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SUBJECT: CITYWIDE LEVEL OF SERVICE FORECAST UPDATE

SR305

The purpose of this memo is to describe TSI's updated intersection and segment level of service (LOS) forecast for the State Route 305 (SR 305) corridor in Bainbridge Island. This forecast is a product of (1) the citywide planning model conversion as described in the memo dated February 26, 2016, (2) the updated citywide LOS model, and (3) a proposed segment capacity and LOS methodology which considers the capacity impacts of nonmotorized facilities.

Level of Service Methodology

Intersection and street segment level of service calculation methodologies are described below. The intersection LOS methodology used for this analysis is consistent with current WSDOT practice. The segment LOS methodology follows an approach which has been developed by TSI for citywide planning-level analysis and is described below. The segment LOS results described here, therefore, may not be consistent with a WSDOT analysis.

Intersection Level of Service

The intersection capacity and LOS calculations summarized below are consistent with Highway Capacity Manual 2010 (HCM2010) methodology, including the LOS thresholds identified in Table 1. HCM2010 intersection levels of service are calculated in Synchro 9 software.

Roundabout LOS analysis used HCM2010 methodology with follow-up gap and critical headway parameters updated to represent current WSDOT roundabout analysis policy. To maintain consistency with WSDOT policy, roundabouts were analyzed using signalized LOS thresholds.

Table 1. Intersection Level of Service Thresholds

LOS	Signalized/Roundabout Delay (sec/veh)	Unsignalized Delay (sec/veh)
A	≤10	≤10
B	>10 – 20	>10 – 15
C	>20 – 35	>15 – 25
D	>35 – 55	>25 – 35
E	>55 – 80	>35 – 50
F	>80	>50

Table 3. Recommended Bainbridge Island Street Segment LOS Characteristics

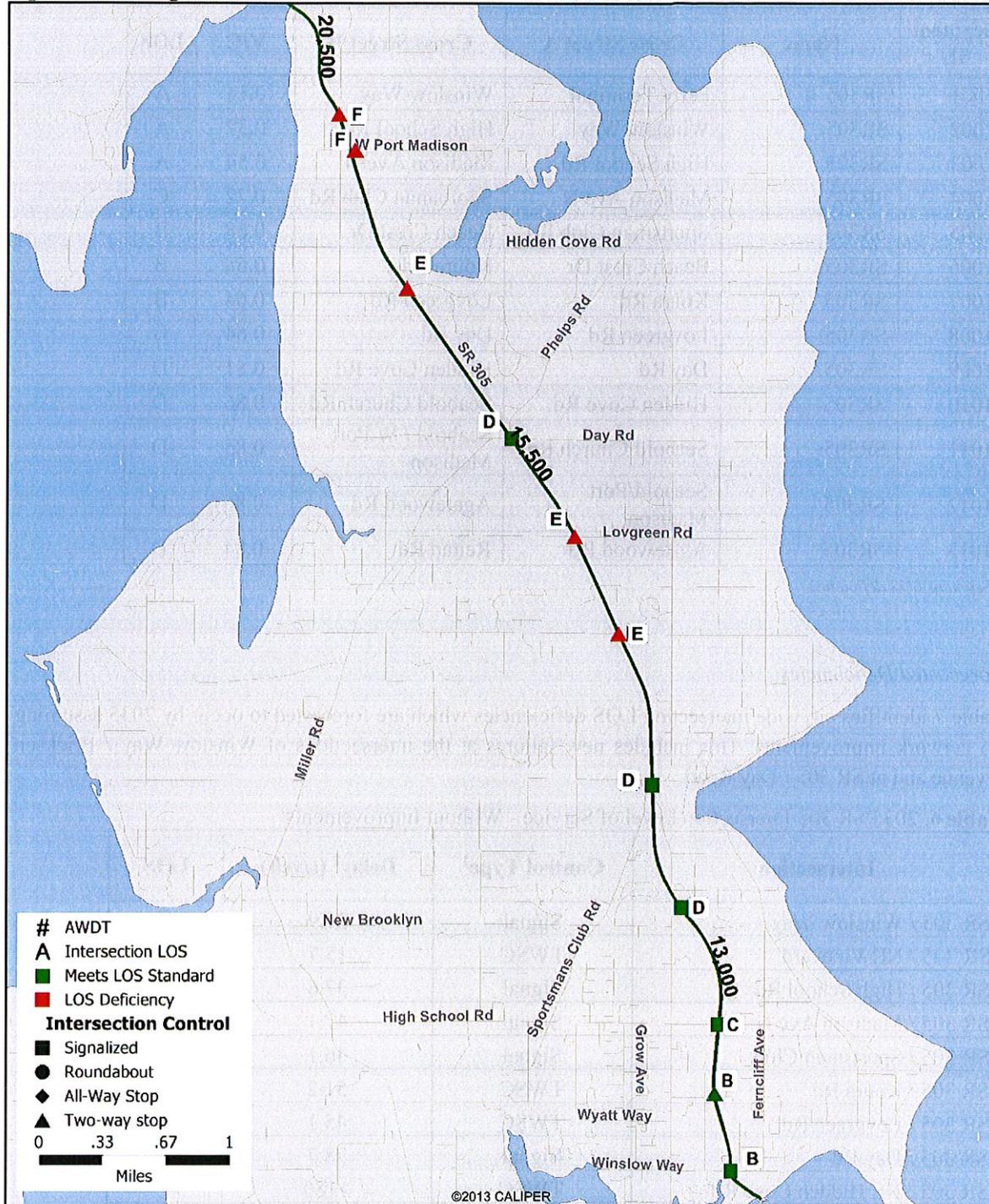
LOS	Volume / Capacity	Description
A	≤ 0.60	Facility accommodates all modes of transportation. Vehicles experience free flow, with low volumes and high speeds
B	0.61 – 0.70	Stable flow, with traffic conditions beginning to restrict operating speeds. Drivers still have reasonable maneuverability between multiple lanes. All modes are accommodated
C	0.71 – 0.80	Fairly stable flow, but higher volumes more closely constrict speeds and maneuverability.
D	0.81 – 0.90	Approaching unstable flow, with tolerable operating speeds and limited maneuverability. Facilities without nonmotorized facilities and heavy pedestrian/bike volume may experience unstable flow.
E	0.91 – 1.00	Nonmotorized users in travel lanes will conflict with heavy vehicle volume and cause breakdowns in flow. Vehicles experience unstable flow with reduced operating speeds.
F	> 1.00	Facility is unable to accommodate all modes. Vehicles experience forced flow, operating under stop-and-go conditions

Citywide Planning Model Update

TSI has upgraded Bainbridge Island’s citywide transportation planning model from TransCAD software to PTV Visum software per the memo dated February 25, 2016. The updated model maintains consistency with the land use and network assumptions included in the TransCAD model. It includes more refined node and turn volume-delay functions which improve the accuracy of the demand forecast.

Note that the intersection of SR 305 and Suquamish Way north of the Agate Pass Bridge is outside the scope of the citywide planning and operational models and therefore the forecasts described here assumed free flow condition (i.e. no demand metering) north of the City.

Figure 1. Existing SR 305 Level of Service



Forecasted segment LOS failures on SR 305 are identified in Table 8. SR 305 will experience declining LOS, with all segments north of Day Road falling below minimum LOS standard as increased PM peak hour northbound demand converges near the Agate Pass Bridge.

Table 7. 2035 SR 305 Segment Level of Service – Without Improvements

Segment ID	Name	Cross Street A	Cross Street B	V/C	LOS
1001	SR305	Ferry Terminal	Winslow Way	0.17	A
1002	SR305	Winslow Way	High School Rd	0.38	A
1003	SR305	High School Rd	Madison Ave N	0.60	B
1004	SR305	Madison Ave N	Sportsman Club Rd	0.75	C
1005	SR305	Sportsman Club Rd	Beach Crest Dr	0.74	C
1006	SR305	Beach Crest Dr	Koura Rd	0.74	C
1007	SR305	Koura Rd	Lovgreen Rd	0.70	C
1008	SR305	Lovgreen Rd	Day Rd	0.71	C
1009	SR305	Day Rd	Hidden Cove Rd	0.95	E
1010	SR305	Hidden Cove Rd	Seabold Church Rd	1.03	F
1011	SR305	Seabold Church Rd	Seabold/Port Madison	1.01	F
1012	SR305	Seabold/Port Madison	Agatewood Rd	1.05	F
1013	SR305	Agatewood Rd	Reitan Rd	1.05	F

Segment LOS deficiency

SR 305 Improvement Scenarios

Three preliminary SR 305 improvement alternatives were developed to examine different future scenarios to see if there is a way to overcome the identified SR 305 operational deficiencies.

Alternative A: Signalization of At-Grade Intersections

The first improvement scenario, Alternative A, retains all existing at-grade crossings with signalization at several intersections which are currently two-way stop-controlled. A reversible transit and car pool lane is added north of Day Road where segment LOS failures will otherwise occur. Limited access is included at some north Island locations.

This concept includes:

- Access from both sides of SR 305 at Reitan Rd.
- Frontage road serving Agate Beach Ln. and Agatewood Dr.
- Coordinated signals at Agatewood Dr. and West Port Madison Rd.
- Widening of the north and south intersection approaches at Day Rd. to include queueing lanes.
- Widening of the north and south intersection approaches at Sportsman's Club Rd to include queueing lanes.
- Reversible transit and car pool lane north of Day Road
- Right-in-right-out (RIRO) access during peak hour at minor unsignalized intersections:
 - SR 305 / Koura Road
 - SR 305 / Lovgreen Road
 - SR 305 / Hidden Cove Road

Signals are to be spaced from the SR 305 / Sportsman's Club Road intersection north at regular intervals such that signals can be coordinated to minimize travel times along SR 305. In this scenario, funding is prioritized to ensure that most Island locations have reliable access to SR305. The State envisions a roundabout at Suquamish Way to be one viable long term alternative. If constructed, limited access between the roundabout and the first traffic signal on the Island would be needed as there would be no control of traffic flow at peak hours.

This scenario proposes limited access (right-in-right-out) at the intersections of SR 305 with Koura Road, Lovgreen Road, and Hidden Cove Road. Access restrictions would be limited to PM peak hour, when minor street delay would be at its highest. Alternative access from these locations will be provided at other major intersections along SR 305 which can be accessed via Miller Road, Madison Avenue, Phelps Road, Day Road, and Seabold Road, depending on location.

LOS analysis also assumed that the reversible HOV/transit lane would operate northbound during PM peak hour. To prevent the HCM2010 intersection capacity methodology from overestimating HOV lane capacity, a lane utilization factor of 0.80 was applied.

Partial lane utilization was also assumed for queueing lanes at the intersections of SR 305 with Day Road and Sportsman Club Road. Because of the downstream lane drop it can be expected that many drivers will choose to wait in a longer queue than to assertively change lanes shortly downstream..

Forecasted intersection and segment LOS forecasts are shown in Tables 8 and 9 and Figure 3.

The improvements in Alternative A would mitigate all forecasted intersection LOS deficiencies. The intersection of SR 305 and Sportsman Club Road is not forecasted to operate below LOS D by 2035, however the queuing lanes on the north and south legs would reduce average delay and mitigate a failure that would likely occur at some point beyond the planning horizon. The stop-controlled intersections at Koura Rd, Lovgreen Rd, and Hidden Cove Rd would operate at LOS C with RIRO access during PM peak hour.

The reversible HOV/transit lane north of Day Road provides the capacity necessary to mitigate the forecasted segment LOS deficiencies.

Alternative B: Roundabouts at At-Grade Intersections

The second improvement scenario, Alternative B, retains all existing at-grade crossings with new roundabouts at several key intersections north of the Winslow area. Signalized intersections at Sportsman's Club and at Day Road are converted to roundabouts. A reversible transit and car pool lane is added north of Day Road where segment LOS failures will otherwise occur. Limited access is included at some north Island locations.

This concept includes:

- Access from both sides of SR 305 at Reitan Rd.
- Frontage road serving Agate Beach Ln. and Agatewood Dr.
- Roundabouts at Agatewood Dr. and West Port Madison Rd.
- Conversion from signal to roundabout control at the intersections of Sportsman's Club and Day Rd
- Reversible transit and car pool lane north of Day Road
- Right-in-right-out (RIRO) access during peak hour at minor unsignalized intersections:
 - SR 305 / Koura Road
 - SR 305 / Lovgreen Road
 - SR 305 / Hidden Cove Road

This scenario proposes limited access (right-in-right-out) at the intersections of SR 305 with Koura Road, Lovgreen Road, and Hidden Cove Road. Access restrictions would be limited to PM peak hour, when minor street delay would be at its highest. Alternative access from these locations will be provided at other major intersections along SR 305 which can be accessed via Miller Road, Madison Avenue, Phelps Road, Day Road, and Seabold Road, depending on location. See Table 8.

LOS analysis also assumed that the reversible HOV/transit lane would operate northbound during PM peak hour. To prevent the HCM2010 intersection capacity methodology from overestimating HOV lane capacity, a lane utilization factor of 0.80 was applied.

Roundabouts were analyzed using HCM2010 methodology with calibration parameters and LOS thresholds adjusted to reflect WSDOT roundabout analysis policy.

The LOS forecast indicates that single-lane roundabouts at the Port Madison and Agatewood Road intersections will operate at the minimum LOS standard, LOS D, by 2035. By contrast, the signalized alternatives described in Alternative A are forecasted to operate at LOS A. The difference is the result of highly unbalanced major/minor approach volumes at these intersections.

Table 11 identifies segment LOS associated with SR 305 Alternative B. Similar to Alternative A, all segment LOS failures along SR 305 are mitigated by the reversible HOV/transit lane north of Day Road.

Figure 4. 2035 SR 305 Level of Service – Alternative B

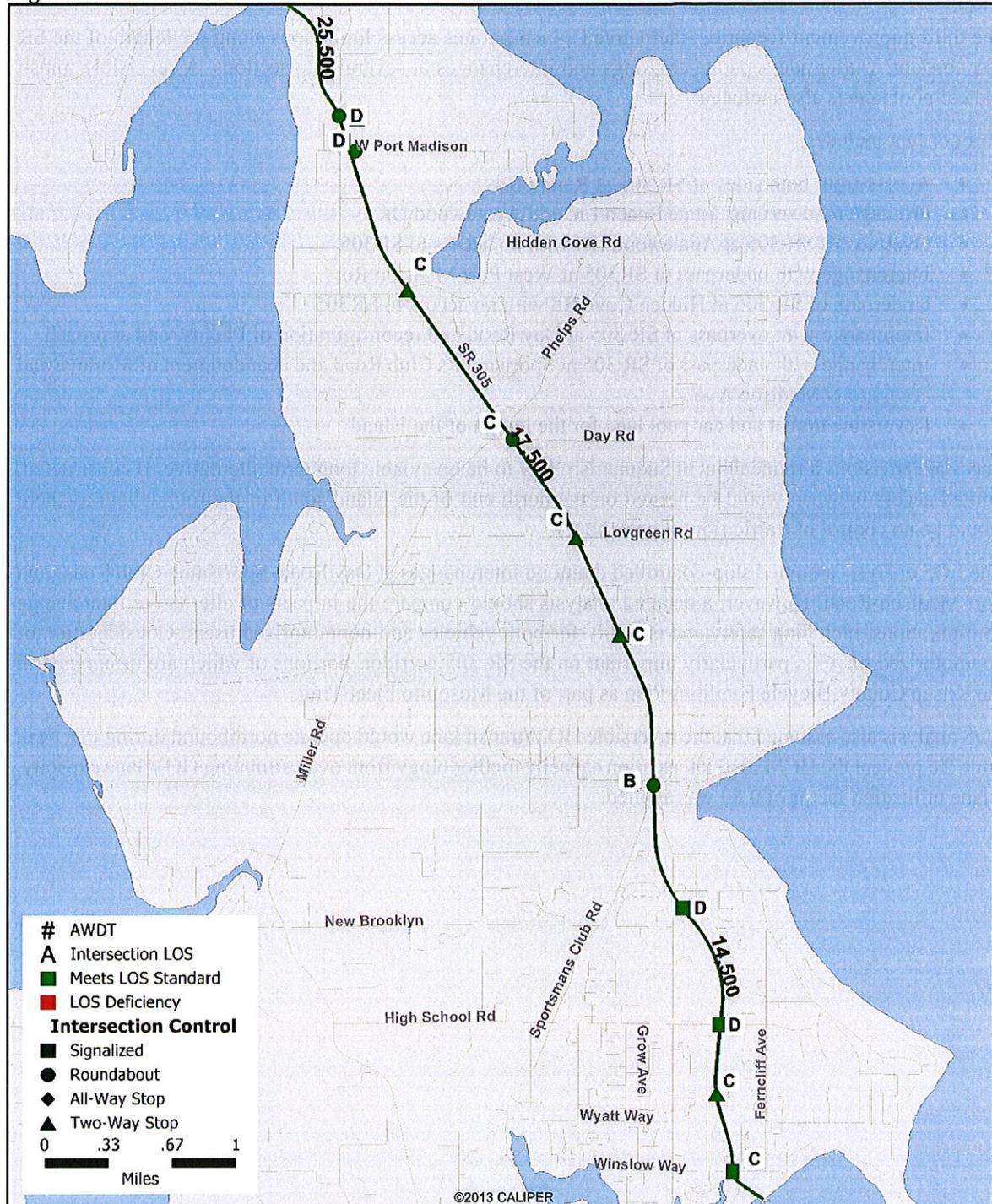


Table 12. 2035 SR 305 Intersection LOS – Alternative C

Intersection	2035 No Improvements			SR 305 Alternative C		
	Control Type ¹	Delay ² (s/veh)	LOS	Intersection Improvement	Delay ² (s/veh)	LOS
SR 305 / Winslow	Signal	20.7	C		20.7	C
SR 305 / NE Vineyard	TWSC	15.4	C		15.4	C
SR 305 / High School Rd	Signal	37.3	D		37.0	D
SR 305 / Madison Ave N	Signal	47.3	D	Reversible HOV lane	20.4	C
SR 305 / Sportsman Club	Signal	46.7	D	Removed	-	-
SR 305 NB ramp / Sportsman Club	-	-	-	New TWSC interchange ramp	10.6	B
SR 305 SB ramp / Sportsman Club	-	-	-	New TWSC interchange ramp	9.3	A
SR 305 / Kuora Rd	TWSC	51.4	F	Reversible HOV lane	32.5	D
SR 305 / Lovgreen Rd	TWSC	45.2	E	Reversible HOV lane	38.5	E
SR 305 / Day Rd	Signal	75.4	E	Removed	-	-
SR 305 NB ramp / Day Rd	-	-	-	New TWSC interchange ramp	10.1	B
SR 305 SB ramp / Day Rd	-	-	-	New TWSC interchange ramp	8.3	A
SR 305 / Hidden Cove	TWSC	>180	F	Removed*	-	-
SR 305 /Port Madison Rd	TWSC	>180	F	Removed	-	-
SR 305 NB ramp / Port Madison Rd	-	-	-	New TWSC interchange ramp	8.6	A
SR 305 SB ramp / Seabold Rd	-	-	-	New TWSC interchange ramp	9.0	A
SR 305 / Agatewood Rd	TWSC	>180	F	Removed*	-	-

Intersection LOS deficiency

*Alternative access to SR 305 will be provided for removed intersections:

- Lovgreen Rd access via N Madison Ave or Miller Rd
- Hidden Cove Rd access via Phelps Rd, Seabold Rd or Day Rd
- Agatewood Rd via frontage road

¹TWSC = Two-Way Stop Control; AWSC = All-Way Stop Control; RAB = Roundabout; Signal = Signalized

²Average control delay for all movements. For TWSC, delay is reported for the movement with the highest delay.

Based on the improvements and assumptions described above, the improvements included in Alternative C will mitigate most arterial intersection LOS failures along SR 305. The intersection at Lovgreen Road is forecasted to operate at LOS E during PM peak hour. The traveling public could choose to access SR 305 via Miller Road or N Madison Avenue during these times. While not included in this Plan, an underpass of SR305 could be added at Koura Road. The stop-controlled ramp terminals are forecasted to operate well, with LOS B or better in 2035.

Using the segment LOS methodology identified above, addition of a reversible HOV/transit lane running the length of the SR 305 corridor would provide sufficient capacity to mitigate LOS failures along SR 305. Segments north of Day Road would operate at LOS D with volume-to-capacity ratio less than 0.90 during PM peak hour. See Table 13. Results are shown graphically in Figure 5.

Figure 5. 2035 SR 305 Level of Service – Alternative C





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May 3, 2016

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SUBJECT: CITYWIDE LEVEL OF SERVICE FORECAST UPDATE – NON-STATE ROUTES

The purpose of this memo is to describe TSI’s updated intersection and segment level of service (LOS) forecast for City streets in Bainbridge Island. This forecast is the result of (1) the citywide planning model conversion as described in the memo dated February 26, 2016, (2) the updated citywide LOS model, including the SR 305 forecast as described in the memo dated March 16, 2016, and (3) a proposed segment capacity and LOS methodology which considers the capacity impacts of nonmotorized facilities.

Level of Service Methodology

Intersection and street segment level of service calculation methodologies are described below. The intersection LOS methodology used for this analysis is consistent with current WSDOT practice. The segment LOS methodology follows an approach which has been developed by TSI for citywide planning-level analysis and is described below. The segment LOS results described here, therefore, may not be consistent with a WSDOT analysis.

Intersection Level of Service

The intersection capacity and LOS calculations summarized below are consistent with Highway Capacity Manual 2010 (HCM2010) methodology, including the LOS thresholds identified in Table 1. HCM2010 intersection levels of service are calculated in Synchro 9 software.

Roundabout LOS analysis used HCM2010 methodology with follow-up gap and critical headway parameters updated to represent current WSDOT roundabout analysis policy. To maintain consistency with WSDOT policy, roundabouts were analyzed using signalized LOS thresholds.

Table 1. Intersection Level of Service Thresholds

Level of Service	Signalized/Roundabout Delay (sec/veh)	Unsignalized Delay (sec/veh)
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C	>20 – 35	>15 – 25
D	>35 – 55	>25 – 35
E	>55 – 80	>35 – 50
F	>80	>50

Table 3. Recommended Bainbridge Island Street Segment LOS Characteristics

LOS	Volume / Capacity	Description
A	≤ 0.60	Facility accommodates all modes of transportation. Vehicles experience free flow, with low volumes and high speeds
B	0.61 – 0.70	Stable flow, with traffic conditions beginning to restrict operating speeds. Drivers still have reasonable maneuverability between multiple lanes. All modes are accommodated
C	0.71 – 0.80	Fairly stable flow, but higher volumes more closely constrict speeds and maneuverability.
D	0.81 – 0.90	Approaching unstable flow, with tolerable operating speeds and limited maneuverability. Facilities without nonmotorized facilities and heavy pedestrian/bike volume may experience unstable flow.
E	0.91 – 1.00	Nonmotorized users in travel lanes will conflict with heavy vehicle volume and cause breakdowns in flow. Vehicles experience unstable flow with reduced operating speeds.
F	> 1.00	Facility is unable to accommodate all modes. Vehicles experience forced flow, operating under stop-and-go conditions

Level of Service Standards

The City of Bainbridge Island defines minimum LOS standards for city streets based on functional classification and each of four City-defined zones which reflect differences in the Island’s character: Urban, Sub-Urban, Neighborhood Services Centers, and the SR 305 corridor.

Minimum LOS for state facilities is set by the Washington State Department of Transportation (WSDOT). State Route 305 through the City is designated by WSDOT as a Highway of Statewide Significance per RCW 47.06.140, with a minimum LOS D. The City has similarly adopted an LOS D standard for the SR 305 corridor. See Table 4.

Table 4. Minimum LOS Standards

Zone	Description	Functional Classification	Minimum Level of Service
SR 305 Corridor	State Highways	All Roadways	LOS D
Urban Zone	The most developed areas of the City, mainly the greater Winslow area	Minor Arterial	LOS D
		Collector	LOS D
		Local Access	LOS C
Neighborhood Service Centers (NSC) Zone	City-defined Centers of Rolling Bay, Island Center, and Lynwood Center	Minor Arterial	LOS D
		Collector	LOS C
		Local Access	LOS C
Sub-Urban Zone	Areas outside the Winslow core and NSCs – remainder of the Island	Minor Arterial	LOS C
		Collector	LOS C
		Local Access	LOS B

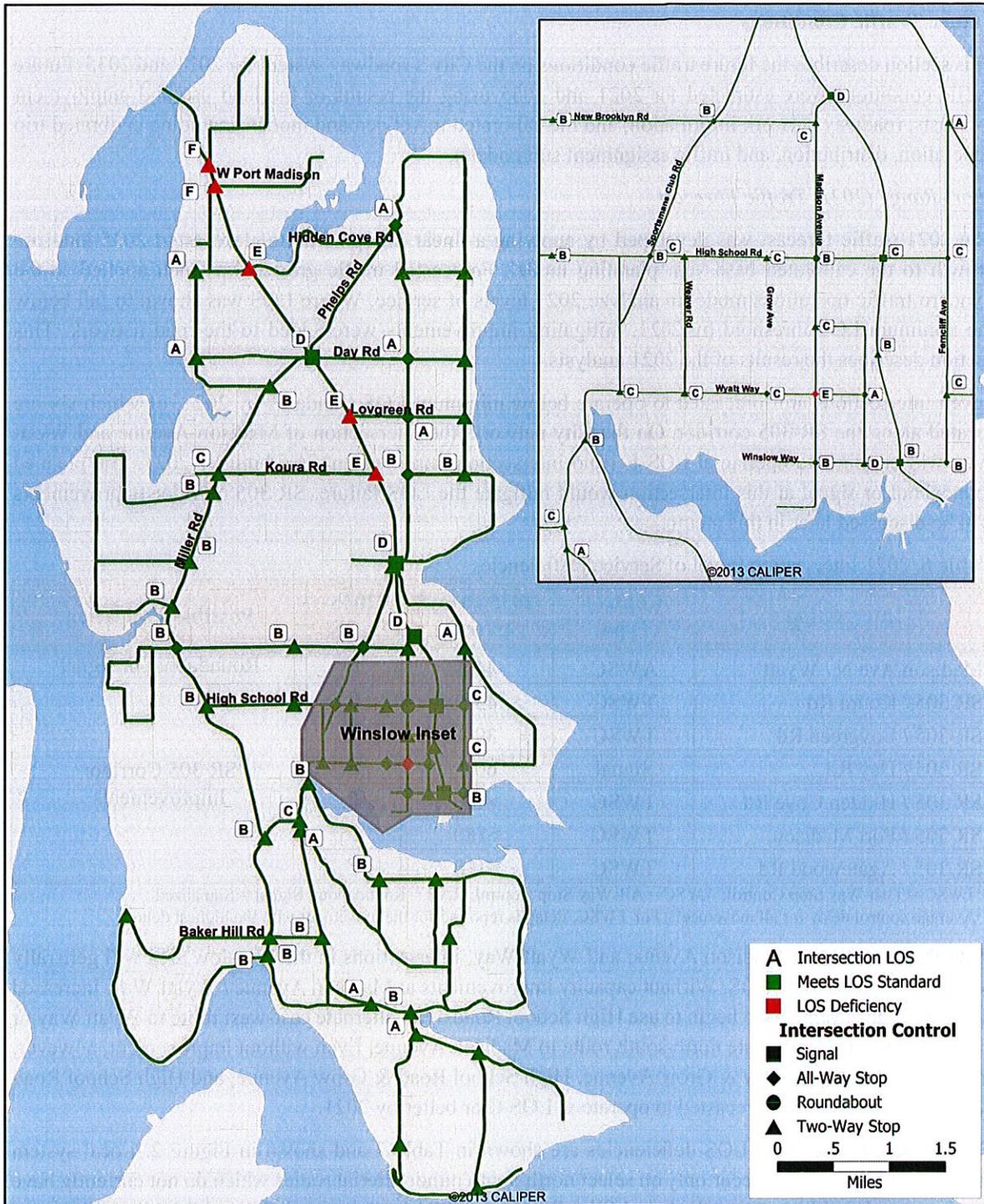


Figure 1
2015 Level of Service



Table 7. 2021 Segment Level of Service Deficiencies

Segment	From	To	V/C	LOS
SR305	Day Rd	Hidden Cove Rd	0.94	E
SR305	Hidden Cove Rd	Seabold Church Rd	0.96	E
SR305	Seabold Church Rd	Seabold/W Port Madison	0.93	E
SR305	Seabold/W Port Madison	Agatewood Rd	0.99	E
SR305	Agatewood Rd	Reitan Rd	0.98	E
Bucklin Hill Rd	Blakely Ave	Eagle Harbor Dr	0.84	D
Miller Rd	New Brooklyn Rd	Battle Point Dr	0.99	E
Miller Rd	Battle Point Dr	Tolo Rd	0.84	D
Miller Rd	Tolo Rd	Arrow Point Dr	0.85	D
Eagle Harbor Dr	Bucklin Hill Rd	Finch Rd	0.84	D

Long-Range (2035) Traffic Forecast

Eight intersections are forecasted to operate below minimum LOS standards by 2035 assuming no capacity improvements. Six of the intersection failures will occur along the SR 305 corridor with the other two will occur in the Winslow subarea, at Wyatt Way & Madison Avenue and at Winslow Way & Ericksen Avenue. This assumes that the planned Wyatt Way intersection improvements will not be constructed by 2035.

Several intersections in the Winslow subarea are forecasted to operate at LOS D by 2035, which is acceptable per City standards. Deferral of the Wyatt Way / Madison Avenue intersection improvements would induce increased volume on alternate routes Grow Avenue and High School Road, as discussed previously. The two-way stop-controlled intersections at either end of Grow Avenue would continue to meet the Winslow LOS standard at LOS D, however cut-through traffic which tends to operate at higher speeds than local traffic could pose a safety hazard on Grow Avenue which is a 25 mph local access street.

Table 8. 2035 Intersection Level of Service Deficiencies

Intersection	Control Type ¹	2035 Delay ² (s/veh)	2035 LOS	Possible Mitigation
Madison Ave N / Wyatt	AWSC	42.9	E	Roundabout or signal
Winslow Way / Erickson Ave	TWSC	64.4	F	Access restrictions / RIRO
SR 305 / Koura Rd*	TWSC	51.2	F	SR 305 Corridor Improvements ³
SR 305 / Lovgreen Rd ⁴	TWSC	45.1	E	
SR 305 / Day Rd	Signal	78.7	E	
SR 305 / Hidden Cove Rd ⁴	TWSC	>180	F	
SR 305 / Port Madison	TWSC	>180	F	
SR 305 / Agatewood Rd	TWSC	>180	F	

¹TWSC = Two-Way Stop Control; AWSC = All-Way Stop Control; RAB = Roundabout; Signal = Signalized

²Average control delay for all movements. For TWSC, delay is reported for the movement with the highest delay.

³Specific corridor improvements identified below

⁴Alternative access to SR 305 is provided for locations w/RIRO access during PM peak hour:

- Koura Rd access via Miller Rd
- Lovgreen Rd access via N Madison Ave or Miller Rd
- Hidden Cove access via Phelps Rd, Seabold Rd or Day Rd

Forecasted 2035 segment LOS deficiencies are shown in Table 9 and shown in Figure 3. These are consistent with the forecasted 2021 failures and include Miller Road near the Island Center NSC and Bucklin Hill Road / Eagle Harbor Drive southwest of the Winslow subarea. All segments of SR 305 north of Day Road will continue to operate below minimum LOS by 2021 barring improvements.

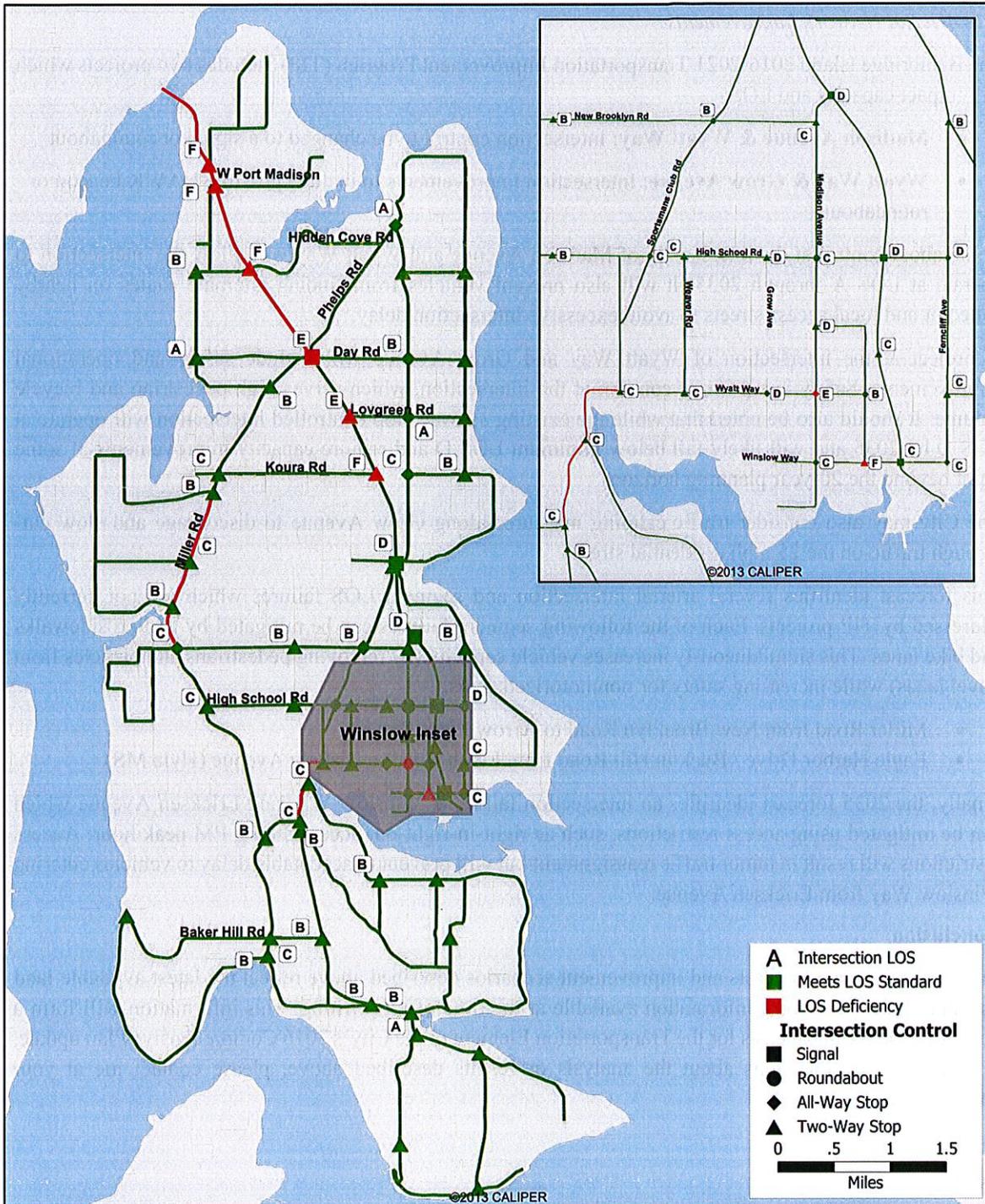


Figure 3
2035 Level of Service

