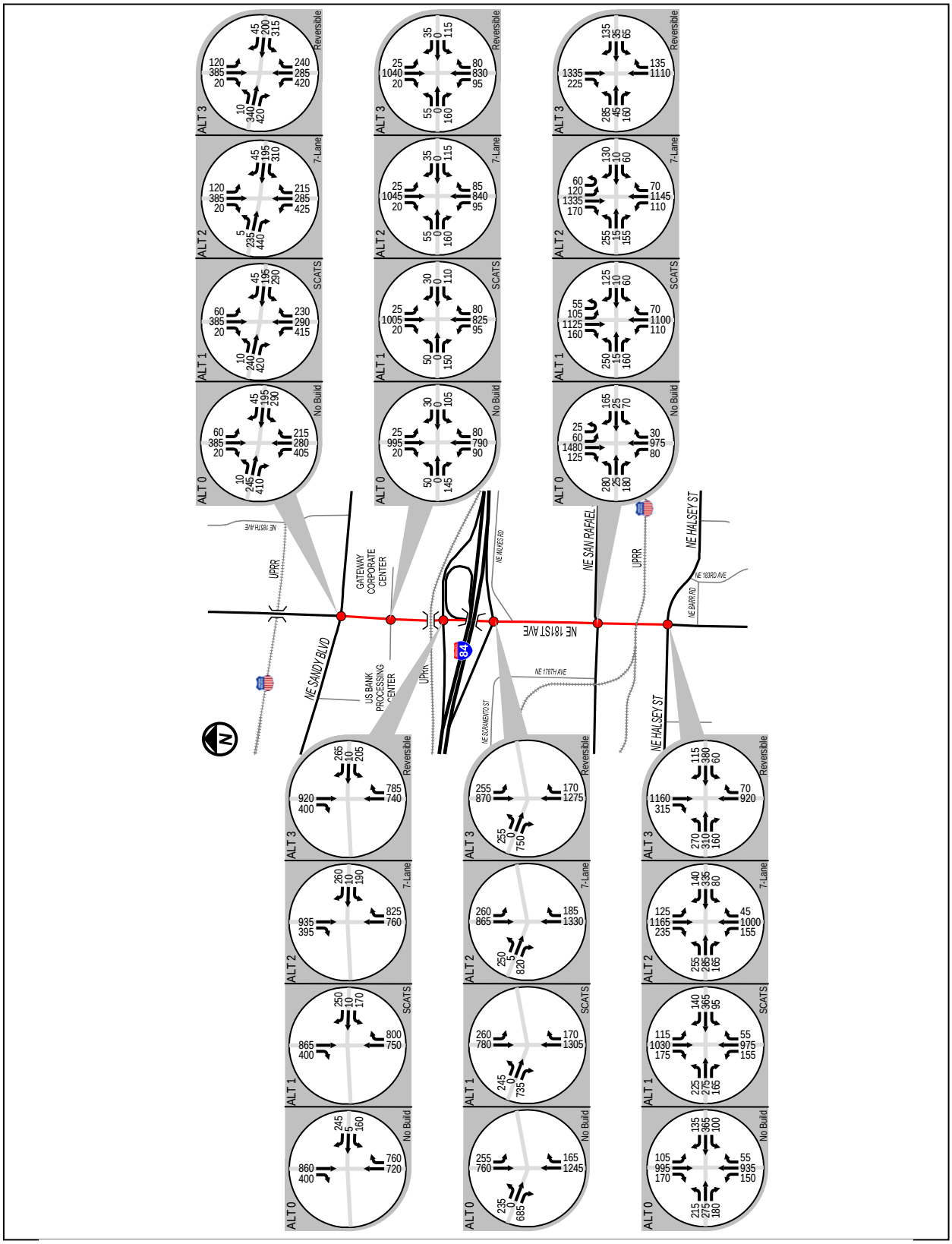

Figure 5: 2027 Future Forecast Midday Peak Hour Turning Movement Volumes

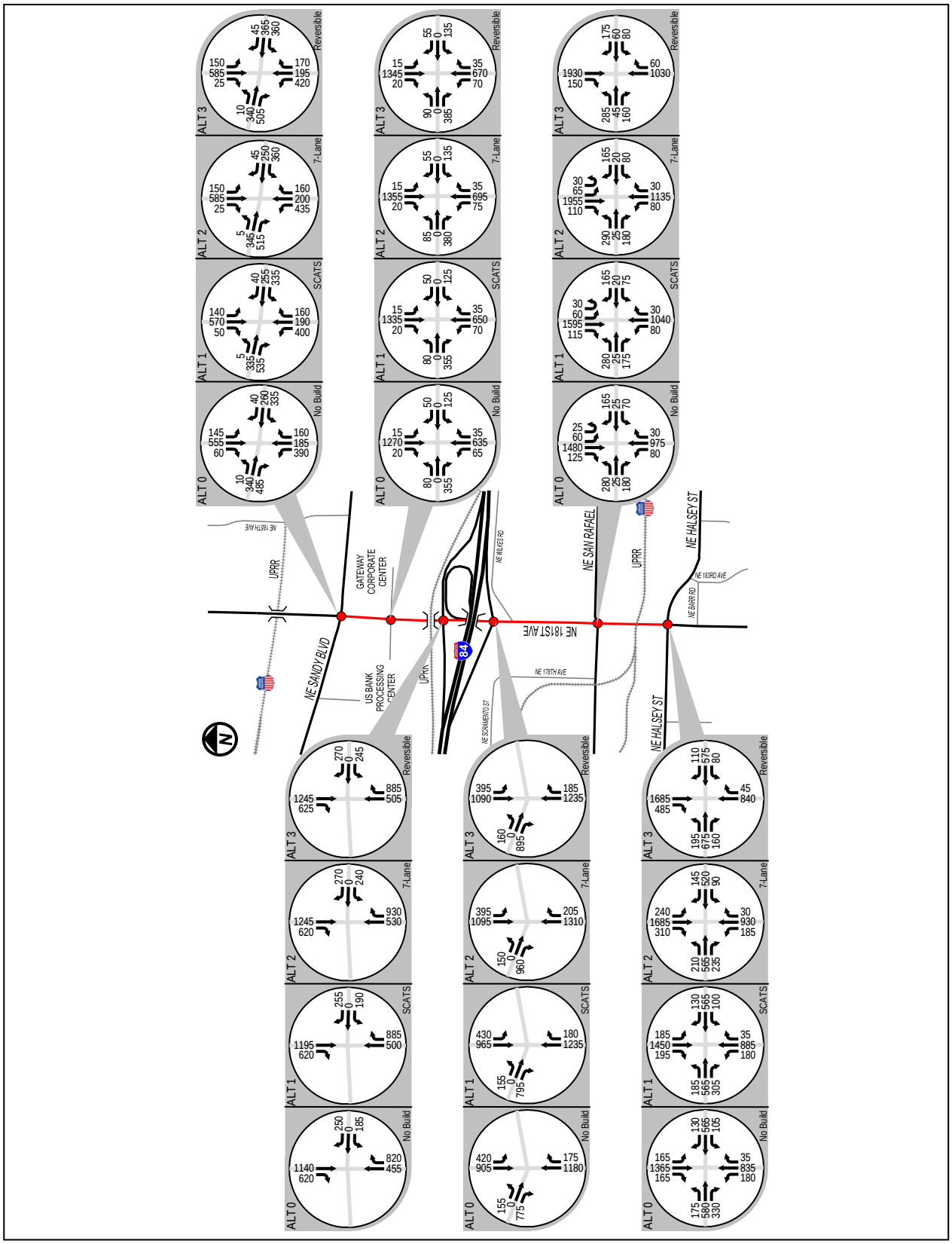

Figure 6: 2027 Future Forecast PM Peak Hour Turning Movement Volumes

Future Alternatives Corridor Traffic Operations Analysis

Future Alternatives Intersection Performance

Table 9 and Table 10 contain the 2027 future midday peak hour intersection performance and queue length results, respectively, for the six study intersections in the four future alternatives.

Table 9: 2027 Future Alternatives Midday Peak Hour Intersection Performance

	Alt 0 - No Build					Alt 1 - SCATS Adaptive				
	Intersection Average			Movement with Highest V/C Ratio		Intersection Average			Movement with Highest V/C Ratio	
Intersection	LOS	Delay (sec)	V/C Ratio	Movement	V/C Ratio	LOS	Delay (sec)	V/C Ratio	Movement	V/C Ratio
181st & Sandy	D	46.8	0.82	NB Left	0.93	D	44.6	0.76	WB Left	1.02
181st @ US Bank	C	24.9	0.54	SB Thru	0.81	B	10.9	0.55	WB Left	0.75
181st & I-84 WB	A	7.1	0.57	WB Thru	0.67	A	9.8	0.52	WB Thru	0.77
181st & I-84 EB	B	16.6	0.72	SB Left	0.83	C	20.9	0.66	EB Thru	0.72
181st & San Rafael	D	37.6	0.82	SBL & SBT	0.94	C	30.7	0.71	SB Left	0.79
181st & Halsey	D	35.9	0.88	EB Left	0.97	D	39.1	0.80	EB Left	0.92

	Alt 2 - 7-Lane					Alt 3 - Reversible				
	Intersection Average			Movement with Highest V/C Ratio		Intersection Average			Movement with Highest V/C Ratio	
Intersection	LOS	Delay (sec)	V/C Ratio	Movement	V/C Ratio	LOS	Delay (sec)	V/C Ratio	Movement	V/C Ratio
181st & Sandy	D	49.9	0.77	WB Left	1.05	D	43.2	0.79	NB Left	0.92
181st @ US Bank	B	11.6	0.53	WB Left	0.76	B	11.3	0.57	WB Left	0.66
181st & I-84 WB	A	9.5	0.51	WB Thru	0.80	A	7.3	0.57	WB Thru	0.68
181st & I-84 EB	B	13.5	0.67	EB Thru	0.63	B	11.0	0.58	SB Left	0.67
181st & San Rafael	C	29.9	0.75	WB Right	0.73	B	16.0	0.58	EBL & NBT	0.60
181st & Halsey	D	36.1	0.81	EB Left	0.93	B	19.9	0.67	EB Left	0.90

Overall intersection performance is acceptable at all intersections during the midday, even with Alt 0, the no-build alternative. The substandard westbound left turn at Sandy with Alt 1 and Alt 2 is the result of coordinated timing at that intersection. During the midday the other alternatives have fully-actuated timing at that intersection, which improves the performance of individual movements.

In the midday peak, cycle failures are predicted for the westbound and northbound left-turn movements at Sandy for all four alternatives. The southbound U- and left-turn movement at San Rafael is also consistently suffering cycle failures in the alternatives where those movements are permitted.

Table 10: 2027 Midday Peak Hour Future Alternatives
95th Percentile Queue Lengths

Alt 0 - No Build	Eastbound			Westbound			Northbound			Southbound		
Intersection	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)
181st & Sandy	30	326	106	#483	205	28	#626	173	-	109	245	-
181st @ US Bank	56	0	-	108	0	-	m115	164	m3	43	368	-
181st & I-84 WB	-	-	-	-	163	89	-	106	542	-	32	-
181st & I-84 EB	-	233	193	-	-	-	-	m124	-	219	210	-
181st & San Rafael	151	145	52	-	86	142	m93	m#601	-	#246	#734	-
181st & Halsey	#303	151	-	122	210	-	#226	418	-	m66	m#476	-

Alt 1 - SCATS Adaptive	Eastbound			Westbound			Northbound			Southbound		
	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)
181st & Sandy	29	290	98	#468	195	28	#592	124	-	102	221	-
181st @ US Bank	78	0	-	158	0	-	m152	78	m5	m40	m123	-
181st & I-84 WB	-	-	-	-	230	125	-	176	482	-	70	-
181st & I-84 EB	-	286	255	-	-	-	-	208	-	m332	173	-
181st & San Rafael	191	186	62	-	104	180	m152	m290	-	#252	506	-
181st & Halsey	#322	200	-	146	285	-	#243	496	-	m133	275	-

Alt 2 - 7-Lane	Eastbound			Westbound			Northbound			Southbound		
	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)
181st & Sandy	19	284	101	#498	191	27	#625	166	-	174	221	-
181st @ US Bank	83	0	-	163	0	-	m140	108	m6	m38	m129	-
181st & I-84 WB	-	-	-	-	255	141	-	117	394	-	78	-
181st & I-84 EB	178	186	0	-	-	-	-	143	-	m340	137	-
181st & San Rafael	195	189	61	-	101	183	m153	m269	-	232	339	-
181st & Halsey	319	188	-	127	264	-	215	333	-	190	139	-

Alt 3 - Reversible	Eastbound			Westbound			Northbound			Southbound		
	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)
181st & Sandy	29	290	98	#496	195	27	#628	186	-	174	221	-
181st @ US Bank	59	0	-	114	0	-	m104	70	m3	40	281	-
181st & I-84 WB	-	-	-	-	171	109	-	125	289	-	47	-
181st & I-84 EB	126	126	0	-	-	-	-	279	-	m224	100	-
181st & San Rafael	135	130	46	-	101	51	-	m306	-	-	323	-
181st & Halsey	233	107	-	73	171	-	-	341	-	-	64	-

m Queue is metered by upstream signal

95th percentile volume exceeds capacity--this is the queue experienced after two cycles

Table 11: 2027 Future Alternatives Midday Peak Hour Arterial Level of Service

		Alt 0 - No Build		Alt 1 - SCATS		Alt 2 - 7-Lane		Alt 3 - Reversible	
Arterial	Cross Street	Arterial Speed (mph)	LOS	Arterial Speed (mph)	LOS	Arterial Speed (mph)	LOS	Arterial Speed (mph)	LOS
NB *NE 181st Avenue*	Halsey	24.3	C	24.2	C	25.8	C	28.9	B
	San Rafael	14.0	E	19.4	D	16.2	E	19.4	D
	I-84 EB	24.0	C	21.4	D	24.2	C	22.9	C
	I-84 WB	26.0	C	23.6	C	28.2	B	26.5	C
	US Bank	13.9	E	27.3	C	24.4	C	25.9	C
	Sandy	12.7	F	21.1	D	16.8	E	12.0	F
	TOTAL -	**19.6**	**D**	**22.9**	**C**	**22.8**	**C**	**22.7**	**C**
SB *NE 181st Avenue*	Sandy	19.7	D	22.3	C	22.4	C	21.1	D
	US Bank	9.2	F	24.0	C	23.5	C	17.4	D
	I-84 WB	27.2	C	25.9	C	24.1	C	26.8	C
	I-84 EB	18.1	D	18.0	D	22.9	C	24.9	C
	San Rafael	13.2	E	16.6	E	17.5	D	21.7	D
	Halsey	17.1	D	19.2	D	19.2	D	24.2	C
	TOTAL -	**16.6**	**E**	**20.6**	**D**	**21.2**	**D**	**21.9**	**D**

Table 11 shows the modeled arterial level of service for the midday peak hour. For the midday the models show a problem with the corridor northbound at Sandy for Alt 0 and Alt 3, which are the two scenarios that did not coordinate Sandy with the other five intersections. For Alt 1 and Alt 2 the Synchro optimization coordinated Sandy as part of the system during the midday peak.

Given the acceptable intersection performance during the midday peak and limited scope of the problem movements shown by the queue results, the future midday peak does not warrant extensive further study. The choice of a preferred alternative will be based on forecast 2027 p.m. peak hour results.

Table 12 and Table 13 show the 2027 future p.m. peak hour intersection performance and queue length results, respectively, for the six study intersections in the four future alternatives.

Table 12: 2027 Future Alternatives P.M. Peak Hour Intersection Performance

	Alt 0 - No Build					Alt 1 - SCATS Adaptive				
	Intersection Average			Movement with Highest V/C Ratio		Intersection Average			Movement with Highest V/C Ratio	
Intersection	LOS	Delay (sec)	V/C Ratio	Movement	V/C Ratio	LOS	Delay (sec)	V/C Ratio	Movement	V/C Ratio
181st & Sandy	E	62.3	0.98	NB Left	1.05	D	54.9	0.90	WB Left	1.00
181st @ US Bank	B	19.0	0.95	WB Left	0.91	B	16.8	0.98	WB Left	0.89
181st & I-84 WB	A	8.1	0.75	WB Thru	0.79	A	7.8	0.71	WB Thru	0.77
181st & I-84 EB	C	29.5	0.72	NB Thru	0.77	C	25.6	0.69	SB Left	0.78
181st & San Rafael	D	40.5	0.93	WBR & SBT	0.98	C	34.9	0.86	SB Thru	0.95
181st & Halsey	E	68.4	1.06	NB Left	1.09	D	54.3	0.97	NB Left	1.03

	Alt 2 - 7-Lane					Alt 3 - Reversible				
	Intersection Average			Movement with Highest V/C Ratio		Intersection Average			Movement with Highest V/C Ratio	
Intersection	LOS	Delay (sec)	V/C Ratio	Movement	V/C Ratio	LOS	Delay (sec)	V/C Ratio	Movement	V/C Ratio
181st & Sandy	E	64.9	0.93	WBL & NBL	0.98	E	59.3	0.92	WBL & NBL	0.98
181st @ US Bank	C	22.8	0.90	WB Left	0.91	C	20.2	0.89	WB Left	0.89
181st & I-84 WB	A	7.9	0.76	WB Thru	0.77	A	7.7	0.78	SB Thru	0.80
181st & I-84 EB	B	11.3	0.67	SB Left	0.90	A	9.6	0.66	SB Left	0.79
181st & San Rafael	C	30.5	0.80	SB Thru	0.93	B	19.1	0.70	SB Thru	0.77
181st & Halsey	D	39.1	0.95	SB Thru	0.98	C	23.0	0.85	EB Left	0.91

During the p.m. peak hour, the future modeled alternatives show a consistent problem at Sandy in terms of intersection delay and V/C ratio. The intersection V/C ratio at 181st & Halsey is higher than standards allow for all but Alt 3, which removes two of the eight phases at the intersection.

Surprisingly, the intersection V/C ratio at US Bank also fails to meet city standards for those same three alternatives. This may point to a problem for the eastbound and westbound phases, where the westbound left turns conflict with the heavy projected eastbound right turns. While there may be a question as to whether the forecast volumes and assignments at that intersection are realistic, a revision could shift some of the eastbound right turns to westbound left turns (or vice versa), so the conflict would remain. A modification to the eastbound and westbound phasing would be required for acceptable future performance.

Table 13: 2027 P.M. Peak Hour Future Alternatives 95th Percentile Queue Lengths

Alt 0 - No Build	Eastbound			Westbound			Northbound			Southbound		
Intersection	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)
181st & Sandy	30	#534	211	#551	265	30	#634	107	-	213	#411	-
181st @ US Bank	99	264	-	#202	0	-	m114	144	m10	m17	m275	-
181st & I-84 WB	-	-	-	-	253	77	-	12	343	-	142	-
181st & I-84 EB	-	223	356	-	-	-	-	m410	-	519	309	-
181st & San Rafael	238	231	68	-	146	#319	m108	m156	-	m132	#1026	-
181st & Halsey	#332	#624	-	#223	#498	-	#361	460	-	m144	m#890	-

Alt 1 - SCATS Adaptive	Eastbound			Westbound			Northbound			Southbound		
	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)
181st & Sandy	20	#476	#318	#529	250	28	#599	108	-	201	363	-
181st @ US Bank	96	248	-	180	0	-	120	175	m6	m18	m297	-
181st & I-84 WB	-	-	-	-	251	76	-	0	334	-	176	-
181st & I-84 EB	-	207	352	-	-	-	-	213	-	536	281	-
181st & San Rafael	227	218	66	-	140	#288	m111	m176	-	m136	#1080	-
181st & Halsey	#345	#572	-	#187	#470	-	#341	447	-	m155	m#909	-

Alt 2 - 7-Lane	Eastbound			Westbound			Northbound			Southbound		
	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)
181st & Sandy	21	#550	#323	#577	256	31	#674	170	-	180	388	-
181st @ US Bank	85	201	-	#197	0	-	108	161	m2	34	580	-
181st & I-84 WB	-	-	-	-	243	66	-	64	141	-	144	-
181st & I-84 EB	102	102	0	-	-	-	-	135	-	m345	150	-
181st & San Rafael	180	172	56	-	114	#204	m62	m112	-	m119	#809	-
181st & Halsey	#308	#386	-	119	#327	-	#283	280	-	m213	m#610	-

Alt 3 - Reversible	Eastbound			Westbound			Northbound			Southbound		
	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)
181st & Sandy	30	#511	#317	#574	267	32	#645	158	-	175	373	-
181st @ US Bank	76	134	-	#175	0	-	81	120	m5	28	#554	-
181st & I-84 WB	-	-	-	-	194	57	-	98	191	-	#206	-
181st & I-84 EB	89	89	0	-	-	-	-	312	-	m259	102	-
181st & San Rafael	152	147	46	-	128	82	-	m216	-	-	#583	-
181st & Halsey	#236	295	-	91	249	-	-	248	-	-	#155	-

m Queue is metered by upstream signal

95th percentile volume exceeds capacity--this is the queue experienced after two cycles

From these results it appears that the added capacity that would come with Alt 2 would attract enough additional trips to cancel out the benefit of that corridor improvement. This is not true for Alt 3, where the additional southbound through capacity and elimination of left-turn phases at San Rafael and Halsey would provide good corridor performance. Ultimately, Alt 3 is not a solution that's suitable for the freight-sensitive needs on the corridor.

At Sandy, the northbound and westbound left-turn movements would consistently experience cycle failure during the p.m. peak hour with the existing intersection configuration.

For Alt 0 and Alt 1, the San Rafael intersection has a significant metering effect southbound at the Halsey intersection. For the other two alternatives the metering effect is less pronounced because there is more through capacity at San Rafael. The significant queue lengths and cycle failures at San Rafael that are shown for Alt 0, Alt 1, and to a lesser extent for Alt 2, point to a

capacity issue that is not reflected in the delay and V/C results at that intersection. Modifications will be needed at that intersection to improve corridor throughput.

The increased capacity of the south half of the study segment in Alt 2 and Alt 3 attracts additional trips through the north end, introducing such problems as the extended queue and cycle failure for the southbound through movement at US Bank.

The 2027 modeled arterial level of service for the p.m. peak hour is shown in Table 14.

Table 14: 2027 Future Alternatives P.M. Peak Hour Arterial Level of Service

		Alt 0 - No Build		Alt 1 - SCATS		Alt 2 - 7-Lane		Alt 3 - Reversible	
Arterial	Cross Street	Arterial Speed (mph)	LOS	Arterial Speed (mph)	LOS	Arterial Speed (mph)	LOS	Arterial Speed (mph)	LOS
NB *NE 181st Avenue*	Halsey	22.5	C	23.1	C	22.9	C	29.7	B
	San Rafael	22.2	C	23.1	C	24.7	C	19.5	D
	I-84 EB	17.4	D	20.6	D	23.6	C	22.9	C
	I-84 WB	29.8	B	30.4	B	26.5	C	28.2	B
	US Bank	18.4	D	22.6	C	21.4	D	21.4	D
	Sandy	16.9	E	17.3	D	7.1	F	7.7	F
	TOTAL -	**20.6**	**D**	**22.4**	**C**	**19.5**	**D**	**21.0**	**D**
SB *NE 181st Avenue*	Sandy	17.3	D	19.5	D	17.9	D	18.4	D
	US Bank	20.9	D	21.5	D	11.5	F	11.6	F
	I-84 WB	23.8	C	23.9	C	22.9	C	21.4	D
	I-84 EB	13.6	E	14.4	E	24.6	C	25.9	C
	San Rafael	12.6	F	13.8	E	13.7	E	19.5	D
	Halsey	9.4	F	14.4	E	14.8	E	29.5	B
	TOTAL -	**15.0**	**E**	**17.4**	**D**	**16.5**	**E**	**18.5**	**D**

The arterial LOS results point to the problem intersections in terms of corridor performance. The northbound average corridor speed at Sandy and southbound speed at US Bank are below 10 miles per hour in Alt 2 and Alt 3, a result of the higher traffic volumes on the corridor. Alt 0 and Alt 1, on the other hand, have southbound capacity restrictions at the south end of the corridor, at San Rafael and Halsey.

Additional Improvements to the Future Alternatives

Improvements need to be made at the study intersections for each of the alternatives that will bring intersection performance up to City of Gresham standards during the p.m. peak hour. Some of these improvements are already listed as Transportation Impact Fee Projects in the City of Gresham's Capital Improvement Plan. Each of the four p.m. peak hour future alternative models was modified to incorporate the improvements required to bring the intersections into compliance with City performance standards. Figure 7 shows these additional improvements for each alternative.

The improvements at most intersections are the same for all alternatives:

At Sandy:

- At the NE Sandy Boulevard intersection, an unfunded Traffic Impact Fee project (No. 521200) would add a dual westbound left-turn lane and a northbound right-turn pocket.

The northbound right-turn pocket is not required, however. Instead, a dual northbound left-turn pocket would be required to make the intersection function acceptably in 2027.

At US Bank/Gateway Corporate Center driveways:

- At the US Bancorp/Gateway Corporate Center driveway intersection, the westbound left-turn movement requires a protected phase to operate acceptably because of the heavy volumes on the conflicting eastbound right turn movement. All four future alternatives were modified to incorporate protected-permitted left-turn phasing eastbound and westbound at the intersection.

At freeway ramps:

- No additional modifications are necessary at the freeway ramp intersections for any of the four future alternatives beyond what is proposed for the alternatives themselves. The unfunded TIF project that would widen southbound 181st to three lanes between US Bank and the westbound freeway (No. 521300) would not be required, nor would the TIF that would replace the southbound left-turn pocket at the eastbound ramps with a partial cloverleaf (No. 516600). However, the impact of those unfunded TIF projects will be examined later in this report.

At San Rafael:

- The crosswalk over the north leg of the San Rafael intersection should be closed for all alternatives to reduce the minimum split for the westbound approach.
- In the models for Alt 0 and Alt 1, the southbound U turn at the San Rafael intersection would be prohibited and the restriction on the westbound right turn on red would be removed. The U-turning vehicles were assumed to be mostly redirected, with 25% instead turning southbound left and the remaining 75% assigned to the eastbound left (for the traffic that reroute from the businesses west of 181st back to northbound 181st via 178th and San Rafael). Removing the U turn will be unpopular with local businesses, however.
- For Alt 2, the added capacity at the intersection allows the U-turn movement to remain at San Rafael.
- For Alt 3, the northbound and southbound left turns are removed, so the U turn was already removed from this model.

At Halsey:

- The unfunded TIF project at the Halsey intersection (No. 515200) would add northbound and southbound dual left-turn pockets, as well as eastbound, westbound and southbound right-turn pockets with overlap. The westbound slip lane with yield control would be removed. This project was incorporated into the models for Alt 0, and Alt 1 with improvements.
- For Alt 2, the added capacity on the 181st mainline removes the need for the additional turn lanes that would be built with the TIF project.
- For Alt 3, the elimination of the northbound and southbound left turn phases at Halsey renders the dual left-turn lanes in the TIF project moot. However, the future performance at Halsey in Alt 3 wouldn't require the addition of the TIF project.

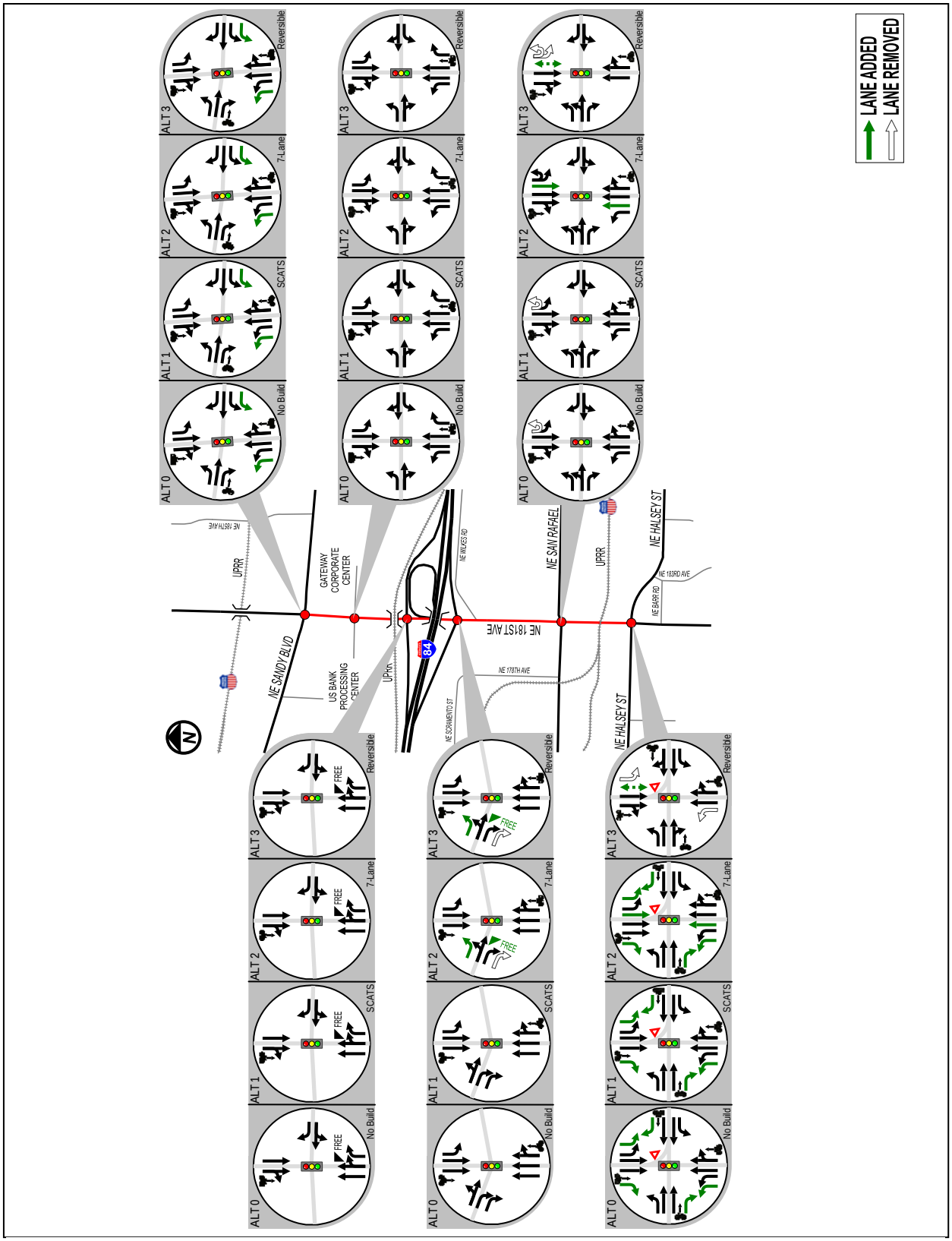

Figure 7: Future Alternatives Intersection Channelization with Improvements

Future Alternatives with Additional Improvements Traffic Operations Analysis

Future Alternatives with Additional Improvements Intersection Performance

Table 15 contains the 2027 future intersection performance results for the six study intersections.

The proposed intersection improvements at Sandy bring that intersection into compliance with City standards in all four alternatives, as do the phase changes at the US Bank intersection and the improvements at the Halsey intersection for Alt 0 and Alt1.

Table 15: 2027 Future Alternatives with Additional Improvements P.M. Peak Hour Intersection Performance

	Alt 0 - No Build					Alt 1 - SCATS Adaptive				
	Intersection Average			Movement with Highest V/C Ratio		Intersection Average			Movement with Highest V/C Ratio	
Intersection	LOS	Delay (sec)	V/C Ratio	Movement	V/C Ratio	LOS	Delay (sec)	V/C Ratio	Movement	V/C Ratio
181st & Sandy	**D**	**43.1**	**0.74**	WB Left	0.86	**D**	**41.5**	**0.73**	WB Left	0.84
181st @ US Bank	**C**	**21.0**	**0.77**	EB Thru	0.89	**B**	**19.7**	**0.72**	EB Thru	0.87
181st & I-84 WB	**A**	**7.6**	**0.76**	WBT & SBT	0.76	**A**	**6.7**	**0.71**	WB Thru	0.74
181st & I-84 EB	**C**	**25.2**	**0.74**	SB Left	0.89	**C**	**25.1**	**0.70**	SB Left	0.78
181st & San Rafael	**C**	**29.5**	**0.82**	SB Thru	0.93	**C**	**25.2**	**0.78**	SB Thru	0.87
181st & Halsey	**D**	**36.6**	**0.88**	EB Left	0.92	**C**	**33.2**	**0.80**	EB Left	0.91

	Alt 2 - 7-Lane					Alt 3 - Reversible				
	Intersection Average			Movement with Highest V/C Ratio		Intersection Average			Movement with Highest V/C Ratio	
Intersection	LOS	Delay (sec)	V/C Ratio	Movement	V/C Ratio	LOS	Delay (sec)	V/C Ratio	Movement	V/C Ratio
181st & Sandy	**D**	**39.6**	**0.69**	WB Left	0.87	**D**	**38.3**	**0.74**	NB Left	0.98
181st @ US Bank	**B**	**19.0**	**0.74**	EB Thru	0.88	**B**	**19.4**	**0.70**	EB Thru	0.79
181st & I-84 WB	**A**	**7.2**	**0.76**	WB Thru	0.78	**A**	**8.3**	**0.78**	SB Thru	0.80
181st & I-84 EB	**B**	**10.1**	**0.66**	SB Left	0.74	**B**	**10.2**	**0.66**	SB Left	0.79
181st & San Rafael	**C**	**28.5**	**0.79**	WB Right	0.97	**B**	**17.7**	**0.70**	SB Thru	0.74
181st & Halsey	**C**	**30.3**	**0.82**	EB Left	0.93	**C**	**23.7**	**0.82**	EB Left	0.91

Future Alternatives with Additional Improvements Queue Lengths

Table 16 contains the 2027 future queue length results for the four alternatives with additional improvements. The alternative with the fewest movements that would experience cycle failure is Alt 1. Alt 3 best improves throughput on 181st southbound, but its added volumes at the north end of the corridor cause failures at those intersections.

Table 16: 2027 Future Alternatives with Improvements P.M. Peak Hour 95th Percentile Queue Lengths

Alt 0 - No Build	Eastbound			Westbound			Northbound			Southbound		
Intersection	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)
181st & Sandy	27	#405	429	#196	240	17	220	113	-	190	320	-
181st @ US Bank	87	255	-	#141	0	-	m107	180	m10	m17	411	-
181st & I-84 WB	-	-	-	-	222	71	-	94	197	-	94	-
181st & I-84 EB	-	190	311	-	-	-	-	257	-	#521	321	-
181st & San Rafael	210	203	60	-	137	73	m111	m166	-	m90	#952	-
181st & Halsey	#271	303	291	#183	#344	65	117	358	-	m71	m#176	m3

Alt 1 - SCATS Adaptive	Eastbound			Westbound			Northbound			Southbound		
	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)
181st & Sandy	19	374	463	194	237	17	201	81	-	182	314	-
181st @ US Bank	86	249	-	126	0	-	107	150	m1	m17	438	-
181st & I-84 WB	-	-	-	-	223	71	-	0	256	-	125	-
181st & I-84 EB	-	187	324	-	-	-	-	292	-	486	241	-
181st & San Rafael	209	203	59	-	#141	73	m114	m154	-	m93	#951	-
181st & Halsey	#274	297	182	141	308	74	116	369	-	m85	253	m3

Alt 2 - 7-Lane	Eastbound			Westbound			Northbound			Southbound		
	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)
181st & Sandy	17	352	425	#213	213	14	233	14	-	179	277	-
181st @ US Bank	87	261	-	#131	0	-	111	177	m6	m17	405	-
181st & I-84 WB	-	-	-	-	256	69	-	123	73	-	62	-
181st & I-84 EB	106	106	0	-	-	-	-	m142	-	m356	127	-
181st & San Rafael	185	178	57	-	127	#270	m99	m73	-	m125	#722	-
181st & Halsey	#291	261	132	122	256	74	#262	294	-	m146	121	m3

Alt 3 - Reversible	Eastbound			Westbound			Northbound			Southbound		
	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)	Left (feet)	Thru (feet)	Right (feet)
181st & Sandy	24	309	#365	#196	202	9	#282	111	-	151	245	-
181st @ US Bank	71	110	-	100	0	-	88	182	m14	27	#582	-
181st & I-84 WB	-	-	-	-	194	57	-	98	189	-	#233	-
181st & I-84 EB	89	89	0	-	-	-	-	310	-	m258	102	-
181st & San Rafael	152	147	80	-	#153	75	-	m195	-	-	439	-
181st & Halsey	#236	295	-	91	249	-	-	248	-	-	#147	-

m Queue is metered by upstream signal

95th percentile volume exceeds capacity--this is the queue experienced after two cycles

Table 17 shows the p.m. peak hour arterial level of service for the four future alternatives with additional improvements. The improvements to the Sandy, San Rafael, and Halsey intersections have brought the arterial performance up to LOS C northbound and LOS D in the peak southbound direction.

Table 17: 2027 Future Alternatives with Improvements
P.M. Peak Hour Arterial Level of Service

		Alt 0 - No Build		Alt 1 - SCATS		Alt 2 - 7-Lane		Alt 3 - Reversible	
Arterial	Cross Street	Arterial Speed (mph)	LOS	Arterial Speed (mph)	LOS	Arterial Speed (mph)	LOS	Arterial Speed (mph)	LOS
NB *NE 181st Avenue*	Halsey	26.0	C	26.4	C	23.3	C	29.7	B
	San Rafael	21.1	D	21.7	D	24.1	C	20.5	D
	I-84 EB	19.5	D	19.0	D	23.6	C	21.9	D
	I-84 WB	27.7	C	30.4	B	27.9	C	28.2	B
	US Bank	20.8	D	21.1	D	21.2	D	18.8	D
	Sandy	17.8	D	19.7	D	22.4	C	11.9	F
	TOTAL -	**22.7**	**C**	**23.2**	**C**	**23.5**	**C**	**22.7**	**C**
SB *NE 181st Avenue*	Sandy	20.2	D	22.6	C	24.0	C	25.0	C
	US Bank	15.3	E	15.4	E	16.1	E	12.4	F
	I-84 WB	24.1	C	25.3	C	24.5	C	20.2	D
	I-84 EB	14.0	E	16.5	E	25.1	C	25.9	C
	San Rafael	14.9	E	17.1	D	15.9	E	21.0	D
	Halsey	19.3	D	20.2	D	20.3	D	18.6	D
	TOTAL -	**18.0**	**D**	**19.9**	**D**	**20.8**	**D**	**21.1**	**D**

Evaluation of Transportation Impact Fee Projects and Urban Renewal Projects

There are three NE 181st Avenue corridor projects shown in the current City of Gresham Traffic Impact Fee project list in addition to those already incorporated into the "Future with Improvements" models. There are also projects listed in the Urban Renewal CIP to improve connectivity within the industrial area. Other projects included in this section are those designed to retain the southbound U turn at NE San Rafael Street while improving the freight mobility through that intersection. The following is a list of these projects.

Southbound Widening between I-84 Westbound Ramps and NE Halsey Street (TIF No. 515100, unfunded)

This project could have been modeled as a separate alternative in the report, although Alt 2, the 7-lane alternative, without additional improvements, is a close approximation of it during the midday and p.m. peaks. To evaluate this specific TIF project, the p.m. peak hour Alt 2 model with and without improvements was modified to remove the third northbound through lane and then re-optimized. The results are shown in Table 19.

Table 19: P.M. Peak Hour Intersection Performance of TIF Project 515100 (Southbound 181st Widening)

	Without Addl. Improvements					With Additional Improvements				
	Intersection Average			Movement with Highest V/C Ratio		Intersection Average			Movement with Highest V/C Ratio	
Intersection	LOS	Delay (sec)	V/C Ratio	Movement	V/C Ratio	LOS	Delay (sec)	V/C Ratio	Movement	V/C Ratio
181st & Sandy	E	64.9	0.93	WBL & NBL	0.98	D	39.7	0.69	WB Left	0.87
181st @ US Bank	C	22.9	0.90	WB Left	0.91	B	19.0	0.74	EB Thru	0.88
181st & I-84 WB	A	8.0	0.76	WB Thru	0.77	A	7.2	0.76	WB Thru	0.78
181st & I-84 EB	A	9.3	0.64	SB Left	0.78	B	10.5	0.66	SB Left	0.74
181st & San Rafael	C	33.3	0.83	SB Thru	0.93	C	30.5	0.82	WB Right	0.97
181st & Halsey	D	40.1	0.95	SB Thru	0.98	C	31.3	0.78	EB Left	0.93

The southbound widening TIF project, together with the intersection improvements at Halsey, US Bank, and Sandy, would improve performance to a level nearly equivalent to Alt 2 with improvements. But, like Alt 2, it's ultimately not a reasonable improvement, given the high costs of acquiring right of way on the west side of NE 181st Avenue.

Southbound Right-Turn Drop Lane at I-84 Westbound Ramps (TIF No. 521300, unfunded)

The addition of a third southbound lane between US Bank and the westbound I-84 ramps is intended to improve performance during the p.m. peak hour, and any time of day the shifts change at the US Bank facility and workers leave the Gateway Corporate Center opposite. The addition of this third lane would likely eliminate the need for the left-turn protected phases at the US Bank intersection, as the westbound left turns and eastbound right turns could be made simultaneously with the added lane.

The future performance at the westbound I-84 ramps intersection does not require this additional lane, however, with overall intersection LOS A in all future alternatives during the p.m. peak. This would be an expensive project with little net benefit.

San Rafael Intersection Realignment

Realignment of San Rafael could be accomplished within the existing pavement by eliminating the dual eastbound left turn, converting the westbound shared left-through lane to an exclusive left-turn lane and the westbound exclusive right-turn lane to a shared through-right lane. This "paint only" realignment would not be viable through to 2027; sensitivity tests show that intersection performance would fail to meet City requirements starting in 2019 and it would impact arterial performance sooner than that. Figure 8 shows the channelization of the San Rafael intersection after the "paint only" realignment.

Figure 8: "Paint Only" San Rafael Realignment Channelization

This minor realignment, with or without the closure of the north crosswalk, would not improve performance at the intersection, based on the Synchro modeling. Both the intersection and the corridor performance suffer when the dual eastbound left turn is removed. Table 20 also includes the arterial performance of the "paint only" realignment

alternative, assuming the closure of the north crosswalk and the prohibition of the southbound U turn.

Figure 9: Required 2027 San Rafael Realignment Channelization

The main drawback to split intersection phasing is the additional time required to serve the pedestrian crossing times for both directions. The additional improvements to this intersection for all four future alternatives would close the crosswalk over the north leg, eliminating this drawback. If it is important to leave the crosswalk in place, however, the San Rafael intersection could be reconstructed to allow for simultaneous eastbound and westbound left-turn movements. The southbound U turn would still be prohibited. Figure 9 shows the required intersection channelization for San Rafael to operate within City standards and retain the crosswalk over the north leg of the intersection.

To model the impact to the corridor of realignment, the p.m. peak hour Alt 1 'with improvements' model was modified. Table 20 shows the resulting arterial level of service for Alt 1 with San Rafael realigned. Also shown are the Alt 1 models with and without improvements for comparison.

For 2027, there would be only a marginal improvement in the peak southbound corridor speed with the full realignment of San Rafael. The 'with improvements' version of Alt 1 itself would reduce the needed split for the westbound approach by closing the pedestrian crosswalk over the north leg and removing the restriction on westbound right turns on red. This reduction brings the portion of the cycle needed for the San Rafael movements down to what could be achieved with conventional protected left-turn phasing.

Table 20: 2027 P.M. Peak Hour Arterial Level of Service with Realigned San Rafael Intersection

		Alt 1 - SCATS		Alt 1 - SCATS with Improvements		Realigned San Rafael "Paint Only"		Realigned San Rafael Full Widening	
Arterial	Cross Street	Arterial Speed (mph)	LOS	Arterial Speed (mph)	LOS	Arterial Speed (mph)	LOS	Arterial Speed (mph)	LOS
NB *NE 181st Avenue*	Halsey	23.1	C	26.4	C	26.7	C	26.7	C
	San Rafael	23.1	C	21.7	D	18.9	D	23.9	C
	I-84 EB	20.6	D	19.0	D	18.2	D	19.3	D
	I-84 WB	30.4	B	30.4	B	30.4	B	30.4	B
	US Bank	22.6	C	21.1	D	22.3	C	22.4	C
	Sandy	17.3	D	19.7	D	20.4	D	20.5	D
	TOTAL -	**22.4**	**C**	**23.2**	**C**	**22.8**	**C**	**23.9**	**C**
SB *NE 181st Avenue*	Sandy	19.5	D	22.6	C	23.4	C	23.4	C
	US Bank	21.5	D	15.4	E	15.5	E	15.5	E
	I-84 WB	23.9	C	25.3	C	25.3	C	25.3	C
	I-84 EB	14.4	E	16.5	E	16.5	E	16.5	E
	San Rafael	13.8	E	17.1	D	12.6	F	18.6	D
	Halsey	14.4	E	20.2	D	17.4	D	17.1	D
	TOTAL -	**17.4**	**D**	**19.9**	**D**	**18.4**	**D**	**20.1**	**D**

San Rafael Westbound Free Right Turn and Dual Right Turn

A westbound free-right-turn movement at the San Rafael intersection would greatly increase the capacity of the westbound right-turn movement, and, if properly designed, would allow the southbound U-turn movement to be retained. Similarly, the addition of a second westbound right-turn pocket would almost double the capacity of the right-turn movement at the intersection while retaining the southbound U turn.

The westbound free-right would require some widening of northbound 181st, ideally for the entire segment between San Rafael and the eastbound I-84 onramp. If the southbound U-turn movement is to be retained, a short segment of barrier between the existing lanes and the new add-lane would be required for safety. Table 21 compares the detailed intersection performance of the San Rafael intersection, showing Alt 1 with the U-turn permitted (the original 2027 future design), the U-turn prohibited (the "with Improvements" design, which also eliminated the pedestrian crossing over the north leg of the intersection), and with the channelized free right-turn pocket.

The dual right turn improvement would add a second right-turn pocket, which would retrain the restriction on right turns on red. The turn radius on that northeast corner would be widened to allow trucks to more easily turn side by side. The estimated cost for this improvement is $200,000, assuming the turn radius widening does not require that the signal pole be relocated.

Table 21: San Rafael Intersection P.M. Peak Hour Performance Comparison

	Alt 1 - U-Turn Permitted			Alt 1 - U-Turn Prohibited			Alt 1 - with Free Right			Alt 1 - with Dual Right		
Intersection	LOS	Delay (sec)	V/C Ratio	LOS	Delay (sec)	V/C Ratio	LOS	Delay (sec)	V/C Ratio	LOS	Delay (sec)	V/C Ratio
181st & San Rafael	**C**	**34.9**	**0.86**	**C**	**25.2**	**0.78**	**C**	**23.9**	**0.80**	**C**	**28.6**	**0.83**
NB Left	E	70.0	0.66	E	56.0	0.61	E	56.0	0.61	D	54.2	0.61
NB Thru & Right	A	6.9	0.62	A	8.6	0.54	A	8.6	0.55	A	8.9	0.57
SB U-Turn & Left (or Left Only)	E	69.2	0.57	E	63.9	0.56	E	71.4	0.68	E	70.4	0.68
SB Thru & Right	D	37.1	0.95	C	24.9	0.87	C	23.5	0.86	C	27.1	0.89
EB Left	E	75.5	0.73	E	63.7	0.71	E	64.2	0.69	E	65.2	0.70
EB Thru	E	73.6	0.71	E	62.3	0.68	E	62.8	0.67	E	63.6	0.68
EB Right	A	10.0	0.44	A	8.5	0.41	A	9.0	0.42	A	9.1	0.43
WB Left & Thru	E	56.6	0.35	E	73.0	0.63	E	73.0	0.63	E	61.2	0.49
WB Right	F	99.1	0.89	B	20.0	0.65	A	0.2	0.13	E	70.9	0.72

For a project that would likely cost at least $500,000, the addition of a free right turn westbound will not increase overall intersection performance significantly when compared to the "with improvements" design. It should only be considered if the U-turn movement must be retained. Similarly, the dual right is a viable alternative only if the U turn is prohibited. Its cost is much lower than the free right, however.

Wilkes Connection from I-84 Eastbound On-Ramp (Urban Renewal)

Urban Renewal seeks to create a full-service connection between NE 181st Avenue and NE Wilkes Road to provide better freight access to the heavy industrial uses immediately south of the freeway. With the current road network, trucks wanting access to Wilkes from the freeway must first turn east onto NE San Rafael Street, then turn north onto NE 192nd Avenue, and then

turn west onto NE Wilkes Road. Given the spacing requirements set by ODOT and the City of Gresham, improving the current intersection of Wilkes & 181st to full access isn't a viable option.

One proposed alternative improvement would create a new off-ramp from the I-84 eastbound onramp, which would allow trucks arriving from the freeway to easily access Wilkes directly. Like the current access from NE 181st Avenue, this would remain a one-way, entrance only connection, but would allow southbound traffic to access Wilkes in addition to northbound. To return to 181st and the freeway, traffic would still be required to circle south to NE San Rafael Street.

This proposed improvement was modeled by Metro for the midday and p.m. peak to determine the overall demand volume on the new link. The Metro 2030 model, which was built as a variant of the Alt 1 model (SCATS adaptive), projects that 354 vehicles would use the new connection during the p.m. peak 2-hour period (which translates to approximately 185 vehicles during the peak hour). During the midday peak hour, only 22 vehicles are projected to use the new link, which is likely the amount of truck traffic that could be anticipated during that time period. However, the 185 vehicles in the p.m. peak hour would likely be mostly cut-through commute traffic. Correspondingly, there is a reduction in the number of southbound left-turn movements at San Rafael (20 vehicles) and Halsey (40 vehicles) when that connection is opened up, which does offer some improvement at those intersections.

The new connection would improve the access to Wilkes, which may make the heavy industrial zone more attractive for redevelopment. However, its impact to the operations of 181st Avenue would be minimal. For example, the reduction in southbound left-turn volumes at the Halsey intersection would not be enough to eliminate the need for the dual southbound left-turn pockets for acceptable performance during the p.m. peak hour.

New Connection between NE Wilkes Road and NE San Rafael Street West of NE 181st Avenue (Urban Renewal Project)

If connectivity between Wilkes and 181st cannot be improved, this new north-south connection between Wilkes and San Rafael would greatly reduce the time required to access the heavy industrial zone adjacent to Wilkes.

Currently, the only full access to the former Firestone site on NE Wilkes Road near 181st is via 192nd and San Rafael, with only northbound 181st vehicles provided direct access at Wilkes and 181st. Southbound traffic on 181st is detoured approximately 7,300 feet along 181st, San Rafael, 192nd, and Wilkes to reach the site. A new connection, through what would be NE 186th Avenue, would cut this indirect distance in half, to approximately 3,500 feet.

As was the case with the Wilkes access from the eastbound I-84 onramp, the reduction in travel time might make the site more attractive to redevelopment. However, it is even less likely to significantly alter travel patterns on NE 181st Avenue. The primary access to Wilkes for traffic arriving from the freeway would remain via the San Rafael intersection on 181st. The only impacts would be from new trips generated by industrial redevelopment.

Other Urban Renewal Projects Listed in the 2007 Industrial Opportunity Study

The *Rockwood-West Gresham Urban Renewal Industrial Opportunity Study* that was adopted by the Gresham Redevelopment Commission in May, 2007 lists several proposed projects that will

be considered to make the redevelopment of the urban renewal area more attractive. These include corridor upgrades to collector status for NE Wilkes Road, NE San Rafael Street east of 181st, and NE 192nd Avenue between Halsey and Wilkes.

As with the proposed 186th Avenue connection, these projects may make redevelopment more likely within the urban renewal zone. The redevelopment itself may increase trips on 181st, but the 181st corridor performance would not be significantly impacted.

Conclusion

With the necessary improvements, including currently unfunded TIF projects, all four future alternatives will provide acceptable intersection and corridor performance. The available City resources and constructability of the different alternatives will ultimately determine the future of the corridor:

- Alt 1, which would introduce adaptive signal timing technology to the six study intersections, would provide performance that would meet City of Gresham standards, although intersection improvements at the Halsey and Sandy intersections will be required within 20 years.
- Alt 2, the 7-lane alternative, would attract additional trips to the corridor. Those new trips would mostly offset the performance improvements that would come with the added capacity.
- With Alt 3, the reversible lane alternative, most performance gains come at the expense of route choice: the reversible lane design eliminates the northbound and southbound left-turn movements at Halsey and San Rafael. The loss of these left-turn movements would hamper the redevelopment east of 181st.

TIF Projects

Two of the Transportation Impact Fee projects that are planned for the corridor are required to help improve performance of the corridor. These projects are:

515200 The 181st at Halsey TIF would add dual northbound and southbound left-turn pockets, as well as eastbound, westbound, and southbound right-turn pockets. This project is necessary for future operations.

521200 This unfunded TIF project, Sandy Intersection Improvements, would widen the intersection to add dual westbound left-turn lanes and a northbound right-turn pocket. The project should be modified. The northbound right-turn pocket is **not** needed for adequate intersection operation, however. What is needed is a second northbound left-turn pocket.

The remaining Transportation Impact Fee projects that are planned for the corridor are not necessary to ensure future performance of the corridor. These projects include:

515100 This unfunded TIF project would widen NE 181st Avenue between the I-84 freeway eastbound ramps and Halsey. Its additional capacity would attract new trips, which would partially offset the performance gains on the corridor. The viability of the project is limited by the difficulty in acquiring the right of way on the west side of 181st.

516600 The analysis showed that this unfunded TIF, which would reconstruct the eastbound I-84 ramps intersection to eliminate the southbound left-turn phase and replace it with an uncontrolled partial cloverleaf, isn't required within the 2027 time period.

521300 This unfunded TIF project would add a southbound lane to NE 181st Avenue between the US Bank driveway intersection and the I-84 westbound ramps intersection. The added capacity it would provide is not needed to ensure adequate corridor performance.

San Rafael Intersection

Signal phase changes at the San Rafael intersection should be constructed immediately to improve corridor throughput and westbound right-turn performance:

- The current, signed prohibition on westbound right turns on red should be removed at the San Rafael intersection. To do this, an electronic "no right turn" sign will be installed in its place. That sign will only be lit during the southbound U turn phase, meaning that right turns on red will be permitted during most of the cycle.
- The curb radius on the northeast corner of the San Rafael intersection will be widened to allow trucks to turn more easily into moving traffic.
- The westbound crosswalk (over the north leg of the intersection) should be closed.
- A median barrier between the southbound left-turn pocket and the northbound lanes should be installed from the planted island near McDonalds south to within 30 feet of the intersection. This island will prevent unsafe and illegal uncontrolled U turns north of the intersection.

Modifications to the operations at the intersection of NE 181st Avenue and NE San Rafael Street are required for adequate performance in the near term.

US Bancorp/Gateway Corporate Center Driveways Intersection

If the p.m. peak hour volumes exiting the US Bank and Gateway Corporate Center driveways continue to grow as projected, the left-turns for the side-street approaches there would eventually require protected phasing to operate acceptably.

Urban Renewal Capital Projects

Most of the Urban Renewal capital projects that were studied for this report can be expected to attract new industrial development to the area, but would have minimal impact to the performance of the NE 181st Avenue corridor.

- The new connection between Wilkes and San Rafael, near what would be NE 186th Avenue, would shorten the travel distance from the intersection of 181st and Wilkes and the former Firestone property on Wilkes by more than half, from 7,300 feet to 3,500 feet.
- The Urban Renewal projects that would rebuild San Rafael and 192nd to collector standards.

A full or improved connection between NE Wilkes Road and NE 181st Avenue would not be permitted by ODOT. The future modeling of a proposed off-ramp to Wilkes from the I-84 eastbound onramp shows that it would attract cut-trough traffic during the p.m. peak commute.

Recommended Corridor Alternative Implementation

Funding for the SCATS adaptive signal project is currently programmed in the Urban Renewal CIP in the 2008-2009 fiscal year. Developer-sourced funds were also added to the project funding. The SCATS implementation and associated physical improvements are scheduled for completion by late spring, 2009.

If approved, the proposed intersection modifications at the San Rafael intersection (lifting the prohibition on westbound right turns on red, prohibiting the southbound U turn, and closing the

crosswalk over the north leg of the intersection) would be completed prior to implementation of SCATS.

Public Participation Plan

Urban Renewal has been meeting with industrial businesses in the area since 2006 to discuss infrastructure needs. The one concern consistently expressed was the need to improve the intersection of NE 181st Avenue and NE San Rafael Street to give westbound trucks more frequent right-turn opportunities. The current signal configuration delays truck movement to I-84 significantly. Further input from businesses and haulers in the industrial zone reinforces their desire for intersection improvements to ease turns to northbound 181st for freight.

DES staff has created a Public Participation Plan for the project to determine neighborhood and business concerns about the project, particularly the changes at San Rafael. The leadership of the Wilkes East Neighborhood Association has expressed support for the SCATS implementation as has the Rockwood Business Coalition. Two open houses on the project, focusing on the San Rafael intersection, were held in September, 2008. The consensus of the attendees at these public meetings was that the southbound U turn should be retained and that the City should explore other ways to improve intersection performance for westbound right turns. The final recommendations for the San Rafael intersection in the subsection above are the result of this input from the public.