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Final Methodology Memorandum

Date: August 11, 2015 Project #: 18547
To: Devin Hearing, ODOT Region 4 & Rick DuMilieu, Lake County
From: Matt Kittelson, PE

This memorandum documents the methodology and key assumptions to be used in preparation of the existing and future conditions analyses for the Lake County and City of Paisley Transportation System Plan (TSP) Update. The methodologies included in this memorandum are based on guidance provided in the Oregon Department of Transportation (ODOT) *Transportation System Plan Guidelines (2008)* and the *Analysis Procedures Manual* (APM), Versions 1 and 2 as they relate to rural counties in southern Oregon.

STUDY INTERSECTIONS

Per the scope of work (SOW) intersection turning movement traffic counts will be collected at the intersections listed in Table 1. These counts are expected to be collected during May 2015. The locations for these intersection counts were agreed upon by ODOT, the County, and the consultant team during the development of the project scope. The counts will be 2-hour intersection turning movement counts and will be used to provide pedestrian volumes, bicycle volumes, truck volumes, passenger car volumes, and various calculation factors.

Table 1. Study Intersections (Location of 2-Hour Intersection Turning Movement Count)

ID Number	East-West Name	North-South Name
1	OR 31	US 395
2	OR 140 (east leg)	US 395

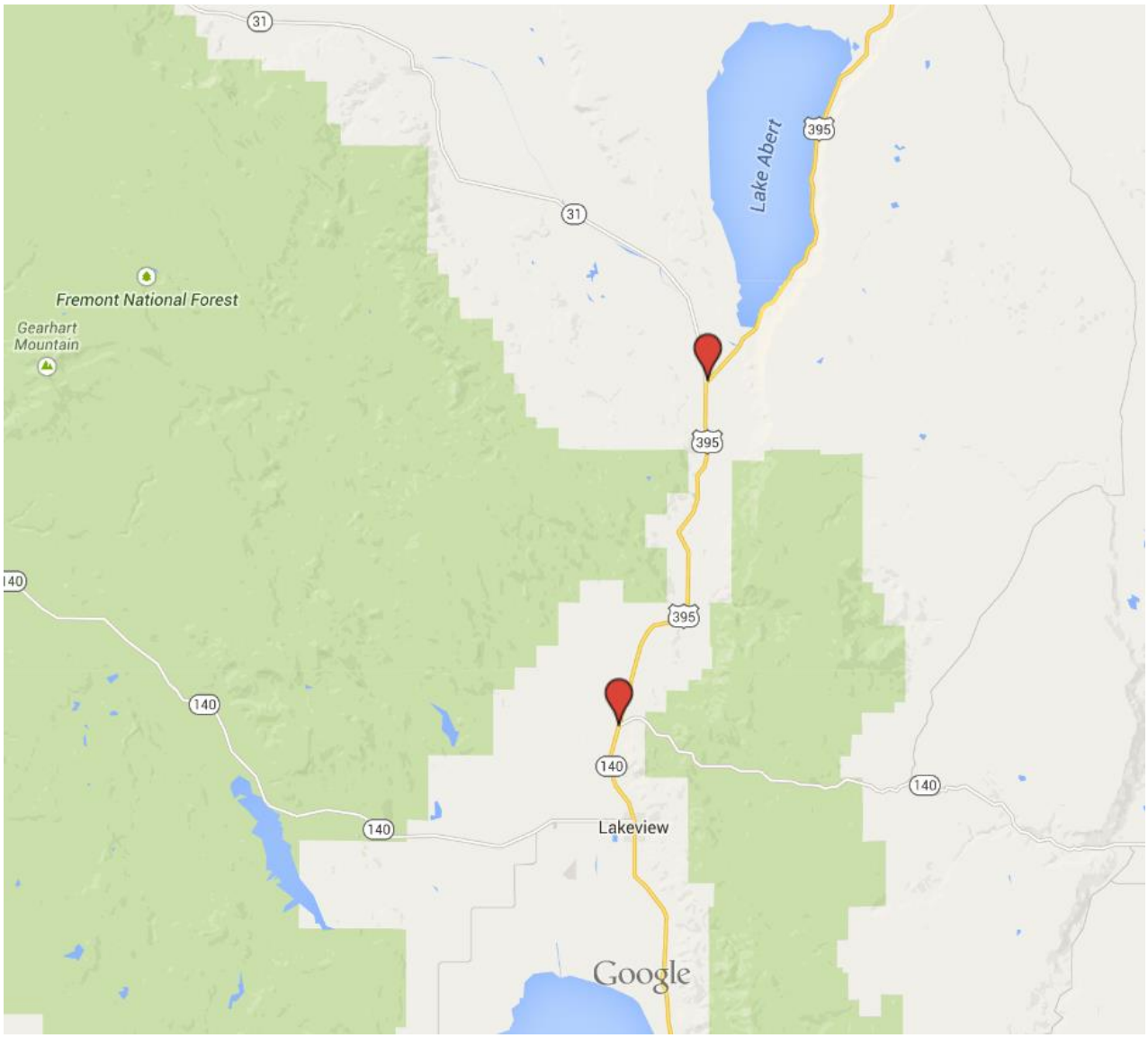

Figure 1: Study Intersections

PEAK HOUR DEVELOPMENT

The study intersections are over 17 miles apart. Therefore, the application of a system peak hour would not be meaningful. We propose to analyze the intersections based on their respective intersection peak hours.

INTERSECTION OPERATIONAL STANDARDS

Per the project scope, we will present the following performance thresholds for the study intersections, regardless of jurisdictional control:

- Volume-to-capacity (v/c) ratio;
- Level-of-service (LOS);
- Delay;
- 95th Percentile queuing (not-simulation based); and
- Turning movement counts.

This information will be provided in tables, figures, and/or technical appendices, but where possible will be provided in figures to give the general public a more clear and relatable understanding of the analysis results.

ODOT Facilities

For reference, this section summarizes the applicable performance thresholds for study intersections that fall within ODOT's jurisdiction.

ODOT assesses intersection operations based on volume-to-capacity (V/C) ratio. Table 6 of the *Oregon Highway Plan* (OHP) provides volume-to-capacity targets for facilities outside the Metro area. The OHP ratios are used to evaluate existing and future no-build conditions, while Table 10-2 of the ODOT 2012 Highway Design Manual (HDM) provides V/C ratios used to assist in identifying future system deficiencies and evaluating future alternatives on state highways.

The mobility targets for the study intersections shown in Table 1 are:

- OR 31/US 395 – 0.70 v/c (OHP), 0.60 (HDM)
- OR 140 (east leg)/US 395 – 0.70 v/c (OHP), 0.60 (HDM)

SEASONAL ADJUSTMENT FACTOR

30th highest hour design volumes will be based on applicable adjustment factors. Version 2 of the APM identifies three methods for identifying seasonal adjustment factors for highway traffic volumes. All three methods utilize information provided by Automatic Traffic Recorders (ATR) located in select

locations throughout the State Highway System that collect traffic data 24-hours a day/365 days a year. There are three permanent ATR stations in Lake County (locations shown in Figure 2):

- ATR 19-004: Located on US 395, 0.26 miles south of Lakeview-Burns Highway
- ATR 19-008: Located on US 395, 0.30 miles north of Oregon-California State Line
- ATR 19-010: Located on OR 31, 2.25 miles southeast of 1st Street;

Based on the locations of ATR stations in Lake County, a combination of the On-Site ATR method and the ATR Characteristic Table Method will be used to calculate volumes at study intersections.

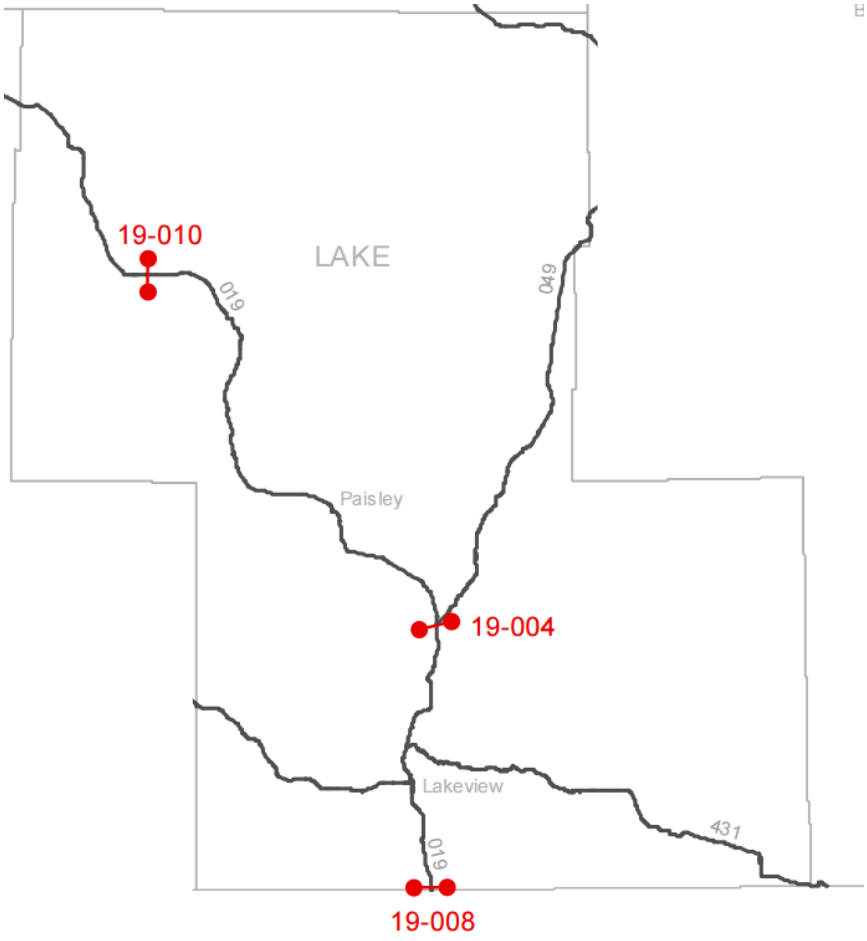

Figure 2 – ATR Locations in Lake County

On-Site ATR Method

The On-Site ATR Method requires that the ATR be located within or near the project area. If the ATR is located outside the project area, there should be no major intersections between the ATR and the project area, and the Average Annual Daily Traffic (AADT) collected by the ATR must be within 10 percent of the AADT near the project area. *ODOT's Transportation Volume Tables will be used to*

identify AADT for highway segments. Based on these requirements, one ATR station in Lake County can be used to calculate seasonal adjustment factors.

- ATR 19-010 can be used for nearby highway segments on OR 31.

The seasonal adjustment factors were calculated following the process outlined in the Version 2 APM, as summarized in Appendix A. The recommended seasonal adjustment factors are summarized in Table 2.

Table 2. On-Site ATR Method Seasonal Adjustment Method

ATR Station	Weekly Traffic Trend	May Seasonal Adjustment Factor	Roadway Applied To
ATR 19-008	Weekday	0.93	OR 31

ATR Characteristic Table Method

The ATR Characteristic Table Method is proposed to calculate seasonal adjustment factors along OR 140 and county roads to the north. The Characteristic Table Method requires:

1) The ATR must be located on a facility that shares similar characteristics with the facility to be adjusted, such as seasonal traffic trends, area type, and number of lanes.
2) AADT collected by the ATR must be within 10 percent of the AADT near the project area.

ATR station 18-017 was identified for the area east of US 395 based on: the seasonal traffic trend identified for this area (Summer < 2500), AADT, and traffic trends. The seasonal adjustment factors calculated for these ATRs are shown in Table 3 and will be applied to the roadways as reported in the table.

Table 3 ATR Characteristic Table Method Seasonal Adjustments

ATR Station	Weekly Traffic Trend	May Seasonal Adjustment Factor	Roadways Applied To
ATR 18-017	Weekday	0.91	OR 140 E of Lakeview, County Roads

Characteristic Tables are included in Appendix 1. Monthly seasonal adjustment factors for all ATRs in Table 2 and Table 3 are included in Appendix 2.

ATR Application

Since existing count volumes are low in Lake County and ATR values suggest a reduction in volumes for seasonal adjustment values, no modifications will be made to existing counts.

STUDY SEGMENTS

ODOT conducted tube counts at the segment locations identified in Table 4. These tube counts will be used to conduct two-lane highway capacity analysis using HCM 2010 methodologies. The tube counts did not contain vehicle classification information and therefore cannot be used to calculate the percentage of heavy vehicles using the roadways.

Table 4. Study Segments (48-Hour Tube Count Locations)

Roadway Name	County Type
○ OR31/Fort Rock Road	48 hour
○ OR31/Bear Flat Ln (cutoff between US97 and OR31 from the south)	48 hour
○ OR140/Plush-Adel Road & Twenty Mile Road ▪ OR140 0.10 miles east of Plush-Adel Road ▪ OR140 0.10 miles west of Plush-Adel Road	48 hour
○ Plush-Adel Road & Plush Cutoff Road ▪ North Leg	48 hour

ANALYSIS MODEL PARAMETERS

The bullets below identify the proposed sources of data and methodologies to be used to analyze traffic conditions in Lake County. Analyses of all state facilities will be conducted according to the most-recent version of the APM, unless otherwise agreed upon by both ODOT's Transportation Planning and Analysis Unit (TPAU) and the consultant team.

1. *Intersection/Roadway Geometry* (lane numbers and arrangements, cross-section elements, signal phasing, etc.) will be verified for consistency with previous work efforts, reviewed through aerial photography, and confirmed through a site visit. Available as-built data may also be used to verify existing roadway geometry. The analysis models will be built on scaled roadway line work from GIS or aerial photography in Vistro analysis software. ODOT's two-way stop-controlled intersection calculator tool will be used to calculate expected queue lengths for two-way stop-controlled intersections.

2. *Operational Data* (such as posted speeds, intersection control, parking, right-turn on red, etc.) will be field verified. Data will be reviewed during a site visit and supplemented by available GIS data, aerials, photos, and the ODOT Video Log.

3. *Peak Hour Factors* (PHF) will be calculated for each intersection and applied to the existing conditions analyses. PHFs of 0.95 will be used for the future analysis for high-order facilities (arterials), with 0.90 applied to medium-order facilities (collectors) and 0.85 applied to local roads. If the existing PHF is greater than these default future values, the existing PHF will be applied.

4. Traffic Operations

a. The 2010 Highway Capacity Manual (HCM) methodology shall be used for intersection analyses of the design hour conditions. The existing and future no-build analysis will utilize Vistro software for all study intersections. Roundabouts (if applicable) will be analyzed using HCM 2010 analysis methods. Level-of-service, delay, and volume-to-capacity ratios will be reported at each of the study intersections regardless of roadway jurisdiction.

b. Queuing analysis methodology will be based on Vistro 95th percentile queue lengths as appropriate; ODOT's two-way stop-controlled intersection calculator tool will be used to estimate queue lengths for two-way stop-controlled intersections. Microsimulation is not proposed as part of the long-range planning effort.

TRAFFIC ANALYSIS SOFTWARE AND INPUT ASSUMPTIONS

Vistro software will be used for the intersection analysis. The reported results will be the level of service, intersection delay, v/c ratios, and 95th percentile queue lengths generated by the HCM report. None of the study intersections are signalized intersections; therefore no parameters have been provided for signal timing. Analysis assumptions are listed in Table 5.

Table 5. Operations Parameters/Assumptions

Arterial Intersection Parameters	Existing Conditions
Peak Hour Factor	From traffic counts
Conflicting Bikes and Pedestrian per Hour	From traffic counts, as available
Ideal Saturation Flow Rate (for all movements)	1,750 passenger cars per hour green per lane
Lane Width	12 feet unless field observations suggest otherwise
Percent Heavy Vehicles	From traffic counts by movement, as available
Bus Blockages	None
95th percentile vehicle queues	Vistro HCM summary output

CRASH ANALYSES

The most recent five years (2009 through 2013) of crash data will be reviewed at the study intersections and study segments (where tube count data was collected). Any state highways in Lake County that are identified as a Safety Priority Index System site will be included in the crash data. The data will be analyzed for a variety of factors to include type, severity, general conditions, and location to identify potential crash patterns or anomalies. Additional details will be provided on countywide crash trends and any issues that are identified through the overall review at the County, corridor/segment, and intersection level, and will include specific details on fatalities and crashes involving pedestrians and bicyclists.

Intersection crash rates will be calculated and compared to statewide crash rate performance thresholds to determine which segments or intersections have crash rates higher than similar

facilities. Given the limited number of study intersections to be studied, calculation of a critical crash rate based on the Highway Safety Manual methodology is not a reliable method for identifying a safety performance threshold. Therefore, we will use the established crash rate performance threshold based on the 90th percentile crash rates for statewide rural intersections by traffic control type as documented in Exhibit 4-1 of the APM. Crash patterns and potential countermeasures/safety improvements will be identified and presented at intersections that exceed the statewide crash rate performance threshold.

FORECAST YEAR VOLUME DEVELOPMENT

We developed 20-year growth factors using ODOT's historical trends method, which relies on traffic volumes from previous years to develop a growth pattern for use in projected future volumes. ODOT maintains Future Volumes Tables that summarize current and future year traffic volumes for state roadways throughout the State. To calculate the growth rate for Lake County, all Lake County locations were selected from the Future Volumes Tables. Based on guidance from ODOT's Analysis Procedures Manual (APM), data with an R-squared value (RSQ, a measure of fit) of less than 0.75 was not used. The growth rates of the remaining locations were averaged to develop an annual growth rate of 0.21%. We propose to use 0.25% to project future traffic volumes at all study intersections and segments. Table 6 shows the ODOT Future Volumes Table.

NON-AUTOMOBILE TRANSPORTATION ANALYSIS

Per the scope, the non-automobile transportation analysis will include a review of collector and arterial roadways to identify deficiencies (availability of sidewalks and bicycle lanes, and gaps in primary routes) based on available GIS data and online mapping.

Table 6. ODOT Future Volume Table (Lake County Locations with RSQ > 0.75)

HWY	MP	Description	2010	2033	RSQ	RSQ* > 0.75?	Calculated Growth Rate
019	18.21	Klamath-Lake County Line, 0.59 mile south of Mowich Spring Road (NF-2516)	870	950	0.0278	N	0.38%
019	49.60	Silver Lake Automatic Traffic Recorder, Sta. 19-010, 2.25 miles southeast of 1st Street	710	720	0.2030	N	0.06%
019	62.95	Picture Rock Pass Summit	530	540	0.1753	N	0.08%
019	97.60	0.02 mile north of Red House Lane	470	480	0.4341	N	0.09%
019	98.34	0.02 mile north of Mill Street	750	760	0.6562	N	0.06%
019	98.38	0.02 mile south of Mill Street	870	880	0.8171	Y	0.05%
019	98.89	East city limits of Paisley, 0.11 mile south of Murphy Lane	590	600	0.8905	Y	0.07%
019	120.37	0.20 mile north of Lakeview-Burns Highway (US395)	590	600	0.3833	N	0.07%
019	120.83	Valley Falls Automatic Traffic Recorder, Sta. 19-004, 0.26 mile south of Lakeview-Burns Highway No. 49 (US395)	770	780	0.7938	Y	0.06%
019	138.29	0.05 mile north of Warner Highway (OR140)	820	830	0.6141	N	0.05%
019	138.39	0.05 mile south of Warner Highway (OR140)	1300	1400	0.1706	N	0.32%
019	140.71	0.02 mile north of Goldmohr Terrace Road (Sunnyslope Lane)	1500	1600	0.8823	Y	0.28%
019	142.60	0.02 mile north of N. 9th Street	1800	1900	0.8562	Y	0.24%
019	142.88	0.02 mile north of N. 6th Street	1900	2000	0.9716	Y	0.22%
019	143.01	0.02 mile north of Klamath Falls-Lakeview Highway (OR140)	2700	2800	0.9002	Y	0.16%
019	143.06	0.03 mile southeast of Klamath Falls-Lakeview Highway (OR140)	5200	5300	0.7819	Y	0.08%
019	143.32	0.02 mile south of Center Street	4200	4300	0.9169	Y	0.10%
019	143.65	0.02 mile north of 4th Street South	3700	3800	0.9070	Y	0.12%
019	143.86	0.02 mile north of 7th Street South	3300	3400	0.8535	Y	0.13%
019	144.08	0.02 mile south of "F" Street South	2200	2300	0.8627	Y	0.19%
019	144.22	0.02 mile south of 10th Street South	2000	2200	0.0591	N	0.42%
019	144.47	0.02 mile south of 12th Street South	1400	1600	0.0174	N	0.58%
019	148.63	0.02 mile north of Crane Creek Road	1000	1100	0.2190	N	0.42%
019	157.43	New Pine Creek Automatic Traffic Recorder, Sta. 19-008, 0.30 mile north of Oregon-California State Line	940	950	0.6874	N	0.05%
020	70.73	4.00 miles southeast of Quartz Mountain Pass Summit	760	790	0.0413	N	0.17%
020	88.96	0.10 mile west of Tunnel Hill Road	1000	1100	0.1554	N	0.42%
020	89.16	0.10 mile east of Tunnel Hill Road	1100	1200	0.3184	N	0.38%
020	92.43	0.70 mile east of Westside Road at Maddock Corner	1400	1500	0.3251	N	0.30%
020	93.88	0.02 mile west of road to Airport	1600	1700	0.8518	Y	0.26%
020	95.39	0.02 mile east of Roberta Avenue	2100	2200	0.7302	N	0.20%
020	95.72	0.02 mile east of N. "R" Street	2600	2700	0.8530	Y	0.16%
020	96.03	0.02 mile west of "L" Street	3100	3200	0.8341	Y	0.14%
020	96.35	0.02 mile west of Fremont Highway (US395)	3000	3100	0.8492	Y	0.14%
049	0.20	0.19 mile south of Central Oregon Highway (US20)	380	500	0.7461	Y	1.20%
049	89.52	0.50 mile north of Fremont Highway (OR31)	270	280	0.3691	N	0.16%
431	0.10	0.10 mile east of Fremont Highway (US395)	550	580	0.3165	N	0.23%
431	8.07	0.02 mile west of Summit Prairie Road	530	570	0.3385	N	0.32%
431	15.81	0.02 mile east of Plush Cutoff Road	420	440	0.1447	N	0.20%
431	28.08	0.10 mile west of Twenty Mile Road	310	320	0.1032	N	0.14%
431	28.28	0.10 mile east of Twenty Mile Road	280	290	0.0005	N	0.15%
431	65.28	Oregon-Nevada State Line	180	190	0.1552	N	0.24%
					Average Growth Rate:		**0.21%**

*RSQ = R-squared value, which describes the fit of the data to a line.

Appendix 1 On-site ATR Characteristics

ATR CHARACTERISTIC TABLE (Printed: 09/18/14)										
SEASONAL TRAFFIC TREND	**AREA TYPE**	**# OF LANES**	**WEEKLY TRAFFIC TREND**	**AADT**	**OHP CLASSIFICATION**	**ATR**	**COUNTY**	**HIGHWAY ROUTE, NAME, & LOCATION**	**MP**	**STATE HWY NUMBER**
SUMMER < 2500	RURAL	2	WEEKDAY	800	DISTRICT HWY	01-001	BAKER	US30, LA GRANDE-BAKER HIGHWAY, 4.84 MILES SOUTH OF UNION BAKER COUNTY LINE	37.70	66

ATR CHARACTERISTIC TABLE (Printed: 09/18/14)										
SEASONAL TRAFFIC TREND	**AREA TYPE**	**# OF LANES**	**WEEKLY TRAFFIC TREND**	**AADT**	**OHP CLASSIFICATION**	**ATR**	**COUNTY**	**HIGHWAY ROUTE, NAME, & LOCATION**	**MP**	**STATE HWY NUMBER**
RECREATIONAL SUMMER	RURAL	2	WEEKEND	890	STATEWIDE HWY	18-017	KLAMATH	OR140, KLAMATH FALLS-LAKEVIEW HIGHWAY, 4.14 MILES EAST OF YELLOW JACKET SPRINGS ROAD AT BEATTY	44.92	20

Appendix 2 ATR Summary Information

ODOT ATR 19-004: US395; MP 120.83; Freemont Highway No. 19, 0.26 miles south of Lakeview-Burns Highway No. 49 (US395)												
Year	**15-Jan**	**15-Feb**	**15-Mar**	**15-Apr**	**15-May**	**15-Jun**	**15-Jul**	**15-Aug**	**15-Sep**	**15-Oct**	**15-Nov**	**15-Dec**
2013	64	75	86	95	109	127	129	141	130	104	90	74
2012	64	74	78	98	114	126	132	143	134	104	94	68
2011	74	73	88	100	110	127	133	133	134	101	88	74
2010	68	81	85	89	104	121	141	138	141	117	87	70
2009	67	71	82	99	113	125	135	133	133	105	89	76
Average	66.3	74.0	84.3	97.3	110.7	126.0	133.3	137.3	133.7	104.3	89.0	72.7
Count Adj.	**1.51**	**1.35**	**1.19**	**1.03**	**0.90**	**0.79**	**0.75**	**0.73**	**0.75**	**0.96**	**1.12**	**1.38**

Represent min/max values removed from average

ODOT ATR 19-008: US395; MP 157.43; Freemont Highway No. 19, 0.30 miles north of Oregon-California State Line												
Year	**15-Jan**	**15-Feb**	**15-Mar**	**15-Apr**	**15-May**	**15-Jun**	**15-Jul**	**15-Aug**	**15-Sep**	**15-Oct**	**15-Nov**	**15-Dec**
2013	70	80	87	100	107	117	123	130	125	107	92	78
2012	76	78	82	94	109	119	125	132	128	104	94	75
2011	109	100	88	88	108	123	126	121	113	93	82	73
2010	64	70	82	85	96	115	123	128	139	124	103	96
2009	71	73	83	98	109	120	126	123	126	102	95	78
Average	72.3	77.0	84.0	93.3	108.0	118.7	124.7	127.0	126.3	104.3	93.7	77.0
Count Adj.	**1.38**	**1.30**	**1.19**	**1.07**	**0.93**	**0.84**	**0.80**	**0.79**	**0.79**	**0.96**	**1.07**	**1.30**

Represent min/max values removed from average

ODOT ATR 01-001: US 30; MP 37.70; La Grande-Baker Highway No. 66, 4.84 miles south of Union-Baker County Line												
Year	**15-Jan**	**15-Feb**	**15-Mar**	**15-Apr**	**15-May**	**15-Jun**	**15-Jul**	**15-Aug**	**15-Sep**	**15-Oct**	**15-Nov**	**15-Dec**
2013	79	94	98	109	111	116	142	128	117	111	101	90
2012	89	102	100	113	114	113	118	116	116	112	100	89
2011	77	86	89	110	120	121	125	123	125	111	103	92
2010	90	95	102	107	113	121	121	119	117	108	93	86
2009	80	89	94	107	118	131	120	120	114	108	100	94
Average	82.7	92.7	97.3	108.7	115.0	119.3	122.0	120.7	116.7	110.0	100.3	90.3
Count Adj.	**1.21**	**1.08**	**1.03**	**0.92**	**0.87**	**0.84**	**0.82**	**0.83**	**0.86**	**0.91**	**1.00**	**1.11**

Represent min/max values removed from average

ODOT ATR 18-017: OR 140; MP 44.98; Klamath Falls-Lakeview Highway No. 20, 4.20 miles east of Yellow Jacket Spring Road at Beatty												
Year	**15-Jan**	**15-Feb**	**15-Mar**	**15-Apr**	**15-May**	**15-Jun**	**15-Jul**	**15-Aug**	**15-Sep**	**15-Oct**	**15-Nov**	**15-Dec**
2013	71	75	81	91	109	124	126	128	123	104	89	74
2012	74	74	73	86	106	120	136	137	131	114	87	73
2011	88	94	92	86	116	123	122	126	116	99	79	76
2010	60	65	70	75	95	129	145	140	139	120	94	77
2009	67	69	74	87	113	125	125	130	125	114	88	79
Average	70.7	72.7	76.0	86.3	109.3	124.0	129.0	131.7	126.3	110.7	88.0	75.7
Count Adj.	**1.42**	**1.38**	**1.32**	**1.16**	**0.91**	**0.81**	**0.78**	**0.76**	**0.79**	**0.90**	**1.14**	**1.32**

Represent min/max values removed from average