



MEMORANDUM

DATE: November 28, 2023

TO: Jennifer Pollom, Mehdi Moeinaddini | SRTA

FROM: David Tokarski | DKS Associates

SUBJECT: ShastaSIM 2.0 Supplemental Documentation

Project #19032

This memorandum serves as updated model documentation for ShastaSIM 2.0, the updated Activity Based Travel Demand Model for SRTA and Shasta County. This documentation serves as a supplement to (and not a replacement for) the Model Development Report adopted for ShastaSIM 1.2 in September 2018 and the Model Users Guide adopted for ShastaSIM 1.2 in October 2018. This documentation focuses on the following key changes in the model since 2018:

- Model Inputs
 - o Land Use Assumptions
 - o Roadway and Bicycle Network Assumptions
 - o Transit Assumptions
- Model Validation
- Model Outputs and Performance Measures
 - o VMT Methodology and Results
- Model Structure

Because the 2022 RTP/SCS update analysis is focused on 2035 and 2040 horizon years, this documentation focuses specifically on those two horizon years and how assumptions and results have changed for 2035 and 2040 forecasts.

MODEL INPUTS

LAND USE ASSUMPTIONS

Land use assumptions (represented by households, population, and employees in the model) for the previous model update in 2018 date back to a 2010 base year and a series of “Phased Development” tables prepared by SRTA with direct input from each jurisdiction in the County. Those assumptions

represented forecasts in growth prior to the COVID-19 pandemic and were based on previous DOF (Department of Finance) projections for Shasta County. Recent changes in demographic trends due in part to the pandemic and in part to other factors have resulted in updated DOF forecasts that predict lower growth rates in Shasta County. Additionally, SRTA requested that each local agency update their portion of the Phased Development tables to reflect any changes in the status of development projects, including changing the amount of development or the year it is anticipated to occur. Both of these resulted in changes to the land use forecasts assumed in the updated ShastaSIM model. **Table 1** shows changes in population, **Table 2** shows changes in households, and **Table 3** shows changes in employment between ShastaSIM 1.2 and ShastaSIM 2.0. The largest change is a large reduction in households (and therefore population) by 2035 (and therefore 2040) associated with reductions in DOF forecasts. For Shasta County as a whole, population forecasts by 2035 (and 2040) reduce from nearly 215,000 (and just over 223,000) to approximately 188,000 for both 2035 and 2040. Employment changes are far less dramatic, with changes of approximately 600 in 2035 and 1,000 in 2040. **Table 4** shows the updated Phased Development Table, as provided by SRTA.

TABLE 1: CHANGES IN POPULATION (SHASTASIM 1.2 TO SHASTASIM 2.0)

	2005	2010	2015	2020	2035	2040
SHASTASIM 1.2 (2018 RTP/SCS)						
TOTAL SHASTA COUNTY	174,495	176,465	182,261	191,905	214,856	223,042
UNINCORPORATED SHASTA CO	64,752	65,633	66,232	67,248	77,319	80,416
CITY OF REDDING	89,936	91,148	95,570	102,978	112,618	117,570
CITY OF ANDERSON	9,767	9,796	10,523	11,319	13,462	13,031
CITY OF SHASTA LAKE	10,040	9,888	9,936	10,360	11,457	12,025
SHASTASIM 2.0 (2022 RTP/SCS)						
TOTAL SHASTA COUNTY	174,495	176,465	182,261	182,250	187,559	188,241
UNINCORPORATED SHASTA CO	64,752	65,633	66,232	66,994	68,254	68,588
CITY OF REDDING	89,936	91,148	95,570	93,796	99,140	99,047
CITY OF ANDERSON	9,767	9,796	10,523	11,407	11,504	11,652
CITY OF SHASTA LAKE	10,040	9,888	9,936	10,384	8,661	8,984
SHASTASIM 1.2 to SHASTASIM 2.0 Change						
TOTAL SHASTA COUNTY	-	-	-	-9,655	-27,297	-34,801
UNINCORPORATED SHASTA CO	-	-	-	-254	-9,065	-11,828
CITY OF REDDING	-	-	-	-9,182	-13,478	-18,523
CITY OF ANDERSON	-	-	-	-243	-1,958	-1,379
CITY OF SHASTA LAKE	-	-	-	+24	-2,796	-3,041

TABLE 2: CHANGES IN HOUSEHOLDS (SHASTASIM 1.2 TO SHASTASIM 2.0)

	2005	2010	2015	2020	2035	2040
SHASTASIM 1.2 (2018 RTP/SCS)						
TOTAL SHASTA COUNTY	70,343	71,136	73,471	77,283	86,532	89,837
UNINCORPORATED SHASTA CO	26,254	26,342	26,620	27,235	31,127	32,300
CITY OF REDDING	36,170	36,795	38,613	41,440	45,494	47,459
CITY OF ANDERSON	3,926	3,991	4,204	4,535	5,327	5,318
CITY OF SHASTA LAKE	3,993	4,008	4,034	4,073	4,584	4,760
SHASTASIM 2.0 (2022 RTP/SCS)						
TOTAL SHASTA COUNTY	70,343	71,136	73,471	73,453	75,533	75,815
UNINCORPORATED SHASTA CO	26,254	26,342	26,620	26,947	27,426	27,527
CITY OF REDDING	36,170	36,795	38,613	37,777	39,948	40,085
CITY OF ANDERSON	3,926	3,991	4,204	4,486	4,650	4,663
CITY OF SHASTA LAKE	3,993	4,008	4,034	4,243	3,509	3,540
SHASTASIM 1.2 to SHASTASIM 2.0 Change						
TOTAL SHASTA COUNTY	-	-	-	-3,830	-10,999	-14,022
UNINCORPORATED SHASTA CO	-	-	-	-288	-3,701	-4,773
CITY OF REDDING	-	-	-	-3,663	-5,546	-7,374
CITY OF ANDERSON	-	-	-	-49	-677	-655
CITY OF SHASTA LAKE	-	-	-	+170	-1,075	-1,220

TABLE 3: CHANGES IN EMPLOYMENT (SHASTASIM 1.2 TO SHASTASIM 2.0)

	2005	2010	2015	2020	2035	2040
SHASTASIM 1.2 (2018 RTP/SCS)						
TOTAL SHASTA COUNTY	62,213	63,664	69,524	73,585	82,075	84,543
UNINCORPORATED SHASTA CO	13,461	13,404	15,482	16,516	18,311	18,991
CITY OF REDDING	43,525	44,762	48,197	50,796	56,356	57,568
CITY OF ANDERSON	3,289	3,587	3,787	4,007	4,625	5,176
CITY OF SHASTA LAKE	1,938	1,911	2,058	2,266	2,783	2,808
SHASTASIM 2.0 (2022 RTP/SCS)						
TOTAL SHASTA COUNTY	62,213	63,664	69,524	73,404	82,682	85,633
UNINCORPORATED SHASTA CO	13,461	13,404	15,482	16,409	18,286	18,916
CITY OF REDDING	43,525	44,762	48,197	50,722	57,250	59,027
CITY OF ANDERSON	3,289	3,587	3,787	4,007	4,749	5,273
CITY OF SHASTA LAKE	1,938	1,911	2,058	2,266	2,397	2,417
SHASTASIM 1.2 to SHASTASIM 2.0 Change						
TOTAL SHASTA COUNTY	-	-	-	-181	607	1,090
UNINCORPORATED SHASTA CO	-	-	-	-107	-25	-75
CITY OF REDDING	-	-	-	-70	894	1,459
CITY OF ANDERSON	-	-	-	-	124	97
CITY OF SHASTA LAKE	-	-	-	-	-386	-391

Figure 1 and **Figure 2** display the data for 2035 visually, focusing on the urban areas of Shasta County, as those are the areas with the most significant changes. The figures both display both changes between models by parcel and by traffic analysis zone (TAZ).

Land use file structures are the same for ShastaSIM 2.0 as they were for ShastaSIM 1.2, however the way the files are used in the model are different based on the use of updated DAYSIM software. As with ShastaSIM 1.2, ShastaSIM 2.0 uses the parcel-based land use file called "[PARCEL_UPDATE_ALLOCHH.CSV](#)" that is stored in the <scenario> directory under the "base" directory within the parent catalog directory. This file is formatted the same as previous ShastaSIM versions and includes the same data fields. Additionally, this file is created in the same manner as the previous version of ShastaSIM using a macro enabled spreadsheet called "[CREATE_RTP_PARCELS_20XX.XLSM](#)". New users can refer to the previous (2018) documentation for specifically how to edit or update these files.

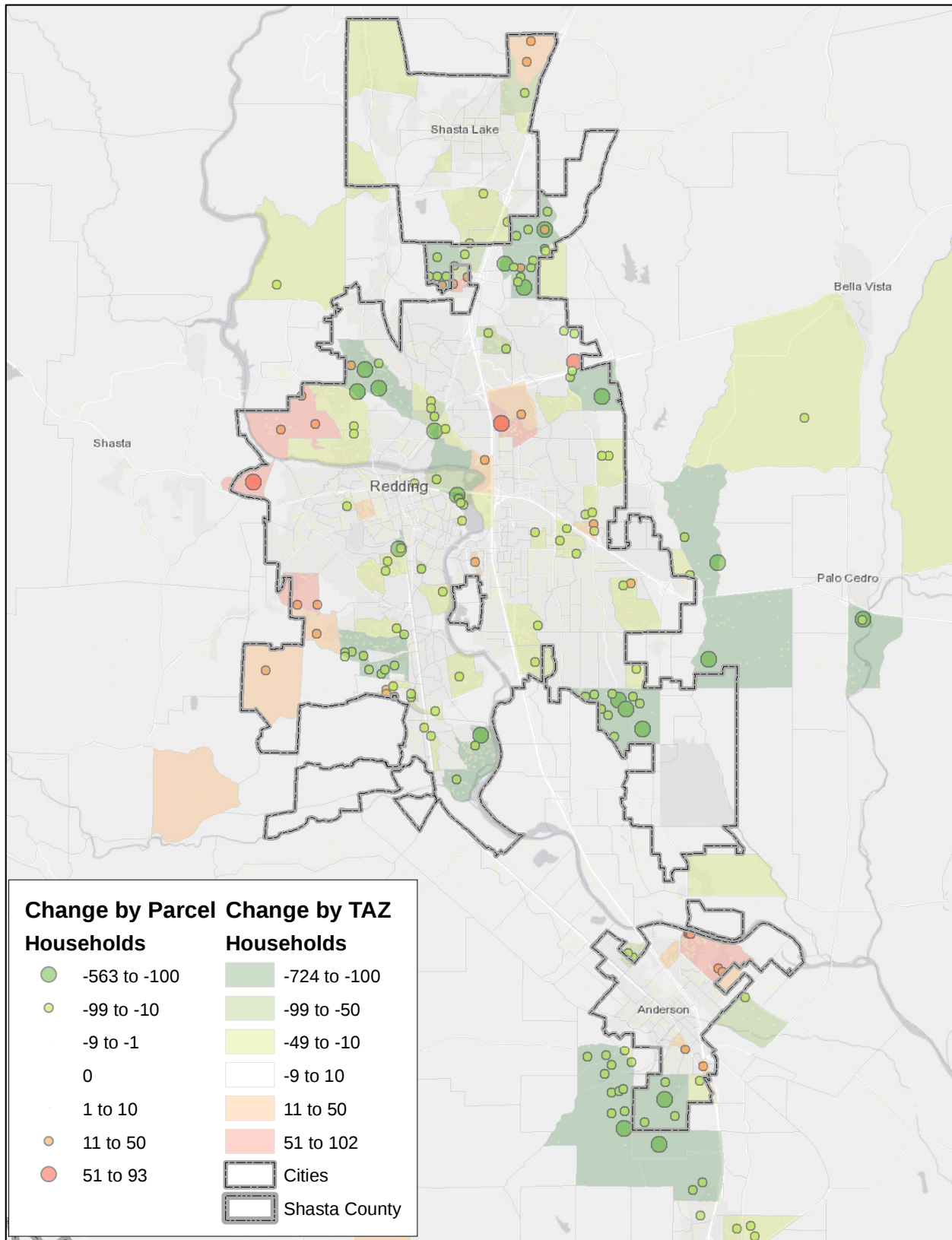


FIGURE 1: CHANGE IN HOUSEHOLDS SHASTASIM 1.2 TO SHASTASIM 2.0 - 2035

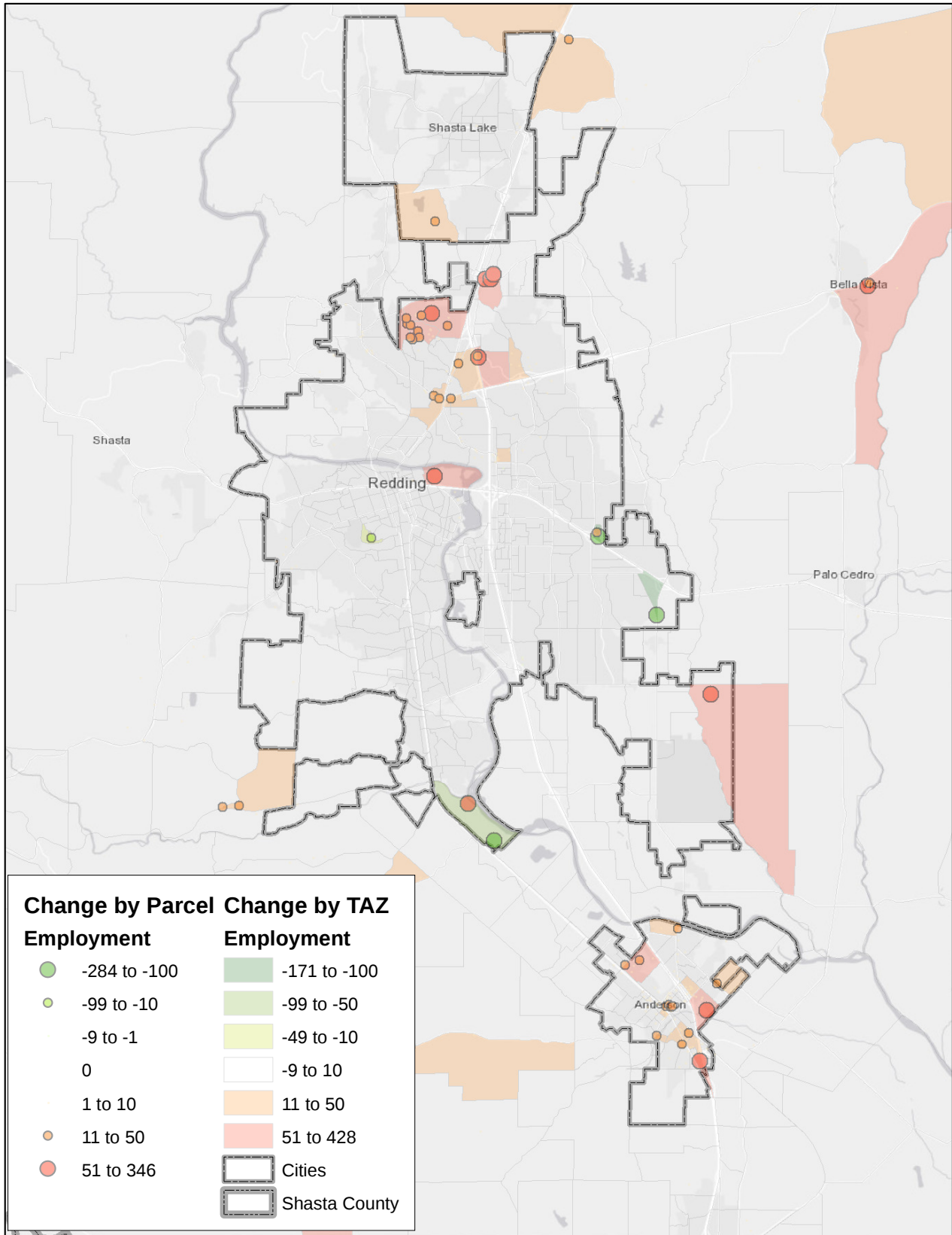


FIGURE 2: CHANGE IN EMPLOYMENT SHASTASIM 1.2 TO SHASTASIM 2.0 – 2035

TABLE 4: UPDATED PHASED DEVELOPMENT TABLE

Development	Address	Land Use	Units	2010	2015	2020	2025	2030	2035	2040	2045	2050 & Beyond (Previously "after 2040")	TOTAL	Percent Developed by 2045
CITY OF ANDERSON														
Anderson Commercial	Anderson	Retail	SF	0	0	10,000	0	0	0	58,500		58,500	127,000	54%
Anderson Condos	Anderson	MF Attached	DU	0	70	0	0	0	0	0		0	70	100%
Anderson Conference Facility	Anderson	Restaurant	SF	0	2,500	0	0	0	0	0		0	2,500	100%
Anderson Potential Target Site	Anderson	Retail	SF	0	0	0	0	0	130,000	66,000		130,000	326,000	60%
		Fast Food	SF	0	2,500	0	0	2,500	2,500	0		0	7,500	100%
Church Property	Anderson	SF Detached	DU	0	0	0	0	0	69	0		0	69	100%
Silvergate Subdivision	Anderson	MF Attached	DU	16	16	0	0	0	0	0		0	32	100%
River Pointe	Anderson	SF Detached	DU	0	0	0	111	74	0	0		0	185	100%
Homewood	Anderson	SF Detached	DU	43	60	0	0	0	0	0		0	103	100%
Vineyards	Anderson	SF Detached	DU	15	85	157	722	848	981	839		648	4,295	85%
		MF Attached	DU	0	640	0	287	287	0	0		0	1,214	100%
		Retail	SF	0	0	0	0	0	70,000	20,000		50,000	140,000	64%
		Office	SF	0	0	0	0	0	50,000	0		50,000	100,000	50%
		School	Emps	0	0	0	0	0	50	50		0	100	100%
Willow Glen	Anderson	SF Detached	DU	28	28	0	0	0	0	0		0	56	100%
CITY OF REDDING														
Airpark Manor	Redding (Placer St.)	SF Detached	DU	10	10	0	0	0	0	0		0	20	100%
Airport Rd. Auto Dealer Site	Redding (3900 Airport Rd.)	Service Commercial	SF	0	0	0	0	0	44,000	135,000		0	179,000	100%
Alize Subdivision	Redding (160 Quartz Hill Rd.)	SF Detached	DU	0	93	87	0	0	0	0		0	180	100%
Avalon Park	Redding (11701 Twin Tower Dr.)	SF Detached	DU	0	55	0	0	0	0	0		0	55	100%
Bel Air	Redding (Quartz Hill Rd.)	SF Detached	DU	13	12	0	0	0	0	0		0	25	100%
Bel Air Estates	Redding (2430 Snow Ln.)	SF Detached	DU	149	0	0	0	0	0	0		0	149	100%
Buenaventura Senior Housing	Redding (1350 Buenaventura)	Senior Housing	DU	0	0	120	0	0	0	0		0	120	100%
Chapel of the Ferns	Redding (1400 Industrial St.)	SF Detached	DU	0	0	80	0	0	0	0		0	80	100%
City of Redding	Redding (7251 Eastside Rd.)	Industrial	SF	0	0	0	0	0	198,000	298,000		496,000	992,000	50%
Clover Creek	Redding (3901 Airport Rd.)	Office	SF	0	0	0	36,400	0	36,400	0		0	72,800	100%
Cottages at Bel Air	Redding (Quartz Hill Rd.)	SF Detached	DU	14	41	0	0	0	0	0		0	55	100%
Del Monte PSL	Redding (Del Monte St.)	Retail	SF	0	0	0	0	0	0	61,500		67,000	128,500	48%
East Oaks Estates	Redding (1283 Douglas Ln.)	SF Detached	DU	37	37	0	0	0	0	0		0	74	100%
Emily Estates	Redding (Oasis Rd.)	SF Detached	DU	58	0	0	0	0	0	0		0	58	100%
Fleur de Lac	Redding (1870 Shasta View Dr.)	SF Detached	DU	39	39	0	0	0	0	0		0	78	100%
Forootan	Redding (187 Sulphur Creek Rd.)	SF Detached	DU	0	0	23	41	41	41	41		0	187	100%
Gironda	Redding (Shasta View Dr.)	SF Detached	DU	0	0	102	102	103	0	0		0	307	100%
Gold Hills Park	Redding (2141 Gold Hills Dr.)	SF Detached	DU	0	175	0	0	0	0	0		0	175	100%
Green	Redding (Hillmonte Dr.)	Retail	SF	0	0	0	0	0	4,000	0		0	4,000	100%
Highland Park	Redding (Davis Ridge Rd.)	SF Detached	DU	0	100	200	120	0	0	0		0	420	100%
Hilltop Center	Redding (1085 Hilltop Dr.)	Retail	SF	0	46,500	46,500	0	0	0	0		0	93,000	100%
Hilltop Estates	Redding (240 Hilltop Dr.)	SF Detached	DU	27	0	0	0	0	0	0		0	27	100%
Hinds Feet LLC	Redding (Laurel Ave.)	SF Detached	DU	0	0	11	37	0	0	0		0	48	100%
Hope Lane	Redding (1175 Hope Ln.)	SF Detached	DU	44	0	0	0	0	0	0		0	44	100%
Kohn	Redding (4730 Aloe Vera Dr.)	SF Detached	DU	0	202	0	0	0	0	0		0	202	100%
Lakeside Avenues	Redding (1397 Buenaventura)	SF Detached	DU	40	0	0	0	0	0	0		0	40	100%

TABLE 4 (CONT.) UPDATED PHASED DEVELOPMENT TABLE

Development	Address	Land Use	Units	2010	2015	2020	2025	2030	2035	2040	2045	2050 & Beyond (Previously "after 2040")	TOTAL	Percent Developed by 2045
CITY OF REDDING														
Lanzing	Redding (1335 Hope Ln.)	SF Detached	DU	0	0	30	0	0	0	0		0	30	100%
Lemm	Redding (2300 Lakeside Dr.)	SF Detached	DU	0	0	0	0	0	0	38		0	38	100%
McConnell Land	Redding (Old Oregon Trail)	SF Detached	DU	0	0	0	0	0	605	447		337	1,389	76%
MD Development	Redding (Oasis Rd.)	SF Detached	DU	0	50	50	0	0	0	0		0	100	100%
Mercy Hospital	Redding (2655 Airpark Dr.)	Retail	SF	0	0	0	0	0	0	11,000		0	11,000	100%
		Office	SF	0	0	0	0	0	0	11,000		0	11,000	100%
Metz Road Development	Redding (2230 Metz Rd.)	Industrial	SF	0	0	0	0	200,000	200,000	200,000		392,000	992,000	60%
Michiels	Redding (5900 Riverside Dr.)	SF Detached	DU	0	0	0	0	0	0	260		0	260	100%
Mid State Apartments	Redding (Cedars Rd.)	MF Attached	DU	12	36	0	0	0	0	0		0	48	100%
Money Vest	Redding (Tarmac Rd.)	SF Detached	DU	7	22	0	0	0	0	0		0	29	100%
		Retail	SF	0	41,000	0	0	0	0	0		0	41,000	100%
Morgan	Redding (2425 Rancho Rd.)	SF Detached	DU	0	20	0	0	0	0	0		0	20	100%
Niemann	Redding (Westside Rd.)	MF Attached	DU	12	34	0	0	0	0	0		0	46	100%
Oasis Point Village	Redding (6021 Oasis Road)	SF Detached	DU	40	121	0	0	0	0	0		0	161	100%
Oasis Road Specific Plan	Redding	SF 1-5 DU/Acre	DU	0	0	5	4	3	0	0		0	12	100%
		SF 2-3.5 DU/Acre	DU	0	0	30	30	30	0	0		0	90	100%
		SF 6-10 DU/Acre	DU	0	0	30	30	0	0	0		0	60	100%
		MF 15 DU/Acre	DU	0	0	100	100	100	100	100		435	935	53%
		Regional Commercial	SF	0	160,000	180,000	45,000	50,000	185,000	50,000		1,614,722	2,284,722	29%
		General Commercial	SF	0	0	40,000	0	0	40,000	40,000		454,000	574,000	21%
		Shopping Center	SF	0	0	0	37,500	0	37,500	75,000		77,000	227,000	66%
		General Office	SF	0	0	0	0	10,000	9,800	0		0	19,800	100%
		Limited Office	SF	0	0	0	0	7,000	6,100	0		0	13,100	100%
Park Marina Drive Specific Plan (Turtle Bay listed separately)	Redding	Retail	SF	0	8,000	0	12,500	0	27,500	50,000		89,200	187,200	52%
		Office	SF	0	0	22,000	20,500	0	0	0		0	42,500	100%
		Hotel	SF	0	0	0	0	0	50,500	0		0	50,500	100%
Parkview/Orange	Redding (Mark St.)	SF Detached	DU	54	-	-	-	-	-	-		-	54	100%
Quartz Hill PSL	Redding (850 Quartz Hill Rd.)	SF Detached	DU	-	-	120	-	-	-	-		-	120	100%
Redding PD-03-02	Redding (Collyer Dr.)	MF Attached	DU	-	232	-	-	-	-	-		-	232	100%
Redding S.51.90	Redding (Santa Rosa Way)	SF Detached	DU	-	-	160	-	149	-	-		-	309	100%
Redding SDP.18.04	Redding (Linden/West)	MF Attached	DU	-	15	15	-	-	-	-		-	30	100%
Redding SDP.24.04	Redding (2649 Twin View Blvd.)	MF Attached	DU	-	140	140	-	-	-	-		-	280	100%
Roesner	Redding (4655 Goodwater Ave.)	SF Detached	DU	-	-	-	-	-	23	-		-	23	100%
Roman Catholic Bishop	Redding (1300 Ridge Dr.)	SF Detached	DU	-	-	-	-	-	-	79		-	79	100%
Salt Creek	Redding (4402 Eureka Way)	SF Detached	DU	-	-	120	250	70	-	-		-	440	100%
Scarborough	Redding (3600 Argyle Rd.)	MF Attached	DU	-	67	-	-	-	-	-		-	67	100%
Shascade	Redding (950 Lake Blvd.)	SF Detached	DU	-	-	-	-	-	38	-		-	38	100%
Shasta Bible College	Redding (3005 Hartnell Ave.)	MF Attached	DU	-	100	-	-	-	-	-		-	100	100%
Shastina Ranch	Redding	SF Detached	DU	-	-	150	200	125	-	-		-	475	100%
		School	Emps	-	-	-	-	50	-	-		-	50	100%
Sierra Pacific	Redding (Branstetter Ln.)	SF Detached	DU	5	64	113	-	-	-	-		-	182	100%
Signature Northwest	Redding (4200 Sunglow Dr.)	SF Detached	DU	-	78	-	-	-	-	-		-	78	100%

TABLE 4 (CONT.) UPDATED PHASED DEVELOPMENT TABLE

Development	Address	Land Use	Units	2010	2015	2020	2025	2030	2035	2040	2045	2050 & Beyond (Previously "after 2040")	TOTAL	Percent Developed by 2045
CITY OF REDDING														
Stillwater Business Park	Redding	Industrial	SF	-	224,000	-	-	-	-	224,000	-	3,753,000	4,201,000	11%
		Office	SF	-	105,500	-	-	-	132,700	132,700	-	1,726,600	2,097,500	18%
Stone Creek Subdivision	Redding (Rancho Rd.)	SF Detached	DU	-	-	155	-	-	-	-	-	-	155	100%
Stonesfair Subdivision	Redding (Rancho Rd.)	SF Detached	DU	-	-	215	-	-	-	-	-	-	215	100%
Summer Field Meadows	Redding (3555 Sacramento Dr.)	SF Detached	DU	18	18	-	-	-	-	-	-	-	36	100%
Tarmac Ridge Villas	Redding (2260 Tarmac Rd.)	SF Detached	DU	43	43	-	-	-	-	-	-	-	86	100%
Thomason	Redding (3901 Airport Rd.)	Retail	SF	-	-	-	-	-	72,500	-	-	-	72,500	100%
Tip Top Partners	Redding (2425 Sonoma St.)	Retail	SF	-	-	-	-	-	-	-	-	6,500	6,500	0%
		Office	SF	-	6,500	-	-	-	-	-	-	-	6,500	100%
Turtle Bay Hotel	Redding	Hotel	SF	-	70,000	-	-	-	-	-	-	-	70,000	100%
		Restaurant	SF	-	8,000	-	-	-	-	-	-	-	8,000	100%
Tuscany Villas	Redding (6111 Oasis Rd.)	SF Detached	DU	-	79	-	-	-	-	-	-	-	79	100%
Van Eperen	Redding (5304 Bo Peep Ln.)	SF Detached	DU	43	43	-	-	-	-	-	-	-	86	100%
Veterans Home	Redding (3400 Knighton Rd.)	Residential Care	SF	-	145,000	-	-	-	-	-	-	-	145,000	100%
Villages at Shasta View Gardens	Redding (2275 Tarmac Rd.)	SF Detached	DU	31	93	-	-	-	-	-	-	-	124	100%
Viale	Redding (1817 Kenton Dr.)	SF Detached	DU	-	-	-	-	112	-	-	-	-	112	100%
Vistas	Redding (355 Quartz Hill Rd.)	SF Detached	DU	-	210	-	-	-	-	-	-	-	210	100%
Western Acres	Redding (890 Hilltop Dr.)	SF Detached	DU	-	-	-	-	-	80	-	-	-	80	100%
Westridge Subdivision	Redding (950 Canyon Creek Rd.)	SF Detached	DU	-	-	132	-	-	-	-	-	-	132	100%
Westward Estates	Redding (16989 Campo Calle St.)	SF Detached	DU	-	-	150	-	-	-	-	-	-	150	100%
Williams	Redding (670 Churn Creek Rd.)	SF Detached	DU	-	-	18	-	-	-	-	-	-	18	100%
CITY OF SHASTA LAKE														
Deer Creek Manor	Shasta Lake	SF Detached	DU	-	5	5	10	10	10	10	-	35	85	59%
Mountain Gate at Shasta	Shasta Lake	SF Detached	DU	-	-	-	30	25	25	25	-	1,095	1,200	9%
		MF Attached	DU	-	-	-	150	100	-	150	-	-	400	100%
		Service Commercial	SF	-	-	-	50,000	50,000	50,000	50,000	-	-	200,000	100%
Mountain Properties	Shasta Lake	SF Detached	DU	-	-	10	10	10	10	10	-	114	164	30%
Oak Ridge	Shasta Lake	SF Detached	DU	-	-	5	5	5	5	5	-	3	28	89%
Shasta Gateway Industrial Park	Shasta Lake (Phase 1)	Light Industrial	SF	-	-	-	10,000	50,000	50,000	-	-	90,000	200,000	55%
	Shasta Lake (Phase 2)	Industrial	SF	-	-	-	-	-	-	-	-	1,970,000	1,970,000	0%
Shasta Lake Commercial Center	Shasta Lake	Service Commercial	SF	-	-	20,000	60,000	10,000	10,000	-	-	-	100,000	100%
Windsor Estates	Shasta Lake	SF Detached	DU	-	3	5	5	5	5	5	-	10	38	74%

TABLE 4 (CONT.) UPDATED PHASED DEVELOPMENT TABLE

Development	Address	Land Use	Units	2010	2015	2020	2025	2030	2035	2040	2045	2050 & Beyond (Previously "after 2040")	TOTAL	Percent Developed by 2045
SHASTA COUNTY														
Alman	Shasta Co. (APN: 093-130-007)	SF Detached	DU	5	2	2	2	1	1	-	-	-	13	100%
Anderson	Shasta Co.	SF Detached	DU	-	2	3	3	2	1	-	-	-	11	100%
Aventino	Shasta Co.	SF Detached	DU	-	-	2	3	10	10	6	-	14	45	69%
Burney Commons	Shasta Co. (APN: 028-100-020)	Multi-Family	DU	-	-	16	14	-	-	-	-	-	30	100%
Cabb LLC	Shasta Co. (APN: 086-400-001)	SF Detached	DU	4	5	9	4	-	-	-	-	-	22	100%
Canto De Las Lupine	Shasta Co. (APN: 208-190-041)	SF Detached	DU	2	3	2	2	3	2	1	-	-	15	100%
Cassel Ridge	Shasta Co. (APN: 031-520-016)	SF Detached	DU	-	-	4	13	10	8	8	-	-	43	100%
Timber Ridge Subdivision	Shasta Co. (APN: 028-400-037)	SF Detached	DU	-	-	2	5	6	7	-	-	-	20	100%
Dersch Estates	Shasta Co. (APN: 056-160-006)	SF Detached	DU	-	-	3	3	3	2	-	-	-	11	100%
Keswick Dam	Shasta Co.	SF Detached	DU	17	-	-	-	-	-	-	-	-	17	100%
Manzanillo	Shasta Co.	SF Detached	DU	2	2	5	3	1	1	1	-	-	15	100%
Maverik (Gas Station and Retail)	Shasta Co. (APN: 055-160-012)	Retail	SQ FT				6,000						6,000	100%
Mountain Gate Meadows	Shasta Co.	SF Detached	DU	3	1	3	3	1	-	-	-	-	11	100%
Nelson	Shasta Co.	SF Detached	DU	-	1	4	5	5	7	-	-	-	22	100%
Nichols	Shasta Co. (APN: 099-230-001)	SF Detached	DU	-	5	5	5	5	5	5	-	-	30	100%
Nunes	Shasta Co. (APN: 701-090-014)	SF Detached	DU	-	-	2	4	4	3	3	-	-	16	100%
Palo Cedro Oaks	Shasta Co. (APN: 059-470-059)	SF Detached	DU	-	5	9	8	5	2	1	-	-	30	100%
Platina Road Subdivision	Shasta Co.	SF Detached	DU	-	1	3	2	2	-	-	-	-	8	100%
Ricks	Shasta Co. (APN: 058-300-060)	SF Detached	DU	-	-	-	3	3	3	2	-	-	11	100%
Rock Ledge Estates	Shasta Co. (APN: 030-110-035)	SF Detached	DU	1	2	5	5	5	3	3	-	3	24	100%
Stillwater Meadows	Shasta Co. (APN: 076-260-002)	SF Detached	DU	-	1	2	3	3	2	-	-	-	11	100%
SHASTA RED East	Shasta Co. (APN: 061-210-001)	SF Detached	DU	-	-	5	10	10	10	15	-	116	166	30%
Shingle Glen	Shasta Co. (APN: 096-290-032)	SF Detached	DU	-	1	4	5	5	8	-	-	-	23	100%
Shingletown Sierra Pacific	Shasta Co. (APN: 095-170-017)	SF Detached	DU	-	4	3	6	6	6	6	-	4	35	89%
Silver Saddles Estate	Shasta Co.	SF Detached	DU	-	4	2	3	2	1	1	-	-	13	100%
Stillwater Ranch Unit 1	Shasta Co. (APN: 111-290-011)	SF Detached	DU	1	3	3	3	-	-	-	-	-	10	100%
Stillwater Ranch Unit 2	Shasta Co. (APN: 111-090-013)	SF Detached	DU	-	-	7	7	7	8	-	-	-	29	100%
Whiteoak Subdivision	Shasta Co.	SF Detached	DU	-	3	3	2	-	-	-	-	-	8	100%
Wine Village	Shasta Co.	Retail	SQ FT	-			7,500	4,500	10,000				22,000	100%
		Restaurant	SQ FT				2,500						2,500	100%

ROADWAY AND BICYCLE NETWORK ASSUMPTIONS

SRTA requested that a number of roadway and bicycle network changes be implemented for the ShastaSIM 2.0 update. These changes are shown in **Figure 3** and are described below.

- Roadway Improvements
 - o Implement Fix 5 Cascade Gateway (managed freight-only lanes on I-5) between Redding and Shasta Lake by 2030
 - o Widen Bechelli Lane north of South Bonneyview Road from 2 lanes to 4 lanes
 - o Widen I-5 north of Deschutes Road in Anderson from 4 lanes to 6 lanes
 - o Remove Shasta View Drive/ Twin Tower Drive extension north of State Route 299
- Bicycle Facility Improvements
 - o Class I bicycle path along Collyer Drive between Hawley Road/ Churn Creek Road and Old Oregon Trail (including over both freeway under crossings)
 - o Class II bicycle lanes on SR 273 (South Market Street) between Wyndham Road and Parkview Avenue
 - o Class I East Palisades separated bike path between SR 299 and SR 44
 - o Fix minor missing Class II bike lane on SR 299 west of I-5

Additionally, various roadway improvements (widening and extensions) that were previously assumed to be in place by 2040 were changed to be post-2040 improvements. These changes resulted in changes in roadway lane miles as shown in **Table 5**.

TABLE 5: CHANGE IN MODEL ROADWAY LANE MILES – SHASTASIM 1.2 TO SHASTASIM 2.0

FACILITY TYPE	SHASTASIM 1.2			SHASTASIM 2.0			CHANGE		
	2020	2035	2040	2020	2035	2040	2020	2035	2040
TOTAL	2,865	2,911	3,026	2,884	2,919	2,924	+19	+8	-102
FREEWAY	329	341	361	348	351	352	+19	+10	-9
HIGHWAY	514	514	523	514	514	512	-	-	-11
EXPRESSWAY	52.7	53.6	56.8	52.7	53.6	53.6	-	-	-3.2
ARTERIAL	601	621	673	601	619	622	-	-2	-51
COLLECTOR	965	980	1,007	965	980	982	-	-	-25
LOCAL	367	365	369	367	365	365	-	-	-4
RAMP	36.4	36.5	36.5	36.4	36.5	36.5	-	-	-

Note: Excludes zone “centroid” connectors

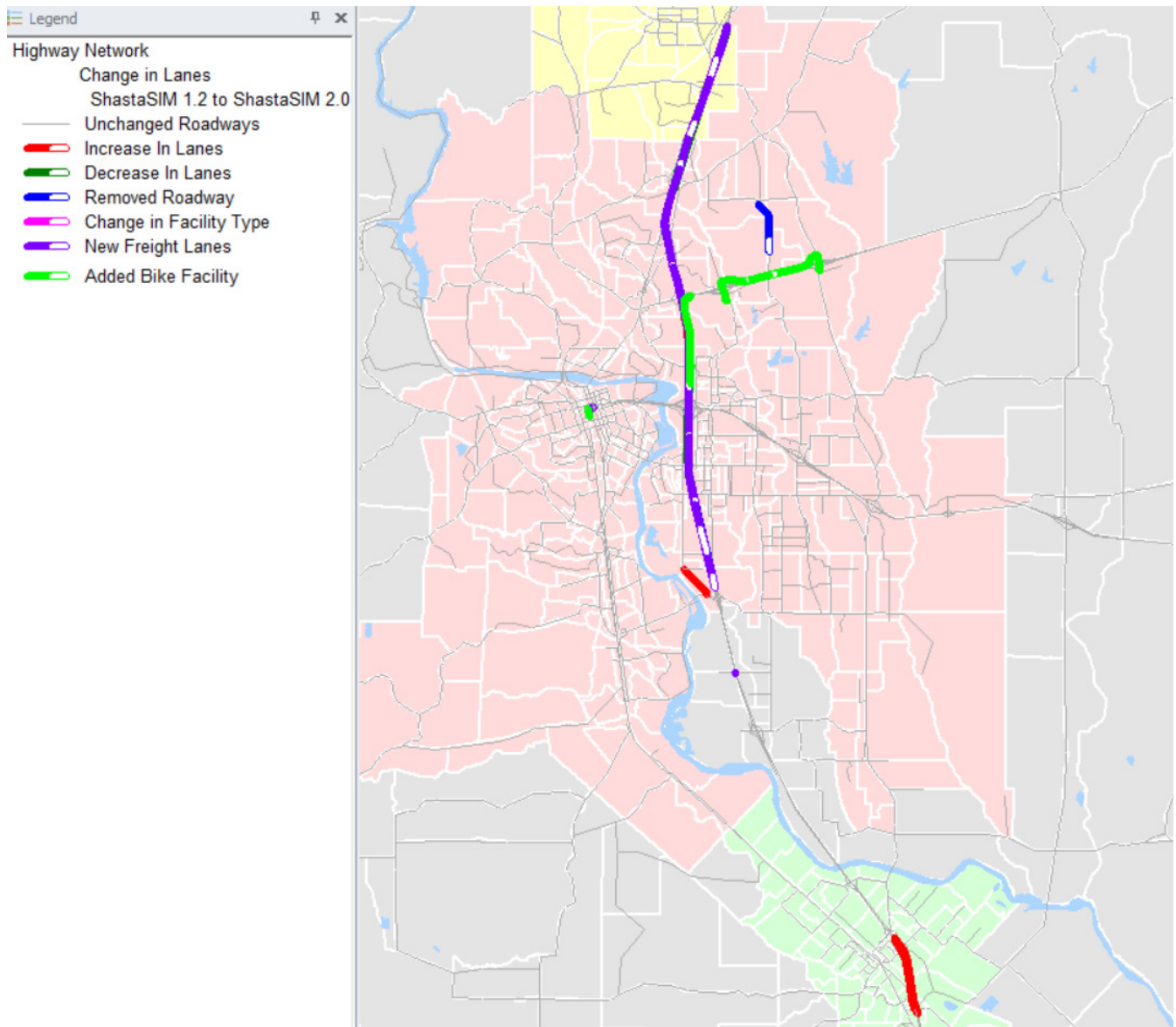


FIGURE 3: SHASTASIM 1.2 TO 2.0 MODEL NETWORK CHANGES

Roadway network files are the same format as previous versions of ShastaSIM, based on a network file called "[20xxBASE.NET](#)" that is stored in the <scenario> directory under the "base" directory within the parent catalog directory. This file is formatted the same as previous ShastaSIM versions and includes the same data fields.

TRANSIT ASSUMPTIONS

Transit assumptions for the 2018 RTP/SCS (ShastaSIM 1.2) were based on RABA bus routes and assumptions dating back previous to 2018, while transit assumptions for the 2022 RTP/SCS (ShastaSIM 2.0) have been updated based on RABA route changes that occurred just prior to and during the COVID-19 pandemic. RABA routes and frequencies are shown in **Table 6**.

TABLE 6: RABA BUS ROUTE ASSUMPTIONS

ROUTE	SHASTASIM 1.2 2035/40		SHASTASIM 2.0 2035/40	
	PEAK FREQUENCY	OFF-PEAK FREQUENCY	PEAK FREQUENCY	OFF-PEAK FREQUENCY
ROUTE 1	60	60	60	60
ROUTE 2	15	30	15	30
ROUTE 2 CC			120	120
ROUTE 3	30	30	30	30
ROUTE 4	60	60	60	60
ROUTE 5	30	30	30	30
ROUTE 6	30	30	30	30
ROUTE 7	30	30	30	30
ROUTE 9	60	60	60	60
ROUTE 11	30	30	30	30
ROUTE 14	30	30	30	30
ANDERSON COMMUTER	60	60	150	
AIRPORT EXPRESS	60	60	60	60
BURNEY EXPRESS	100	100	100	100
SCHOOL EXPRESS AM/PM	60	60	150	
CROSS-TOWN EXPRESS	60	60	30	30
COTTONWOOD EXPRESS	30	60	60	60

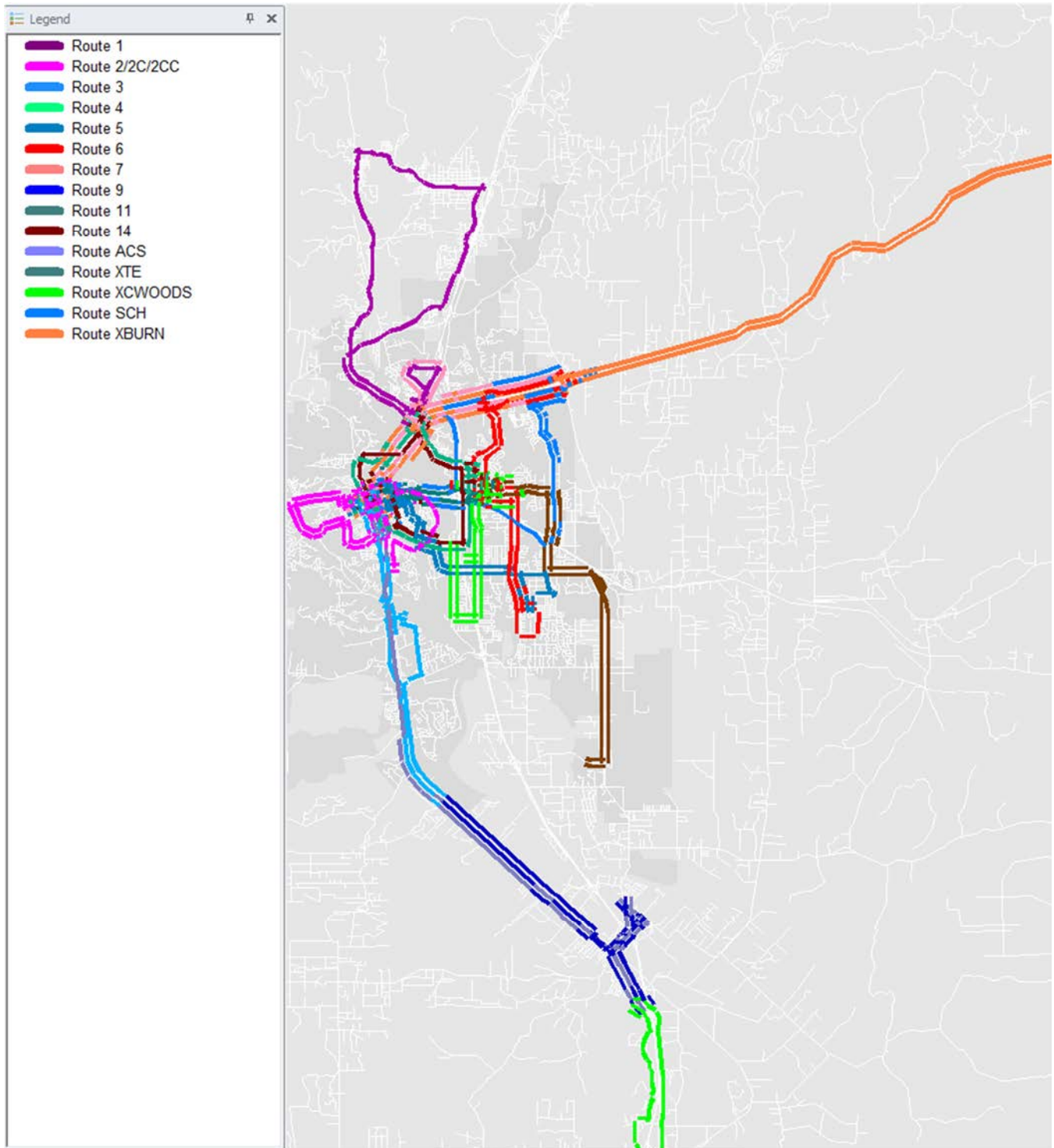


FIGURE 4: MODEL TRANSIT ROUTES – SHASTASIM 1.2

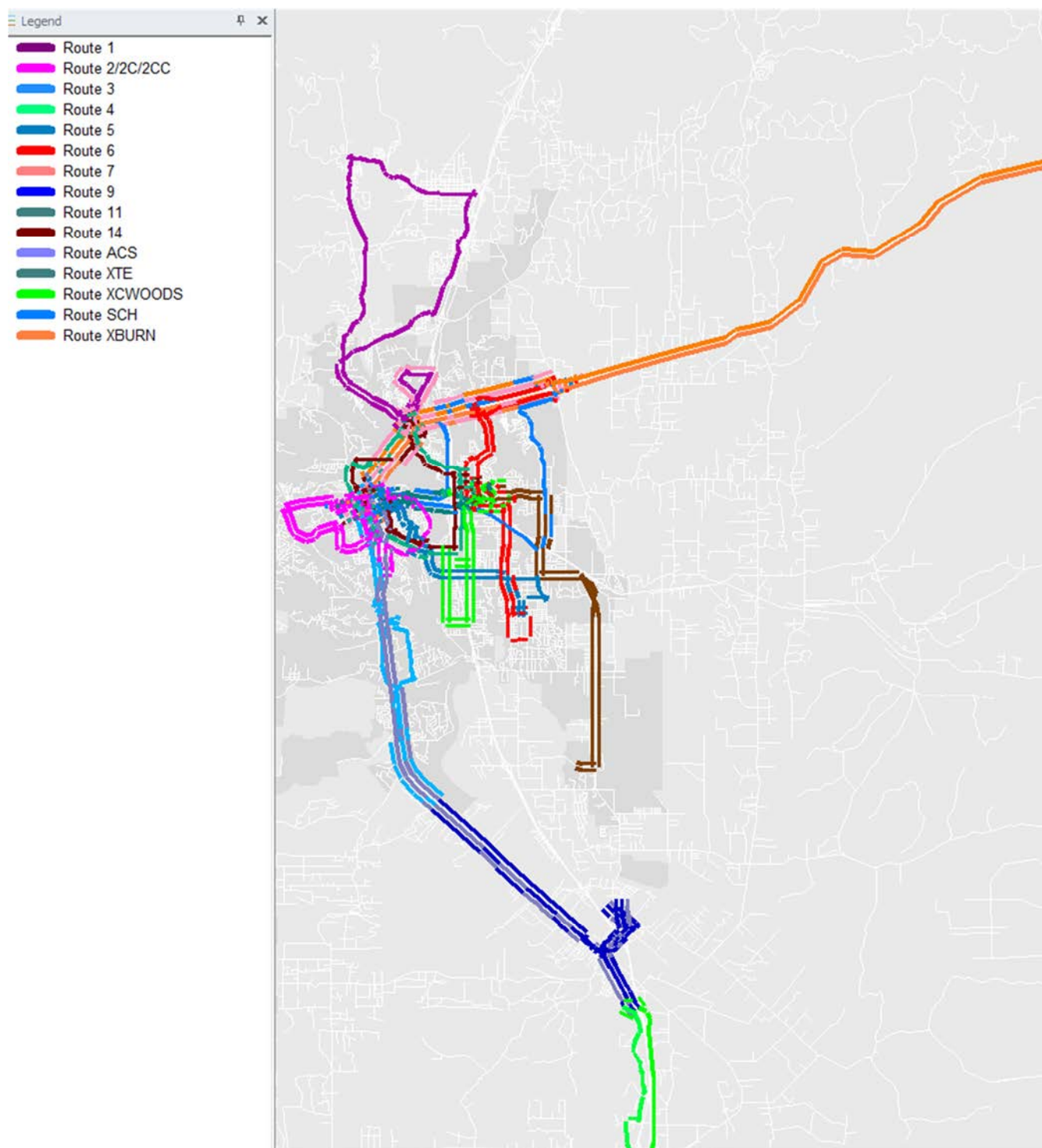


FIGURE 5: MODEL TRANSIT ROUTES – SHASTASIM 2.0

MODEL VALIDATION

The ShastaSIM 2.0 model was re-validated to 2019 conditions utilizing a combination of various data sources including 2019 Traffic Volume Counts (daily and peak period) provided by SRTA, Replica (big data) estimated volume and trip lengths for 2019 at select gateway locations, and Caltrans Traffic Volume Census data for 2019.

Table A: Daily Validation by Road Type

Class	Links	Count	Model	Percent	FHWA Standard	Meets	Shasta Standard	Meets
1 Freeway	50	1,051,400	1,103,357	4.9%	+/- 7%	YES	+/- 10%	YES
2-3 Highway/Expwy	80	336,716	357,199	6.1%	+/- 10%	YES		
4 Arterial	186	625,789	674,715	7.8%	+/- 15%	YES	+/- 20%	YES
5-6 Collector/Local	176	145,286	114,508	-21.2%	+/- 25%	YES	+/- 25%	YES
7-9 Ramps	0	0	0	#DIV/0!				
11 Gateways	0	0	0	#DIV/0!				
TOTAL	492	2,159,190	2,249,778	4.2%	+/- 7%	YES		YES

Table B: AM Peak Hour Validation by Road Type

Class	Links	Count	Model	Percent	FHWA Standard	Meets	Shasta Standard	Meets
1 Freeway	46	69,276	62,641	-9.6%	+/- 7%	NO	+/- 10%	YES
2-3 Highway/Expwy	78	24,849	21,505	-13.5%	+/- 10%	NO		
4 Arterial	181	45,543	42,865	-5.9%	+/- 15%	YES	+/- 20%	YES
5-6 Collector/Local	178	12,243	8,123	-33.7%	+/- 25%	NO	+/- 25%	NO
7-9 Ramps	0	0	0	#DIV/0!				
11 Gateways								
TOTAL	483	151,911	135,133	-11.0%	+/- 7%	NO		

Table C: PM Peak Hour Validation by Road Type

Class	Links	Count	Model	Percent	FHWA Standard	Meets	Shasta Standard	Meets
1 Freeway	46	75,815	76,698	1.2%	+/- 7%	YES	+/- 10%	YES
2-3 Highway/Expwy	78	29,224	27,060	-7.4%	+/- 10%	YES		YES
4 Arterial	181	49,651	54,929	10.6%	+/- 15%	YES	+/- 20%	YES
5-6 Collector/Local	178	12,017	10,095	-16.0%	+/- 25%	YES	+/- 25%	YES
7-9 Ramps	0	0	0	#DIV/0!				
11 Gateways								
TOTAL	483	166,707	168,783	1.2%	+/- 7%	YES		YES

Table D: Validation by Root Mean Square Error

Class	Daily			AM Peak Hour			PM Peak Hour		
	Daily RMSE	Shasta Standard	Meets	Daily RMSE	Shasta Standard	Meets	Daily RMSE	Shasta Standard	Meets
1 Freeway	11.8%			31.6%			26.1%		
2-3 Highway/Expwy	52.5%			41.1%			41.5%		
4 Arterial	68.9%			50.3%			42.5%		
5-6 Collector/Local	88.7%			89.5%			74.9%		
7-9 Ramps	#DIV/0!			#DIV/0!			#DIV/0!		
11 Gateways	#DIV/0!								
TOTAL	37.6%	40.0%	YES	57.1%	40.0%	NO	48.7%	40.0%	NO

FIGURE 6: DAILY AND PEAK HOUR MODEL VALIDATION STATISTICS

As shown in **Figure 6** above, model volumes at approximately 500 links were compared to available traffic count data for locations throughout Shasta County. Model volume to count ratios were calculated and summarized for reasonableness based on current FHWA validation standards. The approximately 500 links used in the daily (24 hour) validation included 50 freeway links, 80 highway and expressway links, 186 arterial links, and 176 collector and local roadways. The 483 links used in the AM and PM peak hour validation included 46 freeway links, 78 highway and expressway links, 181 arterial links, and 178 collector and local roadways. **Figure 6** shows the validation statistics for the model update and that the model passes most of the FHWA validation standards. **Figure 7** displays a scatter plot of model volumes to counts throughout the model network, along with associated statistical results.

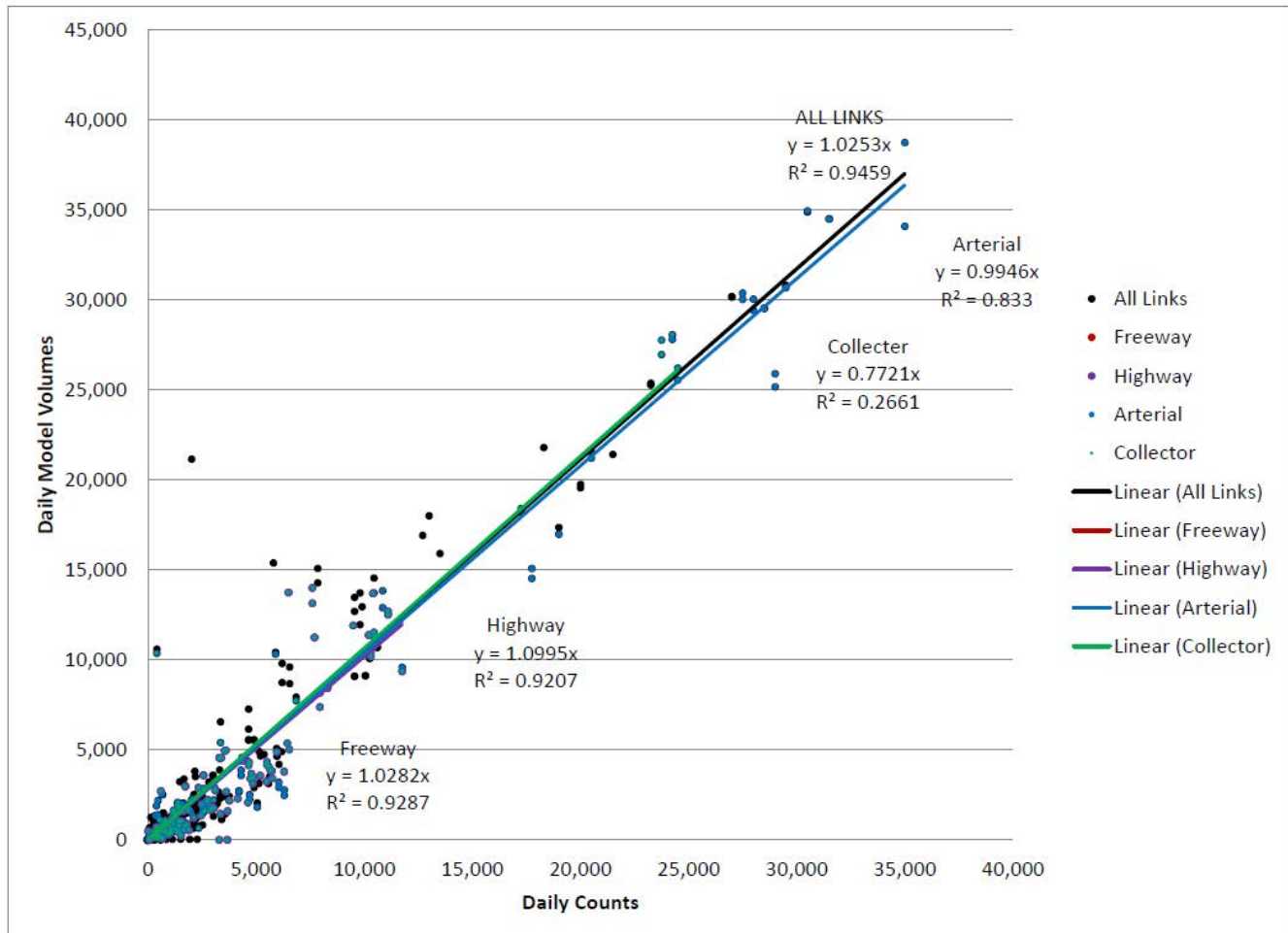


FIGURE 7: SCATTER PLOT OF MODEL VOLUME TO COUNT RATIOS

MODEL OUTPUTS AND PERFORMANCE MEASURES

As with previous model updates (ShastaSIM 1.0 for the 2015 RTP/SCS and ShastaSIM 1.2 for the 2018 RTP/SCS) the Activity Based Model (ABM) has been used to calculate measures of effectiveness including vehicle miles traveled (VMT) for use in populating required data tables for the 2022 RTP/SCS update.

Table 7 summarizes model-based performance metrics used in the RTP/SCS updates in recent cycles. The table includes total vehicle miles traveled (VMT) and well as SB 375 VMT (excluding through trips that do not originate or terminate in Shasta County and also excluding certain classes of heavy-duty vehicles) and resultant VMT per Capita for the county. Due to changes assumed since the last RTP/SCS update (including the major reduction in assumed population growth, as well as the modified ShastaSIM 2.0 model) VMT per Capita shows a decrease from approximately 28 to 29 VMT per capita to approximately 21 to 22 VMT per Capita under 2035 Plus Project and 2040 Plus Project scenarios, respectively.

Decreased population and traffic volume growth results in a decrease in congested roadways at LOS “E” or LOS “F” as shown in the table and in **Figure 10** and **Figure 11**. Miles of Class I and Class II bicycle facilities increase based in added facilities identified by SRTA staff for inclusion in the model as shown in the table and in **Figure 3**.

Mode share (percent of total trips or VMT by mode including drive alone, shared ride (2 people), shared ride (3+ people), transit, bike, and walk) changes slightly between ShastaSIM 1.2 and ShastaSIM 2.0 but remains fairly consistent. The number of households within ½ mile of a transit stop decreases based on the decrease in overall households and population growth, while the amount of employment within ½ mile of a transit stop remains fairly consistent. Reduced congestion based on reduced population has the effect of reducing average commute time (in minutes) by workers in the county according to the model. Travel times by mode also decrease somewhat due to reduced congestion levels.

Table 8 shows VMT per capita and employee by jurisdiction for 2020, 2035, and 2040 conditions. VMT per Capita is based on daily “tours” from ShastaSIM and thus does not exactly match values presented in **Table 7**. **Figure 8** and **Figure 9** show how VMT per Capita and VMT per Employee compare to the regional average for areas within the urban portion of Shasta County, including the incorporated cities of Redding, Anderson, and Shasta Lake.

TABLE 7: SHASTASIM 2.0 PERFORMANCE MEASURES

PERFORMANCE MEASURES	SHASTASIM 1.2 2018 RTP/SCS		SHASTASIM 2.0 2022 RTP/SCS	
	2035	2040	2035	2040
Transportation System Utilization and Mode Share				
AVERAGE DAILY VMT (TOTAL)	7,386,838	7,806,135	5,970,291	6,206,623
AVERAGE DAILY SB 375 VMT (MINUS THROUGH TRIPS)	5,296,383	5,597,020	4,020,036	4,153,408
AVERAGE DAILY VMT PER CAPITA (MINUS THROUGH TRIPS)	24.7	25.1	21.4	22.0
MILES OF ROADWAY AT LOS "E" OR "F"	10.8	16.6	1.9	7.0
DAILY TRANSIT BOARDINGS (MODELED)	6,573	6,564	5,991	5,940
MILES OF CLASS I BIKEWAY	64.1	64.1	72.5	72.5
MILES OF CLASS II BIKEWAY	209.3	209.3	211.0	211.0
Percentage of Trips by Mode (Daily)				
DRIVE ALONE	46.1%	46.0%	46.5%	46.4%
SHARED RIDE (2 PERSONS)	26.4%	26.6%	27.0%	27.1%
SHARED RIDE (3+ PERSONS)	18.2%	18.1%	17.3%	17.4%
SCHOOL BUS	1.8%	1.8%	1.3%	1.4%
TRANSIT	0.6%	0.6%	0.7%	0.7%
BIKE	1.2%	1.3%	0.7%	0.7%
WALK	5.6%	5.5%	6.4%	6.4%
Mobility/ Accessibility				
NUMBER OF HOUSEHOLDS WITHIN ½ MILE OF TRANSIT)	46,795	48,116	41,993	42,113
NUMBER OF JOBS WITHIN ½ MILE OF TRANSIT	67,674	67,489	66,599	68,640
AVERAGE COMMUTE TIME (MINUTES) BY WORKERS	17.4	17.6	10.2	10.2
Average Trip Duration (minutes) by Mode				
DRIVE ALONE	9.8	9.9	8.5	8.5
SHARED RIDE (2 PERSONS)	7.8	7.7	8.4	8.4
SHARED RIDE (3+ PERSONS)	8.1	8.1	8.8	8.9
TRANSIT	37.5	38.4	34.0	33.7
BIKE	12.7	12.5	21.0	21.8
WALK	14.3	14.2	21.9	21.8
ALL MODES	10.0	10.0	9.7	9.7

Note: 2035 Plus Project and 2040 Plus Project

TABLE 8: VMT PER CAPITA AND EMPLOYEE BY JURISDICTION

JURISDICTION	VMT CATEGORY	VMT PER CAPITA OR EMPLOYEE			PERCENT OF REGIONAL AVERAGE		
		2020	2035	2040	2020	2035	2040
REGIONWIDE	Per Capita	20.48	22.28	22.84	100%	100%	100%
	Per Employee	30.24	32.94	33.56	100%	100%	100%
CITY OF ANDERSON	Per Capita	23.87	26.60	27.34	117%	119%	120%
	Per Employee	43.55	47.20	48.40	144%	143%	144%
CITY OF REDDING	Per Capita	13.50	15.06	15.64	66%	68%	68%
	Per Employee	26.93	29.42	29.89	89%	89%	89%
CITY OF SHASTA LAKE	Per Capita	18.00	19.70	19.90	88%	88%	87%
	Per Employee	27.20	30.46	30.89	90%	92%	92%
UNINCORPORATED SHASTA COUNTY	Per Capita	30.06	32.00	32.51	147%	144%	142%
	Per Employee	37.64	40.52	41.18	124%	123%	123%

Note: Based on Activity Based Model “tour” data

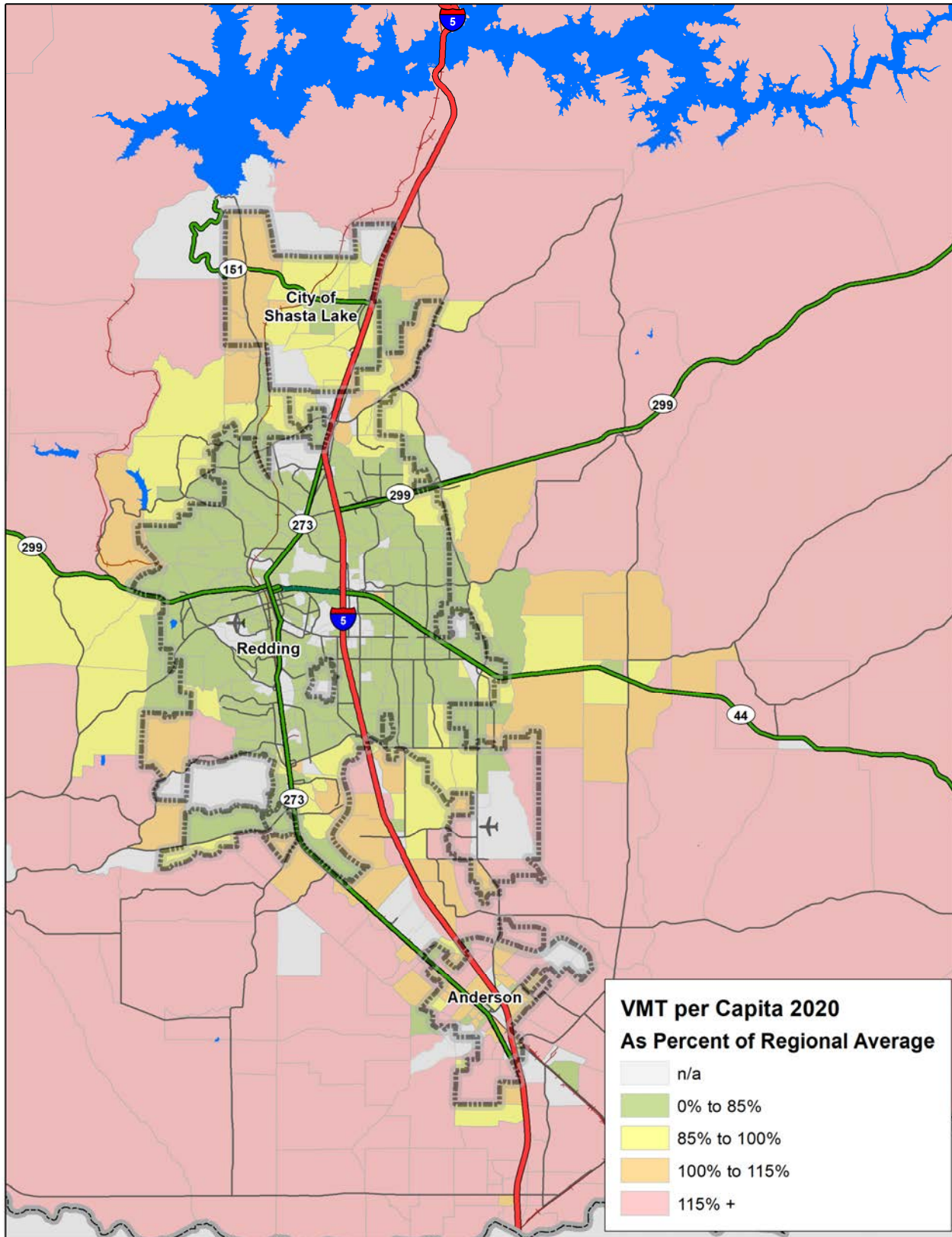


FIGURE 8: VMT PER CAPITA (2020)

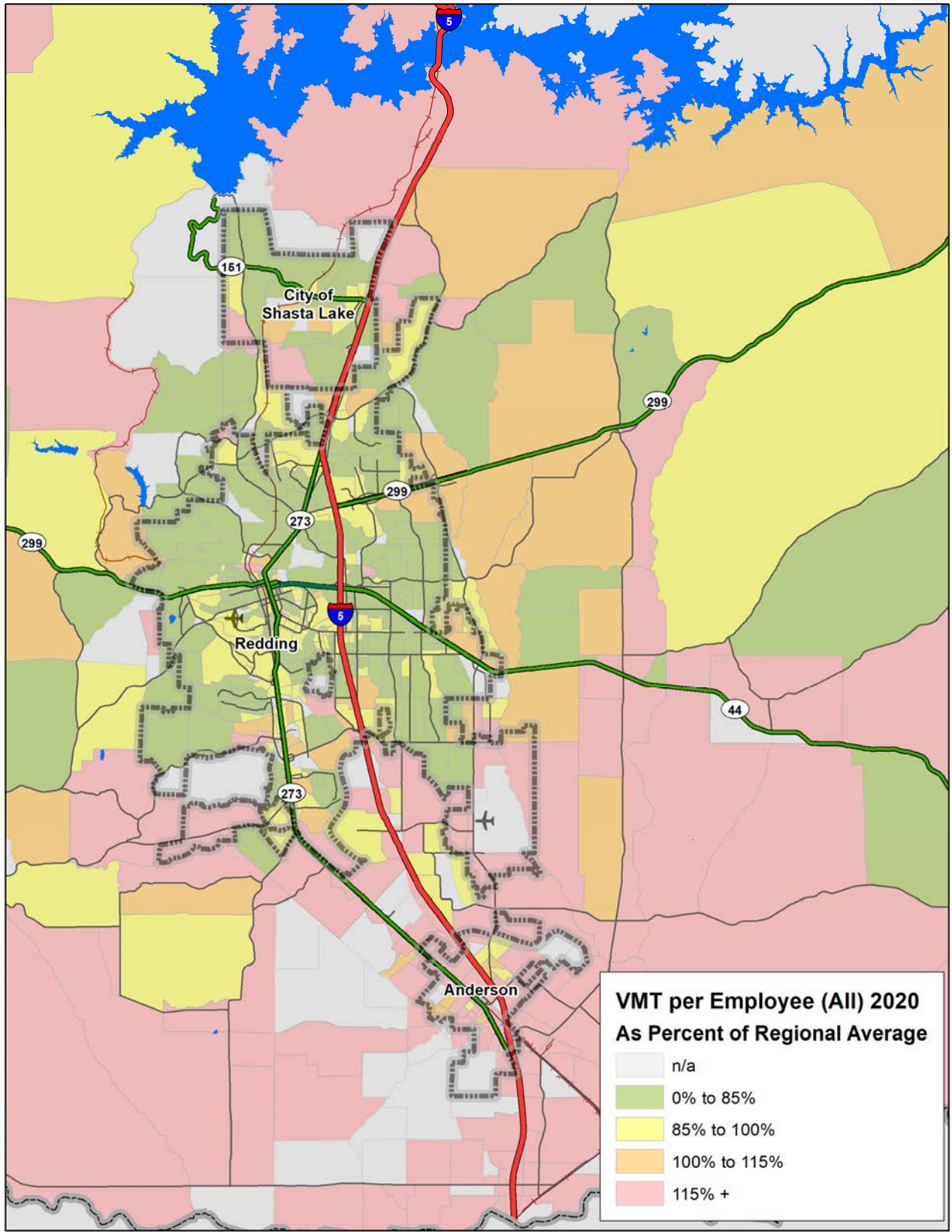


FIGURE 9: VMT PER EMPLOYEE (2020)

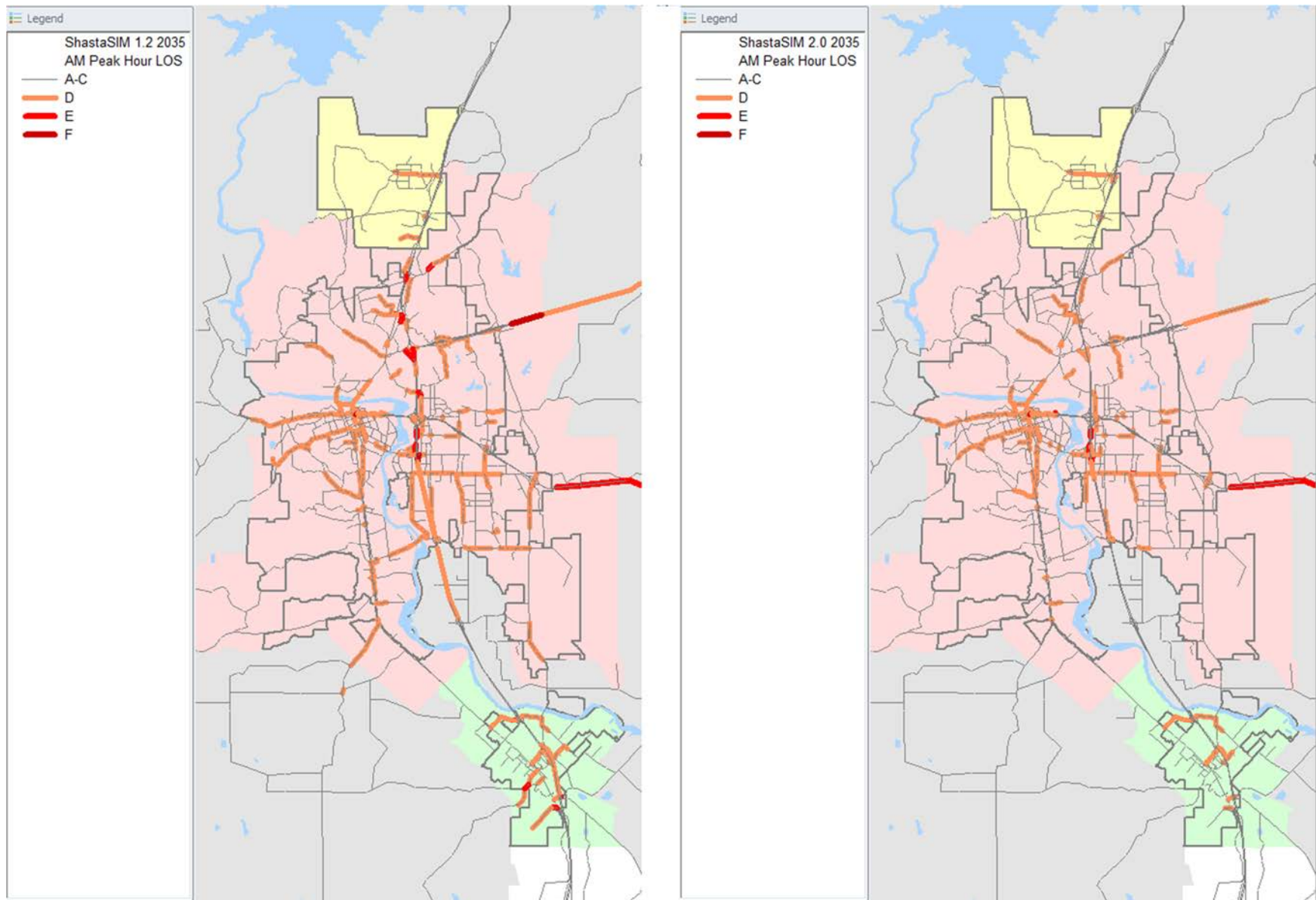


FIGURE 10: 2035 AM PEAK HOUR LEVEL OF SERVICE (LOS) – SHASTASIM 1.2 & SHASTASIM 2.0

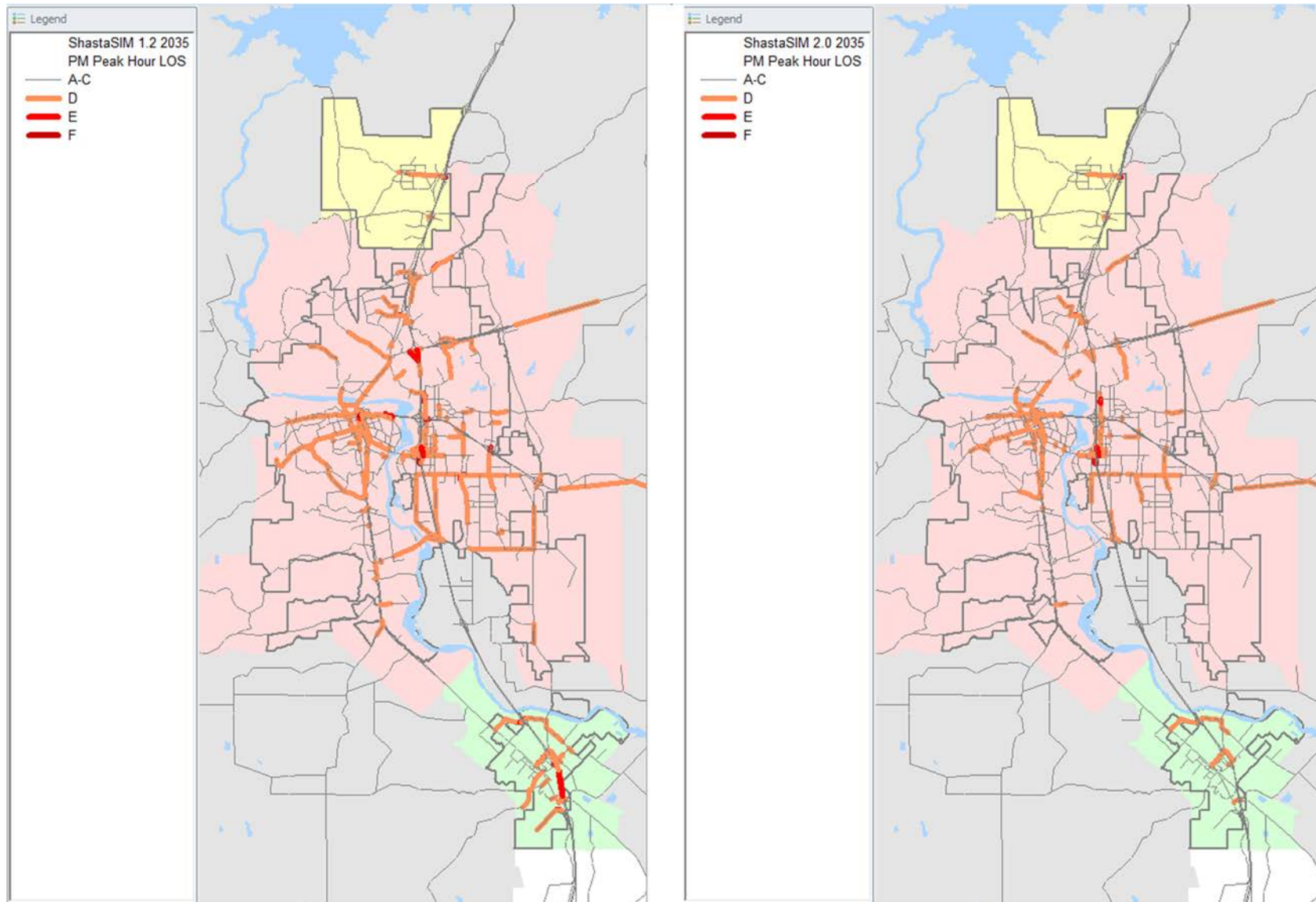


FIGURE 11: 2035 PM PEAK HOUR LEVEL OF SERVICE (LOS) – SHASTASIM 1.2 & SHASTASIM 2.0

MODEL STRUCTURE

In order to update the ShastaSIM model to the latest version of DAYSIM (the Activity Based Model daily person “tour” simulation model) certain aspects of the model structure had to be changed. For the most part, the model structure remains the same, consisting of the following Bentley Cube catalogs:

- **SHASTASIM.CAT**
- **SHASTASIM_COMPARE_INPUTS.CAT**
- **SHASTASIM_COMPARE_OUTPUTS.CAT**

As with previous versions of ShastaSIM, the first catalog listed above is used to set up scenarios and actually run the model, while the second and third catalogs are used to compare model input and output files, respectively.

Under the base catalog directory, ShastaSIM 1.2 contains the following directories and subdirectories:

- **Mandatory Folders**
 - **APPLICATIONS**
 - **AB_MODEL**
 - **INPUTS**
 - **OUTPUTS**
 - **TRANSIT**
 - **BASE**
 - **SHxx**
 - **COMPARE**
 - **LU**
 - **NETWORKS**
 - **OUTPUT**
 - **DELTA**
 - **LOS**
 - **VMT**
 - **VOLUME**
 - **PARCEL**
 - **TRANSIT**
- **Non-Mandatory Folders**
 - **CREATE PARCELS**
 - **GIS**
 - **MOE**

Under the base catalog directory, ShastaSIM 2.0 contains the following directories and subdirectories. The primary change is the need for the **COMMON FILES** folder to be copied into the root catalog directory and the **COEFFICIENTS** directory to be copied into each scenario under the BASE directory.

- Mandatory Folders
 - o **APPLICATIONS**
 - **AB_MODEL**
 - **INPUTS**
 - **OUTPUTS**
 - ~~TRANSIT~~ (no longer needed by ShastaSIM 2.0)
 - o **BASE**
 - **SHXX**
 - **COEFFICIENTS** (new directory needed by ShastaSIM 2.0)
 - **OUTPUT** (new directory created by ShastaSIM 2.0)
 - **WORKING** (new directory created by ShastaSIM 2.0)
 - o **COMMON FILES** (new directory needed by ShastaSIM 2.0)
 - o **COMPARE**
 - **LU**
 - **NETWORKS**
 - **OUTPUT**
 - **DELTA**
 - **LOS**
 - **VMT**
 - **VOLUME**
 - **PARCEL**
 - **TRANSIT**
- NON-MANDATORY FOLDERS
 - o CREATE PARCELS
 - o GIS

In addition to the folder structure changes mentioned above, VMT and VMT per Capita calculations that previously were located in the [SHASTASIM_COMPARE_OUTPUTS.CAT](#) catalog, they are now located in the main model run catalog and are calculated automatically.

SENSITIVITY ANALYSIS

The model has been subjected to a number of sensitivity tests to determine the impacts of making various changes to the model by comparing the results of the model with the change to the model without the change. Changes to the model included three land use changes and two roadway network changes. Changes tested include the following:

- Land Use Changes
 - o Add 200 single family dwelling units
 - o Add 200 multi-family dwelling units
 - o Add 100 retail (retail plus food plus service) employees
 - o Add 100 non-retail (office plus medical, plus government plus industrial) employees
- Roadway Network Changes
 - o Widen existing roadways

These changes were all made to the base 2020 ShastaSIM 2.0 model. For the two “add households” scenarios, 200 households (either single or multifamily) were added to the Westward Estates project in TAZ 382 in the western portion of the City of Redding off Placer Road. For the two “add employment” scenarios, 100 employees (non-retail or retail) were added to TAZ 711 in the City of Redding, east of Churn Creek Road between Cypress Avenue and Hartnell Avenue. For the non-retail employment scenario, the 100 employees were applied as 25 office employees, 25 medical employees, 25 industrial employees, and 25 government employees. For the retail employment scenario, the 100 employees were applied as 34 retail employees, 33 food/beverage employees, and 33 service employees).

For the roadway network changes scenario, 4 lane roadways regionwide (roadways with 2 lanes per direction) were widened to be 6 lanes (3 lanes per direction). This included the widening of roadway classes including freeways, highways, arterials, and collectors. Based on model roadway links, this scenario resulted in increases in lane miles as follows:

- Freeways: increase of 118.3 lane miles, or 25.3%
- Highways: increase of 18.0 lane miles, or 3.4%
- Expressways: increase of 25.1 lane miles, or 32.3%
- Arterials: increase of 62.4 lane miles, or 9.4%
- Collectors: increase of 6.0 lane miles, or 0.6%
- Local Roadways: increase of 0.0 lane miles, or 0.0%
- All Roadways: Increase of 231.5 lane miles, or 5.6%

Figure 12 shows the locations of the land use increases (households and employment) as well as the distribution of the assumed roadway widenings.

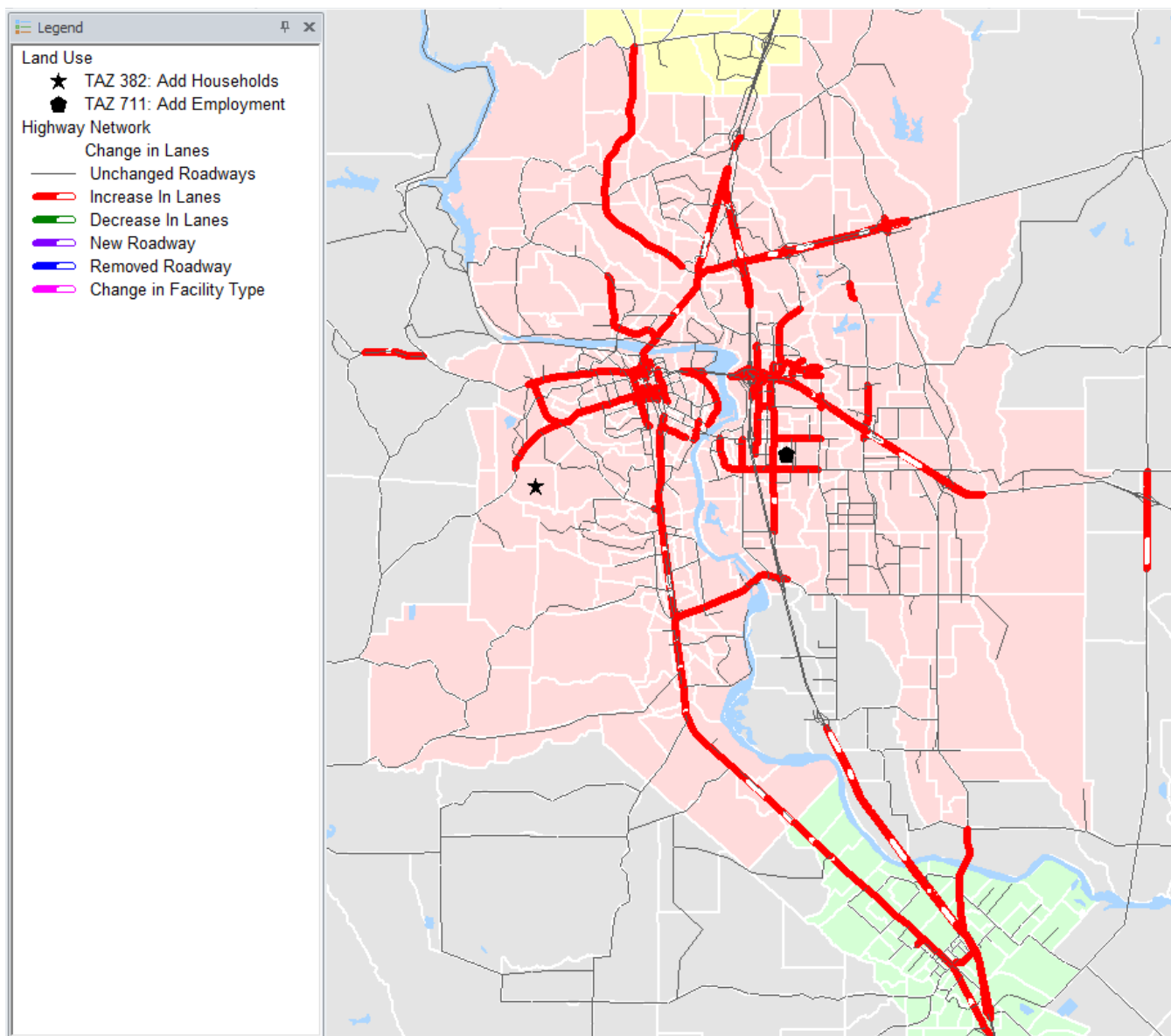


FIGURE 12: SENSITIVITY ANALYSIS LOCATIONS

For each of these scenarios, assigned roadway volume “deltas” were calculated and mapped as was the change in total network VMT (vehicle miles traveled). The results are summarized in **Table 9** and **Figure 13** through **Figure 17**. The table shows that all sensitivity tests result in increases in regionwide network VMT between 1% and 2%. The figures show that there are a couple of areas where volumes shift between parallel roadways, particularly on one-way couplets in downtown Redding. These shifts can likely be attributed to model noise and the number of iterations the model uses to achieve equilibrium in assignments.

TABLE 9: SENSITIVITY ANALYSIS CHANGE IN NETWORK VMT

	NETWORK VMT	CHANGE IN NETWORK VMT	PERCENT CHANGE IN NETWORK VMT
Base 2020 Model			
BASE 2020 RTP/SCS PROJECT	6,122,085		
Land Use Changes			
ADD 200 SINGLE FAMILY HOUSEHOLDS	6,234,707	+112,622	+1.8%
ADD 200 MUTIFAMILY HOUSEHOLDS	6,210,093	+88,008	+1.4%
ADD 100 NON-RETAIL EMPLOYEES	6,227,192	+105,108	+1.7%
ADD 100 RETAIL EMPLOYEES	6,226,417	+104,332	+1.7%
Network Changes			
WIDEN ALL 4 LANE RODWAYS TO 6 LANES	6,227,920	+105,835	+1.7%

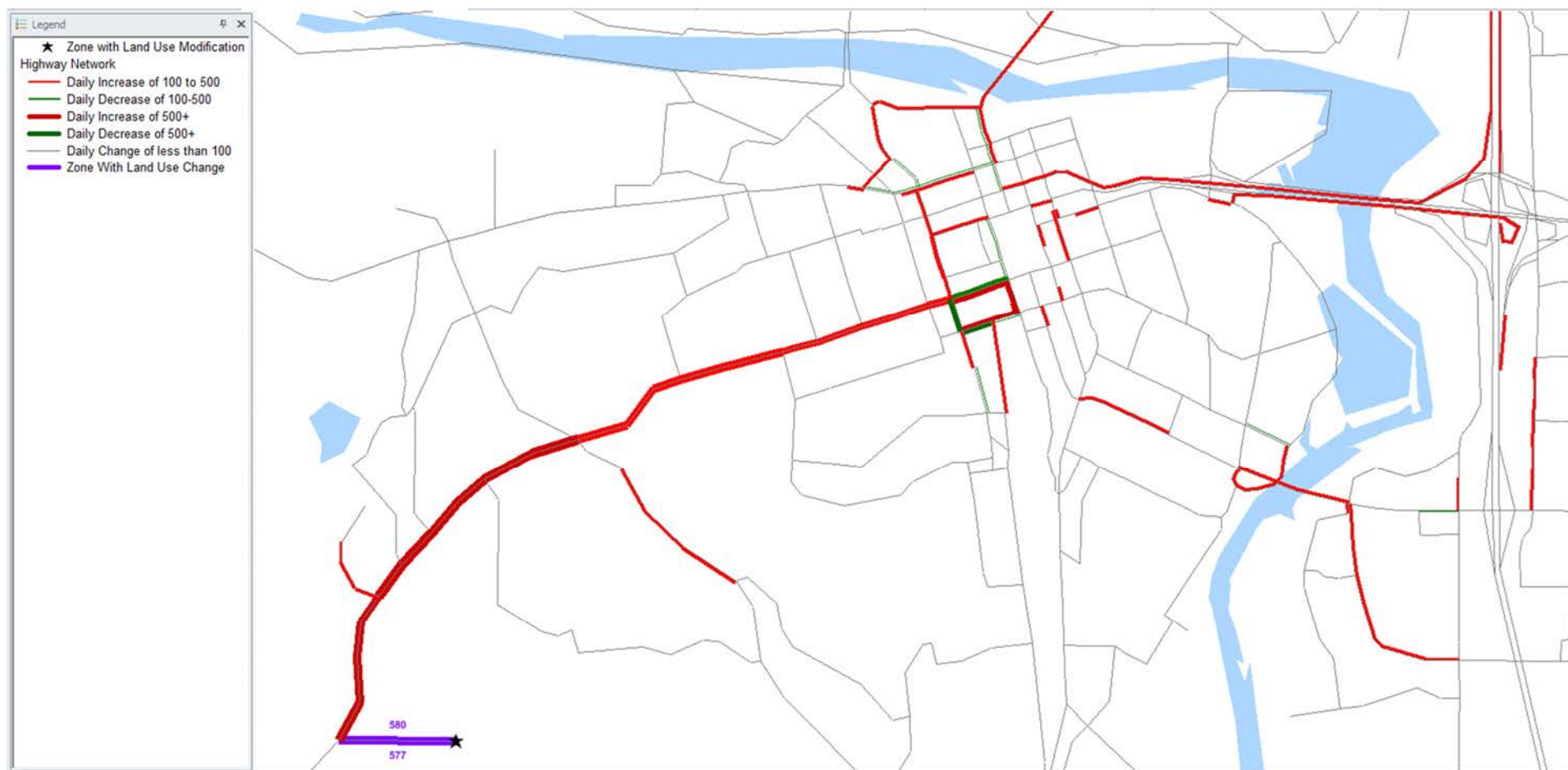


FIGURE 13: VOLUME CHANGES WITH ADDITION OF 200 SINGLE FAMILY DWELLING UNITS

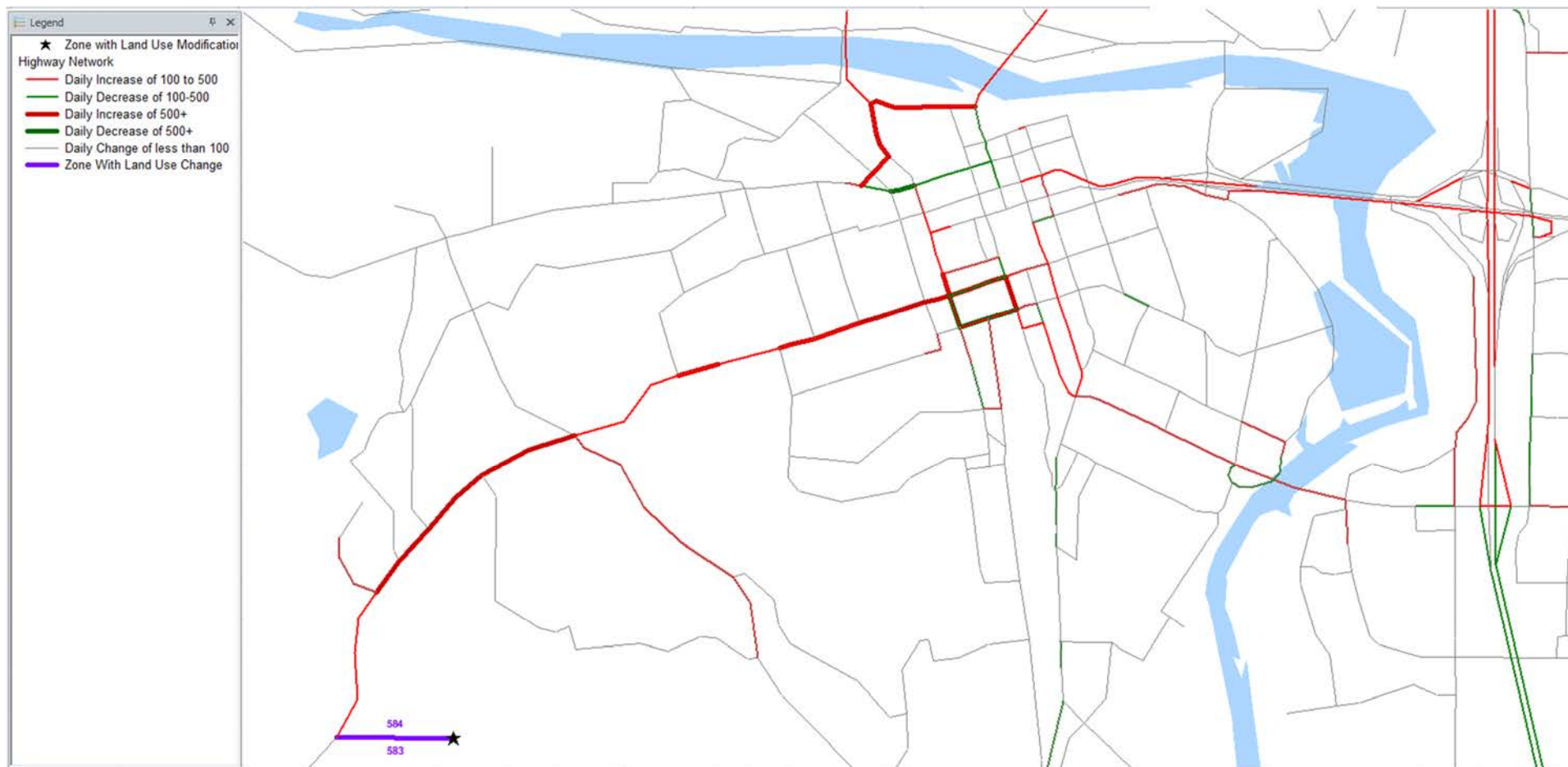


FIGURE 14: VOLUME CHANGES WITH ADDITION OF 200 MULTI FAMILY DWELLING UNITS

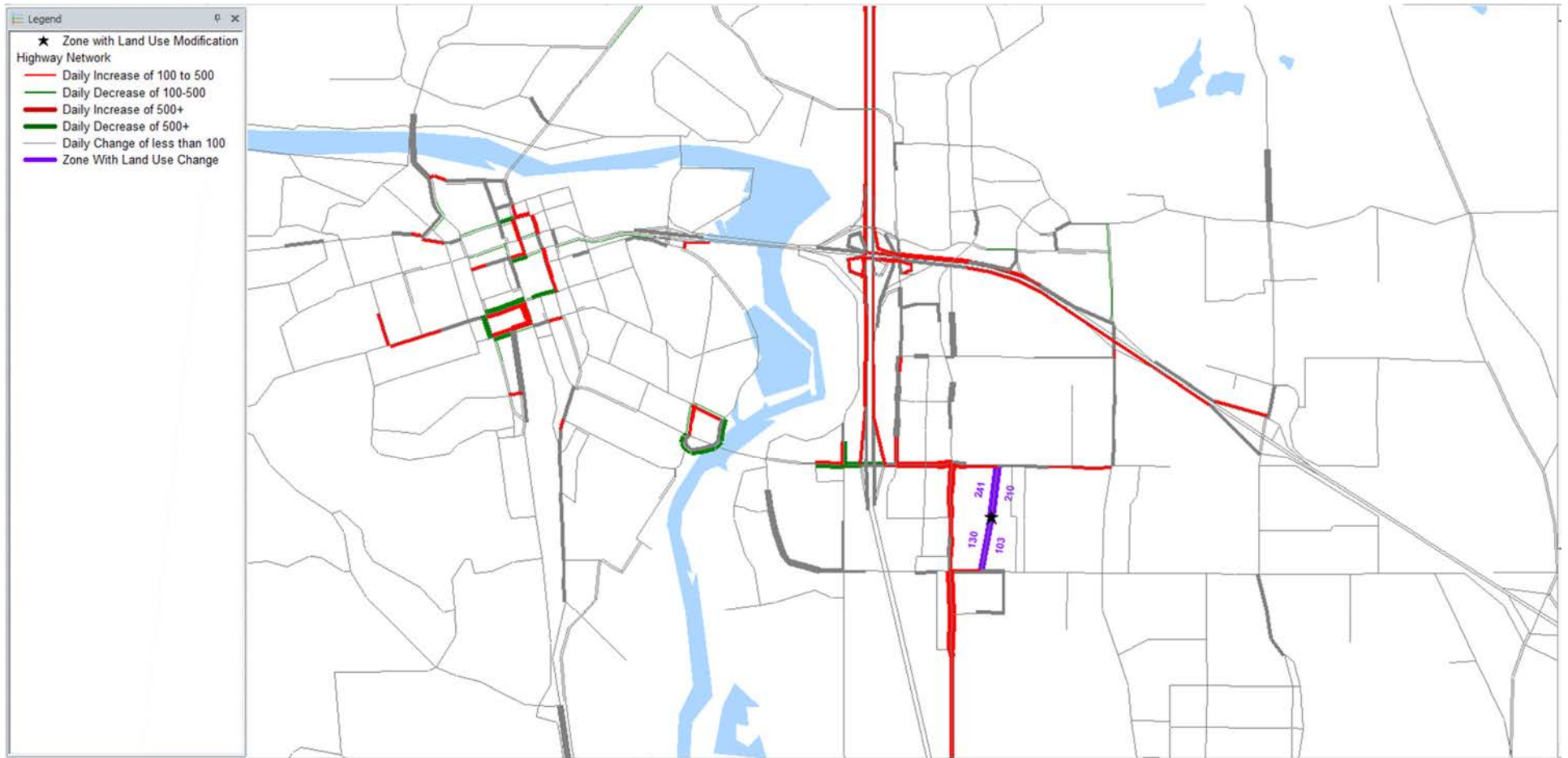


FIGURE 15: VOLUME CHANGES WITH ADDITION OF 100 NON-RETAIL EMPLOYEES

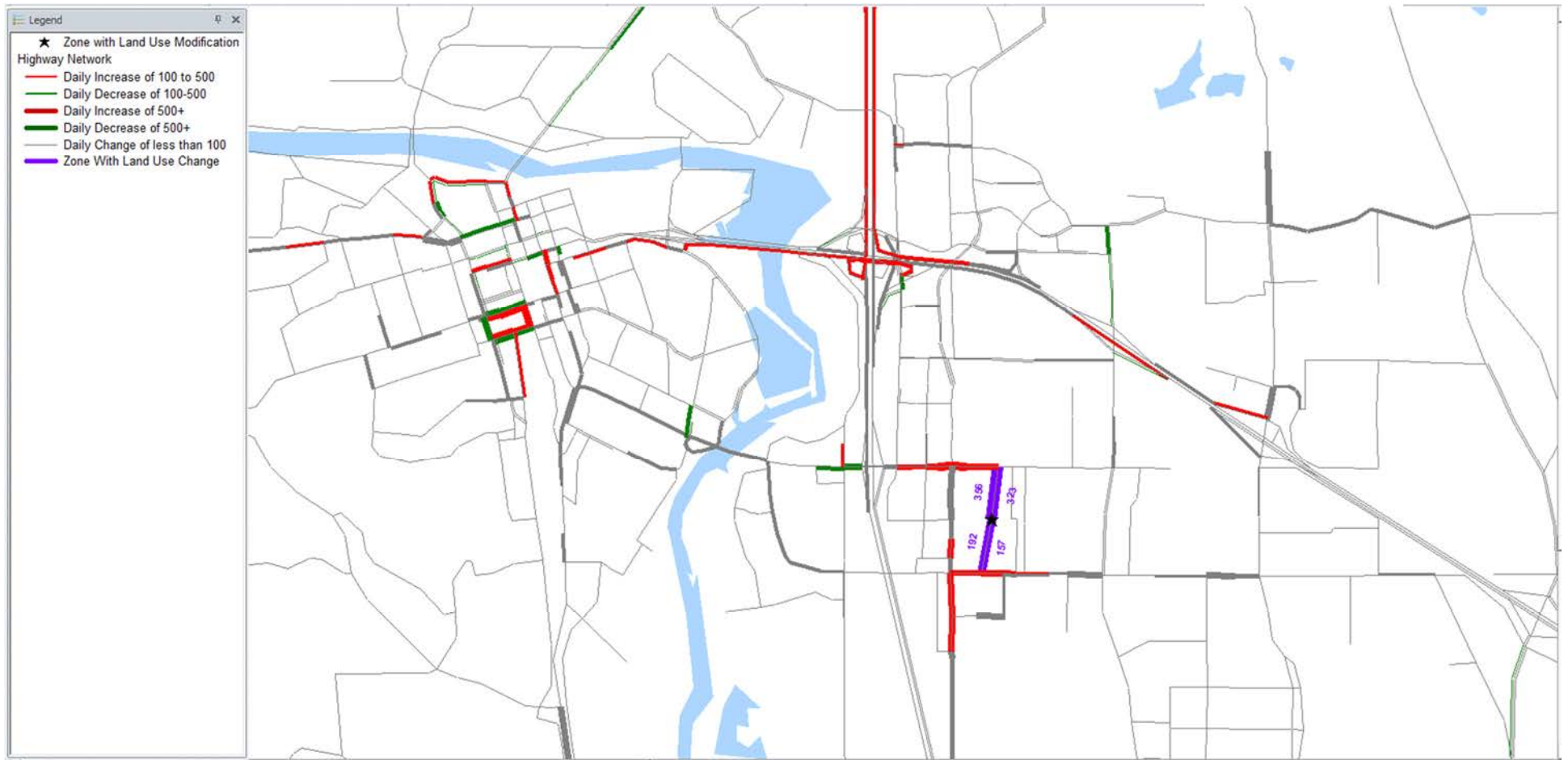


FIGURE 16: VOLUME CHANGES WITH ADDITION OF 100 RETAIL EMPLOYEES

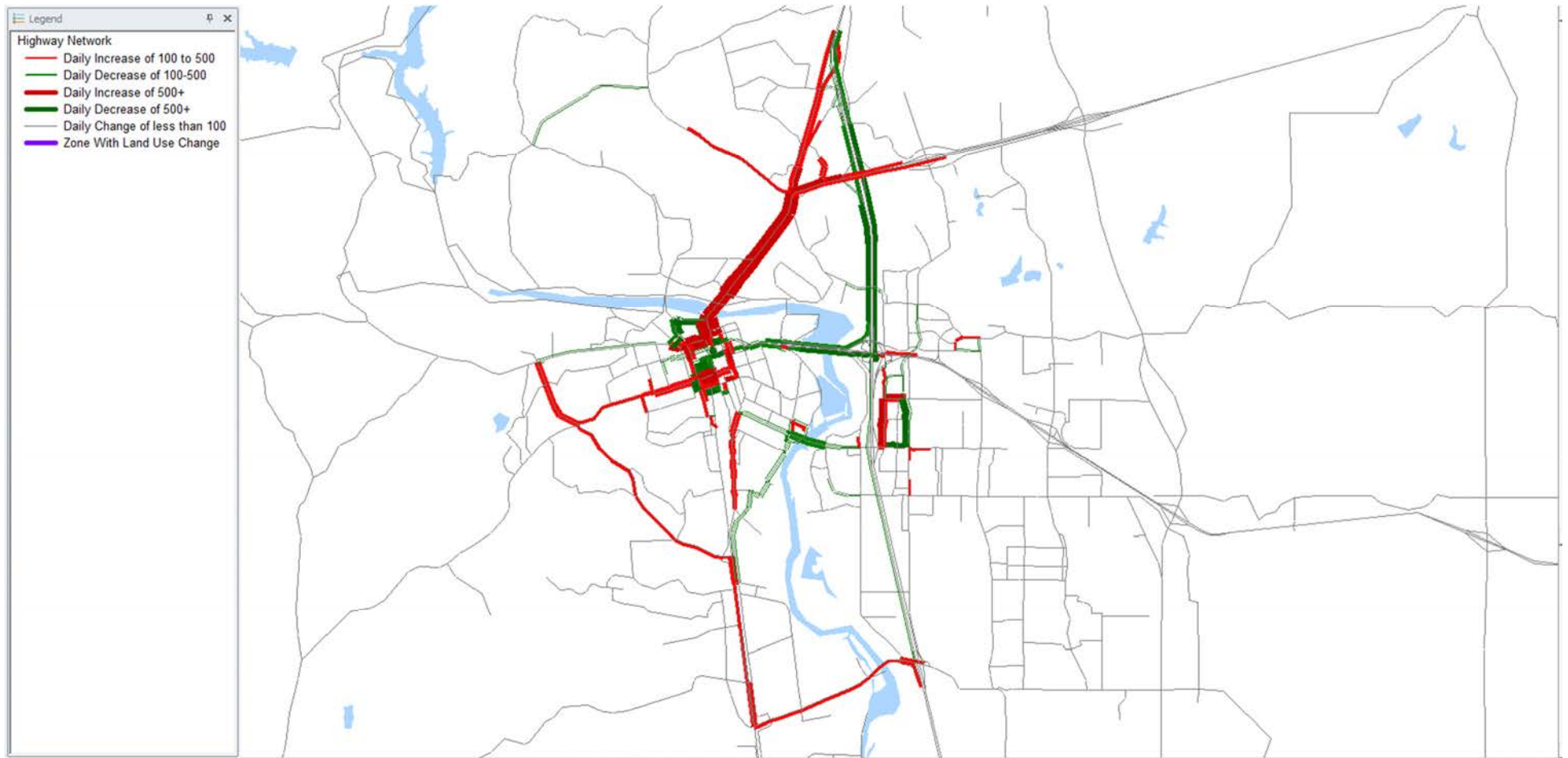


FIGURE 17: VOLUME CHANGES WITH ROADWAY WIDENINGS FROM 4 LANES TO 6 LANES