

APPENDIX A

AQ/GHG Emissions Data

Rohert Park PDAP
Sonoma-San Francisco County, Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
Condo/Townhouse High Rise	341.00	Dwelling Unit	3.86	336,108.00	975
Apartments Mid Rise	417.00	Dwelling Unit	10.01	419,442.00	1193
Single Family Housing	78.00	Dwelling Unit	3.70	85,250.00	223
Strip Mall	440.89	1000sqft	7.50	440,886.00	0
General Office Building	189.32	1000sqft	3.40	189,315.00	0
Government Office Building	62.81	1000sqft	2.90	62,807.00	0
General Light Industry	129.32	1000sqft	5.94	129,315.00	0
Enclosed Parking with Elevator	2,217.00	Space	19.95	886,800.00	0
Parking Lot	2,324.00	Space	20.92	929,600.00	0
Other Asphalt Surfaces	44.95	1000sqft	1.03	44,946.00	0

1.2 Other Project Characteristics

Urbanization	Urban	Wind Speed (m/s)	2.2	Precipitation Freq (Days)	75
Climate Zone	4			Operational Year	2035
Utility Company	Pacific Gas & Electric Company				
CO2 Intensity (lb/MW hr)	641.35	CH4 Intensity (lb/MW hr)	0.029	N2O Intensity (lb/MW hr)	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics -

Land Use - site specific data from project description

Construction Phase -

Vehicle Trips - Trip rates from Traffic Impact Study

Table Name	Column Name	Default Value	New Value
tblArchitecturalCoating	EF_Nonresidential_Exterior	150.00	250.00
tblArchitecturalCoating	EF_Nonresidential_Interior	100.00	250.00
tblArchitecturalCoating	EF_Residential_Exterior	150.00	250.00
tblLandUse	LandUseSquareFeet	341,000.00	336,108.00
tblLandUse	LandUseSquareFeet	417,000.00	419,442.00
tblLandUse	LandUseSquareFeet	140,400.00	85,250.00
tblLandUse	LotAcreage	5.33	3.86
tblLandUse	LotAcreage	10.97	10.01
tblLandUse	LotAcreage	25.32	3.70
tblLandUse	LotAcreage	10.12	7.50
tblLandUse	LotAcreage	4.35	3.40
tblLandUse	LotAcreage	1.44	2.90
tblLandUse	LotAcreage	2.97	5.94
tblProjectCharacteristics	OperationalYear	2014	2035
tblVehicleTrips	ST_TR	7.16	6.65
tblVehicleTrips	ST_TR	7.16	6.65
tblVehicleTrips	ST_TR	1.32	5.94
tblVehicleTrips	ST_TR	2.37	11.03
tblVehicleTrips	ST_TR	10.08	6.65
tblVehicleTrips	ST_TR	42.04	44.32
tblVehicleTrips	SU_TR	6.07	6.65
tblVehicleTrips	SU_TR	6.07	6.65

tblVehicleTrips	SU_TR	0.68	5.94
tblVehicleTrips	SU_TR	0.98	11.03
tblVehicleTrips	SU_TR	8.77	6.65
tblVehicleTrips	SU_TR	20.43	44.32
tblVehicleTrips	WD_TR	6.59	6.65
tblVehicleTrips	WD_TR	6.59	6.65
tblVehicleTrips	WD_TR	6.97	5.94
tblVehicleTrips	WD_TR	11.01	11.03
tblVehicleTrips	WD_TR	68.93	33.82
tblVehicleTrips	WD_TR	9.57	6.65

2.0 Emissions Summary

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2016	0.7037	7.7134	5.5983	6.5300e-003	1.2349	0.3840	1.6189	0.5822	0.3546	0.9368	0.0000	608.8251	608.8251	0.1735	0.0000	612.4695
2017	1.7334	10.2910	19.9184	0.0354	2.5393	0.3554	2.8947	0.7829	0.3304	1.1133	0.0000	2,870.5679	2,870.5679	0.1887	0.0000	2,874.5314
2018	1.7230	9.5525	21.5301	0.0426	2.3593	0.2918	2.6511	0.6371	0.2724	0.9095	0.0000	3,344.2421	3,344.2421	0.1693	0.0000	3,347.7984
2019	1.5794	8.6862	20.1912	0.0426	2.3594	0.2583	2.6177	0.6371	0.2411	0.8782	0.0000	3,260.1405	3,260.1405	0.1616	0.0000	3,263.5331
2020	1.4408	7.6546	18.9741	0.0427	2.3684	0.2283	2.5967	0.6395	0.2131	0.8526	0.0000	3,173.8596	3,173.8596	0.1560	0.0000	3,177.1354
2021	1.3454	6.5799	18.0162	0.0425	2.3595	0.2000	2.5595	0.6371	0.1866	0.8238	0.0000	3,135.4590	3,135.4590	0.1508	0.0000	3,138.6254
2022	1.2453	5.8600	16.8437	0.0424	2.3507	0.1788	2.5295	0.6348	0.1668	0.8016	0.0000	3,099.5197	3,099.5197	0.1467	0.0000	3,102.5995
2023	28.1962	1.4563	3.8646	9.7600e-003	0.5216	0.0572	0.5788	0.1402	0.0533	0.1935	0.0000	708.5996	708.5996	0.0625	0.0000	709.9125
Total	37.9671	57.7939	124.9366	0.2645	16.0930	1.9538	18.0469	4.6908	1.8184	6.5092	0.0000	20,201.2135	20,201.2135	1.2091	0.0000	20,226.6050

2.1 Overall Construction

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2016	0.7037	7.7133	5.5983	6.5300e-003	1.2349	0.3840	1.6189	0.5822	0.3546	0.9368	0.0000	608.8244	608.8244	0.1735	0.0000	612.4688
2017	1.7334	10.2910	19.9184	0.0354	2.5393	0.3554	2.8947	0.7829	0.3304	1.1133	0.0000	2,870.5675	2,870.5675	0.1887	0.0000	2,874.5309
2018	1.7230	9.5525	21.5301	0.0426	2.3593	0.2918	2.6511	0.6371	0.2724	0.9095	0.0000	3,344.2418	3,344.2418	0.1693	0.0000	3,347.7980
2019	1.5794	8.6862	20.1912	0.0426	2.3594	0.2583	2.6177	0.6371	0.2411	0.8782	0.0000	3,260.1402	3,260.1402	0.1616	0.0000	3,263.5327
2020	1.4408	7.6546	18.9741	0.0427	2.3684	0.2283	2.5967	0.6395	0.2131	0.8526	0.0000	3,173.8592	3,173.8592	0.1560	0.0000	3,177.1351
2021	1.3454	6.5798	18.0162	0.0425	2.3595	0.2000	2.5595	0.6371	0.1866	0.8238	0.0000	3,135.4586	3,135.4586	0.1508	0.0000	3,138.6250
2022	1.2453	5.8600	16.8437	0.0424	2.3507	0.1788	2.5295	0.6348	0.1668	0.8016	0.0000	3,099.5194	3,099.5194	0.1467	0.0000	3,102.5992
2023	28.1962	1.4563	3.8646	9.7600e-003	0.5216	0.0572	0.5788	0.1402	0.0533	0.1935	0.0000	708.5994	708.5994	0.0625	0.0000	709.9123
Total	37.9671	57.7938	124.9366	0.2645	16.0930	1.9538	18.0469	4.6908	1.8184	6.5092	0.0000	20,201.2103	20,201.2103	1.2091	0.0000	20,226.6018

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2.2 Overall Operational**Unmitigated Operational**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	16.5217	0.0904	7.7808	1.8000e-003		0.2597	0.2597		0.2597	0.2597	23.1958	33.3029	56.4988	0.0562	1.6000e-003	58.1755
Energy	0.1174	1.0294	0.6206	6.4000e-003		0.0811	0.0811		0.0811	0.0811	0.0000	7,438.9383	7,438.9383	0.3061	0.0800	7,470.1732
Mobile	9.5066	14.4205	77.5826	0.2841	19.3283	0.3286	19.6569	5.1903	0.3035	5.4938	0.0000	18,270.9207	18,270.9207	0.4889	0.0000	18,281.1871
Waste						0.0000	0.0000		0.0000	0.0000	263.9045	0.0000	263.9045	15.5963	0.0000	591.4270
Water						0.0000	0.0000		0.0000	0.0000	51.7613	340.9525	392.7137	5.3318	0.1287	544.5850
Total	26.1457	15.5403	85.9840	0.2923	19.3283	0.6693	19.9977	5.1903	0.6442	5.8345	338.8616	26,084.1144	26,422.9760	21.7792	0.2103	26,945.5477

2.2 Overall Operational

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	16.5217	0.0904	7.7808	1.8000e-003		0.2597	0.2597		0.2597	0.2597	23.1958	33.3029	56.4988	0.0562	1.6000e-003	58.1755
Energy	0.1174	1.0294	0.6206	6.4000e-003		0.0811	0.0811		0.0811	0.0811	0.0000	7,438.9383	7,438.9383	0.3061	0.0800	7,470.1732
Mobile	9.5066	14.4205	77.5826	0.2841	19.3283	0.3286	19.6569	5.1903	0.3035	5.4938	0.0000	18,270.9207	18,270.9207	0.4889	0.0000	18,281.1871
Waste						0.0000	0.0000		0.0000	0.0000	263.9045	0.0000	263.9045	15.5963	0.0000	591.4270
Water						0.0000	0.0000		0.0000	0.0000	51.7613	340.9525	392.7137	5.3308	0.1285	544.5024
Total	26.1457	15.5403	85.9840	0.2923	19.3283	0.6693	19.9977	5.1903	0.6442	5.8345	338.8616	26,084.1144	26,422.9760	21.7783	0.2101	26,945.4651

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N2O	CO2e
Percent Reduction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Demolition	Demolition	1/1/2016	5/19/2016	5	100	
2	Site Preparation	Site Preparation	5/20/2016	8/11/2016	5	60	
3	Grading	Grading	8/12/2016	3/16/2017	5	155	
4	Building Construction	Building Construction	3/17/2017	2/23/2023	5	1550	
5	Paving	Paving	2/24/2023	7/27/2023	5	110	
6	Architectural Coating	Architectural Coating	7/28/2023	12/28/2023	5	110	

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 387.5

Acres of Paving: 0

**Residential Indoor: 1,702,620; Residential Outdoor: 567,540; Non-Residential Indoor: 2,672,936; Non-Residential Outdoor: 890,979
(Architectural Coating – sqft)**

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Demolition	Concrete/Industrial Saws	1	8.00	81	0.73
Demolition	Rubber Tired Dozers	2	8.00	255	0.40
Demolition	Excavators	3	8.00	162	0.38
Grading	Excavators	2	8.00	162	0.38
Site Preparation	Tractors/Loaders/Backhoes	4	8.00	97	0.37
Building Construction	Generator Sets	1	8.00	84	0.74
Grading	Rubber Tired Dozers	1	8.00	255	0.40
Grading	Tractors/Loaders/Backhoes	2	8.00	97	0.37
Building Construction	Cranes	1	7.00	226	0.29
Building Construction	Forklifts	3	8.00	89	0.20
Building Construction	Tractors/Loaders/Backhoes	3	7.00	97	0.37
Grading	Graders	1	8.00	174	0.41
Paving	Pavers	2	8.00	125	0.42
Paving	Rollers	2	8.00	80	0.38
Paving	Paving Equipment	2	8.00	130	0.36
Architectural Coating	Air Compressors	1	6.00	78	0.48
Site Preparation	Rubber Tired Dozers	3	8.00	255	0.40
Grading	Scrapers	2	8.00	361	0.48
Building Construction	Welders	1	8.00	46	0.45

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Demolition	6	15.00	0.00	0.00	12.40	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Site Preparation	7	18.00	0.00	0.00	12.40	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Grading	8	20.00	0.00	0.00	12.40	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Building Construction	9	1,632.00	529.00	0.00	12.40	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Paving	6	15.00	0.00	0.00	12.40	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Architectural Coating	1	326.00	0.00	0.00	12.40	7.30	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

3.2 Demolition - 2016

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.2144	2.2828	1.7515	1.9900e-003		0.1146	0.1146		0.1068	0.1068	0.0000	185.4868	185.4868	0.0504	0.0000	186.5461
Total	0.2144	2.2828	1.7515	1.9900e-003		0.1146	0.1146		0.1068	0.1068	0.0000	185.4868	185.4868	0.0504	0.0000	186.5461

3.2 Demolition - 2016**Unmitigated Construction Off-Site**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	3.2000e-003	4.4000e-003	0.0431	8.0000e-005	6.7600e-003	6.0000e-005	6.8200e-003	1.8000e-003	6.0000e-005	1.8600e-003	0.0000	6.1365	6.1365	3.5000e-004	0.0000	6.1439
Total	3.2000e-003	4.4000e-003	0.0431	8.0000e-005	6.7600e-003	6.0000e-005	6.8200e-003	1.8000e-003	6.0000e-005	1.8600e-003	0.0000	6.1365	6.1365	3.5000e-004	0.0000	6.1439

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.2144	2.2828	1.7515	1.9900e-003		0.1146	0.1146		0.1068	0.1068	0.0000	185.4866	185.4866	0.0504	0.0000	186.5459
Total	0.2144	2.2828	1.7515	1.9900e-003		0.1146	0.1146		0.1068	0.1068	0.0000	185.4866	185.4866	0.0504	0.0000	186.5459

3.2 Demolition - 2016

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	3.2000e-003	4.4000e-003	0.0431	8.0000e-005	6.7600e-003	6.0000e-005	6.8200e-003	1.8000e-003	6.0000e-005	1.8600e-003	0.0000	6.1365	6.1365	3.5000e-004	0.0000	6.1439
Total	3.2000e-003	4.4000e-003	0.0431	8.0000e-005	6.7600e-003	6.0000e-005	6.8200e-003	1.8000e-003	6.0000e-005	1.8600e-003	0.0000	6.1365	6.1365	3.5000e-004	0.0000	6.1439

3.3 Site Preparation - 2016

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.5420	0.0000	0.5420	0.2979	0.0000	0.2979	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.1523	1.6390	1.2332	1.1700e-003		0.0882	0.0882		0.0811	0.0811	0.0000	110.6313	110.6313	0.0334	0.0000	111.3321
Total	0.1523	1.6390	1.2332	1.1700e-003	0.5420	0.0882	0.6302	0.2979	0.0811	0.3790	0.0000	110.6313	110.6313	0.0334	0.0000	111.3321

3.3 Site Preparation - 2016**Unmitigated Construction Off-Site**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	2.3000e-003	3.1700e-003	0.0310	6.0000e-005	4.8600e-003	4.0000e-005	4.9100e-003	1.2900e-003	4.0000e-005	1.3400e-003	0.0000	4.4183	4.4183	2.5000e-004	0.0000	4.4236
Total	2.3000e-003	3.1700e-003	0.0310	6.0000e-005	4.8600e-003	4.0000e-005	4.9100e-003	1.2900e-003	4.0000e-005	1.3400e-003	0.0000	4.4183	4.4183	2.5000e-004	0.0000	4.4236

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.5420	0.0000	0.5420	0.2979	0.0000	0.2979	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.1523	1.6390	1.2332	1.1700e-003		0.0882	0.0882		0.0811	0.0811	0.0000	110.6312	110.6312	0.0334	0.0000	111.3320
Total	0.1523	1.6390	1.2332	1.1700e-003	0.5420	0.0882	0.6302	0.2979	0.0811	0.3790	0.0000	110.6312	110.6312	0.0334	0.0000	111.3320

3.3 Site Preparation - 2016**Mitigated Construction Off-Site**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	2.3000e-003	3.1700e-003	0.0310	6.0000e-005	4.8600e-003	4.0000e-005	4.9100e-003	1.2900e-003	4.0000e-005	1.3400e-003	0.0000	4.4183	4.4183	2.5000e-004	0.0000	4.4236
Total	2.3000e-003	3.1700e-003	0.0310	6.0000e-005	4.8600e-003	4.0000e-005	4.9100e-003	1.2900e-003	4.0000e-005	1.3400e-003	0.0000	4.4183	4.4183	2.5000e-004	0.0000	4.4236

3.4 Grading - 2016**Unmitigated Construction On-Site**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.6722	0.0000	0.6722	0.2787	0.0000	0.2787	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.3272	3.7781	2.4814	3.1200e-003		0.1810	0.1810		0.1665	0.1665	0.0000	293.8884	293.8884	0.0887	0.0000	295.7500
Total	0.3272	3.7781	2.4814	3.1200e-003	0.6722	0.1810	0.8532	0.2787	0.1665	0.4453	0.0000	293.8884	293.8884	0.0887	0.0000	295.7500

3.4 Grading - 2016**Unmitigated Construction Off-Site**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	4.3000e-003	5.9300e-003	0.0581	1.1000e-004	9.1000e-003	8.0000e-005	9.1800e-003	2.4200e-003	8.0000e-005	2.5000e-003	0.0000	8.2638	8.2638	4.8000e-004	0.0000	8.2738
Total	4.3000e-003	5.9300e-003	0.0581	1.1000e-004	9.1000e-003	8.0000e-005	9.1800e-003	2.4200e-003	8.0000e-005	2.5000e-003	0.0000	8.2638	8.2638	4.8000e-004	0.0000	8.2738

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.6722	0.0000	0.6722	0.2787	0.0000	0.2787	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.3272	3.7781	2.4814	3.1200e-003		0.1810	0.1810		0.1665	0.1665	0.0000	293.8881	293.8881	0.0887	0.0000	295.7497
Total	0.3272	3.7781	2.4814	3.1200e-003	0.6722	0.1810	0.8532	0.2787	0.1665	0.4453	0.0000	293.8881	293.8881	0.0887	0.0000	295.7497

3.4 Grading - 2016**Mitigated Construction Off-Site**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	4.3000e-003	5.9300e-003	0.0581	1.1000e-004	9.1000e-003	8.0000e-005	9.1800e-003	2.4200e-003	8.0000e-005	2.5000e-003	0.0000	8.2638	8.2638	4.8000e-004	0.0000	8.2738
Total	4.3000e-003	5.9300e-003	0.0581	1.1000e-004	9.1000e-003	8.0000e-005	9.1800e-003	2.4200e-003	8.0000e-005	2.5000e-003	0.0000	8.2638	8.2638	4.8000e-004	0.0000	8.2738

3.4 Grading - 2017**Unmitigated Construction On-Site**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.6722	0.0000	0.6722	0.2787	0.0000	0.2787	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.1647	1.8790	1.2637	1.6700e-003		0.0896	0.0896		0.0824	0.0824	0.0000	154.6396	154.6396	0.0474	0.0000	155.6346
Total	0.1647	1.8790	1.2637	1.6700e-003	0.6722	0.0896	0.7617	0.2787	0.0824	0.3611	0.0000	154.6396	154.6396	0.0474	0.0000	155.6346

3.4 Grading - 2017**Unmitigated Construction Off-Site**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	2.0000e-003	2.8100e-003	0.0272	6.0000e-005	4.8600e-003	4.0000e-005	4.9100e-003	1.2900e-003	4.0000e-005	1.3300e-003	0.0000	4.2489	4.2489	2.3000e-004	0.0000	4.2537
Total	2.0000e-003	2.8100e-003	0.0272	6.0000e-005	4.8600e-003	4.0000e-005	4.9100e-003	1.2900e-003	4.0000e-005	1.3300e-003	0.0000	4.2489	4.2489	2.3000e-004	0.0000	4.2537

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.6722	0.0000	0.6722	0.2787	0.0000	0.2787	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.1647	1.8790	1.2637	1.6700e-003		0.0896	0.0896		0.0824	0.0824	0.0000	154.6394	154.6394	0.0474	0.0000	155.6344
Total	0.1647	1.8790	1.2637	1.6700e-003	0.6722	0.0896	0.7617	0.2787	0.0824	0.3611	0.0000	154.6394	154.6394	0.0474	0.0000	155.6344

3.4 Grading - 2017**Mitigated Construction Off-Site**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	2.0000e-003	2.8100e-003	0.0272	6.0000e-005	4.8600e-003	4.0000e-005	4.9100e-003	1.2900e-003	4.0000e-005	1.3300e-003	0.0000	4.2489	4.2489	2.3000e-004	0.0000	4.2537
Total	2.0000e-003	2.8100e-003	0.0272	6.0000e-005	4.8600e-003	4.0000e-005	4.9100e-003	1.2900e-003	4.0000e-005	1.3300e-003	0.0000	4.2489	4.2489	2.3000e-004	0.0000	4.2537

3.5 Building Construction - 2017**Unmitigated Construction On-Site**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.3195	2.7198	1.8673	2.7600e-003		0.1835	0.1835		0.1723	0.1723	0.0000	246.6635	246.6635	0.0607	0.0000	247.9384
Total	0.3195	2.7198	1.8673	2.7600e-003		0.1835	0.1835		0.1723	0.1723	0.0000	246.6635	246.6635	0.0607	0.0000	247.9384

3.5 Building Construction - 2017**Unmitigated Construction Off-Site**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.6230	4.8162	8.2986	0.0128	0.3479	0.0692	0.4171	0.0998	0.0636	0.1634	0.0000	1,142.3884	1,142.3884	8.8100e-003	0.0000	1,142.5735
Worker	0.6241	0.8732	8.4616	0.0181	1.5144	0.0131	1.5275	0.4031	0.0120	0.4151	0.0000	1,322.6276	1,322.6276	0.0716	0.0000	1,324.1312
Total	1.2471	5.6894	16.7602	0.0309	1.8623	0.0823	1.9446	0.5029	0.0756	0.5785	0.0000	2,465.0160	2,465.0160	0.0804	0.0000	2,466.7047

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.3195	2.7198	1.8673	2.7600e-003		0.1835	0.1835		0.1723	0.1723	0.0000	246.6632	246.6632	0.0607	0.0000	247.9381
Total	0.3195	2.7198	1.8673	2.7600e-003		0.1835	0.1835		0.1723	0.1723	0.0000	246.6632	246.6632	0.0607	0.0000	247.9381

3.5 Building Construction - 2017**Mitigated Construction Off-Site**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.6230	4.8162	8.2986	0.0128	0.3479	0.0692	0.4171	0.0998	0.0636	0.1634	0.0000	1,142.3884	1,142.3884	8.8100e-003	0.0000	1,142.5735
Worker	0.6241	0.8732	8.4616	0.0181	1.5144	0.0131	1.5275	0.4031	0.0120	0.4151	0.0000	1,322.6276	1,322.6276	0.0716	0.0000	1,324.1312
Total	1.2471	5.6894	16.7602	0.0309	1.8623	0.0823	1.9446	0.5029	0.0756	0.5785	0.0000	2,465.0160	2,465.0160	0.0804	0.0000	2,466.7047

3.5 Building Construction - 2018**Unmitigated Construction On-Site**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.3483	3.0355	2.2880	3.5000e-003		0.1950	0.1950		0.1833	0.1833	0.0000	308.9844	308.9844	0.0756	0.0000	310.5723
Total	0.3483	3.0355	2.2880	3.5000e-003		0.1950	0.1950		0.1833	0.1833	0.0000	308.9844	308.9844	0.0756	0.0000	310.5723

3.5 Building Construction - 2018**Unmitigated Construction Off-Site**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.6787	5.5292	9.7645	0.0162	0.4406	0.0810	0.5216	0.1264	0.0745	0.2009	0.0000	1,421.580 1	1,421.580 1	0.0110	0.0000	1,421.810 3
Worker	0.6960	0.9878	9.4776	0.0229	1.9188	0.0158	1.9346	0.5107	0.0146	0.5253	0.0000	1,613.677 6	1,613.677 6	0.0828	0.0000	1,615.415 7
Total	1.3747	6.5170	19.2421	0.0391	2.3593	0.0968	2.4561	0.6371	0.0891	0.7261	0.0000	3,035.257 7	3,035.257 7	0.0937	0.0000	3,037.226 0

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.3483	3.0355	2.2880	3.5000e-003		0.1950	0.1950		0.1833	0.1833	0.0000	308.9841	308.9841	0.0756	0.0000	310.5720
Total	0.3483	3.0355	2.2880	3.5000e-003		0.1950	0.1950		0.1833	0.1833	0.0000	308.9841	308.9841	0.0756	0.0000	310.5720

3.5 Building Construction - 2018**Mitigated Construction Off-Site**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.6787	5.5292	9.7645	0.0162	0.4406	0.0810	0.5216	0.1264	0.0745	0.2009	0.0000	1,421.580 1	1,421.580 1	0.0110	0.0000	1,421.810 3
Worker	0.6960	0.9878	9.4776	0.0229	1.9188	0.0158	1.9346	0.5107	0.0146	0.5253	0.0000	1,613.677 6	1,613.677 6	0.0828	0.0000	1,615.415 7
Total	1.3747	6.5170	19.2421	0.0391	2.3593	0.0968	2.4561	0.6371	0.0891	0.7261	0.0000	3,035.257 7	3,035.257 7	0.0937	0.0000	3,037.226 0

3.5 Building Construction - 2019**Unmitigated Construction On-Site**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.3069	2.7359	2.2342	3.5000e-003		0.1677	0.1677		0.1577	0.1577	0.0000	305.5302	305.5302	0.0743	0.0000	307.0913
Total	0.3069	2.7359	2.2342	3.5000e-003		0.1677	0.1677		0.1577	0.1577	0.0000	305.5302	305.5302	0.0743	0.0000	307.0913

3.5 Building Construction - 2019**Unmitigated Construction Off-Site**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.6454	5.0568	9.4365	0.0162	0.4406	0.0753	0.5159	0.1264	0.0693	0.1957	0.0000	1,398.683 4	1,398.683 4	0.0107	0.0000	1,398.908 5
Worker	0.6272	0.8936	8.5205	0.0229	1.9188	0.0153	1.9341	0.5107	0.0142	0.5249	0.0000	1,555.926 9	1,555.926 9	0.0765	0.0000	1,557.533 3
Total	1.2725	5.9503	17.9570	0.0391	2.3594	0.0906	2.4500	0.6371	0.0835	0.7205	0.0000	2,954.610 3	2,954.610 3	0.0872	0.0000	2,956.441 8

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.3069	2.7359	2.2342	3.5000e-003		0.1677	0.1677		0.1577	0.1577	0.0000	305.5299	305.5299	0.0743	0.0000	307.0909
Total	0.3069	2.7359	2.2342	3.5000e-003		0.1677	0.1677		0.1577	0.1577	0.0000	305.5299	305.5299	0.0743	0.0000	307.0909

3.5 Building Construction - 2019**Mitigated Construction Off-Site**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.6454	5.0568	9.4365	0.0162	0.4406	0.0753	0.5159	0.1264	0.0693	0.1957	0.0000	1,398.683 4	1,398.683 4	0.0107	0.0000	1,398.908 5
Worker	0.6272	0.8936	8.5205	0.0229	1.9188	0.0153	1.9341	0.5107	0.0142	0.5249	0.0000	1,555.926 9	1,555.926 9	0.0765	0.0000	1,557.533 3
Total	1.2725	5.9503	17.9570	0.0391	2.3594	0.0906	2.4500	0.6371	0.0835	0.7205	0.0000	2,954.610 3	2,954.610 3	0.0872	0.0000	2,956.441 8

3.5 Building Construction - 2020**Unmitigated Construction On-Site**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.2766	2.5000	2.2019	3.5100e-003		0.1458	0.1458		0.1371	0.1371	0.0000	302.1514	302.1514	0.0736	0.0000	303.6973
Total	0.2766	2.5000	2.2019	3.5100e-003		0.1458	0.1458		0.1371	0.1371	0.0000	302.1514	302.1514	0.0736	0.0000	303.6973

3.5 Building Construction - 2020**Unmitigated Construction Off-Site**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.5829	4.3324	8.9431	0.0162	0.4423	0.0675	0.5097	0.1269	0.0621	0.1889	0.0000	1,372.067 1	1,372.067 1	0.0104	0.0000	1,372.286 2
Worker	0.5813	0.8223	7.8291	0.0230	1.9261	0.0151	1.9412	0.5126	0.0140	0.5266	0.0000	1,499.641 2	1,499.641 2	0.0719	0.0000	1,501.151 9
Total	1.1642	5.1546	16.7722	0.0392	2.3684	0.0826	2.4509	0.6395	0.0761	0.7156	0.0000	2,871.708 2	2,871.708 2	0.0824	0.0000	2,873.438 2

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.2766	2.5000	2.2019	3.5100e-003		0.1458	0.1458		0.1371	0.1371	0.0000	302.1510	302.1510	0.0736	0.0000	303.6969
Total	0.2766	2.5000	2.2019	3.5100e-003		0.1458	0.1458		0.1371	0.1371	0.0000	302.1510	302.1510	0.0736	0.0000	303.6969

3.5 Building Construction - 2020**Mitigated Construction Off-Site**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.5829	4.3324	8.9431	0.0162	0.4423	0.0675	0.5097	0.1269	0.0621	0.1889	0.0000	1,372.067 1	1,372.067 1	0.0104	0.0000	1,372.286 2
Worker	0.5813	0.8223	7.8291	0.0230	1.9261	0.0151	1.9412	0.5126	0.0140	0.5266	0.0000	1,499.641 2	1,499.641 2	0.0719	0.0000	1,501.151 9
Total	1.1642	5.1546	16.7722	0.0392	2.3684	0.0826	2.4509	0.6395	0.0761	0.7156	0.0000	2,871.708 2	2,871.708 2	0.0824	0.0000	2,873.438 2

3.5 Building Construction - 2021**Unmitigated Construction On-Site**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.2471	2.2629	2.1582	3.5000e-003		0.1246	0.1246		0.1172	0.1172	0.0000	301.0339	301.0339	0.0725	0.0000	302.5568
Total	0.2471	2.2629	2.1582	3.5000e-003		0.1246	0.1246		0.1172	0.1172	0.0000	301.0339	301.0339	0.0725	0.0000	302.5568

3.5 Building Construction - 2021**Unmitigated Construction Off-Site**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.5535	3.5561	8.5932	0.0161	0.4408	0.0605	0.5013	0.1265	0.0557	0.1821	0.0000	1,366.408 9	1,366.408 9	0.0104	0.0000	1,366.627 2
Worker	0.5449	0.7608	7.2648	0.0229	1.9188	0.0149	1.9336	0.5107	0.0138	0.5245	0.0000	1,468.016 2	1,468.016 2	0.0679	0.0000	1,469.441 3
Total	1.0984	4.3170	15.8580	0.0390	2.3595	0.0754	2.4349	0.6372	0.0695	0.7066	0.0000	2,834.425 1	2,834.425 1	0.0783	0.0000	2,836.068 5

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.2471	2.2629	2.1582	3.5000e-003		0.1246	0.1246		0.1172	0.1172	0.0000	301.0335	301.0335	0.0725	0.0000	302.5565
Total	0.2471	2.2629	2.1582	3.5000e-003		0.1246	0.1246		0.1172	0.1172	0.0000	301.0335	301.0335	0.0725	0.0000	302.5565

3.5 Building Construction - 2021**Mitigated Construction Off-Site**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.5535	3.5561	8.5932	0.0161	0.4408	0.0605	0.5013	0.1265	0.0557	0.1821	0.0000	1,366.408 9	1,366.408 9	0.0104	0.0000	1,366.627 2
Worker	0.5449	0.7608	7.2648	0.0229	1.9188	0.0149	1.9336	0.5107	0.0138	0.5245	0.0000	1,468.016 2	1,468.016 2	0.0679	0.0000	1,469.441 3
Total	1.0984	4.3170	15.8580	0.0390	2.3595	0.0754	2.4349	0.6372	0.0695	0.7066	0.0000	2,834.425 1	2,834.425 1	0.0783	0.0000	2,836.068 5

3.5 Building Construction - 2022**Unmitigated Construction On-Site**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.2209	2.0197	2.1226	3.4900e-003		0.1047	0.1047		0.0986	0.0986	0.0000	299.9946	299.9946	0.0718	0.0000	301.5017
Total	0.2209	2.0197	2.1226	3.4900e-003		0.1047	0.1047		0.0986	0.0986	0.0000	299.9946	299.9946	0.0718	0.0000	301.5017

3.5 Building Construction - 2022**Unmitigated Construction Off-Site**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.5121	3.1329	7.9628	0.0160	0.4393	0.0594	0.4986	0.1261	0.0546	0.1807	0.0000	1,360.613 9	1,360.613 9	0.0106	0.0000	1,360.836 2
Worker	0.5122	0.7073	6.7583	0.0228	1.9114	0.0147	1.9261	0.5087	0.0136	0.5224	0.0000	1,438.911 2	1,438.911 2	0.0643	0.0000	1,440.261 7
Total	1.0244	3.8403	14.7211	0.0389	2.3507	0.0741	2.4247	0.6348	0.0683	0.7030	0.0000	2,799.525 1	2,799.525 1	0.0749	0.0000	2,801.097 9

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.2209	2.0197	2.1226	3.4900e-003		0.1047	0.1047		0.0986	0.0986	0.0000	299.9943	299.9943	0.0718	0.0000	301.5013
Total	0.2209	2.0197	2.1226	3.4900e-003		0.1047	0.1047		0.0986	0.0986	0.0000	299.9943	299.9943	0.0718	0.0000	301.5013

3.5 Building Construction - 2022**Mitigated Construction Off-Site**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.5121	3.1329	7.9628	0.0160	0.4393	0.0594	0.4986	0.1261	0.0546	0.1807	0.0000	1,360.613 9	1,360.613 9	0.0106	0.0000	1,360.836 2
Worker	0.5122	0.7073	6.7583	0.0228	1.9114	0.0147	1.9261	0.5087	0.0136	0.5224	0.0000	1,438.911 2	1,438.911 2	0.0643	0.0000	1,440.261 7
Total	1.0244	3.8403	14.7211	0.0389	2.3507	0.0741	2.4247	0.6348	0.0683	0.7030	0.0000	2,799.525 1	2,799.525 1	0.0749	0.0000	2,801.097 9

3.5 Building Construction - 2023**Unmitigated Construction On-Site**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0305	0.2791	0.3161	5.2000e-004		0.0136	0.0136		0.0128	0.0128	0.0000	45.0147	45.0147	0.0107	0.0000	45.2392
Total	0.0305	0.2791	0.3161	5.2000e-004		0.0136	0.0136		0.0128	0.0128	0.0000	45.0147	45.0147	0.0107	0.0000	45.2392

3.5 Building Construction - 2023**Unmitigated Construction Off-Site**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0728	0.3976	1.1547	2.4000e-003	0.0659	8.7000e-003	0.0746	0.0189	8.0000e-003	0.0269	0.0000	203.7665	203.7665	1.4700e-003	0.0000	203.7974
Worker	0.0726	0.0995	0.9492	3.4200e-003	0.2867	2.1900e-003	0.2889	0.0763	2.0300e-003	0.0783	0.0000	212.6495	212.6495	9.2200e-003	0.0000	212.8431
Total	0.1454	0.4971	2.1039	5.8200e-003	0.3526	0.0109	0.3635	0.0952	0.0100	0.1053	0.0000	416.4160	416.4160	0.0107	0.0000	416.6404

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0305	0.2791	0.3161	5.2000e-004		0.0136	0.0136		0.0128	0.0128	0.0000	45.0147	45.0147	0.0107	0.0000	45.2392
Total	0.0305	0.2791	0.3161	5.2000e-004		0.0136	0.0136		0.0128	0.0128	0.0000	45.0147	45.0147	0.0107	0.0000	45.2392

3.5 Building Construction - 2023

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0728	0.3976	1.1547	2.4000e-003	0.0659	8.7000e-003	0.0746	0.0189	8.0000e-003	0.0269	0.0000	203.7665	203.7665	1.4700e-003	0.0000	203.7974
Worker	0.0726	0.0995	0.9492	3.4200e-003	0.2867	2.1900e-003	0.2889	0.0763	2.0300e-003	0.0783	0.0000	212.6495	212.6495	9.2200e-003	0.0000	212.8431
Total	0.1454	0.4971	2.1039	5.8200e-003	0.3526	0.0109	0.3635	0.0952	0.0100	0.1053	0.0000	416.4160	416.4160	0.0107	0.0000	416.6404

3.6 Paving - 2023

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0557	0.5499	0.7857	1.2300e-003		0.0276	0.0276		0.0254	0.0254	0.0000	107.8042	107.8042	0.0349	0.0000	108.5364
Paving	0.0288					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0845	0.5499	0.7857	1.2300e-003		0.0276	0.0276		0.0254	0.0254	0.0000	107.8042	107.8042	0.0349	0.0000	108.5364

3.6 Paving - 2023**Unmitigated Construction Off-Site**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	1.8800e-003	2.5800e-003	0.0246	9.0000e-005	7.4300e-003	6.0000e-005	7.4900e-003	1.9800e-003	5.0000e-005	2.0300e-003	0.0000	5.5127	5.5127	2.4000e-004	0.0000	5.5177
Total	1.8800e-003	2.5800e-003	0.0246	9.0000e-005	7.4300e-003	6.0000e-005	7.4900e-003	1.9800e-003	5.0000e-005	2.0300e-003	0.0000	5.5127	5.5127	2.4000e-004	0.0000	5.5177

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0557	0.5499	0.7857	1.2300e-003		0.0276	0.0276		0.0254	0.0254	0.0000	107.8041	107.8041	0.0349	0.0000	108.5362
Paving	0.0288					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.0845	0.5499	0.7857	1.2300e-003		0.0276	0.0276		0.0254	0.0254	0.0000	107.8041	107.8041	0.0349	0.0000	108.5362

3.6 Paving - 2023

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	1.8800e-003	2.5800e-003	0.0246	9.0000e-005	7.4300e-003	6.0000e-005	7.4900e-003	1.9800e-003	5.0000e-005	2.0300e-003	0.0000	5.5127	5.5127	2.4000e-004	0.0000	5.5177
Total	1.8800e-003	2.5800e-003	0.0246	9.0000e-005	7.4300e-003	6.0000e-005	7.4900e-003	1.9800e-003	5.0000e-005	2.0300e-003	0.0000	5.5127	5.5127	2.4000e-004	0.0000	5.5177

3.7 Architectural Coating - 2023

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Archit. Coating	27.8824					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0105	0.0717	0.0996	1.6000e-004		3.9000e-003	3.9000e-003		3.9000e-003	3.9000e-003	0.0000	14.0429	14.0429	8.4000e-004	0.0000	14.0605
Total	27.8930	0.0717	0.0996	1.6000e-004		3.9000e-003	3.9000e-003		3.9000e-003	3.9000e-003	0.0000	14.0429	14.0429	8.4000e-004	0.0000	14.0605

3.7 Architectural Coating - 2023

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0409	0.0560	0.5348	1.9300e-003	0.1615	1.2300e-003	0.1628	0.0430	1.1500e-003	0.0441	0.0000	119.8091	119.8091	5.1900e-003	0.0000	119.9182
Total	0.0409	0.0560	0.5348	1.9300e-003	0.1615	1.2300e-003	0.1628	0.0430	1.1500e-003	0.0441	0.0000	119.8091	119.8091	5.1900e-003	0.0000	119.9182

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Archit. Coating	27.8824					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0105	0.0717	0.0996	1.6000e-004		3.9000e-003	3.9000e-003		3.9000e-003	3.9000e-003	0.0000	14.0429	14.0429	8.4000e-004	0.0000	14.0605
Total	27.8930	0.0717	0.0996	1.6000e-004		3.9000e-003	3.9000e-003		3.9000e-003	3.9000e-003	0.0000	14.0429	14.0429	8.4000e-004	0.0000	14.0605

3.7 Architectural Coating - 2023

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0409	0.0560	0.5348	1.9300e-003	0.1615	1.2300e-003	0.1628	0.0430	1.1500e-003	0.0441	0.0000	119.8091	119.8091	5.1900e-003	0.0000	119.9182
Total	0.0409	0.0560	0.5348	1.9300e-003	0.1615	1.2300e-003	0.1628	0.0430	1.1500e-003	0.0441	0.0000	119.8091	119.8091	5.1900e-003	0.0000	119.9182

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	9.5066	14.4205	77.5826	0.2841	19.3283	0.3286	19.6569	5.1903	0.3035	5.4938	0.0000	18,270.9207	18,270.9207	0.4889	0.0000	18,281.1871
Unmitigated	9.5066	14.4205	77.5826	0.2841	19.3283	0.3286	19.6569	5.1903	0.3035	5.4938	0.0000	18,270.9207	18,270.9207	0.4889	0.0000	18,281.1871

4.2 Trip Summary Information

Land Use	Average Daily Trip Rate			Unmitigated	Mitigated
	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
Apartments Mid Rise	2,773.05	2,773.05	2773.05	6,190,463	6,190,463
Condo/Townhouse High Rise	2,267.65	2,267.65	2267.65	5,062,225	5,062,225
Enclosed Parking with Elevator	0.00	0.00	0.00		
General Light Industry	768.13	768.13	768.13	2,242,567	2,242,567
General Office Building	2,088.14	2,088.14	2088.14	4,990,149	4,990,149
Government Office Building	2,124.13	0.00	0.00	2,601,881	2,601,881
Other Asphalt Surfaces	0.00	0.00	0.00		
Parking Lot	0.00	0.00	0.00		
Single Family Housing	518.70	518.70	518.70	1,157,928	1,157,928
Strip Mall	19,540.07	19,540.07	19540.07	30,092,350	30,092,350
Total	30,079.88	27,955.74	27,955.74	52,337,563	52,337,563

4.3 Trip Type Information

Land Use	Miles			Trip %			Trip Purpose %		
	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
Apartments Mid Rise	12.40	4.30	5.40	26.10	29.10	44.80	86	11	3
Condo/Townhouse High Rise	12.40	4.30	5.40	26.10	29.10	44.80	86	11	3
Enclosed Parking with Elevator	9.50	7.30	7.30	0.00	0.00	0.00	0	0	0
General Light Industry	9.50	7.30	7.30	59.00	28.00	13.00	92	5	3
General Office Building	9.50	7.30	7.30	33.00	48.00	19.00	77	19	4
Government Office Building	9.50	7.30	7.30	33.00	62.00	5.00	50	34	16
Other Asphalt Surfaces	9.50	7.30	7.30	0.00	0.00	0.00	0	0	0
Parking Lot	9.50	7.30	7.30	0.00	0.00	0.00	0	0	0
Single Family Housing	12.40	4.30	5.40	26.10	29.10	44.80	86	11	3
Strip Mall	9.50	7.30	7.30	16.60	64.40	19.00	45	40	15

LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
0.471369	0.078902	0.178820	0.147049	0.061984	0.009364	0.021694	0.013140	0.002967	0.002368	0.009182	0.000413	0.002748

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Electricity Mitigated						0.0000	0.0000		0.0000	0.0000	0.0000	6,277.4216	6,277.4216	0.2839	0.0587	6,301.5877
Electricity Unmitigated						0.0000	0.0000		0.0000	0.0000	0.0000	6,277.4216	6,277.4216	0.2839	0.0587	6,301.5877
NaturalGas Mitigated	0.1174	1.0294	0.6206	6.4000e-003		0.0811	0.0811		0.0811	0.0811	0.0000	1,161.5167	1,161.5167	0.0223	0.0213	1,168.5855
NaturalGas Unmitigated	0.1174	1.0294	0.6206	6.4000e-003		0.0811	0.0811		0.0811	0.0811	0.0000	1,161.5167	1,161.5167	0.0223	0.0213	1,168.5855

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
Condo/Townhouse High Rise	6.64084e+006	0.0358	0.3060	0.1302	1.9500e-003		0.0247	0.0247		0.0247	0.0247	0.0000	354.3806	354.3806	6.7900e-003	6.5000e-003	356.5373
Enclosed Parking with Elevator	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
General Light Industry	3.54452e+006	0.0191	0.1738	0.1460	1.0400e-003		0.0132	0.0132		0.0132	0.0132	0.0000	189.1493	189.1493	3.6300e-003	3.4700e-003	190.3004
General Office Building	3.26e+006	0.0176	0.1598	0.1342	9.6000e-004		0.0122	0.0122		0.0122	0.0122	0.0000	173.9662	173.9662	3.3300e-003	3.1900e-003	175.0250
Government Office Building	1.08154e+006	5.8300e-003	0.0530	0.0445	3.2000e-004		4.0300e-003	4.0300e-003		4.0300e-003	4.0300e-003	0.0000	57.7149	57.7149	1.1100e-003	1.0600e-003	58.0662
Other Asphalt Surfaces	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Parking Lot	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Single Family Housing	2.75207e+006	0.0148	0.1268	0.0540	8.1000e-004		0.0103	0.0103		0.0103	0.0103	0.0000	146.8610	146.8610	2.8100e-003	2.6900e-003	147.7548
Strip Mall	1.09781e+006	5.9200e-003	0.0538	0.0452	3.2000e-004		4.0900e-003	4.0900e-003		4.0900e-003	4.0900e-003	0.0000	58.5831	58.5831	1.1200e-003	1.0700e-003	58.9396
Apartments Mid Rise	3.38922e+006	0.0183	0.1562	0.0665	1.0000e-003		0.0126	0.0126		0.0126	0.0126	0.0000	180.8616	180.8616	3.4700e-003	3.3200e-003	181.9623
Total		0.1174	1.0294	0.6206	6.4000e-003		0.0811	0.0811		0.0811	0.0811	0.0000	1,161.5167	1,161.5167	0.0223	0.0213	1,168.5855

5.2 Energy by Land Use - NaturalGas

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
Condo/Townhouse High Rise	6.64084e+006	0.0358	0.3060	0.1302	1.9500e-003		0.0247	0.0247		0.0247	0.0247	0.0000	354.3806	354.3806	6.7900e-003	6.5000e-003	356.5373
Enclosed Parking with Elevator	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
General Light Industry	3.54452e+006	0.0191	0.1738	0.1460	1.0400e-003		0.0132	0.0132		0.0132	0.0132	0.0000	189.1493	189.1493	3.6300e-003	3.4700e-003	190.3004
General Office Building	3.26e+006	0.0176	0.1598	0.1342	9.6000e-004		0.0122	0.0122		0.0122	0.0122	0.0000	173.9662	173.9662	3.3300e-003	3.1900e-003	175.0250
Government Office Building	1.08154e+006	5.8300e-003	0.0530	0.0445	3.2000e-004		4.0300e-003	4.0300e-003		4.0300e-003	4.0300e-003	0.0000	57.7149	57.7149	1.1100e-003	1.0600e-003	58.0662
Other Asphalt Surfaces	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Parking Lot	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Single Family Housing	2.75207e+006	0.0148	0.1268	0.0540	8.1000e-004		0.0103	0.0103		0.0103	0.0103	0.0000	146.8610	146.8610	2.8100e-003	2.6900e-003	147.7548
Strip Mall	1.09781e+006	5.9200e-003	0.0538	0.0452	3.2000e-004		4.0900e-003	4.0900e-003		4.0900e-003	4.0900e-003	0.0000	58.5831	58.5831	1.1200e-003	1.0700e-003	58.9396
Apartments Mid Rise	3.38922e+006	0.0183	0.1562	0.0665	1.0000e-003		0.0126	0.0126		0.0126	0.0126	0.0000	180.8616	180.8616	3.4700e-003	3.3200e-003	181.9623
Total		0.1174	1.0294	0.6206	6.4000e-003		0.0811	0.0811		0.0811	0.0811	0.0000	1,161.5167	1,161.5167	0.0223	0.0213	1,168.5855

5.3 Energy by Land Use - Electricity

Unmitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
Apartments Mid Rise	1.47058e+006	427.8073	0.0193	4.0000e-003	429.4542
Condo/Townhouse High Rise	1.47012e+006	427.6745	0.0193	4.0000e-003	429.3210
Enclosed Parking with Elevator	5.97703e+006	1,738.7871	0.0786	0.0163	1,745.4809
General Light Industry	1.16771e+006	339.7015	0.0154	3.1800e-003	341.0093
General Office Building	3.7314e+006	1,085.5067	0.0491	0.0102	1,089.6855
Government Office Building	1.23793e+006	360.1269	0.0163	3.3700e-003	361.5132
Other Asphalt Surfaces	0	0.0000	0.0000	0.0000	0.0000
Parking Lot	818048	237.9795	0.0108	2.2300e-003	238.8957
Single Family Housing	551689	160.4928	7.2600e-003	1.5000e-003	161.1106
Strip Mall	5.15396e+006	1,499.3453	0.0678	0.0140	1,505.1173
Total		6,277.4216	0.2838	0.0587	6,301.5877

5.3 Energy by Land Use - Electricity

Mitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
Apartments Mid Rise	1.47058e+006	427.8073	0.0193	4.0000e-003	429.4542
Condo/Townhouse High Rise	1.47012e+006	427.6745	0.0193	4.0000e-003	429.3210
Enclosed Parking with Elevator	5.97703e+006	1,738.7871	0.0786	0.0163	1,745.4809
General Light Industry	1.16771e+006	339.7015	0.0154	3.1800e-003	341.0093
General Office Building	3.7314e+006	1,085.5067	0.0491	0.0102	1,089.6855
Government Office Building	1.23793e+006	360.1269	0.0163	3.3700e-003	361.5132
Other Asphalt Surfaces	0	0.0000	0.0000	0.0000	0.0000
Parking Lot	818048	237.9795	0.0108	2.2300e-003	238.8957
Single Family Housing	551689	160.4928	7.2600e-003	1.5000e-003	161.1106
Strip Mall	5.15396e+006	1,499.3453	0.0678	0.0140	1,505.1173
Total		6,277.4216	0.2838	0.0587	6,301.5877

6.0 Area Detail

6.1 Mitigation Measures Area

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	16.5217	0.0904	7.7808	1.8000e-003		0.2597	0.2597		0.2597	0.2597	23.1958	33.3029	56.4988	0.0562	1.6000e-003	58.1755
Unmitigated	16.5217	0.0904	7.7808	1.8000e-003		0.2597	0.2597		0.2597	0.2597	23.1958	33.3029	56.4988	0.0562	1.6000e-003	58.1755

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	1.5211					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	13.7648					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Hearth	1.0463	0.0186	1.5459	1.4600e-003		0.2251	0.2251		0.2251	0.2251	23.1958	23.0666	46.2624	0.0463	1.6000e-003	47.7313
Landscaping	0.1895	0.0718	6.2350	3.3000e-004		0.0346	0.0346		0.0346	0.0346	0.0000	10.2363	10.2363	9.9000e-003	0.0000	10.4442
Total	16.5217	0.0904	7.7808	1.7900e-003		0.2597	0.2597		0.2597	0.2597	23.1958	33.3029	56.4988	0.0562	1.6000e-003	58.1755

6.2 Area by SubCategory

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	1.5211					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	13.7648					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Hearth	1.0463	0.0186	1.5459	1.4600e-003		0.2251	0.2251		0.2251	0.2251	23.1958	23.0666	46.2624	0.0463	1.6000e-003	47.7313
Landscaping	0.1895	0.0718	6.2350	3.3000e-004		0.0346	0.0346		0.0346	0.0346	0.0000	10.2363	10.2363	9.9000e-003	0.0000	10.4442
Total	16.5217	0.0904	7.7808	1.7900e-003		0.2597	0.2597		0.2597	0.2597	23.1958	33.3029	56.4988	0.0562	1.6000e-003	58.1755

7.0 Water Detail

7.1 Mitigation Measures Water

	Total CO2	CH4	N2O	CO2e
Category	MT/yr			
Mitigated	392.7137	5.3308	0.1285	544.5024
Unmitigated	392.7137	5.3318	0.1287	544.5850

7.2 Water by Land Use

Unmitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
Apartments Mid Rise	27.1692 / 17.1284	68.8272	0.8880	0.0215	94.1308
Condo/Townhouse High Rise	22.2175 / 14.0067	56.2832	0.7262	0.0176	76.9750
Enclosed Parking with Elevator	0 / 0	0.0000	0.0000	0.0000	0.0000
General Light Industry	29.9029 / 0	56.5577	0.9765	0.0235	84.3333
General Office Building	33.6468 / 20.6222	84.6360	1.0997	0.0266	115.9700
Government Office Building	12.4778 / 7.64769	31.3870	0.4078	9.8600e-003	43.0072
Other Asphalt Surfaces	0 / 0	0.0000	0.0000	0.0000	0.0000
Parking Lot	0 / 0	0.0000	0.0000	0.0000	0.0000
Single Family Housing	5.08201 / 3.20388	12.8742	0.1661	4.0200e-003	17.6072
Strip Mall	32.6578 / 20.0161	82.1484	1.0674	0.0258	112.5614
Total		392.7137	5.3318	0.1287	544.5850

7.2 Water by Land Use

Mitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
Apartments Mid Rise	27.1692 / 17.1284	68.8272	0.8879	0.0214	94.1170
Condo/Townhouse High Rise	22.2175 / 14.0067	56.2832	0.7261	0.0175	76.9638
Enclosed Parking with Elevator	0 / 0	0.0000	0.0000	0.0000	0.0000
General Light Industry	29.9029 / 0	56.5577	0.9763	0.0234	84.3182
General Office Building	33.6468 / 20.6222	84.6360	1.0995	0.0265	115.9530
Government Office Building	12.4778 / 7.64769	31.3870	0.4078	9.8400e-003	43.0009
Other Asphalt Surfaces	0 / 0	0.0000	0.0000	0.0000	0.0000
Parking Lot	0 / 0	0.0000	0.0000	0.0000	0.0000
Single Family Housing	5.08201 / 3.20388	12.8742	0.1661	4.0100e-003	17.6046
Strip Mall	32.6578 / 20.0161	82.1484	1.0672	0.0258	112.5449
Total		392.7137	5.3308	0.1285	544.5024

8.0 Waste Detail

8.1 Mitigation Measures Waste

Category/Year

	Total CO2	CH4	N2O	CO2e
	MT/yr			
Mitigated	263.9045	15.5963	0.0000	591.4270
Unmitigated	263.9045	15.5963	0.0000	591.4270

8.2 Waste by Land Use**Unmitigated**

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
Apartments Mid Rise	191.82	38.9377	2.3012	0.0000	87.2620
Condo/Townhouse High Rise	156.86	31.8412	1.8818	0.0000	71.3581
Enclosed Parking with Elevator	0	0.0000	0.0000	0.0000	0.0000
General Light Industry	160.34	32.5476	1.9235	0.0000	72.9412
General Office Building	176.06	35.7386	2.1121	0.0000	80.0925
Government Office Building	58.41	11.8567	0.7007	0.0000	26.5716
Other Asphalt Surfaces	0	0.0000	0.0000	0.0000	0.0000
Parking Lot	0	0.0000	0.0000	0.0000	0.0000
Single Family Housing	93.66	19.0121	1.1236	0.0000	42.6074
Strip Mall	462.93	93.9706	5.5535	0.0000	210.5942
Total		263.9045	15.5963	0.0000	591.4270

8.2 Waste by Land Use

Mitigated

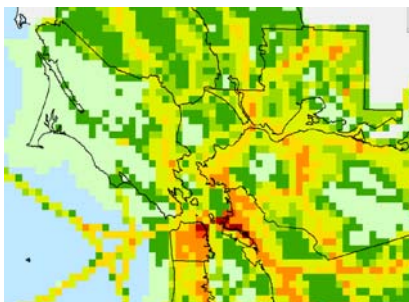
	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
Apartments Mid Rise	191.82	38.9377	2.3012	0.0000	87.2620
Condo/Townhouse High Rise	156.86	31.8412	1.8818	0.0000	71.3581
Enclosed Parking with Elevator	0	0.0000	0.0000	0.0000	0.0000
General Light Industry	160.34	32.5476	1.9235	0.0000	72.9412
General Office Building	176.06	35.7386	2.1121	0.0000	80.0925
Government Office Building	58.41	11.8567	0.7007	0.0000	26.5716
Other Asphalt Surfaces	0	0.0000	0.0000	0.0000	0.0000
Parking Lot	0	0.0000	0.0000	0.0000	0.0000
Single Family Housing	93.66	19.0121	1.1236	0.0000	42.6074
Strip Mall	462.93	93.9706	5.5535	0.0000	210.5942
Total		263.9045	15.5963	0.0000	591.4270

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Vegetation

Bay Area 2010 Clean Air Plan



Final Clean Air Plan - Volume II

Adopted September 15, 2010

**Final
BAY AREA
2010 CLEAN AIR PLAN**

VOLUME II

Adopted September 15, 2010



**BAY AREA
AIR QUALITY
MANAGEMENT
DISTRICT**

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justified. Where a range of emission reduction potential is given for a measure, the lead agency should provide justification for the mitigation reduction efficiency assumed for the project. If mitigation does not bring a project back within the threshold requirements, the project could be cumulatively significant and could be approved only with a Statement of Overriding Considerations and a showing that all feasible mitigation measures have been implemented.

Reductions from mitigation measures should be scaled proportionally to their sector of project-generated emissions. For example, if a measure would result in a 50 percent reduction in residential natural gas consumption, but only 20 percent of a project's emissions are associated with natural gas consumption, and only 10 percent of a project's emissions are from residential land uses, then the scaled reduction would equal one percent ($50\% * 20\% * 10\% = 1\%$).

Once all emission reductions are scaled by their applicable sector and land use, they should be added together for the total sum of emission reductions. Once all emission reductions are scaled by their applicable sector and land use, they should be added together for the total sum of emission reductions.

The Air District prefers for project emissions to be reduced to their extent possible onsite. For projects that are not able to mitigate onsite to a level below significance, offsite mitigation measures serve as a feasible alternative. Recent State's CEQA Guidelines amendments allow for offsite measures to mitigate a project's emissions, (Section 15126.4(c)(4)).

In implementing offsite mitigation measures, the lead agency must ensure that emission reductions from identified projects are real, permanent through the duration of the project, enforceable, and are equal to the pollutant type and amount of the project impact being offset. BAAQMD recommends that offsite mitigation projects occur within the nine-county Bay Area in order to reduce localized impacts and capture potential co-benefits. Offsite mitigation for PM and toxics emission reductions should occur within a five mile radius to the project site.

Another feasible mitigation measure the Air District is exploring establishing is an offsite mitigation program to assist lead agencies and project applicants in achieving emission reductions. A project applicant would enter into an agreement with the Air District and pay into an Air District fund. The Air District would commit to reducing the type and amount of emission identified in the agreement. The Air District would identify, implement, and manage offsite mitigation projects.

The following tables list feasible mitigation measures for consideration in projects. The estimated emission reductions are a work in progress and the Air District will continue to improve guidance on quantifying the mitigation measures.

URBEMIS Mitigation Measures for Operational Mobile Source Emissions

Measure	Sector Reductions	Applicable Pollutants	Sector	Notes	Additional comments
Mix of Uses	-3% to 9%	CAPs, GHGs	Mobile sources	-3 when no housing or employment centers within 1/2 mile	Residential: % reduction is taken from base trips (9.57) and subtracted from ITE trip generation; Nonresidential:
Local serving retail within 1/2 mile of project	2%	CAPs, GHGs	Mobile sources	Uses lower end of reported research to avoid double counting with mix of uses measure	
Transit Service	0% to 15%	CAPs, GHGs	Mobile sources		



URBEMIS Mitigation Measures for Operational Mobile Source Emissions

Measure	Sector Reductions	Applicable Pollutants	Sector	Notes	Additional comments
Bike & Pedestrian	0%–9%	CAPs, GHGs	Mobile sources	Credit is given based on intersection density, sidewalk completeness, and bike network completeness; No reduction if entire area within 1/2 mile is single use	% reduction from ITE trip generation
Affordable Housing	0%–4%	CAPs, GHGs	Mobile sources		
Transportation Demand Management Parking, Transit Passes					
Daily Parking Charge	0%–25%	CAPs, GHGs	Only resident/ employee trips, no visitor/ shopper trips		
Parking Cash-Out	0%–12.5%	CAPs, GHGs		Shoup, Donald. 2005. Parking Cash Out. American Planning Association. Chicago, IL.	
Free Transit Passes	25% of Transit Service Reduction	CAPs, GHGs			
Telecommuting					
Employee Telecommuting Program	1%–100%	CAPs, GHGs	Mobile sources, Worker Trips only		
Compressed Work Schedule 3/36	1%–40%	CAPs, GHGs			
Compressed Work Schedule 4/40	1%–20%	CAPs, GHGs			
Compressed Work Schedule 9/80	1%–10%	CAPs, GHGs			
Other Transportation Demand Measures					
Secure Bike Parking (at least 1 space per 20 vehicle spaces)	At least 3 elements: 1% reduction, plus 5% of the reduction for transit and pedestrian/bike friendliness; At least 5 elements: 2% reduction, plus 10% of the reduction for transit and pedestrian/bike friendliness	CAPs, GHGs	Mobile sources, Worker Trips only		
Showers/Changing Facilities Provided					
Guaranteed Ride Home Program Provided					
Car-Sharing Services Provided					
Information Provided on Transportation Alternatives (Bike Schedules, Maps)					
Dedicated Employee Transportation Coordinator					


URBEMIS Mitigation Measures for Operational Mobile Source Emissions

Measure	Sector Reductions	Applicable Pollutants	Sector	Notes	Additional comments
Carpool Matching Program					
Preferential Carpool/Vanpool Parking					
Parking Supply	0%–50%	CAPs, GHGs	Mobile sources		
On Road Trucks	As input by user in URBEMIS	CAPs, GHGs	Mobile sources		

URBEMIS Mitigation Measures for Operational Area-Source Emissions

Measure	Sector Reductions	Applicable Pollutants	Sector	Notes
Increase Energy Efficiency Beyond Title 24	Same as % improvement over Title 24	CAPs, GHGs	Natural gas sector in URBEMIS for applicable land use only	User should specify baseline year for the Title 24 standards
Electrically powered landscape equipment and outdoor electrical outlets	Same as % of landscape equipment emissions	CAPs, GHGs	Landscape emissions: residential only	
Low VOC architectural coatings	Same as % VOC reduction in applicable coatings (Interior/Exterior)	ROG only	Architectural coating	

NON-URBEMIS Energy Efficiency Mitigation Measures

Measure	Sector Reductions	Applicable Pollutants	Sector	Notes	Additional comments
Plant shade trees within 40 feet of the south side or within 60 feet of the west sides of properties.	30%	GHGs	R,C A/C Electricity	USDA Forest Service, Pacific Northwest Research Station. "California Study Shows Shade Trees Reduce Summertime Electricity Use." Science Daily 7 January 2009. 20 February 2009 < http://www.sciencedaily.com/releases/2009/01/090105150831.htm >.	Electricity-related measures reduce CAPs off-site, but they are not typically quantified as part of a CEQA analysis.
Require cool roof materials (albedo	34%	GHGs	C A/C Electricity	U.S. EPA Cool Roof Product Information,	



NON-URBEMIS Energy Efficiency Mitigation Measures

Measure	Sector Reductions	Applicable Pollutants	Sector	Notes	Additional comments
>= 30)	69%	GHGs	R A/C Electricity	Available: < http://www.epa.gov/heatisl and/resources/pdf/CoolRoofsCompendium.pdf >	
Install green roofs	1%	GHGs	R,C A/C Electricity	Reductions are based on the Energy & Atmosphere credits (EA Credit 2) documented in the Leadership in Energy & Environmental Design (LEED), Green Building Rating System for New Constructions and Major Renovations, Version 2.2, October 2005. The reduction assumes that a vegetated roof is installed on a least 50% of the roof area or that a combination high albedo and vegetated roof surface is installed that meets the following standard: (Area of SRI Roof/0.75)+(Area of vegetated roof/0.5) >= Total Roof Area.	
Require smart meters and programmable thermostats	10%	CAPs, GHGs	R, C electricity and natural gas space heating	U. S. Environmental Protection Agency. 2009. Programmable Thermostat. http://www.energystar.gov/ia/new_homes/features/ProgThermostats1-17-01.pdf	
Meet GBC standards in all New construction	17%	GHGs	R electricity	California Energy Commission [CEC] 2007. Impact Analysis 2008 Update to the California Energy Efficiency Standards for Residential and Nonresidential Buildings	
	7%	GHGs	C electricity		
	9%	CAPs, GHGs	R natural gas		
	3%	CAPs, GHGs	C natural gas		
Retrofit existing buildings to meet CA GBC standards	38%	GHGs	R electricity	California Energy Commission [CEC] 2003. Impact Analysis 2005 Update to the California	
	12%	GHGs	C electricity		
	18%	CAPs, GHGs	R natural gas		


NON-URBEMIS Energy Efficiency Mitigation Measures

Measure	Sector Reductions	Applicable Pollutants	Sector	Notes	Additional comments
	12%	CAPs, GHGs	C natural gas	Energy Efficiency Standards for Residential and Nonresidential Buildings; California Energy Commission [CEC] 2007. Impact Analysis 2008 Update to the California Energy Efficiency Standards for Residential and Nonresidential Buildings	
Install solar water heaters	70%	CAPs, GHGs	R natural gas water heating	Energy Star. 2009. Solar Water Heater. http://www.energystar.gov/ia/new_homes/features/WaterHtrs_062906.pdf ; Department of Energy. California Energy Commission [CEC] 2007. Impact Analysis 2008 Update to the California Energy Efficiency Standards for Residential and Nonresidential Buildings	Cannot take credit for both solar and tank-less water heater measures
	70%	CAPs, GHGs	C natural gas water heating	California Energy Commission [CEC] 2007. Impact Analysis 2008 Update to the California Energy Efficiency Standards for Residential and Nonresidential Buildings	
Install tank-less water heaters	35%	CAPs, GHGs	R natural gas water heating	Tankless Water Heater. 2008. Available: http://www.eere.energy.gov/consumer/your_home/water_heating/index.cfm/mytopic=12820	
	35%	CAPs, GHGs	C natural gas water heating		
Install solar panels on residential and commercial buildings	100%	GHGs	R, C electricity		



NON-URBEMIS Energy Efficiency Mitigation Measures

Measure	Sector Reductions	Applicable Pollutants	Sector	Notes	Additional comments
100% increase in diversity of land use mix	5%	CAPs, GHGs	Mobile sources	Ewing, Reid, et al. 2001. <i>Travel and the Built Environment: A Synthesis</i> . Transportation Research Record 1780. Paper No. 01-3515 as cited in Urban Land Institute. 2008. <i>Growing Cooler</i> . ISBN: 978-0-87420-082-2. Washington, DC	
Jobs housing balance	$\text{Trip reduction} = (1 - (\text{ABS} (1.5 * \text{HH} - \text{E}) / (1.5 * \text{HH} + \text{E}) - 0.25) / 0.25 * 0.03;$ where ABS = absolute value; HH = study area households ; E = study area employment	CAPs, GHGs	Mobile sources	Nelson/Nygaard Consultants. 2005. <i>Crediting Low-Traffic Developments: Adjusting Site-Level Vehicle Trip Generation Using URBEMIS</i> . Pg 12, (adapted from Criterion and Fehr & Peers, 2001)	
100% increase in design (i.e., presence of design guidelines for transit oriented development, complete streets standards)	3%	CAPs, GHGs	Mobile sources	Ewing, Reid, et al. 2001. <i>Travel and the Built Environment: A Synthesis</i> . Transportation Research Record 1780. Paper No. 01-3515 as cited in Urban Land Institute. 2008. <i>Growing Cooler</i> . ISBN: 978-0-87420-082-2. Washington, DC	



NON-URBEMIS Energy Efficiency Mitigation Measures

Measure	Sector Reductions	Applicable Pollutants	Sector	Notes	Additional comments
100% increase in density	5%	CAPs, GHGs	Mobile sources	Ewing, Reid, et al. 2001. <i>Travel and the Built Environment: A Synthesis</i> . Transportation Research Record 1780. Paper No. 01-3515 as cited in Urban Land Institute. 2008. <i>Growing Cooler</i> . ISBN: 978-0-87420-082-2. Washington, DC	
HVAC duct sealing	30%	GHGs	R,C A/C electricity	Sacramento Metropolitan Utilities District. 2008. Duct Sealing. Available: < http://www.pge.com/myhome/saveenergymoney/rebates/coolheat/duct/index.shtml >.	
Provide necessary infrastructure and treatment to allow use of 50% greywater/ recycled water in residential and commercial uses for outdoor irrigation	SFR: 74%*50% = 37.5% MFR: 58% * 50% = 29% Commercial: 12% * 50% = 6%	GHGs	R electricity (water consumption) C electricity (water consumption)	Department of Water Resources. 2001. Statewide Indoor/Outdoor Split. Accessed December 2, 2008. Available at: < http://www.landwateruse.water.ca.gov/annualdata/urbanwateruse/2001/landuselvels.cfm?use=8 >.	
Complete streets (i.e., bike lanes and pedestrian sidewalks on both sides of streets, traffic calming features such as pedestrian bulb-outs, cross-walks, traffic circles, and elimination of physical and psychological barriers (e.g., sound walls and large arterial roadways, respectively).)	1-5%	CAPs, GHGs	Mobile sources	Dierkers, G., E. Silsbe, S. Stott, S. Winkelman, and M. Wubben. 2007. <i>CCAP Transportation Emissions Guidebook</i> . Center for Clean Air Policy. Washington, D.C. Available: < http://www.ccap.org/safe/guidebook.php >. as cited in California Air Pollution Control Officers Association (CAPCOA) 2008. <i>CEQA and Climate Change</i> .	



NON-URBEMIS Energy Efficiency Mitigation Measures

Measure	Sector Reductions	Applicable Pollutants	Sector	Notes	Additional comments
Maximize interior day light		GHGs	R, C, M		
Increase roof/ceiling insulation		CAPs, GHGs	R, C, M		
Create program to encourage efficiency improvements in rental units		CAPs, GHGs	R		
Install rainwater collection systems in residential and Commercial Buildings		GHGs	R,C,M		
Install low-water use appliances and fixtures		GHGs	R,C,M	California Air Pollution Control Officers Association (CAPCOA) 2008. CEQA and Climate Change.	
Restrict the use of water for cleaning outdoor surfaces/Prohibit systems that apply water to non-vegetated surfaces		GHGs	R,C,M	California Attorney General's Office GHG Reduction Measures	
Implement water-sensitive urban design practices in new construction		GHGs	R,C,M		

NON-URBEMIS Waste Reduction Mitigation Measures

Provide composting facilities at residential uses		GHGs	R		
Create food waste and green waste curb-side pickup service		GHGs	R,C,M		
Require the provision of storage areas for recyclables and green waste in new construction		GHGs	R,C,M		

Notes: CAPs = Criteria Air Pollutants; GHGs = Greenhouse Gases; ROG = Reactive Organic Gases; R = Residential Development; C = Commercial Development; M = Mixed Use Development; A/C = Air Conditioning; and VOC = Volatile Organic Compounds.

Source: Information compiled by EDAW 2009.

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Bay Area 2010 Clean Air Plan

Control Strategy

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SSM 2: Digital Printing	TCM B – Improve System Efficiency B-1: Freeway & Arterial Operations Strategies B-2: Transit Efficiency & Use Strategies B-3: Bay Area Express Lane Network B-4: Goods Movement Improvements & Emission Reduction Strategies	MSM A-2: Zero Emission Vehicles & Plug-in Hybrids
SSM 3: Livestock Waste		MSM A-3: Green Fleets
SSM 4: Natural Gas Processing & Distribution	TCM C – Encourage Sustainable Travel Behavior C-1: Voluntary Employer-Based Trip Reduction Program C-2: Safe Routes to School & Safe Routes to Transit C-3: Rideshare Services & Incentives C-4: Conduct Public Outreach & Education C-5: Smart Driving	MSM A-4: Replacement or Repair of High-Emitting Vehicles
SSM 5: Vacuum Trucks		MSM B-1: Fleet Modernization for Medium- & Heavy-Duty Trucks
SSM 6: General Particulate Matter Weight Rate Limitation	TCM D – Support Focused Growth D-1: Bicycle Access & Facilities Improvement D-2: Pedestrian Access & Facilities Improvements D-3: Local Land Use Strategies	MSM B-2: Low NOx Retrofits in Heavy-Duty Trucks
SSM 7: Open Burning	TCM E – Implement Pricing Strategies E-1: Value Pricing Strategies E-2: Promote Parking Pricing to Reduce Motor Vehicle Travel E-3: Implement Transportation Pricing Reform	MSM B-3: Efficient Drive Trains
SSM 8: Coke Calcining		MSM C-1: Construction & Farming Equipment
SSM 9: Cement Kilns		MSM C-2: Lawn & Garden Equipment
SSM 10: Refinery Boilers & Heaters		MSM C-3: Recreational Vessels
SSM 11: Residential Fan Type Furnaces		
SSM 12: Space Heating		
SSM 13: Dryers, Ovens, Kilns		
SSM 14: Glass Furnaces		
SSM 15: GHG in Permitting	SSM 17: New Source Review for Toxic Air Contaminants	
SSM 16: New Source Review Addressing PM _{2.5}	SSM 18: Revise Air Toxics “Hot Spots” Program	

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Land Use & Local Impact Measures	Energy & Climate Measures	DRAFT Further Study Measures	FSM 9: GHGs in Permitting - BACT
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LUM 2: Indirect Source Review Rule LUM 3: Updated CEQA Guidelines & Enhanced Review	ECM 2: Renewable Energy	FSM 2: Reactivity in Coatings & Solvents	FSM 11: Magnet Source Rules
LUM 3: Updated CEQA Guidelines & Enhanced Review	ECM 3: Urban Heat Island Mitigation	FSM 3: Solvent Cleaning & Degreasing	FSM 12: Wood Smoke
LUM 4: Land Use Guidance LUM 5: Reduce Health Risk in Impacted Communities	ECM 4: Shade Tree Planting	FSM 4: Cooling Towers FSM 5: Equipment Leaks	FSM 13: Energy Efficiency
LUM 5 Reduce health Risk in Impacted Communities		FSM 5: Equipment Leaks	FSM 14: Wineries
LUM 6: Enhanced Air Quality Monitoring		FSM 6: Wastewater from Coke Cutting	FSM 15: Composting Operations
		FSM 7: SO2 from Refinery Processes	FSM 16: Vanishing Oils & Rust Inhibitors
		FSM 8: LPG, Propane & Butane	FSM 17: Ferry System Expansion
			FSM 18: Greenhouse Gas Fee on Stationary Sources

BAY AREA 2010 CLEAN AIR PLAN

VOLUME II

Section A

Stationary Source Measures

September 2010



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SSM 1 - Metal Melting Facilities

Brief Summary:

Limit emissions of organic compounds, fine particulates, toxic compounds and odors from foundry operations and metal melting facilities in the District.

Purpose:

Reduce organic compounds, fine particulates, toxic compounds and odor emissions.

Source Category:

Stationary

Regulatory Context and Background:

Foundries specialize in melting and casting metal into desired shapes. Foundry products are most often used in automobiles, truck parts, pipe and plumbing fixtures, train locomotives, airplanes and as metal pieces in other kinds of equipment. Die casting facilities melt metal and inject it into molds under pressure. In addition, some facilities melt metals from scrap to create specific alloys to be re-melted and cast at different locations, either in or out of the District.

Emissions produced by metal melting directly relate to the metal type, the furnace type and the molding technology used. Nonferrous foundries and steel foundries may produce hazardous emissions because of the lead, mercury, zinc, manganese, nickel, cadmium and other metals present.

Emissions of coarse and fine particulate come from mold making, pouring metal into molds, mold removal and any sand reclamation for re-use. Toxic compounds can also be emitted from fine sand particles from the shakeout (mold removal) step. Also, particulate matter is generated from receiving scrap metal for melting. Die casting uses molds, called tools, of machined steel for producing multiple casts, so little particulate matter is generated from the tool once manufactured. Metal melting and pouring can be the source of vaporized toxic compounds and odors can be generated from the organic binder systems used in mold making and from metal pouring and cooling.

Facilities in the District are currently regulated under Title V, the California ATCM for Non-Ferrous Foundries, and NESHAPS rules for Iron and Steel Foundries (40 CFR 63, subpart ZZZZZ), Aluminum, Copper and other Nonferrous Foundries (subpart EEEEE and ZZZZZZ), Secondary Aluminum Production (subpart RRR) and Electric Arc Furnace Steelmaking Facilities (subpart YYYYY). In addition, District standards governing particulate matter (Regulation 6, Rule 1) apply to these facilities and some are subject to the District's odor regulation (Regulation 7).

Implementation Actions:

The control measure would be implemented through the adoption of a new regulation targeted specifically at metal melting industries. The regulation would contemplate particulate matter control for the molding process, also consider controls on the metal melting, pouring and cooling, scrap receiving and processing and odor controls as appropriate. These would likely consist of baghouses. In addition, organic compounds (including odorous compounds) from these steps could be abated by carbon. Sand reclamation, which reduces waste from the facility, is typically done by burning, which generates fine particulate and odors. This could be abated by afterburner. Further requirements of the regulation could enhance capture of emissions through improved operating methods.

Emission Reductions:

Unknown at this time.

Emission Reduction Methodology:

TBD. Methodologies could include setting emission standards, work practice standards and management plans to reduce fugitive emissions.

Exposure Reduction:

TBD

Emission Reduction Trade-offs:

If afterburners were used to control PM and other compounds from sand reclamation, NO_x and CO₂ emissions would result.

Cost:

Unknown at this time.

Co-benefits:

None. The measure would directly target PM and VOC emissions.

Monitoring Mechanisms:

Source testing, parametric / CEM.

Issues/Impediments: The technology to implement the control measure is in place at some operations, however, cost may be an impediment for smaller businesses.

Sources:

1. National Emissions Standards for Iron and Steel Foundries (40 CFR, Part 63, Subpart EEEEE)
2. National Emissions Standards for Iron and Steel Foundries, Area Sources (40 CFR, Part 63, Subpart EEEEE)
3. Iron and Steel Foundries
4. Aluminum, Copper and other Nonferrous Foundries (40 CFR, Part 63, Subpart ZZZZZ)

SSM 2 - Digital Printing

Brief Summary:

This control measure would reduce ROG emissions from digital printing operations by one of two approaches:

- Adopting VOC limits on inks and solvents used, or
- Adopting control technology requirements.

Purpose:

Reduce emissions of VOC from digital printing operations.

Source Category:

Area Source

Regulatory Context and Background:

District Regulation 8, Rule 20: Graphics Arts Printing and Coating Operations limits organic emissions from traditional graphic arts operations during printing, coating, adhesive, and cleaning activities. Traditional printing technologies include lithographic, letterpress, gravure, flexographic, and screen printing. VOC limits are further differentiated by the types of inks and substrates used during the printing process.

The digital printing (DP) is a fairly new, non-traditional printing process that is emerging virtually every segment of the graphic arts industry. In this process a digital image stored on a computer is converted into an image that can be printed on a wide variety of substrates besides paper, such as textiles; three dimensional objects, like ball bearings; and synthetic skin. This differs from traditional graphic arts printing, which uses fixed-image masters or "plates." One primary reason DP is gaining greater acceptance is that DP has a faster turnaround time because it requires considerably less setup time for each job compared to other printing processes. Furthermore, last minute revisions are easily carried out without having to make significant changes, and may have environmental advantages, such as reduced waste. The five basic types of digital printing technology are liquid inkjet printing; thermal wax printing; laser printing, including liquid electrophotographic printing; solid ink printing; and dye sublimation printing. Of all the digital printing operations, inkjet printing appears to be gaining the largest market share in the graphic arts industry on a world-wide basis. Although DP accounted for only about three percent of the total U.S. printing industry output in 1991, it is forecast to have at least a 21 percent market share by 2025.

Emissions from the DP industry are not regulated by the District's rule to control emissions from printing presses, Regulation 8, Rule 20, however the 2008 amendments to Regulation 8, Rule 20 require certain large commercial digital printing operations to keep records of the usage of ink and other VOC-containing materials. Staff has identified two DP technologies that are believed to have significant emissions, District-wide: liquid electrophotographic printing and solvent-based inkjet printing. Staff reviewed records on one large liquid

electrophotographic press and estimated that the VOC emissions were approximately 1 ton/year. Solvent-based inkjet printers can produce images on the widest formats in the printing industry and use inks that contain high VOC contents. Inkjet printing appears to be the most likely to emit significant ROG emissions.

Implementation Actions:

One option is to establish a limit for VOC emissions from DP facilities, such as Maryland's 100 pounds per day limit. Lower VOC inks may be able to be developed, although the necessary properties of inks for some types of DP may preclude low-VOC formulations. Add-on controls or equipment requirements could be developed to prevent emissions, or add-on controls could be required. Finally, emission limits could be established for each printing technology, allowing a combination of low-VOC materials, on-board controls and add-on controls, as necessary.

Emission Reductions:

TBD. It is estimated that 40 – 50 large, liquid electrophotographic presses may exist in the Bay Area. The number of large, commercial inkjet printers is not known.

Emission Reduction Methodology:

TBD

Exposure Reduction:

TBD

Emission Reductions Trade-offs:

Add on control equipment may require the use of electricity or natural gas, increasing GHGs.

Cost:

Unknown at this time. Some DP may reduce emissions through internal controls of ink usage, making ink available for re-use.

Co-benefits:

- Reduction in ROG emissions may reduce emissions of toxic organic compounds.

Monitoring Mechanisms:

Source testing, recordkeeping, parametric monitoring.

Issues/Impediments:

Unlike traditional printing, technical barriers to the development of low-VOC inks may exist due to the nature of how the DP creates images. Inkjet printing relies on ink with a very low viscosity to be sprayed through tiny nozzles. Electrophotographic printing relies on the polarity of ink molecules to be attracted to charged plates.

Sources:

1. EPA Office of Compliance sector Notebook Project: Profile of the Printing & Publishing Industry, 1995
<http://www.epa.gov/compliance/resources/publications/assistance/sectors/notebooks/printpt1.pdf>
2. EPA Design for the Environment Printing Industry Profile,
<http://www.p2pays.org/ref/01/00936/execsum.htm>
3. Digital Printing: The Reference Handbook, 2004, Uri Levy & Gilles Biscos
4. Today's Digital Imaging: Version 5.0, 2005, Smart Papers
5. Conference call with Sandra Lowe-Leseth, Rule Developer, San Joaquin Valley Air Pollution Control District, 5/2/07
6. Code of Maryland Regulations: 26.11.19.18. 18 Control of Volatile Organic Compound Emissions from Screen Printing and Digital Imaging
<http://www.dsd.state.md.us/comar/26/26.11.19.18.htm>

SSM 3 - Livestock Waste

Brief Summary:

This control measure would reduce organic emissions from livestock waste by requiring best management practices already being implemented in San Joaquin Valley Unified Air Pollution Control District, Sacramento Metropolitan and South Coast Air Quality Management Districts to be applied at Bay Area dairies.

Purpose:

Reduce emissions of organic compounds from livestock waste.

Source Category:

Area source.

Regulatory Context and Background:

California law and District regulations have historically exempted agricultural sources of air pollution from obtaining air quality permits, or complying with most air quality regulation. This exemption was revoked in 2003 with the passing of Senate Bill 700 that requires air districts to adopt regulations for large confined animal facilities and amends air pollution control requirements of the California Health and Safety Code (CH&SC) related to agricultural sources of air pollution, effective January 1, 2004.

Pursuant to Senate Bill 700, the District adopted Regulation 2, Rule 10: Large Confined Animal Facilities in 2006. The regulation requires that large confined animal facilities (at least 1000 milk-producing cows for dairies) obtain a permit to operate and implement control measures to reduce emissions of POC (Precursor Organic Compound), NO_x, and PM₁₀ from the facility. The rule allows the APCO to establish a reasonable compliance schedule for facilities to implement these control measures within one year of the date on which the permit is issued.

Currently, the District does not provide a list of control measures that are applicable under this regulation. Based on the District's review of USDA census data, no facility in the Bay Area currently meets the applicability requirements of Regulation 2, Rule 10. According to the California Food and Agriculture Report for 2005, there are approximately 100 dairies in the Bay Area with an average herd size of 350 milking cows. Milking cows must give birth to calves in order to produce milk. On average, a milking cow produces 17,000 pounds of milk a year. Due to the high number of calf births required for cows to continue to lactate, dairy operations must also handle calves, heifers, and other support stock. Support stock typically composes about 50 percent of the total cattle on a dairy, although many larger dairies are sending calves and heifers to special farms in order to focus solely on milk producing cows.

In addition to dairies, the Bay Area also supports a small stock of chicken, turkey, goat, and swine farms. Research is ongoing to determine the number of facilities in operation and the average amount of animals being supported at these facilities. Most of these facilities as well as the dairies are located in Sonoma or Marin Counties.

Implementation Actions:

Emission mitigation measures are based on San Joaquin Valley Unified Air Pollution Control District Rule 4570 and South Coast Air Quality Management District Rule 223. Because most Bay Area dairies are smaller operations than those in San Joaquin and South Coast, the District is focusing on implementation of best management practices rather than requiring controls at this time. Preliminary research by Schmidt (2005) has shown that organic compounds emitted from the feed may constitute over 50% of the total organic emissions from animal facilities. Simple techniques such as keeping silage covered and reducing wet feed can potentially reduce organic emissions. Additionally, feeding the animals food that will result in more complete digestion can reduce organic emissions directly from the animal and the waste. The District will review the best management practices implemented in San Joaquin and South Coast and determine if any may be applied to Bay Area dairies. The practices include:

- Prepare feed according to National Research Council guidelines specified in the most recent version of the “Nutrient Requirements of Dairy Cattle”
- Store grain in a weatherproof storage structure from October through May
- Remove feed from the area where animals eat at least once every 14 days
- Cover the horizontal surface of silage piles, except for the area where feed is being removed from the silage pile.
- Flush or hose milking parlor immediately prior to, immediately after, or during each milking
- Flush freestalls more frequently than the milking schedule
- Use non-manure-based bedding for at least 90% of the bedding material, by weight, for freestalls (e.g., rubber mats, almond hulls, sand, or waterbeds)
- Inspect water pipes and troughs and repair leaks at least once every 14 days
- Clean concrete areas such that the depth of animal waste does not exceed twelve inches at any point or time, except in-corral mounding
- Manage corrals such that the animal waste depth in the corral does not exceed twelve inches at any point or time, except for in-corral mounding
- Knock down fence line animal waste build-up prior to it exceeding a height of twelve inches at any time.
- Scrape or flush feed aprons in corrals at least once every seven days
- Maintain corrals to ensure drainage and to prevent water from standing more than 48 hours
- Cover dry animal waste piles outside of the corrals with a waterproof covering from October through May, except for times, not to exceed 24 hours, when wind removes the covering
- Cover dry separated solids outside the corrals with a waterproof covering from

October through May, except for times, not to exceed 24 hours, when wind removes the covering.

- Remove solids from the waste system with a solid separator system, prior to the waste entering the lagoon
- Manage the liquid animal waste so it stands in the fields no more than 24 hours, if it is applied on land as fertilizer
- Do not apply any solid animal waste that has a moisture content of more than 50% as fertilizer on fields.

Emission Reductions:

<u>Pollutants (tons per day)</u>	<u>2012</u>	<u>2020</u>
ROG	0.30	0.30
CO ₂ -e	65.00	65.00

The emission reductions potential for this measure equals 3.4 tons per day TOG, or 0.3 tons per day ROG and 3.1 tpd of methane. Based on its global warming potential (GWP) factor of 21, the 3.1 tpd of methane emissions are equivalent to 65 tpd of CO₂-e.

Emission Reduction Methodology:

The emission reduction estimates considers that a dairy would adopt all of the best management practices listed above. Additional reductions are possible from large facilities that may opt to install advanced control technologies including anaerobic digesters, aerobic lagoons, aerated static piles, and/or biofilters. Because most of these technologies are new and just beginning to reach commercial use, the emission reduction potentials are unknown. Because of the capital costs associated with construction of these technologies, they may be better suited for larger confined animal facilities similar to those typically found in San Joaquin or South Coast.

The 2005 emission inventory estimates emissions from dairy cattle are 13.75 tons per day of TOG and 1.1 tons per day of ROG. Adoption of best management practices is estimated to reduce TOG emissions by 25% or 3.4 tons per day. The majority of dairies in the Bay Area are considered small operations that house an average of 350 milking cows. It is possible that some of the Bay Area dairies are already implementing some of these practices, in which case, the emissions, and potential emission reductions, may not be as significant.

Exposure Reduction:

TBD

Emission Reduction Trade-offs:

None.

Cost:

The control costs are based on San Joaquin staff report and knowledge of current operations performed at the affected sources. San Joaquin's Rule 4570 applies only to

Large Confined Animal Facilities and due to their small size, no Bay Area dairy meets this definition. As such, the District only estimated costs for facilities to adopt the best management practices. The annual cost is estimated at approximately \$15 per cow. The District has approximately 80,000 dairy cows, so total costs are estimated to be \$1.2 million per year. For an average dairy in the Bay Area that houses 350 dairy cows, the cost is estimated at \$5,250 per year.

Co-benefits:

The adoption of best management practices may also reduce emissions of ammonia, a secondary precursor to the formation of particulate matter and methane, a greenhouse gas.

Monitoring Mechanisms:

District Compliance and Enforcement Staff will monitor adoption of the best management practices through facility inspections. The success of this control measure in terms of emissions reductions would be difficult to monitor, as the majority of facilities would remain exempt from permitting due to their small size. Furthermore, the ongoing variability in the determination of emission factors for livestock may complicate efforts to quantify the reduction of emissions from adoption of these management practices.

Issues/Impediments:

There may be some opposition from this industry to being regulated when only recently they were exempt from complying with air quality regulations. The best management practices, however, are supported by industry representatives and were developed through a collaborative effort with effected parties in the San Joaquin and South Coast districts.

Sources:

1. Bay Area Proposed Regulation 2, Rule 10: Large Confined Animal Facilities, Staff Report, dated 7/5/2006
2. Mitoehner, F. et al, Volatile Fatty Acids, Amine, Phenol, and Alcohol Emissions from Dairy Cows and Fresh Waste. Final Report, dated 5/31/2006.
3. Sacramento Metropolitan Air Quality Management District, Rule 496 Large Confined Animal Facilities, Staff Report, dated 6/19/2006.
4. San Joaquin Rule 4570: Confined Animal Facilities, Final Draft Staff Report, dated 6/15/2006
5. Schmidt, C.E., and Card, T.R., Dairy Air Emissions, Summary of Dairy Emission Estimation Procedures, dated May 2006.
6. South Coast Rule 1127: Emission Reductions from Livestock Waste, Final Staff Report, dated 8/6/2004

SSM 4 - Natural Gas Production and Processing

Brief Summary:

Equipment at natural gas wells in the District is prone to leaks and excess emissions. Emissions are mostly methane, which is a potent greenhouse gas (GHG), with smaller amounts of volatile organic compounds (VOCs) and some toxic compounds. Exemptions for these gas wells in Rule 8-37 would be reconsidered and excess emissions controlled.

Purpose:

Control fugitive emissions, including methane, from natural gas production wells and associated equipment.

Source Category:

Stationary source.

Regulatory Context and Background:

The District has many natural gas wells in eastern Contra Costa County and southern Solano County. These wells extract natural gas from pockets that are found at greater than 1000 ft below grade. This gas is stripped of moisture and then pressurized to main-line pressure for use by utilities. This gas has been found to contain greater than 90 percent methane. Liquids stripped from the gas often contain toxic airborne contaminants (TAC). These gas wells typically have the following equipment on site:

- Gas well
- Liquid knockout
- Compressor (natural gas fired)
- Dehydrator with associated tanks
- Pneumatic liquid transfer pump
- Oil/water separator
- Fixed roof tank(s) for water and condensate

Gas well: A gas well may have a natural pressure of up to 7200 pounds per square inch (psi) though most wellheads are typically 40 to 150 psi. The gas wells in the District have methane content at about 92 percent with a large nitrogen component in the remaining eight percent of the gas. This gas is “wet” (meaning it contains water vapor), and contains other hydrocarbons, including toxic compounds.

Liquid knockout: The liquid knockout or separator is simple tank that utilizes a series of baffles. The collected liquids are routed to the “produced water” tank via an automatic liquid level controller. These controllers are powered by pressurized natural gas and are of two types. Type one is the normally open variety that continually vents natural gas to atmosphere. Type two is a unit that is normally closed to atmosphere except when liquids are being routed to the produced water tank.

Compressor (natural gas-fired): The engine for the compressor is usually a four-cylinder, natural gas-fired compressor that is exempt from District permits and emission requirements due to being less than 50 brake horse power (Rule 2-1-114.2.1 and Rule 9-8-110.2). However these units are often 1960s units that are in very poor condition. These units should be source tested initially as they may not meet the requirements of Rule 8-2-301 for 300 ppm and 15 lbs/day.¹ The compressor is usually coupled to a two stage horizontally opposed positive displacement compressor with liquid knockout with automatic liquid level controllers that dump to the produced water tankage. Utility line pressure is generally about 500 to 600 psi. These compressors continuously emit natural gas from leaks.

Dehydration units with associated tanks: The dehydration unit is used to remove residual moisture from the gas stream prior to release of the gas to the utility. The gas stream is routed through a contact tower containing a glycol solution. The glycol solution absorbs both water and non-methane hydrocarbons, leaving the natural gas. This “dried” gas is then sent on to the utility. The glycol is regenerated via heating, which drives off the hydrocarbon and water from the glycol and this resulting vapor is then condensed via overhead piping and collected in the “cooling tank”.

In the past these dehydration units just vented the vapors to atmosphere; but since 1998, more of these units have captured the vapors, referred to as closed loop systems. This additional condensing and liquid collection equipment has been added to the existing equipment in the field on an ‘as needed’ basis. There can be many problems with the closed loop systems, primary of which is that the cooling of the vapors is insufficient to collect them effectively. Most systems use a long, gently sloped overhead metal line (two-inch galvanized pipe approximately 50 feet long); often, these systems are not adequate to sufficiently cool the vapors. Dehydration units also generally have flash drums between the absorber tower and the regeneration units that flash methane and other light components from the glycol before generation.

Pneumatic liquid transfer pumps: These pumps are powered with natural gas that vent to the atmosphere with every stroke of the pump.

Pneumatic controls: These controls are powered with natural gas that vents to the atmosphere for safety reasons and because there is generally no electricity at remote locations.

Oil/water separator: Only a few of the facilities separate the hydrocarbons from water via equipment called a “Gun Barrel.” This equipment is basically a vertical tower that allows for phase separation. Without the Gun Barrel, sites will co-mingle water and hydrocarbons in

¹ Rule 8-2 applies to miscellaneous sources of VOC emissions that are not addressed by any other rule. It limits VOC emissions from such sources to both 300 ppm and 15 lbs/day.

the single tank that is called the “produced water tank.” Phase separation also occurs in the tank.

Fixed roof tank(s) for water and for condensate “produced water”: As discussed above the produced water tankage allows for phase separation of hydrocarbons and water. Sampling has shown total vapor pressure of 3.2 to 3.5 psi in these tanks with 1.0 percent benzene, 5.9 percent toluene, and 6.5 percent xylene in the hydrocarbon phase. Vapor headspace sampling of these same tanks found total hydrocarbon concentrations of up to 55,000 ppm; control of these vapors would reduce emissions when tanks are serviced.

These tanks are emptied via vacuum truck from a fitting on the bottom of the tank. Vacuum truck operators commonly remove the lid from these tanks while emptying the tank due to concerns of collapsing the tank. A common problem is that these lids remain open after the unloading of the liquids.

Implementation Actions:

Staff would consider a range of possible controls including the following:

- Pumps / Compressors:
 - Identify “high bleed” pneumatic pumps (bleed natural gas at a rate of 6 scf/h) and replace with “low” (less than 1 scf/h) or no bleed pumps.
 - Address combustion emissions from compressors with requirements similar to those in Rule 9-8: IC Engines.
- Tanks:
 - Amend Rule 8-37 to address the tanks that are associated with the dehydration unit (condensation tank) that is very specialized and should be considered part of the dehydration process unit.
 - Amend Rule 8-5 to address the set pressure PV valves on fixed roof tanks that are the standard in the industry. Many of these facilities use polyethylene tanks where the set pressure of the tank’s PV valve is zero, allowing venting of emissions.
 - Require that lids and hatches on tanks remain sealed at all times (including during liquid transfers), except when performing maintenance (reflect language in Rule 8-8: Wastewater Collection and Separation Systems).
- Valves:
 - Include monitoring requirement for leak checking of the pressure vacuum valves installed on the tanks and also on the piping and equipment associated with the dehydration unit.
 - Address adequate flow requirements for pressure vacuum valves when connected to vacuum trucks.
- Pipes / Connectors
 - Address fugitive emissions from vapor return lines when the reboiler burner is off.
 - Address liquids issues on the vapor return line from the cooling tank. During the summer, it is common to see uncondensed vapor at the end of the cooling segments of the vapor return line from the condensation tank. These may be controlled by requiring the condensate to be refrigerated.

- Reconsider the exemption in Rule 8-37 that allows gas wells to petition for an exemption from the standards of Rule 8-37 if the gas is more than 90 percent methane. Gas typically is predominately methane, a potent GHG.
- Require that dehydration units operate as a closed loop systems, as required in Yolo-Solano Air Quality Management District, to prevent the stripped hydrocarbons from being emitted to the atmosphere.
- Identify “high bleed” pneumatic controls and replace with “low bleed” (less than 1 scf/h) controls.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0	0.30
CO ₂ -e	0	120.00

Emission Reduction Methodology:

Emission reductions are based on an overall leakage rate of 1.4 percent and the relative amounts of the components of natural gas, methane, ethane, propane and butane. Total emissions are estimated to be 11.1 tpd of total organic gases (TOG), including 0.44 tpd of ROG. Emissions reductions are estimated to be between 6 - 9 tpd TOG. This includes 0.3 tpd of ROG and 5.7 tpd of methane. Based on its global warming potential (GWP) factor of 21, the 5.7 tpd of methane emissions are equivalent to 120 tpd of CO₂-e.

Exposure Reduction:

TBD

Emission Reductions Trade-offs:

Potential increases in CO₂ due to combustion control equipment (which would be greatly offset with the reductions in methane emissions).

Costs:

TBD

Co-benefits:

Reductions in GHG, ROG and toxics.

Monitoring Mechanisms:

Source testing, LDAR, and parametric monitors.

Issues/Impediments:

The majority of emissions reductions would be from methane, which has historically been exempt from VOC rules.

Sources:

1. <http://72.14.253.104/search?q=cache:w5Ctbf5xgrsJ:www.its.ucdavis.edu/publications/2003/UCD-ITS-RR-03-17E.pdf+emission+factors+%2B+oil+production&hl=en&ct=clnk&cd=16&gl=us> or
2. <http://www.its.ucdavis.edu/publications/2003/UCD-ITS-RR-03-17E.pdf>.
3. http://www.engineeringtoolbox.com/gas-density-d_158.html
4. http://www.epa.gov/gasstar/documents/II_pneumatics.pdf

SSM 5 - Vacuum Trucks

Brief Summary:

This control measure would reduce organic emissions from vacuum trucks by requiring emission controls on vacuum trucks utilized in liquid clean-up and transfer operations in refineries and at other locations.

Purpose:

Reduce emissions of organic compounds venting from mobile vacuum trucks used to clean up and transfer organic containing liquids.

Source Category:

Area source.

Regulatory Context and Background:

This measure was analyzed in the 1994 Clean Air Plan as Control Measure B6: Control of Emissions from Cleaning Up Organic Liquids. The analysis concluded that the measure would not be cost effective. However, in addition to cleaning up spills, vacuum trucks have been observed in frequent use as part of refinery operations, such as removing water from tank surfaces, cleaning of oil-water separators, and transport of sludge, slop oils and tank bottoms. Further investigation of this source category was recommended as part of the Bay Area 2005 Ozone Strategy, identified as Further Study Measure FS 11, Vacuum Trucks.

At one refinery, it was estimated that over 1,000,000 gallons of hydrocarbon containing liquids were put in vacuum trucks per month, which is the equivalent of approximately 145,000 gallons of hydrocarbons per month. On a volume basis, at least 1.5 gallons of air is emitted for every gallon of vacuum tank capacity. In some cases, emissions from the tanks are controlled by the use of a carbon canister that adsorbs organic vapors as they are emitted from the truck tank, primarily to control odors. Further analysis can more precisely determine the emissions from these activities, emission reductions and costs.

Implementation Actions:

Vacuum trucks are routinely used to transfer organic liquids throughout the District. They operate both from facility to facility and also in dedicated service within the bounds of a facility such as a refinery. Although the trucks are mobile sources, the exclusion from District regulation in Regulation 1 applies only to the engines powering the trucks. Some of these trucks control emissions by carbon adsorption, but this is not universal and usually only employed to control odors.

Additional analysis will be undertaken to more accurately determine the number of vacuum trucks in use and the level of control already employed in practice. Compliance and Enforcement personnel assigned to refineries may be able to facilitate this inventory effort, but the larger equipment providers would need to be queried to determine the extent of

vacuum truck use outside of refinery operations. Source testing could determine the efficiency of carbon adsorbers if in use, and overall emission rates.

Potential control requirements could include a requirement to use carbon adsorption when organic liquids are being collected, a sizing requirement for the carbon based on truck capacity, and a requirement to change out the carbon canister at appropriate intervals before the carbon becomes saturated. Other options could include the use of a balance system to route vacuum tank air back into the evacuated vessel.

Emission Reductions:

<u>Pollutants (tons per day)</u>	<u>2012</u>	<u>2020</u>
ROG	6.00	6.00

Emission Reduction Methodology:

The emission reduction estimates are based on discussions with a supplier of vacuum trucks and other tank degassing equipment. There are roughly 200 hours of vacuum truck operation per day based on rough estimates of the number of operating vacuum trucks in the Bay Area (125 trucks at 80% utilization). Assuming that each truck is likely to pull a vacuum for two hours per day, uncontrolled emissions could be as high as 15 tons per day. Assuming that current control is only 50% due to intermittent use and ineffective monitoring and change out of spent carbon canisters, emissions would still be 7.5 tons per day. Implementation of control requirements coupled with improved monitoring and change-out of the canisters could be expected to achieve 90% control of emissions resulting in emissions reductions of 6 tons per day. Additional research will refine this estimate, including a breakdown of the emission constituents. Vacuum trucks clean up a variety of compounds from a variety of sources, including non-organic materials. The mixtures and presence of water may greatly impact the volatility of the material in the tanks.

Exposure Reduction:

TBD

Emission Reduction Trade-offs:

If activated carbon is used for control, this media will need to be stripped of organics or reactivated. Reactivation of carbon is an energy intensive process that may result in emissions of organics as well as NO_x and CO from combustion if done on site. Alternatively, carbon disposal or reactivation off site would result in combustion emissions from hauling to a waste or regeneration facility.

Cost:

Activated carbon is readily available at costs between \$1,100 and \$2,000 per ton. Regeneration of spent carbon may be more costly than purchasing new carbon. The loading capacity for the carbon remains to be determined but is likely to be no more than 50% (by weight) and may be as low as 20% (by weight). Using the high estimate for virgin activated carbon with the low loading rate would result in a cost of \$10,000 per ton of TOG reduced

(\$60,000 per day or \$21.9 M per year). This does not take into account the costs of regeneration or disposal of spent carbon, but it does use the highest price for new carbon. Using the lower cost estimate and highest loading rate, costs would equal \$2200 per ton TOG reduced (\$13,200 per day or \$4.8 M per year).

Co-benefits:

Reduction in exposure to toxic air contaminants, depending on what liquid is being collected.

Monitoring Mechanisms:

District Compliance and Enforcement staff will monitor adoption of emissions control through facility inspections. Vacuum trucks could be permitted as portable equipment, although they are not equipment subject to the statewide Portable Equipment Registration Program. Vacuum trucks could also be registered with the District to facilitate monitoring and enforcement.

Issues/Impediments:

Further research will be performed to improve the estimates of costs of control, the number of vacuum trucks in operation, as well as the extent that emissions control is already employed. There may also be other means of control that may prove more effective or less costly than carbon adsorption. If control were by means of combustion, the potential for increases in greenhouse gas emissions would need to be evaluated.

Sources:

1. 1994 Clean Air Plan Control Measure B6: Control of Emissions from Cleaning Up Organic Liquids
2. Bay Area 2005 Ozone Strategy, Further Study Measure FS 11, Vacuum Trucks
3. Steve Sellinger, Senior Engineer, Envent Corporation, personal communication 12 May 2005
4. BAAQMD Regulation 8, Rules 2, 5 and 9.
5. Maintenance/Startup/Shutdown (MSS) Permitting Issues, prepared by Sage Environmental Consulting, LP for The Texas Oil and Gas Association Refinery Environmental Committee, 11 June 2007

SSM 6 - General Particulate Matter Emission Limitation

Brief Summary:

Reduce the District's allowable weight rate limitations for particulate matter (PM).

Purpose:

The purpose of this measure is to reduce emissions of particulate matter in order to decrease population exposure and protect public health, both at the regional scale and in impacted communities.

Source Category:

Stationary source.

Regulatory Context and Background:

Particulate matter includes both coarse PM, PM₁₀ or particles with an aerodynamic radius of 10 microns or less, and PM_{2.5}, particles with an aerodynamic radius of 2.5 microns or less. As discussed in both Chapter 1 and Appendix A of the 2010 CAP, current evidence suggests that PM, and especially PM_{2.5}, is the pollutant that imposes the greatest health impact on Bay Area residents. The District has had a particulate matter emission limitation in Regulation 6, Rule 1 since 1960. Reg. 6-1 contains visible emissions standards, concentration rates in terms of weight per volume of exhaust gas, and an allowable emissions rate expressed in terms of weight per weight of material processed, as well as other limits for specialized operations. Other districts have lower limitations. For example, San Joaquin's Rule 4202 allows less than 15 lbs per hour of particulate matter emission for a process weight rate of 20,000 lbs/hr; the South Coast's Rule 405 allows less than 12 lbs/hr. BAAQMD Rule 6-1 allows 19 lbs/hr for a process weight rate of 20,000 lbs/hr.

Implementation Actions:

Amend Regulation 6, Rule 1 to reduce the particulate matter allowable emissions rate.

Emission Reductions:

Pollutants (tons per day)	2012	2020
PM ₁₀	0	2.58
PM 2.5	0	0.29

Emission Reduction Methodology:

The 2005 Base Year Emissions Inventory was used to select the potential emissions that might be subject to the particulate emissions rate. Nine categories resulted in 7.79 tpd emissions of total PM. The four largest categories are Concrete Batching, Basic Refining Processes, Stone, Sand, and Gravel (Quarrying) and Other Commercial Industrial Processes. Other categories, such as Cooking and Landfills (fugitive emissions) have not been included although they have significant emissions. If facilities were operating at the current allowable emissions rate and could reduce emissions to the South Coast rate, emissions

reductions would be 2.87 tpd. However, it is not known if all facilities are currently operating at close to the allowable rate. It is likely that many facilities, through the installation of more efficient control equipment reflected in their permit conditions, operate at far lower rates.

Reduction in the allowable weight rate of particulate matter would not be expected to reduce total PM, PM10 and PM2.5 equally, because the smaller particles (those that have the greatest health impact) are the lightest. This could be considered during rule development efforts.

Exposure Reduction:

TBD

Emission Reduction Trade-off:

None expected, although a need to increase control equipment could result in greater electricity use, generating more CO2 emissions.

Cost:

TBD

Co-benefits:

Reduced particulate matter is associated with improved visibility.

Issues/Impediments:

Further research is needed to determine if existing sources are operating at or already below the allowable emissions rate.

Sources:

1. BAAQMD Regulation 6, Rule 1: General Particulate Matter
2. South Coast Rule 405: Solid Particulate Matter - Weight
3. San Joaquin Valley Unified APCD Rule 4202: Particulate Matter Emission Rate

SSM 7 - Open Burning

Brief Summary:

Consider further limitations on open burning in Regulation 5: Open Burning.

Purpose:

Reduce particulate matter, NO_x and VOC emissions from open burning.

Source Category:

Area source.

Regulatory Context and Background:

The District's Regulation 5 prohibits open burning with some exceptions. These exceptions, to allow certain burning on permissive burn days, include burning for hazardous waste reduction; removal of flood debris; marsh, forest and range management; burning of contraband; fire training; and burning of agricultural debris. Burning of agricultural debris is typically limited to a certain time period depending on what is being burned; e.g., crop stubble, orchard prunings, or crops to be replaced. A permissive burn day is called when air pollution from open burning is not expected to adversely impact ambient air quality or downwind populations according to meteorological criteria established by ARB for the Bay Area. However, Regulation 5 does not limit the quantity of material burned for agricultural operations. As indicated by the level of reported complaints, in some cases, burning of large piles of vineyard prunings have significantly impacted populations on marginally permissive burn days.

In addition, in 2008, the District adopted Regulation 6, Rule 3: Wood-burning Devices, which forbids uses of fireplaces and wood stoves on predicted PM excess nights. On at least one occasion in the winter of 2008, agricultural crops were burned on a permissive burn day prior to a non-burn night. Further limits on open burning would reduce PM emissions, including during periods conducive to high PM levels.

Finally, the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD) is required, pursuant to CH&SC 41855.5, to develop alternatives to burning agricultural waste. The San Joaquin District has committed to work with the agricultural industry to investigate the feasibility of reducing burning, and the consequent emissions, by up to 50%. No specific feasible alternatives to burning are identified in SJVUAPCD's 2006 PM₁₀ plan.

Implementation Actions:

Amend Regulation 5 to restrict the amount burned on permissive burn days or under certain meteorological criteria.

Emission Reductions:

The SJVUAPCD 2006 PM10 plan addresses alternatives to burning. Based on their estimates, if alternatives to burning agricultural crop waste were available for the Bay Area, emissions could be reduced by up to 0.04 tons VOC per day, 0.01 tons NOx per day, and 0.09 tons PM2.5 per day. However, as discussed above, the control measure could reduce exposure to PM without reducing total emissions if additional meteorological conditions for burning were considered for Regulation 5.

Emission Reduction Methodology:

The emission reductions are based on San Joaquin Valley estimates and the Bay Area source inventory. Estimates for the Bay Area are based on two source categories, Managed Burning and Disposal – Agricultural Burning – Prunings and Field Crops. Emission reductions are estimated from the percentage reduction estimated in the San Joaquin Valley's PM10 Plans for PM and NOx, and a reduction of 35% reduction for VOC was estimated, consistent with the NOx PM reduction.

Exposure Reduction:

TBD

Emission Reduction Trade-offs:

Increased composting of agricultural waste could increase emissions from composting operations, a subject of another control measure. However, a reduction of particulate matter in the atmosphere could reduce the number of days that wood burning is prohibited under Reg. 6-3: Wood Burning Devices.

Cost:

TBD

Co-benefits:

Direct reduction in PM, NOx and VOC from open burning.

Issues/Impediments:

Requiring only a part of agricultural waste to be burned may not reduce the total emissions from this source category because the remainder could be allowed to be burned on another day. However, it could result in a reduction in exposure to nearby residents.

Sources:

1. San Joaquin Valley Unified APCD 2003 PM10 Plan
2. San Joaquin Valley Unified APCD 2006 PM10 Plan
3. District emissions inventory, agricultural burning

SSM 8 - Sulfur Dioxide from Petroleum Coke Calcining

Brief Summary:

Limit emissions of sulfur dioxide from coke calcining by requiring a minimum of 80 percent sulfur capture.

Purpose:

Reduce sulfur dioxide and particulate matter emissions.

Source Category:

Stationary source.

Regulatory Context and Background:

Sulfur dioxide emissions are a precursor to fine particulate. Since the District is not in compliance with the federal ambient air quality standard for PM_{2.5}, reductions are needed in PM_{2.5} and/or PM_{2.5} precursors. Combined, the two coke calcining kilns at District Plant 22 (ConocoPhillips Carbon Plant) emit 1232 tons per year of sulfur dioxide. The facility has committed to reducing SO₂ emissions by 42 tpy to provide offsets for their Clean Fuels Expansion Project. The plant currently operates an abatement device to periodically trim emissions of sulfur dioxide to maintain compliance with the current sulfur dioxide emission limit in Regulation 9, Rule 1 of 400 ppm by volume or 113 kg (250 pounds) per hour, whichever is more restrictive. However, the South Coast AQMD requires a minimum of 80 percent sulfur capture, which is more restrictive than the current District rule requires. Hence, this control measure is intended to replicate the control measure that is in place in the South Coast.

Abatement technology includes dry scrubbing (injecting dry sodium bicarbonate or lime) into the flue gas stream, semi-dry scrubbing (injection a slurry of aqueous sodium bicarbonate or lime) into the flue gas stream, or wet scrubbing (using a sodium bicarbonate or lime slurry to absorb the SO₂) from in the flue gas.

Implementation Actions:

Limit emissions of sulfur dioxide from coke calcining operations by requiring at least 80 percent sulfur reduction. This most likely requires a semi-dry flue gas desulfurization technology that has 80 – 90% SO₂ removal efficiency.

Emission Reductions:

Pollutants (tons per day)	2012	2020
SO ₂	0	2.6

Emission Reduction Methodology:

TBD

Exposure Reduction:

TBD

Emission Reductions Trade-offs:

Use of add-on abatement equipment would be expected to increase power demand, indirectly leading to an increase in GHG emissions, mostly CO₂, from power generation.

Cost:

Estimated costs for semi-dry flue gas desulfurization is \$9 million capital, with an additional \$4 million annual operating costs. Total amortized capital and operating costs are \$5.7 million per year. Control efficiency is estimated to be at least 80%, reducing emissions by 950 tons per year. Cost effectiveness is estimated at \$6000 per ton of SO₂ reduced.

Co-benefits:

Reduction of secondary PM formation.

Monitoring Mechanisms:

Source testing, parametric / CEM.

Issues/Impediments:

No impediments have been identified, because the technology is in place at other similar operations.

Sources:

1. South Coast AQMD Rule 1119: Petroleum Coke Calcining Operations – Oxides of Sulfur.

SSM 9 - Cement Kilns

Brief Summary:

This control measure would reduce NO_x and SO_x emissions from cement kilns as well as reduce toxic air contaminants. There is one cement manufacturing facility in the Bay Area, Lehigh Southwest Cement (plant #17).

Purpose:

Reduce NO_x and SO_x emissions, mercury and other toxic air contaminants.

Source Category:

Combustion.

Regulatory Context and Background:

This facility is permitted to produce 1.6 million tons of cement clinker per year. In 2007, the facility switched from burning coal as its primary fuel to burning green petroleum coke. At the permitted production rate, the facility is projected to burn 171,000 tons per year of coke. The District approved the fuel switch based on EPA emission factors that indicated NO_x was no greater, and all other criteria pollutants were reduced. However, EPA has recently obtained data from other areas indicating emissions are very dependent on the type of coal being used, and the characteristics of green petroleum coke. EPA has proposed additional source testing to validate that there is not an emissions increase associated with the switch. Hence, there will be source testing in the near future while burning coal and while burning coke.

2008 emissions were 1788 tpy (6.8 tpd for days in operation) of NO_x and 181 tpy (0.69 tpd for days in operation) of SO₂. This indicates an increase in NO_x but a decrease in SO₂ from coal burning. Further testing will provide better emissions data. 2009 emissions were lower due to production cutbacks.

EPA has recently amended their National Emission Standard for Hazardous Air Pollutants from the Portland Cement Manufacturing Industry (40 CFR 63, Subpart LLL) to reduce emissions of mercury, particulate matter, total hydrocarbons, and hydrochloric acid. The proposed amendments were published in May of 2009, comments received were received through September 2009, and the amendments were finalized in August 2010. The rule sets standards for these pollutants and requires enhanced monitoring equipment and protocols.

Implementation Actions:

Require the use of abatement technology at Lehigh to reduce emissions of NO_x, and consider a wet scrubber to reduce emissions of SO₂ if any synergies in installing SO₂ controls along with NO_x controls (or other controls) can be identified.

Emission Reductions:

90% reduction of NO_x of 1600 tpy, or 4.38 tpd (6.1 tpd for days in operation).

Pollutants (tons per day)	2012	2020
NO _x	0	4.38

In addition to NO_x reductions, SSM 9 also has the potential to provide SO₂ reductions of 160 tons per year, or 0.44 tpd (0.6 tpd for days in operation). However, because of potential high costs for SO₂ controls (see Cost section below), the issue of whether SO₂ reductions should be required as part of this measure will be determined during the rule development process. Therefore, SO₂ reductions have not been included in evaluating the cost-effectiveness of this measure.

Emission Reductions Methodology:

NO_x emissions reductions have been estimated from a 90% emissions factor, consistent with estimates for modern control equipment.

Exposure Reduction:

TBD

Emission Reduction Trade-offs:

Depending on the technology selected, NO_x reductions may increase GHG emissions, specifically CO₂, by reducing efficiency of the process. The installation of either selective catalytic reduction or scrubbers for SO₂ control would require additional power to pull gas through the equipment, indirectly causing more CO₂ emissions from power generation.

In some modeling scenarios, reduction of NO_x from a significant NO_x emitting source with high emission rates has been shown to impact the ozone scavenging effect of NO, resulting in higher ozone concentrations in areas within the source's emission plume.

Cost:

To reduce NO_x, the estimated cost to retrofit selective catalytic reduction into the flue gas train of the kiln is from \$11.0 million capital expenditure, plus another \$1.7 million annual operating costs (total annual costs, including amortization, \$2.8 M). Control efficiency is estimated to be 90%, reducing emissions by 1,600 tons per year. Cost effectiveness when including amortized capital is \$1750 per ton of NO_x reduced. Selective Non-Catalytic Reduction (SNCR) technology may also be effective in this application. SNCR costs are approximately half of SCR costs, but only achieve 40 – 50% NO_x reduction. Other technologies may be applicable. To operate NO_x reduction equipment, particulate may have to first be removed from the flue gas.

As noted in the emission reduction discussion above, this measure may offer potential SO₂ reductions, in addition to NO_x. However, since it is not yet known whether SO₂ reductions will be required, cost-effectiveness calculations for purposes of the CAP are based on NO_x reductions only.

To reduce SO₂, estimated costs to retrofit an SO₂ scrubber into the flue gas train of the kiln is \$140 million capital expenditure, plus another \$2.7 million annual operating costs. Control efficiency is estimated to be 90%, reducing emissions by 160 tons per year. Cost effectiveness when including amortized capital would be on the order of \$150,000 per ton of SO₂ reduced.

The EPA NESHAP for cement kilns will require additional control equipment at this facility. As a result, some of the control equipment proposed in this measure may be able to be implemented more cost effectively.

Co-benefits:

Reduced secondary PM formation from NO_x and SO_x emissions.

Monitoring Mechanisms:

Source testing, CEMs and parametric monitoring.

Issues/Impediments:

The cost of SO₂ control appears to be a significant impediment unless synergies with NO_x control or the NESHAP standards can be identified.

Sources:

1. Emissions from District databank files.
2. Alternative Control Techniques Document Update - NO_x Emissions from New Cement Kilns, U.S. Environmental Protection Agency, EPA-453/R-07-006, November 2007
3. Best Available Retrofit Control Technology Assessment TXI Riverside Cement, South Coast Air Quality Management District, August 8, 2008
4. NO_x Controls Cost Model, Section 4.2, Chapter 1, U.S. Environmental Protection Agency, EPA/452/B-02-001, January 2002
5. NO_x Controls Cost Model, Section 4.2, Chapter 2, U.S. Environmental Protection Agency, EPA/452/B-02-001, January 2002

SSM 10 - Refinery Boilers and Heaters

Brief Summary:

Consider options to further reduce NO_x emissions from petroleum refinery boilers and heaters.

Purpose:

Reduce NO_x emissions.

Source Category:

Stationary source.

Regulatory Context and Background:

BAAQMD Reg. 9, Rule 10 imposes a daily average NO_x limit equivalent to 28 ppmv on refinery heaters that were in service at the time the rule was adopted in 1994. Heaters that subsequently went into service were subject to more stringent NO_x limits through the BAAQMD permitting process (BACT) and are not regulated under this rule. Reg 9-10 imposes a daily NO_x limit of 150 ppmv on each heater classified as a CO boiler because these devices tend to have higher emissions and because their emissions are more difficult to control, compared to non-CO boilers. Only 3 of the Bay Area refineries operate CO boilers, and there are fewer than ten of these devices.

Because Reg 9-10 required final compliance by 2002 and because it does not apply to new heaters (except for new CO boilers), this rule achieved significant emission reductions through 2002, but has had virtually no effect on refinery heaters emissions since then. Because Reg 9-10 allowed refineries to comply on a daily average basis, they installed NO_x controls on the largest and highest emitting heaters. Currently, the majority of refinery heaters have advanced NO_x controls (ultra low-NO_x burners or SCR) and almost all have at least basic low-NO_x burners. The few heaters that have no NO_x controls typically have one or more factors that appear to make them less-than-ideal candidates for cost-effective NO_x control. These factors are being evaluated by staff to verify their validity.

During meetings with refinery personnel and engineering consultants in July 2009, the refineries presented information regarding projected costs to retrofit remaining uncontrolled boilers with low-NO_x burners and SCR and to retrofit low-NO_x burner-equipped boilers with SCR. In addition, there are a number of refinery projects currently ongoing that will involve retrofits or replacements of refinery heaters. This will result in an overall NO_x reduction, the extent of which is currently being evaluated.

Reg 9-10 is not directly comparable to NO_x rules in the other air districts with refinery operations (South Coast AQMD and San Joaquin Valley Unified APCD) because other district rules do not allow refinery averaging as Reg 9-10 does for non-CO boilers, and because these other air districts offer compliance options for the NO_x limits in their rules (a regional

NOx cap-and-trade program at South Coast, and an emission fee option in San Joaquin) that BAAQMD does not offer. Nonetheless, both South Coast AQMD and San Joaquin Valley Unified APCD have made BARCT determinations that are more stringent than the current requirements of Reg 9-10 including:

South Coast: heaters <40 MM BTU/hr and >110 MM BTU/hr, and CO boilers
San Joaquin: heaters >110 MM BTU/hr

These BARCT determinations are being evaluated by staff, considering the different compliance options in each air district, to determine to what extent they may be applied to Bay Area refinery heaters.

Implementation Actions:

Reduce NOx emissions limits in Reg. 9-10 for the averaged heaters and the CO boilers. Other options that could be considered include requiring improved performance of some existing NOx controls.

Emission Reductions:

Total NOx emissions from heaters currently subject to Reg 9-7 are 12.0 ton/day (8.0 ton/day at averaged heaters and 4.0 ton/day at CO boilers). Because CO boilers represent a disproportionate source of emissions and because they have a significantly higher emission limit than the other refinery heaters, it is likely that most emission reductions will come from CO boilers. If all CO boiler emissions are reduced to the current BACT level for these devices, then NOx emissions would be reduced by about 2.9 ton/day.

Pollutants (tons per day)	2012	2020
NOx	0	2.9

Emission Reduction Methodology:

An amendment of Reg 9-10 will achieve emission reductions by either reducing the average daily NOx limit for pre-1994, non-CO heaters, or by reducing the NOx limit for CO boilers, or both. A reduction in the limit for pre-1994, non-CO heaters will require that refineries install low-NOx burners, ultra low-NOx burners or SCR on uncontrolled heaters, or else upgrade existing controls to more effective controls (e.g., replace low-NOx burners with SCR). These controls may be applied on whichever heaters provide the most-effective reductions, in order to achieve compliance with the new, average limit. CO boilers at different refineries have significantly different operating conditions (fuel mix, operating temperature), so it is unlikely that the current CO boiler limit can simply be reduced, since control costs will probably vary significantly at different refineries. Instead, different NOx limits will probably have to be applied to different fuels and operating conditions.

Exposure Reduction:

TBD

Emission Reduction Trade-offs:

The use of SCR could result in an increase in GHG, specifically CO₂ due to increased need for electrical power.

Installation of low-NO_x and ultra low-NO_x burners may increase emissions of CO at the modified heaters, although CO emissions are expected to remain in compliance with the 400 ppmv limit in the rule.

In some modeling scenarios, reduction of NO_x from a significant NO_x emitting source with high emission rates has been shown to impact the ozone scavenging effect of NO, resulting in higher ozone concentrations in areas within the source's emission plume.

Cost:

This measure is currently going through the rule development process. Cost estimates will be refined by District staff during the course of the rule development process.

Because NO_x controls have already been applied to most refinery heaters, and because there have been no cost break-through in NO_x controls since Reg 9-10 was first adopted, any additional NO_x reductions are expected to have relatively high cost effectiveness. Also, because each refinery has implemented a different NO_x control strategy, any reduction in the average daily NO_x limit will result in widely different control costs at each refinery. Although it is expected that each CO boiler arrangement will have a different NO_x limit, refineries with CO boilers will also face widely different control costs because CO boilers currently operate over a wide NO_x emission range.

Because refinery heaters are larger than typical non-refinery boilers and heaters and because of the complicating factors in refinery heater NO_x control, control may be less cost-effective than for NO_x reductions on natural gas-fired boilers. These complicating factors include: higher heating value of refinery gas and temporal and constituency variations in refinery gas.

Co-benefits: NO_x reductions will also reduce secondary particulate formation.

Monitoring Mechanisms:

Initial source tests, ongoing monitoring with CEMs or periodic source tests.

Issues/Impediments:

Internal and external space limitations at uncontrolled heaters may make the installation of low-NO_x burners, ultra low-NO_x burners or SCR problematic. Where installation of controls is feasible, these factors may increase the cost of control. Poor or variable fuel quality, as well as the use of high-heating value fuel that results in high combustion temperatures will generally prevent refinery heaters from complying with NO_x limits consistent with non-refinery heaters using natural gas fuel.

Sources:

1. U.S. EPA. 1994. "Alternative Control Techniques Document - NO_x Emissions from Industrial, Commercial, Institutional (ICI) Boilers." EPA document no. EPA-453/R-94-022.
2. BAAQMD, Draft Amendments to Regulation 9, Rule 10: Nitrogen Oxides and Carbon Monoxide from Boilers, Steam Generators and Process Heaters in Petroleum Refineries, Workshop Report, 2010.

SSM 11 – Residential Fan Type Furnaces

Brief Summary:

This control measure would reduce oxides of nitrogen (NO_x) emissions from residential fan type central furnaces by reducing allowable NO_x emission limits on new and replacement furnace installations. This control measure does not address older homes with simple small floor heaters or larger central furnaces for condominiums, apartment buildings, and commercial space heating.

Purpose:

Reduce emissions of NO_x from Residential Central Furnaces.

Source Category:

Combustion.

Regulatory Context and Background:

Natural gas fired fan-type central furnaces are used in residential and commercial buildings to provide comfort heating. Most single-family homes and many multi-unit residences have this type of heating equipment. Many older homes, with below floor furnaces, have been retrofitted with this type of forced air heaters. Typically, residential units have burners rated between 50,000 and 175,000 British thermal units per hour (Btu/hr). District Regulation 9, Rule 4 currently limits NO_x emissions from fan type residential central furnaces with heat input less than 175,000 Btu/hr. Regulation 9, Rule 4 is a “point-of-sale” type regulation, requiring that any residential furnace offered for sale, installed, or sold must be certified to meet 40 nanograms (ng) of NO_x per joule of delivered heat, which is equivalent to an emission concentration of about 55 ppmv at 3% oxygen. Regulation 9, Rule 4: Nitrogen Oxides from Fan Type Residential Central Furnaces was adopted in December of 1983, and has not been amended since that time. South Coast Rule 1111 includes the same NO_x limit as does San Joaquin Rule 4905.

Low NO_x burners have since been developed for many types of combustion equipment. These burners have been successfully retrofitted to large process heaters and boilers, and are now being designed for smaller combustion devices like residential water heaters. San Joaquin Control Measure S-COM-10 indicates that burners have been developed that achieve a 50% NO_x emission reduction, although these burners are not currently commercially available. These low NO_x burners can achieve NO_x emission rates of about 10 – 14 ng/joule (15 – 20 ppm) of delivered heat for water heaters. This technology can be further adapted for residential space heating, due to the similar configuration of the appliances.

Implementation Actions:

Current low NO_x burner technology is capable of meeting 10 – 14 ng/joule. This represents at least a 65 percent NO_x reduction potential. This proposal would continue the “point-of-

sale” approach for residential furnaces to minimize the impact on individual homeowners and landlords. Central furnaces have a life expectancy of about 30 years. Should proposed amendments take a replacement, rather than a retrofit or forced retirement approach, NOx reductions will occur over the 30-year replacement cycle, or approximately a two percent NOx reduction each year.

Implementation timing may be lengthy. Efficiency and safety standards were also incorporated into low NOx residential water heaters, requiring significant redesign to meet all the requirements. There appears to be a three- to five-year period from re-design to marketable product for gas appliances.

Emission Reductions:

Pollutants (tons per day)	2012	2020
NOx	0	TBD

The emission reductions from this measure will be phased in as existing furnaces are replaced over the coming 20-30 years. Emissions reductions will be 4.2 tons per day when the measure is fully implemented.

Emission Reduction Methodology:

NOx emissions from residential space heating are included in the emission inventory as a specific category of emissions: *Category 283- Domestic Natural Gas Space Heating*. Base year 2005 emissions are estimated at 8.62 tons per day (tpd). This includes older homes that just have small floor heater units. This emission estimate includes heating devices for large apartment buildings that are larger than 175,000 Btu/hr. A rough estimate of ten percent (of the emissions inventory for this category) is attributed to these floor heaters, and 15% of the total for very large furnaces leaves 75 percent, or 6.5 tpd NOx emissions attributable to residential fan type central furnaces.

The emission reduction estimates are based on implementation only for new installations, or replacement of residential central furnaces. NOx reduction potential is 65 percent of the current 6.5 tpd NOx, or at least 4.2 tpd cumulative over the 30-year replacement cycle.

Exposure Reduction:

TBD

Emission Reduction Trade-offs:

Depending on the technology selected, NOx reductions may increase GHG emissions, specifically CO2, by reducing efficiency of the process. This is unlikely for this control measure, however, because efficient low-NOx burners have been developed for similar types of appliances. New forced air heaters will probably be more efficient than the ones they replace, reducing GHG emissions.

Cost:

Control costs are based on the costs of power premixed burners used to reduce emissions for large water heaters and small boilers. These burners are estimated to add an additional \$100 to \$200 to the capital cost of a furnace. Assuming a 30 year replacement cycle, total added capital cost is \$150 million based on replacing 750,000 heaters over the 30 year period. Annual costs are \$5.0 million.

The cost estimates above exclude potential advantages of probable improved efficiency for the furnace itself, and the opportunity to improve the efficiency of the fan and heated air ductwork, attractive to a homeowner installing a new furnace because of the potential savings in fuel usage. These cost estimates also exclude the potential to improve the thermal efficiency of the home by taking advantage of combined space / water heating or heat pump technology.

Co-benefits:

There are potential positive benefits of reduced greenhouse gases through improved thermal efficiency of space heating, and potential combined efficiency of space and water heating through re-design of the home energy use systems.

Monitoring Mechanisms:

Manufacturers of residential fan-type furnaces would be required to certify the furnace to a NOx limit of 14 ng/joule. Only certified furnaces could be sold in the District.

Issues/Impediments:

No specific issues or impediments have been identified.

Sources:

1. SCAQMD Rule 1111
2. BAAQMD Regulation 9, Rule 4
3. San Joaquin Valley Ozone Plan, Page 405 – 406, Natural Gas-Fired, Fan-Type Residential Central Furnaces (S-COM-10)

SSM 12 - Large Residential and Commercial Space Heating

Brief Summary:

This control measure would reduce oxide of nitrogen (NO_x) emissions from large condominium and apartment building central furnaces, and from commercial space heating through retrofit of low NO_x burners.

Purpose:

Reduce NO_x emissions from large condominium and apartment building central furnaces, and from commercial space heating.

Source Category:

Combustion.

Regulatory Context and Background:

Natural gas fired fan-type central furnaces are used in residential and commercial buildings to provide comfort heating. Most single family homes and many multi-unit residences have this type of heating equipment. Typically, residential units have burners rated between 50,000 and 175,000 British thermal units per hour (Btu/hr). The District Regulation 9, Rule 4: Nitrogen Oxides from Fan Type Residential Central Furnaces (Rule 9-4) currently limits NO_x emissions from fan type residential central furnaces with heat input less than 175,000 Btu/hr. There is currently no regulation of larger central furnaces for condominium or apartment complexes, or commercial space heating. Unregulated combustion devices typically generate 75 to 100 ppm or more NO_x.

Low NO_x burners have been developed for many types of combustion equipment. These burners have been successfully retrofitted to large process heaters and boilers, and are now being designed for smaller combustion devices like residential water heaters. These low NO_x burners can achieve NO_x emissions of 14 ng/joule (approximately 20 ppm) of delivered heat for large water heaters. It appears this technology can be further developed for large central furnace and commercial space heating applications, due to similar space and size configurations of the affected units.

NO_x emissions from residential space heating are included in the emission inventory as a specific category of emissions: *Category 283 - Domestic Natural Gas Space Heating*. Base year 2005 emissions are estimated at 8.62 tons per day (tpd). This emission estimate includes heating devices for large condominiums and apartment buildings that are larger than 175,000 Btu/hr. A rough estimate of 15 percent of the total for these very large furnaces are responsible for 1.3 tpd of NO_x emissions.

In addition, *Category 1590 – Other External Combustion Natural Gas (area sources)* has base year 2005 emissions estimated at 7.03 tpd. Analysis of month-to-month gas consumption data indicates that approximately 24 percent of the natural gas use is for commercial

facilities, and 21 percent of the commercial gas use is cyclical from summer to winter. NOx from commercial space heating is estimated to be 0.35 tpd.

Implementation Actions:

Current low NOx burner technology is capable of meeting 14 ng/joule. This represents at least a 70 percent NOx reduction potential. This proposal includes retrofit, and probable registration of large central furnaces for condominium and apartment complexes, and commercial space heaters. These large central furnaces have a life expectancy of about 30 years. This proposal assumes a retrofit strategy for existing large furnace and space heaters. Implementation can take place over a reasonable period of 10 – 15 years, when the furnace reaches half of its potential life span.

Emission Reductions:

<u>Pollutants (tons per day)</u>	<u>2012</u>	<u>2020</u>
NOx	0	TBD

The emission reductions from this measure will be phased in as existing furnaces are replaced over the coming 15-20 years. Emission reductions are expected to be 1.2 tons per day NOx when the measure is fully implemented.

Emission Reduction Methodology:

The emission reduction estimates consider retrofit or replacement of existing large central furnaces and space heaters. NOx reduction potential is 70 percent of the current 1.65 tpd NOx, or at least 1.2 tpd cumulative over the 15-year half life of these devices.

Exposure Reduction:

TBD

Emission Reduction Trade-offs:

Depending on the technology selected, NOx reductions may increase GHG emissions, specifically CO2, by reducing efficiency of the process. However, low-NOx burners of the sort used in similar applications do not tend to reduce the efficiency of the appliance noticeably. New forced air furnaces would likely be more efficient than the ones they replace, reducing GHG emissions.

Cost:

Control costs are based on the costs of power premixed burners used to reduce emissions for large water heaters and small boilers. These low-NOx burners are expected to add \$500 to the cost of a large furnace replacement (\$3000 - \$10,000). There are an estimated 50,000 large forced air furnaces in the District, so based on a 30 year expected lifespan, approximately 1667 would be replaced annually. In 15 years, 25,000 of the furnaces will be retrofitted with low NOx burners at a cost of \$12.5M, resulting in an annual cost of \$833,333 a year and a cost effectiveness of \$3800 per ton of NOx reduced.

Approximately half the large furnaces may not be retrofitted with low-NOx burners and need to be replaced within 15 years (half their lifespan), the additional replacement capital costs are estimated at \$3000, and would amortize to a total of \$6.0 M annually. Cost effectiveness for these heaters is \$27,400 per ton of NOx reduced. Overall cost effectiveness for this control measure is \$15,600 per ton of NOx reduced.

The cost estimates above exclude potential advantages of any improved efficiency for the furnace itself, and the opportunity to improve the efficiency of the fan and heated air ductwork. These cost estimates also exclude the potential to improve the thermal efficiency of a building by taking advantage of combined space / water heating or heat pump technology.

Co-benefits:

There are potential positive benefits of reduced greenhouse gases through improved thermal efficiency of space heating, and potential combined efficiency of space and water heating through re-design of the building energy use systems.

Monitoring Mechanisms:

Manufacturers of space heaters would be required to certify the heater to a NOx limit of 14 ng/joule. Only certified heaters could be sold in the District.

Issues/Impediments:

No specific issues of impediments have been identified.

Sources:

1. SCAQMD Rule 1111
2. BAAQMD Regulation 9, Rule 4
3. San Joaquin Valley Ozone Plan, Page 405 – 406, Natural Gas-Fired, Fan-Type Residential Central Furnaces (S-COM-10)

SSM 13 - Dryers, Ovens, and Kilns

Brief Summary:

This control measure would reduce oxides of nitrogen (NO_x) emissions from combustion devices that are currently exempt from the requirements of Regulation 9, Rule 7: *Nitrogen Oxides and Carbon Monoxide from Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters* (Reg 9-7). Reg. 9-7 exempts the following types of combustion devices: kilns, ovens, and furnaces used for drying, baking, heat treating, cooking, calcining, or vitrifying (§9-7-110.6).

Purpose:

Reduce emissions of NO_x from kilns, ovens, and furnaces.

Source Category:

Combustion.

Regulatory Context and Background:

The District regulates NO_x emissions from a variety of combustion source categories. Reg. 9-7 is a non-industry specific rule that applies to a broad range of combustion devices that heat water or other fluids. Reg. 9-7 includes an exemption for "kilns, ovens and furnaces used for drying, baking, heat treating, cooking, calcining, or vitrifying." Historically, most California air districts that had a general combustion rule similar to Reg. 9-7 also had an exemption similar to that in §9-7-110.6, and did not have a separate rule that applied to these exempt devices. In December 2005 the San Joaquin Valley APCD (SJVUAPCD) adopted Rule 4309 to limit emissions of NO_x from dryers, dehydrators and ovens with a rated heat input of 5 MM BTU/hr or more. Rule 4309 was fully implemented in December 2008. In December 2008 the South Coast AQMD (SCAQMD) published a draft of a new rule (Rule 1147) that would limit emissions of NO_x from "ovens, dryers, dehydrators, heaters, kilns, calciners, furnaces, crematories, incinerators, heated pots, cookers, roasters, fryers, closed and open heated tanks and evaporators, distillation units, afterburners, degassing units, vapor incinerators, catalytic or thermal oxidizers, soil and water remediation units". This proposed rule has not been adopted.

The draft staff report for proposed SCAQMD Rule 1147 indicates that low-NO_x burners are commercially available for all affected devices in the proposed rule.

A database query for permitted combustion devices in this category identified 62 devices with total NO_x emissions of 2.1 ton per day (tpd). The cement kiln at Lehigh Southwest Cement (Plant #17) and two coke calciners at the Conoco Phillips Coke Plant (Plant #22) generate approximately 93% of the emissions from this source category. This kiln and calciners are the subject of other proposed control measures. The remaining NO_x emissions from this source category are about 0.45 tpd.

Implementation Actions:

Adopt a rule similar to SCAQMD Rule 1147 for this source category.

Emission Reductions:

In the draft staff report for proposed Rule 1147, SCAQMD staff estimated that current, uncontrolled NOx emission rates at devices that would be subject to Rule 1147 range from 110 to 170 ppmv at 3% O2. The proposed NOx limits in this rule range from 30 to 60 ppmv at 3% O2. Small driers, ovens and kilns are assumed to be exempt because NOx reduction would not be cost effective for small devices. If none of these devices in the District has already implemented NOx controls, the emission reduction available by applying the SCAQMD proposed NOx limits ranges from 45% to 80%, or from 0.20 tpd to 0.36 tpd.

Pollutants (tons per day)	2012	2020
NOx	0	0.20

Cost: Low NOx burners are estimated to add \$5000 to the cost of a dryer, oven or kiln replacement. Devices of this size and type may not be able to be retrofitted with low-NOx technology. There have been 59 driers, ovens and kilns identified in the Air District, half of which may be exempt because of low fuel usage. For devices unable to be retrofitted, replacement before the end of their useful life may be required. At an estimated cost of \$100,000 each, replacement of all devices will cost \$3M capital, amortized to \$570,000 annually. The SJVUAPCD estimated costs between \$7,300 and \$22,300 per ton of NOx reduced for Rule 4309. The SCAQMD has estimated costs between \$4,000 and \$17,000 per ton of NOx reduced for proposed Rule 1147.

Emission Reduction Methodology:

The emissions reductions are derived from South Coast's estimated emissions reductions and the emissions from applicable sources in the Bay Area.

Exposure Reduction:

TBD

Emission Reduction Trade-offs:

Depending on the technology selected, NOx reductions may increase GHG emissions, specifically CO2, by reducing efficiency of the process.

Co-benefits:

NOx is a precursor to secondary PM formation.

Monitoring Mechanisms:

Source tests, monitoring.

Issues/Impediments:

SJVUAPCD Rule 4309 exempts units used to precondition onions and garlic prior to dehydration. Gilroy Foods, Inc. (Plant #11327) has eight sources that could be controlled. It is not known if the rationale for the San Joaquin exemption would apply to these units. Proposed SCAQMD Rule 1147 does not provide a similar exemption.

Sources:

1. SJVUAPCD Rule 4309: <http://www.valleyair.org/rules/currnrules/r4309.pdf>
2. SCAQMD Proposed Rule 1147:
<http://www.aqmd.gov/rules/proposed/1147/PR1147Nov408.pdf>
3. SCAQMD Proposed Rule 1147 Draft Staff Report:
<http://www.aqmd.gov/rules/proposed/1147/PR1147DraftStaffReportNov408.pdf>

SSM 14 - Glass Furnaces

Brief Summary:

This control measure would reduce NOx emission from gas-fired glass melting facilities.

Purpose:

Reduce NOx

Source Category:

Stationary source.

Regulatory Context and Background:

SJVUAPCD Rule 4354 imposes NOx limits for several types of glass plants: flat glass, container glass, and fiberglass. The limit went to 4.0 lbs NOx / ton of glass in 2008. In 2008, SJVUAPCD adopted further amendments to Rule 4354 that set a standard for container glass of 1.5 lbs NOx / ton effective in 2014.

BAAQMD Regulation 9, Rule 12: Nitrogen Oxides from Glass Melting Furnaces (Rule 9-12) imposes a NOx limit of 5.5 lbs NOx / ton glass. This limit was based on the South Coast limit but also on differences between Bay Area furnaces and South Coast furnaces. The South Coast furnaces are largely end-port furnaces. The operators of the furnaces used electric boost and flame modifications to reduce emissions to meet the SCAQMD limit. The Bay Area has only one facility (Plant 30) that has three glass melting furnaces. These three furnaces are side port furnaces, and flame modification techniques used in the South Coast cannot be used on these furnaces. In addition, the Bay Area furnaces use electric boost to increase production and, therefore, cannot use it to reduce emissions without decreasing production. Limits lower than 4.0 lbs NOx / ton glass have been achieved by an oxy-fuel system operated by Gallo in Modesto, but this plant manufactures glass for Gallo wines and does not sell to the open market. It is unclear whether oxy-fuel combustion is cost-effective in the current market.

Another relatively new technology, the Pilkington 3R process, has been developed since the SCAQMD and BAAQMD rules were adopted in the early 1990's; but it has been used only in flat glass furnaces. It is unknown whether the process will prove to be suitable for container glass furnaces and whether there is any potential for emission reductions.

Of the three Bay Area glass melting furnaces, two of these (S-11, S-12) have explicit NOx emission rate limits (4.0 lb/ton of glass in a 3-hr period) imposed by permit conditions that are more stringent than the current Tier 2 limit in San Joaquin's Rule 4354. However, the Tier 3 limit effective in 2014 (1.5 lb/ton, 30-day average) is more strict than the permit conditions for these two furnaces.

Because San Joaquin has adopted "Tier 3" NO_x emission rate limits that are significantly stricter than those in BAAQMD Rule 9-12 or in the permit conditions applicable to Plant 30, further emission reductions at Plant 30 may be able to be obtained. The 2005 Base Year inventory for the source category "glass melting furnaces - natural gas" included 1.42 ton/day of NO_x.

San Joaquin's Tier 3 standard represents a 43 percent reduction in NO_x emissions compared to the weighted average emission rate (2.65 lb NO_x/ton glass) at the three furnaces at Plant 30.

Implementation Actions:

The control measure will be implemented through amendments to Rule 9-12.

Emission Reductions:

Pollutants (tons per day)	2012	2020
NO _x	0	0.38

Emission Reduction Methodology:

TBD

Exposure Reduction:

TBD

Emission Reduction Trade-offs:

Depending on the technology selected, NO_x reductions may increase GHG emissions, specifically CO₂, by reducing efficiency of the process.

In some modeling scenarios, reduction of NO_x from a significant NO_x emitting source with high emission rates has been shown to impact the ozone scavenging effect of NO, resulting in higher ozone concentrations in areas within the source's emission plume.

Cost:

An oxy-fuel system or selective catalytic reduction are both viable options to reduce NO_x. The capital cost for either option is estimated to be approximately \$4 M, amortized to \$760,000 per year.

Co-benefits:

Reduction in secondary particulate formation

Monitoring Mechanisms:

Source tests and monitoring equipment will be used to enforce emission standards.

Issues/Impediments:

None identified.

1. **Sources:**

1. http://www.valleyair.org/Air_Quality_Plans/docs/AQ_Ozone_2007_Adopted/11%20Chapter%206%20April%202007.pdfhttp://www.valleyair.org/Air_Quality_Plans/docs/AQ_Ozone_2007_Adopted/26%20Appendix%20I%20April%202007.pdf
2. Workgroup Recommendations and Other Potential Control Measures Stationary Combustion Sources Workgroup – Glass/Fiberglass Furnaces, Subhash Shah, New Jersey Department of Environmental Protection, February 22, 2007.
http://www.state.nj.us/dep/baqp/rapt/wps/SCS007_fin2.pdf
3. BAAQMD. 1993. Staff Report, Regulation 9, Rule 12, Nitrogen Oxides from Glass Melting Furnaces.
4. SJVUAPCD. 2002. "Final Draft Staff Report, Amendments to Rule 4354 (Glass Melting Furnaces)." SJVUAPCD. Rule 4354.

SSM 15 - Greenhouse Gases in Permitting, Energy Efficiency

Brief Summary:

This control measure would mitigate increases in greenhouse gas (GHG) emissions from new and modified permitted sources, reviewing implementation of energy efficiency measures, where appropriate on new sources subject to the Air District's jurisdiction.

Purpose:

Reduce GHG emissions from new and modified permitted sources.

Source Category:

Stationary source.

Regulatory Context and Background:

Sources that require permits are evaluated according to the District's Permit Handbook and BACT/TBACT Workbook. Projects are ministerial for the purposes of CEQA if the specific procedures, fixed standards and objective measurements established in the Handbook and Workbook apply to the permit application. For larger sources, those for which there is no BACT established in practice for the specific source, the source would not be classified as ministerial and a CEQA evaluation is required.

When reviewing sources for permitting, District staff does not consider GHG emissions. Under existing federal, state and District guidelines, a new source is required to abate criteria pollutants to the maximum extent feasible consistent with other, like sources, or to install the most effective control technology that can be demonstrated to be cost effective.

Implementation Actions:

This control measure could be implemented in two ways. First, some larger projects that are currently considered ministerial could be made to undergo CEQA, specifically to consider mitigation of GHG emissions. This could be accomplished by a change in the Permit Handbook so that some discretion in the evaluation of these permits could be used. Examples of projects that would fall into this category are boilers, steam generators or process heaters with a rated heat input greater than a specified threshold amount.

Second, some ministerial projects could have certain energy efficiency-related measures imposed as standard permit conditions to minimize the amount of GHGs emitted. As an example, combustion devices such as boilers or internal combustion engines that operate at less than a certain size could be required to have a certain manufacturer's efficiency rating.

AB 32, adopted in 2006, requires CARB to adopt regulations to reduce emissions of GHGs from a variety of sources, both large and small. These include traditional stationary sources that have been regulated for emissions of criteria pollutants by air districts in California. In implementing AB 32, CARB may look at a variety of sources, but most attention will be paid

to existing sources of GHGs, as the emissions from these sources will have to be reduced to meet the mandates of the law. These include permitted stationary sources such as power plants and refineries, non-permitted stationary sources such as natural gas pipelines, and non-stationary sources such as automobiles. CARB is further required to prioritize sources so as to address the largest GHG emissions first. However, the air districts have permitting authority over stationary sources in California, and, consequently, are best positioned to reduce GHG from new sources at permitted facilities during permit review. Staff can structure any permitting requirements for GHG so that they complement CARB programs, including allowing credit for cap-and-trade or other market-based programs.

Emission Reductions:

Undetermined. This control measure would not reduce existing emissions. It would, like new source review provisions, mitigate increases in GHG emissions from new and modified plants and equipment. As existing equipment ages and is replaced, or new facilities are built, this control measure could help reduce GHGs that would otherwise be emitted. As the control measure could apply across many of the permitted sources required to obtain District permits, it is impossible to estimate the amount of emissions subject to control.

Emission Reduction Methodology:

TBD

Exposure Reduction:

TBD

Emission Reduction Trade-offs:

None identified.

Cost:

Increased efficiency as a permit condition may add costs to new equipment, but energy efficiency measures often pay for themselves within 5 years. Flexibility in permitting could reduce applicant costs while reducing GHGs.

Co-benefits:

The co-benefits of reducing GHG emissions are myriad, from reducing the likelihood of increased global temperatures, sea level rise, increased frequency and severity of storm activity, to impacts on water quality from increased salinity in the delta and damage to infrastructure from flooding. The development of energy efficiency technologies and equipment that controls criteria pollutant and TACs that does not produce secondary GHG emissions may spur green job creation. One possible means of reducing GHG emissions would be increased energy efficiency resulting in energy savings and reduced consumer costs in the long term. An additional benefit of energy efficiency for combustion equipment is the reduction of other combustion contaminants, such as SO₂ and PM.

Monitoring Mechanisms:

The success of this control measure would be monitored by examining the emission inventory for increases in criteria pollutants and TACs from permitted sources above what would be expected if this measure were not in place. GHG emissions from permitted sources are tracked as a result of the May 21, 2008 adoption of the GHG fee in Regulation 3, section 334. Trends in GHG emissions from permitted sources would be examined before and after adoption of this measure.

Issues/Impediments:

None identified.

Sources:

1. BAAQMD Permit Handbook:
http://www.baaqmd.gov/pmt/handbook/rev02/permit_handbook.htm
2. BAAQMD Regulations 2-2, and 2-5:
<http://www.baaqmd.gov/dst/regulations/index.htm>

SSM 16 - New Source Review Addressing PM2.5

Brief Summary:

This control measure would amend Regulation 2, Rule 2 to address the District's anticipated non-attainment status of the 24-hour PM2.5 National Ambient Air Quality Standard. In addition, more stringent standards may be considered for sources located in areas of sensitive populations as determined by the Community Air Risk Evaluation (CARE) program.

Purpose:

Reduce emissions of PM2.5 from new and modified permitted sources and to address the cumulative air quality impacts of stationary sources on sensitive receptors and impacted communities.

Source Category:

Stationary source.

Regulatory Context and Background:

Existing District rules require that permit applications be submitted for a wide variety of new and modified stationary sources prior to construction so that District staff can complete a review of compliance with applicable air quality requirements. Applicable air quality requirements include rules and regulations adopted by the District, the California Air Resources Board, and the U.S. Environmental Protection Agency. New Source Review (NSR) rules require that new and modified sources utilize the Best Available Control Technology to minimize air pollution impacts. Additional NSR requirements include emission offsets, air quality impact analysis for criteria air pollutants and their precursors, and health risk screening analysis for toxic air contaminants (TACs). The existing District NSR rules are Regulation 2, Rule 2: New Source Review, and Regulation 2, Rule 5: New Source Review of Toxic Air Contaminants.

The Community Air Risk Evaluation (CARE) Program was initiated in 2004 to evaluate and reduce health risks associated with exposures to outdoor toxic air contaminants (TACs) in the Bay Area. The program examines cumulative TAC emissions from point sources, area sources and on-road and off-road mobile sources. District risk reduction activities will be focused on priority communities that have been identified based on sources of TAC emissions, modeled exposure of sensitive populations, and socioeconomic factors.

US EPA designated the Bay Area as a non-attainment area for the national 24-hour PM2.5 standard in December 2009. As a result the Bay Area will need to prepare a PM2.5 SIP plan. We also anticipate that the Air District will need to amend Regulation 2, Rule 2 regarding NSR to reduce emissions of PM2.5 from permitted sources. At that time, District staff may consider whether more stringent permitting requirements should be established for sources of PM2.5 locating in priority communities.

Implementation Actions:

Prepare amendments to Regulation 2, Rule 2: New Source Review pursuant to EPA requirements. During this process, more stringent requirements for sources located in priority communities may be considered. Amendments to Regulation 2, Rule 5 resulting in more stringent permitting requirements for sources of TACs were adopted by the Air District Board of Directors in January, 2010 (see SSM 17). Lessons learned from this process will help implementation of similar requirements for sources of PM_{2.5} in Regulation 2, Rule 2.

Emission Reductions:

Undetermined. This control measure would reduce increases in PM_{2.5} emissions from new and modified plants and equipment. As existing equipment ages and is replaced, or new facilities are built, this control measure would help reduce PM_{2.5} that would otherwise be emitted. As the control measure could apply across many of the permitted sources required to obtain District permits, the amount of emissions subject to control and emission reductions have not been calculated at this time.

Emission Reduction Methodology:

TBD

Exposure Reduction:

TBD

Emission Reduction Trade-offs:

None expected, although a need to increase control equipment could result in greater electricity use, generating slightly more green house gas emissions.

Cost:

TBD

Co-benefits:

PM_{2.5} can contribute significantly to regional haze and reduction of visibility. A particle of 2.5 microns or less in diameter is also a particle of 10 microns or less in diameter. In other words, PM_{2.5} is a subset of PM₁₀, so a reduction in the former will result in a reduction in the latter.

Monitoring Mechanisms:

The success of this control measure would be monitored by examining the emission inventory for increases in criteria pollutants and TACs from permitted sources above what would be expected if this measure were not in place. In particular, trends in PM_{2.5} from permitted sources would be examined before and after adoption of this measure. Ongoing monitoring of impacted communities as part of the CARE program also will help gauge the success of this measure.

Issues/Impediments:

Amendments to Regulation 2, Rule 2 to address PM_{2.5} in general are unlikely to face significant opposition. However, if more stringent rules or requirements are proposed for sources in impacted communities, this would be likely to raise concerns in the regulated community.

Sources:

3. BAAQMD Permit Handbook:
http://www.baaqmd.gov/pmt/handbook/rev02/permit_handbook.htm
4. BAAQMD Regulations 2-2, and 2-5:
<http://www.baaqmd.gov/dst/regulations/index.htm>
5. Update on CARE Program and Associated Regulatory Initiatives, Memo to Stationary Source Committee from Jack Broadbent 6 July 2009
6. Draft Concept Paper, *More Stringent Permitting Requirements for Proposed New/modified Stationary Sources of Air Pollution Located in Impacted Communities or in Proximity to Sensitive Receptors*. February 23, 2009.
7. Brian Bateman, April 2009 Presentation given to the CARE Task Force.

SSM 17 - New Source Review for Toxic Air Contaminants

Brief Summary:

This measure describes amendments to District permitting requirements via Regulation 2, Rule 5, New Source Review of Toxic Air Contaminants (TACs), adopted by the Air District Board of Directors on January 6, 2010. For priority communities identified in the Air District's Community Risk Evaluation (CARE) Program, cumulative impacts will be addressed by tracking the toxicity-weighted emissions from all sources in the identified communities (see LUM 5). Incorporation of revisions to Cal/EPA's Environmental Health Hazard Assessment (OEHHA) methodologies into District Health Risk Screening Analysis Guidelines will result in more stringent standards for new and modified sources.

Purpose:

Reduce the cumulative air quality effects of TACs from new and modified stationary sources in the District and develop a periodic reporting mechanism to track toxic air contaminant emissions in CARE Priority Communities.

Source Category:

Stationary source.

Regulatory Context and Background:

Existing District rules require that permit applications be submitted for a wide variety of new and modified stationary sources prior to construction so that District staff can complete a review of compliance with applicable air quality requirements. Applicable air quality requirements include rules and regulations adopted by the District, the California Air Resources Board, and the U.S. Environmental Protection Agency. New Source Review (NSR) rules require that new and modified sources utilize the Best Available Control Technology to minimize air pollution impacts. Additional NSR requirements include emission offsets, air quality impact analysis for criteria air pollutants and their precursors, and health risk screening analysis for TACs. The existing District NSR rules are Regulation 2, Rule 2: New Source Review, and Regulation 2, Rule 5: New Source Review of Toxic Air Contaminants.

The requirements of Regulation 2, Rule 5 are based on the results of a site-specific Health Risk Screening Analysis (HRSA), which is an assessment that describes the possible adverse health effects that may result from public exposure to routine and predictable emissions of TACs. All permit applications for new and modified sources are screened for emissions of TACs. Where the predicted health risks from a proposed project exceed specified threshold levels, the new/modified source(s) must use the Best Available Control Technology to minimize TAC emissions (TBACT). The TBACT and Project Risk standards in Regulation 2, Rule 5 are uniformly applied throughout the District's jurisdiction.

Procedures used for completing HRSAs are based on guidelines adopted by Cal/EPA's Office of Environmental Health Hazard Assessment (OEHHA) for use in the Air Toxics Hot Spots Program. Procedures for assessing health risks are intended to protect sensitive individuals such as children, and individuals with pre-existing health conditions. The Children's Environmental Health Protection Act (Senate Bill 25) established specific requirements for OEHHA to determine whether existing health risk assessment procedures are adequate to protect infants and children from the harmful effects of air pollution. OEHHA has already acted under SB 25 to revise procedures for assessing non-cancer health risks to provide a greater margin of safety for children. Age Sensitivity Factors (ASFs) were adopted by OEHHA on June 1, 2009 to account for inherent increased susceptibility to carcinogens during infancy and childhood, and exposure assessment procedures are expected to be revised by mid-2010. These changes in exposure assessment procedures, when combined with ASFs, will increase estimates of residential cancer risk by a factor of 2 to 3 relative to existing procedures.

The Community Air Risk Evaluation (CARE) Program was initiated in 2004 to evaluate and reduce health risks associated with exposures to outdoor TACs in the Bay Area. The program examines cumulative TAC emissions from point sources, area sources and on-road and off-road mobile sources. Based on sources of TAC emissions, modeled exposure of sensitive populations, and socioeconomic factors, Priority Communities have been identified where District risk reduction activities will be focused.

Implementation Actions:

On January 6, 2010, the Air District Board of Directors adopted amendments to Regulation 2, Rule 5: New Source Review of Toxic Air Contaminants. The amendments incorporate the latest OEHHA health risk assessment methodologies into Health Risk Screening Analyses completed for proposed new/modified permitted sources. These amendments effectively increase the stringency of the standards of Regulation 2, Rule 5. Incorporation of ASFs increases the stringency of cancer risk standards by a factor of 1.7. Incorporation of revised exposure assessment procedures, when combined with the use of ASFs, further increases the stringency of these standards by a factor of 2 to 3. Staff also proposes that cumulative emissions of toxic air contaminants be tracked in CARE communities on a toxicity-weighted basis and reported periodically, as further described in LUM 5.

Emission Reductions:

Undetermined. This control measure would reduce increases of TAC emissions from new and modified plants and equipment. As existing equipment is replaced, or new facilities are built, this control measure would reduce TACs that would otherwise be emitted. As the control measure could apply across many of the permitted sources required to obtain District permits, the amount of emissions subject to control and potential emission reductions have not been calculated at this time. The District will calculate and track emission reductions as the rule is implemented.

Emission Reduction Methodology:

TBD

Exposure Reduction:

TBD

Emission Reduction Trade-offs: None expected, although a need to increase control equipment could result in greater electricity use, generating slightly more greenhouse gas emissions.

Cost:

TBD

Co-benefits:

Reducing TAC emissions will likely result in reduced emissions of TOG, ROG, and possibly particulate matter.

Monitoring Mechanisms:

The District will track cumulative toxicity-weighted risk from affected facilities in Priority Communities along with other sources of emissions. Ongoing ambient monitoring of impacted communities as part of the CARE program also will help gauge the success of this measure.

Issues/Impediments:

On January 6, 2010, the Board of Directors adopted amendments to Regulation 2, Rule 5 including provisions to track cumulative impacts in CARE communities. However, the Board directed staff to evaluate the potential for setting different standards in the CARE communities for permit issuance under this rule.

Sources:

1. BAAQMD Permit Handbook:
http://www.baaqmd.gov/pmt/handbook/rev02/permit_handbook.htm
2. BAAQMD Regulations 2-5:
3. <http://www.baaqmd.gov/dst/regulations/index.htm>
4. Update on CARE Program and Associated Regulatory Initiatives, Memo to Stationary Source Committee from Jack Broadbent 6 July 2009
5. Brian Bateman, April 2009 Presentation given to the CARE Task Force.
6. Proposed Amendments to Regulation 2-5, Workshop Report, July 2009.
7. Brian Bateman, October 2009 Presentation given to the CARE Task Force
8. Update on Proposed Amendments to Regulation 2, Rule 5: New Source Review of Toxic Air Contaminants report to the Stationary Source Committee, October 19, 2009

SSM 18 - Revisions to Air Toxics Hotspots Program

Brief Summary:

Revise the District's Air Toxics Hot Spots program focusing on existing sources of toxic air contaminants.

Purpose:

Revise the District's Air Toxic Hotspots program focusing on existing sources of toxic air contaminants (TACs).

Source Category:

Stationary source.

Regulatory Context and Background:

Applicable air quality requirements related to controlling stationary sources include rules and regulations adopted by the District, the California Air Resources Board, and the U.S. Environmental Protection Agency. In California, air districts have the primary responsibility for controlling air pollution from non-vehicular stationary sources of air pollution. The Air District regulates stationary sources through rulemaking for specific source categories, through its permitting process and New Source Review for new and modified sources, and by administering the Air Toxics "Hot Spots" Program for existing sources.

The Air Toxics "Hot Spots" (ATHS) program is a state program implemented by California air districts. Assembly Bill 2588, the Air Toxics "Hot Spots" Information and Assessment Act, was enacted by the State legislature in 1987. AB 2588 requires companies throughout California to provide information to the public about emissions of TACs, and the impact that those emissions may have on public health. SB 1731, which provided the air districts with the authority to require facilities with significant risks to implement a site-specific risk reduction audit and plan, amended the Act in 1992. Each air district has the authority to establish health risk thresholds for public notification and risk reduction requirements.

The requirements of the ATHS program are based on the results of a site-specific Health Risk Screening Analysis (HRSAs), which is an assessment that describes the possible adverse health effects which may result from public exposure to routine and predictable emissions of TACs.

Procedures used for completing HRSAs are based on guidelines adopted by Cal/EPA's Office of Environmental Health Hazard Assessment (OEHHA). Procedures for assessing health risks are intended to protect sensitive individuals such as children, and individuals with pre-existing health conditions. The Children's Environmental Health Protection Act (Senate Bill 25) established specific requirements for OEHHA to determine whether existing health risk assessment procedures are adequate to protect infants and children from the harmful

effects of air pollution. As discussed in SSM 17, OEHHA has already acted under SB 25 to revise certain procedures for assessing non-cancer health risks to provide a greater margin of safety for children. OEHHA is currently in the process of revising its cancer risk assessment procedures.

Implementation Actions:

The District will revise its AHS program for existing facilities to incorporate more stringent risk reduction requirements than are provided in existing District policy. As was previously described, OEHHA is considering revising cancer risk assessment procedures to provide a greater margin of safety for protecting children. Based on discussions with OEHHA staff, it is possible that these revisions could increase calculated residential cancer risks by a factor of three or more relative to existing risk assessment procedures. Due to the potential significance of these revisions in risk assessment methodologies, the District believes that it is prudent to develop the District risk reduction rule concurrent with the OEHHA guideline revisions. OEHHA does not expect that these risk assessment guideline revisions will be finalized for some time, perhaps late in 2010.

Emission Reductions:

TBD

Emission Reduction Methodology:

TBD

Exposure Reduction:

TBD

Emission Reduction Trade-offs:

None expected.

Cost:

TBD

Co-benefits:

Reducing TAC emissions will likely result in reduced emissions of TOG, ROG, and possibly particulate matter.

Monitoring Mechanisms:

The success of this control measure would be monitored by examining the emission inventory for increases in criteria pollutants and TACs from permitted sources above what would be expected if this measure were not in place. Ongoing monitoring of impacted communities as part of the CARE program will help gauge the success of this measure.

Issues/Impediments:

The regulated community not already subject of the current AHS program may oppose more stringent thresholds for these requirements. Those sources already subject to the notification and risk reduction requirements may be opposed to increased restrictions as a result of lowering these thresholds.

Sources:

1. BAAQMD Permit Handbook:
http://www.baaqmd.gov/pmt/handbook/rev02/permit_handbook.htm
2. BAAQMD Regulations 2-5:
3. <http://www.baaqmd.gov/dst/regulations/index.htm>
4. Update on CARE Program and Associated Regulatory Initiatives, Memo to Stationary Source Committee from Jack Broadbent 6 July 2009
5. Draft Concept Paper, *More Stringent Permitting Requirements for Proposed New/modified Stationary Sources of Air Pollution Located in Impacted Communities or in Proximity to Sensitive Receptors*. February 23, 2009.
6. Brian Bateman, April 2009 Presentation given to the CARE Task Force.

BAY AREA 2010 CLEAN AIR PLAN

VOLUME II

Section B

Mobile Source Measures

September 2010



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MSM A-1 - Promote Clean, Fuel-Efficient Light and Medium-Duty Vehicles

Brief Summary:

The Air District, in cooperation with local businesses, city and county governments, and state and federal agencies, will expand the use of Super Ultra-low Emission (SULEV) and Partial-Zero (ZEV) emission light-duty passenger vehicles and trucks within the Bay Area. Emphasis will be placed on vehicles capable of using renewable, low-carbon fuels.

Purpose:

This measure will reduce emissions of ozone precursors, ROG and NOx, and CO₂, a key greenhouse gas. It will also support the renewable and low carbon fuel policies and rules established by the State of California, and implemented by the California Energy Commission and the California Air Resources Board.

Source Category:

Passenger Vehicles and Light-Duty Trucks.

Regulatory Context and Background:

The California Air Resources Board's Low Emission Vehicle standards require car manufacturers to meet increasingly more stringent emission standards for their vehicles. The Bay Area benefits from the LEV-II emission standards whenever a new vehicle replaces an old vehicle that is then scrapped. This measure will focus on accelerating these benefits by supporting early turn-over of the vehicle fleet.

Specifically, this measure will focus on the purchase of light-duty vehicles certified by CARB as meeting the Super Ultra Low Emission Vehicle or Partial Zero Emission Vehicle standards. The SULEV and PZEV standards represent the two cleanest standards for light duty vehicle using internal combustion engines. The SULEV standard was adopted by CARB as part of the LEV-II program and PZEV standards as part of the Zero Emission Vehicle regulation;; both standards apply to MY 2004 and newer vehicles. There is no distinct difference in criteria emissions between gasoline or alternative fuel vehicles rated as either a SULEV or PZEV. In November 2009, CARB staff released a white paper outlining potential changes to the Zero Emission Vehicle regulation. One potential change relevant to this control measure is the establishment of new MY 2014 light-duty vehicle emission standards using PZEVs as the baseline. CARB staff refers to this proposal as "LEV III – Criteria Pollutants." CARB is planning on bringing changes to both the Zero Emission Vehicle and the LEV-III regulations to their Board in November, 2010. The Air District will follow the development of the proposed modifications to both regulations, and may modify the goals of this control measure by increasing support for PZEV vehicles.

The State of California has adopted goals to increase the use of renewable transportation fuels, thereby decreasing petroleum importation and greenhouse gases. This measure

supports the statewide goals by making support for renewable-fuel vehicles a high priority for the District's grant programs.

On June 24, 2009, the President signed the *Consumer Assistance to Recycle and Save Act of 2009* into law. In response to the Act, the National Highway Traffic Safety Administration (NHTSA) established the Car Allowance Rebate Program (CARS). This is a \$3 billion government program that helps consumers buy or lease a more environmentally friendly vehicle from a participating dealer when they trade in a less fuel-efficient car or truck. Consumers receive a \$3,500 or \$4,500 discount from a car dealer when they trade in their old vehicle and purchase or lease a new one. While the program is designed to energize the economy by boosting auto sales and put safer, cleaner and more fuel-efficient vehicles on the nation's roadways, many of the eligible new vehicles are certified by CARB at either the SULEV or PZEV emissions levels. The program has been successful; however, the US Congress has not renewed the program for 2010. The Air District and its partners will advocate for continued involvement from the federal government in providing incentives for SULEV and PZEV vehicles.

Implementation Actions:

The BAAQMD and partner agencies will collaborate to:

- Provide incentives for the purchase of SULEV/PZEV or other vehicles.
- Target high-mileage vehicles for fleet turnover, such as delivery vehicles and taxis.
- Initiate and support demonstration projects of renewable fuels from 2010 – 2012, with the goal of wide-spread retail availability by 2020.
- Initiate and support demonstration projects for GHG efficient vehicles and PM emission controls for vehicles.
- Encourage federal participation in incentive programs for light duty vehicles.
- Continue public outreach and education on efficient driving habits and importance of vehicle maintenance for emission controls.

Goals for this measure are as follows:

- By 2012, place up to 10,000 renewable fuel SULEVs and up to 10,000 renewable fuel P-ZEVs into service, primarily in fleets;
- By 2020, place up to 100,000 renewable fuel SULEVs and up to 100,000 renewable fuel P-ZEVs into service, largely in fleets.

Emission Reductions:

This measure will result in the following annual emission reductions (in tons per day) by the end of 2012 and the end of 2020:

Emissions Reductions:

<u>Pollutants (tons per day)</u>	<u>2012</u>	<u>2020</u>
ROG	0.05	0.51
NO _x	0.03	0.29

PM ₁₀	0.01	0.20
CO ₂ -e	0.00	0.18

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: NH₃ (ammonia), benzene, 1,3 butadiene, formaldehyde, and acetaldehyde.

Emission Reduction Methodology:

Emission reductions have been estimated by comparing the incremental difference in emissions between a new vehicle meeting the fleet wide average under the LEV-II emissions standards and the zero mile maximum emission allowable emission rate for a new SULEV or PZEV vehicle. There are no appreciable difference in the emission rates of particulate matter between LEV-II compliant vehicles and SULEV or PZEV vehicles. Emission rates developed by CARB were used in this analysis. The new vehicles are assumed to average 12,000 miles of travel per year.

The estimation of reductions in CO₂ emissions is highly dependent upon the fuel type of the purchased vehicles. For the purposes of the current plan, it is assumed that 50% of the new vehicles will be fueled by ethanol obtained from a 80%/20% blend of California corn using the dry mill process and from crop and wood waste using cellulosic processes and 50% will be fueled by natural gas recovered from landfills and bio-digesters. Emission factors reflecting the full-fuel cycle developed by CARB for the Low Carbon Fuel Standard were used in this analysis. Vehicles were assumed to achieve an average fuel economy of 30 miles per gasoline gallon equivalent and consume the equivalent of 400 gasoline gallons per year in fuel.

Exposure Reduction:

To the extent that use of more fuel efficient vehicles or combustion of renewable fuels results in lower levels of toxic emissions from light and medium duty vehicles, exposure will be lessened.

Emission Reduction Trade-offs:

To avoid trade-offs, it will be important to avoid renewable fuels whose full life-cycle impact may result in increased emissions of any criteria pollutant or greenhouse gas.

Cost:

New gasoline and ethanol light duty vehicles certified to the SULEV and PZEV standards generally cost the same as other vehicles on the market. However, vehicles powered by an alternative fuel, such as natural gas, currently sell at a modest price premium. Additionally, an incentive is often required to induce vehicle owners to undertake early replacement of a vehicle. For this measure, it is assumed that an average subsidy of approximately \$2,500 per vehicle will be required to accelerate vehicle turnover. The costs of this measure are assumed then to be:

Phase 1: \$50 million

Phase 2: \$450 million

It is anticipated that the District will provide up to \$6 million per year on average towards the accelerated purchase of qualifying vehicles. Additional incentives funds will need to come from state and federal incentive programs, tax refunds and rebates, and private sources.

This control measure focuses only on the purchase and deployment of cleaner vehicles; no costs estimates are provide here for necessary infrastructure. The availability of public and private financing for the development of refueling equipment, especially for locally produced, renewable fuels will need to be considered during the implementation phases of this measure.

Monitoring Mechanisms:

- Vehicle registration data from the Department of Motor Vehicles.
- Fuel sales data from the Franchise Tax Board.
- Progress and Final reports from any Air District grants or incentives.
- Progress and Final reports made available from the Environmental Protection Agency, the Department of Energy, the US Department of Transportation, the CEC and CARB for their alternative fuel, technology advancement and climate change programs.

Issues/Impediments:

- Funding for vehicle subsidies.
- Limited availability of SULEV and PZEV vehicles capable of using renewable, low-carbon fuels.
- Limited availability of renewable, low-carbon fuels.
- Local permitting of bio-refineries.

Sources:

1. California Air Resources Board, (CARB), Low –Emission Vehicle Program, <http://www.arb.ca.gov/msprog/levprog/levprog.htm>
2. CARB, Title 17, California Code of Regulations Section 95480 *et seq.*
3. CARB, *Resolution 09-31* (Low Carbon Fuel Standard), April 23, 2009. <http://www.arb.ca.gov/regact/2009/lcfs09/res0931.pdf>
4. CARB, *Proposed Regulation to Implement the Low Carbon Fuel Standard: Volume 1: Staff Report: Initial Statement of Reason*, March 5, 2009.
5. CARB, *Proposed Environmental Analysis Work plan for the California Low Carbon Fuel Standard*, 2009. http://www.arb.ca.gov/fuels/lcfs/120208lcfs_environ.pdf
6. CARB, *Preliminary Discussion Paper – Amendments to California’s Low-Emission Vehicle Regulations for Criteria Pollutants – LEVIII*, February 8, 2010. http://www.arb.ca.gov/msprog/levprog/leviii/meetings/030210/lev_iii_discussion_paper_2-10.pdf

7. California Energy Commission, [*FINAL Adopted State Alternative Fuels Plan*](#), December 5, 2007, Publication #CEC-600-2007-011-CMF.
8. California Energy Commission, [*Alternative and Renewable Fuel and Vehicle Technology Program Regulations*](#), May 7, 2008, Publication # CEC-600-2008-013-F.
9. California Energy Commission, Final Regulation Language Alternative and Renewable Fuels and Technologies Program, Title 20, CCR, SECTIONS 3100 – 3108, January 2, 2009.
10. California Energy Commission, [*Investment Plan for the Alternative and Renewable Fuels and Technologies Program*](#), April 2009. Publication #CEC-600-2009-008-CTF.
11. Department of Transportation, National Highway Traffic Safety Administration, *Car Allowance Rebate System (CARS)*, <http://www.cars.gov/>

MSM A-2 - Zero Emission Vehicles (ZEV) and Plug-in Hybrids

Brief Summary:

The Air District, in cooperation with local businesses, city and county governments, and state and federal agencies, will expand the use of Zero Emission (ZEV) and Plug-in Hybrid (PHEV) passenger vehicles and light-duty trucks within the Bay Area.

Purpose:

This measure will reduce ozone precursors and greenhouse gases.

Source Category:

On-Road Motor Vehicles: Passenger Cars/Light Duty Trucks

Regulatory Context and Background:

In September 1990, ARB adopted a low-emission vehicle regulation whose aim is to drastically reduce pollution from passenger cars and light-duty trucks. As part of the newly created program, the Board included a goal of requiring large auto manufacturers to commercialize vehicles with zero emissions, beginning with 1998 model-year vehicles. The original ZEV program required that 10 percent of new vehicle sales by large manufacturers have zero emissions, starting with 1998 models. The Board modified the program in 1998 and 2001 to allow up to 60 percent of the requirement to be met with vehicles having extremely low emissions and other specific attributes. In 2009 up to 85 percent of the requirements may be met with these vehicles. Vehicles meeting these standards are referred to as “partial zero emission vehicles” (PZEV) and “advanced technology partial zero emission vehicles” (AT-PZEV).

Manufacturers originally planned to meet the ZEV requirements with battery electric vehicles. In 1996, due to cost and performance issues, the ARB eliminated the early (1998) requirements to allow additional time for battery research and development. To ensure a significant market for advanced battery manufacturers, the ARB entered into agreements with manufacturers to place in California roughly 1,800 advanced-battery electric vehicles between 1998 and 2000. The agreements were designed to provide battery developers with the necessary initial production volumes to meet the cost and performance goals needed for commercial production.

CARB’s most recent amendments to the ZEV program in 2008 increased the percentage of ZEVs required in 2012 to 11 percent , with manufacturers being provided additional flexibility to meet their regulatory obligations through sale of plug-in hybrid vehicles and fuel cell vehicles. The ZEV requirement has been implemented by CARB to catalyze efforts to commercialize sustainable transportation. The program has prompted manufacturers to develop extremely clean gasoline, alternative fuel and hybrid electric vehicles. There are currently twenty-one auto manufacturers subject to the ZEV regulation. Six are defined as

large volume manufacturers: General Motors, Toyota, Ford, Honda, Chrysler and Nissan. The remaining 15 are intermediate volume manufacturers.

In November 2009, CARB staff released a white paper outlining potential changes to the Zero Emission Vehicle regulation that may be considered by the Air Resources Board. One potential change relevant to this control measure is the establishment of new Green House Gas light-duty vehicle emission standards using AT-PZEVs as the baseline. CARB staff refers to this proposal as “LEV III – Green House Gas.” CARB is planning on bringing changes to both the ZEV and the Low Emission Vehicle regulations to their Board in November, 2010. The Air District will follow the development of the proposed modifications to both regulations, and may modify the goals of this control measure by increasing support for battery electric and fuel cell vehicles.

Implementation Actions:

- Commit motor vehicle grant registration funds towards qualifying vehicle purchases and infrastructure development subsidies.
- Partner with private, local, state and federal programs to promote the purchase of battery-electric and plug-in hybrid electric vehicles.
- Partner with private, local, state and federal programs to install and expand public charging infrastructure. Promote existing charging infrastructure. (In August 2010, the Air District allocated \$5 million for installation of electric vehicle charging stations in the Bay Area.)
- Support research programs advancing technology for plug-in hybrid, battery electric and hydrogen-fueled vehicles.
- Advocate for increased government subsidies and research programs with local businesses, non-profits and governments through the Bay Area Electric Vehicle Initiative.
- Support the use of renewable electricity in both ZEVs and PHEVs, with additional support for low carbon, renewable fuels in the onboard internal combustion engines in PHEVs.

Goals for this measure are as follows:

- By 2012, place 1,000 ZEVs and 5,000 PHEVs into service, primarily in fleets;
- By 2012, expand regional recharging network with 500 new charging stations;
- By 2020, place 10,000 ZEVs and 100,000 PHEVs into service;
- By 2020, expand regional recharging network with 2,000 new charging stations.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.01	0.18
NO _x	0.01	0.13
PM ₁₀	0.01	0.02
PM _{2.5}	0.00	0.01

C02-e	0.00	0.30

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: NH₃ (ammonia), benzene, 1,3 butadiene, formaldehyde, and acetaldehyde.

Emission Reduction Methodology:

Emission reductions were calculated by assuming that each ZEV and PHEV is in lieu of an average brand new gasoline powered vehicle. For zero emission vehicles, the emission reductions are calculated as the difference between new vehicle emissions and zero emissions in the years 2012 and 2020.

For plug-in hybrid vehicles, it is assumed that the vehicles operate in electric mode for 50% of the annual VMT, or 6,000 miles, and that 75% of the electric power derives from grid supplied electricity stored in batteries, while the remaining 25% of the electricity comes from burning gasoline in the vehicle engine.

Exposure Reduction:

Reduction in the use of gasoline will also reduce public exposure to air toxics, particularly in communities near heavily traveled roads and freeways.

Emission Reduction Trade-offs:

This measure will not increase emissions of any pollutant from motor vehicles; however, to the extent that it helps to increase the number of ZEVs and PHEVs in use within the Bay Area, it may slightly increase emissions of criteria pollutants and greenhouse gases from power plants that generate the required electricity.

Cost:

Cost for the measure is determined by the marginal cost for the cleaner ZEVs and PHEVs over a standard car, plus infrastructure costs. Based on the Air District's 2009 application for federal stimulus funding from the Department of Energy, the marginal or incremental vehicle costs are \$12,000 per vehicle and infrastructure is \$19,000 per recharging unit on average. Costs to implement are estimated to be:

Phase 1:	Vehicle Costs	\$72 million
	Infrastructure	\$9.5 million
Phase 2:	Vehicle Costs	\$53 million
	Infrastructure	\$19 million

It is anticipated that the District will provide up to \$6 million per year on average towards the accelerated purchase of qualifying vehicles. Additional incentives funds will need to come from state and federal incentive programs, tax refunds and rebates, and private sources. It is likely that public fleet orders will comprise the bulk of the purchases during the 2010 to 2012 period.

Co-benefits:

The expanded use of newer, cleaner electric powered cars will reduce water pollution and decrease reliance on crude oil for transportation fuel. Benefits of “green” job creation are dependent on commitments to manufacture compliant vehicles within the Bay Area.

Monitoring Mechanisms:

This measure can be monitored via annual vehicle registration data compiled by the DMV, as well as tracking any grant contracts for incentive funding paid out by the Air District.

Issues/Impediments:

- Funding for vehicle subsidies
- Limited availability of ZEV and Plug-in Hybrid vehicles.
- Vehicle price and ongoing maintenance costs
- Battery Technology

Sources:

1. BAAQMD, *Grant Application, U.S. Department of Energy (DOE), National Energy Technology Laboratory, Funding Opportunity: Clean Cities FY09 Petroleum Reduction Technologies Projects for the Transportation Sector, Area Interest #4; Funding Opportunity Number DE-PS26-09NT01236-04; CFDA Number 81.086*. June 2009
2. CARB, *Status Report on the California Air Resources Board’s Zero Emission Vehicle Program*, April 20, 2007
3. CARB, *Status and Prospects for Zero Emission Vehicle Technology: Report of the ARB Independent Expert Panel 2007*, April 13, 2007.
4. CARB, *Preliminary Summary of Air Resources Board Action (3/27/08) – Zero Emission Vehicle (ZEV) Program*, April 2008.
5. CARB, *California Hydrogen Highway Network: 2008 Report to the Legislature*, January 2009.
6. CARB, *White Paper: Summary of Staff’s Preliminary Assessment of the Need for Revisions to the Zero Emission Vehicle Regulation*, November 25, 2009.
7. CARB, Staff Presentation: Workshop to Discuss Potential Modifications to the Zero Emission Vehicle (ZEV) Regulation, May 3, 2010, Sacramento, California.
8. For a list of existing public EV charging stations in the Bay Area, see <http://www.evchargermaps.com/>.

MSM A-3 - Green Fleets

Brief Summary:

This control measure consists of three elements: a) development of a green fleet certification as part of the ABAG Green Business Program; b) the promotion of best practices for green fleets through outreach to local governments and business groups, and through grant applicants to promote best practices; and c) potential revisions to the District's Transportation Fund for Clean Air (TFCA) and other grant programs to ensure funding is directed towards fleets meeting GHG performance standards.

Purpose:

This measure will further reduce ozone precursors and greenhouse gases, as well as particulate matter and PM precursors.

Source Categories/Travel Markets Affected:

On-Road Light, Medium, and Heavy-Duty Vehicles

Regulatory Context and Background:

There has been little experience to-date with regulatory efforts requiring cleaner, greener fleets. The South Coast AQMD adopted a number of fleet regulations including: Less-Polluting Street Sweepers, Clean On-Road Light- and Medium-Duty Public Fleet Vehicles, Clean On-Road Transit Buses, Clean On-Road Residential and Commercial Refuse Collection Vehicles, Commercial Airport Ground Access Vehicles (Taxicabs, Shuttles, etc.), Clean On-Road School Buses, and Clean On-Road Heavy-Duty Public Fleet Vehicles. These regulations apply to public and private fleets and require the purchase of mostly natural gas powered vehicles. ARB has a number of recently adopted regulations targeting fleet turnover, clean-up of heavy duty trucks, and truck hybridization research programs.

With regards to voluntary efforts, the federal EPA has promoted its SmartWay program as means for reducing energy usage from long-haul trucking operations. ABAG has a Bay Area-wide Green Business Program which uses a checklist for businesses/agencies to complete. ABAG has customized checklists for businesses, such as hotels, printers, and offices. San Francisco uses a customized Green Business checklist with several vehicle related requirements for businesses. Puget Sound Clean Air Agency has an entire website, <http://www.psgreenfleets.org/>, devoted to assisting agencies and businesses in creating a green fleet. The website contains grant/incentives resources, a green fleet calculator, and regulatory updates.

Implementation Actions:

Green Fleet Certification – The Air District will coordinate with the ABAG/Bay Area Green Business program to explore development of a “green fleet” certification. The Air District and ABAG will encourage public agencies and the private sector to contract with certified green fleets, and with other certified businesses that implement green fleet practices.

Promote best practices – Green fleet best practices include purchasing low emission vehicles, properly maintaining vehicles, minimizing fleet size, reducing reliance on petroleum based transportation fuels, increasing use of locally produced renewable fuels, and encouraging efficient driving habits. The green fleet toolkit developed by Sustainable Earth Initiatives with funding from the Air District’s Climate Protection Grant Program, and the San Francisco Department of Environment’s Green Fleet calculator represent excellent examples of best practices to promote.

Incentives/Grants Strategy – Track and assist public agencies in “greening” their fleets. Performance standards for cleaner burning and GHG efficient vehicles may be established for the Air District’s grant programs based on ARB’s GHG vehicle labeling program and green fleet best practices. The Air District and its partners may utilize the EPA SmartWay program as a source for establishing performance standards for heavy-duty trucks.

Emission Reductions:

<u>Pollutants (tons per day)</u>	<u>2012</u>	<u>2020</u>
ROG	0.02	0.08
NO _x	0.02	0.10
PM ₁₀	0.03	0.07
PM _{2.5}	0.02	0.05
CO ₂ -e	0.00	0.33

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: NH₃ (ammonia), benzene, 1,3 butadiene, formaldehyde, and acetaldehyde.

Emission Reduction Methodology:

Overall, the Air District will aim to achieve emission reductions from fleets in three ways: increase the use of alternative fuels, increase the use of fuel efficient light duty vehicles, and reduced VMT.

For the purposes of calculating potential benefits under the measure, the Air District will work towards the following goals:

2012

- 1,000 diesel trucks begin using a 20% biodiesel fuel blend.
- 400,000 gallons of gasoline fuel saved from the use of more fuel efficient light-duty vehicles.
- 12 million fewer miles driven by light-duty fleet vehicles.

2020

- 5,000 diesel trucks begin using a 20% biodiesel fuel blend.

- 2 million gallons of gasoline fuel saved from the use of more fuel efficient light-duty vehicles.
- 60 million fewer miles driven by light-duty fleet vehicles.

The increased use of biodiesel will contribute to the reduction of PM2.5 and CO2, while the use of more efficient vehicles and the reduction in VMT will reduce NOx, ROG, PM2.5, PM10 and CO2. Emission factors are derived from work by CARB on the low carbon fuel standard and LEV-II program. It is assumed that heavy-duty trucks switching to biodiesel on average are driven 25,000 miles per year with a fuel economy of 5 miles per gallon (mpg). It was also assumed that gasoline savings by improving vehicle fuel economy from 20 mpg to 30 mpg.

Exposure Reduction:

The adoption of “green” practices by automotive fleet operators will reduce gasoline and diesel usage, which in turn will lower exposure to toxic compounds emitted by light duty gasoline vehicles and medium- and heavy-duty diesel trucks.

Emission Reduction Trade-offs:

None. Adoption of green fleet practices should lead to the reduction of all emissions.

Cost:

The development of a green fleet certification element to the Bay Area Green Business program is estimated to cost \$250,000 in staff and consultant fees. The promotion of the Green Fleets Toolkit is estimated to cost \$300,000 annually in staff, material and advertising.

Co-benefits:

Promoting a Green Fleets program will help to reduce water and noise pollution. This measure should also reduce petroleum usage in the Bay Area.

Monitoring Mechanisms:

- The annual level of effort by Air District and ABAG Staff to promote Green Fleet best practices.
- The annual increase in fleets making use of the Green Fleets Toolkit.
- Development of green fleet standards and a checklist of robust green vehicle requirements for the Bay Area Green Business certification program.

Issues/Impediments:

The main issues are the availability of resources to implement a Green Fleet certification component of the ABAG/Bay Area Green Business Program, as well as promote “best practices” to fleet operators; and interest/acceptance by fleet operators in changing from current practices.

Sources:

1. Association of Bay Area Governments, *Bay Area Green Business Program*, online at <http://www.greenbiz.ca.gov/>
2. The Sustainable Earth Initiative, et al., *San Francisco Bay Area Green Fleets Toolkit*, February 2009. Available at http://www.sfenvironment.org/downloads/library/clean_fleets_toolkit_greening_commercial_fleet.pdf
3. CARB, *Subarticle 1, sections 95300 to 95312, title 17, California Code of Regulations*
4. CARB, *Heavy Duty Vehicle Greenhouse Gas Emission Reduction Measure*, 2009, <http://www.arb.ca.gov/cc/hdghg/hdghg.htm>
5. CARB, *Proposed Regulation to Implement the Low Carbon Fuel Standard: Volume 1: Staff Report: Initial Statement of Reason*, March 5, 2009.
6. CARB, *Detailed California-Modified GREET Pathway for Ultra Low Sulfur Diesel (ULSD) from Average Crude Refined in California*, April 22, 2008.
7. CARB, *Detailed California-Modified GREET Pathway for Biodiesel Produced in California from Used Cooking Oil*, July 20, 2009.
8. EPA, SmartWay Program, <http://www.epa.gov/smartway/>

MSM A-4 - Replacement or Repair of High-Emission Vehicles

Brief Summary:

This control measure proposes enhancements to three long-running programs to control emissions from in-use light-duty motor vehicles: the Air District's Vehicle Buy Back and Smoking Vehicle Assistance Program, and the State's Smog Check program.

Purpose:

The purpose of this measure is to reduce ozone precursors, PM, air toxics, and greenhouse gases from high-emitting vehicles by accelerating the replacement or repair of such vehicles.

Source Category/Travel Market Affected:

On-Road Motor Vehicles Passenger Cars & Light-Duty Trucks

Regulatory Context and Background:

Late-model vehicles that are equipped with recent emission control technologies and properly maintained emit very little ozone precursors or PM. By contrast, older vehicles, or vehicles that are not properly maintained, can emit pollutants at a much higher rate. There are approximately 325,000 pre-1989 model year vehicles on the road in the Bay Area. Although they account for only about 7% of the total vehicle fleet, these older vehicles have much higher emission rates, so that they account for a disproportionate share of total vehicle emissions. Accelerating the replacement or repair of high-emitting vehicles offers a cost-effective strategy to reduce emissions of criteria pollutants and air toxics. In addition, removing older vehicles can help to reduce emissions of CO₂.

Vehicle Buy-Back: The Air District has operated a Vehicle Buy-Back (VBB), or scrappage, program since 1996. VBB provides cash to vehicle owners to voluntarily retire old vehicles. Payment per vehicle initially was set at \$500; it increased in FY 2006/2007 to \$650; and again in 2009 to \$1,000. Funding has primarily come from the District's Transportation Fund for Clean Air. This program has led to the early retirement of more than 42,000 older, higher emitting vehicles. The average rate of retirement for the first 10 years of the program was 2,700 vehicles per year; this increased to an average of 7,800 vehicles in the most recent two years, the result of an increased budget and the higher per vehicle payout to vehicle owners and expanded model year eligibility. In February 2009, the Air District also expanded the program to cover model years (MY) 1988 and 1989 vehicles.

The District administers the VBB program based upon guidelines issued by the California Air Resources Board for its Voluntary Accelerated Light-Duty Vehicle Retirement (VAVR) Program. The ARB adopted revisions to the VAVR regulation on December 7, 2006, that incorporate the use of remote sensing devices (RSD) and other technologies to identify high emitting vehicles as possible candidates for voluntary retirement to generate additional emission reductions.

In 2007, the South Coast Air Quality Management District launched its High Emitter Repair or Scrap (HEROS) Program. The HEROS program initially explored the potential benefits of using remote sensing devices to identify gross polluting vehicles operating on local roads and highways, and then offering the vehicles owners cash to either repair or scrap their vehicles. The initial experience with the program has been positive, with the program being expanded in 2009.

Smoking Vehicle Assistance Program: The Air District's program to connect owners of older, polluting vehicles to repair and buy-back programs began in December 1992. Smoking vehicles are identified and reported to the Air District by Bay Area residents through the 1-800-EXHAUST phone line and the www.smokingvehiclehelp.org website. After a report is made, the Air District contacts the vehicle owner and encourages them to either have the vehicle repaired or retire it through the Vehicle Buy Back Program. Each year an average of 35,000 calls are received reporting vehicles emitting excessive visible exhaust.

Both the Bureau of Automotive Repair (BAR) and the Air District offer assistance programs to owners of older, polluting vehicles. For vehicles that have recently failed the biennial smog check inspection, BAR offers owners up to \$500 towards repairs or \$1,000 to retire their vehicle. For model year 1989 or older vehicles that have passed the biennial smog check, the Air District offers owners \$1,000 to retire their vehicle, as described in the Vehicle Buy-Back discussion above.

Smog Check: Motor vehicle emissions have been subject to controls since 1961, when California adopted a regulation that required new cars to have positive crankcase ventilation – the recycling of crankcase emissions back into the engine instead of the atmosphere. Since then, progressively tighter limits on exhaust have spurred the development of a variety of abatement equipment and systems.

In recognition that keeping the abatement equipment and systems operating at peak efficiency ensures the best results from the emissions controls, the Air District in 1980 proposed an inspection and maintenance program. This proposal eventually was adopted in modified form by the California State Legislature and Smog Check was begun in 1984. Enhancements to the program were adopted in 1996 and phased in to many parts of California, with the enhanced program begun in the Bay Area in 2003.

The Smog Check program is operated by the California Bureau of Automotive Repair, with advice from the California Air Resources Board. South Coast Air District required biennial test of motor vehicles to assure they meet applicable emission standards. The Inspection and Maintenance Review Committee monitors and recommends enhancements to South Coast's program.

In November 2008, the State of California's Inspection and Maintenance Review Committee published a draft report on the current status of the Smog Check program. In this draft

report, the Review Committee has made several useful suggestions for additional modifications and enhancements to the California Smog Check program. The recommendations in the report serve as the basis for the proposed advocacy plan in this control measure.

Implementation Actions:

The Vehicle Buy-Back, Smoking Vehicle Assistance, and Smog Check programs have all helped to improve air quality in the Bay Area. Nonetheless, high-emitting vehicles are still a major contributor to air quality problems. The Air District has recently developed a campaign to help strengthen awareness of and responsiveness to the VBB and Smoking Vehicle Assistance programs.

Vehicle Buy Back - The Air District will:

- Consider expanding its marketing of the program through targeted outreach in impacted communities defined through the CARE Program, advertising at Smog Check test sites, specialized or supplemental direct mail solicitation and advertising to owners of pre-1975 vehicles and smog-exempt vehicles, and through the District's Smoking Vehicle Assistance Program.
- Study the potential for including motorcycles in the District's Vehicle Buy Back program.
- Evaluate the possible benefits of offering a higher incentive for vehicles located in priority communities identified through the CARE program.
- Evaluate South Coast Air Quality Management District's experience with a vehicle repair program –\$500 for repairs to a vehicle's emission control systems – as an option for the Bay Area.

Smoking Vehicle Assistance Program - The Air District will:

- Continue operation of 1-800-EXHAUST phone line, the www.smokingvehiclehelp.org website, and advertisement campaign;
- Conduct an assessment of the program's effectiveness in reducing emissions. The assessment will consist of follow-up surveys of vehicle owners receiving complaint letters from the Air District; amend the program as warranted.
- Propose program enhancements or revisions as appropriate.

California Smog Check - The Air District will:

- Seek and/or support legislation to enhance the smog check program, e.g., require annual inspections of older model year and of high mileage vehicles, include testing for exhaust particulate matter (PM) in the program; add motorcycles to Smog Check;
- Consider offering incentives to encourage newer model and/or lower mileage vehicle owners to submit their vehicles for annual inspections;
- Consider replicating the SCAQMD's high emitter identification and repair program – HEROS.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	4.37	14.60
NO _x	2.06	6.90
PM ₁₀	0.03	0.10
PM _{2.5}	0.02	0.07
Benzene	0.09	1.30
1,3 Butadiene	0.02	0.28
Formaldehyde	0.06	0.93
Acetaldehyde	0.04	0.65
CO ₂ -e	44.14	147.14

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: NH₃ (ammonia).

Emission Reduction Methodology:

Emission reduction estimates for this measure are based on past performance of the Vehicle Buy Back and Smoking Vehicle Assistance Programs.

Estimates of potential benefits from adding motorcycles to the VBB program and implementing a HEROS style remote sensing and repair program are not included; such estimates will be developed as part of the District's review and consideration of these initiatives.

Exposure Reduction:

In general terms, harmful emissions are at their lowest when abatement equipment on a vehicle is well maintained and operating as designed. Programs that remove the oldest, most-polluting vehicles from operation reduce exposure to toxic air contaminants emitted by gasoline vehicles.

Emission Reduction Trade-offs:

Programs that require the destruction of old vehicles may lead to incremental increases in green house gases; that is, the energy required to destroy the old vehicles may not be offset by the generally higher fuel efficiency of new vehicles. Investigation of this potential trade-off will need to be undertaken during the implementation of this measure.

Cost:

Costs associated with increased frequency of testing under the Inspection & Maintenance program, or inclusion of motorcycles in the program, will be borne by the vehicle owners. There would be some costs to the State of California to update tracking and notification systems.

If the Air District decides to replicate the HEROS program, there will be costs involved in deploying remote sensing equipment to identify gross polluting vehicles, establishing systems for notifying vehicle owners, and the cost of repairing or scrapping vehicles. Costs

for this effort will be primarily borne by the Air District, although opportunities exist to utilize funds from private firms or other governmental programs.

The cost for the Vehicle Buy Back Program is \$1,000 per vehicle, plus overhead to the car scrapping companies that administer the program. At present, the Vehicle Buy Back Program is funded with Mobile Source Incentive Funds, Carl Moyer Program Funds, and the Air District's Transportation Fund for Clean Air.

The annual budget for the Smoking Vehicle Assistance Program is approximately \$1 million per year. Funding comes from the Air District's Transportation Fund for Clean Air.

Co-benefits:

Repairing or scrapping gross polluting vehicles will reduce energy consumption, reduce consumer costs, and avoid water pollution (storm water runoff). The expansion of the Smog Check program to annual inspections and inspections of motorcycles, as well as the implementation of a HEROS type program, may lead to the creation of "green" jobs.

Monitoring Mechanisms:

California Smog Check - The primary means for monitoring progress on this measure will be through the California Legislature, and their effort to expand the Smog Check program.

Vehicle Buy Back and Smoking Vehicles - Monitoring will be accomplished through progress and final reports to the Board of Directors on the initiatives described above, through implementation plans, and budget requests for any expansion of the Vehicle Buy Back and Smoking Vehicle Assistance programs.

Expanded use of follow-up surveys for the Smoking Vehicle Assistance Program will allow the Air District to better assess the on-going need for the complaint line.

Issues/Impediments:

- Changes to the Smog Check program require legislative approval.
- An issue for the Smoking Vehicle Assistance Program is the declining incidence of vehicles operating with visible exhaust. Tighter emissions controls, higher mileage warranties, advanced engineering, and fleet turnover have all worked to reduce the likelihood for a vehicle to emit visible exhaust, unless there has been a major failure to an engine system.

Sources:

1. State of California, Inspections & Maintenance Review Committee, *IMRC 2008 Smog Check Review Report*, November 18, 2008.
http://www.imreview.ca.gov/reports/index_reports.shtml
2. State of California, Bureau of Automotive Repair, <http://www.smogcheck.ca.gov/>
3. South Coast Air Quality Management District, *High Emitter Repair or Scrap (HEROS) Program*, <http://www.aqmd.gov/news1/2007/remotesensingfactsheet.html>

4. Bay Area Air Quality Management District, various annual reports & staff reports on the VBB program.
5. South Coast Air Quality Management District, Final 2007 AQMP, Appendix IV-A, pp 148-155, 2007
6. State of California, Air Resources Board, Voluntary Accelerated Vehicle Regulations, <http://www.arb.ca.gov/msprog/avrp/avrpfaq.htm>

MSM B-1 - Fleet Modernization for Medium- and Heavy-Duty On-Road Vehicles

Brief Summary:

Between 2010 and 2015, the Air District will directly provide, and encourage other organizations to provide, incentives for the purchase of new trucks that meet the California Air Resources Board's 2010 emission standards for heavy-duty engines. This program is designed to assist truck owners/operators to replace pre-2003 heavy-duty diesel trucks (Class 7 and 8) with new diesel-fueled or natural gas-fueled trucks in advance of requirements of CARB's in-use truck regulation.

Purpose:

This measure will reduce ozone precursors and diesel particulate matter emissions.

Source Category/Travel Market Affected:

Medium and Heavy Duty On-Road Vehicles

Regulatory Context and Background:

Emissions from heavy duty trucks account for nearly 24% of NO_x emissions in the Bay Area; they are also a significant source of diesel PM. Since 1988, when the first emission standards for trucks came into effect, trucks have become significantly cleaner. Beginning with the model year (MY) 2010 standards adopted by both CARB and the federal EPA, truck emissions for both particulate matter and NO_x will be at near-zero levels.

However, because heavy-duty trucks are kept in service for many years and fleet turnover is slow, it can take a long-time to see the air quality benefits of the new engine standards. In 2008, to accelerate the replacement or retrofit of old trucks, CARB adopted a regulation that requires truck fleets to meet progressively more stringent limits as calculated on a fleet-average basis.

The benefits of the fleet-average regulation can be further accelerated by offering financial incentives to truck owners to replace an existing truck 3-5 years in advance of the regulatory requirements. The Air District currently offers incentives for the purchase of MY 2007 and newer trucks as part of the Carl Moyer Program and other grant programs.

Implementation Actions:

Between 2010 and 2015, the Air District will directly provide and/or work with other entities to provide incentives to accelerate the replacement of up to 5,000 heavy-duty on-road diesel engines in advance of requirements for the ARB in-use heavy-duty truck regulation. In order to maximize reductions in green house gases, priority will be given to the purchase of new trucks fueled by natural gas or locally produced bio-fuels.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.10	0.25
NO _x	5.00	12.5
PM ₁₀	0.11	0.28
PM _{2.5}	0.03	0.27
Formaldehyde	0.01	0.02
Acetaldehyde	0.02	0.04
CO ₂ -e	0.64	233.24

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: NH₃ (ammonia), Benzene, and 1,3 Butadiene.

Emission Reduction Methodology:

To estimate the emission reductions from the early replacement of heavy-duty diesel trucks, District staff assumed that on average a model year 2000 truck that travels 50,000 miles per year would be replaced by a model year 2010 CARB/EPA compliant truck. The emission reductions represent the difference in emission rates between the old and new trucks. We assumed that of the 5,000 truck replacements targeted under this measure, 3,000 of the new trucks would be fueled by natural gas. We also assumed that 2,000 truck replacements would occur by 2012, with the balance occurring by 2015. Benefits from the early replacement of the trucks would occur over a 3-5 year period.

Exposure Reduction:

This measure will accelerate the health benefits of an adopted CARB regulation by reducing exposure to diesel PM and by reducing NO_x emissions that contribute to regional ozone formation. Impacted communities near freeways and roads with significant truck traffic will benefit.

Emission Reduction Trade-offs:

Exhaust controls on diesel trucks meeting the MY 2010 standards may decrease fuel economy, thereby increasing CO₂ emissions.

Cost:

The cost to implement this measure will be determined primarily by the level of financial incentive that will be offered to fleet owners to encourage early compliance with the CARB truck regulations. The incentive amount will be determined during the development of the program. An existing fleet modernization program operated through the Carl Moyer Program provides approximately \$35,000 per heavy-duty truck.

Based on the current incentive levels, this measure will potentially cost \$175 million to implement. It is anticipated that the District will make available up to \$10 million per year in incentives for the purchase of new trucks between 2010 and 2015.

Co-benefits:

To the extent this measure is successful in replacing diesel trucks with natural gas or other alternative fuel trucks, there will be a reduction in petroleum usage in the Bay Area. Reductions in the use of petroleum will help reduce stationary source pollution and water pollution.

Monitoring Mechanisms:

The benefits of the program will be monitored via the contracts for the financial incentives. The District will track emission reductions.

Issues/Impediments:

This control measures sets forth enhancements for an existing program and should not give rise to any new obstacles, as long as funding for the incentives is secured.

Sources:

1. BAAQMD, Carl Moyer Incentive Program, www.baaqmd.gov
2. California Air Resources Board, *2008 Carl Moyer Guidelines*, Chapters III and IV, April 22, 2008

MSM B-2 - Low NO_x Retrofits in Heavy-Duty On-Road Vehicles

Brief Summary:

Between 2010 and 2015, the Air District will provide incentives to install CARB-verified abatement equipment to reduce NO_x emissions from existing on-road heavy-duty truck engines. Emphasis will be placed on bringing existing engines into early compliance with CARB's in-use truck regulation. The Air District will also continue to require software updates to engine control modules in model year (MY) 1993-1998 diesel trucks to reduce excess NO_x emissions as a condition of all heavy-duty vehicle retrofit grants. The Air District will work with CARB to evaluate the feasibility of installing or replacing catalytic convertors on gasoline powered heavy-duty vehicles.

Purpose:

This measure will reduce ozone precursors.

Source Category/Travel Market Affected:

Heavy Duty On-Road Vehicles

Regulatory Context and Background:

Electronic control of the operation of truck engines became commonplace in 1994. Electronics allow for more precise control of engine timing and fuel injection; this has provided significant reductions of NO_x and PM emissions. Electronic engine control has also opened up opportunities for integration of exhaust abatement devices, such as lean NO_x catalysts, NO_x absorbers, exhaust gas recirculation and selective catalytic reduction (SCR) systems. In fact, engine manufacturers will be using SCR systems extensively to comply with ARB's MY 2010 NO_x standard for new engines. The increasing availability of retrofit devices to reduce NO_x from existing engines provides an opportunity for the Bay Area to achieve benefits in advance of historical fleet turnover rates.

Low NO_x software upgrade is computer programming for electronic control modules in certain heavy-duty engines that reduces excess emissions of oxides of nitrogen (NO_x). The software upgrades were developed by the engine manufacturers as part of a legal settlement with the federal Environmental Protection Agency and ARB. Installing low NO_x software can reduce emissions from most model year 1993-1998 California-registered heavy-duty trucks, school buses, motor homes, and interstate vehicles that visit California, with engines manufactured by Caterpillar, Cummins, Detroit Diesel Corporation, Mack/Renault, Volvo and International. CARB's truck and bus regulation requires replacement of 1994-1999 model engines to reduce NO_x emissions by January 1, 2013.

Implementation Actions:

The Air District will either directly provide and/or work with other entities to provide cash incentives for the installation of retrofit devices that reduce NO_x emissions from 5,000 MY

1994-2006 engines between 2010 and 2015. Targeted technologies include, but are not limited to, exhaust gas recirculation systems and selective catalytic reduction devices. As a condition of grant incentives, the Air District will continue to require software upgrades to the engine control modules in any MY 1993-1998 on-road engines to install either diesel PM filters and/or NOx retrofit devices. The Air District will also encourage other providers of incentives to incorporate as similar requirement in their grant programs. The Air District will work with CARB to evaluate the feasibility of installing or replacing catalytic converters on gasoline powered heavy-duty vehicles.

Emission Reductions:

<u>Pollutants (tons per day)</u>	<u>2012</u>	<u>2020</u>
NO _x	0.99	2.98

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: ROG, PM₁₀, PM_{2.5}, NH₃ (ammonia), Benzene, Formaldehyde, Acetaldehyde, 1,3 Butadiene and CO₂-e.

Emission Reduction Methodology:

To estimate the emission reductions from the retrofit of heavy-duty diesel trucks, District staff assumed that on average a model year 2004 truck that travels 50,000 miles per year would be retrofitted with a CARB verified device that achieves sufficient NOx reductions to bring emission levels on par with a model year 2007 diesel engine. The emission reductions represent the difference in NOx emission rates between a MY 2004 and MY 2007 truck. We also assumed that 1,250 truck retrofits would occur by 2012, with the balance occurring by 2015. Benefits from the retrofit of the trucks would occur over a 3-5 year period.

Exposure Reduction:

Efforts to reduce NOx emissions from existing on-road engines will assist in reducing exposure to ozone and secondary particulate matter. Installation of catalytic converters on heavy-duty gasoline engines, if feasible, may reduce exposure to a number of toxic air pollutants present in the exhaust from gasoline engines.

Emission Reduction Trade-offs:

Both the installation of NOx retrofits and the upgrade of the engine control software may reduce the overall efficiency of existing engines, resulting in increases in greenhouse gases, primarily CO₂. Additionally, installation of selective catalytic reduction devices could increase emissions of ammonia.

Cost:

The retrofit of heavy duty diesel engines with NOx abatement equipment is estimated to cost \$30,000 per engine. District staff anticipates that about 75% of the retrofits will occur between 2013 and 2015 as fleets prepare to comply with NOx requirements in the ARB in-use truck engine regulation. Costs are estimated to be:

Phase 1: \$37.5 million

Phase 2: \$75 million

It is anticipated that the District will make available up to \$3-5 million per year in incentives for the retrofit of existing trucks between 2010 and 2015.

Co-benefits:

This control measure, by focusing on incentives to install retrofit devices, may result in an increase in “green” jobs in the Bay Area, largely at manufacturers of retrofit devices, local truck repair facilities, and diesel engine distributors.

Monitoring Mechanisms:

Progress and Final reports from any Air District grants or incentives.

Progress and Final reports made available from other incentive programs.

Annual reports submitted to ARB under the in-use, on-road truck regulation.

Issues/Impediments:

The main obstacles for this control measure are: a) durability and availability of NOx retrofit devices, and b) ability of retrofit devices to reduce NOx on existing levels to the EPA/CARB 2007 emissions standards.

Sources:

1. California Air Resources Board, Descriptions of various Level 3 Verified Emission Control Devices, <http://www.arb.ca.gov/diesel/verdev/level3/level3.htm>
2. California Air Resources Board, *Software Upgrade for Diesel Trucks*, <http://www.arb.ca.gov/msprog/hdsoftware/hdsoftware.htm>
3. Kubsh, Joe, Manufacturers of Emission Controls Association, *Diesel Retrofit Technologies for Combined Reductions of PM and NOx*, November 2008. Available online at <http://www.arb.ca.gov/diesel/verdev/wn/jkubsh.pdf>
4. Manufacturers of Emission Controls Association, *Emission Control Technologies for Heavy-Duty Trucks and Buses*, 2009. Available online at <http://www.meca.org/page.wv?section=Emission+Control+Technology&name=Trucks+%26+Buses>
5. Brodrick, C.J., et al., Urea-SCR System Demonstration and Evaluation for Heavy-Duty Diesel Trucks, UCTC No 493, The University of California Transportation Center, Berkeley, November 15, 1999. Available online at <http://www.uctc.net/papers/493.pdf>.
6. DieselNet, “Johnson Matthey demonstrating retrofit SCR System,” posted online on March 26, 2008: <http://www.dieselnet.com/news/2008/03jm.php>

MSM B-3 - Efficient Drive Trains

Brief Summary:

The Air District will either directly commit and/or work with partner agencies and companies to provide funding to underwrite development and demonstration of hybrid drive trains for medium- and heavy-duty vehicles.

As technologies become commercially available, the Air District will offer cash incentives to accelerate deployment of more efficient vehicles. The Air District will coordinate this effort with the CalStart Hybrid Truck User Group, the California Air Resources Board, the California Energy Commission and other air districts.

Purpose:

This measure will reduce ozone precursors, particulate matter and greenhouse gases.

Source Category/Travel Market Affected:

On-Road Medium and Heavy Duty Vehicles

Regulatory Context and Background:

Since 1988, heavy-duty truck engines have been progressively regulated to reduce harmful emissions of criteria pollutants, such as NO_x, PM and ROG. Until recently, however, little effort has been made to reduce greenhouse gas emissions. In response to higher fuel costs, and growing awareness of the need to reduce emissions of CO₂ from transportation sources, truck makers, truck owners, and government agencies have been increasing their efforts to develop more efficient drive-trains and power systems for trucks, focusing on electric vehicles, hybrid-electric and hydraulic systems.

In the Bay Area, the Napa Valley Unified School District has been testing a plug-in electric-diesel hybrid system in a school bus; Pacific Gas & Electric has been testing a diesel electric system in maintenance trucks, and others have proposed hybrid systems for transit buses, delivery vehicles and garbage trucks. Freightliner currently offers a diesel electric hybrid for its medium-heavy-duty chassis.

These promising efforts have been fostered largely through the collaborative Hybrid Truck Users Forum operated by the non-profit CalStart consortium. This control measure proposes to build on the existing work by directing financial incentives toward the various field demonstrations being currently operated or proposed by participants in the HTUF program.

Implementation Actions:

The Air District will either directly provide and/or work with partner agencies and companies to provide funding between 2010 and 2015 to underwrite development and demonstration of hybrid drive trains for medium- and heavy-duty vehicles.

As technologies become commercially available, the Air District will either directly and/or work with partner agencies and companies to offer financial incentives to accelerate deployment of more efficient vehicles. The goals for the measure are to place 1000 efficient medium- and heavy-duty trucks on the region's roadways by 2012 and 4000 additional vehicles by 2020.

The Air District will participate in these efforts with the CalStart Hybrid Truck User Forum, the California Air Resources Board, the California Energy Commission, other air districts, local private and public entities and truck manufacturers.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.01	0.05
NO _x	0.29	1.44
PM ₁₀	0.01	0.01
PM _{2.5}	0.01	0.01
CO ₂ -e	0.23	1.14

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: NH₃ (ammonia), Benzene, Formaldehyde, Acetaldehyde, and 1,3 Butadiene.

Emission Reduction Methodology:

To estimate the emission reductions from this measure, District staff has assumed that the efficient drive trains will result in a 30% reduction in fuel usage per truck. The baseline fuel economy is assumed to be 5.6 mpg. It is assumed that each truck will travel 50,000 miles per year. We also assumed that of the 5,000 truck replacements targeted under this measure, 1,000 will occur by 2012 and 4,000 additional trucks by 2020.

Exposure Reduction:

This control measure is focused on the reduction of greenhouse gases from trucks. However, technologies such as hybrid electric power systems that improve energy efficiency also further reduce criteria pollutants. Reductions in both diesel PM and NO_x will reduce exposure to toxic pollutants locally and ozone regionally.

Emission Reduction Trade-offs:

None. Improvements in energy efficiency will reduce all pollutants.

Cost:

There are two parts to the costs for this measure. First, there is an un-estimated amount of costs associated with the development of the hybrid technologies that will go into more efficient drive trains for medium- and heavy-duty vehicles. These costs will be borne by a

variety of private firms and federal, state and local government agencies. Second, there will be incremental costs associated with the purchase of the vehicles with the advanced drive trains. For the purposes of discussion, District staff has assumed the incremental costs will average \$20,000 per vehicle between 2010 and 2020.

Phase 1: \$20 million

Phase 2: \$60 million

The District anticipates making available up to \$3 million per year towards both the development and deployment of more efficient drive trains for medium- and heavy-duty vehicles, subject to availability of funding and approval of the District governing board.

Co-benefits:

Development and widespread usage of more energy efficient drive-trains and power systems for trucks will reduce water pollution, save fuel, and increase opportunities for “green” jobs. There is also the potential for reduced business and consumer costs, especially in light of rising petroleum fuel costs.

Monitoring Mechanisms:

Progress and Final reports from any Air District grants or incentives.

Progress and Final reports made available from the CEC and CARB for their alternative fuel, technology advancement and climate change programs.

Reports developed as part of the Calstart Hybrid Trucks Users Group’s efforts.

Progress and Final reports made available from the federal EPA, DOT and DOE.

Issues/Impediments:

As with all technology advancement efforts, obstacles for this measure revolve around feasibility, durability and cost of hybrid electric and hybrid hydraulic engine systems. However, since this measure is focused on research and development, any efforts to advance the development of more energy efficient systems will be an advantage.

Sources:

1. CalStart/Weststart, Hybrid Truck Users Forum,
<http://www.calstart.org/Projects/Hybrid-Truck-Users-Forum.aspx>
2. Van Amburg, Bill, CalStart, “Emerging Clean Fuel & Vehicle Technology Options for Fleets: How Fleets Can Prepare and Plan for Change,” presented to NAFA Conference, New Orleans, LA, April 27, 2009. Available online at
http://www.calstart.org/Libraries/Consulting/Emerging_Clean_Fuel_Vehicle_Technology_Options_for_Fleets.sflb.ashx
3. Lowe, Marcy et al., Center on Globalization Governance & Competitiveness, Manufacturing Climate Solutions, Carbon-Reducing Technologies and U.S. Jobs, Chapter 9, Hybrid Drivetrains for Medium- and Heavy-Duty Trucks, June 10, 2009. Available online at

- http://www.cggc.duke.edu/environment/climatesolutions/greeneconomy_Ch9_HybridDrivetrainsforTrucks.pdf
4. Kenworth Trucks brochure, "Kenworth T270 Class 6 and T370 class 7 Medium Duty HYBRID CONVENTIONAL," 2008.
<http://www.kenworth.com/brochures/T270T370Hybrid.pdf>
 5. Slezak, Lee, *Annual Progress Report for Advanced Vehicle Technology Analysis and Evaluation Activities and Heavy Vehicle Systems Optimization Program*, United States Department of Energy, Vehicle Technologies Program, 2009
 6. Department of Energy and 21st Century Truck Partnership, *Roadmap and Technical White Papers*, 21CTP-003, December 2006.
 7. ARB, "Hybrid Truck and Bus Incentive Program (HTIP) Development: Concepts for HTIP Implementation," January 13, 2009 AQIP Working Group.
http://www.arb.ca.gov/msprog/aqip/meetings/hyip_wg_discussion_paper_01_13_09.pdf

MSM C-1 - Construction and Farming Equipment

Brief Summary:

The Air District will work to reduce emissions from construction and farming equipment by pursuing the following strategies: a) expenditure of cash incentives between 2010 and 2020 to retrofit engines with diesel particulate filters or upgrade to equipment with electric, Tier III or Tier IV off-road engines; b) work with the California Air Resources Board, the California Energy Commission and others to develop more fuel-efficient off-road engines and drive-trains; and c) work with local communities, contractors, farmers and developers to encourage the use of renewable electricity and renewable fuels, such as biodiesel from local crops and waste fats and oils, in applicable equipment.

Purpose:

This measure will reduce ozone precursors, diesel particulate matter, and carbon dioxide.

Source Category/Travel Market Affected:

Farm and Construction Equipment

Regulatory Context and Background:

Construction and farming equipment contribute approximately 15% of the regional inventory of NO_x emissions, and 5% of PM_{2.5} emissions. Construction equipment is also a contributor to local exposure of diesel PM. Criteria pollutant emissions from the engines – which are primarily diesel – in construction and farming equipment are subject to control under regulations adopted by both California Air Resources Board and the federal Environmental Protection Agency.

The ARB's control of criteria pollutant emissions from off-road engines used in construction and farming equipment was authorized by the California Clean Air Act as codified in the Health and Safety Code sections 43013 and 43018. In 1992, ARB approved initial regulations to control exhaust emissions from heavy-duty off-road compression ignition (CI) engines 175 horsepower (130 kilowatts) and above. These initial standards are referred to as Tier I standards. In 1994, ARB approved the State Implementation Plan (SIP) for ozone containing measures calling for new state and national emission standards for off-road CI engines beginning in 2005.

U.S. EPA promulgated new emission standards for off-road engines in 1998, with ARB adopting parallel standards in 2000. The standards were progressive and phased in through two additional stages which are referred to as Tiers 2 and 3. In 2004, final Tier 4 emission standards were adopted; Tier 4 standards are scheduled to phase in for new engines between 2011 and 2014. The coordinated efforts of ARB, U.S. Environmental Protection Agency, and the engine manufacturers to introduce lower-emission off-road CI engines nationwide will result in substantial air quality benefits in California and the rest of the country.

However, recognizing that construction and farming equipment are long-lived, with existing engines remaining in service for many years, ARB adopted in 2007 a regulation to accelerate reductions of NO_x and diesel PM from existing off-road engines between 2012 and 2023 by requiring operators to either install abatement equipment, upgrade to Tier 3 and eventually Tier 4 engines, or to retire older equipment with Tier 1 and 2 engines.²

ARB's AB 32 Scoping Plan, adopted in 2008, identified a strategy for reducing CO₂ from a variety of sources in California, including construction and farming equipment. ARB's strategies include reducing the carbon content of diesel fuel; promoting alternative, renewable diesel fuels, and investigating ways of increasing fuel economy.

Implementation Actions:

This control measure will primarily focus on assisting fleets to achieve early compliance with the ARB in-use off-road engine control measure and supporting research efforts to develop and deploy more efficient engines and cleaner, renewable fuels for construction and farming equipment.

- Between 2010 and 2020 work to either directly and/or encourage partners to provide incentives for the early deployment of 1000 electric, Tier 3 and 4 off-road engines, as well as installation of 500 verified retrofit devices to control diesel PM. The interim goals for 2012 are 200 new engines and 100 retrofits.
- Between 2010 and 2015, coordinate with ARB and the CEC, as well as construction firms, farmers and others, to support field demonstrations of advanced technology for off-road engines and hybrid drive trains. Targeted technology should be those that reduce both criteria pollutants and greenhouse gases at the same time by focusing on fuel economy and renewable fuels.
- Between 2010 and 2015, provide support for the field demonstration of off-road equipment that runs on renewable electricity and diesel, with an emphasis placed on fuels that can be developed and produced locally.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.04	0.20
NO _x	0.72	3.60
PM ₁₀	0.02	0.09
PM _{2.5}	0.02	0.09

² At its April 22, 2010 meeting, the Air Resources Board directed their staff to develop amendments to the Off-Road In-use regulation to provide regulatory relief to construction firms hard-hit by the economic slump. The initial direction is for staff to provide compliance flexibility for diesel PM, while maintaining a 2014 deadline, and to relax requirements for reducing NO_x.

More information is available at <http://www.arb.ca.gov/msprog/ordiesel/documents/diesel2010may.pdf>

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: NH₃ (ammonia), Benzene, Formaldehyde, Acetaldehyde, and 1,3 Butadiene.

Emission Reduction Methodology:

To estimate emission reductions for this measure, District staff assumed that the typical projects over the next ten years will consist of the replacement of Tier 1 compliant off-road engines rated at 350 brake horse power-hour with new Tier 4 compliant engines. Each engine is assumed to operate 1,000 hours with an average load factor of 60%. Staff also assumed that for the 2020 goal one-half of the new engines will operate on biodiesel.

Exposure Reduction:

Efforts to reduce diesel PM will reduce exposure of residents and workers in the vicinity of construction sites and farms. Additionally, reduction of NO_x emissions will help reduce regional ozone levels/exposure, while reductions in both NO_x and diesel PM emissions will contribute to reductions in the directly emitted PM and formation of secondary PM, reducing overall population exposure to fine particulate matter.

Emission Reduction Trade-offs:

The installation of diesel PM filters and other abatement devices generally reduces fuel economy by approximately 3%, and therefore increases emissions of CO₂ by a corresponding amount.

Cost:

District staff assumes that the cost of this measure is equal to the incentive amount offered to get a fleet operator to replace a Tier 1 engine with a Tier 4 engine in advance of the CARB regulation. We estimate the average incentive to be \$50,000 per engine. We estimate diesel PM retrofit filters to cost \$20,000 per engine. Based on these assumptions, this measure will cost approximately:

Phase 1: \$12 million

Phase 2: \$41 million

It is anticipated that the District will make available up to \$3 million per year in incentives for the purchase of new electric, Tier 3 and Tier 4 engines, as well as the installation of verified diesel PM control devices between 2010 and 2020.

Co-benefits:

New engines for construction and farming equipment are incorporating better control of lubricating oils and unburned fuel droplets from crankcases, resulting in less oil leaking on the ground, thereby reducing harmful water pollution. The development of more energy efficient engines and drive-trains, as well as local development of renewable diesel should both result in energy savings and the creation of “green” jobs.

Monitoring Mechanisms:

- Equipment and engine information submitted to CARB as part of the off-road in-use ATCM.
- Progress and Final reports from Air District grants or incentives.
- Progress and Final reports made available from the CEC and CARB for their alternative fuel, technology advancement and climate change programs.

Issues/Impediments:

- Funding for engine subsidies.
- Interest from fleets in early compliance with CARB's off-road in-use engine air toxic control measure.
- Availability of diesel PM retrofits for construction and farm equipment.

Sources:

1. BAAQMD, Base Year 2005 Emissions Inventory: Summary Report, December 2008
2. BAAQMD, Base Year 2005 Emissions Inventory: Source Categories, December 2008
3. BAAQMD, Source Inventory of Bay Area Greenhouse Emissions, December 2008
4. State of California, Air Resources Board, *Staff Report: Initial Statement of Reasons for Proposed Rulemaking: Proposed Regulation for In-Use Off-Road Diesel Vehicles*, April 2007.
5. State of California, Code of Regulations, Title 13, Section 2449 et seq., 2009
6. State of California, Air Resources Board, Carl Moyer Program:
<http://www.arb.ca.gov/msprog/moyer/moyer.htm>

MSM C-2 - Reduce Emissions from Lawn and Garden Equipment

Brief Summary:

Use of gasoline lawn mowers and leaf blowers contribute to summertime ozone levels primarily through the release of ROG. While progressively more stringent emission standards have reduced pollution from lawnmowers and leaf blowers, sufficient numbers of older two-stroke and four stroke engines remain in use in the Bay Area to warrant Air District efforts to pursue a clean-up program. The Air District will pursue removal of these older engines through voluntary exchange programs that target residential lawn mowers and backpack-style leaf blowers used by professional gardeners and landscapers.

Purpose:

This measure will reduce ozone precursors, particulate matter, toxic air contaminants and greenhouse gases.

Source Category/Travel Market Affected:

Lawn, Garden & Utility Equipment: Gasoline Lawn Mowers and Leaf Blowers

Regulatory Context and Background:

The lawn, garden & utility equipment category is comprised of a wide variety of small engines used in lawn mowers, leaf blowers, chainsaws, trimmers, shredders, stump grinders, commercial turf equipment and other types of equipment that collectively account for slightly more than 5% of the total ROG inventory in the Bay Area. This equipment primarily uses gasoline engines, although there is some diesel and propane powered equipment. Electric powered equipment has begun to gain market share, particularly with lawnmowers, chainsaws, leaf blowers and other small equipment used by homeowners.

The gasoline engines on such small equipment were first regulated in 1995 by the Air Resources Board, with the newest, most stringent regulations becoming effective with the MY 2008 equipment. Staff currently estimates there to be 1.16 million lawnmowers and leaf blowers in the Bay Area, of which approximately 70,000 are two stroke lawnmowers and 258,000 are two-stroke leaf blowers. Two stroke engines generate significantly more air pollution, especially particulate matter, compared to four stroke engines. The Air District conducted lawn mower exchange programs between 1999 and 2006 by offering cash incentives to consumers to purchase electric or mechanical equipment. Residents exchanged slightly more than 7800 two- and four-stroke lawnmowers for new electrical and mechanical mowers. Estimated emission reductions from the program were 5.3 tons per year of ROG, NOx and PM, at an annualized cost-effectiveness of approximately \$7,800 per ton. The Air District expended \$780,000 to buy down the cost of the new lawnmowers for the participating homeowners, along with additional funds on administration and advertising by the then Public Information and Outreach Division (now the Communication and Outreach Division).

Funding for implementing lawn and garden equipment exchange programs was included in the AB 118 Air Quality Improvement Program (AQIP). The AQIP program is administered by CARB, with assistance from local air districts. The purpose of the AQIP Lawn and Garden Equipment Replacement Project is to encourage further development and deployment of cordless zero-emission lawn and garden equipment. Under this program, up to \$250 will be made available for each electric cordless residential lawn mower purchased by a qualified homeowner. In 2009, \$1.6 million was awarded to eight air districts; the Bay Area was not among the awardees. It is anticipated that additional AQIP funding will be available in 2010 and 2011.

The South Coast Air Quality Management District periodically conducts exchange programs for “backpack” style leaf blowers used by professional gardeners and landscapers. The program’s fourth round of exchanges was conducted in August 2009. Under this program, companies pre-register to exchange up to ten leaf blowers; for each old leaf blower turned in, the company can purchase a new low emission machine at a 50% to 60% discount.

Implementation Actions:

The Air District will:

- Re-establish its exchange program for replacing older gasoline lawnmowers with mechanical push and electrical lawnmowers. The program will target two-stroke engines as an initial priority prior to targeting pre-2008 four-stroke gasoline engines.
- Establish an exchange program for gasoline powered two-stroke “backpack” leaf blowers used by professional gardeners and landscapers.
- Explore options to expand the program to cover chainsaws, trimmers, shredders, stump grinders, commercial turf equipment and other types of lawn mowers. Expansion of the program will depend on the availability of significantly cleaner replacement equipment, costs, equipment turnover rates, and population size.

By 2012: Replace up to 3,000 lawn mowers and up to 5,000 leaf blowers

By 2020: Replace up to 10,000 lawn mowers and up to 50,000 leaf blowers

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.04	0.26
NO _x	0.01	0.01
PM ₁₀	0.01	0.07
PM _{2.5}	0.01	0.05
CO ₂ -e	0.00	0.64

Emission Reduction Methodology:

For this measure, District staff assumed that the typical project would consist of replacing an existing two-stroke 4 hp lawnmower or leaf blower with a new electric or mechanical push lawnmower or an electric or new Tier 3 compliant, four-stroke gasoline leaf blower. Emission factors were taken from the Air Resources Board OFFROAD2007 emissions model.

Exposure Reduction:

Older gasoline engines emit high levels of hydrocarbons, many species of which are listed as air toxics. Exchanging the older equipment with either electric or low-emission new engines will result in reductions in toxic emissions.

Emission Reduction Trade-offs:

This measure will reduce emissions of NO_x, ROG, CO, PM and CO₂, but because it replaces a piece of gasoline powered equipment with an electric powered equivalent, it will contribute to an incremental increase in electricity production, which may cause slight increases in emissions from power plants.

Cost:

The main cost of this measure is the discount for the new electric lawn mowers and leaf blowers that are provided to program participants. The cost of this program will be shared by the Air District, vendors and the equipment owner. The cost of an electric lawn mower ranges from \$200 to \$300; the cost of a mechanical push mower ranges from \$80 to \$140; the cost of an electric leaf blower ranges from \$30 to \$70. The Air District anticipates seeking up to \$2 million per year to fund this measure. In addition to direct cost for rebates on new equipment, additional costs would be incurred by the Air District to manage and advertise the program, and to ensure appropriate disposal of the older equipment that will be retired through the replacement program.

Co-benefits:

Use of push lawn mowers, electric lawn mowers and low-emission leaf blowers will result in reductions in water pollution and fossil fuel use. There will also be consumer savings. New leaf-blowers also operate at lower decibel levels, reducing noise impacts.

Monitoring Mechanisms:

Progress will be measured by tracking the number of older gasoline engines that are removed from service in exchange for mechanical and electric powered equipment.

Issues/Impediments:

The main obstacle is the need to secure funding to implement this measure. While funding is potentially available through the CARB-administered AB 118 program, limitations on the amount available statewide and types of qualifying equipment will mean other sources of funding will be crucial for the success of this control measure. If funding is secured, then the level of interest from residents and professional gardeners in replacing old equipment with new zero and low-emission equipment could also be a limiting factor.

Experience with the earlier lawn mower exchange program from 1999 to 2006 suggests that a program that focuses on offering rebates through the manufacturers instead of an exchange effort will enhance the program's cost-effectiveness and simplify implementation.

Sources:

1. BAAQMD, Base Year 2005 Emissions Inventory: Summary Report, December 2008
2. BAAQMD, Base Year 2005 Emissions Inventory: Source Categories, December 2008
3. BAAQMD, Source Inventory of Bay Area Greenhouse Emissions, December 2008
4. CARB, *Article 1, Chapter 9, Division 3, Title 13, California Code of Regulations*
5. CARB, Initial Statement of Reasons for Proposed Rulemaking: Exhaust and Evaporative Emission Control Requirements for Small Off-Road Equipment and Engines Less Than or Equal to 19 Kilowatts, August 8, 2003
6. CARB, website for AB 118 Lawn and Garden Equipment Replacement Project:
<http://www.arb.ca.gov/msprog/aqip/lger.htm>
7. CARB, Proposed AB 118 Air Quality Improvement Program Funding Plan for Fiscal Year 2009-10, March 23, 2009.
8. CARB, AB 118 Air Quality Improvement Program: FY 2010-11 Funding Plan Discussion Document, 4/1/2010.
9. SCAQMD, *Leaf Blower Exchange Program*,
<http://www.aqmd.gov/tao/leafblowerexchange.htm>

MSM C-3 - Reduce Emissions from Recreational Watercraft

Brief Summary:

Use of four-stroke or two-stroke inboard/outboard engines in pleasure craft contribute to summertime ozone levels primarily through the release of ROG. While progressively more stringent emission standards have reduced pollution from these engines, sufficient numbers of older four- and two-stroke engines remain in use in the Bay Area to warrant Air District efforts to pursue a clean-up program. In addition, new inboard/outboard engines are also more fuel efficient.

Purpose:

This measure will reduce ozone precursors, particulate matter and greenhouse gases.

Source Category/Travel Market Affected:

Recreational Watercraft

Regulatory Context and Background:

The recreational vessel category is comprised of relatively small outboard engines that are mounted to the rear or side of small craft and sailboats, as well as larger inboard engines that are mounted within the vessel and connect to propellers via a shaft. This measure focuses on reducing emissions from the small outboard motors.

Outboard gasoline engines were first regulated in 1995 by the Air Resources Board, with the newest, most stringent regulations becoming effective with the MY 2008 equipment. There are currently an estimated 135,500 inboard/outboard engines in the Bay Area, of which approximately 87,000 or 64% are two-stroke, high-emitting outboard engines. Increasingly stringent emission standards and resulting advances in engineering have made four-stroke gasoline inboard/outboard and electric engines readily available.

Implementation Actions:

The Air District will establish a voluntary exchange program to retire older gasoline-powered four-stroke and two-stroke outboard engines used in small pleasure craft. The Air District is focusing on the replacement of outboard engines under this measure because of the lower replacement costs per engines. The goal of the program will be to:

- Replace up to 3,000 outboard motors by 2012.
- Replace up to 10,000 outboard motors by 2020.

Emission Reductions:

<u>Pollutants (tons per day)</u>	<u>2012</u>	<u>2020</u>
ROG	0.06	0.02
NO _x	0.01	0.01
PM _{2.5}	0.01	0.01
CO ₂ -e	0.42	1.38

Emission Reduction Methodology:

Emission reductions have been estimated by comparing the incremental difference in emissions between a new four-stroke 50 horsepower (HP) engine meeting the lowest emission standards and an average MY 2000 two-stroke 50 hp engine. Emission factors and usage rates are from CARB's OFFROAD model. The outboard engines were assumed to operate approximately 1100 hours per year.

Exposure Reduction:

Older gasoline engines emit high levels of hydrocarbons, many species of which are listed as air toxics. Exchanging the older equipment with either electric or low-emission new engines will result in reductions in toxic emissions.

Emission Reduction Trade-offs:

To the extent electric motors are purchased as replacements there will be an incremental increase in the production of electricity, which may incrementally increase emissions of particulate matter and greenhouse gases from power plants.

Cost:

Costs for this measure may be borne by government agencies in the form vouchers to buy-down the price of new motors, disposal of old engines, and program administration. The main cost for consumers will be the balance of the purchase price for a new engine. The Air District has not identified possible funding sources for this measure, but anticipates seeking up to \$2-3 million in funding per year.

Co-benefits:

Use of four-stroke engines will decrease water pollution: Two-stroke engines use a gasoline and oil fuel mixture, with unburned fuel being exhausted directly into the water. The increase use of more fuel-efficient electric and four-stroke gasoline engines will reduce oil consumption; the improved fuel economy of newer engines will also reduce fuel costs for consumers.

Monitoring Mechanisms:

This measure will be monitored via the vouchers awarded to participants to purchase a cleaner outboard motor.

Issues/Impediments:

The main issues for this measure are:

- Interest in the public in participating in the voluntary buy-down/exchange program for new outboard engines;
- Availability of monetary incentives from government agencies to fund the program.

Sources:

1. BAAQMD, Base Year 2005 Emissions Inventory: Summary Report, December 2008
2. BAAQMD, Base Year 2005 Emissions Inventory: Source Categories, December 2008
3. BAAQMD, Source Inventory of Bay Area Greenhouse Emissions, December 2008
4. Air Resources Board, OFFROAD2007 Emissions Model,
<http://www.arb.ca.gov/msei/offroad/offroad.htm>
5. South Coast Air Quality Management District, "SCOFFRD-06 -- Accelerated Turnover and Catalyst Based Standards for Pleasure Craft [VOC, NOx, PM]," FINAL 2007 Air Quality Management Plan, June 2007.

BAY AREA 2010 CLEAN AIR PLAN

VOLUME II

Section C

Transportation Control Source Measures

September 2010



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TCM A-1 – Local and Area-wide Bus Service Improvements

Brief Summary:

TCM A-1 will improve transit by sustaining and improving existing service, including new Express Bus or Bus Rapid Transit on major travel corridors, funding the replacement of older and dirtier buses, and implementing the Transit Priority Measures (TPMs) component of the Transportation Climate Action Campaign.

Purpose:

This measure will reduce emissions of the key ozone precursors, ROG and NOx by sustaining and improving bus service throughout the Bay Area. In addition, the measure will reduce emissions of particulate matter, air toxics and greenhouse gases.

Travel Market Affected:

This measure would affect all intraregional travel, including commute travel; shopping, personal business, social and recreational travel; passenger and commute trips to airports; and school trips.

Regulatory Context and Background:

In its Transportation 2035 Plan, MTC estimates that transit operating and capital replacement costs for Bay Area transit providers are projected to total \$138 billion over the next 25 years. This includes \$98 billion in operating costs plus \$40 billion for capital replacement. Revenues available to address these needs total \$113 billion, leaving a shortfall of \$25 billion (\$8 billion for operations and \$17 billion for capital replacement). Bus and other bus capital needs total approximately \$13 billion; the Transportation 2035 Plan includes \$5 billion in committed funds and \$2 billion in discretionary funds towards these needs, leaving a remaining shortfall of \$6 billion.

In light of the transit operating and capital replacement shortfalls, the Transportation 2035 Plan also sets forth MTC's commitment to proceed with the Transit Sustainability Project. This Project aims to improve transit's core performance and financial stability as well as identify service productivity improvements that will yield more from the region's investment in transit services. Further, it may help transit operators, each of whom are responsible for their own transit operating and capital budgets, to prioritize and make more cost-effective use of limited transit funds.

Adopted as part of the 2001 Regional Transportation Plan, MTC's Resolution 3434 Regional Transit Expansion Program is an \$18 billion, long-term, and multifaceted funding strategy for directing local, regional, state and federal dollars to nearly two dozen high-priority bus, rail and ferry expansions. The bus service expansion projects included in Resolution 3434 are as follows:

- AC Transit Berkeley/Oakland/San Leandro Bus Rapid Transit
- AC Transit Enhanced Bus: Hesperian/Foothill/MacArthur corridors

- Regional Express Bus (multiple transit operators)
- SFCTA/SFMTA Van Ness Avenue Bus Rapid Transit
- VTA Downtown to East Valley Bus Rapid Transit

In 2004, voters passed Regional Measure 2 (RM 2), raising the toll on the seven State-owned toll bridges by \$1.00. This extra dollar funds various transportation projects within the region, including express buses that reduce congestion or make improvements to travel on the toll bridges, as identified in SB 916 (Chapter 715, Statutes of 2004).

Adding more service and development of new service concepts (such as enhanced bus, Bus Rapid Transit (BRT), and Regional Express Buses) to better serve existing markets and fill in regional transit gaps are determined by the individual transit operators as revenue permits. Decisions on expanding bus service must address both the needs of commuters as well as low-income, elderly, disabled and youth travelers who do not have access to other travel options. During weekday peak hours in 2006, bus transit provided over 1.3 million seat miles per hour in the Bay Area.³

Diesel bus emissions can be reduced by acquiring new heavy-duty clean air vehicles or installing retrofit devices on existing heavy-duty diesel bus engines. MTC has provided \$14 million in Congestion Mitigation Air Quality Improvement (CMAQ) funds to retrofit 1,700 diesel buses operated by 12 transit operators; the Air District contributed the required CMAQ match (11.5%) for this project. In addition, since 2003 the Air District's Lower Emission School Bus Program has replaced 84 school buses at a cost of approximately \$11.2 million and retrofitted 204 buses with diesel particulate filters at a cost of \$1.3 million. The Air District has also spent \$7 million on retrofitting diesel transit buses and purchasing alternative fuel transit buses since 2003. The Air District's Advanced Technology Program provides funding to promote new vehicle technologies, such as hybrid heavy-duty trucks and buses.

MTC's Transportation 2035 Plan launched a new program, the Transportation Climate Action Campaign, to reduce the region's carbon footprint. The \$400 million campaign includes new funding for Transit Priority Measures. Transit Priority Measures (TPMs) are operational improvements or road-related infrastructure that preserves and improves bus speed and on-time reliability, and reduces variability in travel times and delay of buses. Case studies indicate significant ridership gains can be realized when TPMs are packaged with improvements in headways and other operations improvements (fewer bus stops, unique branding, all-door boarding and pre-paid fares) typically associated with BRT (Koonce, et al 2006). Note that as of December 2009, MTC approved \$80 million in the first programming cycle of the new federal transportation act for four primary climate initiatives: 1) Public

³ Seat miles are a measure of transit capacity and are calculated by multiplying the number of transit vehicle miles traveled by the number of seats in each vehicle. For more information, see Table C-3 in the T2035 Travel Forecast Data Summary (Dec. 2008) available on the MTC website.

Education/Outreach; 2) Safe Routes to Schools, 3) Innovative Grants; and 4) Climate Action Program Evaluation. Funding for TPMs has yet to be identified.

Implementation Actions:

Phase 1 (2012):

MTC to fund:

- The timely replacement of worn-out buses in local transit operator fleets (\$900 million)
- Operations of existing services where feasible with available funding (\$4 billion)
- Regional Measure 2 Express Bus North and Express Bus South Improvements (\$62 million)
- Transit Priority Measures component of the Transportation Climate Action Campaign (includes arterial bus lanes, transit signal priority, queue jumper lanes, and bus bulbs) (\$TBD – as noted above, funding for the TPM element of the Transportation Climate Action Campaign has not yet been identified.)

BAAQMD to fund:

- Lower Emission School Bus Program (LESBP) to replace and retrofit school buses. (\$45 million)
- The Advanced Technology Program to fund hybrid buses and demonstration projects (\$1.5 million)

Phase 2 (2020):

MTC to fund:

- Sustain service of Express Buses as identified in Phase 1 and operations of existing services where feasible with available funding (\$72 million)
- The timely replacement of worn out buses in local transit operator fleets as funding becomes available (\$2.4 billion)
- Bus Rapid Transit Service on the Telegraph Avenue/International Boulevard/E. 14th Street Corridor (\$250 million)
- Bus Rapid Transit Service on the Grand-MacArthur Corridor (\$41 million)
- Enhanced Rapid Bus Service in Livermore, Dublin, and Pleasanton (includes higher frequencies, new stops and improved stop amenities) (\$14 million)
- Bus Rapid Transit project on Van Ness Avenue (includes dedicated transit lanes, signal priority and pedestrian and urban design upgrades) (\$88 million)
- Bus Rapid Transit as Phase 1 in the Santa Clara-Alum Rock Corridor with the potential to convert to light-rail in the future (Santa Clara-Alum Rock Phase 1) (\$132 million)
- Transit Priority Measures component of the Transportation Climate Action Campaign (includes arterial bus lanes, transit signal priority, queue jumper lanes, and bus bulbs) (\$TBD)

BAAQMD to continue to fund Phase 1 programs:

- Lower Emission School Bus Program (LESBP) to replace and retrofit school buses. (\$120 million)

- The Advanced Technology Program to fund hybrid buses and demonstration projects (\$4 million)

Supporting Actions by Partner Entities:

- Transit agencies and CMAs to work with MTC as appropriate to implement service improvements.
- School Districts, transit agencies and CMAs to work with BAAQMD to implement diesel emission reduction programs.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.03	0.04
NO _x	0.03	0.04
PM _{2.5}	0.001	0.001
PM ₁₀	0.005	0.01
CO ₂	22.53	71.37
CO ₂ -e	23.36	72.80

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: NH₃ (ammonia), benzene, 1,3 butadiene, formaldehyde, and acetaldehyde.

Emission Reduction Methodology:

Implementing Express/BRT Service: This analysis uses Transportation 2035 Travel Forecasts data to estimate future ridership due to the expansion of Regional Express Buses, and it uses existing ridership projections for BRT developed by AC Transit, SFCTA, and VTA. Growth factors, based on increases in each transit operator's ridership modeled as a part of the T2035 travel forecasts, are applied to bring the ridership estimates to analysis years 2012 and 2020. Using local data, estimated new ridership is reduced to factor in new riders that are transit dependent and those who drive to access the bus, resulting in the number of vehicle trips reduced. Additional adjustments are made to calculate vehicle miles traveled reduced based on average transit trip lengths and the average distance traveled to the bus stop by non-motorized modes.

Transit Priority Measures: While funding has not yet been identified for TPMs, this emissions analysis assumes a very limited implementation of TPMs in four corridors, specifying an assumed cost of \$5 million for two corridors in Phase 1. This analysis uses empirical findings that suggest a 4-7% increase in corridor ridership is reasonable to expect after implementation of TPMs. The average ridership among major bus corridors in the Bay Area is increased by 8-14% in 2012 (assuming TPMs will be implemented on two corridors) and 16-28% in 2020 (assuming TPMs will be implemented on an additional two corridors). Using local data, estimated new ridership is reduced to factor in new riders that are transit dependent and those who drive to access the bus, resulting in the number of vehicle trips reduced. Additional adjustments are made to calculate vehicle miles traveled reduced

based on average transit trip lengths and the average distance traveled to the bus stop by non-motorized modes.

Advanced Technology Program: Assumes an average project life of 7 years for each project. Emission reductions estimates are based on emission reductions achieved in previous funding years.

Analysis excludes: maintaining bus fleet and operating existing services, Express Bus North and South capital improvements, enhanced rapid bus in Livermore, Dublin, and Pleasanton, and Lower Emissions School Bus Program.

Exposure Reduction:

This measure will reduce region-wide population exposure to air pollutants based on the estimated reduction in emissions.

Emission Reduction Trade-offs:

Adding diesel retrofit devices to diesel engines may result in a decrease in fuel efficiency. This will thereby cause a modest increase in emissions of carbon dioxide, a greenhouse gas that contributes to climate change. For example, CARB and the EPA estimate that an urban bus with a retrofit device added to reduce emissions of PM and/or NOx would experience a decrease in fuel efficiency of 3.5 percent on average. For an urban bus traveling 20,000 miles per year, this decrease is estimated to result in an additional 4,026 pounds per year of carbon dioxide.

Cost:

Phase 1: \$5.0 billion

Phase 2: \$3.1 billion

Co-benefits:

- Improved connectivity between transit services and destinations.
- Travel time savings from TPMs and new express/enhanced bus projects that provide faster and/or more direct service between trip origins and destinations.
- Transportation cost savings by providing new bus transit options that may allow some households to own fewer or no cars.
- Community enhancements through creation of more and higher quality transit options and services.
- Provide incentives to jump-start the heavy-duty hybrid bus market and create demonstration projects that increase knowledge about the technological feasibility of hybrid buses.

Monitoring Mechanisms:

- Track capital rehabilitation and replacement using the Regional Transit Capital Inventory (RTCI).

- Track number of diesel buses retrofitted or replaced and emissions benefits associated with these upgrades.
- Track implementation status of express bus or BRT projects.
- Track on-time performance on routes with TPMs.
- Track performance of in-service hybrid buses.

Issues/Impediments:

Implementation of this TCM requires that funding is available for these programs. Due to the current economic recession, cuts in State transit funding, including funds for cleaner buses, reductions in sales tax revenue for transit, Bay Area transit operators are facing challenges to maintain and sustain their existing systems and, in light of financial constraints, are cutting their transit budgets, cutting service, increasing fares, and/or delaying or deferring capital maintenance and service expansions. Thus, maintaining the existing fleet, sustaining existing services, restoring service that has been cut, and expanding service will require new funding. New revenues may be available in the future from higher gas taxes, bridge tolls, and voter approved sales tax revenues in individual counties.

Sources:

1. MTC's Transportation 2035 Plan and Travel Forecasts Data Summary:
http://www.mtc.ca.gov/planning/2035_plan/
2. AC Transit's Strategic Vision: A World Class Transit System for the East Bay 2001-2010,
http://www.actransit.org/pdf/planning_focus/planning_focus_121.pdf?PHPSESSID=9
3. SFCTA's Van Ness Avenue Bus Rapid Transit (BRT) Feasibility Study,
<http://www.sfcta.org/content/view/425/252/>
4. VTA's Draft Environmental Impact Report (DEIR) for the Santa Clara-Alum Rock Transit Improvement Project (2008), http://www.vta.org/projects/dtev/eir_draft.html
5. Koonce, Peter, Paul Ryus, David Zagel, Young Park, and Jamie Parks (2006). "An Evaluation of Comprehensive Transit Improvements – TriMet's Streamline Program." Journal of Public Transportation, 2006 BRT Special Edition, pp. 103-115,
<http://www.nctr.usf.edu/jpt/pdf/JPT%209-3S%20Koonce.pdf>

TCM A-2 - Local and Regional Rail Service Improvements

Brief Summary:

TCM A-2 will improve rail service by sustaining and expanding existing services and by providing funds to maintain rail-cars, stations, and other rail capital assets. Specific projects for implementation include BART extensions, Caltrain electrification, Transbay Transit Center Building and rail foundation, Capital Corridor intercity rail service, and Sonoma Marin Area Rail Transit (SMART) District commuter rail project.

Purpose:

This measure will reduce emissions of the key ozone precursors, ROG and NOx by sustaining and improving rail service throughout the Bay Area. In addition, the measure will reduce emissions of particulate matter, air toxics and greenhouse gases.

Travel Market Affected:

This measure would affect all intraregional travel, including commute travel; shopping, personal business, social and recreational travel; passenger and commute trips to airports; and school trips. In addition, it would affect inter-regional travel.

Regulatory Context and Background:

In its Transportation 2035 Plan, MTC estimates that transit operating and capital replacement costs for Bay Area transit providers are projected to total \$138 billion over the next 25 years. This includes \$98 billion in operating costs plus \$40 billion for capital replacement. Revenues available to address these needs total \$113 billion, leaving a remaining shortfall of \$25 billion (\$8 billion for operations and \$17 billion for capital replacement). Rail-car and other rail capital needs total approximately \$26 billion; the Transportation 2035 Plan includes \$11 billion in committed funds and \$4 billion in discretionary funds towards these needs, leaving a remaining shortfall of \$11 billion.

The Bay Area's rail system includes light-rail (such as Muni Metro and VTA Metro), rapid rail (such as BART), and commuter rail (such as Caltrain, Capitol Corridor and ACE) services. During weekday peak hours in 2006, rail transit provided over 2 million seat miles per hour in the Bay Area⁴.

Adopted as part of the 2001 Regional Transportation Plan, MTC's Resolution 3434 Regional Transit Expansion Program is an \$18 billion, long-term, and multifaceted funding strategy for directing local, regional, state and federal dollars to nearly two dozen high-priority bus, rail and ferry expansions. The rail service expansion projects included in Resolution 3434 are as follows:

⁴ Seat miles are a measure of transit capacity and are calculated by multiplying the number of transit vehicle miles traveled by the number of seats in each vehicle. For more information, see Table C-3 in the T2035 Travel Forecast Data Summary (Dec. 2008) available on the MTC website.

- BART/Oakland Airport Connector
- Tri-Valley Transit Access Improvements to BART
- East Contra Costa BART Extension (eBART)
- BART: Fremont to Warm Springs and Warm Springs to San Jose/Santa Clara
- Caltrain Express: Baby Bullet (Open for service)
- Caltrain Express: Phase 2
- Caltrain Electrification
- Transbay Transit Center (Phases 1 and 2)
- Capitol Corridor Expansion and Enhancements
- MUNI Third Street Light-Rail Central Subway
- ACE Service Expansion
- Sonoma-Marin Rail (SMART)
- Dumbarton Rail
- Downtown to East Valley Light Rail

MTC, in partnership with California High-Speed Rail Authority (CHSRA), Caltrain, and BART, adopted the Regional Rail Plan in September 2007, which included an evaluation of a Bay Area to Central Valley high-speed rail alignment. CHSRA certified the Bay Area to Central Valley Program EIR/EIS in July 2008. The CHSRA is currently proceeding with detailed project-level EIR/EIS for the high-speed train from San Jose to San Francisco. In addition, the CHSRA is currently working with Bay Area and Central Valley transportation agencies (via the Altamont Corridor Partnership Working Group) to implement a joint use regional rail and high-speed rail infrastructure project in the Altamont Corridor.

In November 2008, California voters passed Proposition 1A, the Safe, Reliable High-Speed Passenger Train Bond Act, which includes nearly \$10 billion in general obligation rail bond proceeds to help finance construction of a high-speed rail link between San Francisco and San Diego. The Bay Area is slated to receive \$408 million for improvements to ACE, BART, Caltrain, SFMTA, and VTA light-rail. In addition, the Bay Area is well-positioned to receive a significant portion of the \$8 billion appropriation for high-speed rail included in the American Recovery and Reinvestment Act of 2009 (ARRA).

Seven of the 9 counties have adopted local sales tax measures that fund transportation improvements including rail expansion projects. Most recently, in November 2008, Santa Clara County voters approved the 1/8-cent Measure B to fund operations and maintenance of the BART to San Jose/Santa Clara extension and Sonoma and Marin county voters approved the 1/4-cent Measure Q to fully fund construction and operation of the Sonoma Marin Area Rail Transit (SMART) commuter rail.

Implementation Actions:

Phase 1 (2012)

MTC to fund:

- The timely replacement of worn out rail-cars and other rail capital assets in local transit operator fleets as funding becomes available (\$1.8 billion)

- Operations of existing rail services where feasible with available funding (\$2 billion)

Phase 2 (2020)

MTC to fund:

- The timely replacement of worn out rail-cars and other rail capital assets in local transit operator fleets as funding becomes available (\$4.9 billion)
- Existing rail services where feasible with available funding (\$5.3 billion)
- A BART Oakland Airport Connector between Coliseum BART station and Oakland International Airport (\$459 million)
- Transit access improvements to BART in the Tri-Valley (\$168 million)
- Extension of BART/East Contra Costa Rail (eBART) eastward from the Pittsburg/Bay Point BART station into eastern Contra Costa County (\$525 million)
- Extension of BART from Fremont to Warm Springs (\$890 million)
- Electrification of Caltrain from Tamien to San Francisco (\$626 million)
- Transbay Terminal Phase 1: construct the new Transbay Transit Center Building and rail foundation (\$1.2 billion)
- Capitol Corridor intercity rail service (includes increased track capacity, rolling stock and frequency improvements (\$108 million)
- Sonoma Marin Area Rail Transit District (SMART) commuter rail project (\$1.1 billion)
- Acquisition of right-of-way for ACE rail service between Stockton and Niles Junction, complete track improvements between San Joaquin County and Alameda County, and expand Alameda County station platforms (\$150 million)
- Extension of BART from Fremont (Warm Springs) to San Jose/Santa Clara (\$7.6 billion)
- Electrification of Caltrain line from Tamien Station to Gilroy (\$140 million)
- Extension of Caltrain Express service (Phase 2): design and implement safety elements related to signal communication and positive train control; and implement system-wide level boarding program and terminal improvements (\$427 million)
- Transbay Terminal Phase 2: extend Caltrain to the new Transbay Terminal (\$3 billion)
- Capitol Corridor: Phase 2 enhancements (includes grade separations at High Street, Davis Street and Hesperian Street) (\$89 million)
- Extension of Third Street Light-Rail line from north of King Street to Clay Street in Chinatown via a new Central Subway (\$1.6 billion)
- Conversion of Bus Rapid Transit (BRT) to light-rail transit in the Santa Clara-Alum Rock corridor (Santa Clara-Alum Rock Phase 2) (\$327 million)
- Commuter rail service on the Dumbarton Bridge (\$301 million)
- High-Speed Rail: fund supporting infrastructure for ACE, BART, Caltrain, MUNI and VTA (\$408 million)

Supporting Actions by Partner Entities: Transit, CMAs, airports and other agencies to work with MTC as appropriate to implement service improvements.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG		0.15

NO _x	0.15
PM _{2.5}	0.03
PM ₁₀	0.04
Ammonia (NH ₃)	0.12
CO ₂	506.29
CO ₂ -e	516.00

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: benzene, 1,3 butadiene, formaldehyde, and acetaldehyde.

Emission Reduction Methodology:

This analysis uses existing ridership projections for rail developed by transit operators for each project. Growth factors, based on increases in each transit operator's ridership modeled as a part of the Transportation 2035 travel forecasts, are applied to bring the ridership estimates to analysis year 2020 (analysis does not assume completion of any rail projects by 2012). Using local data, estimated new ridership is reduced to factor in new riders that are transit dependent and those who drive to access rail, resulting in the number of vehicle trips reduced. Additional adjustments are made to calculate vehicle miles traveled reduced based on average transit trip lengths and the average distance traveled to the rail station by non-motorized modes.

This analysis excludes estimates of emissions reduced from maintaining existing rail services and transit access improvements to transit access improvements to BART in the Tri-Valley, Caltrain electrification, extension of Caltrain to the Transbay Terminal, and supporting infrastructure for high-speed rail.

Exposure Reduction:

This measure will reduce region-wide population exposure to air pollutants based on the estimated reduction in emissions.

Emission Reduction Trade-offs:

None identified.

Cost:

Phase 1: \$3.8 billion

Phase 2: \$30.1 billion

Co-benefits:

- Improved connectivity between transit services and destinations
- Travel time savings from providing new rail services that provide faster and/or more direct service between trip origins and destinations.
- Transportation cost savings by providing new rail transit options that may allow some households to own fewer or no cars.

- Community enhancements through creation of more and higher quality transit options and services.

Monitoring Mechanisms:

Track implementation status of rail projects.

Issues/Impediments:

Implementation of this TCM requires that funding is available for these programs. Due to the current economic recession, cuts in State transit funding, and reductions in sales tax revenue for transit, Bay Area transit operators are facing challenges to maintain and sustain their existing systems and, in light of financial constraints, are cutting their transit budgets, cutting service, increasing fares, and/or delaying or deferring capital maintenance and service expansions. Thus, maintaining the existing fleet, sustaining existing services, restoring service that has been cut, and expanding service will require new funding. New revenues may be available in the future from higher gas taxes, bridge tolls, and voter approved sales tax revenues in individual counties.

Environmental clearance, right-of-way availability and costs, funding for the capital, operating and maintenance costs and level of public support are major impediments to sustain, improve, upgrade, and expand rail services.

Sources:

1. MTC's Transportation 2035 Plan: http://www.mtc.ca.gov/planning/2035_plan/

TCM B-1 - Freeway and Arterial Operations Strategies

Brief Summary:

TCM B-1 will improve the performance and efficiency of freeway and arterial systems through operational improvements. These improvements include implementing the Freeway Performance Initiative (FPI), the Bay Area Freeway Service Patrol (FSP), and the Arterial Management Program.

Purpose:

This measure will reduce emissions of the key ozone precursors, ROG and NOx by improving the efficiency of existing freeways and roadways throughout the Bay Area. In addition, the measure will reduce emissions of particulate matter, air toxics and greenhouse gases.

Travel Market Affected:

This measure would affect all intraregional travel, including commute travel; shopping, personal business, social and recreational travel; passenger and commute trips to airports; and school trips.

Regulatory Context and Background:

Caltrans manages freeway operations through a comprehensive system for surveillance (traffic detectors, CCTV cameras), communication with motorists (traffic advisory signs) and system control (ramp meters, incident management). Through its Transportation Management Center (TMC), Caltrans is able to collect and process traffic information; to detect incidents as reported by freeway cameras, loop detectors in the freeway pavement, motorist calls and other sources; and to respond to incidents.

The Freeway Performance Initiative (FPI) aims to maximize the efficiency and improve the management and reliability of the existing freeway infrastructure, while limiting traditional expansion of the system to only the most essential locations. FPI addresses both recurrent daily traffic that comes from the surge of commuters using the freeways during rush hours and non-recurrent congestion that results from unanticipated incidents and blockages of highway lanes. In fact, half of the total congestion experienced in the Bay Area is caused by vehicle breakdowns, vehicular accidents, material spills and other incidents. In performance assessments of infrastructure packages evaluated during the development of Transportation 2035 Plan, MTC found that FPI is the most cost-effective means to deal with traffic congestion in the region.

In its Transportation 2035 Plan, MTC set-aside \$1.6 billion over the next 25 years to implement FPI. FPI includes (a) Traffic Operations Systems (TOS): full deployment of monitoring and surveillance systems and implementation of ramp metering on the region's entire freeway network to improve efficiency and maximize use of the freeway system's available capacity; (b) TOS replacement: consistent maintenance and periodic replacement of infrastructure to ensure a fully functioning system; (c) Arterial coordination and

management: coordination with and optimization of major arterials to maximize efficiency of the freeway system; and (d) Performance monitoring: monitoring to measure progress in freeway performance.

Arterial management includes traffic signals, signing and pavement marking, access management, parking management, and traffic calming. Over 3,500 of the Bay Area's 7,000+ traffic signals are part of coordinated systems. An additional 1,700 signals are close enough to be included in coordinated systems, but most local agencies cannot afford to interconnect their signals. Based on feedback from local traffic engineers, their greatest unmet needs involve resources and expertise for traffic signal timing and funding for the operation and maintenance of Smart Corridors. Most cities have not been able to meet these needs since the dot.com bust in 2001.

MTC has been investing in arterial management for over 20 years through the Traffic Engineering Technical Assistance Program (TETAP) and the Regional Signal Timing Program (RSTP). Between 2004 and 2009, over 3,500 traffic signals have been retimed, yielding 10 percent savings in travel time and fuel consumption, 7 percent reductions in mobile source emissions, and a benefit: cost ratio of 34:1. Similarly, since its inception in 1993, TETAP has funded over 250 operations and safety studies.

The Bay Area FSP is a joint project of the Metropolitan Transportation Commission Service Authority for Freeways and Expressways (MTC SAFE), the California Highway Patrol (CHP) and Caltrans. The service is provided by private tow truck companies, and during the hours of operation, the vehicles and drivers are exclusively dedicated to patrolling their freeway beat. Currently, a fleet of 83 trucks patrols some 550 miles of the Bay Area's freeways. Patrol routes are selected based on several factors, including a high rate of traffic and congestion, frequent accidents or stalls, and lack of shoulder space for disabled vehicles. The program is intended to augment the MTC SAFE network of motorist-aid call boxes in the nine Bay Area counties.

Implementation Actions:

Phase 1 (2012)

MTC to implement the following actions (\$155 million):

- Through FPI, fill gaps in TOS infrastructure.
- Through FPI, install ramp meters at entrance ramps.
- Through the RSTP, coordinate traffic signals and continue to update timing plans. Arterial management strategies will consider and prioritize transit needs.
- Maintain the current level of FSP service which involves patrolling 540 miles of the Bay Area freeways. By 2012, FSP anticipates a reduction of up to ten trucks from the FSP fleet. Note that the FSP service levels are subject to change though the freeway miles covered are unlikely to be significantly affected.

Phase 2 (2020)

MTC to implement the following actions (\$TBD):

- Through FPI, conduct routine replacement of TOS infrastructure at the end of its useful life.
- Through FPI, install additional TOS infrastructure.
- Through FPI, install additional ramp meters at entrance ramps and monitor and adjust meter timing as appropriate.
- Through the RSTP, coordinate additional traffic signals and continue to update timing plans.
- Expand FSP on I-280 from SR 92 to SR 85 in San Mateo and Santa Clara counties.

Supporting Actions by Partner Entities: Local governments, Caltrans, CMAAs and transit agencies to work with MTC as appropriate to implement service improvements.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.99	1.06
NO _x	3.25	3.83
PM _{2.5}	0.12	0.16
PM ₁₀	0.18	0.24
Ammonia (NH ₃)	0.07	0.09
Benzene	0.02	0.02
Formaldehyde	0.01	0.01
Acetaldehyde	0.01	0.01
CO ₂	2,403.08	3,303.24
CO ₂ -e	2,451.00	3,369.30

Emission Reduction Methodology:

This analysis includes emissions reductions associated with implementation of the Freeway Performance Initiative (FPI), the Freeway Service Patrol (FSP), and the Regional Signal Timing Program (RSTP). These three components are calculated separately. The Freeway Performance Initiative uses model output from the Transportation 2035 Vision Analysis which compared four different investment scenarios on a range of performance objectives: 1) Baseline, 2) Freeway Performance (Freeway Operational Improvement) 3), High-Occupancy/Toll (HOT) Lanes Network And Express + Local Bus, and 4) Regional Rail and Water Transit. The net difference between air quality emissions associated with the Baseline and the Freeway Performance scenarios are used to determine emissions reductions associated with the project. Emissions reductions are estimated for year 2012 and 2020 based on 2035 model output. The Freeway Service Patrol uses a benefit-cost model developed by Caltrans with the cooperation of the 13 local agencies that operate the FSP programs around the state. Emission reductions were last calculated for the 2004-05 fiscal year. Similarly, estimates for the regional signal timing program use a benefit-cost model in which the general methodology, fuel consumption factors, and health costs of motor vehicle emissions are based on Caltrans' California Life-Cycle Benefit/Cost Analysis

Model; estimates are calculated using the average benefits from 64 projects involving 1975 retimed traffic signals. For both FSP and RSTP, the 2004-05 emissions reductions are used to estimate 2012 and 2020 emissions reductions.

Exposure Reduction:

This measure will reduce region-wide population exposure to air pollutants based on the estimated reduction in emissions.

Emission Trade-offs:

ARB's motor vehicle emissions factors indicate that tailpipe emission rates for ROG, NO_x, PM, and CO₂ are lowest when vehicles travel in the 30-50 mph speed range. The estimated emission reduction benefits for this measure are based on the anticipated improvement in average vehicle speed due to expected reduction in congestion in the affected corridors. While the regional travel model estimates transportation emissions due to temporal, spatial and mode shifts resulting from increased roadway capacity, the potential emission reduction benefits of this measure may be eroded if reduced travel time in these corridors encourages additional vehicle travel or changes in land uses that would result in longer vehicle trips. To address this issue, the Air District will perform an independent analysis to evaluate the long-term impacts of this measure on vehicle travel and emissions.

Cost:

Phase 1: \$ 155 million

Phase 2: \$ TBD million

Co-benefits:

- Health and economic savings for both businesses and travelers from reduced congestion.
- Improved travel times, reduced fuel consumption and fewer collisions from retiming signals.
- Reductions in fuel usage, improved safety for stranded motorists, reductions in secondary accidents and improved motorist travel times from FSP services.

Monitoring Mechanisms:

- Track mobility (how well the corridor moves people and freight), reliability (the predictability of travel times), and safety as part of the comprehensive FPI corridor studies.
- Track savings in travel time, fuel consumption, and air emissions on a project-by-project and on an annual basis for Arterial Management Program.
- Collect detailed assist data and motorist experience information for Freeway Service Patrol services. The assist data is used by Caltrans to calculate benefit-cost ratios, fuel-savings, and pollutant reductions.

Issues/Impediments:

By making more efficient use of existing capacity, the FPI should help to improve air quality by reducing peak period congestion, as well as incident-related delay, on the Bay Area's freeways. However, ramp-metering may provide a greater travel time savings for vehicles making longer trips. Levinson and Zhang (2006) found that: "Ramp meters are particularly helpful for long trips relative to short trips... trips longer than three exits in length benefit, while many trips 3 exits or less are hurt by ramp meters." Reducing travel time for long distance commuters could, at least in theory, encourage longer commutes from residential locations in the periphery of the region. If this were to occur, it could erode the air quality benefits of this measure over time.

Local jurisdictions may be concerned that ramp meters will spill over onto local streets and disrupt their arterial operations (although these impacts are most often mitigated prior to the operation of the ramp meters through protocols for the ramp metering timing or local street improvements to accommodate the ramp queues).

Where arterial signal coordination requires cooperation of multiple jurisdictions, the negotiations can take time to resolve both technical and policy issues.

Installation and replacement of TOS infrastructure, retiming traffic signals, and expansion of FSP is constrained by the availability of funding.

Sources:

1. MTC's Transportation 2035 Plan and Travel Forecasts Data Summary: http://www.mtc.ca.gov/planning/2035_plan/
2. MTC's Arterial Management Program: http://www.mtc.ca.gov/services/arterial_operations/
3. MTC's Transportation 2035 Vision Analysis: http://www.mtc.ca.gov/planning/2035_plan/tech_data_summary_report.pdf
4. SAFE's Freeway Service Patrol Program: <http://www.mtc.ca.gov/services/fsp/>
5. Levinson, David and Lei Zhang (2006). "Ramp Meters on Trial: Evidence from the Twin Cities Metering Holiday" *Transportation Research Part A: Policy and Practice*, Volume 40, Issue 10, pp. 810-828.
6. Levinson, David and Lei Zhang (2003). "Relationships between Ramp Metering and Sprawl" Draft working paper available through the University of Minnesota [Http://nexus.umn.edu/Papers/RampMetersSprawl.pdf](http://nexus.umn.edu/Papers/RampMetersSprawl.pdf).

TCM B-2 - Transit Efficiency and Use Strategies

Brief Summary:

This measure will improve transit efficiency and make transit more convenient for riders, through continued operation of 511 Transit, and full implementation of Clipper (formerly “Translink”) fare payment system and the Transit Hub Signage Program.

Purpose:

This measure will reduce emissions of the key ozone precursors, ROG and NOx by improving transit efficiency and use through financial incentives, improved real-time transit service information, coordinated fare payment and collection, and improved transit connectivity. In addition, the measure will reduce emissions of particulate matter, air toxics and greenhouse gases.

Travel Market Affected:

This measure would affect intraregional travel on transit, including commute travel; shopping, personal business, social and recreational travel; passenger and commute trips to airports; and school trips.

Regulatory Context and Background:

Public transit services in the Bay Area are operated by 26 agencies, each with its own budget, policies, procedures, service plan and operating practices tailored to its immediate service area. The agencies do not always coordinate effectively with neighboring service areas for purposes of facilitating seamless regional travel and customer service.

Since 2002, the Bay Area’s telephone and Web-based 511 traveler information service provides up-to-the-minute, on-demand transportation-related information that supports transit riders throughout the nine-county region. On the phone, 511 provides direct transfers to over two dozen transit agencies and various paratransit providers as well as real-time transit departure predictions for SF Muni and BART. It will expand to cover other agencies that develop real-time capabilities. On the web, 511 offers a transit trip planner which allows users to create itineraries for their trips, including trips requiring transfers between transit agencies. The project also has a call center interface used by transit agencies to provide trip-planning information to customers over the phone. The 511 web service also provides schedules, route maps, information on fares and passes, and service announcements. In the near future, a personalized MY 511 service on the phone and the web will allow users to save trips for real-time departure predictions. The Bay Area system has received nearly 25 million calls since 2002, and averages 100,000 transit-related calls and over 1.3 million transit itinerary requests each month. In light of a planned 50 percent decrease in 511 Transit project funding starting in FY 2014, as well as potential project impacts due to recent State Transit Assistance budget reductions, the project will assess possible approaches to reduce ongoing operational costs such as further automating

data transfer/processing from the region's over two dozen transit agencies and/or scaling back project functionality/features provided to the public.

Clipper offers transit riders a convenient and secure way to pay fares on multiple transit systems. The Clipper system reduces the hassle associated with paying transit fares using exact change, multiple tickets and paper transfers. The reloadable Clipper card stores value in the form of electronic cash (e-cash), which is accepted by all participating agencies, and transit passes. Clipper has been available on all AC Transit and Dumbarton Express buses and on all Golden Gate Transit and Ferry routes since November 2006. Clipper is currently operating on all San Francisco Muni routes, but Muni is encouraging only limited use of the system by the public in order to closely monitor the system's performance and customer response. Furthermore, Clipper is fully installed on the Caltrain system, and Caltrain will begin encouraging the public to use the system once an employee testing phase is complete. Clipper use by BART customers began in August 2009, and use by Santa Clara VTA and SamTrans customers will begin in 2010. Clipper will also be available for use at a limited number of San Francisco Municipal Transportation Agency (SFMTA) parking garages on a pilot basis in 2010. When fully implemented, Clipper[®] will serve more than 600,000 transit riders every day.

A number of programs provide services to Bay Area employers to facilitate use of pre-tax purchases of transit tickets and other transit benefits. (See discussion re: transit benefit ordinances in TCM C-1.) Transit riders can apply their transit benefits directly to their Clipper card. The Clipper program is also working with AC Transit and a number of housing developers to offer transit benefits to residents of new transit-oriented housing developments.

MTC prepared the Transit Connectivity Plan to improve passenger transfers between connecting transit systems. Aside from reinforcing the importance of 511 Transit and Clipper to improve transit system-wide, several key issues emerged, including (a) lack of wayfinding signage to guide transit riders between systems and to their final destinations; (b) lack of information about connecting services such as schedules, fares and routes; (c) lack of real-time transit departure information; (d) disconnects in schedule coordination; (e) lack of "last mile" services for riders to get to/from mainline transit service such as shuttles, pedestrian access, bicycle parking or taxis; and (f) few hub amenities such as weather protection, restrooms and security measures. MTC, in partnership with transit operators, will implement the Hub Signage Program to address wayfinding signage, transit information and real-time transit information recommendations at 21 transit hubs and 3 airports. Transit operators will lead implementation of other Plan recommendations over time (no cost assumption in TCM).

Implementation Actions:

Phase 1 (2012)

MTC to:

- Operate and maintain 511 Transit (\$10 million)

- Deploy, operate and maintain Clipper on Bay Area transit agencies (\$59 million)
- Provide pre-tax and other transit benefits through Clipper (\$5 million)
- Implement, operate and maintain Transit Hub Signage Program (\$3 million)

Phase 2 (2020)

MTC to:

- Operate and maintain 511 Transit (\$18 million)
- Operate and maintain Clipper on Bay Area transit agencies (\$117 million)
- Provide pre-tax and other transit benefits through Clipper (assume cost is absorbed in Clipper budget)
- Operate and maintain Transit Hub Signage Program (\$10 million)

Supporting Actions by Partner Entities:

- Local governments and transit agencies to work with MTC on the Transit Hub Signage Program.
- Local governments, CMAs, transit agencies and other agencies to work with MTC to deploy, operate and maintain Clipper and 511 Transit.
- Local governments are encouraged to implement programs that offer residents, students and employees free or discounted transit passes, such as Santa Clara's Ecopass program, and other innovations to encourage transit use.

Pollutants (tons per day)	2012	2020
ROG	0.004	0.006
NO _x	0.005	0.007
PM _{2.5}	0.00	0.00
PM ₁₀	0.00	0.00
CO ₂	6.01	10.01
CO ₂ -e	6.12	10.21

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: PM_{2.5}, PM₁₀, NH₃ (ammonia), benzene, 1,3 butadiene, formaldehyde, and acetaldehyde.

Emissions Reduction Methodology:

This analysis uses a "transit efficiency" elasticity of 0.651; that is, every 1% increase in "transit efficiency" will result in a 0.651% increase in ridership. This elasticity was selected based on an analysis of output from the Transportation 2035 travel forecasts that examined change in mode share given a reduction of in-vehicle travel time by transit and wait time for transit, both by 20%. Reductions of this magnitude were selected based on review of empirical studies that examined how information improvements affect passengers' perceived and actual wait time and travel time (Litman 2008). This elasticity was then applied to a share of the entire transit market (ranging from 2.7% to 3.4% in Phase 1 and 3.4% to 5.4% in Phase 2), which was estimated based on the current share of transit riders that use the 511 Transit Trip Planner 3.4%; and scaling by 100-125% in Phase 1 and by 125%

to 200% in Phase 2 to assume additional impact from the other elements of the TCM beyond the 511 transit trip planner. Using local data, estimated new ridership is reduced to factor in new riders that are transit dependent and those who drive to access the bus, resulting in the number of vehicle trips reduced. Additional adjustments are made to calculate vehicle miles traveled reduced based on average transit trip lengths and the average distance traveled to the bus stop by non-motorized modes. Note: this analysis excludes impact and costs associated with Clipper as there is insufficient empirical research regarding the travel impacts associated with implementation of universal fare card payment systems.

Exposure Reduction:

This measure will reduce region-wide population exposure to air pollutants based on the estimated reduction in emissions.

Emission Trade-offs:

None identified.

Cost:

Phase 1: \$77 million

Phase 2: \$145 million

Co-benefits:

- Improved transit customer experience
- Travel time savings

Monitoring Mechanisms:

- Monitor customer use of 511 web and phone features to obtain transit schedule, route and fare information as well as real-time transit departure times. Monitor use of 511 Transit data by third party Information Service Providers
- Monitor customer use of Clipper card and Clipper market penetration
- Track number of people receiving transit benefits through Clipper
- Track completion of sign installation (way-finding, transit information displays, real-time transit) at each of 21 hubs and 3 airports

Issues/Impediments:

Implementation of this TCM requires that funding is available for these programs. In addition, technological issues, institutional support, and market penetration are factors that may impede full implementation of 511, Clipper and other transit connectivity improvements.

Sources:

1. MTC's Transportation 2035 Plan: http://www.mtc.ca.gov/planning/2035_plan/

2. Litman, Todd (2008). "Valuing Transit Service Quality Improvements." *Journal of Public Transportation*, Vol. 11, No. 2, pp. 43-63. <http://www.nctr.usf.edu/jpt/pdf/JPT11-2Litman.pdf>.

TCM B-3 - Bay Area Express Lane Network

Brief Summary:

TCM B-3 will seek to price travel demand on Bay Area highways by developing and implementing a seamless, regionally-managed Express Lane Network throughout the Bay Area and improving regional transit service. This system will offer free-flowing conditions for carpools, buses and toll payers by adjusting tolls based upon the level of congestion.

Purpose:

This measure will reduce emissions of the key ozone precursors, ROG and NOx, by improving the efficiency of and managing congestion on existing freeways throughout the Bay Area through the use of express lanes, and by generating revenues to make corridor improvements such as improved regional transit. In addition, the measure will reduce emissions of particulate matter, air toxics and greenhouse gases.

Travel Market Affected:

This measure would affect all intraregional travel, including commute travel; shopping, personal business, social and recreational travel; passenger and commute trips to airports; and school trips.

Regulatory Context and Background:

Bay Area highway congestion is the second-worst in the nation; regional travel is slow and unreliable. The carpool lane system, which has been under construction for over 30 years, is fragmented by gaps. If we rely on traditional funding sources, these gaps will not be fully closed for many decades due to the lack of funds, making carpools and transit less effective.

Currently, the Bay Area is authorized to develop and implement only a handful of express lane projects in Alameda and Santa Clara counties. The first such projects, on Interstates 580 and 680, are now under construction and are scheduled to open in 2010/2011.

MTC will seek authority to implement the regional Express Lane Network under existing law:

- California Streets and Highways Code Section 149.7 empower the California Transportation Commission (CTC) to authorize two express lane facilities in Northern California.
- The California Transportation Finance Authority, created in 2009, is empowered to grant local and regional agencies the authority to issue toll revenue bonds and implement express lane project.

. Key features will include:

- A management and operations structure involving the BATA, the county Congestion Management Agencies, Caltrans, and the California Highway Patrol.
- Conversion of 500 miles of existing or fully funded HOV lanes to express lanes.

- Construction of 300 miles of new express lanes, including 200 miles of gap closure and 100 miles of outward expansion. The outward expansion segments are:
 - I-80 SOL: I-505 to Yolo County Line – 28 miles
 - I-80 SOL: Air Base to I-505 – 18 miles
 - I-580 ALA: Greenville to San Joaquin County Line – 17 miles
 - US 101 SCL: Cochrane to SR 25 – 30 miles
- Qualifying carpools and public transit use network free of charge; non-carpoolers pay toll (collected electronically).
- Free-flowing traffic for carpools, buses and toll payers maintained by adjusting tolls as congestion rises and falls.
- Toll revenue pays for construction, operation, maintenance and enforcement of the Express Lane Network, with remaining net revenue available for additional transportation improvements, including public transit, in network corridors. Current law requires net revenue from express lanes be spent in the corridor in which it was generated.

The Express Lane Network will be built in phases; the first phase will likely include primarily HOV conversions, followed by gap closures, with the last segments being the outward extensions.

MTC expects that the express lanes will be operated on a full-time (24/7) basis when tolling is introduced in a corridor, subject to further evaluation.

Implementation Actions:

Phase 1 (2012)

MTC will implement the following express lane projects (\$2.7 billion)⁵:

- Existing Express Lane projects under development on I-680 (Sunol), I-580, SR 85 and US 101, including the SR 237/I-880 direct connector
- I-680 corridor from the I-680/SR 24 interchange south
- I-880 corridor in Alameda and Santa Clara counties
- I-80 in Alameda and Contra Costa
- Portions of US 101 in Marin and Sonoma County
- SR 87 in Santa Clara County
- I-280 in Santa Clara County
- Bridge approaches (SR 84, SR 92, and on I-680 and I-80)
- SR 237 in Santa Clara
- I-80 between Air Base and I-680
- I-80 between I-680 and the Carquinez Bridge

Phase 2 (2020)

⁵ Assumes project implementation during Phase 1/Phase 2 time horizons. The actual implementation year is subject to change based on the Bay Area Express Lane implementation plan.

The outward expansion projects (see list in Regulatory Context and Background section above) identified in Phase 2 are included subject to additional air quality analysis to determine if they will be beneficial for air quality.

MTC to implement the following express lane projects (\$1 billion):

- SR 4 in Contra Costa County
- US 101 North (Novato Narrows) in Marin and Sonoma counties
- US 101 SM: Millbrae to Whipple – 22 miles
- I-80 SOL: I-505 to Yolo County Line – 28 miles
- I-80 SOL: Air Base to I-505 – 18 miles
- I-580 ALA: Greenville to San Joaquin County Line – 17 miles
- US 101 SCL: Cochrane to SR 25 – 30 miles
- I-680 in Solano County
- I-580 between 238 and I-680

Supporting Actions by Partner Entities: Local governments, transit agencies, Caltrans, and CMAAs to work with MTC as appropriate to implement express lane projects while implementing or maintaining express bus service and land uses supportive of transit.

Pollutants (tons per day)	2012	2020
ROG	0.86	0.82
NO _x	1.34	1.11
PM _{2.5}	0.28	0.37
PM ₁₀	0.66	0.9
Ammonia (NH ₃)	0.11	
Benzene	0.02	
Formaldehyde	0.01	
Acetaldehyde	0.01	
CO ₂	1855.00	2551.50
CO ₂ -e	1892	2602.53

Emission Reduction Methodology:

This analysis uses model output from the Transportation 2035 Vision Analysis which compared four different investment scenarios on a range of performance objectives: 1) Baseline, 2) Freeway Performance (Freeway Operational Improvement, 3) High-Occupancy/Toll (HOT) Lanes Network And Express + Local Bus, and 4) Regional Rail and Water Transit. The net difference between air quality emissions associated with the Baseline and the High-Occupancy/Toll and Express/Local Bus scenarios are used to determine emissions reductions associated with the project. Emissions reductions are reduced to factor out the emissions reductions associated with expanded transit service (which is modeled in TCMs A-1 and A-2). The estimated emissions reductions are interpolated for year 2012 and 2020 from 2006 and 2015 estimates.

Exposure Reduction:

This measure will reduce region-wide population exposure to air pollutants based on the estimated reduction in emissions.

Emission Reduction Trade-offs:

Implementing the express lane network and providing express bus service in these corridors should reduce freeway congestion and decrease motor vehicle emissions in the near term. ARB's motor vehicle emissions factors indicate that tailpipe emission rates for ROG, NO_x, PM, and CO₂ are lowest when vehicles travel in the 30-50 mph speed range. The estimated emission reduction benefits for this measure are based on the anticipated improvement in average vehicle speed due to expected reduction in congestion in the affected corridors. However, this measure will also increase vehicle capacity on segments within some of these corridors. While the regional travel model estimates transportation emissions due to temporal, spatial and mode shifts resulting from increased roadway capacity, the potential emission reduction benefits of this measure may be eroded if the increased capacity in these corridors encourages additional vehicle travel or changes in land uses that would result in longer vehicle trips. To address this issue, the Air District will perform an independent analysis to evaluate the long-term impacts of this measure on vehicle travel and emissions.

Cost:

Phase 1: \$2.7 billion

Phase 2: \$1 billion

Co-benefits:

- Travel time savings.
- Generation of net toll revenue for corridor improvements.

Monitoring Mechanisms:

- Track miles of express lanes implemented.

- Track average vehicle speeds in both express lanes and general travel lanes (changes in congestion).
- Track changes in Vehicle Hours of Delay.

Issues/Impediments:

Implementation of this TCM requires that funding is available for these programs. In addition, legislation is required to give BATA the authority to finance, develop and operate the Bay Area Express Lane Network. AB 744 (Torrico) is currently being considered by the State Legislature.

The network includes a variety of design challenges due to both environmental, geographic, and development constraints.

There is mixed public opinion regarding value pricing, with concerns about the impact on existing carpoolers, potential environmental impacts, the use of network net revenues, and charging for the use of the highway.

The program calls for rapid implementation of a large network of managed lanes, which will require significant resources and institutional support from a number of agencies.

Sources:

1. MTC's Transportation 2035 Plan and Travel Forecasts Data Summary:
http://www.mtc.ca.gov/planning/2035_plan/
2. MTC's Bay Area Express Lane page: <http://mtc.ca.gov/planning/hov/>
3. MTC's Transportation 2035 Vision Analysis:
http://www.mtc.ca.gov/planning/2035_plan/tech_data_summary_report.pdf

TCM B-4 - Goods Movement Improvements and Emission Reduction Strategies

Brief Summary:

Goods movement is a critical component of the Bay Area's economic and transportation system, and a significant contributor to air quality issues. Exposure to diesel pollution from goods movement greatly impacts the health of residents near ports, rail yards, distribution centers, and roads with high truck volumes. Investing in the Bay Area's trade corridors and continuing to offer incentives for diesel engine owners to reduce emissions will address existing air quality issues as well as help the region to prepare for continued growth in this important sector of our economy.

Purpose:

This measure will reduce emissions of the key ozone precursors, ROG and NOx, and diesel particulate matter associated with goods movement by investing in the Bay Area's trade corridors and by providing incentive funding for diesel equipment owners to purchase cleaner-than-required vehicles and equipment. In addition, some projects implemented through this measure will reduce emissions of greenhouse gases. The District will endeavor to meet the California Air Resources Board (ARB) 2007 Goods Movement Action Plan goal to reduce goods movement emissions to the greatest extent possible and at least back to 2001 levels by year 2010.

Travel Market Affected:

This measure would affect all goods movement activity within the region.

Regulatory Context and Background:

Goods movement is a critical component of the Bay Area's economic and transportation system. Whether it is delivering construction materials or consumer goods to the growing population, or exporting electronics and food throughout the world, a robust goods movement system is essential for both business and residents to function and thrive in the Bay Area.

Exposure to diesel pollution from goods movement operations greatly impacts the health of community residents near ports, rail yards, distribution centers, and roads with high truck volumes. Analysis by the Air District has found that emissions of diesel particulate matter (PM) account for 80 percent of the risk from toxic air contaminants (TACs) in the Bay Area. Twenty-two percent of the total California population living in close proximity to goods movement corridors is located in the Bay Area. This population is exposed to approximately 20 percent (or 5.6 tons per day) of the total PM and 20 percent (or 124 tons per day) of the total NOx emission from goods movement statewide.

Nearly 40 percent of the region's economic output is in manufacturing, freight transportation, and the warehouse and distribution businesses. For example, the Port of Oakland is one of the nation's busiest container ports, and although cargo volumes are

currently down due to the economic recession, projections show cargo volumes at the Port and throughout the region and state will grow significantly over the next 20 years. The Port of Oakland plays a particularly important role in supporting the state's agricultural sector, providing the primary means of transporting produce from the Central Valley to the Pacific Rim. Goods movement businesses create over 10 percent of regional employment. More than 80 percent of the goods movement in the Bay Area involves trucking in several major corridors: Interstates 80, 580, and 880 and U.S. Highway 101.

In November 2006, California voters approved Proposition 1B, a \$19.9 billion transportation infrastructure bond. Proposition 1B included a \$2 billion Trade Corridors Improvement Fund (TCIF) to improve goods movement infrastructure statewide. In 2008 the state augmented the program to nearly \$2.5 billion and programmed just over \$3 billion for high-priority goods movement projects. A coalition of regional agencies in Northern California, representing 23 counties and the three major ports, was able to secure \$825 million for 14 Northern California transportation projects that are to be in construction by 2013. Nearly \$585 million of this total will fund seven key Bay Area goods movement projects.

Proposition 1B also included \$1 billion for a Goods Movement Emissions Reduction program. The BAAQMD is responsible for developing various programs for the bond, including a diesel truck replacement program.

In addition, the California Air Resources Board (ARB) 2007 Goods Movement Action Plan seeks to meet five specific goals for addressing the air pollution associated with goods movement, including reducing "total statewide international and domestic goods movement emissions to the greatest extent possible and at least back to 2001 levels by year 2010."

In the Transportation 2035 Plan, MTC allocated \$45 million toward the District's Goods Movement Emission Reduction Program, which aims to reduce particulate matter emissions and health risks by replacing and/or retrofitting up to 800 port and general regional goods movement trucks currently operating along the Bay Area's priority trade corridors.

Since 2003, the District has spent approximately \$55.6 million on projects through the Carl Moyer Program. These funds purchased cleaner-than-required on-road, off-road, marine, rail, and agricultural equipment.

In addition, since 2003, the District has spent approximately \$18 million on projects through the Transportation Fund for Clean Air (TFCA) that reduce pollution from on-road trucks that move goods, including port trucks, garbage and street sweepers, and construction dump trucks. Beginning in 2009, the District will set aside \$1.5 million in TFCA funds a year. These dollars will fund the Advanced Technology Program, which will provide grants for heavy-duty hybrid trucks and demonstration projects.

The California Air Resources Board (CARB) has adopted rules that require owners of diesel trucks and equipment, including those associated with goods movement, such as on-road trucks and harbor craft, to limit emissions from their fleets. The federal government has also taken action to limit emissions from locomotive engines. Although these regulations will require that equipment meets stringent standards, anticipated growth in goods movement over the next 20 years may offset much of the benefits that these regulations will achieve. Thus, incentive programs offered through the District are designed to provide emission reductions that go beyond reductions required by CARB. For example, regulations require upgrades to equipment in future years; the District incentive programs offer funds for engine owners to upgrade equipment in advance of these regulations, thereby funding emission reductions that are not yet mandated. Incentive programs can also offer funds for reduction of pollutants that are not required, for example, NO_x and ROG reductions, when only PM reductions are required. In sum, although CARB (and federal) requirements will result in substantial emission reductions from the goods movement sector, incentive funding can be used to speed up these reductions or generate additional emission reductions that would otherwise not occur.

Implementation Actions:

Phase 1 (2012)

BAAQMD to implement:

- State-funded diesel emission reduction incentive programs, including the Carl Moyer Program and Proposition 1B Goods Movement program (\$144 million)
- Replacement or retrofit of port and general goods movement trucks operating in the region via Goods Movement Emission Reduction Program, (subject to availability of funding)
- The TFCA-funded Advanced Technology Program to fund hybrid heavy-duty trucks and demonstration projects (\$1.5 million a year).

Phase 2 (2020)

MTC to implement the following seven Proposition 1B Trade Corridors Improvement Fund (TCIF) projects (\$585 million):

- 7th Street Grade Separation
- I-80 Eastbound, Cordelia Truck Scales Relocation
- Martinez Subdivision Rail Corridor Improvements
- San Francisco Bay to Port of Stockton Channel Dredging
- I-580 Eastbound Truck Climbing Lane
- I-880 Improvements at 23rd and 29th Avenues
- Outer Harbor Intermodal Terminals

BAAQMD to continue implementation of:

- Goods Movement Emissions Reduction Program to replace or retrofit up to 800 port and general goods movement trucks operating in the region (\$45 million)
- State-funded diesel emission reduction incentive programs (\$384 million)

Supporting Actions by Partner Entities:

- Local governments, Ports, goods movement businesses and other agencies to work with the District to implement grant programs that fund diesel emission reduction programs.
- Local government, Ports, Caltrans and other agencies to work with MTC as appropriate to implement TCIF projects.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG		0.59
NO _x		4.81
PM _{2.5}		0.06
PM ₁₀		0.28
Diesel PM		0.12
Benzene		0.01
Formaldehyde		0.05
Acetaldehyde		0.09
CO ₂		3966.08
CO ₂ -e		4045.00

Emission Reduction Methodology:

Diesel emission reduction program emission reduction estimates are based on emission reductions achieved in past funding years.

Proposition 1B TCIF Projects: Emissions reductions were estimated as a part of the project application for TCIF funds. Growth factors were applied to emissions reduction estimates to bring them to analysis year 2020.

Exposure Reduction:

The District and California Air Resources Board (CARB) studies show that 80% of the risk from toxic air contaminants in the Bay Area comes from diesel particulate emissions. This measure addresses this air quality problem by reducing emissions from vehicles and equipment used in goods movement. This measure directly addresses air quality in impacted communities.

Emission Reduction Trade-offs:

Adding diesel retrofit devices to diesel engines may result in a decrease in fuel efficiency, thereby increasing emissions of carbon dioxide. For example, CARB and the EPA estimate that a heavy-heavy duty (HHD) diesel truck with a retrofit device added would experience a decrease in fuel efficiency of 3.5 percent on average. By District staff computations, for a

HHD truck traveling 30,000 miles per year, this decrease is estimated to result in an additional 4,382 pounds per year of carbon dioxide.

Cost:

Phase 1: \$146 million

Phase 2: \$1 billion

Co-benefits:

- Energy/fuel cost savings from more efficient and reliable engines.
- Economic benefits from faster, more efficient goods movement.

Monitoring Mechanisms:

- Completion of major project milestones for TCIF projects.
- Changes in Vehicle Hours of Delay (VHD) on TCIF corridors.
- Number of goods movement trucks retrofitted or replaced through the Goods Movement Emission Reduction program, and amount of emissions reduced through these retrofits/replacements.
- Number of grants and amount of money awarded through Carl Moyer Program and the Alternative Technology Program, emissions reduced through these grants.

Issues/Impediments:

In designing and implementing goods movement efficiency measures, care should be taken to avoid creating induced demand for goods movement that could increase emissions.

High costs to reduce emissions from aging goods movement equipment and infrastructure may be burdensome for the private sector. For example, large diesel trucks, some of which stay on the road for many years and are replaced at a slow rate, often operate on very small profit margins.

Funding availability may constrain the implementation of goods movement emission reduction programs.

Technological issues may be a limiting factor in retrofitting and replacing on- and off-road mobile sources due to technical capabilities, availability and rate of deployment.

Under existing guidelines, incentive funding can only be made available for projects that reduce emissions that are surplus and not required by existing regulation. As CARB regulations that require owners of diesel engines to replace or retrofit these engines are phased in over the next several years, the number of engines that are eligible for incentive funding will decrease. Therefore, it may be difficult to achieve the same amount of emission reductions through the existing incentive programs. However, since diesel engine owners will be required to reduce emissions by CARB regulations, the Bay Area will still benefit from cleaner diesel operations.

The uncertain state of the economy may limit the number of diesel equipment owners willing to enter into contracts to receive incentive funding because it commits them to monitoring and use requirements.

Sources:

1. MTC's Transportation 2035 Plan: http://www.mtc.ca.gov/planning/2035_plan/
2. MTC's Goods Movement Initiatives 2009 Update:
http://www.mtc.ca.gov/planning/2035_plan/Supplementary/T2035_Goods_movement_update.pdf
3. ARB's Goods Movement Emission Reduction Program:
<http://www.arb.ca.gov/bonds/gmbond/gmbond.htm>
4. BAAQMD's Strategic Initiatives: <http://www.baaqmd.gov/Divisions/Strategic-Incentives.aspx>
5. ARB's Carl Moyer Memorial Air Quality Standards Attainment Program:
<http://www.baaqmd.gov/Divisions/Strategic-Incentives/Carl-Moyer-Program.aspx>

TCM C-1 - Voluntary Employer-Based Trip Reduction Programs

Brief Summary:

This measure will support voluntary efforts by Bay Area employers to encourage their employees to use alternative commute modes, such as transit, ridesharing, bicycling, walking, telecommuting, etc.

Purpose:

This measure will reduce emissions of the key ozone precursors, ROG and NOx by reducing commute trips, vehicle miles traveled, and vehicle emissions. In addition, the measure will reduce emissions of particulate matter, air toxics and greenhouse gases.

Travel Market Affected:

This measure would primarily affect commute trips, which were 23% of total weekday person-trips and about 40% of weekday vehicle miles traveled for personal (non-commercial) travel in 2006 in the Bay Area.

Regulatory Context and Background:

While commute trips make up only about one-quarter of person trips they tend to be longer distance trips and they make up most peak hour trips when traffic congestion is worse. For these reasons, reducing commute vehicle trips can have a significant impact on reducing congestion and improving air quality.

Employees may choose to drive to work for a variety of reasons:

- Workplaces that are not near transit.
- Barriers to ridesharing (see TCM C-3).
- Lack of pedestrian or bicycle connectivity to transit.
- Lack of “first mile” or “last mile” connectivity at origin or destination.
- Lack of bicycling amenities such as bicycle racks/lockers or showers at transit stations or workplaces.
- Lack of information regarding other travel options.
- Availability of free (or underpriced) vehicle parking.

Since 1996, Senate Bill 437 has prohibited mandatory employer trip reduction programs. However, many employers participate in these types of program on a voluntary basis.

511 Rideshare is one component of 511, MTC’s regional transportation information program, which provides a suite of services to facilitate carpooling, vanpooling, taking transit and bicycling. These programs are designed to remove some barriers identified above. 511 Rideshare and congestion management agencies (CMAs) conduct outreach to employers, providing information and encouragement to implement programs that will influence employees to use alternate modes of transportation. 511 Rideshare services and tools include: consultations, marketing and outreach, work site events, employee surveys,

density maps, relocation assistance, online ridematching, vanpool formation and support, commute incentives, and employer referrals. (For additional elements of 511 Rideshare, see TCM C-3).

MTC, through 511 Rideshare, provides funds to each of the 9 county CMAs to conduct outreach to employers in their county. Employer outreach focuses on describing and marketing each of the rideshare services and tools provided by 511 (described above), encouraging implementation of trip reduction programs, as well as informing employers of county-level incentives (see TCM C-3).

BAAQMD administers the Spare the Air program, encouraging individuals to take actions to improve air quality on days when air quality is forecasted to be unhealthy. On summer days with unhealthy levels of ground-level ozone forecast, individuals are encouraged to take transit, carpool, and/or curb driving. As a part of this program, employers participating in the Spare the Air Employer Network designate coordinators to inform their workforce of impending Spare the Air days, educate employees about the ways individuals can improve air quality, and motivate them to take action. BAAQMD provides educational information, incentives and support to participating employers.

Since 2003, BAAQMD's Transportation Fund for Clean Air (TFCA) program has allocated \$117 million for local projects that reduce motor vehicle emissions in the Bay Area. TFCA is funded by a surcharge on motor vehicle registration fees paid within BAAQMD's jurisdiction. The surcharge revenues are to be used to implement specific transportation control measures that are developed and adopted in BAAQMD's Clean Air Plans and are pursuant to the requirements of the 1988 California Clean Air Act. Programs funded by TFCA include regional and local rideshare programs, vanpool/buspool programs, bicycle lockers, rack and parking stations, bicycle paths and lanes.

The Bay Area Clean Air Partnership (BayCAP) ran a shuttles project from 2001 - 2006. The major employer and business organizations involved in BayCAP saw untapped potential for shuttle expansions in the Bay Area. Private sector entities saw the project as an opportunity for a public/private partnership to improve air quality. The shuttles project was funded by BAAQMD with the goals of increasing the Bay Area shuttle ridership, improving partnerships among public agencies, providing technical support and networking information, and improving policy-maker understanding of Bay Area shuttle programs. As Bay Area population grows and public transportation agencies expand service, we will need new shuttles to serve new stations and handle increased overall passenger loads.

Federal law and IRS regulations allow employers to provide transit passes to their employees on a pre-tax basis up to \$230 per month; this substantially reduces the out-of-pocket cost of transit to employees. Many employers already make this benefit available to their employees, either by providing free or subsidized passes to their employees, or by allowing the employee to purchase a transit pass with pre-tax dollars. The employer also benefits by not having to pay payroll taxes on the cost of the transit pass. In fall 2008 the

City of San Francisco adopted a Commute Benefits Ordinance which requires employers with 20 or more employees to offer employees the opportunity to purchase transit passes with pre-tax dollars. By expanding the number of employers who offer transit benefits, the ordinance should help to retain and increase transit use for commute trips. This is especially important in the current economic environment in which transit agencies have been forced to impose significant fare increases to compensate for cuts in public funding and reduced farebox revenues.

Implementation Actions:

Phase 1 (2012)

- MTC to continue to implement employer elements of 511 Rideshare (\$2 million).

BAAQMD to:

- Continue to implement employer elements of the Spare the Air program, evaluate program effectiveness, and implement new ideas to expand the scope and improve the effectiveness of the program at workplaces (\$6 million). Note that the costs associated with this program are accounted for under TCM C-3.
- Continue to provide TFCA funding for shuttle/feeder buses (\$9 million).
- Support legislation to maintain and expand incentives for employer programs, such as tax deductions and credits.
- Encourage local cities to adopt transit benefit ordinances, similar to the ordinances that have been adopted by the cities of San Francisco, Richmond, and Berkeley.
- Support legislation to empower air districts and/or local governments to adopt employer-based trip reduction requirements. (This item is also addressed in the CAP Leadership Platform.)
- Encourage employers and other entities to utilize webcasting and related technologies to reduce travel for business meetings.
- Consider implementing a program similar to the (2001-2006) BayCAP shuttle program. The new program could include any or all of the following elements:
 - Encourage coordination between the private and public sector.
 - Study and implement a consistent regional shuttle program.
 - Encourage the integration of shuttles in regional rail plans and in the planning process.
 - Encourage the expansion of current shuttle operations.
 - Promote the benefits of shuttles to employers, employees, transit operators, and regional agencies.
 - Study alternative access modes to regional transportation stations/hubs, specifically frequent shuttle/feeder buses, from under used parking lots.
 - Study and promote the concept of rapid shuttles using park and ride parking capacity to meet the same need as transit hub parking structures.
 - Work with large housing developments to provide guidance and implement rapid shuttles as an alternative to driving.

Phase 2 (2020)

- MTC to sustain employer elements of 511 Rideshare and CMA programs (\$17 million).
- BAAQMD to sustain other Phase 1 actions (\$40 million).

Supporting Actions by Partner Entities:

- Congestion Management Agencies will continue to implement employer element of CMA programs.
- Local governments are encouraged to require mitigation of vehicle travel as part of new development approval, adopt transit benefits ordinances in order to reduce out-of-pocket transit costs to employees, and develop innovative ways to encourage rideshare, transit, cycling and walking for work trips.
- Transit agencies and shuttle providers should continue to implement and expand shuttle and feeder bus service to complement fixed routes transit service and reduce the demand for parking at transit stations.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.08	0.07
NO _x	0.10	0.07
PM _{2.5}	0.00	0.00
PM ₁₀	0.03	0.04
Ammonia (NH ₃)	0.01	0.01
CO ₂	94.73	103.82
CO ₂ -e	97.00	105.90

In addition to the pollutants shown above, this measure will reduce emissions of the following air toxics by less than 0.01 tons per day: benzene, 1,3 butadiene, formaldehyde, and acetaldehyde.

Emission Reduction Methodology:

Employer elements of 511 Rideshare: This analysis uses a calculation of vehicle trips and vehicle miles traveled reduced through outreach to employers as a part of a previous analysis conducted by 511 Rideshare staff to estimate the combined impacts of travel demand management programs, both for those implemented by MTC and by local partners such as CMAs without double counting any impacts at both the county and regional level. The ratio of trips reduced to total employment in FY 2006-07 (the year the analysis was carried out) is then applied to projected employment levels in 2012 and 2020.

This measure also includes emission reductions based on TFCA funding for shuttle buses. The estimate from this program is based on emission reductions from previous years of the program.

Note that the emission reductions associated with the Spare the Air program are accounted for under TCM C-3.

Exposure Reduction:

This measure will reduce region-wide population exposure to air pollutants based on the estimated reduction in emissions.

Emission Reduction Trade-offs:

None identified.

Cost:

Phase 1: \$ 17 million

Phase 2: \$ 57 million

Co-benefits:

- Reduced travel costs for employees.
- Reduced costs in provision of parking for employers.

Monitoring Mechanism:

- Track number of employers contacting 511 Rideshare for employer services offered.
- Track number of employees served by BayCAP and regional shuttle programs and emission reduced.
- Number of grants and amount of money awarded through TFCA Program and emissions reduced through grants.
- Track municipalities implementing commute benefit ordinances.

Issues/Impediments:

Pursuant to Section 40717.9 of the California Health & Safety Code, the Air District cannot require employers to implement trip-reduction programs. Since the Air District must rely on voluntary participation, this limits the ability to expand employer participation. The current economic downturn and cost of implementing trip reduction programs may also limit employer's willingness to participate. However, future legislation may repeal or revise Section 40717.9 of the California Health & Safety Code, or provide new incentives for employer-based trip reduction programs.

Implementation of this TCM requires that funding is available for this program. Potential lack of funding would preclude MTC, CMAs, county transportation authorities, cities, etc., from implementing this TCM as described.

The BayCAP Shuttles Project identified key barriers that must be addressed if the region is to expand its shuttle system and increase transit ridership, including:

- No consistent regional shuttle program.
- Shuttles are not yet seen as an integral part of the regional rail network.
- Lack of on-going regional funding (TFCA funding is only regional funding available for shuttles).
- Most shuttles are at the work-end; very little experimentation with home end shuttles.

- With certain notable exceptions such as Caltrain/SamTrans/VTA, shuttles are not high priority and shuttles programs are not institutionalized at most transit agencies.
- Some transit agencies see shuttles as competition for fixed route services.

Sources:

1. MTC's Transportation 2035 Plan: http://www.mtc.ca.gov/planning/2035_plan/
2. [South Hayward BART Development, Design and Access](http://www.bart.gov/docs/planning/SouthHaywardDevelopDesignAccessPlanpartA.pdf) Plan: <http://www.bart.gov/docs/planning/SouthHaywardDevelopDesignAccessPlanpartA.pdf>
3. Bay Area 2005 Ozone Strategy: <http://www.baagmd.gov/Divisions/Planning-and-Research/Plans/Bay-Area-Ozone-Strategy/2005-Bay-Area-Ozone-Strategy.aspx>
4. San Francisco County Transportation Authority. Draft Strategic Analysis Report: "The Role of Shuttle Services in San Francisco's Transportation System." November 17, 2009. http://www.sfcta.org/images/stories/Planning/Shuttles/ShuttleSAR_Draft_PnP111709.pdf.

TCM C-2 - Safe Routes to Schools and Safe Routes to Transit Programs

Brief Summary:

This measure will facilitate safe routes to schools and transit by providing funds and working with transportation agencies, local governments, schools, and communities to implement safe access for pedestrians and cyclists. Likely projects will include implementation of bicycle facilities, such as lanes, routes, paths, and parking, and improvements to pedestrian facilities, such as sidewalks/paths, benches, reduced street width, reduced intersection turning radii, crosswalks with activated signals, curb extensions/bulbs, buffers between sidewalks and traffic lanes and streets trees.

Purpose:

This measure will reduce emissions of the key ozone precursors, ROG and NOx by improving bicycle and pedestrian access to schools and transit throughout the Bay Area. In addition, the measure will reduce emissions of particulate matter, air toxics and greenhouse gases.

Travel Market Affected:

The Safe Routes to School component of this measure would affect school trips, which were 6% of total person trips in 2006, and trips to transit stops. The Safe Routes to Transit component of this measure would affect transit trips, which were 5.2% of total person trips in 2006.

Regulatory Context and Background:

Safe Routes to School is a state, regional and local program that encourages children to walk or bicycle to school by removing barriers such as lack of infrastructure, unsafe facilities that result in uninviting walking and bicycling conditions, and lack of education and enforcement programs aimed at children, parents and the community at large. In 2006, home-based grade school trips in the Bay Area accounted for nearly 1.3 million trips/day, or 6 percent of total personal trips. Safe Routes to School reduces vehicle trips to school and parents' vehicle trips to work, who may be able to switch to another mode if they do not need to drop their children off at school.

The State of California's Safe Routes to School program was established in 1999 by Assembly Bill 1475, and in 2007, legislation was passed (Assembly Bill 57) to extend the program indefinitely. Project funding has been issued for 7 two-year funding cycles, the selection of Cycle 8 projects for FY 2008-09 and FY 2009-10 is underway, and the program will continue to issue calls for projects on a bi-annual basis. Examples of Bay Area projects funded in Cycle 7 include:

- New traffic signals with countdown pedestrian heads, crosswalks, radar speed feedback signs and education activities near Ocean View Elementary School in Alameda County;
- Construction of a segment of the Lions Creek Trail for bicyclists and pedestrians, outreach and education activities near Antonio Del Buono Elementary School in Santa Clara County; and

- Installation of in-pavement lighted crosswalk, curb ramps, safety lighting, signing and striping near Windsor High School in Sonoma County.

SAFETEA established a federal Safe Routes to School program between 2005 and 2009. The federal program advises Safe Routes to School projects to include five components, “the Five Es” – engineering, education, enforcement, encouragement and evaluation. Two cycles of federal funding were issued. Examples of Bay Area projected funded include:

- Installation traffic calming features by extending curbs, narrowing an intersection, and installing a pedestrian crossing signal near Mill Valley Middle School in Marin County; and
- Funding to conduct walkability audits/workshops, focus groups, meetings with teacher and parent groups, assemblies, outreach, on-site technical assistance with local bicycle/pedestrian champions, and pedestrian educational presentations at schools in Western Contra Costa County.

In 2004, voters passed Regional Measure 2, raising the toll on the seven State-owned toll bridges by \$1.00. This extra dollar funds various transportation projects within the region, including the Safe Routes to Transit program.

Safe Routes to Transit is a program that funds bicycle and pedestrian planning and capital projects that facilitate walking and bicycling to regional transit, thereby reducing vehicle trips to transit. While removing vehicle trips to transit may have only small impacts on reducing vehicle miles traveled, these reductions have more significant impacts in reducing vehicle engine starts, which are a significant source of total vehicle emissions. The Safe Routes to Transit program is funded by MTC and administered by TransForm and the East Bay Bicycle Coalition. To date nearly \$8 million has been awarded to over 20 capital and planning projects. Example projects funded include:

- Planning for Balboa Park Ocean Avenue pedestrian/bicycle connections in San Francisco;
- Capital improvements to provide safe pedestrian/bicycle routes to Ed Roberts Campus/Ashby Bart in Berkeley; and
- Capital funds to provide electronic bicycle lockers at BART stations.

MTC’s Transportation 2035 Plan launched a new program, the Transportation Climate Action Campaign, to reduce the region’s carbon footprint. The \$400 million campaign includes new funding for Safe Routes to School and Safe Routes to Transit. These funds will supplement the available federal, state, regional and local sources committed to these sources, which are currently oversubscribed, to meet the high demand for funding for these types of projects. Note that as of December 2009, MTC approved \$80 million in the first programming cycle from the new federal transportation act for four primary climate initiatives: 1) Public Education/Outreach; 2) Safe Routes to Schools; 3) Innovative Grants; and 4) Climate Action Program Evaluation. Of the \$80 million, the Safe Routes to Schools program received \$17 million in funding. Funding has not yet been identified for the Safe Routes to Transit program.

Implementation Actions:

Phase 1 (2012)

MTC to:

- Continue to award Regional Measure 2-funded Safe Routes to Transit Program funds (\$23 million)
- Implement the Safe Routes to Schools Program component of the Transportation Climate Action Campaign (\$17 million)

Phase 2 (2020)

- MTC to pursue additional funding for Safe Routes to School and Safe Routes to Transit (\$ TBD)

Supporting Actions by Partner Entities: CMAs, transit agencies, local governments, schools, and communities to work with MTC to implement safe access for pedestrians and cyclists to schools and transit.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.01	0.01
NO _x	0.01	0.01
PM _{2.5}	0.00	0.00
PM ₁₀	0.00	0.00
CO ₂	8.02	17.51
CO ₂ -e	8.18	17.86

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: PM₁₀, PM_{2.5}, NH₃ (ammonia), benzene, 1,3 butadiene, formaldehyde, and acetaldehyde.

Emission Reduction Methodology:

Safe Routes to School: This analysis assumes increases in home-based grade school walk trips by 25-35% and increases in home-based grade school bicycle trips by 60-70%, ranges based on previous analyses of Safe Routes to School travel outcomes from the State of California's Safe Routes to School programs. Because the amount of funding expected to be available for Safe Routes to School programs will not be sufficient to fund programs at all the elementary and middle schools in the Bay Area, the 25-35% increase in walk trips and the 60-70% increase in bike trips are only applied to 2.7% of grade school trips in 2012 and 5.3% of grade school trips in 2020. VMT reduced is then calculated based on an assumed average walk-to-school distance of 0.5 miles and an assumed bike-to-school distance of 2 miles.

Safe Routes to Transit: Because there is very little empirical research estimating the impacts of Safe Routes to Transit-type improvements on travel outcomes, this analysis is grounded

in findings of one empirical study (Cervero 2001) that presents “walk-to-transit” elasticities ranging from .161-.230 for increases in sidewalk miles; that is, a 1% increase in the ratio of sidewalk miles to road miles results in a .16% to .23% increase in the probability of walking to transit. This analysis assumes a 0.5% increase in this ratio in 2012 and a 1% increase in this ratio in 2020. It also assumes a comparable increase in bicycle infrastructure and anticipated increase in the probability of bicycling to transit; although the relationship documented in the study is only for walk trips, the analysis extends the relationship to bicycle trips as results from any more suitable studies were not found. These changes in walk-to-transit and bicycle-to-transit trips are then multiplied by a 2 mile bicycle access/egress distance and a 0.7 mile walk access/egress distance to calculate vehicle miles reduced.

This analysis assumes \$17 million in SRTS and \$10 million SR2T funds available in Phase 1 (though no funding has yet been identified for SR2T), and an additional \$10 million for each program in Phase 2.

Exposure Reduction:

This measure will reduce region-wide population exposure to air pollutants based on the estimated reduction in emissions.

Emission Reduction Trade-offs:

None identified.

Cost:

Phase 1: \$ 40 million

Phase 2: \$ TBD

Co-benefits:

- Improved safety/reduced pedestrian-motor vehicle and bicycle-motor vehicle accidents.
- Improved public health/reduced obesity.
- Reduced travel costs.

Monitoring Mechanisms:

- Track the number of new Safe Routes to School programs and the change in number of bicycle and walk trips to school at schools with Safe Routes to School programs
- Track the number of new Safe Routes to Transit Projects

Issues/Impediments:

Implementation of this TCM requires that funding is available for these programs. The Safe Routes to School and Safe Routes to Transit programs receive a high volume of grant applications and have only limited amount of funds to award to projects. While funding for these programs have been identified in the short-term, many of these sources will sunset in the future. However, the new federal transportation bill could include additional funding for

Safe Routes to School and Transit. New funds may also be available from higher gas taxes, bridge tolls, and voter approved sales tax measures in individual counties.

Sources:

1. MTC's Transportation 2035 Plan: http://www.mtc.ca.gov/planning/2035_plan/
2. Safe Routes to School Safety & Mobility Analysis: Report to the California Legislature: http://www.saferoutespartnership.org/media/file/SR2S_Final_Report_3_1_07.pdf
3. Cervero, Robert (2001). "Walk-and-Ride: Factors Influencing Pedestrian Access to Transit." *Journal of Public Transportation*, Vol. 3, No. 4, pp. 1-23.

TCM C-3 - Ridesharing Services and Incentives

Brief Summary:

This measure will promote ridesharing services and incentives through the implementation of the 511 Regional Rideshare Program, as well as local rideshare programs implemented by Congestion Management Agencies. These activities will include marketing rideshare services, operating the rideshare information call center and website, and providing vanpool support services. In addition, this measure includes provisions for encouraging car-sharing programs where appropriate.

Purpose:

This measure will reduce emissions of the key ozone precursors, ROG and NOx by reducing single occupancy vehicle trips through the promotion of rideshare services and incentives throughout the Bay Area, and car-sharing programs where feasible. In addition, the measure will reduce emissions of particulate matter, air toxics and greenhouse gases.

Travel Market Affected:

The ridesharing component of this measure would primarily affect commute trips, which were 23% of total weekday person-trips and approximately 40% of weekday vehicle miles traveled for personal travel in 2006 in the Bay Area. Car-sharing programs are more likely to affect discretionary trips for shopping, errands, business and recreational purposes.

Regulatory Context and Background:

Ridesharing

While commute trips make up only about one-quarter of person trips, they tend to be longer distance trips and they make up most peak hour trips when traffic congestion is worse. For these reasons, reducing vehicle trips to workplaces can have a significant impact on reducing congestion and improving air quality.

Barriers to ridesharing include:

- Difficulty for individuals in identifying others who both live and work proximate to them.
- Difficulty in setting up the logistics of a vanpool (such as establishing driver(s), shared payment for gas and other costs, identifying parking places, etc.).
- Needing to factor in travel time to pick-up other carpoolers.
- Needing flexibility to change travel schedule due to emergencies.

511 Rideshare is MTC's regional rideshare program, providing a suite of services to facilitate carpooling and vanpooling online (511.org) and by telephone (511). These programs help remove some barriers to ridesharing identified above, provide additional incentives for ridesharing, and include:

- A regional ridematching system which connects commuters who live and work near one another (for employer elements of 511 Rideshare see TCM C-1).

- Information and incentives for carpools and vanpools, including gas cards for carpoolers, seat subsidies for vanpoolers, and prizes for both types of ridesharing.
- CMAs, county transportation authorities, cities and counties provide a range of different incentives to encourage non-single occupant vehicle commute trips. Eligibility requirements and types of incentives available vary and include (or will include) the following⁶:
 - Alameda County: guaranteed ride home in emergencies.
 - ACE Rail: guaranteed ride home in emergencies for those who hold monthly ACE Rail passes.
 - 511 Contra Costa: guaranteed ride home in emergencies, discounted vanpool fare for new vanpoolers, cash incentives for vanpool drivers who sustain a vanpool for one year, gift card incentives for carpool participants, complimentary transit tickets for commuters who currently drive alone.
 - Marin County: incentives for new vanpools and guaranteed ride home.
 - Napa County: guaranteed ride home in emergencies, gas cards for new back-up vanpool drivers, gas cards for new vanpools.
 - San Francisco County: preferential vanpool parking, guaranteed ride home in emergencies, carpool parking permits.
 - San Mateo County: guaranteed ride home in emergencies, gas cards for carpool participants, discounted vanpool fare for new vanpoolers, discounted purchase and installation costs for employers to provide bike racks/lockers, free transit coupons for new riders, free lunchtime taxi service.
 - Santa Clara County: EcoPass Transit annual transit pass on South Bay transit systems (for participating employers), preferential parking for 4+ carpools.
 - Solano County: guaranteed ride home in emergencies, gas cards for new back-up vanpool drivers, gas cards for new vanpools, discounted bicycle purchase.
 - Sonoma: guaranteed ride home in emergencies, free 2+ carpool parking in downtown garages, reduced cost transit passes.

Car-Sharing

Car-sharing allows people to forgo or reduce the number of cars in their household and rely on other modes for most of their trips, but still have convenient access to a car when needed for occasion use. There are currently two car-sharing organizations in the Bay Area: City Carshare is a nonprofit organization and Zipcar, (which merged with Flexcar in 2007) is a for profit corporation. Members join for a monthly fee, pay an hourly use fee that includes gasoline, and can schedule use of a car over the internet. Car-sharing has been available in the Bay Area since 2001, but has a longer history in Europe. Members can pick up cars at locations around San Francisco and the east bay, including Oakland, Alameda, Berkeley, Albany, El Cerrito, and in Palo Alto at Stanford University. The advantages to car-sharing include:

⁶ See 511 Rideshare's Commute Rewards and Incentives: County Incentives webpage at http://rideshare.511.org/rideshare_rewards/county.asp.

- Fixed costs are lower than owning a car. Zipcar members report an average savings of approximately \$500 a month when they join Zipcar compared to owning their own car. These fixed costs include car payments, licensing, garage fees, insurance, and maintenance.
- Regardless of how often an owner uses a car, there are high fixed costs to owning a car and lower marginal costs, such as fuel and parking charges. Because of the ratio of fixed costs to marginal costs, car owners tend to use their private auto for trips that could be served by other less polluting transportation modes, including transit, walking and biking. In contrast, car sharing has lower fixed costs and higher marginal costs. This encourages members to use other transportation modes when available and convenient. Overall, car-sharing encourages members to reduce their total number of vehicle trips by taking advantage of other modes of travel.
- For low income people, car-sharing can augment transit, walking and bicycle trips to make occasional trips carrying cargo or outside the transit system's service area.
- Car-sharing service is also available to businesses. This can help Bay Area businesses save money otherwise spent on maintaining, insuring and garaging a fleet of cars.

Implementation Actions:

Phase 1 (2012)

MTC to implement the following actions (\$17 million):

- Continue to provide 511 RideMatch service and implement website enhancements including a trip-tracking tool, functionality for administration of employer-based and local agency-based incentives, a quick search matching tool, and improved interface functionality for employers.
- Continue to provide rideshare support services, including call center services, program marketing and materials and vanpool support services.
- Continue administration of 511 Rideshare Rewards annual campaign and provision of incentives for carpools and vanpools.
- Implement incentive programs sponsored by congestion management agencies, county transportation authorities, cities and counties, and transit agencies.
- Encourage the expansion of car-sharing services.

BAAQMD will encourage car-sharing, as appropriate, as a potential CEQA and ISR mitigation measure.

Phase 2 (2020)

Sustain Phase 1 programs (\$47 million)

Supporting Actions by Partner Entities:

- Local governments, CMAs, and employers to encourage ridesharing and create incentives to promote ridesharing.
- CMAs that support existing local rideshare programs to continue to fund these programs.
- Caltrans to identify and develop new Park and Ride sites as needed.

- Explore the option to encourage or require new projects to include dedicated car-sharing parking spaces and car-sharing services in-lieu of required parking spaces.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.09	0.06
NO _x	0.10	0.05
PM _{2.5}	0.01	0.01
PM ₁₀	0.01	0.02
Ammonia (NH ₃)	0.03	0.03
CO ₂	150.03	170.03
CO ₂ -e	153.00	173.43

In addition to the pollutants shown above, this measure will reduce emissions of the following air toxics by less than 0.01 tons per day: benzene, 1,3 butadiene, formaldehyde, and acetaldehyde.

Emission Reduction Methodology:

This analysis uses a calculation of vehicle trips and vehicle miles traveled reduced through rideshare services and incentives as a part of a previous analysis conducted by 511 Rideshare staff to estimate the combined impacts of travel demand management programs, both for those implemented by MTC and by local partners such as CMAs without double counting any impacts at both the county and regional level. The ratio of trips reduced to total employment in FY 2006-07 is then applied to projected employment levels in 2012 and 2020.

The estimated emission reductions do not include any reductions from car-sharing programs.

Exposure Reduction:

This measure will reduce region-wide population exposure to air pollutants based on the estimated reduction in emissions.

Emission Reduction Trade-offs:

None identified.

Cost:

Phase 1: \$17 million

Phase 2: \$47 million

Co-benefits:

- Reduced travel costs for employees through ridesharing and for Bay Area residents, businesses and visitors through car-sharing.

- Reduced costs in provision of parking for employers.
- Support additional options for residents who seek to reduce their dependence on private vehicles for environmental and financial reasons.

Monitoring Mechanisms:

- Track number of carpools and vanpools matched through the 511 RideMatch service
- Track number of carpools and vanpools participating in 511 Rideshare Rewards program

Issues/Impediments:

Ridesharing

Surveys and focus groups indicate that many commuters need flexibility in their daily trips to conduct errands, or pick-up and drop-off children. This reduces the market for carpooling and vanpooling as traditional participation requires fixed schedules among participants. Incentive programs such as guaranteed ride home programs, which are available to most Bay Area employees, and/or encouraging participants to try carpooling once or more per week can alleviate this impediment.

Potential lack of funding would preclude MTC, CMAs, county transportation authorities, cities, etc., from delivering this TCM as scoped.

Employer support of ridesharing programs, which complement the regional services and incentives, are limited by the economic downturn.

Car-Sharing

Car-sharing works best in dense urban areas; it may not be viable in all parts of the Bay Area.

Sources:

1. MTC's Transportation 2035 Plan: http://www.mtc.ca.gov/planning/2035_plan/
2. <http://www.citycarshare.org/>
3. <http://www.zipcar.com/>

TCM C-4 - Conduct Public Outreach & Education

Brief Summary:

This measure will encourage Bay Area residents to make choices that benefit air quality by educating the public about the health effects of air pollution and the air quality benefits of choosing transportation modes that reduce motor vehicle use, such as carpooling, vanpooling, taking public transit, biking, walking, and telecommuting. BAAQMD will implement this measure through the Spare the Air (STA) Every Day campaign and the Spare the Air episodic program (“STA Alerts”). In addition, MTC and BAAQMD in partnership will implement the outreach component of the Transportation Climate Action Campaign. Implementation actions include marketing and incentive programs to alert the public to the connection between air pollution and motor vehicle usage, and promoting the benefits of reducing single-occupant motor vehicle use every day, and in particular on poor air quality days when BAAQMD issues a STA Alert.

Purpose:

This measure will reduce emissions of the key ozone precursors, ROG and NOx, by educating the public about air quality in the Bay Area and encourage residents, employers and local governments to make choices that have a positive effect on air quality, particularly regarding transportation and consumer activities. In addition, the measure will reduce emissions of particulate matter, air toxics and greenhouse gases.

Travel Market Affected:

This measure would target all intraregional travel, including commute travel; shopping, personal business, social and recreational travel; passenger and commute trips to airports; and school trips. The Spare the Air program emphasizes reduction in morning commute trips. In addition, this measure may help to reduce emissions from the use of consumer products, lawn and garden equipment, recreational watercraft, etc.

Regulatory Context and Background:

Public education and outreach are an important part of the overall strategy to reduce motor vehicle travel and emissions. The BAAQMD administers several public education programs, including Spare the Air (STA) Every Day and the Spare the Air Alert programs. The BAAQMD encourages voluntary actions that reduce air pollution throughout the year.

The STA Every Day Program is the backbone of the BAAQMD’s efforts to encourage the public to take direct action to reduce emissions and improve air quality. Since motor vehicles are the leading source of ozone forming emissions in the Bay Area, efforts to reduce vehicle travel, particularly on days with Spare the Air Alerts, can help avoid exceedances of federal and state standards. STA Every Day includes the following components:

- Outreach Program

- STA Alert notifications via media channels, alert notification sign up lists, and the employer program.
- Advertising campaign through print, billboards, TV ads and website ads.
- Media outreach through news programs and community based outreach channels, such as newsletters.
- Outreach at community events, such as county fairs.
- Coordination with MTC/511.
- Employer Program (see TCM C-1)
- Community Resource Teams
 - Local civic groups, agencies, businesses and environmental organizations meet regularly and work collaboratively to implement projects that promote cleaner air. Team members, with BAAQMD support, are responsible for developing and carrying out local projects.
 - Currently there are nine STA Resource Teams meeting and working together within the Bay Area's nine counties.
- Youth Programs
 - *Protect Your Climate* curriculum which includes 16 lessons for 4th and 5th grade students that focus on air pollution, energy, waste reduction and transportation.
 - *Clean Air Challenge* curriculum, a science-based curriculum which includes experiments that help students understand air pollution and climate change.
 - *Cool the Earth*, a greenhouse gas reduction program for K-8th grade students and their parents.
 - *As the World Warms*, a classroom supplement including news stories and puzzles on climate change for elementary aged students.
 - Development of the *eCO2 Commute Challenge* Project Manual, a tool to help high schools students become a part of the solution to climate change by taking action in their schools to reduce greenhouse gas emissions from student commutes by promoting walking, biking, riding the bus and carpooling.
 - Air District staff make presentations in the classroom as requested by teachers.

MTC's Transportation 2035 Plan launched a new program, the Transportation Climate Action Campaign (TCAC), to reduce the region's carbon footprint. The campaign, which will be implemented by MTC and the BAAQMD in partnership, includes funding for outreach activities to educate Bay Area residents about how they can reduce emissions of greenhouse gases (and criteria air pollutants) on an everyday basis. The outreach campaign will feature multiple outreach messages directly linked to action programs, incentives, projects, policies and advocacy focused on two complementary themes: 1) Smart Driving/Vehicles: actions to reduce emissions of greenhouse gases on a per-mile basis via driving behaviors and vehicle improvements as discussed above, and 2) Smart Traveling: actions to reduce emissions of greenhouse gases by promoting alternatives to driving: e.g., transit, biking, walking, carpooling and telecommute. Note that as of December 2009, MTC approved \$80 million in the first programming cycle of the new federal transportation act for four primary climate initiatives: 1) Public Education/Outreach; 2) Safe Routes to Schools; 3) Innovative Grants;

and 4) Climate Action Program Evaluation. Of the \$80 million, the public education/outreach element received \$10 million in funding.

Implementation Actions:

Phase 1 (2012)

- MTC and BAAQMD to implement outreach component of Transportation Climate Action Campaign (\$10 million).
- BAAQMD to implement Spare the Air Every Day Campaign including STA Alerts, employer program, community resources team, and youth programs (\$6 million).

Phase 2 (2020)

- MTC and BAAQMD to continue implementing outreach component of Transportation Climate Action Campaign (\$TBD).
- BAAQMD to continue implementing Spare the Air Every Day Campaign including STA Alerts, employer program, community resources team, and youth programs (\$16 million).

Supporting Actions by Partner Entities: Local governments, transit agencies, CMAs, schools, media outlets, and businesses are encouraged to participate in the campaign.

Emission Reductions:

The STA Every Day and TCAC programs will result in the following emission reductions, expressed in tons per day.

Pollutants (tons per day)	2012	2020
ROG	0.02	0.01
NO _x	0.02	0.01
PM _{2.5}	0.00	0.00
PM ₁₀	0.00	0.00
CO ₂	38.99	46.96
CO ₂ -e	40.42	47.90

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: NH₃ (ammonia), benzene, 1,3 butadiene, formaldehyde, and acetaldehyde.

Emission Reduction Methodology:

Emission reductions estimates are based on aggregated survey information collected after STA Alerts. The STA Alert data shows that 5 percent of the surveyed population changed travel behavior due to the alert. These individuals were more likely to forgo discretionary (non-work) vehicle trips than work trips. This travel behavior data was then applied to STA Every Day and TCAC programs based on the assumption that the STA Every Day program would result in a behavior change at one-tenth the rate (0.5%) of the episodic Spare the Air

program. This is a conservative assumption: the program may provide greater emission reductions.

Exposure Reduction:

This measure will reduce region-wide population exposure to air pollutants based on the estimated reduction in emissions.

Emission Reduction Trade-offs:

None identified.

Cost:

Phase 1: \$13 million

Phase 2: \$16 million

Note that 3 million of the funds available for the TCAC Program are accounted for under TCM C-5.

Co-benefits:

This measure raises the awareness of the public about the causes of and solutions to the air pollution problem. People who choose to change their travel or other behaviors in response to a voluntary request for a STA Alert may reduce vehicle use or change other polluting activity on a regular basis, as advocated in the STA Every Day and TCAC programs.

Monitoring Mechanisms:

BAAQMD will continue to conduct surveys of travel behavior in response to STA Alerts, possibly expanding this activity to include STA Every Day and the TCAC programs.

Issues/Impediments:

Implementation of this TCM requires that funding is available for these programs. In addition, because the Spare the Air program is voluntary in nature, its effectiveness depends on the cooperation of the general public.

Sources:

1. MTC's Transportation 2035 Plan: http://www.mtc.ca.gov/planning/2035_plan
2. BAAQMD's Spare the Air Program: <http://www.sparetheair.org/>

TCM C-5 - Smart Driving

Brief Summary:

Pollutant emissions rates vary based on the speed a vehicle is traveling. The emission/speed relationship varies for each pollutant, but emission rates generally are lowest in the 30-45 mile per hour mph range. Vehicles traveling on Bay Area freeways at speeds above 65 mph emit significantly more ROG, NOx and greenhouse gases (GHGs) than cars and trucks traveling at speeds between 35 and 55 mph. This measure focuses on public education to encourage drivers to observe posted speed limits and adopt other fuel efficient driving practices, supplemented by more rigorous enforcement of speed limits, especially to reduce high-speed driving on freeways.

Purpose:

This measure will reduce emissions of the key ozone precursors, ROG and NOx, by reducing high speed driving. In addition, the measure will reduce emissions of particulate matter, air toxics and greenhouse gases.

Travel Market Affected:

This measure would affect all intraregional travel, including commute travel; shopping, personal business, social and recreational travel; passenger and commute trips to airports; and school trips. In addition, this measure would primarily address freeway travel within the Bay Area.

Regulatory Context and Background:

Further Study Measure 3 in the Bay Area 2001 Ozone Attainment Plan provides a foundation for this control measure. In response to FSM 3, MTC conducted an analysis on emissions created by vehicles traveling over 65 mph on freeways. This analysis shows that by limiting passenger car travel to 65 mph, there is a potential to reduce VOC by 1 to 2.8 tons per day and NOx by 0.9 to 1.9 tons per day, if applied throughout the Bay Area. Approximately 60% of Bay Area driving (VMT) takes place on the freeway system and, based on Caltrans speed monitoring data, 34% of freeway driving occurs at speeds over 65 mph. Therefore, by addressing over-the-limit freeway driving, this measure could achieve a significant amount of emission reductions. A vehicle driven at 75 mph consumes approximately 40% more fuel and emits 35% more emissions than one driven at 60 mph.

There are a variety of techniques known as “smart driving”, “green driving”, or “eco-driving” that increase the fuel efficiency of auto travel, thereby reducing emissions and saving money; these include:

- Avoiding quick starts and aggressive driving
- Reducing highway speeds (55 mph is the most efficient speed for fuel consumption)
- Using overdrive and cruise control
- Avoiding driving in rush hour
- Using air conditioning sparingly

- Reducing idling
- Reducing drag by removing roof racks, tow-hook carriers, and other items that cause wind resistance
- Removing heavy unneeded items from cars (e.g. golf clubs)
- Properly maintaining vehicles including maintaining optimal tire pressure

In Europe there have been several measures that address the relationship between travel speed and traffic safety, climate effects and air quality. Some of the measures that have been undertaken addressed speed reduction, improved speed enforcement, speed alerts, and driver education. A program to promote “ecodriving” has been implemented by several European countries. Program details vary among countries, but generally the focus is on driving school curriculums, fuel saving devices in vehicles, purchasing behavior, and vehicle maintenance. Evaluation of this program has shown positive benefits in traffic safety, GHG reductions and improved air quality.

Implementation Actions:

Phase 1 (2012)

- BAAQMD and MTC to encourage smart driving as a part of the outreach component of the Transportation Climate Action Campaign (see TCM C-4).

As resources permit, BAAQMD will:

- Coordinate and implement programs with business (e.g., tire companies, insurance companies, driving schools, and vehicle manufacturers) and public agencies.
- Implement and coordinate curriculum with high schools (Driver’s Ed) and driving schools.
- Promote/implement a voluntary certification program with fleet operators that could be used as a marketing tool, utilizing the Sustainable Earth Initiative’s Green Fleets Toolkit, which was produced with a grant from the BAAQMD.
- Evaluate and potentially promote and implement a program to purchase and install fuel consumption feedback devices in vehicles for a nominal price. Devices are available now for various vehicle models and allow drivers to get real-time information about fuel consumption. Access to this information may influence drivers to practice fuel-saving behavior, such as driving the speed limit, maintaining a steady speed, and avoiding unnecessary acceleration and braking.
- Explore and potentially establish with CHP and others agencies such as MTC and/or ARB a partnership to 1) enhance enforcement of freeway speed limits on an on-going daily basis and 2) emphasize the importance of complying with posted speed limits on Spare The Air days, including use of variable message boards on roadways and public outreach messaging.

Phase 2 (2020)

- MTC and BAAQMD to continue Phase 1 activities

Supporting Actions by Partner Entities: Local governments, transit agencies, CMAs, school

districts, other agencies, media outlets and businesses will be encouraged to join BAAQMD and other partners to create an innovative campaign to connect smart driving with climate protection.

<u>Pollutants (tons per day)</u>	<u>2012</u>	<u>2020*</u>
ROG	0.08	
NO _x	0.17	
PM _{2.5}	0.01	
PM ₁₀	0.01	
CO ₂	176.00	
CO ₂ -e	180.00	

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: NH₃ (ammonia), benzene, 1,3 butadiene, formaldehyde, and acetaldehyde.

* 2020 emission reductions are not available at this time.

Emission Reduction Methodology:

The emissions reduction estimate for this measure is based on the following assumptions:

- 35% of freeway travel occurs at speeds over 65 mph
- Of the 65 mph + driving, 50% occurs at 70 mph and 50% at 75 mph
- Speed would be reduced to 65 mph
- The actions described in this measure would reduce five percent of over-the-limit speeding (65 mph for light vehicles and 55 mph for heavy-duty vehicles).

The appropriate emission/speed factors were applied to the above assumptions to calculate the emissions reductions.

It should be pointed out that these assumptions are very conservative. The portion of high-speed driving on freeways may well exceed 35% and many drivers may exceed 75 mph. Using the same assumptions described above, if we assume that all freeway driving in excess of 65 mph were reduced to the 65 mph limit, the reductions would be on the order of 1.6 tpd of ROG, 3.3 tpd of NO_x, and 3500 tpd of CO₂.

Exposure Reduction:

To the extent that freeway corridors are a major source of emissions in many impacted communities, reducing high speed driving should help to reduce emissions of ROG, NO_x, PM, and CO₂ in these corridors and throughout the Bay Area.

Emission Reduction Trade-offs:

None identified.

Cost:

Phase 1: \$ 3 million (\$1 million per year)

Phase 2: \$ TBD

Implementation of this measure will be funded as part of the public outreach campaign described in TCM C-4. It is not yet known how much of this funding will be used to promote speed moderation. However, for purposes of estimating the cost-effectiveness of this measure, we estimate \$1 million per year.

Co-benefits:

- Economic benefits from fuel savings to individual drivers and to the Bay Area economy as whole. If all high-speed freeway driving were eliminated, based on the conservative assumptions described above, this would save approximately 360,000 gallons of gasoline and diesel per day in the Bay Area, yielding a cost savings greater than \$1 million per day.
- Reduced/less frequent servicing, maintenance and repair costs that result from reduced wear and tear of various vehicle components (i.e. tires, clutch, and engine).
- Economic savings from reduced costs associated with automobile crashes. According to the National Highway Traffic Safety Administration (NHTSA) speeding is a significant contributing factor to traffic crashes. Based on 2007 data, the NHTSA estimates that nationally speeding related crashes have a \$40.4 billion cost to society. In a 2008 Bay Area study, the American Automobile Association estimated that the total cost of car crashes (fatalities and injuries) is \$2.7 billion.

Monitoring Mechanisms:

- While monitoring changes in behavior can be difficult, voluntary programs may be monitored by participation rates.

Issues/Impediments:

Implementation of this TCM requires that funding is available for this program. In addition, this program requires collaboration between multiple agencies. Finally, at present the public is accepting of high-speed driving. This TCM requires that the public begin to recognize the consequences of high-speed driving.

Sources:

1. American Automobile Association. Crashes vs. Congestion: <http://www.aaaexchange.com/Assets/Files/2008107142430.CrashesVs.Congestionl.pdf>
2. BAAQMD. 2001 Ozone Attainment Plan: <http://www.baaqmd.gov/Divisions/Planning-and-Research/Plans/Ozone-Attainment-Plans/2001-Ozone-Attainment-Plan.aspx>
3. [European Transport Conference 2007](http://www.etcpceedings.org/paper/the-effects-of-speed-measures-on-air-pollution-and-traffic-safety): The effects of speed measures on air pollution and traffic safety: <http://www.etcpceedings.org/paper/the-effects-of-speed-measures-on-air-pollution-and-traffic-safety>.

4. Dijkema, et al. 2008. Air Quality Effects of an urban highway speed limit reduction: <http://www.sciencedirect.com>.
5. Gauderman, et al. 2007. Effect of exposure to traffic on lung development from 10 to 18 years of age. www.thelancet.com.
6. <http://www.ecodrive.org/>. Ecodriven Campaign Catalogue for European Ecodriving & Traffic Safety Campaigns.
7. UK Safe and Efficient Driving. <http://www.safed.org.uk/About.htm>

TCM D-1 - Bicycle Access and Facilities Improvements

Brief Summary:

TCM D-1 will expand bicycle facilities serving employment sites, educational and cultural facilities, residential areas, shopping districts, and other activity centers. Typical improvements include bike lanes, routes, paths, and bicycle parking facilities. This TCM also includes improving bicycle access to transit and supporting the annual Bike to Work event.

Purpose:

This measure will reduce emissions of the key ozone precursors, ROG and NOx by sustaining and improving bicycle access and facilities throughout the Bay Area. In addition, the measure will reduce emissions of particulate matter, air toxics and greenhouse gases.

Travel Market Affected:

This measure would affect all intraregional travel, including commute travel; shopping, personal business, social and recreational travel; passenger and commute trips to the airport; and school trips.

Regulatory Context and Background:

Bicycles are an inexpensive and widely available type of zero emissions vehicle. Bicycles are well-suited to a wide range of trips in urban settings. In urban contexts, bicycles compete well with cars and transit in terms of door-to-door travel time. Bikes can be combined with public transit for longer trips and trans-bay trips. Cities such as Palo Alto, Davis, Seattle, and Portland have demonstrated that bicycle use can be integrated into local transportation networks.

Improved bicycling facilities increase perceived and actual safety of travel by bicycle as well as its overall attractiveness, encouraging more travel by this mode. The average trip length for all personal trips in the Bay Area is just under 3 miles, a distance short enough for travel by bicycle. In addition, improved bicycle facilities can encourage park-and-ride users to shift modes to bike-and-ride. Bicycle improvements encourage mode shift for shorter trips, which are a majority of total personal trips. The average weekday trip length for all personal travel in the Bay Area in 2006 was 2.95 miles. Of total personal trips in 2006, 21% of trips were less than one mile, 18% were between 1 and 2 miles, 12% were between 2 and 3 miles, and 8% were between 3 and 4 miles.

Many barriers exist that prevent more bicycle trips. In particular, parts of the Bay Area lack bicycling routes that include features such as lower speed limits, bicycle lanes or other facilities, loop detectors that detect bicyclists waiting at red lights, and other complete street features.

MTC's Regional Bicycle Plan for the San Francisco Bay Area, 2009 Update was created to focus regional bicycle-related funding on high-priority bicycle facilities that serve regional

trips. The Plan defines a Regional Bicycle Network made up of key routes in each county. The Plan was updated in 2009 and was adopted as a part of MTC's Transportation 2035 Plan. MTC created the Regional Bicycle Working Group to implement the Regional Bicycle Plan. The Working Group's activities include data collection and analysis; collaboration with transit operators to provide bike parking at stations; and marketing and outreach.

In July 2006, MTC adopted Resolution 3765 to encourage the routine accommodation of bicyclists and pedestrians in projects that are funded by MTC regional discretionary funds. To implement the resolution, MTC developed a Routine Accommodation Checklist Policy, requiring project sponsors to consider the needs of bicyclists and pedestrians in project design.

In its Transportation 2035 Plan, MTC committed \$1 billion in funding over the next 25 years for the Regional Bicycle Program.

The Bicycle Facility Program (BFP) is a component of BAAQMD's Transportation Fund for Clean Air (TFCA) grant program that provides funding to reduce motor vehicle emissions through the implementation of new bicycle facilities in the San Francisco Bay Area. Since 2003, BAAQMD has awarded approximately \$14.6 million towards bicycle facility projects in the Bay Area.

MTC has created the Safety Toolbox, a website that provides tools for preventing collisions, injuries and fatalities, and encouraging walking and bicycling through partnerships between multiple disciplines, multiple jurisdictions, and the public. The site includes information on engineering and maintenance (e.g. design standards and review), law enforcement (e.g. police stings or photo enforcement to identify motorists who violate pedestrian right-of-way crossing streets), planning (e.g. pedestrian- and bicycle-friendly local policies), community involvement (e.g. local jurisdiction pedestrian and bicycle advisory committees), school districts (e.g. Safe Routes to School), and public health (e.g. health promotion).

The Transportation Development Act (TDA) is a quarter-cent sales tax that is imposed statewide in California for transportation purposes. A share of this money, TDA Article 3, goes to fund pedestrian and bicycle projects. To obtain TDA funding from MTC, local jurisdictions must have Bicycle Advisory Committee to plan and prioritize funding for bike projects.

A special issue in the bicycle community is the provision of bike lanes on the Bay bridges. Bay bridges with bicycle lanes currently include the Golden Gate, Carquinez, Antioch, and Dumbarton Bridges. The New East Span of the San Francisco-Oakland Bay Bridge and the new Benicia Bridge will also have bicycle lanes. Caltrans completed a feasibility study to install bicycle lanes on the west span of the Bay Bridge in 2001 and Bridge and Toll Authority (BATA) is currently preparing a Project Study Report (PSR) to update this analysis. In particular, it will identify a new cost estimate and update the engineering and design for the touchdown points on Yerba Buena Island and on Rincon Hill in San Francisco.

Bicycle projects are also funded as a part of MTC's Transportation for Livable Communities (TLC) program (see TCM D-3).

The regional FOCUS program (described in TCM D-3) also seeks to create communities that meet the day-to-day needs of residents in a bicycle-friendly environment.

The State of California also funds bicycle projects through its Bicycle Transportation Account (BTA) which is expected to allocate \$7.2 million statewide in FY 2009-10.

Many Bay Area counties also fund bicycle projects through their local option sales tax expenditure plans. These counties include:

- Alameda: 5% of revenues, measure sunsets in 2022
- Contra Costa: 1.5% of revenues, measure sunsets in 2025
- Marin: 3.5%, measure sunsets in 2025
- San Mateo: 3%, measure sunsets in 2033
- Sonoma: 4%, measure sunsets in 2025

Implementation of bike sharing programs is on the rise around the globe. A number of cities, such as Paris and Montreal, have successfully implemented bike sharing programs.

Implementation Actions:

Phase 1 (2012)

To improve bicycle access and facilities, MTC will:

- Fund bicycle improvements through the Regional Bicycle Program that are a part of the Regional Bikeway Network (\$19.5 million – Note: As of December 2009, MTC approved \$19.5 million in the first programming cycle of the new federal transportation act for the Regional Bicycle Program).
- Apply the Routine Accommodations Checklist Policy to projects funded by regional discretionary sources.
- Continue to fund bicycle projects with TDA Article 3 funds (\$0.4 million).
- Continue to fund and promote annual Bike to Work event (\$0.5 million).
- Continue to provide bicycle education and information dissemination via 511 Bicycle website, including the BikeMapper tool (\$0.3 million).

BAAQMD will:

- Continue to fund bicycle projects with TFCA funds through the Bicycle Facilities Program (BFP) (\$1.8 million).

ABAG will:

- Continue to work with local jurisdictions and special districts to advocate for the completion of the 500-mile Bay Trail, a planned recreational and commute corridor that, when complete, will encircle San Francisco and San Pablo Bays with a continuous

network of bicycling and hiking trails. The Bay Trail provides easily accessible recreational opportunities, as well as key transportation linkages.

Phase 2 (2020)

MTC will:

- Pursue additional funding for the Regional Bikeway Network (\$ TBD).
- Continue to fund bicycle projects with TDA Article 3 funds (\$1.4 million).
- Continue to fund and promote annual Bike To Work event (\$1.2 million).
- Continue to provide bicycle education and information dissemination via 511 Bicycle website, including the BikeMapper tool. (\$0.9 million).

BAAQMD will:

- Continue to fund bicycle projects with TFCA funds through the Bicycle Facilities Program (BFP) (\$4.8 million).
- BAAQMD will encourage MTC to meet its T2035 commitment to provide \$1 billion in funding for the Regional Bicycle Program.
- MTC, BAAQMD and ABAG will sustain other Phase 1 programs.

Supporting Actions by Partner Entities:

- Cities and counties should implement their bicycle plans, provide a comprehensive network of bicycle lanes, routes, and pathways, and provide secure bicycle parking.
- Local governments, including park districts and other special districts, should continue to build, operate, and maintain bicycle facilities.
- Local governments are encouraged to require bicycle access and amenities as a condition of approval of new development projects, and to require secure bicycle parking in existing public and private parking lots and office buildings.
- Local governments should consider using a broader approach to measure roadway performance that considers cyclists and pedestrians as well as motor vehicles, rather than relying on Level of Service (LOS) that is solely based on motor vehicle throughput.
- Caltrans, Congestion Management Agencies and local governments should implement “complete streets” policies to ensure that cyclists and pedestrians are safely accommodated on all streets and roads.
- Transit agencies should implement policies and maintain and expand facilities to accommodate bicycles on rail transit, buses and ferries.
- Local governments should consider implementing bicycle-sharing programs.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.00	0.01
NO _x	0.00	0.00
PM _{2.5}	0.00	0.00
PM ₁₀	0.00	0.00
CO ₂	4.36	9.93
CO ₂ -e	4.44	10.13

This measure will also reduce emissions of the following pollutants by less than 0.01 tons per day: ROG, NO_x, PM_{2.5}, PM₁₀, NH₃ (ammonia), benzene, 1,3 butadiene, formaldehyde, and acetaldehyde.

Emission Reduction Methodology:

This analysis uses a methodology developed using data collected around cycling facilities in the cities of Minneapolis and Saint Paul, Minnesota, to estimate use of a new cycling facility, as well as to estimate how much use is generated by the new facility versus how much is generated by existing cyclists changing routes (see Krizek et al 2006). Because the funds expected to be available to fund the RBN will not be sufficient to build the whole network, this analysis assumes 3% of the unbuilt network will be built by 2012 and 6% will be built by 2020. Using the estimated number of employed residents within ¼ mile, ½ mile, and 1 mile buffers around the unbuilt portion of the RBN and the regional bicycle commute share, the existing number of cycling commuters is estimated. The number of new commuter cyclists is then estimated based on multipliers applied to the number of existing bicycle commuters in each buffer. New cycling trips for non-work purposes are estimated based on the ratio of bike commute trips to bike non-work trips. Vehicle trips reduced is then estimated by assuming 63% of all new cycling trips will replace car trips, and vehicle miles traveled reduced is estimated by assuming a 4.54 mile average bicycle commute distance and a 2 mile average bicycle non-work trip distance. This analysis excludes emissions reductions associated with funding via TFCA, TDA Article 3, Bike to Work Day, and the provision of bicycling information via 511.org.

Exposure Reduction:

This measure will reduce region-wide population exposure to air pollutants based on the estimated reduction in emissions.

Emission Reduction Trade-offs:

None identified.

Cost:

2012: \$22.5 million

2020: \$8 million

Co-benefits:

- Improved safety/reduced bicycle-motor vehicle accidents.
- Improved public health/reduced obesity.
- Reduced travel costs.

Monitoring Mechanisms:

- Track new miles of the Regional Bikeway Network constructed and projects funded through the BFP.

Issues/Impediments:

Bicycle use is limited by factors such as physical ability, terrain, weather, and the need to carry cargo. Personal safety concerns may also prevent some people from switching modes to bicycle. Improving bicycle facilities and public education for bicyclists and drivers can increase perceived and actual safety.

Implementation of this TCM requires that funding is available for these programs. At present, funds for bicycle improvements are limited and funds to implement the bridge portion of the Regional Bikeway Network have not been identified.

Sources:

1. MTC's Transportation 2035 Plan: http://www.mtc.ca.gov/planning/2035_plan/
2. MTC's Regional Bicycle Plan for the San Francisco Bay Area 2009 Update: http://www.mtc.ca.gov/planning/bicyclespedestrians/MTC_Regional_Bicycle_Plan_Update_FINAL.pdf
3. MTC's Safety Toolbox at <http://mtc.ca.gov/planning/bicyclespedestrians/>
4. Krizek, Kevin, et al 2006. *NCHRP Report 552: Guidelines for Analysis of Investments in Bicycle Facilities*. Washington D.C.: Transportation Research Board.: http://onlinepubs.trb.org/Onlinepubs/nchrp/nchrp_rpt_552.pdf.
5. League of American Bicyclists report on the City of Davis Bicycle Plan: http://www.bikeleague.org/programs/bicyclefriendlyamerica/communities/bfc_davis.php
6. League of American Bicyclists report on the City of Portland Bicycle Plan: http://www.bikeleague.org/programs/bicyclefriendlyamerica/communities/bfc_portland.php.

TCM D-2 - Pedestrian Access and Facilities Improvements

Brief Summary:

TCM D-2 will improve pedestrian facilities and encourage walking by funding projects that improve pedestrian access to transit, employment and major activity centers. Improvements may include sidewalks/paths, benches, reduced street width, reduced intersection turning radii, crosswalks with activated signals, curb extensions/bulbs, buffers between sidewalks and traffic lanes, and street trees.

Purpose:

This measure will reduce emissions of the key ozone precursors, ROG and NOx by encouraging walking throughout the Bay Area. In addition, the measure will reduce emissions of particulate matter, air toxics and greenhouse gases.

Travel Market Affected:

This measure would affect all intraregional travel, including commute travel; shopping, personal business, social and recreational travel; and school trips.

Regulatory Context and Background:

Improved pedestrian facilities increase perceived and actual safety of walking on trips as well as the overall attractiveness of walking, encouraging more travel by this mode. About one-fifth of all personal trips are less than a mile, a short enough distance to walk. In addition, improved pedestrian facilities can encourage park-and-ride users to shift modes to walk-and-ride.

Many barriers exist that prevent people from taking more walk trips. In particular, low levels of pedestrian travel can be attributed to low density, single-use land use patterns and development of streets, roads and development projects that lack adequate attention to the pedestrian environment.

Pedestrian improvements encourage mode shift for shorter trips, especially those less than a mile. In 2006, 21% of total weekday personal trips were less than one mile. In addition, for longer trips pedestrian improvements encourage transit users who access transit by car to switch to accessing transit by walking.

These types of barriers can be overcome through a variety of techniques, including:

- Ensuring the design and placement of buildings in new developments provide amenities such as sidewalks/paths, benches, and landscaping; minimize setbacks from street; and provide entrances near sidewalks and transit stops (as well as retrofitting existing developments/streets to include these features).
- Providing an integrated street network with direct routes for pedestrians and ensuring easy pedestrian access between neighboring developments, as well as downtowns, commercial areas and community centers.

- Locating and designing parking so pedestrians have direct, attractive access (see TCM E-2)
- Promoting pedestrian-friendly land uses (see TCM D-3).
- Using street design standards that enhance pedestrian safety and comfort through measures such as reduced street width, reduced turning radii, crosswalks with activated signals, curb extensions/bulbs, buffers between sidewalks and traffic lanes, streets trees, etc.

MTC's Regional Pedestrian Committee was created in 2001. The Pedestrian Program works at the regional and community level to make walking a safe, convenient, and healthy activity by using the best engineering, public education, and law enforcement practices to minimize pedestrian injuries and fatalities.

MTC has created the Safety Toolbox, a website that provides tools for preventing collisions, injuries and fatalities, and encouraging walking and bicycling through partnerships between multiple disciplines, multiple jurisdictions, and the public. The site includes information on engineering and maintenance (e.g. design standards and review), law enforcement (e.g. police stings or photo enforcement to identify motorists who violate pedestrian right-of-way crossing streets), planning (e.g. pedestrian- and bicycle-friendly local policies), community involvement (e.g. local jurisdiction pedestrian and bicycle advisory committees), school districts (e.g. Safe Routes to School), and public health (e.g. health promotion).

Pedestrian projects are funded as a part of MTC's Transportation for Livable Communities (TLC) program (see TCM D-3).

The Transportation Development Act (TDA) is a quarter-cent sales tax that is imposed statewide in California for transportation purposes. A share of this money, TDA Article 3, goes to fund pedestrian and bicycle projects.

Since 2003, BAAQMD has awarded smart growth projects that improve conditions for pedestrians with approximately \$6 million in funds (see TCM D-3).

In 2006, MTC prepared the Bay Area Pedestrian Districts Study to encourage and improve pedestrian planning in the Bay Area. The Pedestrian Districts Study advances the use of pedestrian districts as a concept for creating better pedestrian environments in the Bay Area. Through the development of the pedestrian district typologies and real-life case studies, the study identifies the types and costs of pedestrian facilities that have the greatest impact on improving the pedestrian environment. This study is one tool that cities and counties can use in planning for pedestrian improvements.

Pedestrian projects are also subject to MTC's Routine Accommodation Checklist Policy (see TCM D-1).

The regional FOCUS program (described in TCM D-3) also seeks to create communities that meet the day-to-day needs of residents in a pedestrian-friendly environment.

Implementation Actions:

Phase 1 (2012)

MTC to:

- Continue to fund pedestrian safety and facility improvements with TLC funds (see TCM D-3) and through Safe Routes to School and Safe Routes to Transit programs (see TCM C-2).
- Continue to fund pedestrian projects with TDA Article 3 funds (\$0.6 million).

BAAQMD to:

- Continue to fund projects that enhance pedestrian facilities through TFCA funds (referred to as Smart Growth and traffic calming in TFCA guidelines, see TCM D-3).

ABAG to:

- Continue to work with local jurisdictions and special districts to advocate for the completion of the 500-mile Bay Trail, a planned recreational and commute corridor that, when complete, will encircle San Francisco and San Pablo Bays with a continuous network of bicycling and hiking trails. The Bay Trail provides easily accessible recreational opportunities, as well as key transportation linkages.

Phase 2 (2020)

- MTC to continue to fund pedestrian projects with TDA Article 3 funds (\$1.8 million).
- BAAQMD to continue to fund projects that enhance pedestrian facilities through TFCA funds (referred to as Smart Growth and traffic calming in TFCA guidelines, see TCM D-3).

Supporting Actions by Partner Entities:

- Cities and counties should provide a comprehensive network of facilities, including sidewalks, pathways and provide for pedestrian access in their development plans.
- Local governments are encouraged to require pedestrian access and amenities as a condition of approval of new development projects, such as street trees, furniture, lighting, shelter for transit patrons and inviting environments for walking.
- Local governments should consider using a broader approach to measure roadway performance that considers cyclists and pedestrians as well as motor vehicles, rather than relying on Level of Service (LOS) that is solely based on motor vehicle throughput.
- Local governments should adopt land use policies that support more compact, infill development to make neighborhoods more walkable.
- Caltrans, Congestion Management Agencies and local governments should implement “complete streets” (aka “routine accommodation”) policies to ensure that cyclists and pedestrians are safely accommodated on all streets and roads.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.00	0.01
NO _x	0.00	0.00
PM _{2.5}	0.00	0.00
PM ₁₀	0.00	0.00
CO ₂	1.72	4.26
CO ₂ -e	1.79	4.35

This measure will also reduce emissions of the following pollutants by less than 0.01 tons per day: ROG, NO_x, PM_{2.5}, PM₁₀, NH₃ (ammonia), benzene, 1,3 butadiene, formaldehyde, and acetaldehyde.

Emission Reduction Methodology:

By providing safer and more connected walking routes, funding new pedestrian infrastructure will encourage additional walk trips which would previously have been made by car. Because the location and type of pedestrian improvements that will be made with anticipated future TDA Article 3 and TFCA funds are undefined, the expected travel outcome impact is difficult to quantify. This analysis uses outputs from the more defined RBN investment and anticipated outcomes as a proxy to estimate changes in pedestrian travel. The ratio of the amount of money invested in the RBN relative to the percentage increase in cycling trips expected is applied to the amount of funds anticipated to be spent on pedestrian infrastructure to estimate the percent increase in pedestrian trips. An average walk distance of 0.7 miles is applied to determine the number of vehicle miles reduced.

Exposure Reduction:

This measure will reduce region-wide population exposure to air pollutants based on the estimated reduction in emissions.

Emission Reduction Trade-offs:

None identified.

Cost:

Phase 1: \$0.6 million

Phase 2: \$1.8 million

Co-benefits

- Improved safety/reduced pedestrian-motor vehicle accidents.
- Improved public health/reduced obesity.
- Reduced travel costs.

Monitoring Mechanisms:

- Track number of pedestrian projects funded through TLC and TDA.

Issues/Impediments:

Implementation of this TCM requires that funding is available for these programs.

In addition, long distances, inclement weather, and concerns with safety may all reduce the desirability of pedestrian travel.

Sources:

1. MTC's Transportation 2035 Plan: http://www.mtc.ca.gov/planning/2035_plan/
2. MTC's Safety Toolbox: <http://www.mtc.ca.gov/planning/bicyclespedestrians/safety/policies.htm>

TCM D-3 - Local Land Use Strategies

Brief Summary:

TCM D-3 will support and promote land use patterns, policies, and infrastructure investments that support higher density mixed-use, residential and employment development near transit in order to facilitate walking, bicycling and transit use.

Purpose:

This measure will reduce emissions of the key ozone precursors, ROG and NOx by promoting land use patterns, policies, and infrastructure investments that support higher densities and job creation near transit that facilitate walking, bicycling and transit use. In addition, the measure will reduce emissions of particulate matter, air toxics and greenhouse gases.

Travel Market Affected:

This measure would affect all intraregional travel, including commute travel; shopping, personal business, social and recreational travel; passenger and commute trips to airports; and school trips.

Regulatory Context and Background:

A significant body of research has demonstrated the relationship between land use and travel behavior. People who live in areas with higher densities; a mix of residential, retail and office uses; with well-designed pedestrian, bicycle and transit infrastructure; and that are proximate to transit service have distinctly different travel behavior. They take more transit, bicycle, and walk trips and drive shorter distances, resulting in reduced vehicle miles traveled per household. For example, key findings from MTC's Station Area Residents Survey (STARS) Report include the following:

- People who live within ½ mile of a rail or ferry station are four times as likely to use transit as people living farther than ½ mile from a rail/ferry stop.
- Individuals living and working within ½ mile of a rail/ferry stop use transit for 42% of their work commute trips, whereas those who neither live nor work within ½ mile of a station use transit for only 4% of their work commute trips.
- Households within ½ mile of rail stations/ferry generate about half of the vehicle miles traveled of their suburban and rural counterparts.
- People who live within ½ mile of rail or ferry walk about half the time for all short trips (less than one mile), whereas residents who live greater than ½ mile away walk for only about one quarter of short trips.

The National Research Council concludes that "the most reliable studies estimate that doubling residential density across a metropolitan area might lower household VMT by 5 to 12 percent, and perhaps by as much as 25 percent, if coupled with higher employment concentrations, significant public transit improvements, mixed uses, and other supportive demand management measures."

Land use is directly regulated at the local level by local governments. Cities and counties adopt local general plans, specific plans and zoning ordinances. As local governments support focused growth, these documents will be updated to promote land use patterns with increased densities and mixed land uses, focus development around transit stops, strengthen downtowns and community centers, and promote infill development and reuse/redevelopment of underutilized land.

Since 2003, BAAQMD has awarded smart growth and arterial management projects with approximately \$17.5 million in funds.

Local parking policies also impact travel behavior and offer an opportunity to encourage non-auto trips (see TCM E-2).

In July 2005, MTC adopted a landmark Transit-Oriented Development (TOD) Policy. The TOD Policy ties regional discretionary funds for new transit extension projects (funded via Resolution 3434) to supportive land uses. This policy establishes targets for new housing units in each transit corridor and calls for station area plans and corridor working groups to help achieve the housing targets. Station area plans to meet the housing targets must be adopted by local municipalities prior to receiving MTC discretionary funding for construction of Resolution 3434 funds. MTC has provided over \$10 million in funding to date to Station Area Planning grant recipients.

ABAG, MTC, BAAQMD and BCDC administer FOCUS, a voluntary, local jurisdiction-led effort to identify future locations for infill development and for the preservation of critical habitat and open space. Through this process over 60 local government entities have identified well over 100 Priority Development Areas (PDAs). PDAs are areas near transit with a mix of housing, jobs, services, and stores to meet the day-to-day needs of residents in a pedestrian- and bicycle-friendly environment. The adopted PDAs offer the chance to house over 50% of the region's 25-year housing needs on 3% of the land within the existing built environment. In addition, 98 Priority Conservation Areas have been designated as areas for protection and preservation.

Furthermore, regional agencies are committed to securing financial incentives and providing technical assistance to designated PDAs and PCAs. A few examples of funding opportunities made available to PDAs to date are the Transportation for Livable Communities Program (described below), \$229 million in Proposition 1C funds award by the Department of Housing and Community Development to 21 Bay Area communities (20 of the 21 communities are PDAs), \$7.5 million in Station Area Planning grants were awarded to PDAs, and \$100,000 from an Environmental Justice grant was awarded to PDAs seeking to engage community members on the topic of displacement due to development in their community. In addition, the BAAQMD's grant program, Transportation Fund for Clean Air, offers additional points to proposed projects that are located in PDAs and Potential PDAs.

MTC's Transportation for Livable Communities (TLC) program offers capital grants to cities, counties, and transit agencies to construct projects that support compact development near transit. Since the inception of the TLC program in 1998, MTC has funded 67 planning projects totaling \$2.5 million and 84 capital projects totaling \$85 million. In its Transportation 2035 Plan, MTC allocated \$2.2 billion to TLC over the next 25 years. MTC has developed new TLC program guidelines that direct funding to PDAs and allow a broader set of eligible expenditures that are focused on providing the best possible incentives for TOD. As of December 2009, MTC approved \$85 million in the first programming cycle of the new federal transportation act for the Transportation for Livable Communities Program. In July 2010, the MTC Commission approved an additional \$44 million in TLC funding for 22 projects as part of the second programming cycle.

Bay Area transit agencies are also working to encourage transit-oriented development. For example, by means of its Community Design and Transportation (CDT) program the Santa Clara Valley Transportation Authority encourages mixed-use development, access to transit, and multi-modal travel.

BART continues to advance Transit-Oriented Development (TOD) in partnership with local jurisdictions, communities and selected developers, based upon a revised TOD Policy adopted by the BART Board of Directors in 2005. Nearly all of the BART station areas are in PDAs. Two-thirds of the 43 BART stations have some type of station area planning or development activity underway. Grand openings are anticipated in 2010 for the Ed Roberts Campus at the Ashby BART Station, and for the latest mixed-use phase at the Pleasant Hill BART Station.

Senate Bill 375, signed into law in September 2008, requires metropolitan planning organizations (MPOs) to develop a Sustainable Communities Strategy (SCS) element in their long-range transportation plans to reach greenhouse gas (GHG) reduction targets specified by the California Air Resources Board (CARB). The SCS adds three new elements to the plan: 1) a land-use component that identifies areas within the region to house all of the population in the region; 2) a resource and farmland protection component; and 3) a demonstration of how the development pattern and the transportation network can work together to reduce GHG emissions. In the Bay Area, the provisions of Senate Bill 375 will apply to the successor plan to Transportation 2035, scheduled for adoption in 2013. MTC and ABAG will need to work closely with local and regional agency partners to implement SB 375. SB 375 requires CARB to adopt regional GHG reduction targets for emissions associated with the automobile and light truck sector by September 30, 2010. CARB proposed draft GHG emission reduction targets in June 2010. The targets are expressed as percent reduction in per capita emissions relative to 2005. The draft targets for the San Francisco Bay Area are 5% - 10% by 2020 and 3% - 12% by 2035. CARB will issue final targets in September 2010.

MTC distributes funds to each of the nine county congestion management agencies (CMAs) in the Bay Area for transportation planning, programming and transportation/land use

coordination. The interagency funding agreements for FY 2010-12 will include language that encourages county planning activities to support climate protection and reduce VMT.

Implementation Actions:

Phase 1 (2012)

MTC to:

- Award funds through new TLC program to support transit-supportive land uses in FOCUS PDAs (\$85 million).
- Implement the TOD Policy for Resolution 3434 Regional Transit Expansion Program.
- Award Station Area Planning Grants to fund city-sponsored planning efforts for areas around future stations of Resolution 3434 projects and for other transit projects in PDAs.

BAAQMD to:

- Continue to fund smart growth projects through TFCA program (\$3 million).
- Work with local agencies to implement the revised BAAQMD CEQA guidelines. The revised guidelines establish thresholds of significance for greenhouse gases (GHGs) adopted by the BAAQMD Board of Directors in June 2010 (see LUM 2 - Updated CEQA Guidelines and Enhanced CEQA Review).
- Issue guidance for local general plan updates, as well as guidelines to help local jurisdictions address air quality and population exposure issues related to infill development.

Regional agencies to:

- Continue to collaborate with local agencies to implement the FOCUS program and Priority Development Areas under the leadership of the Joint Policy Committee and ABAG.
- Begin developing the SCS pursuant to the requirements of SB 375.

Phase 2 (2020)

Sustain Phase 1 programs (\$TBD)

Supporting Actions by Partner Entities:

- Local governments are encouraged to update general plans and area plans to promote infill development and support land use that allows residents and workers to walk, bicycle, and take transit to reach destinations, instead of relying on private automobiles.
- Local governments are encouraged to revise parking standards required for new development and update parking policies. (See TCM E-2)
- Transit agencies are encouraged to work with local governments and developers to create mixed-use transit-oriented developments in proximity to transit stations and key bus routes.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.26	0.60
NO _x	0.31	0.72
PM _{2.5}	0.15	0.35
PM ₁₀	0.58	1.35
Ammonia (NH ₃)	0.16	0.00
Benzene	0.01	0.00
CO ₂	856.50	1998.94
CO ₂ -e	873.63	2038.92

Emission Reduction Methodology:

As a part of the Transportation 2035 travel forecast process, MTC evaluated the impact that pricing and land use policies would have on achieving regional performance objectives, including improving air quality. In order to evaluate the impact that a more compact development pattern would have on regional travel, MTC used an alternative growth scenario developed by ABAG that goes beyond the Projections 2007 demographic forecast to balance jobs and housing and target growth in existing communities near transit. This land use alternative reflects considerable shifts in regional growth to existing employment and housing centers, areas projected to have either household or employment growth, and areas with existing and/or planned transit. The alternative scenario also assumes fewer in-commuters from neighboring regions by accommodating approximately 37,000 more households within the Bay Area. The emissions reductions estimated as a part of the travel forecasts are interpolated for year 2012 from 2010 and 2015 estimates. ABAG's alternative growth forecast is a good proxy to examine transportation impacts from land use changes; however, the provisions described in this TCM are not expected to result in the precise population/employment distribution used for this analysis. Because the alternative forecast houses an additional 37,000 households within the Bay Area, additional air quality benefits are anticipated from households that would otherwise have located in the Central Valley, but work in the Bay Area. However, because these forecasts are at a regional level, the additional benefits associated with housing this portion of the population regionally are not taken into account in this emissions reduction estimate.

Exposure Reduction:

This measure will reduce region-wide population exposure to air pollutants based on the estimated reduction in emissions.

Emission Reduction Trade-offs:

None identified.

Cost:

Phase 1: \$ 88 million

Phase 2: \$ TBD

Co-benefits:

- Reduced travel costs.
- Reduced greenhouse gases, particulate matter, and toxic air containments.
- Community enhancements through revitalized downtowns, transit centers, and other major activity nodes.
- Closer integration of transportation and land use.
- Increased access to jobs, services, and stores.
- Improved public health by reduced driving and increased walking and biking.

Monitoring Mechanisms:

- Track funds awarded to and completion of station area plans, TLC projects, projects within PDAs, and TFCA and other grant dollars spent to support and promote land use patterns, policies, and infrastructure investments that support higher density mixed-use, residential and employment development near transit.

Issues/Impediments:

Land use changes and new development occur slowly and are directly regulated by local jurisdictions, not regional agencies. In addition, higher density development can raise neighborhood concern over impacts on traffic, parking, localized air pollution, and other impacts. However, FOCUS, TLC, and MTC's TOD Policy all provide incentives that can help to overcome some of these challenges. In addition, as Senate Bill 375 implementation begins, CEQA-relief incentives for projects consistent with the region's land use strategy to reduce greenhouse gas reductions may also reduce both the time and costs associated with this type of development.

Sources:

1. MTC's Transportation 2035 Plan and Travel Forecasts Data Summary:
http://www.mtc.ca.gov/planning/2035_plan/
2. FOCUS: <http://www.bayareavision.org/>
3. Station Area Residents Survey (STARS) Report (September 2006)
http://www.mtc.ca.gov/planning/smart_growth/stars/index.htm.
4. National Research Council. "Driving and the Built Environment: The Effects of Compact Development on Motorized Travel, Energy Use, and CO2 Emissions," (August 2009).
5. BART TOD initiatives: <http://www.bart.gov/about/planning/station.aspx>

TCM E-1 - Value Pricing Strategies

Brief Summary:

TCM E-1 will pursue implementation of value pricing strategies such as tolling on trans-bay bridges and cordon pricing recommendations from San Francisco County's Mobility, Access, and Pricing Study.

Purpose:

This measure will reduce emissions of the key ozone precursors, ROG and NOx, by managing travel demand during congested conditions and improving regional bus service through value pricing on the Bay bridges and in San Francisco. In addition, the measure will reduce emissions of particulate matter, air toxics and greenhouse gases.

Travel Market Affected:

This measure would affect all intraregional travel, including commute travel; shopping, personal business, social and recreational travel; passenger and commute trips to airports; and school trips.

Regulatory Context and Background:

Value pricing (which is also known as congestion pricing) refers to varying road tolls wherein higher prices are set at congested times and locations and lower prices are set at less congested times and locations for purposes of reducing peak-period traffic volumes to optimal levels. Tolls can vary based on a fixed schedule, or they can be dynamic, meaning that rates change depending on the level of congestion that exists at a particular time. Value pricing serves as a demand management strategy on existing roadways to avoid the need to add capacity. In addition, value pricing can raise needed revenues for a wide-range of transportation improvements, including public transit.

The Federal Highway Administration's (FHWA) Value Pricing Pilot (VPP) program, which was initially authorized in the Intermodal Surface Transportation Efficiency Act (ISTEA) and most recently renewed under the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), encourages implementation and evaluation of value pricing pilot projects to manage congestion on highways through tolling and other pricing mechanisms. Three Bay Area transportation agencies have received VPP funding to study value pricing, including area road charging and parking pricing in San Francisco, express lanes on I-580 and I-680 in Alameda County, and pricing strategies in Santa Clara County.

The San Francisco County Transportation Authority (SFCTA) is currently conducting a Mobility, Access, and Pricing Study (MAPS) to examine the feasibility of value pricing in San Francisco, following receipt of a \$1 million VPP study grant from the FHWA. Refined pricing scenarios under evaluation include combining fees on gateway crossings with additional fees on downtown cordon and fees on crossings in the northeast corner of San Francisco. The SFCTA expects to present the final study recommendations in the fall of 2010.

MTC is pursuing legislation via AB 744 (Torrico) to authorize a Bay Area Express Lane Network to deliver congestion relief and public transit funding. Because of this, the HOV (high occupancy vehicle) occupancy requirements on Bay Area bridges must be made consistent with HOV occupancy requirements on adjacent freeways so that the region's bridges and express lane network form a unified system (see TCM B-3).

In January 2010, the Bay Area Toll Authority (BATA) increased the toll on the seven state-owned toll bridges in the Bay Area to pay for the completion of the Toll Bridge Seismic Retrofit Program. Under the new toll pricing structure for the Bay Bridge, which went into effect on July 1, 2010, , motorists pay a \$6 toll during peak hours, a \$4 toll during non-peak hours, and a \$5 toll on weekends. BATA staff will evaluate the value pricing on the Bay Bridge and provide a report to the BATA Oversight Committee on an annual basis after value pricing is implemented.

Implementation Actions:

Phase 1 (2012)

- MTC will assist SFCTA in implementing recommendations of the Mobility, Access, and Pricing Study in San Francisco (if applicable and feasible).

Phase 2 (2020)

- MTC will consider time-of-day pricing on trans-Bay bridges as a part of future bridge toll increases. If the value pricing on the Bay Bridge is successful, value pricing may be considered for application to other bridges in the region, if feasible.
- MTC will continue to assist SFCTA in implementing recommendations of the Mobility, Access, and Pricing Study in San Francisco (if applicable and feasible).

Supporting Actions by Partner Entities:

- Local governments, CMAs and transit agencies are encouraged to partner with MTC to implement value pricing.
- SFCTA will implement recommendations of the Mobility, Access, and Pricing Study in San Francisco (if applicable and feasible).

Emission Reduction:

<u>Pollutants (tons per day)</u>	<u>2012</u>
NO _x	0.02
CO ₂	9.68
CO2-e	9.87

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: PM10, PM2.5 and NH3 (ammonia). Emission reduction estimates for year 2020 will be determined at a later date, depending upon whether value pricing is extended to include other trans-Bay bridges.

Emission Reduction Methodology:

The emissions reduction methodology is based on the 2009 study, "San Francisco-Oakland Bay Bridge Congestion Pricing – Phase 1" prepared for the Bay Area Toll Authority. This

analysis examines the effect of congestion pricing on traffic demand, mode shift and time-of-day shift.

The study determines that the most likely scenario is a 4.7% mode shift from single occupancy travel to other modes, during both the AM and PM peak periods, resulting in the emission reductions reported above.

Exposure Reduction:

This measure will reduce region-wide population exposure to air pollutants based on the estimated reduction in emissions.

Emission Reduction Trade-offs:

None identified.

Cost:

Phase 1: \$26 million per year

Phase 2: TBD.

The cost of \$26 million per year is based on the estimated number of vehicles that will pay the additional \$2 per vehicle congestion surcharge during AM & PM peak periods on weekdays.

Co-benefits:

- Generation of new funds for multi-modal transportation improvements.
- Travel time savings.

Monitoring Mechanisms:

- Track whether new legislative authority is granted SFCTA to implement its MAPS strategies.
- Track implementation status of SFCTA's MAPS strategies.

Issues/Impediments:

There is mixed public opinion regarding value pricing, with concerns about the impact on existing carpoolers, potential environmental impacts, the use of net revenues, and charging for the use of the highway and bridges.

Sources:

1. FHWA's Value Pricing Program,
http://ops.fhwa.dot.gov/tolling_pricing/value_pricing/index.htm
2. San Francisco County Transportation Authority: www.sfmobility.org
3. BATA:
http://apps.mtc.ca.gov/meeting_packet_documents/agenda_1433/5a_tollincreaserecommendationmemo.pdf

4. Cambridge Systematics. "San Francisco-Oakland Bay Bridge Congestion Pricing – Phase 1 Final Report." October 7, 2009.

TCM E-2 - Promote Parking Policies to Reduce Motor Vehicle Travel

Brief Summary:

Parking policies and practices have a profound impact on vehicle travel and mode choice, as well as land use patterns and the quality of the built environment. Parking policies are also an important tool in implementing focused growth strategies. This control measure outlines how the Air District, in cooperation with its regional agency partners, will 1) take actions at the regional level to implement parking policies that will benefit air quality, and 2) encourage and support local agency parking policies to reduce motor vehicle travel and promote focused growth.

Purpose:

This measure will reduce emissions of the key ozone precursors, ROG and NOx by implementing parking policies that support in-fill and transit-oriented development, and reduce vehicles miles traveled, and vehicle emissions through increased transit use, walking and bicycling. In addition, the measure will reduce emissions of particulate matter, air toxics and greenhouse gases.

Travel Market Affected:

This measure would affect all intraregional travel including commute travel; shopping, personal business, social and recreational travel; passenger and commute trips to airports; and school trips.

Regulatory Context and Background:

Local governments have traditionally implemented parking policies that provide plentiful parking. Although “free” parking is often provided, there are both direct and indirect costs associated with all parking. Parking policies and zoning codes that promote an oversupply of parking contribute to sprawl-like growth and undermine infill and transit-oriented development.

Promoting parking policy reform will require political leadership in combination with technical assistance, resources, and incentives and disincentives. Cities and counties have direct authority over parking policies. However, regional agencies can assist local governments by providing technical resources, recommending best practices, and leading by example in adopting internal and external policies.

Many cities base their minimum parking requirements on guidelines in the *Parking Generation* manual published by the Institute of Transportation Engineers with little consideration to the location of the land use. The recommended parking ratios in the guidelines are geared toward meeting peak demand for parking in single-use suburban locations with little transit access. Applying these same parking guidelines to more dense, mixed-use areas well served by transit leads to an oversupply of parking, which in turn serves as a disincentive for people to choose other transportation modes over private

vehicles.

An oversupply of parking and ineffective parking management policies creates a number of adverse impacts. For example, parking in dense areas requires using high-value land for parking lots and structures. The high cost of land and construction to build parking drives up development costs. Construction costs for structured parking can range from \$30,000 to \$60,000 per parking spot. These costs are typically hidden in purchase prices and rents. This exacerbates the shortfall of affordable housing in the Bay Area, creates obstacles to transit-oriented development, and reduces the land available for other uses.

Second, parking supply and the quality of design both influence streetscapes and walkability. For example, the pedestrian friendliness of a commercial main street compared to a strip mall depends in part on parking design. In a typical big box strip mall, large stores are surrounded by sprawling parking lots and people tend to drive and re-park from store to store rather than walk. In contrast, a commercial main street with street parking, or parking behind stores, creates a more pedestrian-friendly environment where people are more likely to park once and walk from store to store. Areas where stores are oriented to the street and parking does not dominate the streetscape are also more accessible to bicyclists, and help reduce motor vehicle travel.

Paved parking areas also contribute to local urban heat island effects, which raises local temperatures. Higher temperatures lead to higher levels of ozone and particulate matter, increase energy use for cooling, and can create health risks for sensitive populations. Paved, impermeable parking surfaces also add to water quality problems including storm water pollution run-off, flooding vulnerability, and reduced groundwater recharge.

Effective parking management can encourage alternative transportation modes, support carpooling and car-sharing, and improve vehicle travel efficiency, thus reducing vehicle miles traveled and emissions. Best practice parking policies and strategies include:

- Coordinated parking policies within jurisdictions and on a regional scale
- Coordinated parking pricing that encourages shorter-term curbside parking and longer-term off-street parking
- Parking design guidelines to promote walkability
- Unbundled parking from residential and commercial rents
- Parking cash-out by employers
- Parking technologies such as real-time parking information and parking payment devices
- Parking financing such as a parking tax or fee and incentives or rebates
- Parking assessment districts
- Reduced parking requirements in coordination with requirements for transit passes and other transportation demand management strategies (TDMs), such as shuttles, for new developments and/or implementation of parking maximums
- Shared parking between land uses with different patterns of demand

Donald Shoup's book, *The High Cost of Free Parking* describes the consequences of non-

market rate parking pricing and strategies to reform parking policy in much greater detail.

Examples of effective parking policies can be found in Bay Area cities. The San Francisco Metropolitan Transportation Agency (SFMTA) is implementing SFPark, a variable rate parking pricing strategy to effectively manage curb, lot, and structured parking spaces. The variable rate will be determined by location, time of day, and day of week. This project is funded through a U.S. Department of Transportation program grant. Prices will be adjusted to direct short-term parking to street parking and longer-term parking to lots and garages.

The City of Redwood City adopted a downtown parking plan and a parking ordinance to allow for periodic adjustment of downtown meter rates. Rates are based on achieving a parking utilization rate of 85 percent.

A number of local governments have reduced parking requirements for new development in conjunction with TDMs, including the cities of San Jose, Berkeley, and San Mateo.

MTC has provided technical information on parking to local agencies. In 2007, MTC conducted a parking policy study with the purpose of developing best practices and modeling tools. The study resulted in several key products including:

- Toolbox/handbook for parking best practices and strategies that support transit oriented development for local governments.
- Parking demand model that can be customized for local conditions.
- Detailed case studies of parking policies for 10 Bay Area cities.
- Parking training seminar for local governments hosted by MTC.

The Joint Policy Committee (JPC) has identified regional parking policies as a priority area in its climate action strategy. MTC, in leading this effort, is preparing a report, "Regional Parking Strategies for Climate Protection," to outline a set of regional parking reform strategies and actions to reduce greenhouse gas emissions. The JPC is in the process of developing regional parking policies. Strategies may include: leading by example, incorporating parking policies into current and conditions for forthcoming regional grants to local jurisdictions (e.g. TLC, Climate Change, Station Area Plans) with regional monitoring, engaging congestion management agencies as partners for climate protection, using or extending existing regulations to parking, conditioning distribution of regional discretionary transportation funding to local jurisdictions on implementation of specified parking management policies/practices, funding parking programs with a regional gas tax, and advocating for elimination of federal tax subsidy for employee parking.

Implementation Actions:

Phase 1 (2012)

- Regional agencies will participate in the Joint Policy Committee (JPC) consideration and adoption of regional parking strategies.
- Regional parking strategies will consider using parking fees to improve transit and other alternative modes of travel, such as biking and walking.

MTC will:

- Provide technical assistance to local jurisdictions such as consultant assistance for individual cities through the TOD Technical Assistance Program (TOD TAP) and offering best practices workshops
- Develop Transportation 2035 Climate Change guidelines regarding capital support for innovative parking strategies.
- Incorporate parking issues into the broader public outreach program for climate action.
- Continue support for State and Federal bills to reduce subsidies for parking.
- Support other BAAQMD efforts described below as relevant and feasible.

BAAQMD will:

- Work with partners to explore ways to provide financial incentives to cities and counties to implement parking policies.
- Work with partners to consider the air quality impacts associated with free parking as part of the District's Indirect Source Review (ISR) Rule development. The District is currently developing an ISR and anticipates rule adoption in 2011. Parking supply and policies may be considered as performance standards in the ISR development.
- Identify appropriate grant opportunities that can be applied to implementing parking policies.
- Make implementation of such policies a condition for receiving certain funds that are awarded at the regional agencies' discretion.
- Implement the District's revised CEQA Guidelines which were released in June 2010, including CEQA thresholds adopted by the BAAQMD Board of Directors on June 2, 2010. The updated CEQA Guidelines include guidance and tools to evaluate the air quality impacts of parking practices. In addition, in providing comment on CEQA analyses to lead agencies, the Air District will continue to recommend that lead agencies require parking best practices as a condition of project approval.
- Highlight parking best practices in its best practices web portal. The District has partnered with the Institute for Local Government to develop a best practices web portal to serve as an information clearinghouse for Bay Area local governments seeking to implement climate protection actions.
- Working with partners, will consider funding a parking technology demonstration projects. Demonstration projects may include providing real-time parking information, pay-by-phone parking, a parking hotline program where people call in advance for automated information on available parking, or related car-sharing or bike-sharing technology project. The goal would be to better understand the potential for these projects to create mode shifts and therefore reduce emissions.
- With its partners promote implementation of parking cash-out programs and advocate for legislation to strengthen and expand the reach of the California parking cash-out law enacted in 1992, including advocating appropriate legislative actions to improve the parking cash-out program, such as identifying potential financial incentives for parking cash-out programs, and recommending that parking cash-out programs be required as a condition of approval in environmental review processes.

ABAG will:

- Integrate parking best practices into its FOCUS program, through technical assistance and other resources provided to local governments.
- ABAG and MTC to administer Station Area Planning grants to FOCUS Priority Development Areas and Resolution 3434 stations that encourage adoption of TOD-oriented parking management strategies in final area plans.

Phase 2 (2020)

- MTC, BAAQMD, and ABAG will continue Phase 1 actions.

Supporting Actions by Partner Entities:

- SFMTA will implement SFpark.
- Local agencies are encouraged to adopt innovative parking strategies, including:
 - Eliminate or reduce minimum parking requirements.
 - Limit the supply of off-street parking in transit-oriented areas.
 - Encourage developers and property owners to unbundle the price of parking spaces from rents and purchase prices.
 - Promote shared parking by different users.
 - Implement market-rate pricing for off-street parking and consider residential permit programs to alleviate spillover concerns.
 - Implement performance-based pricing for curb parking in high-use areas.
 - Implement parking assessment districts that use revenue from street parking to fund pedestrian and streetscape improvements.
 - Adopt design guidelines and policies to minimize surface area for parking.
 - Implement car-sharing and bike-sharing programs in appropriate locations in exchange for reduced parking requirements, and provide as a benefit to renters.
 - Encourage a coordinated parking policy approach among jurisdictions to minimize spillover to other jurisdictions and fears of unfair competition.

Employer-Based Actions:

- Employers, in partnership with regional agencies and in particular BAAQMD, can work to reduce motor vehicle travel by promoting and implementing parking cash-out programs.
- Business groups can work with regional partners to encourage employers to voluntarily implement parking cash out programs, and/or develop other parking best practices.

Emission Reduction:

Pollutants (tons per day)	2012	2020
ROG	0.18	0.16
NO _x	0.19	0.16
PM _{2.5}	0.02	0.03
PM ₁₀	0.02	0.05
Ammonia (NH ₃)	0.05	0.15
CO ₂	288.00	553.00

CO ₂ -e	294.00	564.06

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: benzene, 1,3 butadiene, formaldehyde, and acetaldehyde.

Emission Reduction Methodology:

This measure encompasses a wide range of potential actions by various regional and local agencies, to promote parking policies to reduce motor vehicle travel. The specific combination of strategies and actions that will be implemented has not yet been determined, so the potential emission reductions for this measure cannot be predicted with any degree of confidence as yet. For purposes of estimating potential emission reductions from parking measures we have analyzed the potential emission reductions that might be achieved if parking fees were to be imposed at Bay Area worksites. However, it should be emphasized that employer parking fees are not proposed as part of this measure. Rather, this is used as an example for purposes of estimating potential emission reductions, because analysis of employer parking fees was previously performed and therefore available.

The employee parking fee emission reduction methodology uses empirical findings that support a relationship between employee parking prices and vehicle work trip rates for the Bay Area (Harvey and Deakin, 1997). This data suggests that a \$3.18 employee parking fee will result in a 1.65% decline in vehicle work trips. Based on Transportation 2035 Travel Forecast data, BAAQMD estimated that this charge has the potential to eliminate approximately 62,400 vehicle trips in 2012, and approximately 120,600 vehicle trips in 2020.

This analysis does not take into account that funds raised by parking pricing can be re-invested into the transportation system to improve access to transit and other alternative modes of travel, such as bicycle and pedestrian travel to further promote transit use.

Exposure Reduction:

This measure will reduce region-wide population exposure to air pollutants based on the estimated reduction in emissions.

Emission Reduction Trade-offs:

None identified.

Cost:

Phase 1: \$1.4 billion/year. If a fee as described above were imposed on all employer-provided parking in the region, this would result in costs of approximately \$1.4 billion to employees who continue to park in employer-provided lots. However, as noted above, such a fee is not proposed as part of this measure.

Phase 2: \$1.4 billion/year

Co-benefits:

- Generation of parking revenues.
- Improved housing affordability.
- Conservation of energy.
- Improved water quality / reduced storm water run-off.
- Promotion of more efficient use of land.
- Increased transit ridership, walking, and cycling.
- Enhanced community design and quality of life.
- Cost savings to those providing parking cash-out program.
- Reduced cruising and associated congestion and vehicle emissions.
- Reduced health risks from vehicle emissions and enhanced walkability.
- Potential to use any revenue generated by parking fees to fund improvements to transit and other alternative modes of travel.

Monitoring Mechanisms:

- A panel of academic researchers, including Donald Shoup, will conduct a program evaluation of SFpark.
- MTC will track legislative actions related to parking policies.

Issues/Impediments:

Local government parking reform can be impeded by limited resources and technical expertise, especially in small municipalities. These jurisdictions can seek technical assistance from MTC. Technical assistance may include: training seminars, sharing of best practices across municipalities, and development of outreach and education materials for developers and the public.

Parking policies are a highly political issue on the local level. Local governments may be reluctant to adopt parking reforms due to lack of political will; fear that businesses will protest; fear that their city will be at a disadvantage with competitors in neighboring cities without similar parking reforms; and concern that the process will be stalled due to protests from businesses and residents. Since parking costs are often hidden in rents and purchases, residents may not understand the basis or need for parking reform.

Local governments develop local parking policies based upon local needs and priorities. Willingness to implement policies consistent with regional parking policies will vary among these entities.

Sources:

1. MTC Parking Study including presentations and resource documents:
http://www.mtc.ca.gov/planning/smart_growth/parking_study.htm
2. MTC Regional Parking Strategies for Climate Protection by Nelson\Nygaard Consulting Associates, May 2009
3. SFMTA's SFpark program: <http://www.sfmta.com/cms/psfpark/sfparkindx.htm>
4. Shoup, Donald. *The High Cost of Free Parking*. Washington D.C.: APA Planners Press, 2005.

TCM E-3 - Implement Transportation Pricing Reform

Brief Summary:

Motor vehicle travel imposes a variety of costs on society, including air pollution, that are not fully reflected in the price that drivers currently pay to own and operate a vehicle. Transportation pricing strategies can provide a powerful mechanism to reduce motor vehicle travel, traffic congestion, and tailpipe emissions of criteria pollutants and greenhouse gases. This control measure proposes that the Air District and its regional agency partners collaborate to develop and implement a regional transportation pricing policy strategy.

Purpose:

This measure will reduce emissions of the key ozone precursors, ROG and NOx by implementing transportation pricing policies in the Bay Area through establishment of a regional pricing task force to evaluate transportation pricing policy options and coordinated implementation of a regional transportation pricing strategy. In addition, the measure will reduce emissions of particulate matter, air toxics and greenhouse gases.

Travel Market Affected:

This measure would affect all intraregional travel, including commute travel; shopping, personal business, social and recreational travel; passenger and commute trips to airports; and school trips.

Regulatory Context and Background:

Transportation pricing, if well conceived and implemented, can help to achieve some or all of the following objectives:

- Reduce total vehicle trips and VMT.
- Reduce traffic congestion.
- Reduce emissions of criteria pollutants and greenhouse gases.
- Generate revenues that can be used for a variety of purposes, including support for public transit and alternative modes of transportation.
- Increase use of alternative transportation modes, such as transit, rideshare, walking and biking.

In its Transportation 2035 (T2035) Plan adopted in April 2009, MTC highlighted the importance of transportation pricing to help achieve the performance objectives defined in the Plan.

Transportation pricing mechanisms that may be available at the regional or local level include:

- High-occupancy toll (HOT) lanes – see TCM B-3.
- Value pricing, including variable bridge tolls, congestion pricing of roadways, or zone pricing (e.g. downtown tolls) – see TCM E-1.

- Parking pricing – see TCM E-2.
- Gas tax or fee: This could include imposing a gasoline tax or fee at the regional level (MTC has existing authority to place a regional gas tax measure on the ballot in Bay Area), and/or helping to build support for higher gas taxes at the state and federal levels.
- Diesel tax or fee: Revenues from higher diesel fuel taxes could be used to reduce NOx and particulate matter emissions from older heavy duty diesel trucks, which may stay on the road for many years due to the durability of their engines. Funds could go to help offset the cost of purchasing new vehicles, repowering existing vehicles with cleaner engines, or retrofitting trucks with aftermarket devices that significantly reduce NOx and particulate matter.
- VMT fee: As an alternative to gas or diesel taxes, a fee could be levied based on vehicles miles traveled, i.e., the annual miles that a vehicle is driven.
- Pay-as-you-drive vehicle insurance: Pay-as-you-drive insurance premiums would be more sensitive to the number of miles an individual drives, thereby offering vehicle owners an incentive to cut back on miles driven.
- Emission-based vehicle registration fees: Vehicle registration fees could be used to influence the purchase choices of new vehicles. Annual fees would be based on vehicle emission characteristics and the amount of annual driving that is conducted (which would be assessed at the time the vehicle undergoes a Smog Check). The fees would be used in turn to pay for various air quality programs, such as Voluntary Accelerated Vehicle Retirement programs (VAVR), fixing emission controls on mid-aged vehicles, incentives to tune up vehicles prior to the next smog season, financial assistance to low income families that would face hardships with costly tune-ups, and other programs.
- Feebates: Feebates, incentives for purchasing fuel efficient vehicles, could be offered to consumers for choosing fuel efficient vehicles over other vehicles. Funding from feebates could come from the emission-based vehicle registration fee noted above.

Implementing transportation pricing policies will require political leadership, public support, and coordination among the Bay Area's regional agencies and local jurisdictions. Although the potential benefits of transportation pricing are significant, there are major obstacles as well. The technical means are available to implement several value pricing strategies; the constraints are primarily political. The universe of potential pricing mechanisms is well defined, and pricing measures have been included in Bay Area air quality plans since 1991. The real challenge is how to develop and execute a clear strategy to implement transportation pricing in the Bay Area.

Transportation pricing policies must identify and address equity concerns, specifically those that disproportionately affect low-income drivers and impacted communities. These concerns should be addressed early in the development process. Effective pricing modeling, measures to minimize disproportionate impacts, public outreach, and monitoring of pricing policies equity issues should be incorporated into pricing strategies.

Implementation Actions:

The Air District and MTC will collaborate with their regional agency partners, under the auspices of the Joint Policy Committee, to establish a regional transportation pricing task force. The task force will be charged with:

- Developing a public engagement and input process, and coordinating with key stakeholders.
- Defining goals and outcomes.
- Developing evaluation criteria based upon those goals.
- Analyzing the various pricing options based upon the criteria.
- Identifying and advocating for any necessary enabling legislation.
- Recommending a regional transportation pricing strategy and an action plan to implement the strategy, including policies regarding reinvesting transportation fees to improve transit service and other alternative modes, such as biking and walking.

A regional transportation pricing strategy can help to inform and complement the Sustainable Communities Strategy that will be developed as part of the next update of the Regional Transportation Plan in 2013.

Supporting Actions by Partner Entities:

Local governments, businesses, insurance providers, and other public and private entities are encouraged to develop and implement policies to ensure that user costs to own and operate motor vehicles reflect the full environmental and social costs related to vehicle use. This can be pursued via value pricing of the roadway network (see TCM E-1), parking policies (see TCM E-2), and other pricing measures, such as those described in the “Background” section above.

Emission Reductions:

<u>Pollutants (tons per day)</u>	<u>2012</u>	<u>2020</u>
ROG	0.12	0.06
NO _x	0.12	0.06
PM _{2.5}	0.01	0.01
PM ₁₀	0.02	0.02
Ammonia (NH ₃)	0.07	0.07
CO ₂	184.00	200.00
CO ₂ -e	188.00	204.00

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: benzene, 1,3 butadiene, formaldehyde, and acetaldehyde.

Emission Reduction Methodology:

This measure describes a variety of potential pricing policies and strategies to reduce motor vehicle emissions. The specific combination of strategies and actions that will be endorsed

by the proposed regional transportation pricing task force cannot be predicted with any degree of confidence at this time. For purposes of estimating potential emission reductions from this measure, we have analyzed the potential emission reductions that might be achieved by means of a regional gas tax increase, as described below. We use the regional gas tax as an example because studies have been performed that demonstrate the relationship between higher gas fees and a reduction in vehicle trips and therefore vehicle miles traveled. However, it should be emphasized that such a fee is only one pricing option that may be evaluated by a regional task force and is not explicitly being proposed as part of this measure; rather, it is provided here as an example to illustrate the potential impact of pricing measures in reducing motor vehicle travel and emissions.

The regional gas tax emission reduction methodology uses empirical findings that support a relationship between a gasoline tax increase and decreased trip rates (US EPA). This data suggests that a 1% increase in tax would result in a 0.9% decrease in vehicle trips. At a cost of \$3.01 a gallon, an increase of \$0.30 per gallon was assumed. This is a 10% increase in tax.

Based on Transportation 2035 Travel Forecast data, we estimate that this charge has the potential to eliminate approximately 127,100 vehicle trips in 2012, and approximately 138,300 vehicle trips in 2020. The vehicle trips eliminated include work and non-work trips and it is assumed that 25% percent would be work trips, and 75% percent would be non-work trips. Based on these assumptions, the number of miles and emissions reduced was then estimated.

This analysis does not take into account that funds raised by a gasoline tax can be re-invested into the transportation system to improve access to transit and other alternative modes of travel, such as bicycle and pedestrian travel.

Exposure Reduction:

This measure will reduce region-wide population exposure to air pollutants based on the estimated reduction in emissions.

Emission Reduction Trade-offs:

None identified.

Cost:

Phase 1: \$470 million/year. If gas taxes were increased by \$0.30 per gallon as described above, this would result in costs of approximately \$470 million per year to Bay Area residents, based on current gasoline consumption data. However, as noted above, such a fee is not proposed as part of this measure.

Phase 2: \$500 million/year

Co-benefits:

- Generate revenues that could be invested in supporting transit, other alternative modes of travel, and transit-oriented development.

- Increase transit ridership, walking, and cycling.
- Reduce health risks from vehicle emissions and enhanced walk-ability.

Monitoring Mechanisms:

Progress will be monitored by tracking the progress and outcomes of the Regional Pricing Task Force. An initial work product of the Task Force will be to identify milestones and schedule for their process.

Issues/Impediments:

Transportation pricing reform may be controversial. Any proposal will need to consider equity impacts.

Sources:

1. ICLEI, January 2006. Changing the Pricing Signal. <http://www.iclei.org/>
2. Victoria Transport Policy Institute, <http://www.vtpi.org/>
3. Rand Corporation, 2009. "Equity and Congestion Pricing." http://www.rand.org/pubs/technical_reports/TR680/.
4. U.S. Environmental Protection Agency, "Technical Methods for Analyzing Pricing Measures to Reduce Transportation Emissions," Table 2.2. August 1998. <http://www.epa.gov/OMS/stateresources/policy/transp/tcms/anpricng.pdf>
5. UC Davis, Institute of Transportation Studies, "Feebates: A Complementary Strategy for Reducing GHG from Vehicles." May 2010
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BAY AREA 2010 CLEAN AIR PLAN

VOLUME II

Section D

Land Use and Local Impact Measures

September 2010



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LUM 1 - Goods Movement

Brief Summary:

This control measure aims to reduce emissions and population exposure related to movement of freight in the Bay Area by means of incentives, enforcement, research, strategic partnerships, and outreach. Regional components of this measure will focus on reducing truck use by encouraging a shift to other modes of freight transport by supporting pilot projects and research, as well as working with partner agencies to promote land uses patterns and distribution systems (roadways, logistic systems) that result in less vehicle miles traveled. At the local level, this measure includes targeted enforcement of ARB diesel regulations, outreach to businesses and fleets operating in goods movement corridors to encourage turnover to cleaner engines, and installation of signage to indicate trucks routes and anti-idling regulations. This measure also calls for advocating for container fees to be imposed on goods transported through Bay Area ports to fund strategies to offset goods movement emissions.

Purpose:

The purpose of this measure is to 1) reduce human exposure to diesel emissions from goods movement in the near term and 2) develop and support long-range strategies and partnerships to reduce emissions from the movement of freight in the Bay Area. A key objective of this measure is to reduce air quality impacts related to goods movement in communities identified by the Air District's Community Air Risk Evaluation (CARE) program.

Source Category/Travel Market Affected:

Heavy and medium duty diesel trucks, locomotives and rail, dockside emissions from ships.

Regulatory Context and Background:

The Bay Area is home to a robust and varied economy, including the nation's fourth largest Port and five refineries, and serves as a major gateway for Pacific Rim trade. I-880, I-101, and I-80 freeways are heavily used to transport goods and intersect major metropolitan areas of Western Contra Costa/Richmond, East San Francisco, parts of the South Bay and Alameda County/West and East Oakland. Sensitive receptors and vulnerable populations near these goods movement corridors have been identified through the District's Community Air Risk Evaluation Program as being disproportionately impacted by elevated concentrations of toxic air contaminants, when compared to other areas of the Bay Area. The District has an important role to play in addressing these goods movement corridors as part of fulfilling its mission to protect the public's health and the environment.

The delivery of raw materials and finished products to factories, distribution centers and stores represents a significant segment of the Bay Area's emissions inventory. An extensive State and federal regulatory program will reduce criteria and toxic emissions from these sources down to very low levels per engine over the next 5-10 years. Over the past few years, ARB has adopted regulations consistent with their Goods Movement Emissions

Reduction Plan (GMERP) goal of reducing diesel emission by 85% by 2020. These regulations have addressed: on road drayage trucks, locomotives, harbor craft, ocean going vessels, and off-road equipment.

In addition, regional plans which address the Bay Area's goods movement infrastructure and air pollutant emissions include the Regional Transportation Plan 2035 (RTP), Goods Movement Initiative 2009, and the Port of Oakland's Maritime Air Quality Improvement Plan (MAQIP). Projects identified in these plans will soon be implemented to address numerous impacts associated with the projected increase in goods movement (See TCM B-4).

However, the rate and extent of the decline in goods movement related emissions in the Bay Area will be dictated by how quickly the region can turn over the heavy/medium duty diesel fleet with new technologies and low emission engines. This will in part depend on the Bay Area's growth in population, economic activity, and local development patterns.

Despite the recent economic slump, the volume of goods movement in the region is expected to increase rapidly in the next several decades. The Port of Oakland's Maritime Air Quality Improvement Plan projects a 100% increase in volume of trade by 2020 under its low growth scenario. Notwithstanding uncertainty around economic trends and localized effectiveness of impending state diesel regulations and local plans, this increase will have implications for regional air quality.

This measure is intended to complement ARB's diesel emission reduction regulations as well as Bay Area plans to ensure that the region develops a comprehensive strategy to reduce emissions from the goods movement sector, and protect and improve public health in communities that are disproportionately impacted by goods movement emissions.

Implementation Actions:

Regional Implementation Actions:

- Lead a Collaborative Regional Effort – Continue working with regional partner agencies, transportation stakeholders, and impacted communities in a collaborative regional process to articulate and advance a regional strategy for goods movement in the Bay Area, with a focus on air quality, health, and climate protection. This will include activities already underway, such as the Air District's Green Ports Initiative and the Port of Oakland's Maritime Air Quality Improvement Plan (MAQIP).
- Identify Strategies for Mode Shift – Examine opportunities to shift freight transport from truck to rail and barge in order to reduce emissions and exposure associated with movement of freight in the Bay Area. The District will consider participating in projects where mode shift can be beneficial to local and regional air quality, such as the "marine highway," a project to move freight by barge and tugboat between the Port of Oakland and the Port of Stockton. At the same time, the Air District will promote measures to reduce existing emissions and localized exposure associated with rail and barge, such as

retrofitting or replacing older switcher locomotives, hostlers, and cargo-handling equipment.

- Efficiencies in Distribution Systems (roadways, logistic systems) – Assess current freight distribution systems and routes for major transport modes, and make recommendations for increasing travel efficiencies to reduce emissions. Areas of evaluation may include truck movements on regional highways and local roads between seaports, airports, warehousing/distribution centers, and other magnet sources, and operational and/or design improvements to facilitate more efficient goods movement.
- Best Practices for Goods Movement Land Uses – Warehousing and Distribution Centers. MTC's *Goods Movement Initiatives 2009* highlights a need to preserve land within the Bay Area core for goods movement businesses such as warehousing and distribution in order to decrease trip lengths and emissions associated with goods movement distribution. This may have implications for areas identified as impacted communities by the Air District, because many of these communities are located along the Bay Area's major trade corridors. In order to avoid or mitigate population exposure to emissions from goods movement, the District will work with regional partners and impacted communities to identify and disseminate best practices to promote good air quality, and public health and safety in neighborhoods where goods movement facilities are situated adjacent to residential land uses. Best practices may include site design, zoning, industry operating practices and technological innovations. Best practices will be evaluated based on their ability to promote public health while encouraging infill development, particularly in FOCUS Priority Development Areas. This work will complement efforts by the FOCUS program to address the role of employment centers in smart growth.
- Container Fees – The District will advocate for container fees to be imposed on goods passing through Bay Area ports to be used for environmental mitigation. Fees should be assessed to reflect the air quality impacts that result from goods movement activities, including PM, ozone precursors, air toxics and greenhouse gases. Funds will be used to improve air quality in areas most impacted by goods movement activities.
- Partnerships and Demonstration Projects – The District will work with regional partners and stakeholders to identify, evaluate, and implement innovative projects that reduce emissions and exposure associated with goods movement. Demonstration projects are intended to spark long-range changes in freight movement and technology use that will result in reduced vehicle miles traveled emissions, and human exposure to harmful emissions. Such projects may include implementing cold-ironing (shorepower) infrastructure at Bay Area ports in advance of ARB regulations in order to eliminate ship idling while docked, utilizing liquefied natural gas (LNG) to provide shorepower, promoting the use of LNG to power drayage fleets, funding new switcher engines at Bay Area railyards, measures to reduce emissions related to magnet sources, and continuing

to work in partnerships such as the Green Ports initiative. These efforts will focus on CARE communities, and will be discussed with the CARE Task Force.

Local Implementation Actions:

- Collaborative enforcement - The Air District is developing a diesel enforcement program whereby inspectors enforce ARB's diesel air toxics control measures (ATCMs) specifically targeting impacted areas identified by the CARE program along two major Bay Area trade corridors. Initial enforcement activity will be focused on diesel truck idling and drayage trucks and will expand to include other ATCMs as they become applicable, including cargo handling equipment, truck refrigeration unit (TRU) enforcement, Gen Set enforcement, and off-road construction equipment. The District will also encourage local jurisdictions to create mechanisms for community-based actions to enforce ARB's anti-idling regulation, such as working with community groups to identify idling hotspots and to improve systems for responding to community concerns.
- Systematic outreach and incentives program for independent and fleet truck operators – The District will continue and enhance outreach efforts to independent and fleet truck operators regarding available funds for installing retrofit devices on and/or replacing their trucks. The Air District will continue to operate a trailer at the Port of Oakland to inform truck drivers about ARB's applicable anti-idling ATCMs, emission reducing technologies and fuels, and targeted incentives program in efforts to reduce emissions from the Port and along the I-880 corridor.
- Signage and truck routes – Air District staff will facilitate discussions with county planning departments, county public health departments, local businesses and industries, and community groups to assist in the planning process to identify suitable truck routes in and around impacted communities. Signage will then be placed to discourage idling and promote truck movements along non-residential arterial roads to reduce human exposure.
- Centralizing truck services and overnight parking – Support the Port of Oakland and Alameda County Congestion Management Agency (ACCMA) efforts to move essential truck services from within the impacted communities on to or near Port property or away from residential areas. In a recent survey conducted by the ACCMA, most truck driver access residential areas to repair their truck, to access the public scales, to obtain food or fuel, or to park until their next delivery. By having these services available at a centralized location away from residents, trucks will reduce vehicle miles traveled to these services and also drive less in residential communities thereby reducing emissions and exposure to residents.

Emissions Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.01	0.36
NO _x	1.71	6.00

PM _{2.5}	0.22	0.48
PM ₁₀	0.02	0.20
SO ₂	0.00	0.02
CO ₂	2511	4116
CO ₂ -e	2561	4198

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: NH₃ (ammonia), benzene, 1,3 butadiene, formaldehyde, and acetaldehyde.

Emissions Reduction Methodology:

This measure encompasses a range of potential actions by various regional agencies to address emissions from goods movement. The specific combination of strategies and actions that will be implemented has not yet been determined, so the potential emission reductions for this measure cannot be predicted with any degree of confidence as of yet. For purposes of estimating potential emission reductions we have analyzed the reductions that might be achieved by 2020 if the region successfully implements programs that address mode shift, distribution system efficiencies, container fees, and enhanced regulation enforcement.

For example, if implemented by 2020 we estimated that:

- Shifting from trucking to cleaner goods movement modes could lead to a 25% decrease in pollution from estimates for 2020 based on projected goods movement by truck.
- Increased distribution system efficiencies could lead to a 2% decrease in pollution.
- A container fee program could raise funds for clean technology grants, resulting in additional pollution reductions similar to those associated with current BAAQMD grant programs.
- A combined regulation enforcement effort between CARB and the District could increase truck regulation compliance and decrease pollution.

Exposure Reduction:

The District and California Air Resources Board (CARB) studies show that 80% of the risk from toxic air contaminants in the Bay Area comes from diesel particulate emissions. This measure addresses this air quality problem by reducing emissions from vehicles and equipment used in goods movement. This measure directly addresses air quality in impacted communities.

Emission Reduction Trade-offs:

Adding diesel retrofit devices to diesel engines may result in a decrease in fuel efficiency, thereby increasing emissions of carbon dioxide. For example, CARB and the EPA estimate that a heavy-heavy duty (HHD) diesel truck with a retrofit device added would experience a decrease in fuel efficiency of 3.5% on average. By Air District staff computations, for a HHD

truck traveling 30,000 miles per year, this decrease is estimated to result in an additional 4,382 pounds per year of carbon dioxide.

Cost:

Phase 1: \$14.5 million/year

Phase 2: \$14.5 million/year

Co-benefits:

- Energy/fuel cost savings from more efficient and reliable engines.
- Economic benefits from faster, more efficient goods movement.

Monitoring Mechanisms:

Regional Initiative Outcomes and Benchmarks:

- Progress in continued regional collaborative process focused on goods movement and clean air: stakeholders convened, meetings, outcomes.
- Evaluation of efforts and results to promote shifts in freight transport mode, and infrastructure needed to support mode shift.
- Analysis of air quality exposure impacts associated with current highway truck routes along trade corridors compared to alternative routes.
- Survey of existing best practices in areas where goods movement impacts residential communities to reduce health risks (as well as noise and safety impacts).
- Legislation for container fees for Bay Area ports.
- Annual report on emissions reduction resulting from innovative technologies and projects implemented through partnerships and demonstration projects.
- Summarize and highlight project successes and promote further adoption in the freight movement industry.

Local Initiative Outcomes and Benchmarks:

- Record of violations issued by District staff under collaborative enforcement agreement with ARB.
- Status reports on collaborative enforcement.
- Annual report listing applications for retrofit replacement submitted, funds awarded, and projects implemented.
- Report on needs assessment for signage and number of signs installed.
- Report from community planning process for San Jose, East Oakland, and San Leandro truck routes.

Issues/Impediments:

- Staffing and resources.
- Determining emissions reductions from cooperative enforcement of ARB's regulations.
- Developing regional buy-in for a regional task force for goods movement.

Sources:

1. East Bay Alliance for a Sustainable Economy and Pacific Institute, Taking A Toll: The High Cost of Health, Environment, and Worker Impacts of the Oakland Port Trucking System, http://www.pacinst.org/reports/taking_a_toll/index.htm
2. Southern California Association of Governments, Analysis of Goods Movement Emission Reduction Strategies, Task 1 Final Report, January 2008
<http://www.scag.ca.gov/goodsmove/>
3. Southern California Association of Governments, Reports : Project 99-130 Goods Movement Truck and Rail Study
<http://www.scag.ca.gov/goodsmove/truckrail.htm>
4. MTC's Transportation 2035 Plan, http://www.mtc.ca.gov/planning/2035_plan/
5. MTC's Goods Movement Initiatives 2009 Update,
http://www.mtc.ca.gov/planning/2035_plan/Supplementary/T2035_Goods_movement_update.pdf
6. Goods Movement Plan ARB, <http://www.arb.ca.gov/gmp/docs/gmap-1-11-07.pdf>
7. CARE Report on TAC,
http://www.baaqmd.gov/CARE/documents/care_p1_findings_recommendations_v2.pdf
8. ATCM to Limit Diesel-Fueled Commercial Motor Vehicle Idling,
<http://www.arb.ca.gov/msprog/truck-idling/truck-idling.htm>
9. New Regulation to Significantly Reduce Emissions From Existing On-Road Diesel Vehicles, <http://www.arb.ca.gov/msprog/onrdiesel/onrdiesel.htm>
10. Mobile Cargo Handling Equipment at Ports and Intermodal Rail,
<http://www.arb.ca.gov/ports/cargo/cargo.htm>
11. ARB's PERP Regulation, <http://www.arb.ca.gov/portable/perpact/perpactarchive.htm>
12. ARB's Harborcraft Regulation,
<http://www.arb.ca.gov/ports/marinevess/harborcraft.htm>
13. ARB's Drayage Truck Regulation,
<http://www.arb.ca.gov/msprog/onroad/porttruck/porttruck.htm>
14. ARB's TRU Regulation, <http://www.arb.ca.gov/diesel/tru/documents/faq121708.pdf>
15. Ocean Going Vessels Regulation,
<http://www.arb.ca.gov/ports/marinevess/marinevess.htm>
16. Railyard MOU, <http://www.arb.ca.gov/railyard/railyard.htm>
17. Smartway Transport Partnership, <http://epa.gov/smartway/>
18. Cooperative Enforcement Document, February 17, 2009 California Air Resources Board

LUM 2 - Indirect Source Review

Brief Summary:

The Air District will develop an indirect source review (ISR) rule to reduce construction and operating emissions and population exposure associated with new or modified land uses in the Bay Area. The measure is intended to address potential increases in air pollutant emissions related to economic and population growth in the region. Indirect sources are development projects that generate or attract motor vehicle trips and area source emissions. The rule may also address other sources of emissions, such as fireplaces, home heating and cooling and landscape maintenance equipment. The District will consider the legal issues, political acceptability, local government acceptability, enforceability, staffing or other resources needed when defining the scope of the ISR.

Purpose:

The purpose of indirect source review is to reduce emissions and population exposure associated with new or modified land use development in order to attain ambient air quality standards and protect public health. An ISR rule may also achieve co-benefits by reducing emissions of greenhouse gas.

Source Category/Travel Market Affected:

On-road and off-road mobile emission sources are the main source categories targeted by this measure. However, space heating, landscape maintenance and wood burning emission source categories could also be included.

Regulatory Context and Background:

The California Clean Air Act (CCAA) explicitly grants air districts authority to adopt and implement regulations to reduce or mitigate emissions from indirect and area wide sources of air pollution and that air districts can require the use of measures which reduce the number or length of vehicle trips (Health and Safety Code §40716(a)(1)). Based on CCAA enabling legislation, it is the intent of the Legislature “that districts shall endeavor to achieve and maintain state ambient air quality standards...by the earliest practicable date. In developing attainment plans and regulations to achieve this objective, districts shall consider the full spectrum of emissions sources and focus particular attention on reducing the emissions from transportation and area wide emission sources (H&SC §40910).” The CCAA also states that this ISR authority does not limit or supersede local land use authority of cities and counties. Other relevant ISR sections in the CCAA include: 40717(g), 40918(a)(4), and 42311(g).

The federal Clean Air Act authorizes states to include ISR programs in their state implementation plan under the federal Clean Air Act ((Section 110(a)(5)(42 USC 7410)).

Varying degrees and forms of ISR rules have been implemented in air districts throughout California, including Colusa County, Great Basin Unified, Imperial County, Mendocino

County, Placer County, Sacramento, San Joaquin, and Shasta County. Some of these rules are strictly cost recovery mechanisms for air districts to recoup the costs associated with CEQA review while others encourage new development to implement on-site emission reduction strategies or require applicants to pay an off-site mitigation fee.

In 2005, the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD) adopted Rule 9510 as an ISR rule. The rule applies to residential, commercial, industrial, office and recreational development projects above a certain size (e.g., 50 residential units or 2,000 square feet of commercial space). Development projects must reduce their construction and operational emissions to be below two tons per year of NO_x and PM₁₀ through onsite mitigation or pay an off-site mitigation fee. The fee formula is structured to encourage on-site mitigation measures. SJVUAPCD uses the fees to fund off-site mitigation projects that reduce NO_x and PM₁₀ emissions. To date, the air district has mostly funded off-site projects that include retrofitting or replacing engines in on road and off road vehicles and agriculture equipment.

Imperial County APCD adopted Rule 310, Operational Development Fee, in 2007. It assesses a per square foot fee on all new commercial development and a per unit fee on residential development above 4 units at the point of application for a building permit. Project proponents have the option to either provide on and off site mitigation, pay the mitigation fee, or do a combination of both. Fees collected are used to fund mitigation projects that reduce ozone precursors and PM₁₀.

Sacramento Metropolitan Air Quality Management District and South Coast Air Quality Management District are each currently developing ISR rules for their jurisdictions. Both air districts committed to adopting an ISR rule as part of their state implementation plan to reduce ozone precursors.

The Air District identified the potential for an ISR rule as a further study measure in the *Bay Area 2005 Ozone Strategy*. Further Study Measure 18: Indirect Source Mitigation Program (FS-18) states that the Air District will evaluate ways to reduce emissions from new and existing land uses. Air District staff has determined that due to EPA's adoption of new health based national ambient air quality standards, the successful implementation of the San Joaquin APCD's ISR and Imperial County APCD's ISR, an Indirect Source Review Rule should be brought to the Air District's Board of Directors for consideration.

Implementation Actions:

- The District could adopt a rule that sets air quality performance standards for new and modified development.
- Fees could be assessed for projects that exceed thresholds.
- Standards and fees would be structured to provide incentives for projects located and designed to minimize emissions.
- To initiate the ISR rulemaking process, the Air District has convened a broad-based stakeholder workgroup comprised of representatives from local governments, the

building industry, developers, realtors, other business representatives, and representatives of environmental organizations and community groups.

- District staff will consult with the stakeholder group regarding the scope, structure, and applicability of the ISR rule, and the basis for any fees associated with the rule.
- Details regarding administration of the rule will be determined via the rule-making process.

Emission Reduction:

Pollutants (tons per day)	2012	2020
ROG	0.30	0.30
NO _x	0.24	0.24
PM _{2.5}	0.11	0.11
PM ₁₀	0.47	0.47
Diesel PM	0.18	0.18
Benzene	0.01	0.01
Formaldehyde	0.01	0.01
CO ₂	333.43	333.43
CO ₂ -e	340.00	340.00

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: SO₂ (sulfur dioxide), 1,3 butadiene, and acetaldehyde.

Emission Reductions Methodology:

The emissions reduction methodology for this measure is based on methodology developed and reported by the San Joaquin Valley APCD (SJVAPCD) Indirect Source Review (ISR) program. The SJVAPCD methodology requires the payment of mitigation fees for projects that will result in 2 tons of NO_x or 2 tons of PM emissions a year or more. This District, based on our CEQA database, estimated for years 2010 through 2020 the number of projects that may be subject to the ISR program. The emission reductions above estimate the results if 15% of emissions from new construction are mitigated through off-site mitigations.

Exposure Reduction:

This measure will reduce region-wide population exposure to air pollutants based on the estimated reduction in emissions. This measure will also reduce localized population exposure to air pollution.

Emission Reduction Trade-offs:

None identified.

Cost:

Phase 1: \$1.4 million/year

Phase 2: \$1.4 million/year

These costs represent only those associated with the payment of off-site mitigation fees, not the costs developers may incur implementing on-site measure to reduce their project's emissions.

Co-benefits:

- Improved project design and planning.
- Public health benefits from reduced emissions, improved pedestrian access, and use of green building elements.
- Reduced GHG emissions from motor vehicles, building energy use, and other sources.

Monitoring Mechanisms:

Air District staff will work with the stakeholder group and the public through workshops to identify the most efficient mechanism to monitor implementation of the ISR.

Issues/Impediments:

The ISR needs to be developed to encourage less auto dependent development, to reduce regional VMT and not create an administrative burden on local land use planning. The ISR will need to take into consideration the implementation of measures for AB32 and SB375.

Sources:

1. 2005 Ozone Strategy, Volume II, Appendix E, Further Study Measure 18
2. Memo to Mobile Source Committee, September 11, 2007: *2005 Ozone Strategy Further Study Measure 18: Indirect Source Mitigation Program*
3. SCAQMD ISR: <http://www.aqmd.gov/rules/proposed/2301/index.html>
4. SJVAPCD ISR Web site <http://www.valleyair.org/ISR/ISRHome.htm>
5. SMAQMD 2009 Ozone Plan, page 7-21, IS-1 IS-2
<http://www.arb.ca.gov/planning/sip/planarea/sacsip/sacplanozone2009.pdf>
6. Larry Robinson, Joe Carl, SMAQMD, personal communication
7. Imperial Valley Rule 310 Operational Development Fee -
<http://www.co.imperial.ca.us/ag/Departments/Air%20Pollution/Forms%20&%20Documents/Rule%20310%20Mitigation%20Project%20Report%20Package.pdf>
<http://www.imperialcounty.net/ag/Departments/Air%20Pollution/WORKSHOPS/Past%20Workshops/Rule%20310/Rule%20310%20Public%20Committee%20Nomination%20Ad.doc>
8. 2008 Annual Report on the District's Indirect Source Review Program, SJVUAPCD
http://www.valleyair.org/Board_meetings/GB/agenda_minutes/Agenda/2008/June/Item%2013/GVB%20Agenda%20Item%2013.pdf
9. Socioeconomic analysis SJVUAPCD
http://www.valleyair.org/ISR/Documents/RULE_9510_AppendixF.pdf
10. Survey of ISRs from SCAQMD
http://www.aqmd.gov/rules/proposed/2301/pr2301_is_program_matrix_20090224.pdf

LUM 3 - Updated CEQA Guidelines and Enhanced CEQA Review

Brief Summary:

The Air District recently took action to update its California Environmental Quality Act (CEQA) guidelines to provide guidance on evaluating air quality impacts of development projects and local plans, determining whether an impact is significant, and mitigating significant air quality impacts related to new or modified projects. The updated guidelines include revised thresholds of significance for criteria pollutants and toxic air contaminants, and newly-adopted thresholds of significance for greenhouse gas emissions, adopted by the Air District Board of Directors in June 2010. In addition to issuing revised CEQA guidelines, the District will also strengthen its existing CEQA review program, as resources permit, by increasing the number of CEQA documents that District staff reviews and by quantifying estimated reductions in emissions of criteria pollutants, air toxics, and greenhouse gases from the District's CEQA program.

Purpose:

The purpose of this measure is to reduce emissions associated with new development in order for the region to attain state and national ambient air quality standards, reduce local impacts, reduce greenhouse gases, and improve health outcomes in the region.

Source Category/Travel Market Affected:

This measure would affect new development in the Bay Area subject to the environmental review process as defined by the California Environmental Quality Act.

Regulatory Context and Background:

The California Environmental Quality Act (CEQA) was adopted in 1970 and intended to inform policy-makers and the public about potential environmental effects of a project; identify ways to reduce adverse impacts; offer alternatives to the project; and enhance public participation in the planning process. The District participates in the CEQA review process in several capacities. The District provides guidance to Lead Agencies, consultants, and other parties regarding air quality analyses of project and plans conducted pursuant to CEQA. The District acts as a Lead Agency when it has the primary authority to implement or approve a project, such as a District Clean Air Plan or Rule. The District acts as a Responsible Agency when it has discretionary authority over a project, but does not have the primary decision-making authority of a Lead Agency. In this capacity, the District consults with the Lead Agency regarding potential impacts and may recommend project alternatives or mitigation measures to lessen any potentially significant air quality impacts. As a Commenting Agency, the District reviews environmental documents prepared for development proposals and plans in the Bay Area and provides comments to Lead Agencies regarding the adequacy of the air quality analysis and mitigation measures.

Implementation Actions:

Key implementation actions include the following:

- Update CEQA guidelines; provide revised thresholds of significance and mitigation measures, including new thresholds that address particulate matter and greenhouse gases.
- Conduct outreach to local jurisdictions, consultants, developers, and community members to introduce revised CEQA guidelines and environmental review process and provide technical assistance to lead agencies.
- As described in LUM 4, pursuant to the CEQA thresholds for air toxics, the District will encourage local jurisdictions to develop Community Risk Reduction Plans to reduce public exposure to air toxics and PM, and provide technical assistance in developing these plans, including assistance in developing community engagement plans that create effective channels for public participation to inform and implement the plans.
- Expand CEQA commenting by the Air District:
 - Review CEQA documents prepared for Bay Area projects, evaluate their consistency with the District's Guidelines, and recommend mitigation measures as appropriate.
 - Estimate the emission reductions achieved based on the implementation of mitigation measures recommended by the District.
 - Provide on District's CEQA website a log of CEQA comment letters accessible to the public.
- Develop and implement a monitoring plan for the District's CEQA review program:
 - Develop a database of projects that have been commented on and track implementation of mitigation measures.
 - Conduct regular reviews to evaluate CEQA program performance in achieving its goals and to recommend potential improvements to the program.
 - Review Mitigation Monitoring and Reporting Plans of CEQA documents prepared in the Bay Area.

Emission Reduction:

Pollutants (tons per day)	2012	2020
ROG		0.44
NO _x		0.35
PM _{2.5}		0.16
PM ₁₀		0.67
Diesel PM		0.26
Benzene		0.01
1,3 Butadiene		0.01
Formaldehyde		0.01
CO ₂		438.50
CO ₂ -e		447.00

No emission reductions are estimated for 2012. In addition to the pollutants shown above for year 2020, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: Ammonia (NH₃) and acetaldehyde.

Emissions Reductions Methodology:

The emissions reduction methodology for this measure is based on the District's CEQA database and new development projections for years 2010 through 2020. We estimated the unmitigated emissions for the new land use projects expected over this time period that would be subject to CEQA. We then assumed that the enhanced CEQA program would result in approximately 20% of the total unmitigated emissions from new land development would be reduced through the implementation of feasible mitigation measures on projects that would not have otherwise mitigated their project's emissions.

Exposure Reduction:

This measure will reduce region-wide population exposure to air pollutants based on the estimated reduction in emissions.

Emission Reduction Trade-offs:

None identified.

Cost:

Lead agencies currently prepare air quality analyses in CEQA documents. Air District staff does, and will continue to, provide technical assistance. This measure is not expected to significantly increase or decrease these review costs. However, this analysis does not consider the costs developers may incur preparing environmental analyses or implementing mitigation measures to reduce their project's emissions.

Co-benefits:

This control measure will result in long term adoption of cleaner, greener building practices in the Bay Area, as municipalities, developers, and their consultants adopt green building practices, build closer to transit nodes and job centers, and incorporate travel demand management into their projects and plans.

Monitoring Mechanisms:

Annual performance reviews of program.

The District will report to the CARE Task Force and other interested parties on progress in developing and implementing Community Risk Reductions Plans.

Issues/Impediments:

Implementing the Air District's revised CEQA guidelines will require working with local agencies to help them understand and apply the new guidelines. The District will perform outreach and provide tools and assistance to local agencies to ensure that the guidelines are properly applied. .

Sources:

1. Draft CEQA Thresholds Options Paper
2. Survey of CEQA Thresholds
3. LUM 4 - Land Use Guidance

Brief Summary:

Local land use decisions have direct impacts on air quality and population exposure to air pollutants. This measure summarizes programs and resources that the Air District will make available to local agencies to help them develop goals, policies and implementation measures that will improve air quality, reduce motor vehicle travel and emissions, and reduce population exposure to air pollutants. With its regional partners, the Air District is committed to assisting local governments to include smart growth principles and climate protection elements in their general plans to reduce criteria pollutants and greenhouse gas emissions.

Purpose:

The purpose of this measure is to provide resources to local governments that support local land use patterns to reduce mobile source emissions and population exposure to toxic air contaminants and reduce emissions related to energy use and waste disposal.

Source Category:

This measure will address emissions related to land use patterns and vehicle miles traveled (light-duty, medium-duty, and heavy-duty vehicles), as well as emissions related to energy use and waste disposal.

Regulatory Context and Background:

Local land use strategies and decisions will play a key role in determining whether the Bay Area can achieve our air quality and climate protection goals as our population and economy continue to grow. Because general plans prescribe land use patterns that shape growth in cities and counties for 20 years or more, they represent the most effective mechanisms to reduce vehicle miles traveled, vehicle emissions, and population exposure to toxic air contaminants.

California's Office of Planning and Research recommends that local governments update their general plans every ten years. Approximately ten Bay Area local governments are currently in the process of updating their general plans. The majority of these local governments are integrating smart growth principles and climate protection strategies into their update.

Within the Bay Area, there are approximately 50 cities that have not updated their general plan since 2000. Therefore, within the next several years, nearly half of the Bay Area's 110 local governments can be expected to update their general plan. This presents an opportunity for Bay Area local governments to incorporate smart growth and climate protection policies in their general plans in order to reduce emissions from motor vehicle travel over the long term, while also reducing population exposure to air pollutants.

Implementation Actions:

Link with District Functions: The Air District is implementing a number of programs and projects that can help to inform general plan updates.

- **CEQA Guidelines:** In June 2010 the Air District updated its CEQA Guidelines to assist lead agencies in analyzing air quality impacts. The update contains numerous mitigation measures and general plan policies to implement smart growth principles, minimize construction emissions, and reduce population exposure to air pollutants.
- **CARE Program:** The Community Air Risk Evaluation (CARE) program, initiated in 2004, evaluates and reduces health risks associated with exposures to toxic air contaminants (TACs) in the Bay Area. The program's main objectives are to: identify health risks from exposure to TACS, assess population exposures; identify TAC sources and impacted communities; and develop and implement mitigation measures.
- **Clean Air Communities Initiative (CACI):** This initiative is a multifaceted approach to address health concerns in communities disproportionately impacted with poor air quality and to minimize the effects of land use decisions on cumulative air impacts. CACI will bring to bear regulations, incentives, enforcement, public education, and technical studies to improve air quality.
- **Community Risk Reduction Plans (CRRPs):** The District will work with cities and counties to develop Community Risk Reduction Plans (CRRPs) to reduce population exposure to air toxics and PM, particularly in impacted communities identified through the CARE program. The District will provide technical assistance in preparing these plans, including assistance in developing community engagement plans that create effective channels for public participation to inform and implement the plans. The CRRPs should provide comprehensive plans for defined areas, including public engagement processes, emission inventories, numerical goals or targets, risk modeling, emission reduction measures, and monitoring mechanisms.
- **Indirect Source Review Rule:** As described in LUM 2, the Air District is in the early phases of developing an Indirect Source Review (ISR) regulation to reduce air pollutant emissions from new or modified development. It is anticipated that the ISR will provide incentives to design and locate new and modified development to minimize associated emissions.
- **Climate Protection Grants:** The District's climate protection grant program provided funding to local governments developing climate action plans or integrating climate protection strategies into general plans.
- **Provide Best Practice Guidance:** The Air District has, and will continue, to provide general plan guidance and best practices resources to local governments. In addition, where appropriate, the Air District encourages local jurisdictions to consult with the "Air Quality and Land Use Handbook: A Community Health Perspective," published by the California Air Resources Board.

- Best Practices Web Portal: In partnership with the Institute for Local Government, the Air District has developed a web portal highlighting best practices for local governments to use for their own climate action plans and general plans. The portal enables local governments to search for a wide variety of best practices and upload information on their own success stories. This tool is available at <http://www.ca-ilg.org/SFBayClimate>.
- CAPCOA Resource Documents: CAPCOA (California Air Pollution Control Officers Association) published two separate documents useful to local governments updating their general plans: 1) *Model Policies for Greenhouse Gases in General Plans* (May 2009), a resource for local governments to incorporate general plan policies to reduce greenhouse gas emissions; 2) *CEQA & Climate Change* (January 2008), a resource for evaluating and addressing greenhouse gas emission in CEQA review. In addition, CAPCOA is preparing a document entitled *Quantifying Greenhouse Gas Emissions: A Resource for Local Government to Assess Emission Reductions from Greenhouse Gas Mitigation Measures*. This report, scheduled for release by September 2010, will include quantification methodologies and estimated reductions from a wide variety of GHG mitigation measures.
- Regional Agency Collaboration: The Air District's regional agency partners provide a number of resources to help local governments implement smart growth principles. Resource tools include MTC's parking toolkit, Transportation for Livable Communities (TLC) capital grants; and the multi-agency FOCUS program that directs incentives, including funds for land use planning and capital infrastructure, to Priority Development Areas (PDAs), which are locally-identified infill development opportunity areas near transit.

Expand Assistance to Local Governments: To further enhance its support to local governments, the Air District may implement some or all of the following actions.

- Present Workshops: The Air District will consider conducting a number of workshops to assist local governments in addressing air quality and climate change in their general plan updates.
- Identify Innovative Funding Mechanisms: Lack of financial resources is a major constraint on the ability of local jurisdictions to conduct comprehensive long-range planning. Therefore, the Air District will collaborate with its regional partners to identify innovative funding mechanisms to help jurisdictions address air quality and climate change in their general plans.
- Tailor Best Practices to Local Needs: Guidance for general plans must recognize that our communities are diverse and that no single policy prescription would be appropriate in all cases. Communities that lack transit infrastructure have different challenges than cities with strong transit and/or the potential for transit-oriented development. The Air

District will consider developing tools catered to a variety of community types to reform their development patterns and reduce emissions.

- **Track Local Government Progress:** The Air District will consider monitoring and tracking progress of general plan updates and climate action plans. Monitoring mechanisms may include: tracking the number of climate action plans and emission reduction targets integrated in general plans; and assisting local governments in developing biennial GHG emission inventories to encourage them to track local progress.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.08	0.09
NO _x	0.08	0.10
PM _{2.5}	0.01	0.02
PM ₁₀	0.01	0.03
CO ₂	136.27	346.58
CO ₂ -e	139.00	353.51

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: Diesel PM, sulfur dioxide (SO₂), ammonia (NH₃), benzene, 1,3 butadiene, formaldehyde and acetaldehyde.

Emissions Reductions Methodology:

The emissions reduction methodology is based on methodology in ABAG's report *Projections 2009: What If?* The District estimated that if all General Plan updates in the Bay Area over the next five years emphasized compact development, there would be a 1% reduction in light-duty vehicle miles traveled (VMT) due to changes in land use patterns and increased use of transit. This decline in VMT translates into reductions in emissions, as shown in the table above.

Exposure Reduction:

This measure will provide guidance to local jurisdictions in assessing health impacts associated with new development and in implementing mitigations to reduce population exposure to air pollutants related to land use projects that generate toxic emissions and land use projects that are impacted from existing emission sources.

Emission Reduction Trade-offs:

None identified.

Cost:

Costs would vary. Available resources would be determined through the District's budget process.

Co-benefits:

This measure will 1) foster collaboration with local governments, resulting in more wide spread and effective implementation of this and other District programs, and 2) provide public health benefits, since focused development is more conducive to walking and bicycling.

Monitoring Mechanisms:

Program success will be monitored using:

- Database tracking Bay Area general plan updates including air quality / climate friendly policies and/or elements and emissions reductions quantified in environmental review process, number of climate action plans and emission reduction targets integrated in general plans.
- Tracking local government participation in and satisfaction with land use and air quality web or workshop resources offered by the District.
- Monitoring of ISR and CEQA programs as stated in LUM 2 and LUM 3.
- The District will report to the CARE Task Force and other interested parties on progress in developing and implementing Community Risk Reductions Plans.

Issues/Impediments:

The availability of staff resources to implement the actions identified in this measure is likely to be the main challenge to successful implementation.

Sources:

1. Governor's Office of Planning and Research, California Planners' Book of Lists, <http://opr.ca.gov/index.php?a=planning/publications.html#pubs-C>
2. CEQA Guidelines and Greenhouse Gases, <http://opr.ca.gov/index.php?a=ceqa/index.html>
3. California Air Pollution Control Officers (CAPCOA) CEQA and Climate Change White Paper, <http://www.capcoa.org/CEQA/CAPCOA%20White%20Paper.pdf>
4. CAPCOA Model Policies for Greenhouse Gases in General Plans (May 2009), <http://www.capcoa.org/modelpolicies/CAPCOA%20Model%20Policies%20for%20Greenhouse%20Gases%20in%20General%20Plans%20-%20June%202009.pdf>
5. Air Quality and Land Use Handbook: A Community Health Perspective, (April 2005), <http://www.arb.ca.gov/ch/handbook.pdf>
6. ABAG 2009 Projections: What If? <http://www.abag.ca.gov/rss/pdfs/whatif.pdf>

LUM 4 - Land Use Guidance

Brief Summary:

Local land use decisions have direct impacts on air quality and population exposure to air pollutants. This measure summarizes programs and resources that the Air District will make available to local agencies to help them develop goals, policies and implementation measures that will improve air quality, reduce motor vehicle travel and emissions, and reduce population exposure to air pollutants. With its regional partners, the Air District is committed to assisting local governments to include smart growth principles and climate protection elements in their general plans to reduce criteria pollutants and greenhouse gas emissions.

Purpose:

The purpose of this measure is to provide resources to local governments that support local land use patterns to reduce mobile source emissions and population exposure to toxic air contaminants and reduce emissions related to energy use and waste disposal.

Source Category:

This measure will address emissions related to land use patterns and vehicle miles traveled (light-duty, medium-duty, and heavy-duty vehicles), as well as emissions related to energy use and waste disposal.

Regulatory Context and Background:

Local land use strategies and decisions will play a key role in determining whether the Bay Area can achieve our air quality and climate protection goals as our population and economy continue to grow. Because general plans prescribe land use patterns that shape growth in cities and counties for 20 years or more, they represent the most effective mechanisms to reduce vehicle miles traveled, vehicle emissions, and population exposure to toxic air contaminants.

California's Office of Planning and Research recommends that local governments update their general plans every ten years. Approximately ten Bay Area local governments are currently in the process of updating their general plans. The majority of these local governments are integrating smart growth principles and climate protection strategies into their update.

Within the Bay Area, there are approximately 50 cities that have not updated their general plan since 2000. Therefore, within the next several years, nearly half of the Bay Area's 110 local governments can be expected to update their general plan. This presents an opportunity for Bay Area local governments to incorporate smart growth and climate protection policies in their general plans in order to reduce emissions from motor vehicle travel over the long term, while also reducing population exposure to air pollutants.

Implementation Actions:

Link with District Functions: The Air District is implementing a number of programs and projects that can help to inform general plan updates.

- **CEQA Guidelines:** In June 2010 the Air District updated its CEQA Guidelines to assist lead agencies in analyzing air quality impacts. The update contains numerous mitigation measures and general plan policies to implement smart growth principles, minimize construction emissions, and reduce population exposure to air pollutants.
- **CARE Program:** The Community Air Risk Evaluation (CARE) program, initiated in 2004, evaluates and reduces health risks associated with exposures to toxic air contaminants (TACs) in the Bay Area. The program's main objectives are to: identify health risks from exposure to TACS, assess population exposures; identify TAC sources and impacted communities; and develop and implement mitigation measures.
- **Clean Air Communities Initiative (CACI):** This initiative is a multifaceted approach to address health concerns in communities disproportionately impacted with poor air quality and to minimize the effects of land use decisions on cumulative air impacts. CACI will bring to bear regulations, incentives, enforcement, public education, and technical studies to improve air quality.
- **Community Risk Reduction Plans (CRRPs):** The District will work with cities and counties to develop Community Risk Reduction Plans (CRRPs) to reduce population exposure to air toxics and PM, particularly in impacted communities identified through the CARE program. The District will provide technical assistance in preparing these plans, including assistance in developing community engagement plans that create effective channels for public participation to inform and implement the plans. The CRRPs should provide comprehensive plans for defined areas, including public engagement processes, emission inventories, numerical goals or targets, risk modeling, emission reduction measures, and monitoring mechanisms.
- **Indirect Source Review Rule:** As described in LUM 2, the Air District is in the early phases of developing an Indirect Source Review (ISR) regulation to reduce air pollutant emissions from new or modified development. It is anticipated that the ISR will provide incentives to design and locate new and modified development to minimize associated emissions.
- **Climate Protection Grants:** The District's climate protection grant program provided funding to local governments developing climate action plans or integrating climate protection strategies into general plans.
- **Provide Best Practice Guidance:** The Air District has, and will continue, to provide general plan guidance and best practices resources to local governments. In addition, where appropriate, the Air District encourages local jurisdictions to consult with the "Air

Quality and Land Use Handbook: A Community Health Perspective,” published by the California Air Resources Board.

- Best Practices Web Portal: In partnership with the Institute for Local Government, the Air District has developed a web portal highlighting best practices for local governments to use for their own climate action plans and general plans. The portal enables local governments to search for a wide variety of best practices and upload information on their own success stories. This tool is available at <http://www.ca-ilg.org/SFBayClimate>.
- CAPCOA Resource Documents: CAPCOA (California Air Pollution Control Officers Association) published two separate documents useful to local governments updating their general plans: 1) *Model Policies for Greenhouse Gases in General Plans* (May 2009), a resource for local governments to incorporate general plan policies to reduce greenhouse gas emissions; 2) *CEQA & Climate Change* (January 2008), a resource for evaluating and addressing greenhouse gas emission in CEQA review. In addition, CAPCOA is preparing a document entitled *Quantifying Greenhouse Gas Emissions: A Resource for Local Government to Assess Emission Reductions from Greenhouse Gas Mitigation Measures*. This report, scheduled for release by September 2010, will include quantification methodologies and estimated reductions from a wide variety of GHG mitigation measures.
- Regional Agency Collaboration: The Air District’s regional agency partners provide a number of resources to help local governments implement smart growth principles. Resource tools include MTC’s parking toolkit, Transportation for Livable Communities (TLC) capital grants; and the multi-agency FOCUS program that directs incentives, including funds for land use planning and capital infrastructure, to Priority Development Areas (PDAs), which are locally-identified infill development opportunity areas near transit.

Expand Assistance to Local Governments: To further enhance its support to local governments, the Air District may implement some or all of the following actions.

- Present Workshops: The Air District will consider conducting a number of workshops to assist local governments in addressing air quality and climate change in their general plan updates.
- Identify Innovative Funding Mechanisms: Lack of financial resources is a major constraint on the ability of local jurisdictions to conduct comprehensive long-range planning. Therefore, the Air District will collaborate with its regional partners to identify innovative funding mechanisms to help jurisdictions address air quality and climate change in their general plans.
- Tailor Best Practices to Local Needs: Guidance for general plans must recognize that our communities are diverse and that no single policy prescription would be appropriate in

all cases. Communities that lack transit infrastructure have different challenges than cities with strong transit and/or the potential for transit-oriented development. The Air District will consider developing tools catered to a variety of community types to reform their development patterns and reduce emissions.

- **Track Local Government Progress:** The Air District will consider monitoring and tracking progress of general plan updates and climate action plans. Monitoring mechanisms may include: tracking the number of climate action plans and emission reduction targets integrated in general plans; and assisting local governments in developing biennial GHG emission inventories to encourage them to track local progress.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.08	0.09
NO _x	0.08	0.10
PM _{2.5}	0.01	0.02
PM ₁₀	0.01	0.03
CO ₂	136.27	346.58
CO ₂ -e	139.00	353.51

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: Diesel PM, sulfur dioxide (SO₂), ammonia (NH₃), benzene, 1,3 butadiene, formaldehyde and acetaldehyde.

Emissions Reductions Methodology:

The emissions reduction methodology is based on methodology in ABAG's report *Projections 2009: What If?* The District estimated that if all General Plan updates in the Bay Area over the next five years emphasized compact development, there would be a 1% reduction in light-duty vehicle miles traveled (VMT) due to changes in land use patterns and increased use of transit. This decline in VMT translates into reductions in emissions, as shown in the table above.

Exposure Reduction:

This measure will provide guidance to local jurisdictions in assessing health impacts associated with new development and in implementing mitigations to reduce population exposure to air pollutants related to land use projects that generate toxic emissions and land use projects that are impacted from existing emission sources.

Emission Reduction Trade-offs:

None identified.

Cost:

Costs would vary. Available resources would be determined through the District's budget process.

Co-benefits:

This measure will 1) foster collaboration with local governments, resulting in more wide spread and effective implementation of this and other District programs, and 2) provide public health benefits, since focused development is more conducive to walking and bicycling.

Monitoring Mechanisms:

Program success will be monitored using:

- Database tracking Bay Area general plan updates including air quality / climate friendly policies and/or elements and emissions reductions quantified in environmental review process, number of climate action plans and emission reduction targets integrated in general plans.
- Tracking local government participation in and satisfaction with land use and air quality web or workshop resources offered by the District.
- Monitoring of ISR and CEQA programs as stated in LUM 2 and LUM 3.
- The District will report to the CARE Task Force and other interested parties on progress in developing and implementing Community Risk Reductions Plans.

Issues/Impediments:

The availability of staff resources to implement the actions identified in this measure is likely to be the main challenge to successful implementation.

Sources:

7. Governor's Office of Planning and Research, California Planners' Book of Lists, <http://opr.ca.gov/index.php?a=planning/publications.html#pubs-C>
8. CEQA Guidelines and Greenhouse Gases, <http://opr.ca.gov/index.php?a=ceqa/index.html>
9. California Air Pollution Control Officers (CAPCOA) CEQA and Climate Change White Paper, <http://www.capcoa.org/CEQA/CAPCOA%20White%20Paper.pdf>
10. CAPCOA Model Policies for Greenhouse Gases in General Plans (May 2009), <http://www.capcoa.org/modelpolicies/CAPCOA%20Model%20Policies%20for%20Greenhouse%20Gases%20in%20General%20Plans%20-%20June%202009.pdf>
11. Air Quality and Land Use Handbook: A Community Health Perspective, (April 2005), <http://www.arb.ca.gov/ch/handbook.pdf>
12. ABAG 2009 Projections: What If? <http://www.abag.ca.gov/rss/pdfs/whatif.pdf>

LUM 5 – Reduce and Track Health Risk in Impacted Communities

Brief Summary:

This measure describes a set of complementary actions and programs that comprise key elements of the Air District’s strategy to reduce emissions and population exposure in impacted communities as identified by the Air District’s Community Air Risk Evaluation (CARE) Program. Key elements of this measure include:

- The District will establish a system to track cumulative health risks associated with emissions from stationary, mobile, and area sources in order to help monitor progress in reducing population exposure to toxic air contaminants and to fine particulate matter (PM2.5) in impacted communities.
- The District will revise rules to tighten requirements in order to reduce emissions of air toxics and particulate matter from existing sources via its Air Toxics “Hot Spots” Program and from new sources via its New Source Review rules. See SSM 16, 17, and 18 for additional description of these rule revisions.

Purpose:

The purpose of this measure is to address the cumulative air quality impacts of emissions of toxic air contaminants and directly-emitted PM2.5 from stationary, mobile, indirect sources, magnet sources, and area sources in impacted communities.

Source Category/Travel Market Affected:

The risk tracking system will address the full range of emissions sources. This includes stationary sources subject to the District’s permitting regulations, as well as mobile sources and area sources.

Regulatory Context and Background:

Applicable air quality requirements related to controlling stationary sources include rules and regulations adopted by the District, the California Air Resources Board, and the U.S. Environmental Protection Agency. In California, air districts have the primary responsibility for controlling air pollution from non-vehicular stationary sources of air pollution. The Air District regulates stationary sources through rulemaking for specific source categories, through its permitting process and New Source Review process for new and modified sources, and by administering the Air Toxics “Hot Spots” Program for existing sources.

New Source Review (NSR) requires that new/modified sources utilize the Best Available Control Technology to minimize air pollution impacts. The existing District NSR rules are Regulation 2, Rule 2: New Source Review, and Regulation 2, Rule 5: New Source Review of Toxic Air Contaminants. Additional Air District NSR requirements include emission offsets, air quality impact analysis for criteria air pollutants and their precursors, and health risk screening analysis for toxic air contaminants (TACs).

The Air Toxics “Hot Spots” (ATHS) program is a state program implemented by California air districts. Assembly Bill 2588, the Air Toxics “Hot Spots” Information and Assessment Act, was enacted by the State legislature in 1987. AB 2588 requires facilities throughout California to provide information to the public about emissions of TACs, and the impact that those emissions may have on public health. The Act was amended in 1992 by SB 1731, which provided air districts with the authority to require facilities with significant risks to implement a site-specific risk reduction audit and plan. Each air district has the authority to establish health risk thresholds for public notification and risk reduction requirements.

Regulation 2, Rule 5 and the ATHS program in many cases require the preparation of a site-specific Health Risk Screening Analysis (HRSAs), which is an assessment that describes the possible adverse health effects which may result from public exposure to routine and predictable emissions of TACs. All permit applications for new and modified sources are screened for emissions of TACs. Where the predicted health risks from a proposed project exceed specified threshold levels, the new/modified source(s) must use the Best Available Control Technology to minimize TAC emissions (TBACT). The TBACT and Project Risk standards in Regulation 2, Rule 5, are uniformly applied throughout the District’s jurisdiction.

Procedures used for completing HRSAs are based on guidelines adopted by Cal/EPA’s Office of Environmental Health Hazard Assessment (OEHHA) for use in the Air Toxics Hot Spots Program. Procedures for assessing health risks are intended to protect sensitive individuals such as children, and individuals with pre-existing health conditions. The Children's Environmental Health Protection Act (Senate Bill 25) established specific requirements for OEHHA to determine whether existing health risk assessment procedures are adequate to protect infants and children from the harmful effects of air pollution. OEHHA has already acted under SB 25 to revise certain procedures for assessing non-cancer health risks to provide a greater margin of safety for children, and revisions to cancer risk assessment procedures are expected to be proposed in late 2009, with final action anticipated in 2010.

Implementation Actions:

Specific components of this measure are described below.

- The District will track the maximum cumulative health risks related to toxic air contaminants and directly-emitted PM_{2.5} from the full range of emission sources in the impacted communities defined by the CARE program. To do so, the District will compile detailed local emissions inventories of toxic air contaminants and directly-emitted PM_{2.5}, and perform modeling of local concentrations of these pollutants, and track changes in emissions, concentrations, and population exposures over time. In addition to toxic air contaminants and directly-emitted PM_{2.5}, District staff will evaluate the technical feasibility of including additional criteria pollutants in the risk-tracking system.
- Amendments to Regulation 2, Rule 5: New Source Review of Toxic Air Contaminants, were adopted in January 2010, as described in Stationary Source Measure 17.

- District staff will propose amendments to Regulation 2, Rule 2: New Source Review to address PM_{2.5}, as described in Stationary Source Measure 16.
- The District will consider revising the District's Air Toxics "Hot Spots" Program for existing facilities to incorporate more stringent risk reduction requirements than are provided in existing District policy. See description of Stationary Source Measure 18. As discussed above, OEHHA is considering revising cancer risk assessment procedures to provide a greater margin of safety for protecting children. Based on discussions with OEHHA staff, it is possible that these revisions could increase calculated residential cancer risks by a factor of three or more relative to existing risk assessment procedures. Due to the potential significance of these revisions in risk assessment methodologies, the District believes that it is prudent to develop potential revisions to the District's Hot Spots program concurrent with the OEHHA guideline revisions. OEHHA does not expect that these risk assessment guideline revisions will be finalized for some time, perhaps late in 2010.
- District staff will continue developing and implementing source-category-specific rules to reduce emissions and risk in impacted communities. An example is SSM1: Metal-Melting Facilities, a control measure contained in this draft control strategy which will further control emissions from foundries and metal forging facilities. District staff will assess other source types and facilities throughout the region as candidates for source-category-specific rules. In the context of the CARE program and developing CRRPs, District staff will perform analysis to identify the major sources of emissions and risks in impacted communities. The results of this effort will help to identify the need for more stringent regulations that would reduce emissions from sources in impacted communities and throughout the District as a whole.
- As described in LUM 4, the District will encourage local jurisdictions to develop Community Risk Reduction Plans to reduce public exposure to air toxics and PM, and provide technical assistance in developing these plans, including assistance in developing community engagement plans that create effective channels for public participation to inform and implement the plans.

Emissions Reductions:

The cumulative impacts tracking system described above will not provide any direct emission reductions. The estimated emission reductions for SSMs 16, 17, and 18 are provided in the descriptions of those control measures. Therefore, no emission reductions are directly attributed to LUM 5.

Emissions Reductions Methodology:

See "Emission Reductions" section above.

Exposure Reduction:

This measure has been specifically developed with the objective of reducing population

exposure to emissions of air toxics and directly-emitted PM_{2.5} from stationary, mobile, and area sources of emissions.

Emission Reduction Trade-offs:

No trade-offs are anticipated for this measure.

Cost:

- Monetary costs to industry to install BACT to achieve reduced emissions and risk levels.
- Monetary costs to District to develop regulations, track cumulative risk levels in impacted communities, inform and educate the regulated community and to enforce.

Co-benefits:

- Since many TACs are also reactive organic gases (ROG), any localized reductions in TACs will provide co-benefits by helping to reduce ambient ozone levels. Also, reductions in emissions of diesel PM will help to reduce ambient levels of PM_{2.5} and PM₁₀.

Monitoring Mechanisms:

- On-going monitoring in impacted communities to measure changes in air quality, pollutant concentrations, and exposure.
- Findings from the cumulative risk-tracking system will be made available the on District website, including local emissions inventories of toxic air contaminants and directly-emitted PM_{2.5} for CARE communities, and modeling results regarding local concentrations of, and population exposures to, these pollutants.
- The District will report to the CARE Task Force and other interested parties on progress in developing and implementing Community Risk Reductions Plans.

Issues/ Impediments:

- The District will need to allocate resources to track changes in emissions of TACs in impacted communities.

Sources:

1. July 6, Memo to Stationary Source Committee from Brian Bateman, Update on CARE Program and Associated Regulatory Initiatives.
2. Draft Concept Paper, *More Stringent Permitting Requirements for Proposed New/modified Stationary Sources of Air Pollution Located in Impacted Communities or in Proximity to Sensitive Receptors*. February 23, 2009.
3. Bateman, April Presentation given to the CARE Task Force.

LUM 6 - Enhanced Air Quality Monitoring

Brief Summary:

The Air District will evaluate and enhance its capabilities, as resources permit, to monitor air quality on a region-wide basis, as well as on a localized basis in the impacted communities identified under the District's Community Air Risk Evaluation (CARE) program.

Purpose:

The purpose of this measure is to provide the Air District with sufficient ambient air quality monitoring data needed to inform 1) its efforts to improve air quality in impacted communities and 2) its air quality planning and modeling programs.

Source Category/Travel Market Affected:

Not applicable.

Regulatory Context and Background:

The Air District's Air Monitoring Program operates a network of 28 air monitoring stations, consistent with state and federal air monitoring requirements, designed to 1) provide the data required to determine the Bay Area's attainment status for both National and State ambient air quality standards; 2) provide air quality data to the public in a timely manner; and 3) support air pollution research and modeling studies. Additionally, a network of air toxic monitors collects data to ensure permit conditions are met at stationary sources and for State and National regulatory programs. The *BAAQMD 2008 Air Monitoring Network Plan* describes recent and planned changes and improvements to the District's air monitoring network.

In recent years the Air District has undertaken initiatives, such as the Community Air Risk Evaluation (CARE) program and the Clean Air Communities Initiative, to analyze pollution exposure at a more localized level and identify communities that are disproportionately impacted by air pollution. In many cases, these communities correspond to areas identified as priority development areas (PDAs) under FOCUS—the region's development and conservation strategy. The FOCUS strategy encourages infill development in PDAs to promote smart growth and reduce sprawl. The data and information generated from these new initiatives allows the District to implement more targeted policies and programs to reduce emissions and exposures in these communities.

The Air District has developed limited enhanced monitoring capabilities of key pollutants to gather more complete data to better assess local air quality conditions based upon the resources available. As an example, the Air District recently located a portable monitoring trailer in West Berkeley and Benicia to measure local air quality, and launched a mobile air monitoring van to assist in developing local pollutant concentrations across the West Oakland community to help identify local sources. Such efforts generally require a minimum of one year of data collection to effectively characterize an area's air quality.

These efforts are resource intensive, requiring expensive instrumentation, specialized operators, coordination among many Air District staff, and long site-development and set-up times.

Implementation Actions:

Depending on available resources, specific components of expanded monitoring would include:

- Ensure representative air quality data is being collected in the impacted communities identified under the CARE program. This effort would require review of the existing monitoring network with respect to the impacted communities to ensure that appropriate long term air quality data is being collected.
- Enhance monitoring of local air quality by collecting more information about pollutant concentrations and exposure at localized levels. This effort would be focused around microenvironments that may have significant local emission sources that could be assessed through the use of temporary monitors.
- Partner with County Health Departments to identify areas of poor air quality and collaborate with the community on ways to potentially measure and reduce exposure and emissions from local and regional sources.
- Perform on-going diagnostic analysis of the monitoring network, surveying the utility and effectiveness of monitoring locations and pollutants monitored while ensuring that the existing network continues to meet all federal and state requirements. This could help to verify air quality modeling inputs and predicted concentrations, which in turn would provide a more comprehensive and representative air quality profile of the Bay Area.

Emission Reductions:

Control measure does not directly reduce emission but supports emissions reduction programs.

Emission Reduction Methodology:

Not applicable.

Exposure Reduction:

Control measure does not directly reduce exposure but supports exposure reduction efforts.

Emission Reduction Trade-offs:

None.

Cost:

Costs would vary depending on the extent of enhanced monitoring implemented. Available resources would be determined through the District's budget process.

Co-benefits:

Not applicable.

Monitoring Mechanisms:

Track enhancements to local and regional air monitoring capabilities.

Issues/ Impediments:

Enhanced air quality modeling will require additional resources, including purchase of new instrumentation, equipment maintenance, and additional staff with technical expertise in atmospheric chemistry, and background and familiarity with monitoring equipment.

Sources:

1. BAAQMD 2008 Air Monitoring Network Plan

BAY AREA 2010 CLEAN AIR PLAN

VOLUME II

Section E

Energy and Climate Measures

September 2010



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ECM 1 - Energy Efficiency

Brief Summary:

This control measure consists of three components: 1) provide education and outreach to increase energy efficiency in residential and commercial buildings and industrial facilities, 2) provide technical assistance to local governments to adopt and enforce energy efficiency building codes, and 3) provide incentives for increasing energy efficiency at schools.

Purpose:

Decreasing the amount of energy consumed in the Bay Area through increased efficiency and conservation will reduce the amount of fossil fuels, such as natural gas, needed to produce the electricity that the region uses. This will, in turn, decrease the production of greenhouse gases and criteria pollutants emitted by combustion of fossil fuels.

Source Category Affected:

The emission source affected by this measure is primarily electricity production for commercial and residential buildings and industrial facilities.

Regulatory Context and Background:

The California Global Warming Solutions Act, or AB32, signed into law in 2006, requires the State of California to reduce greenhouse gas emissions to 1990 levels by 2020. In support of this goal, the California Air Resources Board “encourages local governments to adopt a reduction goal for municipal operations emissions and move toward establishing similar goals for community emissions that parallel the State in commitment to reduce greenhouse gas emissions by approximately 15 percent from current levels by 2020.” According to the Air District’s 2008 Source Inventory of Bay Area Greenhouse Gas Emissions, approximately fifty percent of the region’s greenhouse gas emissions are produced through energy used in residential and commercial building, industrial facilities and electricity generation. The Bay Area cannot meet the challenge of AB32 without reducing energy use in buildings and industry.

Energy production at and for residential, commercial, industrial and other buildings is also a significant source of criteria pollutants such as NO_x and PM. Improved energy efficiency can reduce these emissions from power plants, boilers, furnaces, etc.

PUC Strategic Plan: In September 2008, the California Public Utilities Commission (CPUC) adopted the state's first Long Term Energy Efficiency Strategic Plan, presenting an integrated framework of goals and strategies for saving energy from government, utilities and the private sector in the 2009 to 2020 period. Goals in the Strategic Plan include:

- All new residential construction in California will be zero net energy by 2020;
- All new commercial construction in California will be zero net energy by 2030;
- The Heating, Ventilation, and Air Conditioning (HVAC) industry will be reshaped to ensure optimal equipment performance; and

- All eligible low-income homes will be energy efficient by 2020.

Title 24: In California, energy efficiency requirements for new construction are addressed through Title 24 of the California Code of Regulations. Part 6 of Title 24, the California Energy Code, contains energy conservation standards applicable to all residential and non-residential buildings throughout California. In April of 2008, the California Energy Commission adopted new standards for Title 24, with the intent of decreasing energy use and greenhouse gas emissions throughout the state. The 2008 update is expected to achieve 13-15% energy savings in residential buildings and 8% savings in commercial buildings compared to the 2005 standards. The 2008 standards took effect on January 1, 2010.

Progress in energy efficiency will be essential to achieve our greenhouse gas reduction goals. Comprehensive green building programs that include standards for energy efficiency and third party verification of building performance are critical to this objective. The most effective role for the District is to complement and build on the requirements embedded in the 2008 update of the Title 24 standards. One such gap is in the enforcement of Title 24. A study conducted by EDAW on behalf of the City of Seattle concludes that, as building codes and standards become more complex, there is a critical need for education and outreach to ensure that the codes are properly implemented and enforced.

Recently, public schools have been taking advantage of low interest financing provided by a variety of federally backed zero (or near zero) interest bonds to develop energy efficiency and renewable energy projects. In many cases, this type of financing can make energy projects revenue positive for the school districts. These energy savings can reduce the overall carbon emissions from schools and provide additional revenue to school districts. Energy efficiency and renewable energy projects can be more complicated than the typical construction projects school districts are used to, and many school districts lack the in-house capacity to evaluate and implement energy projects themselves. However, there are a growing number of sources that can provide assistance to school districts to design and carry out energy-related projects, such as California High Performance Schools (CHPS), Coalition for Adequate School Housing (CASH), or the California School Board Association (CSBA).

Implementation Actions:

This control measure consists of three components:

- Provide education and outreach, as resources permit, to increase energy efficiency in residential and commercial buildings and industrial facilities, including distributing information on state and local energy programs to permitted sources, and researching the newest methodologies and tools for quantifying GHG emissions from building energy use;
- Provide technical assistance to local governments to adopt and enforce energy efficiency building codes and green building ordinances, including distribution of model ordinances and collaboration with the California Energy Commission to convene building inspector trainings on new Title 24 regulations;

- Provide information and incentives, as resources permit, to increasing energy efficiency at schools, through the District's existing outreach and community grant programs.

Emission Reductions:

It is estimated that all actions in this control measure will result in a 1% reduction in electricity use in the Bay Area which draws from the results to date from local green building ordinances. The Air District's *2008 Source Inventory of Greenhouse Gas Emissions* provides current levels of energy use and resulting CO₂ emissions.

ABAG projects an approximately 28% increase in Bay Area population from 2005 – 2035. From 2005 – 2020, this increase will be approximately 14%. Using the District's *Source Inventory*, the total electricity use is first expanded to incorporate this estimated growth, and then an estimated savings from the control measure implementation actions is applied. The *Source Inventory* uses 2007 data, so instead of applying the full 14% increase (representing an increase from 2005 – 2020), an adjusted increase of 12% has been applied.

After applying the increase due to population growth, a 1% decrease is calculated.

Emissions are in short tons/day (metric tons/day for CO₂):

Daily Energy Use	CO₂	PM 10	PM 2.5	ROG	NO_x	SO₂	CO
149,474 MWh	43,099	28	28	4.2	46	40	57
2020 Projection*	48,270	32	32	4.7	52	44	64
1% Reduction	483	0.32	0.32	0.05	0.52	0.44	0.64

*12% increase over 2007 data

How Emissions Reductions Were Estimated:

Factors for greenhouse gas emissions from electricity use are based solely on the amount of energy used. Factors for criteria air pollutant emissions, on the other hand, are based not just on the amount of energy used, but also on the specific technology being utilized. Therefore, it is far more complicated to develop an emissions factor for criteria pollutants, and the numbers in the table above should be treated as general estimations and not specific projections.

Coefficients to translate electricity into CO₂ emissions were taken from the California Climate Action Reserve General Reporting Protocol, version 3.1. Electricity coefficients for PM, ROG, NO_x, SO₂ and CO were derived by Air District staff based on regional averages of emissions factors from power plants in the region.

Exposure Reduction:

This measure could help to reduce exposure in impacted communities that are located near power plants, particularly "peaker plants", due to the reduction in electricity use.

Emission Reduction Trade-offs:

This control measure is designed purely to reduce energy consumption, so there would be no direct emission trade-offs. There might be indirect emissions associated with the production and delivery of some energy efficient technologies.

Cost:

Investing in energy efficiency is almost always cost-effective because there is a direct return on the investment in the form a reduction in energy expenditures. Numerous state- and utility-sponsored incentive programs exist which provide rebates or financing for purchasing and installing energy efficient technologies. In addition, innovative financing strategies such as the Berkeley PACE model (formerly Berkeley FIRST), have emerged which negate the need for upfront capital investments on the part of building owners.

According to the CEC's Energy Consumption Data Management System, residential electricity use represents approximately 29% of all electricity use in the Bay Area. The table below outlines the net savings to building owners from investing in energy efficiency. The per household cost and savings numbers reflect averages between the cost estimates of new green building policies in San Francisco and Sonoma County, as reported to the CEC.

	Per Household	Total
Incremental annual cost*	\$96	\$27,945,600
Annual savings	\$165	\$48,031,500
Net Savings	\$69	\$20,085,900

*Total incremental cost of \$1,929 amortized over 20 years

Co-Benefits:

Reducing the use of fossil fuels in grid-tied electricity production brings a number of co-benefits to a community, including:

- improved air quality near power plants (due to reduced production)
- Increased reliability of power supply and cost
- energy savings
- financial savings through reduced energy usage
- green job creation (local manufacturers/suppliers/contractors for installing technologies)

Monitoring Mechanisms:

The overall goal of the measure is to reduce fossil fuel use through the direct use of grid-tied electricity. Monitoring and evaluating progress will be measured by:

- Reduction in electricity use (information from PG&E)
- Number of businesses and residents reached, in site visits, meetings, through mailings and other methods of information distribution (tracked by District)
- Number of building inspectors and operators receiving enforcement training on Title 24 (reported to District by CEC)

- Number of permitted sources seeking technical assistance, funding or other assistance from state and federal agencies for energy efficiency as a result of District's information provision (will be tracked through a response survey included in the information packets)
- Reduction in electricity use from permitted sources (reported through permitting process)

Issues/Impediments:

It is not anticipated that there would be significant impediment due to the voluntary nature of this control measure.

Sources:

- 1) *"Re-commissioning' Leans on Education"*, A. Lee Chichester, NEMI Research Report
- 2) "Source Inventory of Greenhouse Gas Emissions" Bay Area Air Quality Management District, December 2008
- 3) *Seattle New Building Energy Efficiency Policy Analysis: Case Study California Title 24 Energy Code*; EDAW (11/2004);
http://www.seattle.gov/environment/documents/GBTF_NewBldg_Title24_Case_Study.pdf
- 4) <http://www.dsa.dgs.ca.gov/Code/title24.htm>
- 5) http://www.seattle.gov/environment/documents/GBTF_NewBldg_Title24_Case_Study.pdf
- 6) http://ag.ca.gov/globalwarming/pdf/green_building.pdf
- 7) http://www.energystar.gov/index.cfm?c=heat_cool.pr_hvac
- 8) <http://www.cpfund.ca/pdf/the-jobs-connection.pdf>

ECM 2 - Renewable Energy

Brief Summary:

This control measure consists of two components: 1) promote incorporation of renewable energy sources into new developments and redevelopment projects, and 2) foster innovative renewable energy projects through provision of incentives. Note: In addition, as part of the Further Study Measure entitled “Enhancement to Energy Measures,” the District will evaluate the cost-effectiveness of solar thermal technology for consideration as a potential solar hot water heating rule.

Purpose:

Promoting the production and use of renewable energy in the Bay Area will reduce the portion of fossil fuel-based energy needed to produce the electricity that the region consumes. This will, in turn, decrease the greenhouse gases and criteria pollutants emitted by combustion of fossil fuels.

Source Category Affected:

The emission sources affected by this measure are primarily natural gas combustion associated with electricity production for commercial and residential buildings and industrial facilities.

Regulatory Context and Background:

The California Global Warming Solutions Act, or AB32, signed into law in 2006, requires the State of California to reduce greenhouse gas emissions to 1990 levels by 2020. In support of this goal, the California Air Resources Board “encourages local governments to adopt a reduction goal for municipal operations emissions and move toward establishing similar goals for community emissions that parallel the State in commitment to reduce greenhouse gas emissions by approximately 15 percent from current levels by 2020.” According to the Air District’s 2008 Source Inventory of Bay Area Greenhouse Gas Emissions, approximately fifty percent of the region’s greenhouse gas emissions are produced through energy used in residential and commercial building, industrial facilities and electricity generation. The Bay Area can not meet the challenge of AB32 without reducing energy use and/or using renewable energy in buildings and industry.

There are two primary approaches to increasing renewable energy: change the fuel mix from which grid-tied electricity is produced; or replace grid-tied electricity with 100% renewable electricity produced through distributed generation such as solar panels, micro wind turbines, or onsite cogeneration.

Changes to the electricity fuel mix are most efficiently made upstream, at the utility level. The State of California has an aggressive “renewable portfolio standard” that requires publicly-held electric utilities to provide electricity that is produced from 20% renewable

energy sources by 2010. The AB32 Scoping Plan adopted by the California Air Resources Board calls for this renewable energy target to increase to 33% by 2030.

A downstream approach to increasing the use of renewable energy is to promote non-fossil fuel-based energy technologies, such as solar thermal panels, solar photovoltaic (PV) panels, cogeneration systems that use waste heat or waste methane, micro-sized wind turbines, etc.

Implementation Actions:

Control measure consists of two components:

- Promote renewable energy sources in new developments and redevelopment projects as an emissions offset option included in both the District's new Indirect Source Review Rule, and as a mitigation measure within the CEQA process (promoted, in part, through the District's CEQA Guidelines)
- Foster innovative renewable energy projects and approaches through existing and new incentive programs (e.g. expand the Berkeley PACE program (formerly Berkeley FIRST), replicate Solar Sonoma County's streamlining of incentives policies)

Emission Reductions:

Currently, the Bay Area has 132 megawatts (MW) of installed solar power. The California Public Utilities Commission oversees the California Solar Initiative, which has a statewide program goal of installing 3,000 MW of new solar power by 2020. Current statewide capacity is 515 MW, reflecting a 482% increase over current capacity. Applying this increase to current Bay Area capacity would indicate that by 2020, installed capacity in the Bay Area would be in the neighborhood of 636 MW.

It is estimated that the implementation actions in this control measure would increase installed solar capacity in the Bay Area by approximately 1-5% above and beyond the goals set by the California Solar Initiative. This would result in additional installed capacity of 64 MW, which would offset grid-tied electricity.

Emission reductions are in short tons/day (metric tons/day for CO₂)

Solar Capacity Increase	Annual MW	MT CO ₂	PM ₁₀	PM _{2.5}	ROG	NO _x	SO ₂	CO
10% by 2020	64	0.05	<.01	<.01	<.01	<.01	<.01	<.01

How Emission Reductions were Estimated:

Factors for greenhouse gas emissions from electricity use are based solely on the amount of electricity used. Factors for criteria air pollutant emissions, on the other hand, are based not just on the amount of energy used, but also on the specific technology being utilized at the power plant. Therefore, it is far more complicated to develop an emissions factor for

criteria pollutants, and the numbers in the table above should be treated as general estimations and not specific projections.

Coefficients to translate electricity use into CO₂ emissions were taken from the California Climate Action Reserve General Reporting Protocol, version 3.1. Electricity coefficients for PM, ROG, NO_x, SO₂ and CO were derived by Air District staff based on regional averages of emissions factors from power plants in the region.

The 10% estimate for increased solar capacity is a conservative estimate which draws from the results to date from local solar promotion programs.

Exposure Reduction:

This measure could help to reduce exposure in impacted communities that are located near power plants, particularly “peaker plants”, due to the switch in electric load from grid-tied to distributed electricity generation.

Emission Reduction Trade-offs:

Emissions are created through the production and transport of renewable energy technologies (solar PV panels, etc.). Life-cycle criteria pollutant and other emissions, such as sulfur dioxide, nitrogen oxide and lead, associated with solar panels are due primarily to raw material extraction and energy consumption in the manufacturing process.

Cost:

The cost of renewable energy can vary widely, depending on available rebates, tax credits and other incentives, the energy needs of the building, and other factors. The payback period for solar PV systems is long (approximately 15-20 years), but may decrease if net metering laws change (see discussion on AB 560 below). In addition, innovative financing strategies such as the Berkeley PACE model (formerly Berkeley FIRST), have emerged which can reduce or negate the need for upfront capital investments on the part of building owners.

The cost of including onsite renewable energy generation in buildings would be born by building and property owners. Potential long-term savings would accrue to property owners as well. In the example below outlining the cost and savings of a typical 2.5 kW PV system, the payback period is approximately 19 years.

Net cost of solar 2.5 kW PV system

	Costs/Credits	Balance	10% increase (25,600 systems)	Annual cost over 10 years
Up-front capital cost	\$20,000	\$20,000	\$512,000,000	
State rebate	-\$6,500	\$13,500		
Federal tax credit	-\$4,050	\$9,450		
Final cost		\$9,450	\$241,920,000	\$24,192,000

Savings

	2.5 kW system	10% increase (25,600 systems)
Annual electricity savings	4,000 kWh	102,400 MWh
Average cost per kWh	12.5 cents	
Annual cost savings	\$500	\$12,800,000
Annual cost (over 10 years)	\$945	\$24,192,000
Annual net cost	\$445	\$11,392,000

Applying these cost and savings figures to the region-wide program outlined in this control measure would result in a total net cost of \$11,392,000.

Co-benefits:

Replacing grid-tied electricity with renewable energy brings a number of co-benefits to a community, including:

- improved air quality near power plants (due to reduced production)
- Increased reliability of power supply and cost
- energy savings, including savings by reducing distribution losses between power plants and the end user
- financial savings through reduced energy usage
- green job creation (local manufacturers/suppliers/contractors for installing technologies – e.g., the world's largest solar cell manufacturer is in Palo Alto)

Monitoring Mechanisms:

The Air District will use existing staff resources to track the amount of solar PV and solar thermal capacity installed in the Bay Area by monitoring organizations which report on these statistics, such as the PUC and the California Solar Initiative.

Issues/Impediments:

It is not anticipated that there would be significant impediment to the voluntary approach described in component (1). Significant impediments to implementation of the incentive-based component to this control measure (2) are not anticipated, however, provision of financial incentives would be dependent upon the availability of adequate financial resources.

Under California's net-metering law, the electric utility is required to "buy back" any electricity generated by a customer-owned generator as measured by an electric meter that can measure the flow of electricity in both directions. At the end of the year, the electric utility calculates the amount of electricity distributed to the grid by the customer and reduces the customer's annual bill by the amount of electricity generated by the customer. In California, utilities currently only have to offer net metering until the load served by net metering represents 5% of the utilities' total load. This limitation creates a general impediment to widespread installation of solar power by limiting its cost-effectiveness.

The many emerging market-based and legislative approaches and responses to financing renewable energy are making this a very dynamic policy field. The Air District will continue to track policy developments in order to most effectively design its programs and activities.

Sources:

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5. http://www.oregon.gov/ODOT/HWY/OIPP/docs/solar_panel_lifecycle.pdf
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ECM 3 - Urban Heat Island Mitigation

Brief Summary:

The control measure includes regulatory and educational approaches to reduce the “urban heat island” (UHI) phenomenon by increasing the application of “cool roofing” and “cool paving” technologies.

Purpose:

The purpose of this control measure is to mitigate the urban heat island phenomenon. Reducing UHI effects can help to reduce ozone levels, as well as emissions of particulate matter (PM), air toxics and greenhouse gases related to energy consumption for air conditioning and cooling. In addition, it can help to offset temperature increases related to global warming.

Source Category Affected:

The sources of emissions affected by this control measure are primarily associated with electricity generation for buildings and evaporative emissions from automobiles.

Regulatory Context and Background:

As urban areas develop, natural, permeable surfaces and vegetation are replaced by impermeable structures and paved surfaces. This development transforms the area into a drier micro-environment, which absorbs, rather than reflects, the heat of the sun. Thus, urban heat islands are created, which can be up to 10⁰ F hotter than natural background temperatures.

Factors that contribute to UHI formation include the following:

- Many man-made surfaces are composed of dark materials that absorb and store the sun’s heat.
- Buildings, industrial processes, motor vehicles and people produce anthropogenic heat.
- Loss of trees and vegetation due to urbanization causes a reduction in cooling from evapo-transpiration.
- Urban structures can form canyons that reduce ventilation and trap heat.

Elevated temperatures caused by UHIs can accelerate the formation of ground level ozone, or smog, and can contribute to adverse health impacts, such as respiratory and heat-related ailments. Higher temperatures can also result in increased electricity use to cool buildings. Mitigation methods include increasing the reflectivity of built surfaces, such as roads, parking lots and rooftops, increasing tree-cover and natural vegetation (for shading and the cooling effect of evapo-transpiration), and increasing ventilation.

Cool Paving: On average, about 12% of an urban city’s land area is devoted to parking lots. This number can be even higher in suburban communities.

Many parking lots are resurfaced every 5-10 years. The amount of parking lot construction and re-surfacing that occurs in the Bay Area provides a significant opportunity to increase albedo (reflectivity) while providing ancillary benefits such as an extended life of the paved surface and storm water benefits associated with use of porous paving.

The hottest pavements tend to be impermeable and dark in color, with solar reflectance values (albedo) under 25%. These pavements can heat to 150°F or more on hot days. Utilizing cool paving techniques can reduce this temperature by 30°F or more. There are two ways to make pavements cooler: 1) by increasing albedo, and 2) by increasing their ability to store and evaporate water.

Cool Roofs: Most existing flat roofs have an albedo (reflectivity) of only 10 to 20 percent of sunlight. These roofs absorb much of the remaining solar radiation and heat up the buildings they cover. Cool roofing technologies, such as lighter or more reflective paint, coatings, membranes, shingles or tiles, can increase a roof's albedo, on average, to about 50-60%. A 2000 study by Lawrence Berkeley National Laboratory revealed a 13-18% reduction in air conditioning-related electricity use in residential and commercial buildings in San Jose due to the application of cool roof strategies.

While cool roofing reduces the need for air conditioning during periods of heat, it can have an opposite impact during periods of cold by reflecting solar radiation away from the buildings, requiring an increase in heating during winter months. In most locations, the balance of these two effects results in a net reduction in energy use. However, in some locations, there may not be an energy reduction benefit from the application of cool roof technologies. Air District staff will continue to follow research efforts in this area.

Implementation Actions:

Control measure consists of the following components:

- Promote building code requirements for new construction or re-roofing/roofing upgrading for commercial and residential multi-family housing to meet specific "cool roof" standards.
- Include minimum "cool roof" standards for new commercial and residential multi-family housing construction and re-roofing or roofing upgrades in specified areas as mitigation measures under the District's CEQA Guidelines and ISR rule.
- Develop and promote adoption of a model zoning ordinance for "cool paving" standards to be met when existing parking lots undergo re-surfacing.
- Provide training for public works staff and private construction/paving companies on benefits of and how to meet new cool paving standards.
- Encourage construction of new and re-surfacing of existing parking lots and other paved surfaces to meet minimum reflective and permeable surface standards by including this as a mitigation measure under the District's CEQA Guidelines and ISR rule.
- Perform outreach to cities and counties to make them aware of the benefits of cool roofing and cool paving, and of new tools available.

- Provide training for building inspectors on benefits of and how to meet new cool roofing standards.

Emission Reductions:

Lawrence Berkeley National Laboratory's (LBNL) Heat Island Group conducted a study of the impacts that surface lightening of rooftops and pavement, combined with tree shading, might have on the Los Angeles air basin. The study found that the widespread application of these combined activities could achieve a decrease in ambient air temperature of 3°C. Half of this temperature reduction is due to albedo (roofs and pavement) and half to trees.

While no similar study has been conducted for the Bay Area, the results can be applied to similar temperature zones, such as San Jose and the Diablo Valley. This reduction in ambient air temperature would result in a reduction in electricity use to cool buildings. While no empirical studies have been conducted for the Bay Area, studies of individual buildings by LBNL, the Florida Solar Energy Center, and others have shown that energy savings on the order of 20% to 30% are commonly achieved with a cool roof surface.

Contra Costa County, Napa County, Santa Clara County and approximately half of Solano County are expected to be the most appropriate locations for applications of cool roofs in the Bay Area Air Quality Management District's jurisdiction due to their warmer temperatures and higher use of air conditioning. It is assumed that cool roofs in these counties would reduce air conditioning-related electricity use by 20%.

Emission reductions are in short tons/day (metric tons/day for CO₂)

Source Category	MWh	CO ₂ (MT)	PM ₁₀	PM _{2.5}	ROG	Nox	SO ₂	CO
Electricity	80	23	0.015	0.15	<0.01	0.03	0.02	0.03

Emission Reduction Methodology:

Factors for greenhouse gas emissions from electricity use are based solely on the amount of electricity used. Factors for criteria air pollutant emissions, on the other hand, are based not just on the amount of energy used, but also on the specific technology being utilized at the power plant. Therefore, it is far more complicated to develop an emissions factor for criteria pollutants, and the numbers in the table above should be treated as general estimations and not specific projections.

Coefficients to translate electricity use into CO₂ emissions were taken from the California Climate Action Reserve General Reporting Protocol, version 3.1, using the most recently CCAR-approved coefficient for PG&E (for year 2007). Electricity coefficients for PM, ROG, NO_x, SO₂ and CO were derived by Air District staff based on regional averages of emissions factors from power plants in the region.

Estimations for electricity used for air conditioning in the selected counties was taken from the Energy Information Administration's (EIA) 2001 Residential Buildings Energy

Consumption Survey and the California Energy Commission's (CEC) 2006 California Commercial End-Use Survey. Data on energy consumption by county and by sector from the CEC's Energy Consumption Data Management System was used to estimate the amount of electricity used for air conditioning that occurred in these counties.

Exposure Reduction:

This measure would help reduce smog formation by reducing the ambient air temperature, particularly in areas that experience excessive heat. It would be especially effective in reducing population exposure in those areas of the Bay Area that experience higher daily ambient temperatures, like San Jose, Concord, and San Leandro/East Oakland.

Emission Reduction Trade-offs:

It is unlikely that this measure would increase any emissions appreciably. However, caution would have to be taken in compiling the technology specifications to ensure that products that could produce toxic emissions during their use are not recommended.

Cost:

Cool roofs deflect some desired heat gain during the winter. In general, though, cool roofs result in net energy savings, especially in areas where electricity prices are high.

Although costs will vary greatly depending on location and local circumstances, the cost premium for cool roofs versus conventional roofing materials ranges from zero to 5 or 10 cents per square foot for most products, or from 10–20 cents for a built-up roof with a cool coating used in place of smooth asphalt or aluminum coating.

A California study found that cool roofs provide an average yearly net savings of almost 50 cents per square foot. This number includes the price premium for cool roofing products and increased heating costs in the winter as well as summertime energy savings, savings from downsizing cooling equipment, and reduced labor and material costs over time due to the longer life of cool roofs compared with conventional roofs.

A 2007 study titled "California Rooftop Photovoltaic (PV) Resource Assessment and Growth Potential by County," conducted by Navigant Consulting for the CEC's PIER program provided estimated roof space for the residential and commercial sectors within the selected counties. An estimated cost of 10 cents per square foot was used to calculate the cost of applying cool roof technologies to this potential roof space. Assuming a cool roof penetration program rate of 10%, we estimated upfront capital cost of \$7,600,637 for the residential sector and \$2,311,504 for the commercial sector.

	Residential	Commercial	Total
Upfront Capital Costs	\$7,600,637	\$2,311,504	\$9,912,141
Annual Savings	\$38,003,185	\$11,557,521	\$49,560,706
Net Annual Savings	\$30,402,548	\$9,246,017	\$39,648,565

To estimate the electricity cost savings that would be achieved in the residential sector, we again reference the California Energy Commission's Energy Consumption Data Management System for the amount of expenditures in California for electric Air Conditioning in 2007. This was then scaled down based on the share of statewide electricity used by the selected counties, and reduced by 80% to arrive at the amount of electricity use that would be avoided by cool roofs. We largely used the same methodology for the commercial sector, except that we did not have actual expenditure data. Instead, we consulted the Energy Information Administration's Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, by State report to find the average retail price of electricity. This was then applied to the scaled down air-conditioning electricity consumption data.

Co-Benefits:

Heat island mitigation measures bring a number of co-benefits to a community, including:

- improved air quality
- improved public health (lower risk of respiratory and heat-related ailments)
- energy savings
- financial savings through reduced energy usage
- green job creation (local suppliers/contractors for installing technologies)

Monitoring Mechanisms:

Monitoring and evaluating progress could include:

- Tracking how many cool roof building codes are adopted
- Measuring increases in square footage of cool roofs, both in new construction and existing buildings
- Measuring increases in square footage of cool parking lots

Issues / Impediments:

Advocating for building code requirements that include "cool roof" standards for re-roofing/roofing upgrades may raise concerns about a potential increase in up-front costs among some stakeholders, such as the construction and development industries or local governments. Similar requirements for "cool paving" may also raise concerns due to a lack of information on the availability and sourcing of these technologies and products. By promoting and encouraging adoption of these types of policies, the Air District will facilitate demonstration of the actual cost benefits of such policies and work toward overcoming these barriers.

Sources:

- 1) Cool Houston: A Plan for Cooling the Region (2004)
- 2) Heat Islands: Understanding and Mitigating Heat in Urban Areas; Gartland (2008)
- 3) California Energy Commission, <http://www.energy.ca.gov/title24/coolroofs/>
- 4) http://www.energy.ca.gov/title24/coolroofs/documents/QUESTIONS-ANSWERS_BUILDING-OWNERS.PDF
- 5) USEPA, <http://www.epa.gov/heatisland/>

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ECM 4 - Shade Tree Planting

Brief Summary:

The control measure includes voluntary approaches to reduce the “urban heat island” phenomenon by increasing shading in urban and suburban communities through planting of (low VOC-emitting) trees and preservation of natural vegetation and ground cover.

Purpose:

The purpose of this control measure is to reduce ozone precursors, criteria pollutants (ozone, NO₂, PM₁₀, SO₂) and greenhouse gases by mitigating the urban heat island phenomenon.

Source Category Affected:

The sources affected by this control measure include electricity generation as well as evaporative emissions from mobile sources.

Regulatory Context and Background:

As discussed in the Urban Heat Island control measure, due to their impermeable structures and paved surfaces, as well as a lack of vegetation, urban areas tend to absorb, rather than reflect, the sun’s heat. These urban heat islands can be up to 10⁰ F hotter than natural background temperatures. These elevated temperatures can accelerate the formation of ground level ozone, or smog. They can also result in increased electricity use to cool buildings. In addition, parked cars can release emissions from the vehicle’s carburetor or fuel system. These “evaporative emissions” increase as ambient temperatures rise.

Planting trees through a comprehensive urban forestry program that includes goal-setting and ongoing management of the urban tree canopy can mitigate the urban heat island phenomenon and conserve energy use in three principal ways:

- Shading reduces the amount of the sun’s energy absorbed and stored by built surfaces
- Transpiration converts moisture to water vapor and thus cools by using solar energy that would otherwise result in heating of the air
- Wind-speed reduction reduces the movement of outside air into interior spaces and conductive heat loss where thermal conductivity is relatively high (e.g., glass windows)

In addition, urban trees provide the following air quality and climate protection benefits:

- Absorbing gaseous pollutants (ozone, nitrogen oxides) through leaf surfaces
- Absorbing CO₂ (carbon sequestration)
- Intercepting particulate matter (e.g., dust, ash, dirt, pollen, smoke)
- Reducing emissions (GHGs and criteria pollutants) from power generation by reducing energy consumption

- Releasing oxygen through photosynthesis
- Reduce evaporative emissions in parking lots
- Street trees also enhance conditions for pedestrians and cyclists, thus supporting alternatives to the automobile.

The Sacramento Municipal Utility District (SMUD) shade tree program has a goal to plant 500,000 trees in Sacramento. The tree planting program was found to produce net benefits from air conditioning savings. Three scenarios were assumed (base, highest, and lowest benefits) based on the SMUD program and a Best Available Control Technology cost analysis was performed to determine if shade trees planted in residential yards can be a cost effective means to improve air quality. Annual planting and maintenance costs, pollutant deposition, and biogenic hydrocarbon emissions were estimated over a 30-year period with existing models.

Some tree species emit volatile organic compounds (VOCs) which contribute to the formation of ground level ozone, particularly in hot weather. It is important for tree planting programs to carefully select the species to be planted, opting for low VOC-emitting species.

Implementation Actions:

Control measure consists of the following components:

- Include tree planting standards for new developments in specified areas as mitigation measures under the District's CEQA Guidelines and ISR rule
- Promote adoption of a model municipal tree planting ordinance, including tree planting in parking lots
- Provide information via outreach materials, presentations and workshops to local government planning and public works department staff on how to maximize air quality, GHG and public health benefits of municipal tree planting programs, including promoting the Bay-Friendly Landscape Guidelines
- Provide information on and encourage the use of low VOC-emitting tree species for new planting and, as appropriate, replanting
- Monitor the outcomes and findings of current tree planting programs, such as the Air District Climate Protection Grant to Urban ReLeaf for tree planting and air quality monitoring in West Oakland.

Emission Reductions:

Implementation actions #1 (include as mitigation options under CEQA and ISR) and #2 (promote municipal tree planting ordinances) are estimated to increase the Bay Area's tree canopy by 1% over the next 10 years, from the current 29% of land cover to 30%.

Increase in Canopy cover (%)	Canopy cover (%)	# of Trees	Increase in # of Trees
Baseline = 0	29	41,172,735	0
Ten year goal = 1	30	42,593,715	1,420,980

The table below illustrates the annual energy savings and emission reduction benefits of planting an average medium sized deciduous tree, in this case a Cherry Plum tree, in a residential neighborhood. Benefits are given for 1,420,980 ten year old trees (representing a 1% increase in existing tree canopy).

Emission reductions are in short tons/day (metric tons/day for CO₂)

	MWh	CO ₂ (MT)	PM ₁₀	PM _{2.5}	ROG	NO _x	SO ₂	CO	BVOCs
Benefits for 1,420,980 trees	85,259	67.56	0.04	0.04	<0.01	0.07	0.062	0.09	-0.002

Emission Reduction Methodology:

Even low-voc trees will result in some release of biogenic VOC. This has been factored into the emission reduction estimates, and these emissions are listed as BVOCs in the table above.

The 1% target for increasing tree canopy is a more conservative, reduced target taken from the report, *“State of the Urban Forest: San Francisco Bay Area Progress Report”*, published by the Center for Urban Forest Research in 2007. This report examines a 3% increase in tree cover. Estimated energy savings were also taken from this report. In quantifying the emission reductions from this measure, coefficients to translate electricity into CO₂ emissions were taken from the California Climate Action Reserve General Reporting Protocol, version 3.1. Electricity coefficients for PM, ROG, NO_x, SO₂ and CO were derived by Air District staff based on regional averages of emissions factors from power plants in the region.

Exposure Reduction:

This measure would reduce smog formation by reducing the ambient air temperature, particularly in areas that experience excessive heat. The measure would also reduce local air pollution by decreasing the accumulation of ozone precursors and PM due to the absorptive ability of trees.

Emission Reduction Trade-offs:

Caution must be taken in compiling the list of recommended species for planting to ensure that only low-VOC emitting trees are recommended. Planting deciduous trees ensures that there is no cooling dis-benefit in cooler months.

Cost:

According to the report, *“City of Berkeley, California Municipal Tree Resource Analysis”*, prepared by the Center for Urban Forest Research in 2005, the energy reduction benefits of the City of Berkeley’s tree planting program are approximately \$15 per tree. Applying these

benefits and costs to the Bay Area as a whole (and planting a total of 1,420,980 trees) creates the following results:

	Per Tree	Total(1)
Total benefits	\$15	\$21,314,700
Total costs	\$65	\$92,363,700
Net cost	\$50	\$71,049,000
Cost-benefit ratio	4.3	

1. This table represents the benefits and costs of planting 1,420,980 trees in the Bay Area.

In this analysis, benefits come from reduced net energy use due to shading.

Co-Benefits:

Tree planting brings a number of co-benefits to a community and the region.

Regional benefits:

- reduced urban heat island effect
- improved air quality
- improved public health (lower risk of respiratory and heat-related ailments)
- green job creation (tree planting and maintenance)

Local benefits:

- reduced energy use in buildings
- financial savings through reduced energy usage
- reduced storm water run-off
- increased community livability/quality of life
- enhanced bike and pedestrian environments
- increased property values

In the *“State of the Urban Forest: San Francisco Bay Area Progress Report”*, the Center for Urban Forest Research estimates that approximately 90% of the monetary benefits achieved by urban tree planting programs are due to increased property values.

Monitoring Mechanisms:

Monitoring and evaluating progress will be done by:

- Tracking local tree planting ordinances and tree planting programs

Issues/Impediments:

Due to the voluntary nature of this measure, significant impediments to implementation are not anticipated.

Sources:

- 1) *Cool Houston: A Plan for Cooling the Region* (2004)
- 2) *Heat Islands: Understanding and Mitigating Heat in Urban Areas*; Gartland (2008)

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BAY AREA 2010 CLEAN AIR PLAN

VOLUME II

Section F

Further Study Measures

September 2010



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FSM 1 - Adhesives and Sealants

Brief Summary:

This further study measure would research the emission inventory for this source category and seek to reconcile discrepancies with the inventories of other districts in the State and to determine if VOC limits found in South Coast AQMD rules are feasible and effective in the Bay Area.

Purpose:

Reduce emissions of VOC from the use of some categories of adhesives and sealants.

Source Category:

Area Source.

Further Study Measure Description:

In 2003 and early 2004, the ARB, San Joaquin, Sacramento and Bay Area districts jointly undertook a rule comparison project for a number of source categories, including adhesives and sealants. The South Coast AQMD rule for adhesives appears to be the most stringent, particularly for architectural adhesives. Architectural adhesives encompass a wide variety of adhesives used in residential and commercial construction: carpet adhesives, flooring adhesives, subfloor adhesives, tile adhesives, drywall adhesives, and multipurpose construction adhesives. The South Coast VOC limits range from 50 to 150 grams per liter (g/l) for various categories of architectural adhesives.

In 1998, the ARB and California districts developed Reasonably Available Control Technology/Best Available Retrofit Control Technology (RACT/BARCT) VOC limits for adhesives and sealants. RACT/BARCT VOC limits range from 100 to 250 g/l for various categories of architectural adhesives. The Bay Area rule, Regulation 8, Rule 51: Adhesive and Sealant Products, meets the BARCT limits in the ARB document.

In the rule comparison discussions, significant differences in inventory between the districts emerged. Specifically, the San Joaquin District has almost no area source adhesive emissions, which includes the architectural adhesives, whereas the Bay Area inventory has over 9 tons organic emissions per day from area source adhesives. When Bay Area staff developed Regulation 8, Rule 51: Adhesives and Sealants, the area source inventory was derived from the Rauch Guide to the US Adhesives and Sealants Industry, by the Rauch Associates, Inc., originally the 1990 edition. This should be updated.

Since Reg. 8-51 was last amended, in 2002, the comparable South Coast rule, Rule 1168, has been amended twice. Consequently, the South Coast has a number of VOC limits for adhesives and sealants that are lower than the Bay Area's. Some VOC limits that are appropriate for southern California, such as subfloor adhesives, may not be feasible for the Bay Area. However, lower limits should be investigated for feasibility.

Sources:

1. California Air Resources Board. 1998. "Determination of Reasonably Available Control Technology and Best Available Retrofit Control Technology for Adhesives and Sealants."
2. South Coast AQMD, Rule 1168
3. South Coast AQMD. 2002. "Final Staff Report: Proposed Amended Rule 1168-Adhesives and Sealants"
4. South Coast AQMD. 2000. "Staff Report: Proposed Amended Rule 1168-Adhesives and Sealant Applications"
5. TIAX. 2003. Sacramento Regional Clean Air Plan Update: Control Measure D3.
6. Walnut, F., TACC International. 2003. Personal Communication.

FSM 2 - Reactivity in Coatings and Solvents

Brief Summary:

Consider photochemical reactivity for the architectural coatings or other coatings categories. This approach targets volatile organic compounds (VOCs) with the greatest ozone forming potential, rather than treating all VOCs equally. Reformulation options may be greater and potential ozone formation less with a reactivity-based strategy, because there is a wide range of reactivity between VOC species.

Purpose:

Reduce emissions of VOCs with the greatest ozone-forming potential from various coatings operations and solvents.

Source Category:

Area source.

Further Study Measure Description:

The District regulates coating operations and solvent use in over 20 district regulations through VOC limits and operational requirements. Because coatings and solvents are manufactured in a consistent manner, it is possible to regulate the amount of VOCs and other compounds that are used to formulate these products. This is the rationale behind developing mass-based VOC limits for coatings and solvents.

When coatings are applied they release organic compounds. Different organic compound species react in the atmosphere to produce different amounts of ozone. The ozone forming potential is called reactivity. A coating containing small amounts of a highly reactive compound could form more ozone than a coating with a greater amount of low-reactive compounds. The relative difference in ozone forming ability is called the “relative reactivity.”

EPA deems organic compounds that form no more ozone than ethane to be “negligibly reactive.” Since that original listing, EPA has designated about 50 compounds as negligibly reactive, many of which are chlorinated or fluorinated compounds, and has excluded these compounds from the federal regulatory definition of VOC. In fact, there is a scale of ozone reactivity among compounds, with some creating many times the amount of ozone as others for each gram of the compound that is emitted. Since the initiation of mass-based VOC limits in the 1970’s, considerable research has gone into characterizing the relative reactivity of organic compounds commonly used in paints and as solvents.

The traditional mass-based approach has led to significant reductions in VOC emissions, and improvements in air quality. However, the ability to get further reductions on a mass basis may be limited, as technological limits inherent in coating and solvent formulation are approached. Consequently, a reactivity-based approach may be a better option and may

allow coating formulators more flexibility to reduce ozone-forming impacts of their products and ultimately, progress towards attainment with state and federal ozone standards.

Sources:

1. Staff Report: BAAQMD Regulation 8, Rule 3: Architectural Coatings, May 2009.
2. Workshop Report: BAAQMD Regulation 8, Rule 45: Motor Vehicle and Mobile Equipment Coating Operations, June 2008.
3. Final Approved Suggested Control Measure for Architectural Coatings, ARB, February 2008.
4. Technical Support Document for the Proposed Suggested Control Measure for Architectural Coatings, ARB, September 2007.
5. 2005 Architectural Coatings Survey, Final Report, ARB, December 2007.

FSM 3 - Solvent Cleaning and Degreasing Operations

Brief Summary:

Reduce emissions of VOCs from solvent cleaning and degreasing operations by implementing control measures based on ARB's statewide study.

Purpose:

Reduce VOC emissions.

Source Category:

Area Source.

Further Study Measure Description:

Cold cleaning describes the use of a cleaning solution in a tank or container into which a part to be cleaned is immersed, or a remote reservoir cleaner that pumps some cleaning solution over a part to be cleaned that then drains back into the reservoir. Wipe cleaning involves wetting a rag, cloth or paper with a cleaning solution and wiping grease or soils from a part by hand. California Districts have either a 25 g/l or a 50 g/l VOC standard for solvent used in cold cleaners and for wipe cleaning. The BAAQMD standard in Regulation 8, Rule 16 is 50 g/l, and wipe cleaning standards in various surface coating rules (Reg. 8, Rules 4, 14, 19 and 31) have a 50 g/l standard. More recently amended rules (Reg. 8, Rules 20, 32 and 45) have incorporated a 25 g/l wipe cleaning standard. This further study measure would investigate whether a 25 g/l VOC standard in Reg. 8-16 and in 50 g/l limit surface coating rules would significantly reduce emissions.

Based on work conducted in 2002, when Reg. 8-16 was last amended, a 25 g/l VOC standard would only result in 0.022 tons/day emissions reductions, and only 0.023 tons/day for wipe cleaning. This is in part due to differences in how emissions are calculated between districts.

In 2007, ARB initiated a research project, conducted by Professor Bill Welch and researchers at the University of California at Riverside, to develop a statewide emissions inventory for solvent and wipe cleaning. The final report of that project, originally scheduled for completion in spring, 2009, has not yet been released.

Sources:

1. Staff report, Proposed Amendments to Regulation 8, Rules 4, 14, 19, 31, 43, BAAQMD, Oct. 2002
2. Staff Report, Proposed Amendments to Reg. 8, Rule 16: Solvent Cleaning Operations, BAAQMD, Sept. 2002
3. Welch, Bill, University of California at Riverside, College of Engineering – Center for Environmental Research and Technology, e-mails and survey drafts, Sept. 2007 through June, 2008.

FSM 4 - Emissions from Cooling Towers

Brief Summary:

Research ways to reduce VOC emissions from cooling towers in refineries.

Purpose:

Reduce VOC emissions.

Source Category:

Stationary source.

Further Study Measure Description:

The emission inventory for refinery cooling towers shows 0.45 tons/day organic emissions, based on cooling water throughput from cooling towers with District permits. AP-42 emission factors of 6 lbs organic emissions per million gallons water throughput were used in this calculation. This assumes organic compound leaks into the cooling water system are not minimized. However, if leaks are minimized, the AP-42 emission factor is 0.7 lb organic emissions per million gallons water. Further study is needed to determine whether leaks from cooling towers are currently minimized and whether there is any potential for emission reductions from regulations.

This further study measure has been initiated. The Texas Commission on Environmental Quality has adopted a regulation requiring monitoring of and limiting emissions from cooling towers at refineries and chemical plants in the Houston – Galveston area. This rule, including a test method, limits emissions of highly reactive VOC's (HRVOC). HRVOC is the basis for the SIP in the Houston – Galveston area. District staff developed a test method to replicate cooling tower emissions and has sought feedback on the method from the refinery representatives. The next step will be to establish a correlation between EPA test method 8015, which quantifies non-halogenated organic compounds in water. From there, the need for further action can be assessed.

Sources:

1. 30 TAC Chapter 115, Subchapter B and H, Cooling Towers, Texas Commission on Environmental Quality
2. BAAQMD 2005 Final Adopted Ozone Strategy, Vol. 2, January 2006
3. Compilation of Air Pollution Emission Factors (AP-42), US EPA, 1995

FSM 5 - Equipment Leaks

Brief Summary:

Research ways to reduce VOC emissions from equipment leaks through remote sensing technologies and other methods.

Purpose:

Reduce VOC emissions.

Source Category:

Stationary Source

Further Study Measure Description:

In 2003 and early 2004, ARB, San Joaquin, Sacramento and Bay Area districts jointly undertook a rule comparison project for a number of source categories, including valves and flanges. Valves and flanges are typically found at refineries and chemical plants, but are also found in other petroleum and gas production facilities. The review found that the Bay Area's existing Regulation 8, Rule 18: Equipment Leaks, is the most stringent regulation in the state. Reg. 8, Rule 18 was amended on January 21, 2004 to fulfill the provisions of control measure SS-16 from the 2001 Ozone Attainment Plan. During that rule development process, staff identified a number of different areas for potential future study to further reduce emissions from valves and flanges. One area recommended for further review was incorporating remote sensing technologies to identify the largest leaking components in the leak detection and repair (LDAR) program. Remote sensing could enhance the effectiveness of existing LDAR programs by identifying leaks sooner and in a manner that is less time consuming and labor intensive. Remote sensing could also expand the applicability of LDAR programs to areas currently not covered by existing rules, such as pipelines. Remote sensing technology is currently not able to detect the low levels required for compliance with Regulation 8, Rule 18, but it could supplement or enhance existing programs or allow more frequent compliance screening of remote valves.

Sources:

1. BAAQMD 2005 Final Adopted Ozone Strategy, Vol. 2, January 2006
2. Staff Report, Proposed Amendments to Regulation 8, Rule 18: Equipment Leaks, January, 2004, BAAQMD

FSM 6 - Wastewater from Coke Cutting

Brief Summary:

Review coke cutting operations to determine if emissions reductions can be achieved from the resulting wastewater.

Purpose:

Reduce VOC emissions.

Source Category:

Stationary source.

Further Study Measure Description:

Refineries operate high pressure water pumps to remove or “cut” coke from coking drums. During the investigation of Further Study Measure FS 9: Refinery Wastewater Systems in the 2001 Ozone Plan, it was noted that coke cutting operations at some facilities generated significant quantities of wastewater. This wastewater, at elevated temperatures, is often recycled. The wastewater from coke cutting is not part of the refinery wastewater collection and treatment system. One possible method of control would be to include coke cutting wastewater in the existing collection and treatment system. Additional research needs to be conducted to determine whether coke cutting wastewater contains significant quantities of VOC and whether there is any potential for emissions reductions from these operations. Because of these uncertainties, it is recommended that coke cutting operations be studied.

This further study measure is currently under way. In addition to the two refineries that have traditionally used this coke cutting operation, Tesoro has added a delayed coker and is now also using this process.

Sources:

1. BAAQMD 2005 Final Adopted Ozone Strategy, Vol. 2, January 2006
2. Draft Technical Assessment Document: Potential Control Strategies to Reduce Emissions from Refinery Wastewater Collection and Treatment Systems, CARB and BAAQMD, Jan., 2003

FSM 7- SO2 from Refinery Processes

Brief Summary:

Review refinery processes to identify opportunities to reduce SO2 emissions.

Purpose:

Reduce SO2 emissions.

Source Category:

Stationary source.

Further Study Measure Description:

The District's emissions inventory indicates that significant quantities of SO2 are emitted from refinery processes. In 2007, Basic Refining Processes (Category 10) emitted 23.8 tons SO2 per day. Other refinery combustion processes (categories 298, 299 and 301) emitted an additional 9.4 tons per day. This is roughly half of the SO2 emissions in the District, and by far the majority of those from stationary sources.

SO2 is a precursor to secondary fine particulate matter formation, and the District is not in attainment for the federal and state PM2.5 standards. Consequently, a reduction in SO2 emissions would help the District toward attainment of PM2.5 standards.

The basic process used in refineries to remove sulfur from oil has not changed in many years. Hydrogen is added to oil (hydrotreating) which converts the sulfur to hydrogen sulfide (H2S), which is then absorbed from the oil with diethanolamine or monoethanolamine. It is then stripped out of the DEA or MEA and combusted to produce elemental sulfur. Regulation 9, Rule 1: Sulfur Dioxide, limits SO2 emissions from fluid catalytic cracking units and fluid cokers to 1000 ppm, limits SO2 emissions from sulfur recovery plants to 250 ppm, and requires 95% removal of H2S from refinery fuel gas. Reg. 9-1 and the various refinery units could be examined to see if additional reductions are feasible.

Sources:

1. BAAQMD Emissions Inventory

FSM 8 - Reduce Emission from LPG, Propane, Butane, and other Pressurized Gases

Brief Summary:

Reduce emissions of LPG, propane, butane and other pressurized organic gases by requiring tanks and relief valves to be gas tight, prohibiting venting during tank filling, and establishing a leakage allowance for hoses.

Purpose:

Reduce VOC emissions.

Source Category:

Area source.

Further Study Measure Description:

The Air District already enforces gas tight requirements at stationary sources for a variety of operations, including refineries and bulk terminals. This control measure would apply similar standards to LPG, propane and butane tanks, prohibit venting from filling of such tanks, and would set a leakage allowance for hoses used in these operations.

Typically, liquid pressurized gases should occupy no more than 80 to 85 percent of the volume of a tank to allow for liquid expansion if a tank gets heated (such as by sunlight). These containers have a bleed valve, which is sometimes used to indicate to the person filling the container when the level of liquid in the tank is at the “full” level (80 to 85 percent full by volume). Containers can be safely refilled without venting by filling to a final weight or by filling to a final liquid volume using a tank gage.

California propane demand is estimated to be about 120,000 barrels per day. If Bay Area demand is 20% of that (although it may be less due to the availability of natural gas) and losses average 1%, losses equal 240 barrels per day. This is equivalent to 21.4 tons per day of propane losses. In addition, it has been estimated that up to 10 tons per day of LPG may be vented in the Bay Area.

A report on a research project at CARB in March, 2009 indicated that technological solutions were available and cost effective.

A further study measure would consider a gas tight standard for propane and other tanks; a prohibition on the filling of a container where the pressure differential for refilling is generated by venting the receiving container; a prohibition on venting to determine if the container is adequately filled; and a leakage allowance for new hoses sold in conjunction with pressurized gas containers.

Such a measure could impact:

- standard containers, such as 20# cylinders and forklift fuel tanks, refilled at high volume central locations
- fleet refueling at large facilities (i.e., forklift tank refueling)
- large stationary pressurized gas containers

Sources:

1. Maximus™ SFI – Measurement and Reduction of Gas Outage Gauge Emissions, the ADEPT Group, Inc. California Air Resources Board, Chair's Air Pollution Seminar, March 19, 2009

FSM 9 - Greenhouse Gas Mitigation in BACT and BACT Determinations

Brief Summary:

Consider flexibility in BACT/TBACT determinations in order to reduce secondary greenhouse gas (GHG) emissions from abatement devices.

Purpose:

Reduce GHG emissions.

Source Category:

Stationary source.

Further Study Measure Description:

New source review regulations, including BAAQMD Regulation 2, Rule 2, mitigate increases from new and modified permitted sources of air pollution for criteria pollutants by making applicants install Best Available Control Technology (BACT) and/or obtain offsets for the emissions increases. In addition, the District's toxic new source review rule, Regulation 2, Rule 5, requires installation of toxic best available control technology (TBACT) for new and modified sources of toxic air contaminants (TACs) where the source risk exceeds a certain health risk level, and denies a permit where the source risk exceeds a greater health risk level.

Currently, District Regulations do not consider GHG emissions. Under existing federal, state and District guidelines, a source required to abate organic emissions can be required to install a highly efficient incinerator to abate those emissions to the maximum extent feasible, even if a relatively large amount of supplemental fuel is required to achieve a high organic destruction efficiency.

The District could advocate for flexibility in BACT/TBACT determinations when a permit application triggered BACT/TBACT and was not ministerial. In these determinations, discretion is allowed on implementation of control equipment, but implementation must be consistent with a maximum reduction in criteria pollutants. With the agreement of EPA and ARB, a lower level of emissions control could be considered if the alternative would emit large amounts of GHGs. Flexibility in BACT/TBACT determinations would require agreement of EPA and ARB, and potentially changes in regulations.

Sources:

8. BAAQMD Permit Handbook:
http://www.baaqmd.gov/pmt/handbook/rev02/permit_handbook.htm
9. BAAQMD Regulations 2-2, and 2-5:
<http://www.baaqmd.gov/dst/regulations/index.htm>

FSM 10 - Further Reductions from Commercial Cooking Equipment

Brief Summary:

Consider reducing emissions from commercial wok cooking, and solid fueled cooking devices such as wood fired pizza ovens.

Purpose:

Reduce PM emissions.

Source Category:

Area source.

Further Study Measure Description:

In 2007, the District adopted a rule to limit emissions from commercial conveyerized and under-fired charbroilers, Regulation 6, Rule 2: Commercial Cooking Equipment. The rule requires the use of control equipment on these cooking devices if certain amounts of beef are cooked. In 2008, the Association of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) tested and developed emissions factors for a number of appliances. The greatest amount of particulate matter came from a solid fueled broiler cooking hamburger and a Chinese wok cooking chicken breast in peanut oil.

The ASHRAE study indicated that the wok cooking emitted the greatest amount of particulate matter, as measured below the ventilation hood, but a breakdown of particle sizes indicated that most of the particulate weight was PM greater than 10 microns in diameter, it is likely that much of this large particulate matter is deposited on the grease filter, in the exhaust stack on the roof. For wok cooking, however, particles in the smaller size ranges (PM10 to PM2.5, PM2.5 and condensable vapors) were still significant. They total 51.7 lbs particulate matter per 1000 lbs food cooked, the second highest of the cooking appliances tested.

In addition, concern has been expressed about the use of wood fired pizza ovens and other cooking devices that are not underfired broilers. Typically, pizza in a wood-fueled oven is placed on a floor or platform, the pizza does not generate particulate matter or organic emissions from contact with the flame. The particulate matter of concern is generated directly by burning wood.

The number of commercial wok cooking appliances in the District has not been determined. Control equipment similar to those used for underfired charbroilers could control the emissions, but the cost effectiveness for wok cooking has not been investigated. For pizza ovens, and other solid-fueled cooking devices, an inventory needs to be established. A broader range of control equipment may be available, but cost effectiveness needs to be determined.

Sources:

1. ASHRAE Study 745-RP, 2008
2. BAAQMD Regulation 6, Rule 2: Commercial Cooking Equipment

FSM 11 - Magnet Source Rule

Brief Summary:

The District will explore as a further study measure the viability of developing a magnet source rule to reduce mobile source emissions from some or all of the types of facilities described below. Emphasis would be given to facilities in impacted communities as identified through the District's CARE program.

Purpose:

The purpose of this measure would be to reduce emissions and population exposure associated with magnet sources.

Source Category:

Transportation emissions.

Further Study Measure Description:

The term "magnet sources" refers to new and existing facilities that attract or generate a high volume of activity or usage of mobile sources of emissions, such as cars, trucks, off-road equipment, etc. Magnet sources can include airports, seaports, warehouses, distribution centers, shopping centers, and other facilities that generate mobile source emissions of criteria air pollutants, toxic air contaminants and greenhouse gases.

District staff are currently developing an indirect source review (ISR) regulation to mitigate the impacts of growth and new development in the Bay Area – see control measure LUM-2. A magnet source rule would be designed so as to complement the ISR regulation.

The District will evaluate the feasibility of developing a magnet source rule. Potential requirements could include calculating and reporting of emissions, estimating health risks and local impacts, developing plans to comply with ARB mobile source regulations, and development of additional emission reduction strategies. Issues to be considered include how to define a "magnet source," which types of sources and pollutants to focus on, specific emission reduction and other requirements, how a magnet source rule would be implemented and enforced, how to quantify emissions produced by magnet sources, potential mechanisms to reduce emissions and population exposure, and how a magnet source rule could supplement the emission reductions expected from ARB's diesel air toxics control measures over the next 5 to 10 years.

FSM 12 - Wood Smoke

Brief Summary:

The Air District will continue to study the impacts of its existing rules regarding wood burning and open burning, in order to develop more effective methods to implement, promote, enforce, and possibly expand, existing rules.

Purpose:

Reduce particulate matter emissions from wood smoke.

Source Category:

Area source.

Further Study Measure Description:

Fine particulate matter (PM) is a serious health concern; these particles can pass through the nose and throat, lodge deep within the lungs, and enter the bloodstream. Residential wood-burning represents the largest source of fine PM in the Bay Area, accounting for up to 30-40% of fine PM during peak pollution days. The Bay Area is home to 1.4 million fireplaces and woodstoves.

In order to protect Bay Area residents from the public health impacts of wood smoke pollution, on July 9, 2008 the Air District adopted a wood-burning rule (Regulation 6, Rule 3) that prohibits the use of wood-burning devices such as fireplaces, woodstoves, or pellet stoves, when air quality is forecast to be unhealthy and a *Winter Spare the Air Alert* is in effect. As defined in the rule, the *Winter Spare the Air* season runs from November 1 through the end of February.

The primary focus during the first year of rule implementation was to educate the public about the new rule, how to comply and the rule's relevance to public health. The *Winter Spare the Air Alert* advertising and outreach campaign utilized TV, print, billboard, radio, direct mail, public events, door-to-door canvassing and the Air District website. The District's No Burn phone line received over 500,000 calls. Enforcement focused on providing information to residents on how to comply with the rule, issuing warning letters to first-time violators who did not comply, and developing enforcement action for repeat violators.

For the 2008/2009 season, eleven *Winter Spare the Air Alerts* were issued. Data indicates that household wood burning was reduced by approximately 50% throughout the entire season⁷. Nevertheless, the national 24-hour ambient air quality standard (35 ug/m³) was exceeded at one or more air monitoring site on 13 days during the winter of 2008/09.

⁷ *Winter Spare the Air Study: 2008-2009 Winter Wood Smoke Season*, Bay Area Air Quality Management District, March 2009, p. 30.

Seven of the alert days still exceeded the standard. It should also be noted that although the District's wood burning rule and the Winter Spare the Air program are focused on reducing exceedances of the 35 ug/m^3 , some individuals may suffer health effects even when PM concentrations are below PM air quality standards.

In addition to residential wood burning, the District has limited agricultural burning in order to control emissions of fine particulate matter. The District will continue to study its current rules regarding wood and agricultural burning to develop rules and strategies to better protect public health. The District's PM emission inventory also indicates that PM emissions from commercial cooking are a significant source of PM emissions (see FSM #10 re: cooking).

Potential actions that the District will evaluate and may implement in future years include:

- Continue to work with local governments to adopt the District's model wood smoke ordinance (40 local governments in the Bay Area have adopted an ordinance as of February 2010);
- Evaluate the trigger level for declaring a *Winter Spare the Air Alert* (the threshold is currently 35 ug/m^3);
- Expand the *Winter Spare the Air Alert* education and outreach campaign;
- Continue to analyze monitoring data and refine models on PM_{2.5};
- Evaluate and modify enforcement response with increasing penalties for repeat violators for enhanced effectiveness;
- Evaluate and potentially revise current exemptions in Regulation 5: Open Burning, and Regulation 6: Particulate Matter;
- Consider revising Regulation 6, Rule 3 to incorporate any new changes to the federal New Source Performance Standard, Subpart AAA for new residential wood heaters;
- Evaluate the feasibility of requiring an upgrade or replacement of existing fireplaces and/or wood stoves when an existing home is sold or changes ownership;
- Evaluate the impact of modified definitions and exemptions in Regulation 6, Rule 3;
- Consider amending Regulation 6, Rule 3 to reduce unnecessary solid-fuel burning; and
- Consider amending Regulation 6, Rule 3 to apply to outdoor as well as indoor wood-burning devices.

FSM 13 - Energy Efficiency and Renewable Energy

Brief Summary:

Fossil fuel combustion to produce the energy that powers our factories, offices, and homes, and other buildings is a major source of emissions of greenhouse gases, criteria pollutants, and air toxics. District staff will evaluate and prioritize potential measures or policies that the District could pursue to reduce energy consumption and promote renewable energy, taking into consideration factors such as the District's legal authority to adopt regulations or fees, the overall regulatory context, potential enforcement mechanisms, in-house experience and expertise, and available resources. Measures that will be evaluated include regulations, partnerships, and market-based mechanisms.

Purpose:

The purpose of this Further Study Measure is to determine whether and how the Air District can play a constructive role in energy efficiency and renewable energy.

Source Category:

Area source.

Further Study Measure Description:

It will be increasingly important to curb fossil fuel use in order to stem the threat of climate change. The Air District has not traditionally addressed energy use in its regional air quality plans or its stationary source rules. However, given the growing threat of local impacts from climate change, including the threat that higher temperatures will degrade our air quality, the District is now exploring how it can use its existing authority to help reduce fossil fuel use by the buildings sector. In many cases the use of fossil fuels is indirect; for example, through the use of electricity produced by burning fossil fuels. Fossil fuel combustion is a major source of criteria air pollutant emissions as well as greenhouse gases.

Potential actions that the District will evaluate and may implement in future years include:

- Research the existing regulatory structure to determine the extent of District authority over building energy use, such as requiring energy audits of commercial and/or industrial buildings;
- Research the interface between Air District authority and implementation measures in the AB32 Scoping Plan;
- Adopt a rule to require installation of solar hot water heating systems in all new residential construction;
- Adopt a rule to require new commercial and residential swimming pools to be heated with solar power;
- Study opportunities to reduce energy use at petroleum refineries and other industrial facilities;

- Collaborate with public agencies, such as the California Public Utilities Commission and the California Energy Commission, to promote energy efficiency, potentially including energy pricing policies to reduce demand on an on-going and/or episodic basis;
- Consider additional actions, such as discouraging the sale or use of “vampire appliances” that consume energy even when not in use.

Sources:

1. <http://www.cpuc.ca.gov/PUC/energy/DistGen/solarhotwater.htm>

FSM 14 – Winery Fermentation

Brief Summary:

Review emissions generated by fermentation at wineries to determine if reductions can be achieved.

Purpose:

Reduce VOC emissions.

Source Category:

Stationary source.

Further Study Measure Description:

In 2005, the San Joaquin district adopted a rule to control emissions from wineries. The rule applies to wineries that emit over 10 tons/year of organic emissions (primarily ethanol) based on formulae in the rule. The rule requires a reduction of fermentation emissions of 35%, which may include payment of an emission mitigation fee. The rule also requires that storage tanks of 5000 gallon size or greater be equipped with a pressure/vacuum valve and kept at a temperature of no greater than 75° F. San Joaquin staff estimated that 18 wineries would be subject to the rule, 14 of which were major stationary sources subject to federal Title V permits. The rule is anticipated to reduce emissions from wineries by 0.6 to 0.7 tons per day from a total inventory of 2.1 tons per day ROG.

The BAAQMD inventory for winery emissions is 0.78 tons ROG per day. The San Joaquin estimates 109 wineries in the San Joaquin district. In the Bay Area, there are over 300 wineries in Napa County alone that collectively account for about 60% of the Bay Area winery emissions. Further research will have to be done to determine whether any of the Bay Area wineries meet the San Joaquin threshold of 10 tons ROG emissions per year, or whether cost-effective controls could be applied to Bay Area facilities.

Sources:

3. Rule 4694: Wine Fermentation and Storage Tanks, San Joaquin Valley Unified Air Pollution Control District, December 15, 2005.
4. Memorandum to Governing Board re: Rule 4694, Crow, David L., San Joaquin Unified Air Pollution Control District, December 15, 2005.

FSM 15 - Composting Operations

Summary:

This measure would consider reductions in organic emissions from Composting Operations.

Purpose:

Reduce emissions of organic compounds from composting operations.

Source Category:

Area source.

Further Study Measure Description:

This measure will consider whether it is feasible to reduce emissions, both ROG and GHG, from composting operations, in cooperation with the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD), South Coast Air Quality Management District (SCAQMD) and Mojave Desert Air Quality Management District. In addition, feasible reductions in ammonia and particulate matter will be explored. In 2003, the SCAQMD adopted Rule 1133.2: Emission Reductions from Co-composting Operations, to limit emissions of both ROG and ammonia. As part of its 2005 Extreme Ozone Attainment Demonstration Plan, SJVUAPCD identified composting and biosolids operations as a source category for emission reductions (Control Measure J). SJVUAPCD adopted Rule 4565, Biosolids, Animal Manure, and Poultry Litter Operations on March 15, 2007 to limit ROG emissions from operations involving the management of biosolids, animal manure, or poultry litter, similar to SCAQMD's Co-composting Rule 1133.2. In 2008, SJVUAPCD initiated a field study to determine emissions factors from a variety of composting methodologies. A final report is due to be issued in the spring of 2010.

Emission mitigation measures may be proposed based on SJVUAPCD Rule 4566 and SCAQMD Rule 1133. These measures, combined with the results of the San Joaquin field study will determine if it is feasible to control composting emissions. In addition, objectives of the Regional Water Quality Control Board and the Integrated Waste Management Board will be integrated into the study measure.

Sources:

1. Mojave Desert Air Quality Management District Technical Report, Feasibility Analysis for Composting and Related Operations, dated 10/22/2007
2. San Joaquin Valley Unified Air Pollution Control District, Preliminary Draft Staff Report for Rule 4566, Composting Green Waste, dated 1/10/2008
3. SJVUAPCD, Final Draft Staff Report for Rule 4566, Organic Waste Operations, dated 12/18/2008
4. The Policy Committee for the Central California Ozone Study, and SJVUAPCD, Request for Proposal for the Organic Waste Composting Study, dated 12/16/2008

5. South Coast Air Quality Management District, Final 2007 Air Quality Management Plan, Control Measure CM # 2007MCS-04, dated 6/1/2007
6. SCAQMD Technology Assessment for Proposed Rule 1133.

FSM 16 - Vanishing oils and rust inhibitors

Brief Summary:

Research VOC reductions from vanishing oils and rust inhibitors.

Purpose:

Reduce VOC emissions.

Source Category:

Stationary Source

Further Study Measure Description:

The South Coast AQMD adopted a rule in 2009 to reduce emissions from vanishing oils and rust inhibitors. Vanishing oils are lubricants metal working fluid (such as cutting oil) or other oil used manufacturing. Rust inhibitors are fluids used to inhibit, protect or prevent corrosion on metal surfaces. The South Coast rule, 1144, does not apply to oils and inhibitors that have a flash point of less than 200°F. It sets an interim VOC limit for rust inhibitor at 300 grams VOC per liter of material, and a final limit for both inhibitor and oil at 50 grams VOC per liter of material. The staff report projects emissions reductions of 2.7 tons per day from a 3.2 ton per day inventory. The businesses likely to be affected include machine shops (job shops), aerospace facilities, steel mills, auto part rebuilders, screw machine shops, steel tube (pipe) manufacturers, steel spring manufacturers and captive machine shops located inside of others type of businesses.

Sources:

1. South Coast AQMD Rule 1144, Staff Report, SCAQMD, March 6, 2009

FSM 17 - Ferry System Expansion

Brief Summary:

MTC, the Air District, and the Water Emergency Transportation Authority (WETA) will collaborate to ensure that expansion of the regional ferry network will provide the greatest possible air quality benefit.

Purpose:

To reduce emissions of criteria pollutants and greenhouse gases.

Travel Market Affected:

This measure would affect all intraregional travel, including commute travel; shopping, personal business, social and recreational travel, including tourism. In particular, expansion of ferry service will affect peak period commute travel, when congestion on bridges is greatest.

Further Study Measure Description:

Because expansion of the ferry system does not show a clear-cut benefit for air quality based on current analytical methodologies, as explained below, TCM 7 (Improve Ferry Service) in the 2005 Ozone Strategy has been reclassified as a Further Study Measure for purposes of the 2010 Clean Air Plan.

Ferry service in the Bay Area is provided by the Golden Gate Bridge, Highway, and Transportation District (GGBHTD) and the Water Emergency Transportation Authority (WETA). GGBHTD provides ferry service from Larkspur and Sausalito to San Francisco. WETA was created by Senate Bill 976, resulting in the consolidation of Alameda, Oakland, and Vallejo ferry services under one authority. WETA issued a final transition plan for consolidation of services in June 2009. This plan also includes expansion projects envisioned over the next five years including new ferry routes from South San Francisco, Berkeley, Treasure Island, and Alameda Point, as well as pre-construction planning for longer term expansion of ferry service to Hercules, Redwood City, Richmond, Martinez, and Antioch. MTC's Resolution 3434 Regional Transit Expansion Program includes new or expanded ferry service to: Berkeley, Alameda/Oakland/Harbor Bay, Hercules, Richmond, and South San Francisco.

All ferry vessels purchased after January 1, 2009 must meet the emission limits set forth in Section 93118.5(e)(5), Title 17, California Code of Regulations, and WETA expansion vessels must comply with the mitigation measures adopted by the Water Transit Authority (now WETA) as part of the Implementation and Operations Plan (IOP) adopted by the California State Legislature in 2003. These measures effectively require that all new ferry vessels reduce emissions of NOx and PM by 85% below EPA Tier 2 emissions standards.

The use of engines that meet the emission standards described above will reduce overall emissions produced by ferry vessels, even as service is expanded. However, analysis of the ferry expansion plan indicates that emissions produced by the ferry vessels will likely outweigh the benefit of reduced emissions from decreased motor vehicle trips by new ferry riders. This is because, on average, ferry vessels require more horsepower per passenger-mile than bus, rail, or private vehicles and motor vehicle emission technology advances for these other transportation modes will continue to reduce emission rates for on-road vehicles in future years.

Ferry service provides a variety of benefits to the region including increased transbay transportation capacity, enhanced mobility, improved connectivity, tourism and recreation, back-up to the regional transportation system in the event of natural or man-made disruptions to the region's transit systems and road and bridge infrastructure, and emergency evacuation.

MTC, the Air District, and WETA will work together to maximize potential air quality benefits of ferry system expansion. Potential measures to improve the air quality outcome include maximizing ridership, promoting non-motorized modes of access to and from ferry terminals, prioritizing routes that would provide the greatest air quality benefit, and exploring how to further reduce emissions from ferry engines by means of operational efficiencies and/or advanced technologies such as hybrid designs. In particular, WETA will evaluate the option of consolidating future projected ridership onto fewer routes. Service consolidation will likely increase ridership demand for individual routes, resulting in a greater number of passengers per vessel trip and an improvement in net emissions reductions.

The three agencies will also work together to thoroughly analyze all assumptions regarding the new routes that will be created, the schedule as to when new routes will be brought into service, ridership projections, assumptions regarding prior mode of ferry riders and transportation mode that ferry patrons will use to access the ferry terminals, and actual emission rates for new ferry vessels. Additionally, WETA will evaluate scenarios on new routes where ridership can be maximized at reduced levels of service during peak and/or off-peak periods. Such scenarios would require fewer ferry operating hours and trips, resulting in a reduction of gross ferry emissions.

Expansion of the ferry network may be included as a transportation control measure in future air quality plans if MTC, the Air District, and WETA agree that expansion of the network would provide a clear air quality benefit.

Sources:

1. MTC's Transportation 2035 Plan: http://www.mtc.ca.gov/planning/2035_plan/
2. Water Emergency Transportation Authority: <http://www.watertransit.org>

3. Water Transit Authority (now WETA) Ridership Model Sensitivity Analysis:
http://www.watertransit.org/files/pubs/techPubPresentations/CS_Sensitivity_analysis.pdf

FSM 18 – Greenhouse Gas Fee

Brief Summary:

The District will explore as a further study measure the viability of assessing a fee on greenhouse gas (GHG) emissions from stationary sources. The purpose of the GHG fee (sometimes referred to as a “carbon fee”) would be to 1) provide these sources with an incentive to reduce their GHG emissions, and 2) generate revenues that could be used to fund replacement of higher-emitting sources with lower-emitting sources, or otherwise reduce GHG emissions.

Purpose:

The purpose of this measure would be to reduce emissions of greenhouse gases and accelerate replacement of sources with more energy-efficient sources. By decreasing combustion of fossil fuels, this measure would also provide co-benefits in reducing emissions of criteria pollutants and air toxics.

Source Category:

Stationary source emissions.

Further Study Measure Description:

As described in CAP Chapter 1, climate change poses a wide range of risks and negative impacts for the Bay Area, including the prospect of degraded air quality. In November of 2010, California voters will decide whether to suspend implementation of AB 32, California’s ground-breaking climate protection law, by voting on Proposition 23. Prop 23 would suspend implementation of AB 32 until the state’s economy experiences an unemployment rate of 5.5% or less for four consecutive quarters. At the federal level, negotiations in the Senate on comprehensive climate protection legislation, including a national GHG cap-and-trade program, have reached an impasse unlikely to be resolved in the near future. Should climate protection efforts falter at the state and federal levels, it will be important to take significant action to reduce GHG emissions at the regional and local levels.

Public opinion seems to favor strategies to reduce GHG emissions from polluting industries. A recent opinion survey by the Public Policy Institute of California ¹ indicates strong public support for government policies to require industry to reduce greenhouse gas emissions from their processes and activities. A recent national survey conducted at Stanford University ² found that more than 50% of Americans surveyed would vote for a law to reduce national greenhouse gas emissions by 85 percent by 2050 even if it resulted in a net cost to households.

The District currently collects fees for greenhouse gas emissions under Regulation 3, Schedule T. For fiscal year 2010-11 the fees are set at \$0.048 per metric ton of CO₂-equivalent. These fees, which are limited by State law to an amount necessary to fund

District programs related to greenhouse gas emissions at stationary sources, are too modest to motivate any major change in GHG emission rates.

Fee programs, or economic incentive programs, as they are referred to by EPA, are market-based programs to encourage people or industries to reduce emissions in an efficient manner. Examples of such programs include emissions fees, subsidies for purchases of zero-emitting vehicles, and transportation pricing. The success of fee programs is based upon establishing the fee at a level that is reasonable, but significant enough to motivate behavioral changes or investment in cleaner technology; clearly defining how fee revenues would be used; and providing flexibility to adjust the financial mechanism, should it prove either too costly or ineffective.

Many economists have argued that a greenhouse gas fee assessed on greenhouse gas emitters would be the fairest, simplest and most effective way to reduce greenhouse gas emissions. Unlike a cap-and-trade program, a greenhouse gas fee is less complex, can be implemented sooner, is transparent, and can more easily address emissions from a variety of economic sectors.

The District will evaluate the feasibility of developing a greenhouse gas fee for stationary sources. The District will consider structuring such a fee to be revenue-neutral, meaning that money collected would be used to fund development and installation of lower-emitting (more energy-efficient) sources. A range of energy efficiencies for certain types of equipment could be evaluated so as to set a fee that incentivizes and provides funds for replacement of less energy-efficient, higher GHG -emitting equipment with more energy-efficient, lower GHG -emitting equipment. New equipment would emit fewer criteria pollutants and toxic air contaminants, as well. The District will consult with other air districts and with ARB and other state agencies in this evaluation.

The District already collects fees on permitted stationary sources, including emissions fees on major stationary sources under Regulation 3, Schedule M. The District will evaluate whether sufficient legal authority exists to promulgate a GHG fee program. Should ample authority not be determined to exist, the District may seek legislation to gain such authority.

Sources:

1. Baldassare, Bonner, Petek and Willcoxon; Californians and the Environment; Public Policy Institute of California;; July 2010;
http://www.ppic.org/content/pubs/survey/S_710MBS.pdf
2. Abt SRB;; Global Warming Poll; July, 2010;
<http://woods.stanford.edu/docs/surveys/July2010-Stanford-Survey.pdf>
3. Improving Air Quality with Economic Incentive Programs; January, 2001; EPA-452/R-01-001



5.5. MITIGATING LOCAL COMMUNITY RISK AND HAZARD IMPACTS

For stationary sources, please refer to [BAAQMD's permit handbook](#) and [BACT/T-BACT workbook](#). For land use projects, BAAQMD is developing community development guidelines to assist lead agencies in identifying mitigation measures to reduce risk and hazard impacts associated with proposed projects. The community development guidelines will contain risk reduction measures with estimated quantified reductions, as well as an analysis worksheet for lead agencies to review as they perform an environmental analysis. The mitigation measures will be helpful in protecting public health for proposed infill and transit-oriented development projects located near TAC sources.

The list below outlines potential mitigation measures for reducing TAC emissions and exposure to sensitive receptors:

1. Increase project distance from freeways and/or major roadways.
2. Redesign the site layout to locate sensitive receptors as far as possible from any freeways, major roadways, or other non-permitted TAC sources (e.g., loading docks, parking lots).
3. Large projects may consider phased development where commercial/retail portions of the project are developed first. This would allow time for CARB's diesel regulations to take effect in reducing diesel emissions along major highways and arterial roadways. Ultimately, lower concentrations would be anticipated along the roads in the near future such that residential development would be impacted by less risk in later phases of development.
4. Projects that propose sensitive receptors adjacent to sources of diesel PM (e.g., freeways, major roadways, rail lines, and rail yards) should consider tiered plantings of trees such as redwood, deodar cedar, live oak and oleander to reduce TAC and PM exposure. This recommendation is based on a laboratory study that measured the removal rates of PM passing through leaves and needles of vegetation. Particles were generated in a wind tunnel and a static chamber and passed through vegetative layers at low wind velocities. Redwood, deodar cedar, live oak, and oleander were tested. The results indicate that all forms of vegetation were able to remove 65–85 percent of very fine particles at wind velocities below 1.5 meters per second, with redwood and deodar cedar being the most effective.
5. Install and maintain air filtration systems of fresh air supply either on an individual unit-by-unit basis, with individual air intake and exhaust ducts ventilating each unit separately, or through a centralized building ventilation system. The ventilation system should be certified to achieve a performance effectiveness, for example, to remove at least 85% of ambient PM_{2.5} concentrations from indoor areas. Air intakes should be located away from emission sources areas, such as major roadways. Users may factor in the amount of time that receptors spend indoors versus out-of-doors to account for air filtration systems in modeling, provided that all assumptions are justified with scientific documentation.
6. Where appropriate, install passive (drop-in) electrostatic filtering systems, especially those with low air velocities (i.e., 1 mph).
7. Require rerouting of nearby heavy-duty truck routes.
8. Enforce illegal parking and/or idling of heavy-duty trucks in vicinity.

APPENDIX B

Biological Resources

Special-Status Species Potentially Occurring or Known to Occur in the Project Area

Scientific Name	Common Name	Status ¹	General Habitat Description	General Habitat Present/ Absent	Potential to Occur on the Project Site
Plants					
<i>Alopecurus aequalis</i> var. <i>sonomensis</i>	Sonoma alopecurus	FE RPR 1B.1	Freshwater wetlands and wetland riparian.	Absent	Not likely. Appropriate habitat is not present on site. Two CNDDDB records of this species have been documented within 5 miles of the project area.
<i>Astragalus claranus</i>	Clara Hunt's milkvetch	FE RPR 1B.1	Open grassy areas and thin clay soil with an affinity for serpentine soils.	Absent	Not likely. Appropriate habitat is not present on site. This species is known from only five occurrences between Sonoma and Napa Counties.
<i>Balsamorhiza macrolepis</i>	big-scale balsamroot	RPR 1B.2	Valley grassland, foothill woodland	Absent	Not likely. Appropriate habitat is not present on site. Two CNDDDB records of this species have been documented within 5 miles of the project area.
<i>Blennosperma bakeri</i>	Baker's stickyseed / Sonoma sunshine	FE, CE RPR 1B.1	Vernal pools within valley grassland, freshwater wetlands, and wetland-riparian habitats.	Absent	Not likely. Appropriate habitat is not present on site. Seven CNDDDB records of this species have been documented within 5 miles of the project area.
<i>Carex albida</i>	white sedge	FE, CE RPR 1B.1	Freshwater-marsh and bogs.	Absent	Not likely. Appropriate habitat is not present on site. This species is known from only one occurrence at Pitkin Marsh.
<i>Centromadia parryi</i> ssp. <i>parryi</i>	pappose tarplant	RPR 1B.2	Grassland, coastal salt marshes, alkaline springs, seeps	Absent	Not likely. Appropriate habitat is not present on site. One CNDDDB record of this species has been documented within 5 miles of the project area.

Special-Status Species Potentially Occurring or Known to Occur in the Project Area

Scientific Name	Common Name	Status ¹	General Habitat Description	General Habitat Present/ Absent	Potential to Occur on the Project Site
<i>Chorizanthe valida</i>	Sonoma spineflower	FE RPR 1B.1	Coastal prairie on deep sandy soils	Absent	Not likely. Appropriate habitat is not present on site. This species is known from only one remaining natural population at Point Reyes National Seashore.
<i>Clarkia imbricata</i>	Vine Hill clarkia	FE, CE RPR 1B.1	Chaparral and valley grassland.	Absent	Not likely. Appropriate habitat is not present on site. This species is known from only one remaining natural occurrence near Vine Hill.
<i>Cordylanthus mollis</i> <i>ssp. mollis</i>	soft bird's beak	FE RPR 1B.2	Coastal salt marsh, wetland-riparian of the Sacramento-San Joaquin River Delta.	Absent	Not likely. Appropriate habitat is not present on site. No CNDDDB occurrences of this species have been recorded within 5 miles of the project area.
<i>Delphinium bakeri</i>	Baker's larkspur	FE, CE RPR 1B.1	Northern coastal scrub	Absent	Not likely. Appropriate habitat is not present on site. This species is known from only one remaining occurrence near Salmon Creek in Sonoma County
<i>Delphinium luteum</i>	yellow larkspur	FE RPR 1B.1	Coastal Prairie, chaparral, and northern coastal scrub. This species is endemic to the rocky, foggy hillsides of coastal Sonoma County, California.	Absent	Not likely. Appropriate habitat is not present on site. No CNDDDB occurrences of this species have been re
<i>Downingia pusilla</i>	dwarf downingia	RPR 2.2	Freshwater wetland, vernal pools, and roadside ditches.	Marginally suitable habitat is present in the form of roadside ditches.	Not likely. This species may inhabit roadside ditches; therefore, marginally suitable habitat is present on site. Two CNDDDB records of this species have been documented within 5 miles of the project area.

Special-Status Species Potentially Occurring or Known to Occur in the Project Area

Scientific Name	Common Name	Status ¹	General Habitat Description	General Habitat Present/ Absent	Potential to Occur on the Project Site
<i>Fritillaria liliacea</i>	fragrant fritillary	RPR 1B.2	Coastal Prairie, Valley Grassland, Northern Coastal Scrub, wetland-riparian	Absent	Not likely. Appropriate habitat is not present on site. One CNDDDB record of this species has been documented within 5 miles of the project area and two additional records were recorded before 1975.
<i>Hesperolinon congestum</i>	Marin dwarf flax	FT, CT 1B.1	Chaparral and valley grassland on serpentine soils.	Absent	Not likely. Appropriate habitat is not present on site.
<i>Lasthenia burkei</i>	Burke's goldfields	FE, CE RPR 1B.1	Vernal pools in foothill woodland, freshwater wetlands, and wetland-riparian.	Absent	Not likely. Appropriate habitat is not present on site. Three CNDDDB records of this species have been documented within 5 miles of the project area.
<i>Lilium pardalinum</i> ssp. <i>pitkinense</i>	Pitkin Marsh lily	RPR 1B.2	Wet meadows and freshwater marshes in western Sonoma County.	Absent	Not likely. Appropriate habitat is not present on site. Three CNDDDB records of this species have been documented within 5 miles of the project area.
<i>Limnanthes vinculans</i>	Sebastopol meadowfoam	FE, CE RPR 1B.1	Vernal pools in foothill woodland, freshwater wetlands, and wetland-riparian.	Absent	Not likely. Appropriate habitat is not present on site. 18 CNDDDB records of this species have been documented within 5 miles of the project area; however, all of these records are located on the west side of Highway 101.
<i>Pleuropogon hooverianus</i>	North Coast semaphore grass	RPR 1B.1	Mixed Evergreen Forest, North Coastal Coniferous Forest, Freshwater Wetlands, wetland-riparian	Absent	Not likely. Appropriate habitat is not present on site. One CNDDDB record of this species has been documented within 5 miles of the project area.

Special-Status Species Potentially Occurring or Known to Occur in the Project Area

Scientific Name	Common Name	Status ¹	General Habitat Description	General Habitat Present/ Absent	Potential to Occur on the Project Site
<i>Potentilla hickmanii</i>	Hickman's potentilla	FE, CE RPR 1B.1	Northern coastal scrub, closed-cone pine forest, freshwater wetlands, and wetland-riparian.	Absent	Not likely. Appropriate habitat is not present on site.
<i>Potentilla uliginosa</i>	Cunningham Marsh cinquefoil	RPR 1A	Low-nutrient wetlands.	Absent	Not likely. This species is presumed extinct, and only one CNDDDB occurrences has been recorded within 5 miles of the project area in 1990.
<i>Sidalcea oregana</i> <i>ssp. valida</i>	Kenwood Marsh checkermallow	FE, CE RPR 1B.1	Freshwater marsh.	Absent	Not likely. Appropriate habitat is not present on site. This species is known from only two locations in Sonoma County, California.
<i>Trifolium amoenum</i>	showy Indian clover	FE RPR 1B.1	Valley grassland and wetland-riparian.	Absent	Not likely. Appropriate habitat is not present on site.
<i>Trifolium hydrophilum</i>	Saline clover	RPR 1B.2	Valley and foothill grassland and vernal pools with an affinity to mesic/alkaline soils.	Absent	Not likely. Appropriate habitat is not present on site and only two CNDDDB records are present within 5 miles of the project area. One CNDDDB occurrence was mapped as occurring within or in the immediate vicinity of the project area. However, the record indicates that the location of the observation is "unknown", and recorded as "near Rohnert Park."

Special-Status Species Potentially Occurring or Known to Occur in the Project Area

Scientific Name	Common Name	Status ¹	General Habitat Description	General Habitat Present/ Absent	Potential to Occur on the Project Site
Invertebrates					
<i>Incisalia mossii bayensis</i>	San Bruno elfin butterfly	FE	Lives only on north facing slopes of the coastal mountains in San Mateo County. Lays eggs on the larval food plant stonecrop (<i>Sedum spathulifolium</i>). The adults have a flight period of late February through mid-April.	Absent	Not likely. No CNDDDB documented occurrences are within 5 miles of the action area. Suitable habitat is not present in the action area. The action area is outside the species' documented range.
<i>Speyeria zerene myrtleae</i>	Myrtle's silverspot butterfly	FE	Inhabits coastal terrace prairie, coastal bluff scrub, and associated non-native grassland habitats in western Marin and southwestern Sonoma Counties.	Absent	Not likely. Myrtle's silverspot is now only known from four populations in northwestern Marin County and southwestern Sonoma County, including two at Point Reyes National Seashore
<i>Syncaris pacifica</i>	California freshwater shrimp	FE CE	The California freshwater shrimp prefers streams that have water flowing year round with predominately low gradient flows. perennial freshwater streams or intermittent streams with perennial pools where banks are structurally diverse with undercut banks, exposed roots, overhanging woody debris, or overhanging vegetation.	Absent	Unlikely. One CNDDDB occurrence of this species is located within 5 miles of the project area. Perennial streams in the project area are connected to Laguna de Santa Rosa, which is known to provide habitat for this species. However, perennial streams in the project area are manmade and are not structurally diverse, with no perennial pools, undercut banks, and little to no overhanging vegetation.

Special-Status Species Potentially Occurring or Known to Occur in the Project Area

Scientific Name	Common Name	Status ¹	General Habitat Description	General Habitat Present/ Absent	Potential to Occur on the Project Site
Fish					
<i>Eucyclogobius newberryi</i>	tidewater goby	FE, SSC	Inhabits estuarine habitats along the California coast, ranging upstream slightly into fresh water and downstream in water of up to approximately 75 percent sea water. Prefers to spawn in calm lagoon conditions afforded by sandbar closure.	Absent	Not Likely. Water of appropriate salinity is not located in the project area. No CNDDDB occurrences of this species are located within 5 miles of the project area.
<i>Hypomesus transpacificus</i>	delta smelt	FT, CE	Migrates upstream from the brackish-water habitat associated with the mixing zone and disperses widely into river channels and tidally influenced backwater sloughs. Generally spawns in tidally influenced backwater sloughs and channel edgewater.	Absent	Not Likely. No CNDDDB documented occurrences are within 5 miles of the action area. Suitable saline aquatic habitat is not present in the action area.
<i>Oncorhynchus kisutch</i>	Coho salmon	FE	Spawn in streams at riffles with small-to-medium gravel substrates.	Present	Possible. Perennial streams in the project area are connected to Laguna de Santa Rosa, which is known to provide habitat for this species. Although the perennial streams in the project area do not provide suitable spawning habitat for this species, individuals may disperse into these streams.

Special-Status Species Potentially Occurring or Known to Occur in the Project Area

Scientific Name	Common Name	Status ¹	General Habitat Description	General Habitat Present/ Absent	Potential to Occur on the Project Site
<i>Oncorhynchus mykiss</i>	Central California Coast steelhead	FT	Spawn in streams at riffles with small-to-medium gravel substrates.	Present	Possible. Perennial streams in the project area are connected to Laguna de Santa Rosa, which is known to provide habitat for this species. Although the perennial streams in the project area do not provide suitable spawning habitat for this species, individuals may disperse into these streams.
<i>Oncorhynchus mykiss</i>	Central Valley steelhead	FT	Spawn in streams at riffles with small-to-medium gravel substrates.	Absent	Not Likely. The project area is outside of the known range of this species.
<i>Oncorhynchus tshawytscha</i>	California coastal chinook salmon	FT	Spawn in streams at riffles with small-to-medium gravel substrates.	Absent	Not Likely. The project area is outside of the known range of this species. Specifically, the project area lies on the southern edge of historic range, and outside of extant range.
<i>Oncorhynchus tshawytscha</i>	Central Valley spring-run chinook salmon	FT, CT	Spawn in streams at riffles with small-to-medium gravel substrates.	Absent	Not Likely. The project area is outside of the known range of this species.
<i>Oncorhynchus tshawytscha</i>	Winter-run chinook salmon, Sacramento River	FT, CE	Spawn in streams at riffles with small-to-medium gravel substrates.	Absent	Not Likely. The project area is outside of the known range of this species.

Special-Status Species Potentially Occurring or Known to Occur in the Project Area

Scientific Name	Common Name	Status ¹	General Habitat Description	General Habitat Present/ Absent	Potential to Occur on the Project Site
Amphibians					
<i>Ambystoma californiense</i>	California tiger salamander	FT, CT	Annual grasslands and grassy understory of valley foothill hardwood habitats with underground refuges and within dispersal distance of vernal pools, stock ponds, or other seasonal water sources for breeding.	Absent	Possible. 71 CNDDDB occurrences of this species have been recorded within 5 miles of the project area, 21 of which were recorded within 1.5 miles of the project area. No suitable breeding habitat, upland habitat, or refugia were observed in the project area. However, California tiger salamander individuals may use perennial stream features (tributaries to Laguna de Santa Rosa) as aquatic dispersal habitat and as a corridor under Highway 101 to access the project area. In addition, the project area is located in close proximity to California tiger salamander critical habitat. Therefore; although the project area does not provide suitable aquatic or upland habitat for this species, California tiger salamander individuals may traverse the project area.

Special-Status Species Potentially Occurring or Known to Occur in the Project Area

Scientific Name	Common Name	Status ¹	General Habitat Description	General Habitat Present/ Absent	Potential to Occur on the Project Site
<i>Rana boylei</i>	Foothill yellow-legged frog	SSC	Found in partially shaded, shallow streams with rocky substrates in woodland, chaparral, and forest . Needs some cobblesized rocks as a substrate for egg laying. Requires water for 15 weeks for larval transformation.	Marginally suitable habitat present	Possible. 5 CNDDDB occurrences of this species have been recorded within 5 miles of the project area. No suitable breeding habitat for this species is located in the project area. One of the CNDDDB records is located approximately 1.3 miles east of the project area, along a perennial stream that traverses the project area. Therefore, although the project area does not provide suitable breeding habitat for this species, perennial streams in the project area may provide marginally suitable aquatic dispersal habitat for this species.
<i>Rana draytonii</i>	California red-legged frog	FT, SSC	Dense, shrubby riparian vegetation (<i>Salix lasiolepis</i> ; also <i>Typha</i> and <i>Scirpus</i> spp.) associated with deep (2.3 feet), still or slow moving water.	Absent	Not Likely. Eight CNDDDB occurrences are documented within 5 miles of the project area. Streams within the project area could provide suitable aquatic dispersal habitat for this species; however, a lack of nearby records and breeding habitat makes it unlikely that this species would occur in the project area.

Special-Status Species Potentially Occurring or Known to Occur in the Project Area

Scientific Name	Common Name	Status ¹	General Habitat Description	General Habitat Present/ Absent	Potential to Occur on the Project Site
Reptiles					
<i>Emys marmorata</i>	Western pond turtle	SSC	Permanent or nearly permanent bodies of water and low gradient, slow moving streams below 6,000 feet elevation; presence of haul-out sites important.	Present	Possible. 12 CNDDDB occurrences of this species are located within 5 miles of the project area, 4 of which are located within 1.5 miles of the project area. Aquatic corridors connected to Laguna de Santa Rosa may provide suitable aquatic dispersal habitat for this species.
Birds					
<i>Agelaius tricolor</i>	Tricolor blackbird	CE	The tricolored blackbird is found primarily in the Central Valley, but is also found in the lowlands west of the Cascade-Sierra axis. Inhabits agricultural grain fields, dairies and feedlots with low-growing vegetation, grasslands, and marshes. Nesting habitat is found in marshes within cattails (<i>Typhus</i> spp.), often with willow (<i>Salix</i> spp.) canopy. The breeding season is from mid-March through early August, and autumnal breeding in the Central Valley occurs from September through November.	Absent	Not likely to nest in the project area. One CNDDDB occurrence of this species is located within 5 miles of the project area. Suitable marsh habitat for this species is not located in the project area.

Special-Status Species Potentially Occurring or Known to Occur in the Project Area

Scientific Name	Common Name	Status ¹	General Habitat Description	General Habitat Present/ Absent	Potential to Occur on the Project Site
<i>Athene cunicularia</i>	Burrowing owl	SSC	Occurs in dry, open habitats such as grasslands and prairies, with low-growing or no vegetation where it occupies underground burrows, typically those of the California ground squirrel (<i>Spermophilus beecheyi</i>). Can also occur in open areas of farmland, levee banks and other disturbed or managed habitats where burrows or burrow-like features are present.	Absent	Not likely. One CNDDDB occurrence of this species is located within 5 miles of the project area. No habitat for this species is present in the project area.
<i>Brachyramphus marmoratus</i>	marbled murrelet	FT, CE	Occurs near coastal areas, generally within 1.2 miles of saltwater. Nests in old-growth forest.	Absent	Not likely. No CNDDDB occurrences for this species are located within 5 miles of the action area and no habitat for this species is present in the action area.
<i>Coccyzus americanus occidentalis</i>	western yellow-billed cuckoo	FT, CE	Occurs in open woodlands with clearings and dense scrubby vegetation, often along water.	Absent	Not likely. Two CNDDDB occurrences of this species were recorded within 5 miles of the project area, both before 1975, and one of which is considered possibly extirpated. No suitable habitat for this species is located in the project area.

Special-Status Species Potentially Occurring or Known to Occur in the Project Area

Scientific Name	Common Name	Status ¹	General Habitat Description	General Habitat Present/ Absent	Potential to Occur on the Project Site
<i>Elanus leucurus</i>	White-tailed kite	CFP	This species builds nests in the tops of dense medium- to large-sized trees located near open areas that are used for foraging. Breeding generally occurs from February through October. White-tailed kite lays three to five eggs, which it incubates for 30 to 32 days, after which fledging occurs at 5 to 6 weeks of age.	Absent	Not likely to nest in the project area. One CNDDDB occurrence of this species was recorded within 5 miles of the project area. Marginally suitable foraging habitat for this species may occur in ruderal patches in the project area.
<i>Charadrius alexandrinus nivosus</i>	Western snowy plover	FT, SSC	Breeding habitat found on barren to sparsely vegetated flats and along the shores of alkaline and saline lakes, reservoirs, ponds, braided river channels, agricultural waste water ponds, and salt evaporation ponds. Adults and broods typically forage near shallow water and on dry flats.	Absent	Not likely. No CNDDDB occurrences for this species are located within 5 miles of the action area. In addition, the San Francisco Bay and associated salt marsh habitat is not located within the vicinity of the project.
<i>Diomedea albatrus</i>	Short-tailed albatross	FE	Require remote islands for breeding habitat and forage in the continental shelf-break areas.	Absent	Not likely. No CNDDDB occurrences for this species are located within 5 miles of the action area. No habitat is present in the project area.
<i>Rallus longirostris obsoletus</i>	California clapper rail	FE, CE	Occurs along the ecotone between mudflat and higher vegetated zones, and in tidal sloughs.	Absent	Not likely. No CNDDDB occurrences for this species are located within 5 miles of the action area. In addition, the San Francisco Bay and associated salt marsh habitat is not located within the vicinity of the project.

Special-Status Species Potentially Occurring or Known to Occur in the Project Area

Scientific Name	Common Name	Status ¹	General Habitat Description	General Habitat Present/ Absent	Potential to Occur on the Project Site
<i>Sternula antillarum</i>	California least tern	FE, CE	Nests in colonies on relatively open beaches where vegetation is limited by natural scouring from tidal action.	Absent	Not likely. No CNDDDB occurrences for this species are located within 5 miles of the action area. In addition, the San Francisco Bay and associated salt marsh habitat is not located within the vicinity of the project.
<i>Strix occidentalis caurina</i>	Northern spotted owl	FT, CT	The species' breeding and roosting habitats are found in forests and woodlands with large old trees and snags, dense canopies, multiple canopy layers, and downed woody debris; foraging habitat includes more open stands. Breeding season is from mid-February to mid-September or early October.	Absent	Not likely. No forest is located within the project area. No CNDDDB records of this species are located within 5 miles of the project area.
Mammals					
<i>Reithrodontomys raviventris</i>	salt marsh harvest mouse	FE, CFP	Marshes of the San Pablo, Suisun, Corte Madera, Richmond and South San Francisco bays. Critically dependent on dense cover. Preferred habitat is pickleweed (<i>Salicornia virginica</i>).	Absent	Not likely. Two CNDDDB occurrences for this species are located within 5 miles of the action area. However; the San Francisco Bay and associated mudflat habitat is not located within the vicinity of the project.

Special-Status Species Potentially Occurring or Known to Occur in the Project Area

Scientific Name	Common Name	Status ¹	General Habitat Description	General Habitat Present/ Absent	Potential to Occur on the Project Site
<i>Taxidea taxus</i>	American badger	SSC		Absent	Not likely. Five CNDDDB occurrences for this species are located within 5 miles of the project area. Existing development makes it unlikely that this species would occur in the project area.
¹ – Listing Status Definitions: FE federal endangered FT federal threatened SE state endangered ST state threatened 1A plant species that are presumed extinct in California (CNPS) 1B plant species that are rare, threatened, or endangered in California and elsewhere (CNPS) SSC state species of concern CFP California Fully Protected Sources: data obtained from USFWS Species List Database, CNPS Rare Plant Database (USGS quadrangles searched include 501C Cotati, 501A Kenwood, 501D Glen Ellen, 501B Santa Rosa, 502A Sebastopol, 502D Two Rock, 485A Point Reyes NE, 484B Petaluma, and 484A Petaluma River), and CNDDDB. CNDDDB occurrences over 30 years old were not used to develop this species list.					

U.S. Fish & Wildlife Service
Sacramento Fish & Wildlife Office
Federal Endangered and Threatened Species that Occur in
or may be Affected by Projects in the Counties and/or
U.S.G.S. 7 1/2 Minute Quads you requested

Document Number: 150311030607

Current as of: March 11, 2015

Quad Lists

Listed Species

Invertebrates

- Incisalia mossii bayensis*
San Bruno elfin butterfly (E)
- Speyeria zerene myrtleae*
Myrtle's silverspot butterfly (E)
- Syncaris pacifica*
California freshwater shrimp (E)

Fish

- Eucyclogobius newberryi*
tidewater goby (E)
- Hypomesus transpacificus*
delta smelt (T)
- Oncorhynchus kisutch*
coho salmon - central CA coast (E) (NMFS)
Critical habitat, coho salmon - central CA coast (X) (NMFS)
- Oncorhynchus mykiss*
Central California Coastal steelhead (T) (NMFS)
Central Valley steelhead (T) (NMFS)
Critical habitat, Central California coastal steelhead (X) (NMFS)
- Oncorhynchus tshawytscha*
California coastal chinook salmon (T) (NMFS)
Central Valley spring-run chinook salmon (T) (NMFS)
Critical habitat, California coastal chinook salmon (X) (NMFS)
winter-run chinook salmon, Sacramento River (E) (NMFS)

Amphibians

- Ambystoma californiense*
California tiger salamander, Sonoma Co. pop (E)
- Rana draytonii*
California red-legged frog (T)
Critical habitat, California red-legged frog (X)

Birds

- Brachyramphus marmoratus*
Critical habitat, marbled murrelet (X)
marbled murrelet (T)
- Charadrius alexandrinus nivosus*
western snowy plover (T)
- Coccyzus americanus occidentalis*
Western yellow-billed cuckoo (T)
- Diomedea albatrus*

short-tailed albatross (E)

Rallus longirostris obsoletus

California clapper rail (E)

Sternula antillarum (=Sterna, =albifrons) browni

California least tern (E)

Strix occidentalis caurina

northern spotted owl (T)

Mammals

Reithrodontomys raviventris

salt marsh harvest mouse (E)

Plants

Alopecurus aequalis var. *sonomensis*

Sonoma alopecurus (E)

Astragalus clarianus

Clara Hunt's milk-vetch (E)

Blennosperma bakeri

Baker's stickyseed [=Sonoma Sunshine] (E)

Carex albida

white sedge (E)

Chorizanthe valida

Sonoma spineflower (E)

Clarkia imbricata

Vine Hill clarkia (E)

Cordylanthus mollis ssp. *mollis*

soft bird's-beak (E)

Delphinium bakeri

Baker's larkspur (E)

Critical habitat, Baker's larkspur (X)

Delphinium luteum

yellow larkspur (E)

Hesperolinon congestum

Marin dwarf-flax (=western flax) (T)

Lasthenia burkei

Burke's goldfields (E)

Lasthenia conjugens

Contra Costa goldfields (E)

Lilium pardalinum ssp. *pitkinense*

Pitkin Marsh lily (E)

Limnanthes vinculans

Sebastopol meadowfoam (E)

Potentilla hickmanii

Hickman's potentilla (=cinquefoil) (E)

Sidalcea oregana ssp. *valida*

Kenwood Marsh checkermallow (=checkerbloom) (E)

Trifolium amoenum

showy Indian clover (E)

Quads Containing Listed, Proposed or Candidate Species:

PETALUMA RIVER (484A)

PETALUMA (484B)

POINT REYES NE (485A)

KENWOOD (501A)

SANTA ROSA (501B)
COTATI (501C)
GLEN ELLEN (501D)
SEBASTOPOL (502A)
TWO ROCK (502D)

County Lists

Sonoma County

Listed Species

Invertebrates

Branchinecta conservatio

Conservancy fairy shrimp (E)

Branchinecta lynchi

Critical habitat, vernal pool fairy shrimp (X)

vernal pool fairy shrimp (T)

Haliotes cracherodii

black abalone (E) (NMFS)

Haliotes sorenseni

white abalone (E) (NMFS)

Incisalia mossii bayensis

San Bruno elfin butterfly (E)

Speyeria callippe callippe

callippe silverspot butterfly (E)

Speyeria zerene behrensii

Behren's silverspot butterfly (E)

Speyeria zerene myrtleae

Myrtle's silverspot butterfly (E)

Syncaris pacifica

California freshwater shrimp (E)

Fish

Acipenser medirostris

green sturgeon (T) (NMFS)

Eucyclogobius newberryi

critical habitat, tidewater goby (X)

tidewater goby (E)

Hypomesus transpacificus

delta smelt (T)

Oncorhynchus (=Salmo) clarki henshawi

Lahontan cutthroat trout (T)

Oncorhynchus kisutch

coho salmon - central CA coast (E) (NMFS)

Critical habitat, coho salmon - central CA coast (X) (NMFS)

Oncorhynchus mykiss

Central California Coastal steelhead (T) (NMFS)

Central Valley steelhead (T) (NMFS)

Critical habitat, Central California coastal steelhead (X) (NMFS)

Critical habitat, Central Valley steelhead (X) (NMFS)

Critical habitat, Northern California steelhead (X) (NMFS)

Northern California steelhead (T) (NMFS)

Oncorhynchus tshawytscha

California coastal chinook salmon (T) (NMFS)

Central Valley spring-run chinook salmon (T) (NMFS)

Critical habitat, California coastal chinook salmon (X) (NMFS)

Critical habitat, winter-run chinook salmon (X) (NMFS)

winter-run chinook salmon, Sacramento River (E) (NMFS)

Amphibians

Ambystoma californiense

California tiger salamander, Sonoma Co. pop (E)

Rana draytonii

California red-legged frog (T)

Critical habitat, California red-legged frog (X)

Reptiles

Caretta caretta

loggerhead turtle (T) (NMFS)

Chelonia mydas (incl. agassizi)

green turtle (T) (NMFS)

Dermochelys coriacea

leatherback turtle (E) (NMFS)

Lepidochelys olivacea

olive (=Pacific) ridley sea turtle (T) (NMFS)

Masticophis lateralis euryxanthus

Alameda whipsnake [=striped racer] (T)

Birds

Brachyramphus marmoratus

Critical habitat, marbled murrelet (X)

marbled murrelet (T)

Charadrius alexandrinus nivosus

Critical habitat, western snowy plover (X)

western snowy plover (T)

Coccyzus americanus occidentalis
Western yellow-billed cuckoo (T)

Diomedea albatrus
short-tailed albatross (E)

Pelecanus occidentalis californicus
California brown pelican (E)

Rallus longirostris obsoletus
California clapper rail (E)

Sternula antillarum (=Sterna, =albifrons) browni
California least tern (E)

Strix occidentalis caurina
northern spotted owl (T)

Mammals

Aplodontia rufa nigra
Point Arena mountain beaver (E)

Arctocephalus townsendi
Guadalupe fur seal (T) (NMFS)

Balaenoptera borealis
sei whale (E) (NMFS)

Balaenoptera musculus
blue whale (E) (NMFS)

Balaenoptera physalus
finback (=fin) whale (E) (NMFS)

Eubalaena (=Balaena) glacialis
right whale (E) (NMFS)

Eumetopias jubatus
Steller (=northern) sea-lion (T) (NMFS)

Physeter catodon (=macrocephalus)
sperm whale (E) (NMFS)

Reithrodontomys raviventris
salt marsh harvest mouse (E)

Plants

Alopecurus aequalis var. *sonomensis*

Sonoma alopecurus (E)*Astragalus clarianus*

Clara Hunt's milk-vetch (E)

Blennosperma bakeri

Baker's stickyseed [=Sonoma Sunshine] (E)

Carex albida

white sedge (E)

Chorizanthe valida

Sonoma spineflower (E)

Clarkia imbricata

Vine Hill clarkia (E)

Cordylanthus mollis ssp. mollis

soft bird's-beak (E)

Cordylanthus tenuis ssp. capillaris

Pennell's bird's-beak (E)

Delphinium bakeri

Baker's larkspur (E)

Critical habitat, Baker's larkspur (X)

Delphinium luteum

Critical habitat, yellow larkspur (X)

yellow larkspur (E)

Eryngium constancei

Loch Lomond coyote-thistle (=button-celery) (E)

Hesperolinon congestum

Marin dwarf-flax (=western flax) (T)

Lasthenia burkei

Burke's goldfields (E)

Lasthenia conjugens

Contra Costa goldfields (E)

Critical habitat, Contra Costa goldfields (X)

Lilium pardalinum ssp. pitkinense

Pitkin Marsh lily (E)

Limnanthes vinculans

Sebastopol meadowfoam (E)

Lupinus tidestromii

clover lupine [Tidestrom's lupine] (E)

Navarretia leucocephala ssp. pauciflora
few-flowered navarretia (E)

Navarretia leucocephala ssp. plieantha
many-flowered navarretia (E)

Orcuttia tenuis
Critical habitat, slender Orcutt grass (X)
slender Orcutt grass (T)

Parvisedum leiocarpum
Lake County stonecrop (E)

Plagiobothrys strictus
Calistoga allocarya (popcorn-flower) (E)

Poa napensis
Napa bluegrass (E)

Potentilla hickmanii
Hickman's potentilla (=cinquefoil) (E)

Sidalcea oregana ssp. valida
Kenwood Marsh checkermallow (=checkerbloom) (E)

Trifolium amoenum
showy Indian clover (E)

Proposed Species

Plants

Cordylanthus mollis ssp. mollis
Critical habitat, soft bird's-beak (PX)

Key:

(E) *Endangered* - Listed as being in danger of extinction.

(T) *Threatened* - Listed as likely to become endangered within the foreseeable future.

(P) *Proposed* - Officially proposed in the Federal Register for listing as endangered or threatened.

(NMFS) Species under the Jurisdiction of the [National Oceanic & Atmospheric Administration Fisheries Service](http://www.noaa.gov/). Consult with them directly about these species.

Critical Habitat - Area essential to the conservation of a species.

(PX) *Proposed Critical Habitat* - The species is already listed. Critical habitat is being proposed for it.

(C) *Candidate* - Candidate to become a proposed species.

(V) Vacated by a court order. Not currently in effect. Being reviewed by the Service.

(X) *Critical Habitat* designated for this species

Important Information About Your Species List

How We Make Species Lists

We store information about endangered and threatened species lists by U.S. Geological Survey 7½ minute quads. The United States is divided into these quads, which are about the size of San Francisco.

The animals on your species list are ones that occur within, **or may be affected by** projects within, the quads covered by the list.

- Fish and other aquatic species appear on your list if they are in the same watershed as your quad or if water use in your quad might affect them.
- Amphibians will be on the list for a quad or county if pesticides applied in that area may be carried to their habitat by air currents.
- Birds are shown regardless of whether they are resident or migratory. Relevant birds on the county list should be considered regardless of whether they appear on a quad list.

Plants

Any plants on your list are ones that have actually been observed in the area covered by the list. Plants may exist in an area without ever having been detected there. You can find out what's in the surrounding quads through the California Native Plant Society's online [Inventory of Rare and Endangered Plants](#).

Surveying

Some of the species on your list may not be affected by your project. A trained biologist and/or botanist, familiar with the habitat requirements of the species on your list, should determine whether they or habitats suitable for them may be affected by your project. We recommend that your surveys include any proposed and candidate species on your list. See our [Protocol](#) and [Recovery Permits](#) pages.

For plant surveys, we recommend using the [Guidelines for Conducting and Reporting Botanical Inventories](#). The results of your surveys should be published in any environmental documents prepared for your project.

Your Responsibilities Under the Endangered Species Act

All animals identified as listed above are fully protected under the Endangered Species Act of 1973, as amended. Section 9 of the Act and its implementing regulations prohibit the take of a federally listed wildlife species. Take is defined by the Act as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect" any such animal.

Take may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or shelter (50 CFR §17.3).

Take incidental to an otherwise lawful activity may be authorized by one of two procedures:

- If a Federal agency is involved with the permitting, funding, or carrying out of a project that may result in take, then that agency must engage in a formal [consultation](#) with the Service. During formal consultation, the Federal agency, the applicant and the Service work together to avoid or minimize the impact on listed species and their habitat. Such consultation would result in a biological opinion by the Service addressing the anticipated effect of the project on listed and proposed species. The opinion may authorize a limited level of incidental take.
- If no Federal agency is involved with the project, and federally listed species may be taken as part of the project, then you, the applicant, should apply for an incidental take permit. The Service may issue such a permit if you submit a satisfactory conservation plan for the species that would be affected by your project.

Should your survey determine that federally listed or proposed species occur in the area and are likely to be affected by the project, we recommend that you work with this office and the California Department of Fish and Game to develop a plan that minimizes the project's direct and indirect impacts to listed species and compensates for project-related loss of habitat. You should include the plan in any environmental documents you file.

Critical Habitat

When a species is listed as endangered or threatened, areas of habitat considered essential to its conservation may be designated as critical habitat. These areas may require special management considerations or protection. They provide needed space for growth and normal behavior; food, water, air, light, other nutritional or physiological requirements; cover or shelter; and sites for breeding, reproduction, rearing of offspring, germination or seed dispersal.

Although critical habitat may be designated on private or State lands, activities on these lands are not restricted unless there is Federal involvement in the activities or direct harm to listed wildlife.

If any species has proposed or designated critical habitat within a quad, there will be a separate line for this on the species list. Boundary descriptions of the critical habitat may be found in the Federal Register. The information is also reprinted in the Code of Federal Regulations (50 CFR 17.95). See our [Map Room](#) page.

Candidate Species

We recommend that you address impacts to candidate species. We put plants and animals on our candidate list when we have enough scientific information to eventually propose them for listing as threatened or endangered. By considering these species early in your planning process you may be able to avoid the problems that could develop if one of these candidates was listed before the end of your project.

Species of Concern

The Sacramento Fish & Wildlife Office no longer maintains a list of species of concern. However, various other agencies and organizations maintain lists of at-risk species. These lists provide essential information for land management planning and conservation efforts. [More info](#)

Wetlands

If your project will impact wetlands, riparian habitat, or other jurisdictional waters as defined by section 404 of the Clean Water Act and/or section 10 of the Rivers and Harbors Act, you will need to obtain a permit from the U.S. Army Corps of Engineers. Impacts to wetland habitats require site specific mitigation and monitoring. For questions regarding wetlands, please contact Mark Littlefield of this office at (916) 414-6520.

Updates

Our database is constantly updated as species are proposed, listed and delisted. If you address proposed and candidate species in your planning, this should not be a problem. However, we recommend that you get an updated list every 90 days. That would be June 09, 2015.

United States Department of the Interior



FISH AND WILDLIFE SERVICE

Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825



March 11, 2015

Document Number: 150311030607

Peter Boice
AECOM
300 California Street Suite 400
San Francisco, CA 94014

Subject: Species List for Rohnert Park Priority Development Area Plan

Dear: Mr. Peter Boice

We are sending this official species list in response to your March 11, 2015 request for information about endangered and threatened species. The list covers the California counties and/or U.S. Geological Survey 7½ minute quad or quads you requested.

Our database was developed primarily to assist Federal agencies that are consulting with us. Therefore, our lists include all of the sensitive species that have been found in a certain area *and also ones that may be affected by projects in the area*. For example, a fish may be on the list for a quad if it lives somewhere downstream from that quad. Birds are included even if they only migrate through an area. In other words, we include all of the species we want people to consider when they do something that affects the environment.

Please read Important Information About Your Species List (below). It explains how we made the list and describes your responsibilities under the Endangered Species Act.

Our database is constantly updated as species are proposed, listed and delisted. If you address proposed and candidate species in your planning, this should not be a problem. However, we recommend that you get an updated list every 90 days. That would be June 09, 2015.

Please contact us if your project may affect endangered or threatened species or if you have any questions about the attached list or your responsibilities under the Endangered Species Act. A list of Endangered Species Program contacts can be found http://www.fws.gov/sacramento/es/Branch-Contacts/es_branch-contacts.htm.

Endangered Species Division

APPENDIX C

Cultural Resources Correspondence

July 29, 2015

Native American Heritage Commission
1550 Harbor Blvd Suite 100
West Sacramento, CA 95691

RE: Request for Native American Sacred Lands File research and Native American contacts list for the Central Rohnert Park Priority Development Area Plan

Dear NAHC Staff,

On behalf of the City of Rohnert Park and in accordance with the California Environmental Quality Act (CEQA) guidelines, AECOM is conducting an initial study of the proposed Central Rohnert Park Priority Development Area Plan project to determine whether an environmental impact report (EIR), a mitigated negative declaration (MND), or a negative declaration (ND) is required for the proposed plan.

AECOM is requesting a search of the Sacred Lands files for any places of concern that may be located within this area and a Native American contact list in order to further facilitate tribal interest in this project. Please find attached the completed NAHC form for this request.

If you have any questions, please feel free to contact me by email at Jenifer.Rogers@aecom.com or telephone (916) 414-5849. We appreciate your contribution to this project and look forward to hearing from you soon.

Thank you,
Jenifer Rogers
Archaeologist
AECOM Environment
2020 L Street Suite 400
Sacramento CA 95811
Desk: 916-414-5849
Fax: 916-414-5850
Jenifer.Rogers@aecom.com

Sacred Lands File & Native American Contacts List Request

Native American Heritage Commission

1550 Harbor Blvd, Suite 100

West Sacramento, CA 95691

916-373-3710

916-373-5471 – Fax

nahc@nahc.ca.gov

Information Below is Required for a Sacred Lands File Search

Project: Central Rohnert Park Priority Development Area Plan

County: Sonoma

USGS Quadrangle Name: Cotati, CA 7.5'

Township: 6N **Range:** 8W **Section(s):** Unsectioned

Company/Firm/Agency: AECOM

Street Address: 2020 L Street Suite 400

City: Sacramento **Zip:** 95811

Phone: (916) 414-5849

Fax: (916) 414-5850

Email: Jenifer.Rogers@aecom.com

Project Description:

The City of Rohnert Park is proposing a Priority Development Area (PDA) Plan, centered on Rohnert Park Expressway (RPX) and State Farm Drive, next to the planned Sonoma Marin Area Rail Transit (SMART) commuter rail station and City Center. The PDA is entirely within the City of Rohnert Park's city limits, in central Sonoma County, east of U.S. Highway 101. The PDA Plan is intended to support transit-oriented development and infill growth in existing communities, adjacent to transit. New roadways, transit, bicycle, and pedestrian improvements and corresponding circulation connections are proposed to improve non-vehicular access within the PDA, connect to and complete regional trails, and support the development of existing and new a mixed-use areas of the community, with a particular focus on providing community access to the SMART station and regional multi-use path (MUP).

From: Rogers, Jenifer
To: nahc@nahc.ca.gov
Subject: Request for Native American Sacred Lands File research and Native American contacts list for the Central Rohnert Park Priority Development Area Plan
Date: Wednesday, August 12, 2015 2:09:00 PM
Attachments: [NAHC request form.docx](#)

Dear NAHC Staff,

I am seeking a response to a request that I submitted to your office July 27, 2015. Following is a restatement of my request in case it is necessary.

On behalf of the City of Rohnert Park and in accordance with the California Environmental Quality Act (CEQA) guidelines, AECOM is conducting an initial study of the proposed Central Rohnert Park Priority Development Area Plan project to determine whether an environmental impact report (EIR), a mitigated negative declaration (MND), or a negative declaration (ND) is required for the proposed plan.

AECOM is requesting a search of the Sacred Lands files for any places of concern that may be located within this area and a Native American contact list in order to further facilitate tribal interest in this project. Please find attached the completed NAHC form for this request.

If you have any questions, please feel free to contact me by email at Jenifer.Rogers@aecom.com or telephone (916) 414-5849. We appreciate your contribution to this project and look forward to hearing from you soon.

Sincerely,
Jenifer Rogers
Archaeologist
AECOM Environment
2020 L Street Suite 400
Sacramento CA 95811
Desk: 916-414-5849
Fax: 916-414-5850
Jenifer.Rogers@aecom.com

NATIVE AMERICAN HERITAGE COMMISSION

1550 Harbor Blvd., ROOM 100
West SACRAMENTO, CA 95691
(916) 373-3710
Fax (916) 373-5471



August 17, 2015

Jenifer Rogers
AECOM
2020 L Street, Suite 400
Sacramento, CA 95811

Email to: Jenifer.Rogers@aecom.com

Re: Central Rohnert Park Priority Development Area Plan, Sonoma County.

Dear Ms. Rogers,

A record search of the sacred land file has failed to indicate the presence of Native American cultural resources in the immediate project area. The absence of specific site information in the sacred lands file does not indicate the absence of cultural resources in any project area. Other sources of cultural resources should also be contacted for information regarding known and recorded sites.

Enclosed is a list of Native Americans individuals/organizations who may have knowledge of cultural resources in the project area. The Commission makes no recommendation or preference of a single individual, or group over another. This list should provide a starting place in locating areas of potential adverse impact within the proposed project area. I suggest you contact all of those indicated, if they cannot supply information, they might recommend others with specific knowledge. By contacting all those listed, your organization will be better able to respond to claims of failure to consult with the appropriate tribe or group. If a response has not been received within two weeks of notification, the Commission requests that you follow-up with a telephone call to ensure that the project information has been received.

If you receive notification of change of addresses and phone numbers from any of these individuals or groups, please notify me. With your assistance we are able to assure that our lists contain current information. If you have any questions or need additional information, please contact me at (916) 373-3712.

Sincerely,

A handwritten signature in cursive script that reads "Katy Sanchez".

Katy Sanchez
Associate Government Program Analyst

**Native American Contact List
Sonoma County
August 17, 2015**

The Federated Indians of Graton Rancheria
Greg Sarris, Chairperson
6400 Redwood Drive, Ste Coast Miwok
Rohnert Park, CA 94928 Southern Pomo
coastmiwok@aol.com
(707) 566-2288 Office

(707) 566-2291 Fax

Suki Waters
P.O. Box 53 Coast Miwok
Jenner, CA 95450 Pomo
watertreks@gmail.com
(707) 865-2249

The Federated Indians of Graton Rancheria
Gene Buvelot
6400 Redwood Drive, Ste 300 Coast Miwok
Rohnert Park, CA 94928 Southern Pomo
coastmiwok@aol.com
(415) 279-4844 Cell
(707) 566-2288 ext 103

This list is current only as of the date of this document.

Distribution of this list does not relieve any person of the statutory responsibility as defined in Section 7050.5 of the Health and Safety Code, Section 5097.94 of the Public Resources Code and Section 5097.98 of the Public Resources Code.

This list is only applicable for contacting local Native Americans with regard to cultural resources for the proposed Central Rohnert Park Priority Development Area Plan, Sonoma County.

August 25, 2015

Gene Buvelot
The Federated Indians of Graton Rancheria
6400 Redwood Drive, Suite 300
Rohnert Park, CA 94928

Subject: City of Rohnert Park Priority Development Area (PDA) Plan

Dear Mr. Buvelot,

On behalf of the City of Rohnert Park and in accordance with the California Environmental Quality Act (CEQA) guidelines, AECOM is conducting an initial study of the proposed Central Rohnert Park Priority Development Area Plan project to determine whether an environmental impact report (EIR), a mitigated negative declaration (MND), or a negative declaration (ND) is required for the proposed plan. The project is located on the USGS Cotati, CA 7.5' Quadrangle, Township 6N, Range 8W, unsectioned.

The City of Rohnert Park is proposing its Priority Development Area (PDA) Plan, centered on Rohnert Park Expressway (RPX) and State Farm Drive, next to the planned Sonoma Marin Area Rail Transit (SMART) commuter rail station and City Center. The Central Rohnert Park PDA Plan is an existing mixed-use area. The proposed project generally consists of various development types, including multi-family residential units, retail/service commercial uses, public institutional uses, office uses, light industrial uses, public park facilities, and open space. New roadways, transit, bicycle, and pedestrian improvements and corresponding circulation connections are proposed to improve non-vehicular access within the PDA, connect to and complete regional trails, and support the development of existing and new mixed-use areas of the community, with a particular focus on providing community access to the SMART station and regional multi-use path.

The Native American Heritage Commission (NAHC) has identified you as a member of a California Native American tribe that is traditionally and culturally affiliated with the geographic area. If you or your tribe has concerns regarding tribal cultural resources in the project footprint you are invited to consult with the City of Rohnert Park. Please respond in writing via letter within 30 days of receipt of this notification. If you do not respond within 30 days the City of Rohnert Park will consider consultation with you and your tribe complete, pursuant to Public Resources Code Section 21082.3(d)(3).



AECOM
2020 L Street, Suite 400
Sacramento, CA 95811
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916.414.5800 tel
916.414.5850 fax

Please send written notification to:
Jenifer Rogers
Archaeologist
AECOM
2020 L Street, Suite 400, Sacramento, CA 95811 USA

Sincerely,

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Archaeologist
AECOM Environment
(916) 414-5849
Jenifer.Rogers@aecom.com

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Enclosure

August 25, 2015

Greg Sarris, Chairperson
The Federated Indians of Graton Rancheria
6400 Redwood Drive, Suite 300
Rohnert Park, CA 94928

Subject: City of Rohnert Park Priority Development Area (PDA) Plan

Dear Chairperson Sarris,

On behalf of the City of Rohnert Park and in accordance with the California Environmental Quality Act (CEQA) guidelines, AECOM is conducting an initial study of the proposed Central Rohnert Park Priority Development Area Plan project to determine whether an environmental impact report (EIR), a mitigated negative declaration (MND), or a negative declaration (ND) is required for the proposed plan. The project is located on the USGS Cotati, CA 7.5' Quadrangle, Township 6N, Range 8W, unsectioned.

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The Native American Heritage Commission (NAHC) has identified you as a member of a California Native American tribe that is traditionally and culturally affiliated with the geographic area. If you or your tribe has concerns regarding tribal cultural resources in the project footprint you are invited to consult with the City of Rohnert Park. Please respond in writing via letter within 30 days of receipt of this notification. If you do not respond within 30 days the City of Rohnert Park will consider consultation with you and your tribe complete, pursuant to Public Resources Code Section 21082.3(d)(3).



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Enclosure

August 25, 2015

Suki Waters
P.O. Box 53
Jenner, CA 95450

Subject: City of Rohnert Park Priority Development Area (PDA) Plan

Dear Suki Waters,

On behalf of the City of Rohnert Park and in accordance with the California Environmental Quality Act (CEQA) guidelines, AECOM is conducting an initial study of the proposed Central Rohnert Park Priority Development Area Plan project to determine whether an environmental impact report (EIR), a mitigated negative declaration (MND), or a negative declaration (ND) is required for the proposed plan. The project is located on the USGS Cotati, CA 7.5' Quadrangle, Township 6N, Range 8W, unsectioned.

The City of Rohnert Park is proposing its Priority Development Area (PDA) Plan, centered on Rohnert Park Expressway (RPX) and State Farm Drive, next to the planned Sonoma Marin Area Rail Transit (SMART) commuter rail station and City Center. The Central Rohnert Park PDA Plan is an existing mixed-use area. The proposed project generally consists of various development types, including multi-family residential units, retail/service commercial uses, public institutional uses, office uses, light industrial uses, public park facilities, and open space. New roadways, transit, bicycle, and pedestrian improvements and corresponding circulation connections are proposed to improve non-vehicular access within the PDA, connect to and complete regional trails, and support the development of existing and new mixed-use areas of the community, with a particular focus on providing community access to the SMART station and regional multi-use path.

The Native American Heritage Commission (NAHC) has identified you as a member of a California Native American tribe that is traditionally and culturally affiliated with the geographic area. If you or your tribe has concerns regarding tribal cultural resources in the project footprint you are invited to consult with the City of Rohnert Park. Please respond in writing via letter within 30 days of receipt of this notification. If you do not respond within 30 days the City of Rohnert Park will consider consultation with you and your tribe complete, pursuant to Public Resources Code Section 21082.3(d)(3).



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Enclosure

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Email Updates

DATE & TIME	STATUS OF ITEM	LOCATION
August 27, 2015 , 11:59 am	Delivered	ROHNERT PARK, CA 94928
Your item was delivered at 11:59 am on August 27, 2015 in ROHNERT PARK, CA 94928.		
August 27, 2015 , 8:23 am	Out for Delivery	ROHNERT PARK, CA 94928
August 27, 2015 , 8:13 am	Sorting Complete	ROHNERT PARK, CA 94928
August 27, 2015 , 6:52 am	Arrived at Unit	ROHNERT PARK, CA 94928
August 26, 2015 , 8:30 pm	Departed USPS Facility	PETALUMA, CA 94999
August 26, 2015 , 6:30 pm	Arrived at USPS Destination Facility	PETALUMA, CA 94999
August 26, 2015 , 3:17 am	Arrived at USPS Facility	SAN FRANCISCO, CA 94188
August 25, 2015 , 10:46 pm	Departed USPS Facility	WEST SACRAMENTO, CA 95799
August 25, 2015 , 7:22 pm	Arrived at USPS Origin Facility	WEST SACRAMENTO, CA 95799
August 25, 2015 , 2:31 pm	Acceptance	SACRAMENTO, CA 95816

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August 27, 2015 , 11:59 am	Delivered	ROHNERT PARK, CA 94928
Your item was delivered at 11:59 am on August 27, 2015 in ROHNERT PARK, CA 94928.		
August 27, 2015 , 8:23 am	Out for Delivery	ROHNERT PARK, CA 94928
August 27, 2015 , 8:13 am	Sorting Complete	ROHNERT PARK, CA 94928
August 27, 2015 , 6:52 am	Arrived at Unit	ROHNERT PARK, CA 94928
August 26, 2015 , 8:30 pm	Departed USPS Facility	PETALUMA, CA 94999
August 26, 2015 , 6:30 pm	Arrived at USPS Destination Facility	PETALUMA, CA 94999
August 26, 2015 , 3:17 am	Arrived at USPS Facility	SAN FRANCISCO, CA 94188
August 25, 2015 , 10:46 pm	Departed USPS Facility	WEST SACRAMENTO, CA 95799
August 25, 2015 , 7:22 pm	Arrived at USPS Origin Facility	WEST SACRAMENTO, CA 95799
August 25, 2015 , 2:31 pm	Acceptance	SACRAMENTO, CA 95816

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On Time

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Postal Product:
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Features:
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Available Actions

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DATE & TIME	STATUS OF ITEM	LOCATION
August 27, 2015 , 8:53 am	Available for Pickup	JENNER, CA 95450
Your item arrived at the JENNER, CA 95450 post office at 8:53 am on August 27, 2015 and is ready for pickup.		
August 27, 2015 , 8:53 am	Arrived at Unit	JENNER, CA 95450
August 26, 2015 , 8:50 pm	Departed USPS Destination Facility	PETALUMA, CA 94999
August 26, 2015 , 6:40 pm	Arrived at USPS Destination Facility	PETALUMA, CA 94999
August 26, 2015 , 3:17 am	Arrived at USPS Facility	SAN FRANCISCO, CA 94188
August 25, 2015 , 10:46 pm	Departed USPS Facility	WEST SACRAMENTO, CA 95799

DATE & TIME	STATUS OF ITEM	LOCATION
August 25, 2015 , 7:22 pm	Arrived at USPS Origin Facility	WEST SACRAMENTO, CA 95799
August 25, 2015 , 2:31 pm	Acceptance	SACRAMENTO, CA 95816

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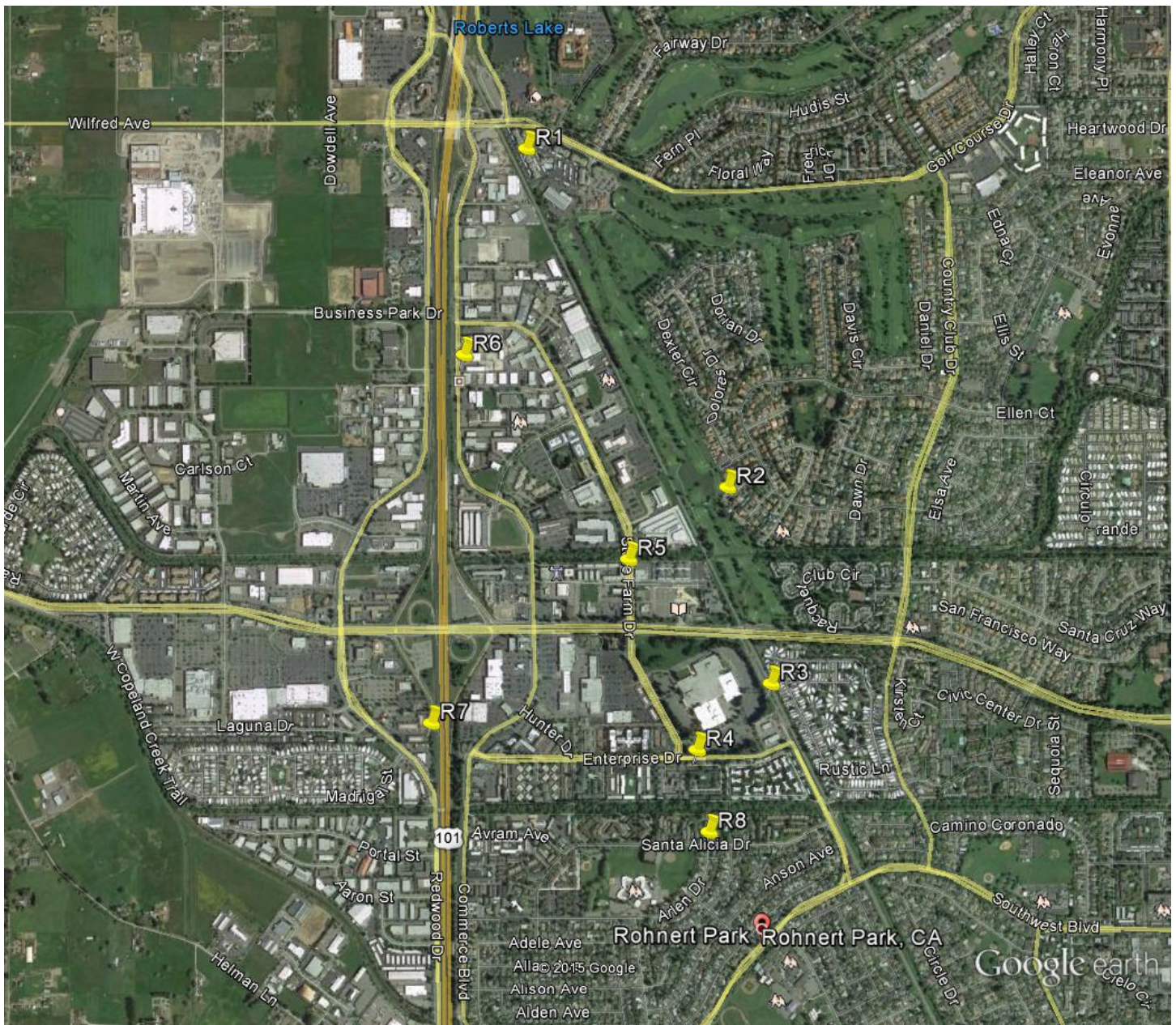
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APPENDIX D

Noise Worksheets

- Ambient Noise Measurements
- Construction Noise Calculations
- Operation Noise Calculations



Google earth

miles 1
km 1



Rohnert Park PDA - Noise Measurement Locations:

- R1 - Off-site sensitive use to the northeast
- R2 - Off-site sensitive use to the east
- R3 - On-site future residential use, also representing existing residential use to the east
- R4 - On-site existing residential use, also representing future residential use
- R5 - On-site existing residential use
- R6 - On-site existing commercial use
- R7 - Off-site sensitive use to the west
- R8 - Off-site sensitive use (school and residential) to the south

Property of AES

**Quest Technologies
2900 Integrating/Logging Sound Level Meter**

Unit Version Number: 02.4
Name:

Serial Number:

Work Area:

Comments:

Meter Calibration: 114.0dB, 3/31/2015 @ 10:29:47 PM

Calibrator Serial Number:

Calibration Date:

Study 1

Measuring Parameters

Range: 40 - 100 dB
Threshold: Off

Weighting: A
Exchange Rate: 3dB

Time Constant: Slow
Peak Weighting: C

Study Started: 4/1/2015 @ 10:17:39 AM
Study Stopped: 4/1/2015 @ 10:32:39 AM
Run Time: 0:15:00
Peak Level: 93.6dB, 4/1/2015 @ 10:21:23 AM
Max Level: 70.9dB, 4/1/2015 @ 10:23:11 AM
Min Level: 47.6dB, 4/1/2015 @ 10:31:55 AM
Overload: 0.00%

LEQ: 55.5dB
LDN: 55.5dB
L1: 63.1dB

SEL(3):85.1dB
CNEL: 55.5dB
L10: 57.7dB

TWA: 40.5dB
Pa2Sec: 0.1
L50: 54.0dB

TAKM3: 56.7dB
L90: 51.1dB

Study 1

Logging (1 Minute)

10:18:39 AM
10:19:39 AM
10:20:39 AM
10:21:39 AM
10:22:39 AM
10:23:39 AM
10:24:39 AM
10:25:39 AM
10:26:39 AM
10:27:39 AM
10:28:39 AM
10:29:39 AM
10:30:39 AM
10:31:39 AM
10:32:39 AM

LEQ

54.4dB
55.1dB
56.3dB
56.6dB
57.3dB
61.0dB
55.5dB
52.5dB
52.2dB
53.9dB
54.8dB
54.0dB
52.0dB
54.0dB
51.5dB

LMAX

63.8dB
60.1dB
58.9dB
61.1dB
59.5dB
70.9dB
57.3dB
55.2dB
56.4dB
56.4dB
58.6dB
56.4dB
54.6dB
58.8dB
53.9dB

Ovl

Study 2

Measuring Parameters

Range: 40 - 100 dB
Threshold: Off

Weighting: A
Exchange Rate: 3dB

Time Constant: Slow
Peak Weighting: C

Study Started: 4/1/2015 @ 10:55:07 AM
Study Stopped: 4/1/2015 @ 11:10:07 AM
Run Time: 0:15:00
Peak Level: 92.0dB, 4/1/2015 @ 11:07:36 AM
Max Level: 54.5dB, 4/1/2015 @ 11:03:15 AM
Min Level: 40.7dB, 4/1/2015 @ 11:08:38 AM
Overload: 0.00%

LEQ: 44.6dB
LDN: 44.6dB
L1: 50.3dB

SEL(3):74.1dB
CNEL: 44.6dB
L10: 46.1dB

TWA: 29.5dB
Pa2Sec: 0.0
L50: 44.0dB

TAKM3: 45.6dB
L90: 42.3dB

Study 2

Logging (1 Minute)

10:56:07 AM
10:57:07 AM
10:58:07 AM
10:59:07 AM
11:00:07 AM
11:01:07 AM
11:02:07 AM
11:03:07 AM
11:04:07 AM
11:05:07 AM
11:06:07 AM
11:07:07 AM
11:08:07 AM
11:09:07 AM
11:10:07 AM

LEQ

43.6dB
44.8dB
45.2dB
44.1dB
44.8dB
44.6dB
43.1dB
45.6dB
46.4dB
43.3dB
45.5dB
44.5dB
45.2dB
42.6dB
43.1dB

LMAX

45.5dB
46.8dB
47.3dB
46.7dB
48.6dB
46.8dB
45.5dB
47.7dB
54.5dB
47.5dB
52.0dB
51.7dB
48.5dB
44.6dB
50.9dB

Ovl

Study 3

Measuring Parameters

Range: 40 - 100 dB
Threshold: Off

Weighting: A
Exchange Rate: 3dB

Time Constant: Slow
Peak Weighting: C

Study Started: 4/1/2015 @ 11:25:27 AM
Study Stopped: 4/1/2015 @ 11:40:27 AM
Run Time: 0:15:00
Peak Level: 98.8dB, 4/1/2015 @ 11:36:45 AM
Max Level: 68.0dB, 4/1/2015 @ 11:36:48 AM
Min Level: 42.3dB, 4/1/2015 @ 11:27:55 AM
Overload: 0.03%

LEQ: 49.3dB
LDN: 49.3dB
L1: 61.1dB

SEL(3):78.9dB
CNEL: 49.3dB
L10: 51.0dB

TWA: 34.3dB
Pa2Sec: 0.0
L50: 45.9dB

TAKM3: 51.3dB
L90: 43.8dB

Study 3

Logging (1 Minute)

	LEQ	LMAX	Ovl
11:26:27 AM	45.0dB	50.4dB	
11:27:27 AM	44.4dB	46.3dB	
11:28:27 AM	43.4dB	44.8dB	
11:29:27 AM	45.5dB	48.5dB	
11:30:27 AM	47.5dB	52.1dB	
11:31:27 AM	50.4dB	56.2dB	
11:32:27 AM	45.3dB	48.4dB	
11:33:27 AM	45.9dB	48.1dB	
11:34:27 AM	47.0dB	51.7dB	*
11:35:27 AM	48.6dB	53.7dB	*
11:36:27 AM	46.1dB	47.4dB	
11:37:27 AM	57.2dB	68.0dB	
11:38:27 AM	48.6dB	55.4dB	
11:39:27 AM	45.1dB	46.5dB	
11:40:27 AM	51.4dB	59.7dB	

Study 4

Measuring Parameters

Range: 50 - 110 dB
Threshold: Off

Weighting: A
Exchange Rate: 3dB

Time Constant: Slow
Peak Weighting: C

Study Started: 4/1/2015 @ 11:44:27 AM
Study Stopped: 4/1/2015 @ 11:59:27 AM
Run Time: 0:15:00
Peak Level: 95.1dB, 4/1/2015 @ 11:58:04 AM
Max Level: 76.7dB, 4/1/2015 @ 11:53:41 AM
Min Level: 46.9dB, 4/1/2015 @ 11:48:10 AM
Overload: 0.00%

LEQ: 63.8dB
LDN: 63.8dB
L1: 71.2dB

SEL(3):93.3dB
CNEL: 63.8dB
L10: 67.7dB

TWA: 48.7dB
Pa2Sec: 0.9
L50: 61.1dB

TAKM3: 66.0dB
L90: 51.1dB

Study 4

Logging (1 Minute)

11:45:27 AM
11:46:27 AM
11:47:27 AM
11:48:27 AM
11:49:27 AM
11:50:27 AM
11:51:27 AM
11:52:27 AM
11:53:27 AM
11:54:27 AM
11:55:27 AM
11:56:27 AM
11:57:27 AM
11:58:27 AM
11:59:27 AM

LEQ

64.5dB
64.0dB
63.3dB
60.7dB
63.6dB
63.3dB
63.7dB
63.4dB
63.7dB
66.2dB
63.2dB
60.9dB
64.8dB
65.3dB
62.5dB

LMAX

71.2dB
74.7dB
69.1dB
68.5dB
71.0dB
72.7dB
71.0dB
70.5dB
70.6dB
76.7dB
69.1dB
68.6dB
70.9dB
71.4dB
69.8dB

Ovl

Study 5

Measuring Parameters

Range: 50 - 110 dB
Threshold: Off

Weighting: A
Exchange Rate: 3dB

Time Constant: Slow
Peak Weighting: C

Study Started: 4/1/2015 @ 12:25:16 PM
Study Stopped: 4/1/2015 @ 12:40:16 PM
Run Time: 0:15:00
Peak Level: 92.8dB, 4/1/2015 @ 12:26:36 PM
Max Level: 68.9dB, 4/1/2015 @ 12:26:36 PM
Min Level: 41.6dB, 4/1/2015 @ 12:29:21 PM
Overload: 0.00%

LEQ: 52.7dB
LDN: 52.7dB
L1: 64.3dB

SEL(3):82.3dB
CNEL: 52.7dB
L10: 56.8dB

TWA: 37.7dB
Pa2Sec: 0.1
L50: 44.3dB

TAKM3: 55.3dB
L90: 41.6dB

Study 5

Logging (1 Minute)

12:26:16 PM
12:27:16 PM
12:28:16 PM
12:29:16 PM
12:30:16 PM
12:31:16 PM
12:32:16 PM
12:33:16 PM
12:34:16 PM
12:35:16 PM
12:36:16 PM
12:37:16 PM
12:38:16 PM
12:39:16 PM
12:40:16 PM

LEQ

50.4dB
58.0dB
53.2dB
53.2dB
42.0dB
52.8dB
52.5dB
43.0dB
55.0dB
55.1dB
53.0dB
48.9dB
53.5dB
45.1dB
49.3dB

LMAX

61.8dB
68.9dB
66.2dB
61.3dB
44.5dB
62.7dB
63.2dB
46.4dB
65.5dB
65.9dB
63.9dB
57.0dB
65.7dB
56.5dB
59.5dB

Ovl

Study 6

Measuring Parameters

Range: 50 - 110 dB
Threshold: Off

Weighting: A
Exchange Rate: 3dB

Time Constant: Slow
Peak Weighting: C

Study Started: 4/1/2015 @ 1:07:10 PM
Study Stopped: 4/1/2015 @ 1:22:10 PM
Run Time: 0:15:00
Peak Level: 103.4dB, 4/1/2015 @ 1:07:36 PM
Max Level: 77.6dB, 4/1/2015 @ 1:11:52 PM
Min Level: 44.8dB, 4/1/2015 @ 1:18:26 PM
Overload: 0.00%

LEQ: 66.6dB
LDN: 66.6dB
L1: 75.2dB

SEL(3):96.1dB
CNEL: 66.6dB
L10: 71.0dB

TWA: 51.5dB
Pa2Sec: 1.6
L50: 62.6dB

TAKM3: 69.0dB
L90: 50.5dB

Study 6

Logging (1 Minute)

	LEQ	LMAX	Ovl
1:08:10 PM	68.2dB	76.1dB	
1:09:10 PM	67.2dB	76.5dB	
1:10:10 PM	66.0dB	73.5dB	
1:11:10 PM	63.0dB	72.7dB	
1:12:10 PM	67.1dB	77.6dB	
1:13:10 PM	67.0dB	73.5dB	
1:14:10 PM	65.6dB	75.5dB	
1:15:10 PM	66.9dB	74.6dB	
1:16:10 PM	67.4dB	76.9dB	
1:17:10 PM	60.4dB	69.4dB	
1:18:10 PM	65.8dB	73.8dB	
1:19:10 PM	66.2dB	75.5dB	
1:20:10 PM	69.4dB	76.0dB	
1:21:10 PM	66.8dB	75.3dB	
1:22:10 PM	64.9dB	73.2dB	

Study 7

Measuring Parameters

Range: 50 - 110 dB
Threshold: Off

Weighting: A
Exchange Rate: 3dB

Time Constant: Slow
Peak Weighting: C

Study Started: 4/1/2015 @ 1:29:53 PM
Study Stopped: 4/1/2015 @ 1:44:53 PM
Run Time: 0:15:00
Peak Level: 98.9dB, 4/1/2015 @ 1:44:14 PM
Max Level: 75.1dB, 4/1/2015 @ 1:44:14 PM
Min Level: 60.6dB, 4/1/2015 @ 1:42:35 PM
Overload: 0.00%

LEQ: 65.6dB
LDN: 65.6dB
L1: 70.9dB

SEL(3):95.1dB
CNEL: 65.6dB
L10: 67.6dB

TWA: 50.5dB
Pa2Sec: 1.3
L50: 64.8dB

TAKM3: 66.5dB
L90: 62.9dB

Study 7

Logging (1 Minute)

1:30:53 PM
1:31:53 PM
1:32:53 PM
1:33:53 PM
1:34:53 PM
1:35:53 PM
1:36:53 PM
1:37:53 PM
1:38:53 PM
1:39:53 PM
1:40:53 PM
1:41:53 PM
1:42:53 PM
1:43:53 PM
1:44:53 PM

LEQ

65.1dB
64.4dB
66.8dB
65.3dB
65.4dB
66.3dB
66.7dB
65.4dB
67.7dB
65.1dB
65.5dB
64.2dB
64.1dB
64.2dB
65.5dB

LMAX

68.1dB
66.5dB
70.3dB
68.1dB
68.1dB
70.7dB
72.4dB
69.1dB
72.8dB
68.5dB
68.6dB
67.8dB
67.8dB
67.1dB
75.1dB

Ovl

Study 8

Measuring Parameters

Range: 50 - 110 dB
Threshold: Off

Weighting: A
Exchange Rate: 3dB

Time Constant: Slow
Peak Weighting: C

Study Started: 4/1/2015 @ 1:54:46 PM
Study Stopped: 4/1/2015 @ 2:09:46 PM
Run Time: 0:15:00
Peak Level: 96.7dB, 4/1/2015 @ 2:03:51 PM
Max Level: 70.3dB, 4/1/2015 @ 2:03:51 PM
Min Level: 54.0dB, 4/1/2015 @ 2:03:13 PM
Overload: 0.00%

LEQ: 62.2dB
LDN: 62.2dB
L1: 68.3dB

SEL(3):91.7dB
CNEL: 62.2dB
L10: 64.9dB

TWA: 47.1dB
Pa2Sec: 0.6
L50: 61.0dB

TAKM3: 63.4dB
L90: 57.7dB

Study 8

Logging (1 Minute)

	LEQ	LMAX	Ovl
1:55:46 PM	61.4dB	65.8dB	
1:56:46 PM	61.2dB	64.3dB	
1:57:46 PM	60.7dB	65.6dB	
1:58:46 PM	63.5dB	68.5dB	
1:59:46 PM	61.1dB	64.3dB	
2:00:46 PM	62.7dB	66.2dB	
2:01:46 PM	61.5dB	66.2dB	
2:02:46 PM	60.3dB	66.5dB	
2:03:46 PM	61.3dB	65.4dB	
2:04:46 PM	64.4dB	70.3dB	
2:05:46 PM	63.6dB	69.7dB	
2:06:46 PM	62.3dB	66.4dB	
2:07:46 PM	61.4dB	66.6dB	
2:08:46 PM	62.0dB	70.3dB	
2:09:46 PM	62.7dB	65.6dB	

Construction Phase: *Demolition*

Equipment

Description	No. of Equip.	Reference Noise Level at 50ft, Lmax	Acoustical Usage Factor	Distance to Receptor, ft	Estimated Noise Shielding, dBA
Rubber Tired Loader	1	79	40%	50	0
Concrete/Industrial Saw	1	90	20%	50	0
Tractor/Loader/Backhoe	1	78	40%	50	0
Haul Truck	1	76	40%	50	0

Receptor: *at 50 feet distance*

Results:
1-hour Leq: **84.4**

Source for Ref. Noise Levels: FHWA RCNM, 2006

Construction Phase: *Grading*

Equipment

Description	No. of Equip.	Reference Noise Level at 50ft, Lmax	Acoustical Usage Factor	Distance to Receptor, ft	Estimated Noise Shielding, dBA
Drill Rig	1	84	20%	50	0
Excavator	2	81	40%	50	0
Front end loader	2	79	40%	50	0
Compactor	1	83	20%	50	0
Crane	1	81	16%	50	0
Haul Truck	2	76	40%	50	0
					0

Receptor: *at 50 feet distance*

Results:
1-hour Leq: **84.9**

Source for Ref. Noise Levels: FHWA RCNM, 2006

Construction Phase: *Building Construction*

Equipment

Description	No. of Equip.	Reference Noise Level at 50ft, Lmax	Acoustical Usage Factor	Distance to Receptor, ft	Estimated Noise Shielding, dBA
Crane	1	81	16%	50	0
Concrete Truck	1	79	40%	50	0
Concrete Pump	1	81	20%	50	0
Front end loader	1	79	40%	50	0
Fork Lift	1	75	20%	50	0
Aerial Lift (gradall)	1	83	40%	50	0
Generator	1	81	50%	50	0
Welder	1	74	40%	50	0

Receptor: *at 50 feet distance*

Results:
1-hour Leq: **84.3**

Source for Ref. Noise Levels: FHWA RCNM, 2006

Project: Rohnert Park PDA



Construction Phase: *Paving*

Equipment

Description	No. of Equip.	Reference Noise Level at 50ft, Lmax	Acoustical Usage Factor	Distance to Receptor, ft	Estimated Noise Shielding, dBA
Pavers	1	77	50%	100	0
Cement and Mortar Mixers	1	79	40%	100	0
Rollers	1	80	20%	100	0
Tractor/Loader/Backhoe	1	78	40%	100	0

Receptor: *at 50 feet distance*

Results:
1-hour Leq: 74.1

Source for Ref. Noise Levels: FHWA RCNM, 2006

Construction Phase: *Demolition*

Equipment

Description	No. of Equip.	Reference Noise Level at 50ft, Lmax	Acoustical Usage Factor	Distance to Receptor, ft	Estimated Noise Shielding, dBA
Rubber Tired Loader	1	79	40%	100	0
Concrete/Industrial Saw	1	90	20%	100	0
Tractor/Loader/Backhoe	1	78	40%	100	0
Haul Truck	1	76	40%	100	0

Receptor: *at 100 feet distance*

Results:
1-hour Leq: 78.3

Source for Ref. Noise Levels: FHWA RCNM, 2006

Construction Phase: *Grading*

Equipment

Description	No. of Equip.	Reference Noise Level at 50ft, Lmax	Acoustical Usage Factor	Distance to Receptor, ft	Estimated Noise Shielding, dBA
Drill Rig	1	84	20%	100	0
Excavator	2	81	40%	100	0
Front end loader	2	79	40%	100	0
Compactor	1	83	20%	100	0
Crane	1	81	16%	100	0
Haul Truck	2	76	40%	100	0
					0

Receptor: *at 100 feet distance*

Results:
1-hour Leq: 78.8

Source for Ref. Noise Levels: FHWA RCNM, 2006

Construction Phase: *Building Construction*

Equipment

Description	No. of Equip.	Reference Noise Level at 50ft, Lmax	Acoustical Usage Factor	Distance to Receptor, ft	Estimated Noise Shielding, dBA
Crane	1	81	16%	100	0
Concrete Truck	1	79	40%	100	0
Concrete Pump	1	81	20%	100	0
Front end loader	1	79	40%	100	0
Fork Lift	1	75	20%	100	0
Aerial Lift (gradall)	1	83	40%	100	0
Generator	1	81	50%	100	0
Welder	1	74	40%	100	0

Receptor: *at 100 feet distance*

Results:
1-hour Leq: 78.3

Source for Ref. Noise Levels: FHWA RCNM, 2006

Project: Rohnert Park PDA



Construction Phase: *Paving*

Equipment

Description	No. of Equip.	Reference Noise Level at 50ft, Lmax	Acoustical Usage Factor	Distance to Receptor, ft	Estimated Noise Shielding, dBA
Pavers	1	77	50%	100	0
Cement and Mortar Mixers	1	79	40%	100	0
Rollers	1	80	20%	100	0
Tractor/Loader/Backhoe	1	78	40%	100	0

Receptor: *at 100 feet distance*

Results:
1-hour Leq: 74.1

Source for Ref. Noise Levels: FHWA RCNM, 2006

Construction Phase: *Demolition*

Equipment

Description	No. of Equip.	Reference Noise Level at 50ft, Lmax	Acoustical Usage Factor	Distance to Receptor, ft	Estimated Noise Shielding, dBA
Rubber Tired Loader	1	79	40%	200	0
Concrete/Industrial Saw	1	90	20%	200	0
Tractor/Loader/Backhoe	1	78	40%	200	0
Haul Truck	1	76	40%	200	0

Receptor: *at 200 feet distance*

Results:
1-hour Leq: 72.3

Source for Ref. Noise Levels: FHWA RCNM, 2006

Equipment

Description	No. of Equip.	Reference	Acoustical Usage Factor	Distance to Receptor, ft	Estimated
		Noise Level at 50ft, Lmax			Noise Shielding, dBA
Drill Rig	1	84	20%	200	0
Excavator	2	81	40%	200	0
Front end loader	2	79	40%	200	0
Compactor	1	83	20%	200	0
Crane	1	81	16%	200	0
Haul Truck	2	76	40%	200	0
					0

Results:

1-hour Leq:	72.8

July 2015

Construction Phase: *Building Construction*

Equipment

Description	No. of Equip.	Reference Noise Level at 50ft, Lmax	Acoustical Usage Factor	Distance to Receptor, ft	Estimated Noise Shielding, dBA
Crane	1	81	16%	200	0
Concrete Truck	1	79	40%	200	0
Concrete Pump	1	81	20%	200	0
Front end loader	1	79	40%	200	0
Fork Lift	1	75	20%	200	0
Aerial Lift (gradall)	1	83	40%	200	0
Generator	1	81	50%	200	0
Welder	1	74	40%	200	0

Receptor: *at 200 feet distance*

Results:
1-hour Leq: **72.2**

Source for Ref. Noise Levels: FHWA RCNM, 2006

Project: Rohnert Park PDA



Construction Phase: *Paving*

Equipment

Description	No. of Equip.	Reference Noise Level at 50ft, Lmax	Acoustical Usage Factor	Distance to Receptor, ft	Estimated Noise Shielding, dBA
Pavers	1	77	50%	200	0
Cement and Mortar Mixers	1	79	40%	200	0
Rollers	1	80	20%	200	0
Tractor/Loader/Backhoe	1	78	40%	200	0

Receptor: *at 200 feet distance*

Results:
1-hour Leq: 68.0

Source for Ref. Noise Levels: FHWA RCNM, 2006

Appendix D
Traffic Noise Prediction Model, (FHWA RD-77-108)
Model Input Sheet



Project Name : Central Rohnert Park PDA Plan
Project Number : 60299353
Modeling Condition : EXISTING
Ground Type : Hard
Metric (L_{eq}, L_{dn}, CNEL) : Ldn

K Factor : 10
Traffic Desc. (Peak or ADT) : Peak

Segment	Roadway	From	To	Traffic Vol.	Speed (Mph)	Distance to CL	% Autos	%MT	% HT	Day %	Eve %	Night %	Offset (dB)
1	Golf Course Drive	West of	US 101	1,705	35	100	98	1	1	80	0	20	0
2	Golf Course Drive	East of	US 101	1,348	35	100	98	1	1	80	0	20	0
3	Rohnert Park Exp	West of	US 101	2,678	40	100	98	1	1	80	0	20	0
4	Rohnert Park Exp	Commerce Blvd.	State Farm Dr.	2,001	35	100	98	1	1	80	0	20	0
5	Rohnert Park Exp	East of	State Farm Dr.	2,186	40	100	98	1	1	80	0	20	0
6	Enterprise Drive	Commerce Blvd.	Hunter Dr.	307	30	100	98	1	1	80	0	20	0
7	Enterprise Drive	Hunter Dr.	State Farm Dr.	564	30	100	98	1	1	80	0	20	0
8	Enterprise Drive	State Farm Dr.	Seed Farm Dr.	829	30	100	98	1	1	80	0	20	0
9	Commerce Boulevard	Golf Course Dr.	State Farm Dr.	1,154	35	100	98	1	1	80	0	20	0
10	Commerce Boulevard	State Farm Dr.	Professional Dr.	672	35	100	98	1	1	80	0	20	0
11	Commerce Boulevard	Professional Dr.	Rohnert Park Exp	841	35	100	98	1	1	80	0	20	0
12	Commerce Boulevard	Rohnert Park Exp	Enterprise Dr.	1,331	35	100	98	1	1	80	0	20	0
13	Commerce Boulevard	South of	Enterprise Dr.	1,456	35	100	98	1	1	80	0	20	0
14	State Farm Drive	Commerce Blvd.	Professional Dr.	540	30	100	98	1	1	80	0	20	0
15	State Farm Drive	Professional Dr.	Rohnert Park Exp	694	35	100	98	1	1	80	0	20	0
16	State Farm Drive	Rohnert Park Exp	Enterprise Dr.	847	30	100	98	1	1	80	0	20	0
17	Professional Center Drive	Commerce Blvd.	State Farm Dr.	151	30	100	98	1	1	80	0	20	0
18	Padre Parkway	Commerce Blvd.	State Farm Dr.	278	30	100	98	1	1	80	0	20	0
19	City Center Drive	East of	State Farm Dr.	167	30	100	98	1	1	80	0	20	0
20	Seed Farm Drive	South of	Enterprise Dr.	811	30	100	98	1	1	80	0	20	0

Appendix D
Traffic Noise Prediction Model, (FHWA RD-77-108)
Predicted Noise Levels



Project Name : Central Rohnert Park PDA Plan
Project Number : 60299353
Modeling Condition : EXISTING
Metric (Leq, Ldn, CNEL) : Ldn

Segment	Roadway	Segment		Noise Levels, dB Ldn				Distance to Traffic Noise Contours, Feet				
		From	To	Auto	MT	HT	Total	70 dB	65 dB	60 dB	55 dB	50 dB
1	Golf Course Drive	West of	US 101	64.2	54.0	59.2	65.7	37	117	369	1167	3689
2	Golf Course Drive	East of	US 101	63.2	52.9	58.1	64.6	29	92	292	922	2917
3	Rohnert Park Exp	West of	US 101	67.8	56.8	61.6	69.0	80	252	798	2524	7982
4	Rohnert Park Exp	Commerce Blvd.	State Farm Dr.	64.9	54.7	59.8	66.4	43	137	433	1369	4330
5	Rohnert Park Exp	East of	State Farm Dr.	66.9	55.9	60.8	68.1	65	206	652	2060	6516
6	Enterprise Drive	Commerce Blvd.	Hunter Dr.	54.8	45.5	52.6	57.1	5	16	52	164	518
7	Enterprise Drive	Hunter Dr.	State Farm Dr.	57.4	48.1	55.2	59.8	10	30	95	301	953
8	Enterprise Drive	State Farm Dr.	Seed Farm Dr.	59.1	49.8	56.9	61.5	14	44	140	443	1401
9	Commerce Boulevard	Golf Course Dr.	State Farm Dr.	62.5	52.3	57.5	64.0	25	79	250	789	2496
10	Commerce Boulevard	State Farm Dr.	Professional Dr.	60.1	49.9	55.1	61.6	15	46	145	460	1454
11	Commerce Boulevard	Professional Dr.	Rohnert Park Exp	61.1	50.9	56.1	62.6	18	58	182	575	1820
12	Commerce Boulevard	Rohnert Park Exp	Enterprise Dr.	63.1	52.9	58.1	64.6	29	91	288	911	2880
13	Commerce Boulevard	South of	Enterprise Dr.	63.5	53.3	58.5	65.0	32	100	315	996	3150
14	State Farm Drive	Commerce Blvd.	Professional Dr.	57.3	47.9	55.0	59.6	9	29	91	289	912
15	State Farm Drive	Professional Dr.	Rohnert Park Exp	60.3	50.1	55.2	61.8	15	47	150	475	1501
16	State Farm Drive	Rohnert Park Exp	Enterprise Dr.	59.2	49.9	57.0	61.6	14	45	143	453	1432
17	Professional Center Drive	Commerce Blvd.	State Farm Dr.	51.7	42.4	49.5	54.1	3	8	26	81	255
18	Padre Parkway	Commerce Blvd.	State Farm Dr.	54.4	45.0	52.2	56.7	5	15	47	148	469
19	City Center Drive	East of	State Farm Dr.	52.2	42.8	49.9	54.5	3	9	28	89	282
20	Seed Farm Drive	South of	Enterprise Dr.	59.0	49.7	56.8	61.4	14	43	137	434	1372

Appendix D
Traffic Noise Prediction Model, (FHWA RD-77-108)
Model Input Sheet



Project Name : Central Rohnert Park PDA Plan

Project Number : 60299353

Modeling Condition : EXISTING + PROJECT

Ground Type : Hard

K Factor : 10

Metric (L_{eq}, L_{dn}, CNEL) : Ldn

Traffic Desc. (Peak or ADT) : Peak

Segment	Roadway	From	Segment To	Traffic Vol.	Speed (Mph)	Distance to CL	% Autos	%MT	% HT	Day %	Eve %	Night %	Offset (dB)
1	Golf Course Drive	West of	US 101	1,755	35	100	98	1	1	80	0	20	0
2	Golf Course Drive	East of	US 101	1,461	35	100	98	1	1	80	0	20	0
3	Rohnert Park Exp	West of	US 101	2,982	40	100	98	1	1	80	0	20	0
4	Rohnert Park Exp	Commerce Blvd.	State Farm Dr.	2,704	35	100	98	1	1	80	0	20	0
5	Rohnert Park Exp	East of	State Farm Dr.	2,430	40	100	98	1	1	80	0	20	0
6	Enterprise Drive	Commerce Blvd.	Hunter Dr.	367	30	100	98	1	1	80	0	20	0
7	Enterprise Drive	Hunter Dr.	State Farm Dr.	697	30	100	98	1	1	80	0	20	0
8	Enterprise Drive	State Farm Dr.	Seed Farm Dr.	996	30	100	98	1	1	80	0	20	0
9	Commerce Boulevard	Golf Course Dr.	State Farm Dr.	1,444	35	100	98	1	1	80	0	20	0
10	Commerce Boulevard	State Farm Dr.	Professional Dr.	771	35	100	98	1	1	80	0	20	0
11	Commerce Boulevard	Professional Dr.	Rohnert Park Exp	1,192	35	100	98	1	1	80	0	20	0
12	Commerce Boulevard	Rohnert Park Exp	Enterprise Dr.	1,391	35	100	98	1	1	80	0	20	0
13	Commerce Boulevard	South of	Enterprise Dr.	1,556	35	100	98	1	1	80	0	20	0
14	State Farm Drive	Commerce Blvd.	Professional Dr.	656	30	100	98	1	1	80	0	20	0
15	State Farm Drive	Professional Dr.	Rohnert Park Exp	916	35	100	98	1	1	80	0	20	0
16	State Farm Drive	Rohnert Park Exp	Enterprise Dr.	1,314	30	100	98	1	1	80	0	20	0
17	Professional Center Drive	Commerce Blvd.	State Farm Dr.	273	30	100	98	1	1	80	0	20	0
18	Padre Parkway	Commerce Blvd.	State Farm Dr.	357	30	100	98	1	1	80	0	20	0
19	City Center Drive	East of	State Farm Dr.	296	30	100	98	1	1	80	0	20	0
20	Seed Farm Drive	South of	Enterprise Dr.	1,087	30	100	98	1	1	80	0	20	0

Appendix D
Traffic Noise Prediction Model, (FHWA RD-77-108)
Predicted Noise Levels



Project Name : Central Rohnert Park PDA Plan
Project Number : 60299353
Modeling Condition : EXISTING + PROJECT
Metric (Leq, Ldn, CNEL) : Ldn

Segment	Roadway	Segment		Noise Levels, dB Ldn				Distance to Traffic Noise Contours, Feet				
		From	To	Auto	MT	HT	Total	70 dB	65 dB	60 dB	55 dB	50 dB
1	Golf Course Drive	West of	US 101	64.3	54.1	59.3	65.8	38	120	380	1201	3797
2	Golf Course Drive	East of	US 101	63.5	53.3	58.5	65.0	32	100	316	1000	3161
3	Rohnert Park Exp	West of	US 101	68.3	57.3	62.1	69.5	89	281	889	2811	8888
4	Rohnert Park Exp	Commerce Blvd.	State Farm Dr.	66.2	56.0	61.2	67.7	58	185	585	1850	5850
5	Rohnert Park Exp	East of	State Farm Dr.	67.4	56.4	61.2	68.6	72	229	724	2290	7243
6	Enterprise Drive	Commerce Blvd.	Hunter Dr.	55.6	46.2	53.4	57.9	6	20	62	196	621
7	Enterprise Drive	Hunter Dr.	State Farm Dr.	58.4	49.0	56.2	60.7	12	37	118	373	1179
8	Enterprise Drive	State Farm Dr.	Seed Farm Dr.	59.9	50.6	57.7	62.3	17	53	168	532	1684
9	Commerce Boulevard	Golf Course Dr.	State Farm Dr.	63.5	53.2	58.4	64.9	31	99	312	988	3124
10	Commerce Boulevard	State Farm Dr.	Professional Dr.	60.7	50.5	55.7	62.2	17	53	167	528	1668
11	Commerce Boulevard	Professional Dr.	Rohnert Park Exp	62.6	52.4	57.6	64.1	26	82	258	815	2578
12	Commerce Boulevard	Rohnert Park Exp	Enterprise Dr.	63.3	53.1	58.3	64.8	30	95	301	952	3010
13	Commerce Boulevard	South of	Enterprise Dr.	63.8	53.6	58.8	65.3	34	106	337	1065	3367
14	State Farm Drive	Commerce Blvd.	Professional Dr.	58.1	48.8	55.9	60.4	11	35	111	351	1109
15	State Farm Drive	Professional Dr.	Rohnert Park Exp	61.5	51.3	56.5	63.0	20	63	198	627	1982
16	State Farm Drive	Rohnert Park Exp	Enterprise Dr.	61.1	51.8	58.9	63.5	22	70	222	702	2221
17	Professional Center Drive	Commerce Blvd.	State Farm Dr.	54.3	45.0	52.1	56.6	5	15	46	146	462
18	Padre Parkway	Commerce Blvd.	State Farm Dr.	55.5	46.1	53.2	57.8	6	19	60	191	604
19	City Center Drive	East of	State Farm Dr.	54.6	45.3	52.4	57.0	5	16	50	158	501
20	Seed Farm Drive	South of	Enterprise Dr.	60.3	51.0	58.1	62.6	18	58	184	581	1838

Appendix D
Traffic Noise Prediction Model, (FHWA RD-77-108)
Model Input Sheet



Project Name : Central Rohnert Park PDA Plan

Project Number : 60299353

Modeling Condition : FUTURE NO PROJECT

Ground Type : Hard

K Factor : 10

Metric (L_{eq}, L_{dn}, CNEL) : Ldn

Traffic Desc. (Peak or ADT) : Peak

Segment	Roadway	From	To	Traffic Vol.	Speed (Mph)	Distance to CL	% Autos	%MT	% HT	Day %	Eve %	Night %	Offset (dB)
1	Golf Course Drive	West of	US 101	4,441	35	100	98	1	1	80	0	20	0
2	Golf Course Drive	East of	US 101	2,967	35	100	98	1	1	80	0	20	0
3	Rohnert Park Exp	West of	US 101	3,929	40	100	98	1	1	80	0	20	0
4	Rohnert Park Exp	Commerce Blvd.	State Farm Dr.	2,743	35	100	98	1	1	80	0	20	0
5	Rohnert Park Exp	East of	State Farm Dr.	2,944	40	100	98	1	1	80	0	20	0
6	Enterprise Drive	Commerce Blvd.	Hunter Dr.	378	30	100	98	1	1	80	0	20	0
7	Enterprise Drive	Hunter Dr.	State Farm Dr.	656	30	100	98	1	1	80	0	20	0
8	Enterprise Drive	State Farm Dr.	Seed Farm Dr.	593	30	100	98	1	1	80	0	20	0
9	Commerce Boulevard	Golf Course Dr.	State Farm Dr.	1,873	35	100	98	1	1	80	0	20	0
10	Commerce Boulevard	State Farm Dr.	Professional Dr.	841	35	100	98	1	1	80	0	20	0
11	Commerce Boulevard	Professional Dr.	Rohnert Park Exp	1,051	35	100	98	1	1	80	0	20	0
12	Commerce Boulevard	Rohnert Park Exp	Enterprise Dr.	1,538	35	100	98	1	1	80	0	20	0
13	Commerce Boulevard	South of	Enterprise Dr.	1,660	35	100	98	1	1	80	0	20	0
14	State Farm Drive	Commerce Blvd.	Professional Dr.	841	30	100	98	1	1	80	0	20	0
15	State Farm Drive	Professional Dr.	Rohnert Park Exp	1,022	35	100	98	1	1	80	0	20	0
16	State Farm Drive	Rohnert Park Exp	Enterprise Dr.	1,090	30	100	98	1	1	80	0	20	0
17	Professional Center Drive	Commerce Blvd.	State Farm Dr.	173	30	100	98	1	1	80	0	20	0
18	Padre Parkway	Commerce Blvd.	State Farm Dr.	387	30	100	98	1	1	80	0	20	0
19	City Center Drive	East of	State Farm Dr.	285	30	100	98	1	1	80	0	20	0
20	Seed Farm Drive	South of	Enterprise Dr.	1,163	30	100	98	1	1	80	0	20	0

Appendix D
Traffic Noise Prediction Model, (FHWA RD-77-108)
Predicted Noise Levels



Project Name : Central Rohnert Park PDA Plan
Project Number : 60299353
Modeling Condition : FUTURE NO PROJECT
Metric (Leq, Ldn, CNEL) : Ldn

Segment	Roadway	Segment		Noise Levels, dB Ldn				Distance to Traffic Noise Contours, Feet				
		From	To	Auto	MT	HT	Total	70 dB	65 dB	60 dB	55 dB	50 dB
1	Golf Course Drive	West of	US 101	68.3	58.1	63.3	69.8	96	304	961	3039	9609
2	Golf Course Drive	East of	US 101	66.6	56.4	61.6	68.1	64	203	642	2030	6420
3	Rohnert Park Exp	West of	US 101	69.5	58.5	63.3	70.7	117	370	1171	3703	11711
4	Rohnert Park Exp	Commerce Blvd.	State Farm Dr.	66.2	56.0	61.2	67.7	59	188	593	1877	5934
5	Rohnert Park Exp	East of	State Farm Dr.	68.2	57.2	62.1	69.4	88	277	878	2775	8775
6	Enterprise Drive	Commerce Blvd.	Hunter Dr.	55.7	46.4	53.5	58.1	6	20	64	202	639
7	Enterprise Drive	Hunter Dr.	State Farm Dr.	58.1	48.8	55.9	60.4	11	35	111	351	1109
8	Enterprise Drive	State Farm Dr.	Seed Farm Dr.	57.7	48.3	55.5	60.0	10	32	100	317	1003
9	Commerce Boulevard	Golf Course Dr.	State Farm Dr.	64.6	54.4	59.6	66.1	41	128	405	1281	4052
10	Commerce Boulevard	State Farm Dr.	Professional Dr.	61.1	50.9	56.1	62.6	18	58	182	575	1819
11	Commerce Boulevard	Professional Dr.	Rohnert Park Exp	62.1	51.9	57.1	63.6	23	72	227	719	2274
12	Commerce Boulevard	Rohnert Park Exp	Enterprise Dr.	63.7	53.5	58.7	65.2	33	105	333	1052	3328
13	Commerce Boulevard	South of	Enterprise Dr.	64.1	53.8	59.0	65.6	36	114	359	1136	3592
14	State Farm Drive	Commerce Blvd.	Professional Dr.	59.2	49.8	57.0	61.5	14	45	142	450	1422
15	State Farm Drive	Professional Dr.	Rohnert Park Exp	62.0	51.7	56.9	63.4	22	70	221	699	2210
16	State Farm Drive	Rohnert Park Exp	Enterprise Dr.	60.3	51.0	58.1	62.7	18	58	184	583	1842
17	Professional Center Drive	Commerce Blvd.	State Farm Dr.	52.3	43.0	50.1	54.7	3	9	29	93	293
18	Padre Parkway	Commerce Blvd.	State Farm Dr.	55.8	46.5	53.6	58.2	7	21	65	207	654
19	City Center Drive	East of	State Farm Dr.	54.5	45.1	52.3	56.8	5	15	48	152	482
20	Seed Farm Drive	South of	Enterprise Dr.	60.6	51.3	58.4	62.9	20	62	197	622	1967

Appendix D
Traffic Noise Prediction Model, (FHWA RD-77-108)
Model Input Sheet



Project Name : Central Rohnert Park PDA Plan

Project Number : 60299353

Modeling Condition : FUTURE + PROJECT

Ground Type : Hard

K Factor : 10

Metric (L_{eq}, L_{dn}, CNEL) : Ldn

Traffic Desc. (Peak or ADT) : Peak

Segment	Roadway	From	To	Traffic Vol.	Speed (Mph)	Distance to CL	% Autos	%MT	% HT	Day %	Eve %	Night %	Offset (dB)
1	Golf Course Drive	West of	US 101	4,491	35	100	98	1	1	80	0	20	0
2	Golf Course Drive	East of	US 101	3,080	35	100	98	1	1	80	0	20	0
3	Rohnert Park Exp	West of	US 101	4,233	40	100	98	1	1	80	0	20	0
4	Rohnert Park Exp	Commerce Blvd.	State Farm Dr.	3,445	35	100	98	1	1	80	0	20	0
5	Rohnert Park Exp	East of	State Farm Dr.	3,188	40	100	98	1	1	80	0	20	0
6	Enterprise Drive	Commerce Blvd.	Hunter Dr.	439	30	100	98	1	1	80	0	20	0
7	Enterprise Drive	Hunter Dr.	State Farm Dr.	789	30	100	98	1	1	80	0	20	0
8	Enterprise Drive	State Farm Dr.	Seed Farm Dr.	760	30	100	98	1	1	80	0	20	0
9	Commerce Boulevard	Golf Course Dr.	State Farm Dr.	2,163	35	100	98	1	1	80	0	20	0
10	Commerce Boulevard	State Farm Dr.	Professional Dr.	940	35	100	98	1	1	80	0	20	0
11	Commerce Boulevard	Professional Dr.	Rohnert Park Exp	1,402	35	100	98	1	1	80	0	20	0
12	Commerce Boulevard	Rohnert Park Exp	Enterprise Dr.	1,598	35	100	98	1	1	80	0	20	0
13	Commerce Boulevard	South of	Enterprise Dr.	1,760	35	100	98	1	1	80	0	20	0
14	State Farm Drive	Commerce Blvd.	Professional Dr.	957	30	100	98	1	1	80	0	20	0
15	State Farm Drive	Professional Dr.	Rohnert Park Exp	1,244	35	100	98	1	1	80	0	20	0
16	State Farm Drive	Rohnert Park Exp	Enterprise Dr.	1,556	30	100	98	1	1	80	0	20	0
17	Professional Center Drive	Commerce Blvd.	State Farm Dr.	295	30	100	98	1	1	80	0	20	0
18	Padre Parkway	Commerce Blvd.	State Farm Dr.	467	30	100	98	1	1	80	0	20	0
19	City Center Drive	East of	State Farm Dr.	414	30	100	98	1	1	80	0	20	0
20	Seed Farm Drive	South of	Enterprise Dr.	1,439	30	100	98	1	1	80	0	20	0

Appendix D
Traffic Noise Prediction Model, (FHWA RD-77-108)
Predicted Noise Levels



Project Name : Central Rohnert Park PDA Plan
Project Number : 60299353
Modeling Condition : FUTURE + PROJECT
Metric (Leq, Ldn, CNEL) : Ldn

Segment	Roadway	Segment		Noise Levels, dB Ldn				Distance to Traffic Noise Contours, Feet				
		From	To	Auto	MT	HT	Total	70 dB	65 dB	60 dB	55 dB	50 dB
1	Golf Course Drive	West of	US 101	68.4	58.2	63.4	69.9	97	307	972	3073	9717
2	Golf Course Drive	East of	US 101	66.7	56.5	61.7	68.2	67	211	666	2107	6664
3	Rohnert Park Exp	West of	US 101	69.8	58.8	63.6	71.0	126	399	1262	3990	12617
4	Rohnert Park Exp	Commerce Blvd.	State Farm Dr.	67.2	57.0	62.2	68.7	75	236	745	2357	7454
5	Rohnert Park Exp	East of	State Farm Dr.	68.6	57.6	62.4	69.8	95	300	950	3005	9502
6	Enterprise Drive	Commerce Blvd.	Hunter Dr.	56.4	47.0	54.1	58.7	7	23	74	235	742
7	Enterprise Drive	Hunter Dr.	State Farm Dr.	58.9	49.6	56.7	61.3	13	42	133	422	1334
8	Enterprise Drive	State Farm Dr.	Seed Farm Dr.	58.7	49.4	56.5	61.1	13	41	129	406	1285
9	Commerce Boulevard	Golf Course Dr.	State Farm Dr.	65.2	55.0	60.2	66.7	47	148	468	1480	4680
10	Commerce Boulevard	State Farm Dr.	Professional Dr.	61.6	51.4	56.6	63.1	20	64	203	643	2033
11	Commerce Boulevard	Professional Dr.	Rohnert Park Exp	63.3	53.1	58.3	64.8	30	96	303	959	3033
12	Commerce Boulevard	Rohnert Park Exp	Enterprise Dr.	63.9	53.7	58.9	65.4	35	109	346	1093	3458
13	Commerce Boulevard	South of	Enterprise Dr.	64.3	54.1	59.3	65.8	38	120	381	1204	3808
14	State Farm Drive	Commerce Blvd.	Professional Dr.	59.7	50.4	57.5	62.1	16	51	162	512	1618
15	State Farm Drive	Professional Dr.	Rohnert Park Exp	62.8	52.6	57.8	64.3	27	85	269	851	2692
16	State Farm Drive	Rohnert Park Exp	Enterprise Dr.	61.9	52.5	59.6	64.2	26	83	263	832	2631
17	Professional Center Drive	Commerce Blvd.	State Farm Dr.	54.6	45.3	52.4	57.0	5	16	50	158	499
18	Padre Parkway	Commerce Blvd.	State Farm Dr.	56.6	47.3	54.4	59.0	8	25	79	249	789
19	City Center Drive	East of	State Farm Dr.	56.1	46.8	53.9	58.5	7	22	70	221	700
20	Seed Farm Drive	South of	Enterprise Dr.	61.5	52.2	59.3	63.9	24	77	243	770	2434

APPENDIX E

Traffic Impact Study



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Traffic Impact Study for the Central Rohnert Park PDA Plan

Draft Report

April 24, 2015

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DRAFT

Introduction

Introduction

This report presents an analysis of the potential traffic and circulation impacts that would be associated with implementation of the Central Rohnert Park Priority Development Area (PDA) Plan. This assessment considers the Draft PDA Plan prepared by AECOM which was released in May 2015. The Draft PDA Plan is the result of extensive community outreach, as well as collaboration with City staff and Rohnert Park decision makers. W-Trans assisted the AECOM team with circulation-related expertise during development of the Plan. This study was completed in accordance with the criteria established by the City of Rohnert Park, and is consistent with standard traffic engineering techniques.

Prelude

The purpose of a traffic impact study is to provide City staff and policy makers with data that they can use to make an informed decision regarding the potential circulation impacts of a proposed project or plan, and any associated improvements that would be required in order to mitigate these impacts to a level of insignificance as defined by the City's General Plan or other policies. Vehicular traffic impacts are typically evaluated by determining the number of new trips that the proposed use would be expected to generate, distributing these trips to the surrounding street system based on existing travel patterns or anticipated travel patterns specific to the proposed project, then analyzing the impact the new traffic would be expected to have on critical intersections. Impacts relative to access for pedestrians, bicyclists, and to transit are also addressed.

Project Profile

The boundaries of the Central Rohnert Park Priority Development Area (PDA) roughly form a triangle bounded by US 101 on the west, the Sonoma-Marín Area Rail Transit (SMART) rail corridor on the east, and Avram Avenue-Santa Alicia Avenue on the south. The SMART commuter rail station is located just south of Rohnert Park Expressway, and passenger rail service is planned to begin in late 2016. From a circulation perspective, one of the goals of the PDA plan is to increase the amount of housing and employment that is proximate to existing and planned transit services, thereby reducing reliance on the private automobile and trips made using single-occupant vehicles. In order to further support transit and reduce automobile reliance, a strong emphasis on pedestrian and bicycle circulation is a key component of the plan.

The PDA plan identifies numerous multimodal improvements to the circulation network ranging from the creation of new pedestrian-bicycle linkages, to establishment of effective bus-rail transfers, to identification of intersection improvements needed to support future traffic growth. The plan would allow for construction of approximately 835 new residential units and approximately 823,000 square feet of additional non-residential uses including commercial, office, and light industrial among five "districts".

A map showing the PDA plan area and the boundaries of its five districts is shown in Figure 1.

Regulatory Framework

Following are the state and local laws and policies that are relevant to the CEQA review process for transportation and circulation.

Caltrans

The California Department of Transportation (Caltrans) is the primary State agency responsible for transportation issues. One of its duties is the construction and maintenance of the State highway system. Caltrans approves the planning, design, and construction of improvements for all State-controlled facilities including US 101 and the associated interchanges for these facilities located in the Plan Area. Caltrans has established standards for roadway traffic flow and developed procedures to determine if State-controlled facilities require improvements.

The following Caltrans procedures and directives are relevant to the transportation analysis conducted for the Rohnert Park PDA Plan:

- **Level of Service Target:** Caltrans has established a level of service (LOS) target of LOS E¹ on mainline US 101 through Rohnert Park, and LOS D for freeway ramp intersections. Where a facility is operating at less than these thresholds without the project, the existing measure of effectiveness should be maintained.
- **Caltrans Director's Policy 22:** This policy establishes support for balancing transportation needs with community goals. Caltrans seeks to involve and integrate community goals in the planning, design, construction, and maintenance and operations processes, including accommodating the needs of bicyclists and pedestrians.

Sonoma County Transportation Authority

In November 1990, the Sonoma County Transportation Authority (SCTA) was designated as the Congestion Management Agency (CMA) for Sonoma County. In 1997, the SCTA relinquished its position as the CMA under new state legislation that made this function optional. The SCTA now serves as the coordinating and advocacy agency for transportation funding for Sonoma County.

The 2009 *Comprehensive Transportation Plan for Sonoma County* (2009 CTP) is the latest county-wide planning document approved by the SCTA. The 2009 CTP includes goals, objectives, and policies for improving mobility on Sonoma County's streets, highways, and transit system and bicycle/pedestrian facilities, and outlines the regional improvements needed to reduce transportation related impacts over the next 25 years. SCTA also oversees Measure M, the Traffic Relief Act for Sonoma County, which is a sales tax measure that was passed by Sonoma County voters in November 2004. Completion of the Golf Course Drive interchange at US 101 and widening of US 101 with HOV and auxiliary lanes are recent Measure M projects overseen by SCTA that have improved circulation in Rohnert Park.

City of Rohnert Park General Plan

The City of Rohnert Park's 2020 General Plan outlines a vision of long-range physical and economic development and resource conservation that reflect the aspirations of the community. The

¹ Caltrans LOS thresholds for Rohnert Park obtained from Graton Rancheria Casino and Hotel Project – Draft Environmental Impact Statement (DEIS) Scoping comments written by the California Department of Transportation (Caltrans), April 2004.

Transportation Element contains goals and policies to encourage the conservation and proper management of the community's resources. Following is a list of the City's General Plan policies related to transportation and traffic that are applicable to the PDA Plan and future development that would be allowed under the Plan.

- Policy TR-1: Establish LOS C as the minimum standard for all arterial and collector roadway segments ("segments") and intersections, except for (1) those specified segments and intersections for which allowable LOS standards are otherwise established [*these are referenced in Table 4.1-2 of the General Plan and include the intersections at Golf Course Drive/US 101 South Ramps, Commerce Boulevard/Golf Course Drive, and Commerce Boulevard/US 101 Northbound Ramps*] and (2) segments and intersections that are operating at LOS D or lower at the time an application for a development project or a specified plan is submitted if no feasible improvements exist to improve the LOS. The then-existing LOS may be permitted to be the standard for those segments and intersections in category (2), provided that the LOS not be permitted to deteriorate further due to the proposed development project or specific plan.
- Policy TR-2: Require mitigation measures, as needed, for new development that increases traffic such that LOS levels fall below the established minimum standard. Ensure that mitigation measures are coordinated with roadway improvements programmed for funding through transportation-related impact fees.
- Goal TR-J: Reduce peak-hour traffic congestion and associated impacts, including air pollution, energy consumption, and noise.
- Goal TR-K: Reduce the need for roadway improvements by making more efficient use of existing roads, bikeways, transit service, and other transportation facilities and services.
- Policy TR-21A: Work with Sonoma County, the City of Santa Rosa, the City of Cotati, and the City of Petaluma ("Contributing Jurisdictions") and the Sonoma County Transportation Authority (SCTA) to plan and implement selected improvements necessary to mitigate impacts of increased traffic congestion on major roads and intersections in Penngrove ("Regional Mitigation Plan"). The Regional Mitigation Plan shall include those roadway and other improvements necessary to mitigate the impacts of increased traffic congestion on major roads and intersections in Penngrove ("Regional Mitigation Projects"), and a financing plan that explains how those improvements will be funded and that determines each Contributing Jurisdiction's proportional share. The City shall contribute its proportional share of the total cost of the Regional Mitigation Plan provided that the City's participation is roughly proportional to the traffic impacts from new development in Rohnert Park.

The City's payment or other contribution of its proportional share shall be provided when all of the following occur: (1) A Regional Mitigation Project is approved by the Sonoma County Board of Supervisors, and each of the Contributing Jurisdictions; (2) a financing plan for the Regional Mitigation Project has been approved by the Sonoma County Board of Supervisors, and each of the Contributing Jurisdictions; (3) new development that contributes to the traffic impacts to be mitigated by the project receives final approval by the City; and (4) each of the Contributing Jurisdictions has appropriated its proportional share to the Regional Mitigation Project. In the event that other jurisdictions do not contribute their proportional share to the Regional Mitigation Project, and funding for their proportional share is provided by some other means to ensure implementation of the Regional Mitigation Project, the City will contribute and be limited to its proportional share.

- Policy TR-22: In cooperation with the Chamber of Commerce, adopt a non-mandatory employer based transportation demand management (TDM) program for Rohnert Park businesses.

- Policy TR-23: Allow reductions in transportation impact fees on new non-residential development commensurate with provision of transportation demand management (TDM) measures, and develop reduction parameters.
- Goal TR-L: Promote local and regional public transit serving Rohnert Park and facilitate transfers between transit routes and operators.
- Policy TR-27: Work with Sonoma County Transit and Golden Gate Transit to develop an expanded bus route system, in order to serve areas of new development in Rohnert Park.
- Policy TR-30: In consultation with Golden Gate Transit and Sonoma County Transit, determine appropriate locations of new bus stops, in conjunction with increased service and expanded routes.
- Policy TR-31: Require project proponents to provide bus stops and shelters in conjunction with new development.
- Policy TR-32: Work with Sonoma County Transit, Golden Gate Transit, and private developers to ensure that bus stops and shelters adhere to the following standards:
 - Bus pull-outs shall be required at bus stop locations, in order to prevent stopping buses from interfering with traffic flow;
 - Bus stop locations shall allow direct, convenient pedestrian access to adjacent development;
 - Pedestrian access to bus stops shall be safe and comfortable;
 - Bus shelters shall provide adequate protection from sun, wind, and rain;
 - Bus stops and shelters shall display schedules and routes; and
 - Bus shelters shall be adequately designed and sized to accommodate waiting passengers during inclement weather.

Circulation Network Setting

Roadway Network

The PDA Plan area is comprised of commercial development throughout the area and is generally fully developed, with few undeveloped parcels in the area. The local circulation system serving the project site is shown in Figure 2. Following is a description of the key roadways within and surrounding the Specific Plan area.

US 101 is the primary route connecting the City of Rohnert Park to the San Francisco Bay Area to the south and Santa Rosa to the north. Within Rohnert Park, US 101 is a six-lane freeway with interchanges at Rohnert Park Expressway and Golf Course Drive.

Golf Course Drive/Golf Course Drive West is an east-west secondary arterial that connects the northeastern portions of Rohnert Park to US 101. The corridor includes four lanes, on-street bicycle lanes, and sidewalks on both sides of the street except along the golf course, where the street has two lanes and on-street bicycle lanes. The posted speed limit is 35 mph.

Commerce Boulevard is identified as a major arterial in the Rohnert Park General Plan, and extends from SR 116 in Cotati to just north of Golf Course Drive, where it turns west and crosses under US 101 and connects to Redwood Drive. Commerce Boulevard has a posted speed limit of 35 mph.

State Farm Drive is identified as a major collector in the Rohnert Park General Plan, and provides internal circulation through the Specific Plan area between Commerce Boulevard and Enterprise Drive. The corridor generally includes four lanes, left-turn lanes into side streets and driveways, and sidewalks on both sides of the street, except for the northernmost one-third mile segment between Professional Center Drive and Commerce Boulevard where the road includes one lane in each direction. On-street bicycle lanes are provided south of Rohnert Park Expressway. The posted speed limit is 30 mph, except between Professional Center Drive and City Center Drive where the posted speed limit is 35 mph.

Rohnert Park Expressway serves as the major east-west arterial for the City of Rohnert Park, connecting residences to the east to the commercial development in the west, as well as to US 101. The corridor generally includes four lanes, on-street bicycle lanes, and sidewalks on both sides of the street. The posted speed limit for Rohnert Park Expressway is 35 mph between Redwood Drive and State Farm Drive, and 40 mph west of Redwood Drive and east of State Farm Drive.

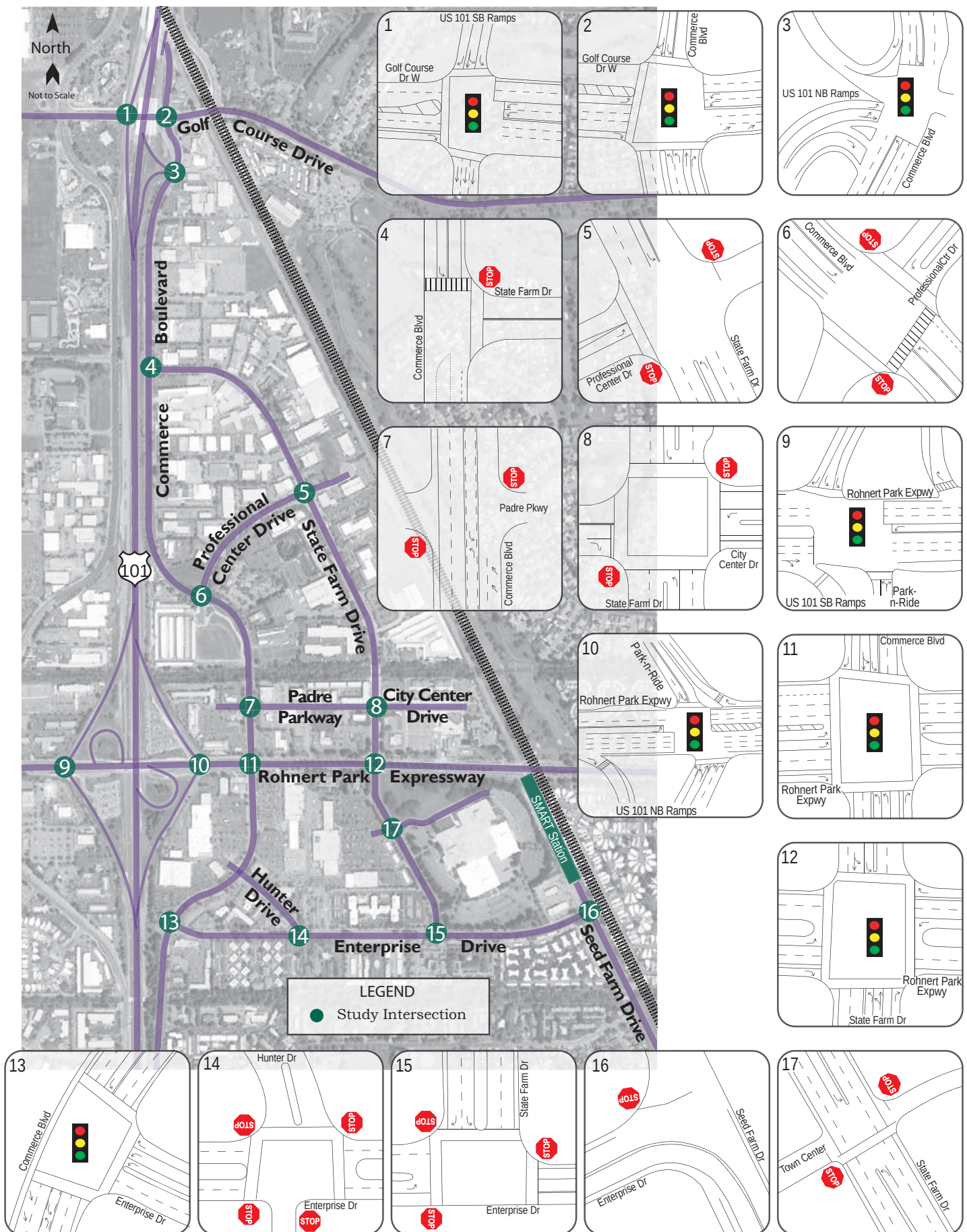
Enterprise Drive is a collector providing internal circulation along the southern part of the Specific Plan area. The corridor is identified as a major collector in the Rohnert Park General Plan west of State Farm Drive, and as a minor collector east of State Farm Drive. Enterprise Drive west of State Farm Drive generally includes four lanes, left-turn pockets for minor-street approaches and driveways, and sidewalks on both sides of the street. East of State Farm Drive, Enterprise Drive includes two travel lanes, a two-way left-turn lane, on-street bicycle lanes, and sidewalks on both sides of the street. Enterprise Drive has a posted speed limit of 30 mph.

Study Intersections and Periods

Study Intersections

The following seventeen study intersections within and adjacent to the PDA were selected for analysis:

1. Golf Course Drive West/US 101 South Ramps
2. Golf Course Drive/Commerce Boulevard



3. Commerce Boulevard/US 101 North Ramps
4. Commerce Boulevard/State Farm Drive
5. State Farm Drive/Professional Center Drive
6. Commerce Boulevard/Professional Center Drive
7. Commerce Boulevard/Padre Parkway
8. State Farm Drive/City Center Drive
9. Rohnert Park Expressway/US 101 South Ramps
10. Rohnert Park Expressway/US 101 North Ramps
11. Rohnert Park Expressway/Commerce Boulevard
12. Rohnert Park Expressway/State Farm Drive
13. Commerce Boulevard/Enterprise Drive
14. Enterprise Drive/Hunter Drive
15. Enterprise Drive/State Farm Drive
16. Enterprise Drive/Seed Farm Drive
17. State Farm Drive/Town Center

Study Periods

Operating conditions during the a.m. and p.m. peak periods were evaluated to capture the highest potential impacts for the proposed project as well as the highest volumes on the local transportation network. The morning peak hour occurs between 7:00 and 9:00 a.m. and reflects conditions during the home to work or school commute, while the p.m. peak hour occurs between 4:00 and 6:00 p.m. and typically reflects the highest level of congestion during the homeward bound commute.

The locations of the study intersections and the existing lane configurations and controls are shown in Figure 2.

Traffic Counts

Traffic counts were obtained at the study intersections in September 2013 and March 2014². All counts were obtained while area schools, including Sonoma State University, were in session. Traffic volumes on mainline US 101 were obtained from raw 2013 data supplied by Caltrans, updated to reflect conditions after opening of the casino portion of the Graton Rancheria Resort and Casino.

Pedestrian Facilities

Pedestrian facilities include sidewalks, paths, crosswalks, pedestrian signal phases, curb ramps, curb extensions, and various streetscape amenities such as lighting, benches, etc. Continuous sidewalks are provided on the east side of Commerce Boulevard north of Utility Court, and on both sides of the street elsewhere except along the frontage of two undeveloped parcels, one on Commerce Boulevard west of Professional Center Drive, and one on State Farm Drive north of Professional Center Drive. Marked crosswalks crossing the major street are generally provided at unsignalized intersections, with the exception of State Farm Drive/Professional Center Drive where the State Farm Drive crossings are unmarked. All of the signalized study intersections include marked crosswalks and pedestrian signal heads.

² Counts obtained at intersections 1-3 and 9-12 in March 2014, and at intersections 4-8 and 13-17 in September 2013

Bicycle Circulation

The *Highway Design Manual*, California Department of Transportation (Caltrans), 2012, classifies bikeways into three categories:

- *Class I Multi-Use Path*: a completely separated right-of-way for the exclusive use of bicycles and pedestrians with cross flows of motorized traffic minimized.
- *Class II Bike Lane*: a striped and signed lane for one-way bike travel on a street or highway.
- *Class III Bike Route*: signing only for shared use with motor vehicles within the same travel lane on a street or highway.

Class II on-street bicycle lanes are provided along Golf Course Drive, Commerce Boulevard south of Utility Court, Rohnert Park Expressway, State Farm Drive south of Rohnert Park Expressway, Enterprise Drive east of State Farm Drive, and Seed Farm Drive. In addition, Class I multi-use paths exist along the west side of Commerce Boulevard between Cascade Court and Professional Center Drive, along Hinebaugh Creek east of Commerce Boulevard, along Copeland Creek east of Commerce Boulevard, and south of Enterprise Drive/Hunter Drive connecting the intersection to the Copeland Creek Class I multi-use path.

Rohnert Park Bicycle and Pedestrian Master Plan

The *Rohnert Park Bicycle and Pedestrian Master Plan* was developed as a component of the *SCTA Countywide Bicycle and Pedestrian Master Plan*. The Plan includes the following objectives and policies which are relevant to the Central Rohnert Park PDA Plan.

- Objective 4.0: Comprehensive Support Facilities – Encourage the development of comprehensive support facilities for walking and bicycling.
- Policy 4.1: Require adequate short-term bicycle parking for retail, office, commercial and industrial uses.
- Policy 4.3: Require new development to construct/install bicycle facilities for project users in proportion to demand generated by the project. Such support facilities may include, but are not limited to, secure indoor and/or covered bicycle parking for project users, and adequate shower and locker facilities for employees.
- Policy 4.5: Install high-visibility crossing treatments, pedestrian scale lighting, street furniture, drinking fountains, and other pedestrian amenities in pedestrian-oriented activity centers, pedestrian corridors, and on Class I trails.

The Plan also identifies several physical projects to be completed in the future in and near the PDA Area:

Future Off-Street Paths

- SMART corridor multi-use path
- Extension of the Hinebaugh Creek Path east of SMART corridor
- Extension of the Hinebaugh Creek Path between Commerce Boulevard and Redwood Drive (including overpass at US 101)

Future Bicycle Lanes

- Commerce Boulevard between the US 101 northbound ramps and Golf Course Drive
- State Farm Drive between Rohnert Park Expressway and Commerce Boulevard
- Hunter Drive between Commerce Boulevard and Enterprise Drive
- Enterprise Drive between Commerce Boulevard and State Farm Drive

Future Pedestrian Crossing Enhancements

- Hinebaugh Creek Path at US 101, Commerce Boulevard, State Farm Drive, and SMART Rail corridor

The SCTA exhibit showing existing and planned pedestrian and bicycle facilities is shown in Figure 3.

Transit Facilities

Sonoma County Transit

Sonoma County Transit (SCT) is the principal transit service within Rohnert Park, providing daily local and intercity service. SCT local Routes 10, 12, and 14 operate together to provide transit access to destinations on both the east and west sides of US 101. Each local route operates with approximately 90- to 120-minute headways between 6:00 a.m. and 6:00 p.m. on weekdays, and 9:30 a.m. and 3:00 p.m. on Saturdays; no local service is provided on Sundays.

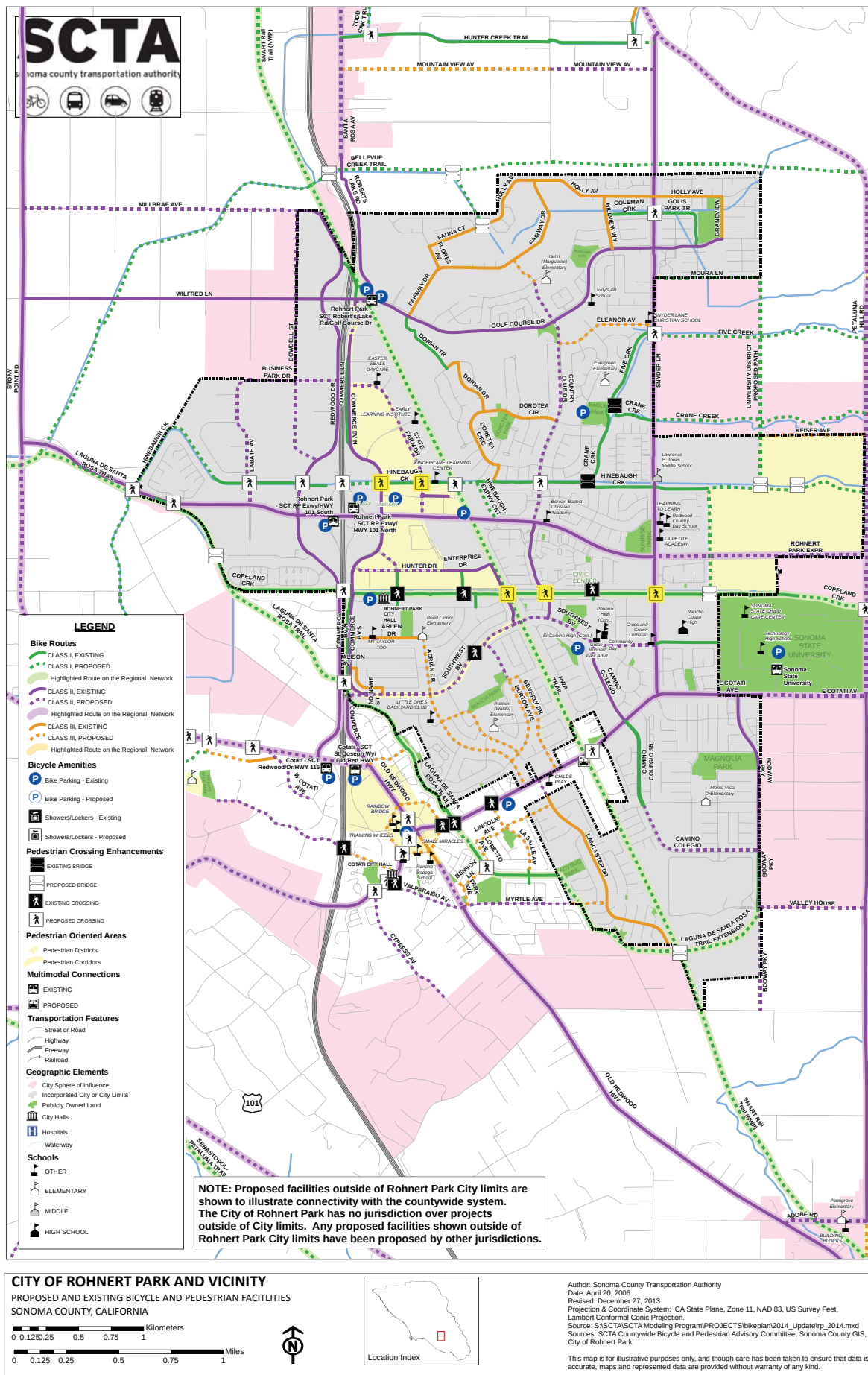
SCT Routes 26, 44, and 48 provide intercity service to Rohnert Park. Route 26 provides service between Rohnert Park and Santa Rosa. Routes 44 and 48 provide service between Petaluma and Santa Rosa. Route 26 operates between approximately 6:30 a.m. and 5:30 p.m., with two runs one hour apart for the morning and evening commutes and one run during the middle of the day. Routes 44 and 48 operate with approximately 40- to 120-minute headways between 6:30 a.m. and 8:30 p.m. on weekdays, with a combined headway of 30 to 60 minutes. On weekends, SCT Routes 44 and 48 operate with approximately two- to four-hour headways between 7:00 a.m. and 8:00 p.m. and a combined headway of one to two hours.

The nearest SCT bus stops serving the Plan area are located at Rohnert Park Expressway and Commerce Boulevard, Raley's Town Center on State Farm Drive between Rohnert Park Expressway and Enterprise Drive, the Senior Center on Hunter Drive, and Chase Bank on Rohnert Park Expressway between Commerce Boulevard and State Farm. On weekdays, the Plan area is served by SCT Routes 10, 12/14, 26, 44/48. On weekends, the Plan area is served by SCT Routes 10/12 and 44/48.

All SCT buses are wheelchair lift-equipped and can transport two wheelchair passengers at a time. SCT allows bikes on all of its buses. Buses are equipped with a front-loading bike rack that accommodates either two or three bicycles. When the front-loading rack is full, bus drivers may allow up to two bikes inside the bus.

Golden Gate Transit

Golden Gate Transit (GGT) provides daily interregional service along the US 101 corridor between Santa Rosa and San Francisco. Route 72 provides weekday commuter service between Santa Rosa and San Francisco, with a southbound stop at Rohnert Park Expressway and one northbound at US 101 and Rohnert Park Expressway. Route 72 operates with 20- to 30-minute headways on weekdays only, with southbound service into San Francisco between 4:00 a.m. and 7:00 a.m. and northbound service out of San Francisco between 3:30 p.m. and 7:30 p.m. GGT Route 101 operates daily along the US 101



corridor between Santa Rosa and San Francisco, with a stop on Commerce Boulevard at Rohnert Park Expressway. Southbound Route 101 service in Rohnert Park begins around 4:00 a.m. with approximately one-hour headways until 10 p.m. In the northbound direction Route 101 operates at approximately one-hour headways between 7:30 a.m. and 2:00 a.m. All GGT buses are handicap accessible and equipped with a front-loading bike rack that accommodates either two or three bicycles. On express buses, storage space for bicycles is provided under the coach.

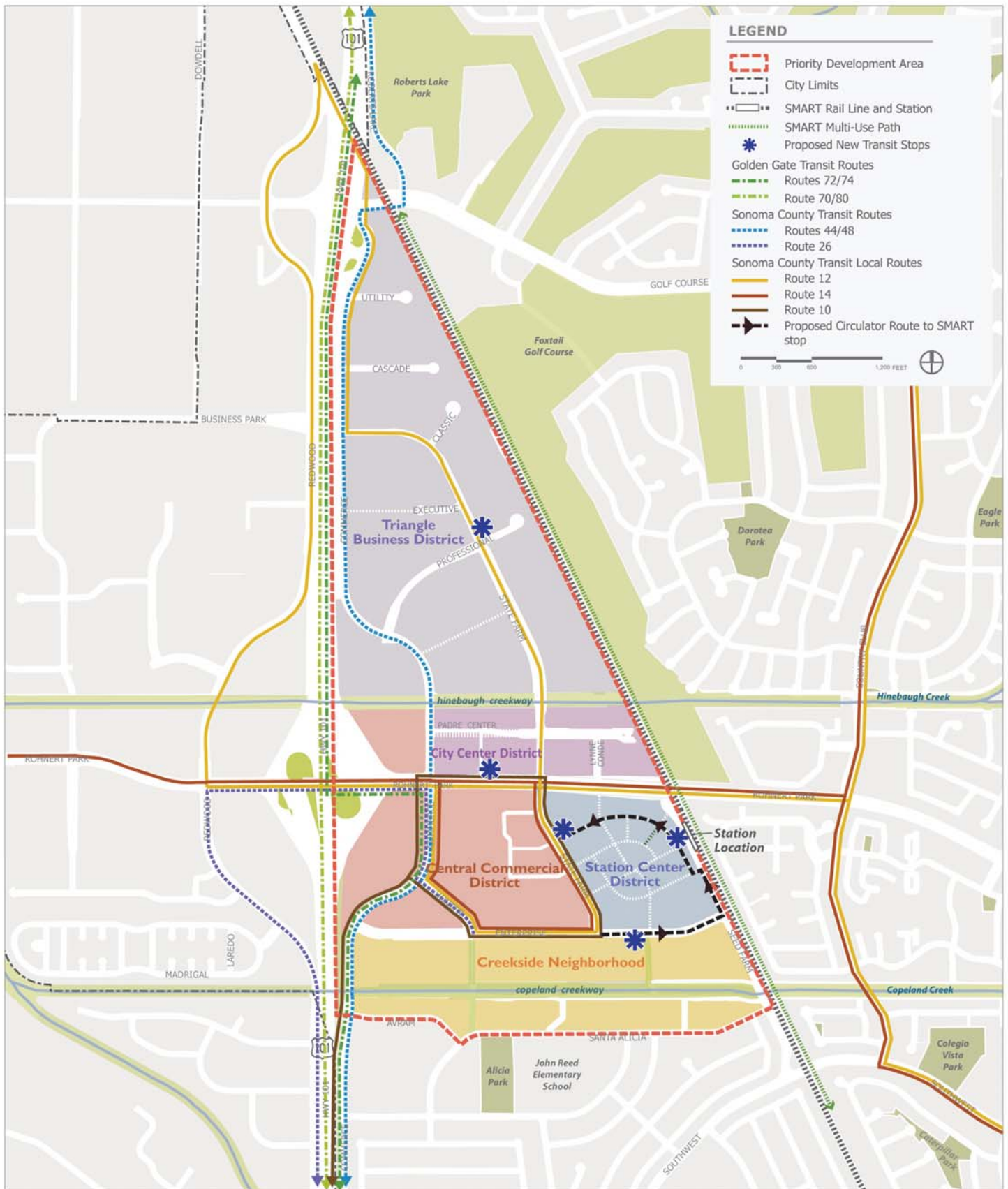
SMART Rail

The SMART commuter rail system is a 70-mile rail line that is planned to run from Cloverdale, at the north end of Sonoma County, to Larkspur, where the Golden Gate Ferry connects Marin County with San Francisco. Along the way, SMART will have stations at the major population and job centers of the North Bay including the downtown Rohnert Park station, which is located just south of Rohnert Park Expressway in the core of the Plan area. Train service will be provided by an estimated 14 round-trip trains on weekdays and four round-trip trains on weekends. Headways during the morning and evening commute periods will be 30 minutes, with longer headways during midday, evening, and weekend periods. SMART plans to initiate rail service between Airport Boulevard in northern Santa Rosa and downtown San Rafael in 2016.

Dial-a-Ride

Dial-a-Ride, also known as paratransit or door-to-door service, is available for those who are unable to independently use the transit system due to a physical or mental disability. Sonoma County Paratransit is designed to serve the needs of individuals with disabilities within Sonoma County. Service days are Monday through Friday from 5:00 a.m. to 11:00 p.m., and Saturday and Sunday from 7:00 a.m. to 9:00 p.m.

A map of transit routes serving the plan area is shown in Figure 4.



Source: AECOM

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Central Rohnert Park PDA Plan
Figure 4 – Transit Routes

Capacity Analysis Methodology and No-Project Operation

Intersection Level of Service Methodologies

Level of Service (LOS) is used to rank traffic operation on various types of facilities based on traffic volumes and roadway capacity using a series of letter designations ranging from A to F. Generally, Level of Service A represents free flow conditions and Level of Service F represents forced flow or breakdown conditions. A unit of measure that indicates a level of delay generally accompanies the LOS designation.

Intersection Operation

The study intersections were analyzed using methodologies published in the *Highway Capacity Manual* (HCM), Transportation Research Board, 2000. This source contains methodologies for various types of intersection control, all of which are related to a measurement of delay in average number of seconds per vehicle.

The Levels of Service for the intersections with side-street stop controls, or those which are unsignalized and have one or two approaches stop controlled, were analyzed using the “Two-Way Stop-Controlled” intersection capacity method from the HCM. This methodology determines a level of service for each minor turning movement by estimating the level of average delay in seconds per vehicle. Results are presented for individual movements together with the weighted overall average delay for the intersection.

The study intersections with stop signs on all approaches were analyzed using the “All-Way Stop-Controlled” Intersection methodology from the HCM. This methodology evaluates delay for each approach based on turning movements, opposing and conflicting traffic volumes, and the number of lanes. Average vehicle delay is computed for the intersection as a whole, and is then related to a Level of Service.

The study intersections that are currently controlled by a traffic signal, or may be in the future, were evaluated using the signalized methodology from the HCM. This methodology is based on factors including traffic volumes, green time for each movement, phasing, whether or not the signals are coordinated, truck traffic, and pedestrian activity. Average stopped delay per vehicle in seconds is used as the basis for evaluation in this LOS methodology.

The ranges of delay associated with the various levels of service are indicated in Table I.

Table I
Intersection Level of Service Criteria

LOS	Two-Way Stop-Controlled	All-Way Stop-Controlled	Signalized
A	Delay of 0 to 10 seconds. Gaps in traffic are readily available for drivers exiting the minor street.	Delay of 0 to 10 seconds. Upon stopping, drivers are immediately able to proceed.	Delay of 0 to 10 seconds. Most vehicles arrive during the green phase, so do not stop at all.
B	Delay of 10 to 15 seconds. Gaps in traffic are somewhat less readily available than with LOS A, but no queuing occurs on the minor street.	Delay of 10 to 15 seconds. Drivers may wait for one or two vehicles to clear the intersection before proceeding from a stop.	Delay of 10 to 20 seconds. More vehicles stop than with LOS A, but many drivers still do not have to stop.
C	Delay of 15 to 25 seconds. Acceptable gaps in traffic are less frequent, and drivers may approach while another vehicle is already waiting to exit the side street.	Delay of 15 to 25 seconds. Drivers will enter a queue of one or two vehicles on the same approach, and wait for vehicle to clear from one or more approaches prior to entering the intersection.	Delay of 20 to 35 seconds. The number of vehicles stopping is significant, although many still pass through without stopping.
D	Delay of 25 to 35 seconds. There are fewer acceptable gaps in traffic, and drivers may enter a queue of one or two vehicles on the side street.	Delay of 25 to 35 seconds. Queues of more than two vehicles are encountered on one or more approaches.	Delay of 35 to 55 seconds. The influence of congestion is noticeable, and most vehicles have to stop.
E	Delay of 35 to 50 seconds. Few acceptable gaps in traffic are available, and longer queues may form on the side street.	Delay of 35 to 50 seconds. Longer queues are encountered on more than one approach to the intersection.	Delay of 55 to 80 seconds. Most, if not all, vehicles must stop and drivers consider the delay excessive.
F	Delay of more than 50 seconds. Drivers may wait for long periods before there is an acceptable gap in traffic for exiting the side streets, creating long queues.	Delay of more than 50 seconds. Drivers enter long queues on all approaches.	Delay of more than 80 seconds. Vehicles may wait through more than one cycle to clear the intersection.

Reference: *Highway Capacity Manual*, Transportation Research Board, 2000

Freeway Operation

The freeway analysis methodology contained in Chapter 10 of the HCM, “Freeway Facilities,” was used to determine levels of service on US 101. The method analyzes extended lengths of freeway composed of continuously connected basic freeway, weaving, merge, and diverge segments, which are collectively referred to as a freeway facility. For each individual segment, the analysis methodologies from the relevant chapters of the HCM, including Chapter 11 “Basic Freeway Segments,” Chapter 12 “Freeway Weaving Segments,” and Chapter 13 “Freeway Merge and Diverge Segments,” were used. The method uses variables such as traffic volumes, geometric configuration of the freeway (i.e. number of lanes, presence of auxiliary lanes, distance between merges and diverges, widths of lanes and shoulders), topography, the percentage of heavy vehicles, and free-flow speeds. These data are used to determine the density of the segment, which is the criteria used for determining freeway LOS. Density is indicative of the travel speed service flow rates and travel demand on a freeway facility, and is measured in the number of passenger cars per mile per lane. The ranges of vehicle density associated with the various Levels of Service are presented in Table 2.

Table 2
Freeway Level of Service Criteria

Level of Service (LOS)	Basic Freeway Segment Density (pc/mi/ln)	Weaving, Merge, and Diverge Segment Density (pc/mi/ln)
A	≤ 11	≤ 10
B	> 11 – 18	> 10 – 20
C	> 18 – 26	> 20 – 28
D	> 26 – 35	> 28 – 35
E	> 35 – 45	> 35
F	> 45 or any component with V/C ratio > 1.00	Demand exceeds capacity

Notes: pc/mi/ln = passenger cars per mile per lane; V/C = volume to capacity

Traffic Operation Standards

The applied thresholds of significance for intersection impacts are based on those included in Policy TR-1 of the Rohnert Park 2020 General Plan. The Project would create a significant circulation impact if it would:

- Fail to maintain LOS C as the minimum standard for signalized intersections in Rohnert Park, except for the following three intersections where LOS D operation is allowed: Golf Course Drive West/ US 101 Southbound Ramps, Golf Course Drive/Commerce Boulevard, and Commerce Boulevard/ US 101 Northbound Ramps.
- Add traffic to an unsignalized intersection where individual movements are projected to operate at LOS F and the peak hour signal warrant criteria in the *California Manual on Uniform Traffic Control Devices*, 2012, would be met.

The applied threshold of significance for the US 101 freeway is based on the Caltrans *Guide for the Preparation of Traffic Impact Studies*, 2002. A project would create a significant impact to freeway facilities if it would:

- Fail to maintain operation on US 101 at or above the LOS E threshold, or in cases where the freeway is already projected to operate deficiently at LOS F without the project, failure to maintain the existing measures of effectiveness (MOE). For such instances where the freeway is anticipated to operate at LOS F, the freeway volume-to-capacity (v/c) ratio is calculated and used as the MOE. A Project-attributable increase in the v/c ratio of 0.01 or greater is considered to be a cumulatively significant impact.

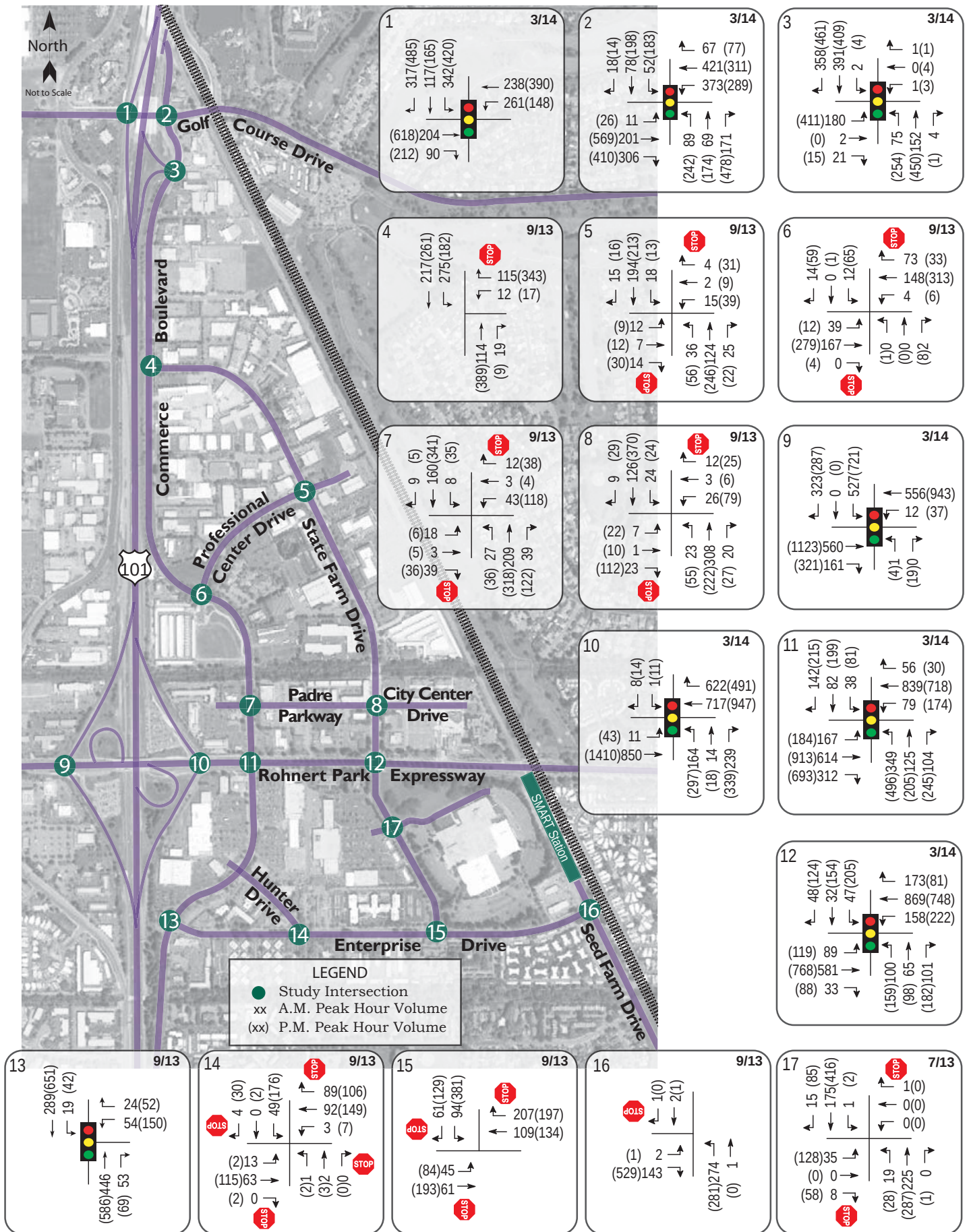
Existing Conditions

The Existing Conditions scenario provides an evaluation of current operation based on existing traffic volumes during the a.m. and p.m. peak periods. This condition does not include the potential growth in traffic volumes associated with development of the Central Rohnert Park PDA.

Existing Intersection Operation

Under existing conditions, 15 of the 17 study intersections are operating acceptably within the LOS criteria established by the City. The intersections at Rohnert Park Expressway/Commerce Boulevard and Rohnert Park Expressway/State Farm Drive are currently operating at LOS D during the p.m. peak hour, which is considered unacceptable since the City's standard at these locations is LOS C. A summary of the intersection level of service calculations is contained in Table 3. The existing traffic volumes are shown in Figure 5 and copies of the Level of Service calculations are provided in Appendix A.

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Central Rohnert Park PDA Plan
Figure 5 – Existing Traffic Volumes

Table 3
Existing Peak Hour Intersection Levels of Service

Study Intersection Approach	AM Peak		PM Peak	
	Delay	LOS	Delay	LOS
1. Golf Course Drive West/US 101 South Ramps	29.8	C	22.1	C
2. Golf Course Drive/Commerce Boulevard	20.1	C	24.7	C
3. Commerce Boulevard/US 101 North Ramps	7.7	A	12.5	B
4. Commerce Boulevard/State Farm Drive	5.0	A	9.9	A
<i>Westbound Approach</i>	<i>11.9</i>	<i>B</i>	<i>28.5</i>	<i>D</i>
5. State Farm Drive/Professional Center Drive	2.2	A	3.6	A
<i>Eastbound Approach</i>	<i>11.3</i>	<i>B</i>	<i>12.7</i>	<i>B</i>
<i>Westbound Approach</i>	<i>11.9</i>	<i>B</i>	<i>16.4</i>	<i>C</i>
6. Commerce Boulevard/Professional Center Drive	1.4	A	2.3	A
<i>Southbound (Professional Center) Approach</i>	<i>10.2</i>	<i>B</i>	<i>12.5</i>	<i>B</i>
7. Commerce Boulevard/Padre Parkway	2.7	A	3.6	A
<i>Eastbound Approach</i>	<i>10.1</i>	<i>B</i>	<i>10.9</i>	<i>B</i>
<i>Westbound Approach</i>	<i>11.7</i>	<i>B</i>	<i>17.3</i>	<i>C</i>
8. State Farm Drive/City Center Drive	2.1	A	5.4	A
<i>Eastbound Approach</i>	9.9	A	12.8	B
<i>Westbound Approach</i>	13.0	B	25.8	D
9. Rohnert Park Expressway/US 101 South Ramps	20.1	C	27.3	C
10. Rohnert Park Expressway/US 101 North Ramps	24.0	C	23.2	C
11. Rohnert Park Expressway/Commerce Boulevard	32.5	C	41.7	D
12. Rohnert Park Expressway/State Farm Drive	33.4	C	41.0	D
13. Commerce Boulevard/Enterprise Drive	9.5	A	8.8	A
14. Enterprise Drive/Hunter Drive	7.2	A	8.8	A
15. Enterprise Drive/State Farm Drive	8.4	A	17.7	C
16. Enterprise Drive/Seed Farm Drive	0.1	A	0.0	A
<i>Southbound Approach</i>	<i>11.1</i>	<i>B</i>	<i>16.4</i>	<i>C</i>
17. State Farm Drive/Town Center	1.4	A	4.9	A
<i>Eastbound Approach</i>	<i>11.5</i>	<i>B</i>	<i>25.2</i>	<i>D</i>
<i>Westbound Approach</i>	9.0	A	0.0	A

Notes: Delay is measured in average seconds per vehicle; LOS = Level of Service; Results for minor approaches to two-way stop-controlled intersections are indicated in *italics*; ** = delay greater than 120 seconds; **Bold** text = deficient operation

Existing Freeway Operation

Existing freeway facilities including mainline, merge-diverge, and weaving segments operations were evaluated between the SR 116 and Todd Road freeway interchanges. All of the freeway facilities are currently operating acceptably at LOS E or better. Summaries of freeway facility levels of service are shown for the a.m. and p.m. peak hours in Table 4 and Table 5, respectively, and calculation worksheets are provided in Appendix E.

Table 4
Existing AM Peak Hour Freeway Levels of Service

US 101 Freeway Segment Direction	Segment Type	V/C Ratio	Density	LOS
Northbound				
SR 116 off-ramp to on-ramp	Basic Segment	0.47	16.0	B
SR 116 on-ramp to RPX off-ramp	Weaving	0.49	17.8	B
RPX off-ramp to RPX EB on-ramp	Basic Segment	0.56	19.1	C
RPX EB on-ramp	On Ramp	0.60	23.8	C
RPX EB on-ramp to RPX WB on-ramp	Basic Segment	0.60	21.3	C
RPX WB on-ramp to Golf Course Dr. off-ramp	Weaving	0.55	20.1	C
Golf Course Dr. off-ramp to on-ramp	Basic Segment	0.70	24.8	C
Golf Course Dr. on ramp to Santa Rosa Ave. off-ramp	Weaving	0.55	21.2	C
Santa Rosa Ave. off-ramp to Todd Rd. off-ramp	Basic Segment	0.74	26.7	D
Southbound				
Todd Rd. on-ramp to Golf Course Dr. off-ramp	Basic Segment	0.79	29.2	D
Golf Course Dr. off-ramp	Off Ramp	0.79	30.5	D
Golf Course Dr. off-ramp to on-ramp	Basic Segment	0.65	22.6	C
Golf Course Dr. on-ramp to RPX off-ramp	Weaving	0.55	21.1	C
RPX off-ramp to RPX WB on-ramp	Basic Segment	0.57	19.5	C
RPX WB on-ramp	On Ramp	0.63	25.7	C
RPX EB on-ramp to SR 116 off-ramp	Weaving	0.52	18.4	B
SR 116 off-ramp to SR 116 on-ramp	Basic Segment	0.57	19.5	C

Notes: V/C ratio = volume to capacity ratio; Density is measured in passenger cars per mile per lane (pc/mi/ln)
LOS = Level of Service; RPX=Rohnert Park Expressway; EB=Eastbound; WB=Westbound

Table 5
Existing PM Peak Hour Freeway Levels of Service

US 101 Freeway Segment Direction	Segment Type	V/C Ratio	Density	LOS
Northbound				
SR 116 off-ramp to on-ramp	Basic Segment	0.79	29.5	D
SR 116 on-ramp to RPX off-ramp	Weaving	0.67	27.0	C
RPX off-ramp to RPX EB on-ramp	Basic Segment	0.75	27.4	D
RPX EB on-ramp	On Ramp	0.83	34.8	D
RPX EB on-ramp to RPX WB on-ramp	Basic Segment	0.83	31.6	D
RPX WB on-ramp to Golf Course Dr. off-ramp	Weaving	0.70	27.1	C
Golf Course Dr. off-ramp to on-ramp	Basic Segment	0.81	30.5	D
Golf Course Dr. on ramp to Santa Rosa Ave. off-ramp	Weaving	0.72	29.2	D
Santa Rosa Ave. off-ramp to Todd Rd. off-ramp	Basic Segment	0.94	39.3	E
Southbound				
Todd Rd. on-ramp to Golf Course Dr. off-ramp	Basic Segment	0.79	29.3	D
Golf Course Dr. off-ramp	Off Ramp	0.79	30.7	D
Golf Course Dr. off-ramp to on-ramp	Basic Segment	0.63	21.8	C
Golf Course Dr. on-ramp to RPX off-ramp	Weaving	0.68	22.2	C
RPX off-ramp to RPX WB on-ramp	Basic Segment	0.55	18.9	C
RPX WB on-ramp	On Ramp	0.59	23.9	C
RPX EB on-ramp to SR 116 off-ramp	Weaving	0.57	21.1	C
SR 116 off-ramp to SR 116 on-ramp	Basic Segment	0.53	18.2	C

Notes: V/C ratio = volume to capacity ratio; Density is measured in passenger cars per mile per lane (pc/mi/ln)
LOS = Level of Service; RPX=Rohnert Park Expressway; EB=Eastbound; WB=Westbound

Future Conditions

Future traffic volume projections were obtained from the Sonoma County Travel Model (SCTM/10), which is maintained by the SCTA. The SCTA provided the most recently available modeling data as of December 2014. The SCTM/10 model includes traffic projections anticipated to occur upon buildout of all development expected to take place by the year 2040 throughout Sonoma County and the Bay Area. Within Rohnert Park, the future development assumptions contained in the model include (but are not limited to) full buildout of the Graton Rancheria Resort and Casino, Wilfred-Dowdell Specific Plan, Stadium Area Master Plan, Northeast Area Specific Plan, University District Specific Plan, Southeast Area Specific Plan, Sonoma Mountain Village development, and Northwest Area Specific Plan.

In addition to a year 2040 future scenario, the SCTM/10 model also includes a baseline scenario that represents all traffic generated by existing development throughout the County. W-Trans developed year 2040 intersection turning movements using the Furness procedure, which adds the incremental traffic increase between the traffic model's baseline and future scenarios to existing turning movement counts. For any intersections not included in the SCTA model, growth factors based on adjacent links and intersections were applied. For the "no project" scenario, the former State Farm campus in the core of the PDA was assumed to remain vacant. Traffic associated with pick-up, drop-off, and park-and-

ride activity at the SMART station is included in the projections. After applying these various procedures and adjustments, the resulting “first draft” set of traffic projections were then reviewed by individual turning movement, and increased where necessary to reflect a minimum growth of 13.8 percent, which translates to 0.5 percent per year.

The SCTM/10 travel model assumes a financially-constrained set of infrastructure improvements identified in the 2009 Comprehensive Transportation Plan (CTP) to be in place by the year 2040. In other words, the model only includes roadway and alternative transportation improvements that SCTA has deemed to be financially-feasible by the year 2040, including the widening of US 101 through the Marin-Sonoma narrows and implementation of Sonoma-Marin Area Rail Transit (SMART) commuter rail service.

Future Intersection Operation

Under the anticipated Future volumes, 13 of the 17 study intersections are expected to operate acceptably within the LOS parameters set by the City. The intersection at Commerce Boulevard/State Farm Drive is projected to operate unacceptably at LOS F during the p.m. peak hour. The Rohnert Park Expressway/Commerce Boulevard intersection is projected to operate at LOS D during the p.m. peak hour, which is considered unacceptable per the City’s LOS standards. The intersection at Rohnert Park Expressway/State Farm Drive is projected to operate unacceptably at LOS D during the a.m. peak hour and LOS E during the p.m. peak hour. Finally, the intersection at Enterprise Drive/State Farm Drive is projected to operate unacceptably at LOS D during the p.m. peak hour. Operating conditions are summarized in Table 6 and future volumes are shown in Figure 6. The intersection LOS calculations are included in Appendix B.

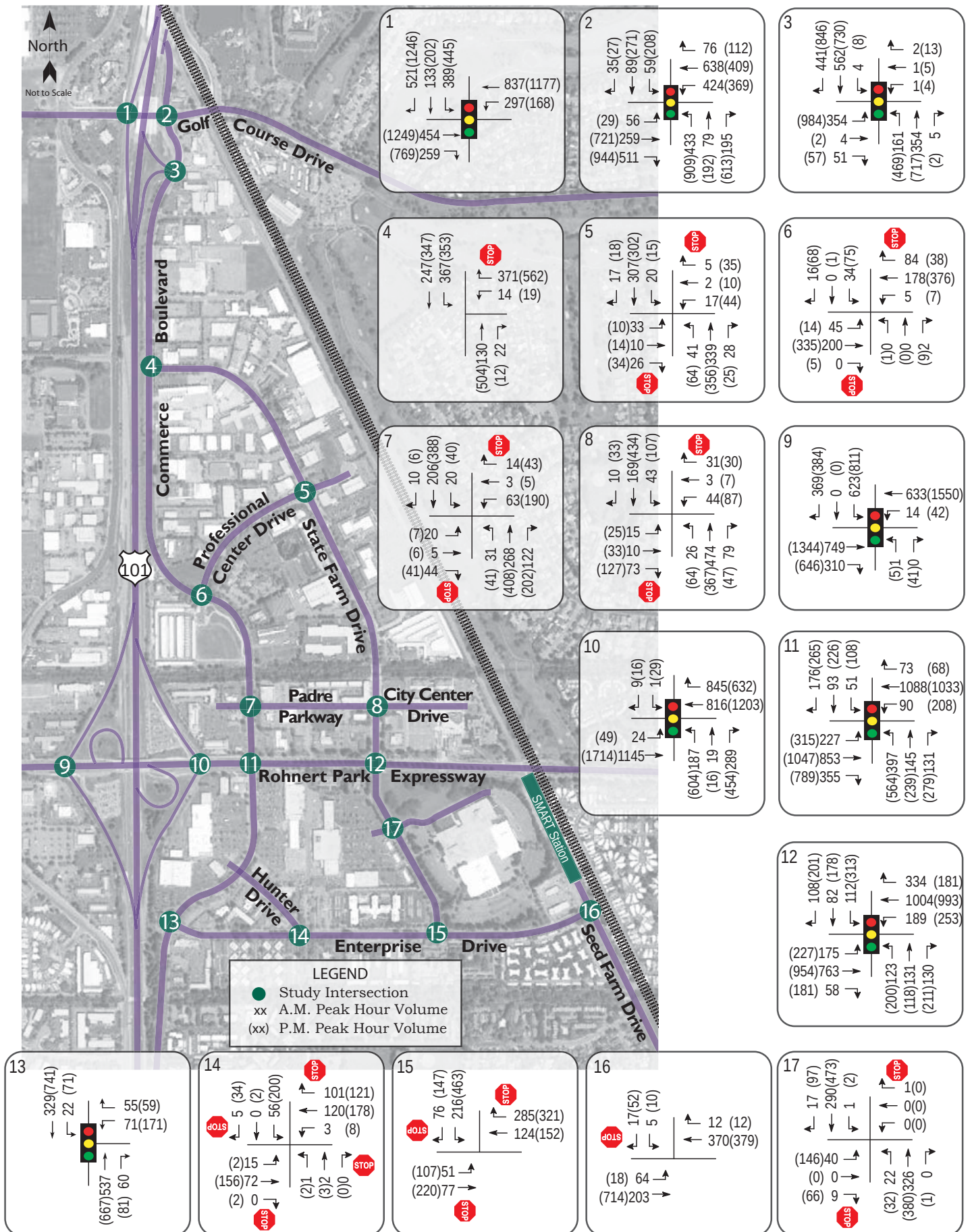


Table 6
Future Peak Hour Intersection Levels of Service

Study Intersection Approach	AM Peak		PM Peak	
	Delay	LOS	Delay	LOS
1. Golf Course Drive West/US 101 South Ramps	24.8	C	36.9	D
2. Golf Course Drive/Commerce Boulevard	25.5	C	38.2	D
3. Commerce Boulevard/US 101 North Ramps	11.3	B	33.8	C
4. Commerce Boulevard/State Farm Drive	7.9	A	56.8	F
<i>Westbound Approach</i>	<i>15.4</i>	<i>C</i>	<i>169.4</i>	<i>F</i>
5. State Farm Drive/Professional Center Drive	2.3	A	3.3	A
<i>Eastbound Approach</i>	<i>14.7</i>	<i>B</i>	<i>13.5</i>	<i>B</i>
<i>Westbound Approach</i>	<i>16.8</i>	<i>C</i>	<i>18.0</i>	<i>C</i>
6. Commerce Boulevard/Professional Center Drive	1.7	A	2.2	A
Southbound (Professional Center) Approach	10.9	B	12.5	B
7. Commerce Boulevard/Padre Parkway	2.7	A	5.4	A
<i>Eastbound Approach</i>	<i>10.4</i>	<i>B</i>	<i>11.2</i>	<i>B</i>
<i>Westbound Approach</i>	<i>12.9</i>	<i>B</i>	<i>25.9</i>	<i>D</i>
8. State Farm Drive/City Center Drive	3.4	A	13.2	C
<i>Eastbound Approach</i>	<i>11.7</i>	<i>B</i>	<i>19.8</i>	<i>C</i>
<i>Westbound Approach</i>	<i>20.5</i>	<i>C</i>	<i>103.3</i>	<i>F</i>
9. Rohnert Park Expressway/US 101 South Ramps	21.5	C	21.6	C
10. Rohnert Park Expressway/US 101 North Ramps	32.9	C	32.9	C
11. Rohnert Park Expressway/Commerce Boulevard	34.6	C	44.1	D
12. Rohnert Park Expressway/State Farm Drive	44.6	D	60.8	E
13. Commerce Boulevard/Enterprise Drive	13.6	B	7.8	A
14. Enterprise Drive/Hunter Drive	7.4	A	9.3	A
15. Enterprise Drive/State Farm Drive	10.7	B	31.1	D
16. Enterprise Drive/Seed Farm Drive	1.4	A	1.0	A
<i>Southbound Approach</i>	<i>12.0</i>	<i>B</i>	<i>13.4</i>	<i>B</i>
17. State Farm Drive/Town Center	1.2	A	6.2	A
<i>Eastbound Approach</i>	<i>13.7</i>	<i>B</i>	<i>33.6</i>	<i>D</i>
<i>Westbound Approach</i>	<i>9.3</i>	<i>A</i>	<i>14.3</i>	<i>B</i>

Notes: Delay is measured in average seconds per vehicle; LOS = Level of Service; Results for minor approaches to two-way stop-controlled intersections are indicated in *italics*; ** = delay greater than 120 seconds; **Bold** text = deficient operation

Future Freeway Operation

Under Future conditions, several freeway facility components are projected to operate below the LOS E threshold established by Caltrans. The freeway segment between Todd Road and Golf Course Drive is projected to operate at LOS F in the southbound direction during the a.m. peak hour, and in both directions during the p.m. peak hour. Related to these LOS F segment operations, the Golf Course Drive southbound off-ramp is also projected to operate at LOS F during both peak hours, as is the northbound weaving segment between Golf Course Drive and Santa Rosa Avenue during the p.m. peak hour.

Freeway facility levels of service under future conditions are summarized for the a.m. and p.m. peak hours in Table 7 and Table 8, respectively, and calculation worksheets are provided in Appendix E.

Table 7
Future AM Peak Hour Freeway Levels of Service

US 101 Freeway Segment Direction	Segment Type	V/C Ratio	Density	LOS
Northbound				
SR 116 off-ramp to on-ramp	Basic Segment	0.51	17.6	B
SR 116 on-ramp to RPX off-ramp	Weaving	0.63	21.6	C
RPX off-ramp to RPX EB on-ramp	Basic Segment	0.65	22.9	C
RPX EB on-ramp	On Ramp	0.71	28.7	D
RPX EB on-ramp to RPX WB on-ramp	Basic Segment	0.71	25.5	C
RPX WB on-ramp to Golf Course Dr. off-ramp	Weaving	0.68	26.0	C
Golf Course Dr. off-ramp to on-ramp	Basic Segment	0.81	30.7	D
Golf Course Dr. on ramp to Santa Rosa Ave. off-ramp	Weaving	0.66	26.6	C
Santa Rosa Ave. off-ramp to Todd Rd. off-ramp	Basic Segment	0.84	32.6	D
Southbound				
Todd Rd. on-ramp to Golf Course Dr. off-ramp	Basic Segment	1.08	44.7	F
Golf Course Dr. off-ramp	Off Ramp	1.08	41.6	F
Golf Course Dr. off-ramp to on-ramp	Basic Segment	0.89	31.1	D
Golf Course Dr. on-ramp to RPX off-ramp	Weaving	0.76	35.2	E
RPX off-ramp to RPX WB on-ramp	Basic Segment	0.83	28.3	D
RPX WB on-ramp	On Ramp	0.90	36.7	E
RPX EB on-ramp to SR 116 off-ramp	Weaving	0.75	24.5	C
SR 116 off-ramp to SR 116 on-ramp	Basic Segment	0.84	29.6	D

Notes: V/C ratio = volume to capacity ratio; Density is measured in passenger cars per mile per lane (pc/mi/ln)

LOS = Level of Service; RPX=Rohnert Park Expressway; EB=Eastbound; WB=Westbound

Bold values indicate operation below acceptable threshold

Table 8
Future PM Peak Hour Freeway Levels of Service

US 101 Freeway Segment Direction	Segment Type	V/C Ratio	Density	LOS
Northbound				
SR 116 off-ramp to on-ramp	Basic Segment	0.56	19.3	C
SR 116 on-ramp to RPX off-ramp	Weaving	0.71	29.6	D
RPX off-ramp to RPX EB on-ramp	Basic Segment	0.84	31.9	D
RPX EB on-ramp	On Ramp	0.93	42.0	E
RPX EB on-ramp to RPX WB on-ramp	Basic Segment	0.93	39.0	E
RPX WB on-ramp to Golf Course Dr. off-ramp	Weaving	0.77	31.8	D
Golf Course Dr. off-ramp to on-ramp	Basic Segment	0.93	44.6	E
Golf Course Dr. on ramp to Santa Rosa Ave. off-ramp	Weaving	0.86	69.2	F
Santa Rosa Ave. off-ramp to Todd Rd. off-ramp	Basic Segment	1.10	44.5	F
Southbound				
Todd Rd. on-ramp to Golf Course Dr. off-ramp	Basic Segment	1.05	44.7	F
Golf Course Dr. off-ramp	Off Ramp	1.05	41.7	F
Golf Course Dr. off-ramp to on-ramp	Basic Segment	0.84	30.4	D
Golf Course Dr. on-ramp to RPX off-ramp	Weaving	0.72	36.0	E
RPX off-ramp to RPX WB on-ramp	Basic Segment	0.79	27.7	D
RPX WB on-ramp	On Ramp	0.83	34.4	D
RPX EB on-ramp to SR 116 off-ramp	Weaving	0.65	21.9	C
SR 116 off-ramp to SR 116 on-ramp	Basic Segment	0.74	25.8	C

Notes: V/C ratio = volume to capacity ratio; Density is measured in passenger cars per mile per lane (pc/mi/ln)

LOS = Level of Service; RPX=Rohnert Park Expressway; EB=Eastbound; WB=Westbound

Bold values indicate operation below acceptable threshold

Plus Project Capacity Analysis

Project Description

Future development permitted under the PDA Plan would entail changes to allowed land uses and densities within the area. Nearly all of the area contained within the PDA boundaries has been developed, though some parcels are currently vacant and/or underutilized. Implementation of the plan would increase the amount of allowable retail, office, and light industrial square footage as well as the number of allowable residential units. For planning purposes the PDA plan area has been subdivided into the following five districts.

- Triangle Business District – This is the largest and most northern district bounded by US 101, the SMART rail corridor, and Hinebaugh Creek. The area is currently characterized by office and light industrial uses along with some retail uses.
- City Center District – This district includes civic uses, some newer mixed-use development, and some traditional suburban-oriented retail uses, and is bounded by Hinebaugh Creek, Rohnert Park Expressway, the SMART rail corridor, and Commerce Boulevard.
- Central Commercial District – This district is largely comprised of existing shopping centers including grocery and drug stores, along with quick-serve restaurants and some office uses. The district includes a northern area bounded by Hinebaugh Creek, Rohnert Park Expressway, US 101, and Commerce Boulevard, as well as a larger southern area bounded by Rohnert Park Expressway, Enterprise Drive, US 101, and State Farm Drive.
- Station Center District – The former State Farm office complex, which is currently vacant, forms the boundaries of this District. The district also includes the downtown SMART station and City corporation yard. Rohnert Park Expressway, Enterprise Drive, State Farm Drive, and the SMART rail corridor form the district boundaries.
- Creekside Neighborhood District – This district is mostly residential in nature, with some retail and office uses including City Hall. The district's boundaries are Enterprise Drive, Avram Avenue, Santa Alicia Drive, Commerce Boulevard, and the SMART rail corridor.

Land Use

AECOM determined the additional development potential that the PDA plan would allow in each of the five districts. The land use summary is shown in Table 9.

Table 9
Additional Development Potential by District

District	Residential	Retail/ Service	Office	Public/ Institutional	Industrial
Triangle Business	0 units	120.88 ksf	91.42 ksf	0 ksf	129.32 ksf
City Center	115 units	56.85 ksf	32.56 ksf	50.36 ksf	0 ksf
Central Commercial	0 units	74.26 ksf	0 ksf	12.45 ksf	0 ksf
Station Center	565 units	171.63 ksf	65.34 ksf	0 ksf	0 ksf
Creekside Neighborhood	155 units	17.53 ksf	0 ksf	0 ksf	0 ksf
TOTAL	835 units	441.15 ksf	189.32 ksf	62.81 ksf	129.32 ksf

Notes: Values represent the additional development that the PDA plan would allow beyond that existing in 2015
ksf=1,000 square feet

It should be noted that the plan would also permit for the construction of up to 500 additional hotel rooms. The square footage of any such hotel(s) are accounted for in the land use quantities shown above.

Circulation

Traffic analyses evaluating the plan's potential impacts to the surrounding circulation network were completed during development of the PDA Plan. This was done to test alternative roadway and intersection configurations, and ultimately to determine the circulation improvements that should be included within the plan itself in order to "self-mitigate" potential impacts to the degree possible. A list of the intersection-related improvements that the Plan includes is shown in Table 10.

Table 10
Intersection Improvements Included in PDA Plan

Intersection	Improvements
Commerce Blvd/State Farm Dr	Signalize with SB left-turn protected phasing and WB right-turn overlap; add WB right-turn pocket
State Farm Dr/Professional Center Dr	Modify NB and SB from L-T-TR to L-TR
Commerce Boulevard/Padre Parkway	Signalize with protected phasing NB/SB and permitted phasing EB/WB; modify NB from L-T-TR to L-T-R and SB from L-T-TR to L-TR
State Farm Dr/City Center Dr	Signalize with protected phasing NB/SB and permitted phasing EB/WB; modify NB from L-T-TR to L-T-R and SB from L-T-TR to L-TR
RPX/Commerce Blvd	Convert Commerce to protected phasing and add NB right-turn overlap; modify SB from L-LT-T-R to L-T-T-R; add bulbout NW corner; extend EB left lanes to 350' and WB left lane to 225'
RPX/State Farm Dr	Convert State Farm to protected phasing; add right-turn overlaps all approaches; modify SB from L-LT-R to L-L-T-R and NB from L-LT-T-R to L-L-T-R
Enterprise Dr/Hunter Dr	Convert EB from LT-TR to L-TR and WB from LT-TR to LT-R
Enterprise Dr/State Farm Dr	Signalize with two-phase operation; modify WB from T-TR to T-R
State Farm Dr/Town Center	Signalize with protected phasing NB/SB and permitted phasing EB/WB; modify NB and SB from L-T-TR to L-T-R; modify EB/WB from LTR to LT-R
RPX/Lynne Conde Way	Add protected pedestrian crossing on RPX (pedestrian signal or HAWK signal); continue to restrict side street movements to right turns on/off of RPX
RPX/SMART multi-use path	Add protected pedestrian crossing on RPX (pedestrian signal or HAWK signal)

Note: NB=Northbound; SB=Southbound; EB=Eastbound; WB=Westbound; L=left-turn lane; T=through lane; R=right-turn lane; lanes shown as grouped (example: L-T-TR is a 3-lane approach with one left-turn lane, one through lane, and a shared through-right turn lane); RPX=Rohnert Park Expressway

Trip Generation

Trip Generation Rate Sources

When determining the potential amount of vehicle traffic generated by future development, transportation planners and engineers typically refer to the publication *Trip Generation Manual*, 9th Edition, 2012, by the Institute of Transportation Engineers (ITE). This publication is a standard reference used by jurisdictions throughout the country, and is based on actual trip generation studies performed at numerous locations in areas of various populations. The following trip generation land use categories were used in the analysis.

- Residential – “Apartment” ITE Land Use #220
- Retail/Service – “Specialty Retail Center” ITE Land Use #826
- Office – “General Office Building” ITE Land Use #710
- Public/Institutional – “Recreational Community Center” ITE Land Use #495

- Industrial – “Light Industrial” ITE Land Use #110

While the PDA plan would allow for up to 500 new hotel rooms, it was determined that on a square footage basis retail uses generate more trips than hotels. For this reason, the analysis conservatively uses retail trip generation rates for all retail/service and hotel uses.

Internal Capture Trips

There are several shortcomings with using unadjusted trip generation rates in mixed-use and/or transit-oriented environments such as those envisioned in portions of the PDA. Because much of the data used to develop trip generation rates has historically been collected in auto-oriented suburban locations where individual land uses are segregated, direct application of these rates could significantly overstate traffic levels. The effects of higher residential densities, diverse land uses, proximity of jobs to housing, transit accessibility, and an interconnected pedestrian and roadway network would not be reflected in these standard rates. It was determined that additional trip estimation resources would be appropriate for the City Center and Station Center districts, which are envisioned to include a diverse mix of pedestrian-oriented uses and are located within one-half mile of the SMART station and several local and regional bus transit stops.

Internal trip reduction rates were determined using NCHRP Report 684, *Enhancing Internal Capture Estimation for Mixed-Use Developments*, Transportation Research Board, 2011. The trip reduction calculations, which are applied to standard ITE rates, are based upon the total quantity of various land uses and their proximity to each other. Based on the anticipated mix of uses in the City Center and Station Center districts, the resulting internal trips deductions are 5 percent during the a.m. peak hour and 24 percent during the p.m. peak hour. Copies of the spreadsheets indicating the derivation of the internal capture rates are provided in Appendix F. While the NCHRP research does not include specific trip reduction guidance for daily trip generation, the anticipated land use mix is likely to have daily internal capture rates that are approximately the average of the two peak hours, or 14 percent.

Total Project Trip Generation

Future development permitted under the proposed land uses contained within the PDA would be expected to result in a total of 27,777 added trips per day, including 1,352 during the AM peak hour and 1,973 during the PM peak hour. A summary of the trip generation estimates by PDA district is shown in Table 11.

**Table 11
Trip Generation Summary**

District Land Use	Units	Daily		AM Peak Hour		PM Peak Hour	
		Rate	Trips	Rate	Trips	Rate	Trips
Triangle Business							
Retail/Service (ITE #826)	120.88 ksf	44.32	5,357	0.96	116	2.71	328
Office (ITE #710)	91.42 ksf	11.03	1,008	1.56	143	1.49	136
Industrial (ITE #110)	129.32	6.97	901	0.92	119	0.97	125
District Total			7,266		378		589
City Center							
Residential (ITE #220)	115 du	6.65	765	0.51	59	0.62	71
Retail/Service (ITE #826)	56.85 ksf	44.32	2,520	0.96	55	2.71	154
Office (ITE #710)	32.56 ksf	11.03	359	1.56	51	1.49	49
Public/Institutional (ITE #495)	50.36 ksf	33.82	1,703	2.05	103	2.74	138
Internal Trip Deduction		-14%	-749	-5%	-13	-24%	-100
District Total			4,598		255		312
Station Center							
Residential (ITE #220)	565 du	6.65	3,757	0.51	288	0.62	350
Retail/Service (ITE #826)	171.63 ksf	44.32	7,607	0.96	165	2.71	465
Office (ITE #710)	65.34 ksf	11.03	721	1.56	102	1.49	97
Internal Trip Deduction		-14%	-1,692	-5%	-29	-24%	-219
District Total			10,393		526		693
Central Commercial							
Retail/Service (ITE #826)	74.26 ksf	44.32	3,291	0.96	71	2.71	201
Public/Institutional (ITE #495)	12.45 ksf	33.82	421	2.05	26	2.74	34
District Total			3,712		97		235
City Center							
Residential (ITE #220)	155 du	6.65	1,031	0.51	79	0.62	96
Retail/Service (ITE #826)	17.53 ksf	44.32	777	0.96	17	2.71	48
District Total			1,808		96		144
TOTAL NEW TRIPS			27,777		1,352		1,973

Note: du = dwelling unit; ksf = 1,000 square feet

Trip Distribution

The pattern used to allocate trips to and from uses within the PDA to the surrounding local and regional street network was based on two “select zone” model runs conducted within the SCTM/10 travel demand model, one of which is based on residential uses and the other of which assumes a mix of employment-based non-residential uses. The resulting trip distribution estimates were then further refined to reflect local street and travel patterns. The trip distribution estimates are shown in Table 12.

Table 12
Trip Distribution Assumptions

Route	Non-Residential Uses	Residential Uses
US 101 North	24%	18%
US 101 South	14%	14%
RPX – west of US 101	16%	14%
RPX – east of SMART	14%	13%
Seed Farm Drive – south of Enterprise	14%	18%
Commerce Blvd – north of Golf Course	2%	1%
Commerce Blvd – south of Enterprise	5%	7%
Golf Course Drive – east of Commerce	4%	3%
Golf Course Drive – west of US 101	3%	4%
Northern PDA area	2%	4%
Southern PDA area	2%	4%
TOTAL	100%	100%

Note: RPX = Rohnert Park Expressway

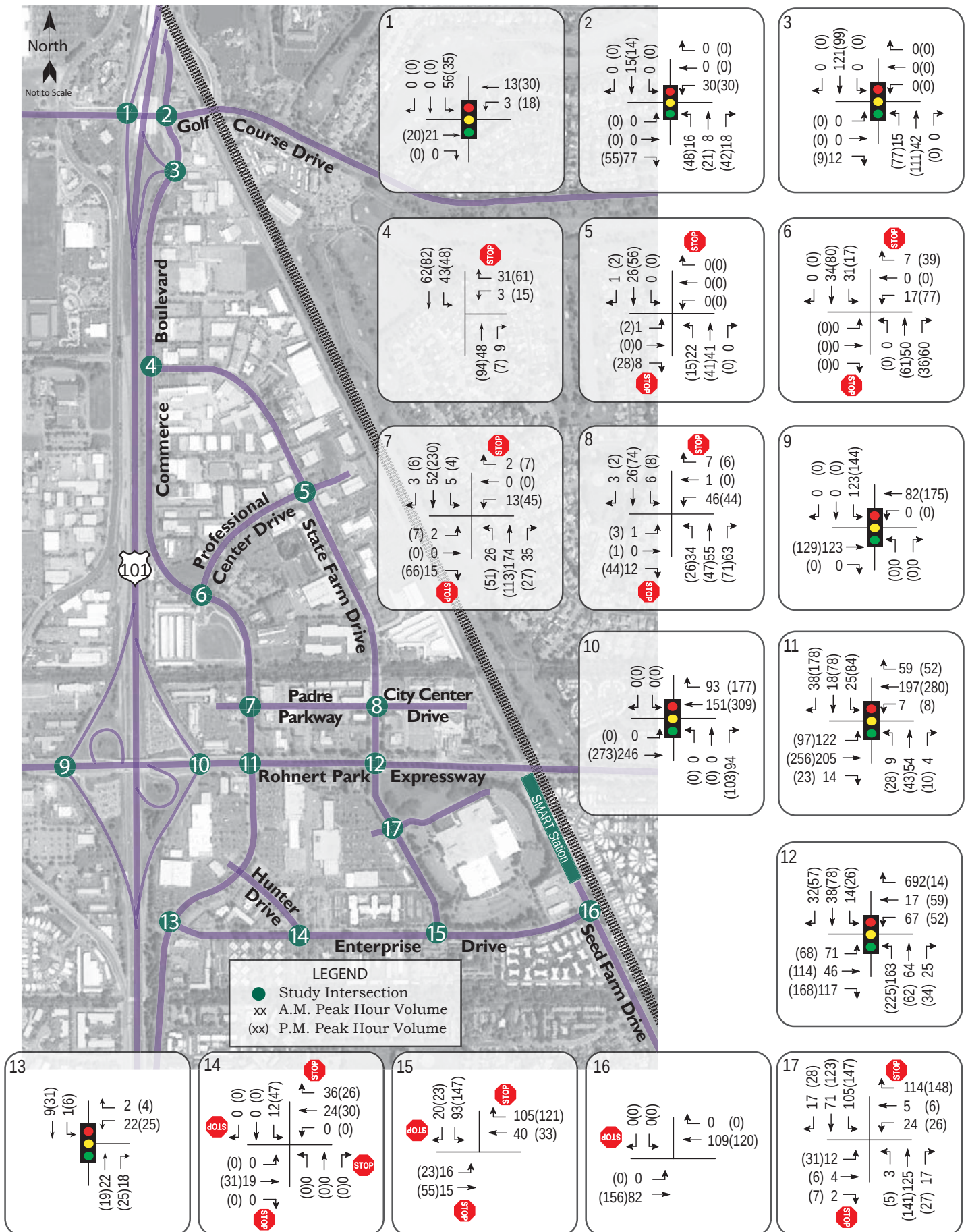
Existing plus Project Operation

Existing plus Project Intersection Operation

Upon the addition of project-related traffic to existing volumes and without any of the intersection improvements proposed by the Plan, 12 of the 17 study intersections are expected to continue operating acceptably. The five intersections projected to operate unacceptably include Commerce Boulevard/State Farm Drive, Rohnert Park Expressway/Commerce Boulevard, Rohnert Park Expressway/State Farm Drive, Enterprise Drive/State Farm Drive, and State Farm Drive/Town Center.

With incorporation of the intersection improvements included in the PDA Plan and shown in Table 10, the intersections at Rohnert Park Expressway/Commerce Boulevard and Rohnert Park Expressway/State Farm Drive would continue to operate at LOS D during the p.m. peak hour. Because these two intersections already operate at LOS D during the existing (no project) p.m. peak hour, and because the PDA plan and its associated intersection improvements would not further degrade the intersections below their current LOS D level, Policy TR-1 of the General Plan considers this LOS D operation to be acceptable. As a result, all 17 study intersections are projected to operate acceptably under Existing plus Project conditions with the proposed improvements.

Existing plus Project level of service results are summarized in Table 13. Project traffic volumes are shown in Figure 7, and copies of the LOS calculations are provided in Appendix C.



Central Rohnert Park PDA Plan
Figure 7 – Project Traffic Volumes

Table 13
Existing and Existing plus Project Intersection Levels of Service

Study Intersection Approach	Existing		Existing plus Project	
	AM Peak	PM Peak	AM Peak	PM Peak
1. Golf Course Drive West/US 101 South Ramps	29.8/C	22.1/C	29.6/C	22.3/C
2. Golf Course Drive/Commerce Boulevard	20.1/C	24.7/C	21.9/C	26.0/C
3. Commerce Boulevard/US 101 North Ramps	7.7/A	12.5/B	8.8/A	14.6/B
4. Commerce Boulevard/State Farm Drive	5.0/A	9.9/A	5.4/A	44.3/E
Westbound Approach	11.9/B	28.5/D	14.6/B	**/F
With PDA Plan Improvements	-	-	9.3/A	14.7/B
5. State Farm Drive/Professional Center Drive	2.2/A	3.6/A	2.4/A	4.1/A
Eastbound Approach	11.3/B	12.7/B	11.7/B	13.2/B
Westbound Approach	11.9/B	16.4/C	13.5/B	21.3/C
With PDA Plan Improvements	-	-	2.5/A	4.6/A
Eastbound Approach	-	-	12.3/B	14.4/B
Westbound Approach	-	-	14.5/B	25.5/B
6. Commerce Boulevard/Professional Center Drive	1.4/A	2.3/A	4.4/A	6.3/A
Southbound (Professional Center) Approach	10.2/B	12.5/B	12.6/B	19.6/C
7. Commerce Boulevard/Padre Parkway	2.7/A	3.6/A	2.9/A	11.2/B
Eastbound Approach	10.1/B	10.9/B	11.0/B	13.7/B
Westbound Approach	11.7/B	17.3/C	16.2/C	72.2/F
With PDA Plan Improvements	-	-	13.2/B	21.7/C
8. State Farm Drive/City Center Drive	2.1/A	5.4/A	3.6/A	20.4/C
Eastbound Approach	9.9/A	12.8/B	10.3/B	15.2/C
Westbound Approach	13.0/B	25.8/D	19.9/C	**/F
With PDA Plan Improvements	-	-	13.9/B	16.8/B
9. Rohnert Park Expressway/US 101 South Ramps	20.1/C	27.3/C	21.6/C	29.4/C
10. Rohnert Park Expressway/US 101 North Ramps	24.0/C	23.2/C	37.3/D	28.1/C
11. Rohnert Park Expressway/Commerce Boulevard	32.5/C	41.7/D	39.5/D	62.5/E
With PDA Plan Improvements	-	-	25.5/C	38.5/D ¹
12. Rohnert Park Expressway/State Farm Drive	33.4/C	41.0/D	44.4/D	71.7/E
With PDA Plan Improvements	-	-	32.7/C	41.8/D ¹
13. Commerce Boulevard/Enterprise Drive	9.5/A	8.8/A	11.1/B	10.8/B
14. Enterprise Drive/Hunter Drive	7.2/A	8.8/A	7.5/A	9.8/A
With PDA Plan Improvements	-	-	7.4/A	9.9/A
15. Enterprise Drive/State Farm Drive	8.4/A	17.7/C	11.6/B	58.1/F
With PDA Plan Improvements	-	-	6.2/A	9.7/A

Table 13
Existing and Existing plus Project Intersection Levels of Service

Study Intersection Approach	Existing		Existing plus Project	
	AM Peak	PM Peak	AM Peak	PM Peak
16. Enterprise Drive/Seed Farm Drive	0.1/A	0.0/A	0.1/A	0.0/A
<i>Southbound Approach</i>	<i>11.1/B</i>	<i>16.4/C</i>	<i>12.9/B</i>	<i>22.3/C</i>
17. State Farm Drive/Town Center	1.4/A	4.9/A	5.0/A	**/F
<i>Eastbound Approach</i>	<i>11.5/B</i>	<i>25.2D</i>	<i>29.5/D</i>	<i>**/F</i>
<i>Westbound Approach</i>	<i>9.0/A</i>	<i>0.0/A</i>	<i>14.3/B</i>	<i>30.1/D</i>
With PDA Plan Improvements	-	-	18.2/B	15.9/B

Notes: Results shown as Delay/LOS; Delay is measured in average seconds per vehicle; LOS = Level of Service; Results for minor approaches to two-way stop-controlled intersections are indicated in *italics*; ** = delay greater than 120 seconds; **Bold** text = deficient operation

¹ LOS D operation considered to be acceptable since the project includes improvements that prevent the existing LOS from further deteriorating

Finding: Upon the addition of project traffic to existing volumes and completion of the intersection improvements identified in the plan, all 17 study intersections are projected to continue operating acceptably under Existing plus Project conditions.

Existing plus Project Freeway Operation

Under existing plus project conditions, all of the freeway facilities are projected to continue operating acceptably at LOS E or better. A summary of freeway facility levels of service is shown for the a.m. and p.m. peak hours is shown in Table 14 and 15, respectively, and calculation worksheets are provided in Appendix E.

Table 14
Existing and Existing plus Project AM Peak Hour Freeway Levels of Service

US 101 Freeway Segment Direction	Existing			Existing plus Project			Δ
	V/C	Density	LOS	V/C	Density	LOS	V/C
Northbound							
SR 116 off-ramp to on-ramp	0.47	16.0	B	0.49	16.8	B	0.02
SR 116 on-ramp to RPX off-ramp	0.49	17.8	B	0.53	18.6	C	0.04
RPX off-ramp to RPX EB on-ramp	0.56	19.1	C	0.56	19.2	C	0.00
RPX EB on-ramp	0.60	23.8	C	0.61	23.9	C	0.01
RPX EB on-ramp to RPX WB on-ramp	0.60	21.3	C	0.61	21.4	C	0.01
RPX WB on-ramp to Golf Course Dr. off-ramp	0.55	20.1	C	0.57	21.0	C	0.02
Golf Course Dr. off-ramp to on-ramp	0.70	24.8	C	0.72	25.7	C	0.02
Golf Course Dr. on to Santa Rosa Ave. off-ramp	0.55	21.2	C	0.56	21.9	C	0.01
Santa Rosa Ave. off-ramp to Todd Rd. off-ramp	0.74	26.7	D	0.76	27.9	D	0.02
Southbound							
Todd Rd. on-ramp to Golf Course Dr. off-ramp	0.79	29.2	D	0.82	31.4	D	0.03
Golf Course Dr. off-ramp	0.79	30.5	D	0.82	32.1	D	0.03
Golf Course Dr. off-ramp to on-ramp	0.65	22.6	C	0.67	23.8	C	0.02
Golf Course Dr. on-ramp to RPX off-ramp	0.55	21.1	C	0.59	22.1	C	0.04
RPX off-ramp to RPX WB on-ramp	0.57	19.5	C	0.57	19.5	C	0.00
RPX WB on-ramp	0.63	25.7	C	0.65	26.4	C	0.02
RPX EB on-ramp to SR 116 off-ramp	0.52	18.4	B	0.53	18.9	B	0.00
SR 116 off-ramp to SR 116 on-ramp	0.57	19.5	C	0.58	20.1	C	0.01

Notes: V/C = volume to capacity ratio; Density is measured in passenger cars per mile per lane (pc/mi/ln)
LOS = Level of Service; RPX=Rohnert Park Expressway; EB=Eastbound; WB=Westbound;
Δ V/C = increase in v/c ratio that is attributable to the project

Table 15
Existing and Existing plus Project PM Peak Hour Freeway Levels of Service

US 101 Freeway Segment Direction	Existing I 5			Existing plus Project			Δ
	V/C	Density	LOS	V/C	Density	LOS	V/C
Northbound							
SR 116 off-ramp to on-ramp	0.79	29.5	D	0.81	30.8	D	0.02
SR 116 on-ramp to RPX off-ramp	0.67	27.0	C	0.70	28.0	D	0.03
RPX off-ramp to RPX EB on-ramp	0.75	27.4	D	0.75	27.5	D	0.00
RPX EB on-ramp	0.83	34.8	D	0.83	35.0	D	0.00
RPX EB on-ramp to RPX WB on-ramp	0.83	31.6	D	0.83	31.7	D	0.00
RPX WB on-ramp to Golf Course Dr. off-ramp	0.70	27.1	C	0.73	28.8	D	0.03
Golf Course Dr. off-ramp to on-ramp	0.81	30.5	D	0.85	32.8	D	0.04
Golf Course Dr. on to Santa Rosa Ave. off-ramp	0.72	29.2	D	0.75	31.2	D	0.03
Santa Rosa Ave. off-ramp to Todd Rd. off-ramp	0.94	39.3	E	0.99	44.1	E	0.05
Southbound							
Todd Rd. on-ramp to Golf Course Dr. off-ramp	0.79	29.3	D	0.83	31.5	D	0.04
Golf Course Dr. off-ramp	0.79	30.7	D	0.83	32.3	D	0.04
Golf Course Dr. off-ramp to on-ramp	0.63	21.8	C	0.66	23.1	C	0.03
Golf Course Dr. on-ramp to RPX off-ramp	0.68	22.2	C	0.75	23.6	C	0.07
RPX off-ramp to RPX WB on-ramp	0.55	18.9	C	0.55	19.0	C	0.00
RPX WB on-ramp	0.59	23.9	C	0.63	25.4	C	0.04
RPX EB on-ramp to SR 116 off-ramp	0.57	21.1	C	0.59	22.1	C	0.02
SR 116 off-ramp to SR 116 on-ramp	0.53	18.2	C	0.56	19.4	C	0.03

Notes: V/C = volume to capacity ratio; Density is measured in passenger cars per mile per lane (pc/mi/ln)
LOS = Level of Service; RPX=Rohnert Park Expressway; EB=Eastbound; WB=Westbound

Finding: US 101 freeway facilities are projected to operate at acceptable levels of service upon the addition of project-generated trips to existing traffic levels.

Future plus Project Operation

Future plus Project Intersection Operation

Upon the addition of project-related traffic to future volumes and without any of the intersection improvements proposed by the Plan, 10 of the 17 study intersections would be expected to continue operating acceptably. The seven intersections projected to operate unacceptably include Commerce Boulevard/State Farm Drive, Commerce Boulevard/Padre Parkway, State Farm Drive/City Center Drive, Rohnert Park Expressway/Commerce Boulevard, Rohnert Park Expressway/State Farm Drive, Enterprise Drive/State Farm Drive, and State Farm Drive/Town Center.

With incorporation of the intersection improvements included in the PDA Plan and shown in Table 10, five of the seven intersections projected to operate unacceptably would improve to LOS C or better overall. The intersections at Rohnert Park Expressway/Commerce Boulevard and Rohnert Park

Expressway/State Farm Drive are projected to operate at LOS D. As in the Existing plus Project scenario, however, these intersections would operate at LOS D (or worse) without the project, and buildout of the PDA Plan and its associated improvements would not cause operation to further degrade. In fact, p.m. peak hour operation at Rohnert Park Expressway/State Farm Drive is projected to be LOS E without the project, but would improve to LOS D with the project (as a result of intersection improvements included in the Plan).

Future plus Project level of service results are summarized in Table 16, and copies of the LOS calculations are provided in Appendix D. Peak hour Future plus Project traffic volumes at the study intersections are shown in Figure 8.

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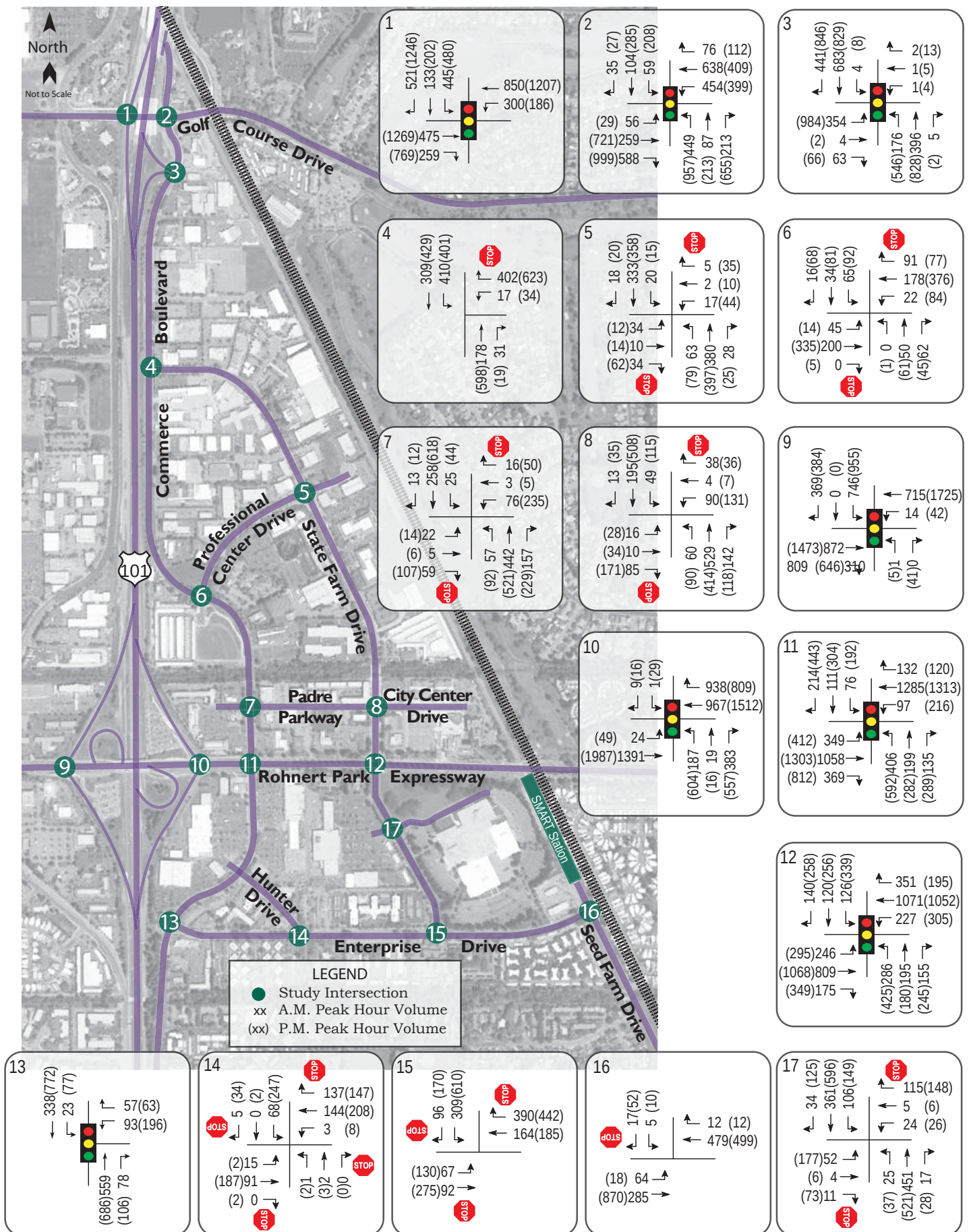


Table 16
Future and Future plus Project Intersection Levels of Service

Study Intersection Approach	Future		Future plus Project	
	AM Peak	PM Peak	AM Peak	PM Peak
1. Golf Course Drive West/US 101 South Ramps	24.8/C	41.8/D	25.7/C	40.8/D
2. Golf Course Drive/Commerce Boulevard	25.5/C	38.3/D	26.2/C	45.4/D
3. Commerce Boulevard/US 101 North Ramps	11.3/B	34.1/C	12.3/B	40.5/D
4. Commerce Boulevard/State Farm Drive	7.9/A	56.8/F	9.6/A	**/F
Westbound Approach	15.4/C	169.4/F	22.1/C	**/F
With PDA Plan Improvements	-	-	9.8/A	21.1/C
5. State Farm Drive/Professional Center Drive	2.3/A	3.3/A	2.5/A	3.8/A
Eastbound Approach	14.7/B	13.5/B	15.9/C	13.8/B
Westbound Approach	16.8/C	18.0/C	19.7/C	22.7/C
With PDA Plan Improvements	-	-	2.8/A	4.3/A
Eastbound Approach	-	-	17.9/C	15.4/C
Westbound Approach	-	-	22.2/C	28.1/D
6. Commerce Boulevard/Professional Center Drive	1.7/A	2.2/A	4.4/A	5.4/A
Southbound (Professional Center) Approach	10.9/B	12.5/B	13.3/B	17.7/C
7. Commerce Boulevard/Padre Parkway	2.7/A	5.4/A	2.9/A	25.7/D
Eastbound Approach	10.4/B	11.2/B	11.3/B	13.8/B
Westbound Approach	12.9/B	25.9/D	17.7/C	**/F
With PDA Plan Improvements	-	-	15.7/B	24.5/C
8. State Farm Drive/City Center Drive	3.4/A	13.2/C	7.9/A	75.2/F
Eastbound Approach	11.7/B	19.8/C	13.0/B	27.5/D
Westbound Approach	20.5/C	103.3/F	55.5/F	**/F
With PDA Plan Improvements	-	-	19.8/B	22.3/C
9. Rohnert Park Expressway/US 101 South Ramps	21.5/C	21.6/C	19.9/B	22.9/C
10. Rohnert Park Expressway/US 101 North Ramps	32.9/C	32.9/C	29.7/C	24.5/C
11. Rohnert Park Expressway/Commerce Boulevard	34.6/C	44.1/D	52.5/D	97.2/F
With PDA Plan Improvements	-	-	28.5/C	50.9/D
12. Rohnert Park Expressway/State Farm Drive	44.6/D	60.8/E	74.1/E	93.8/F
With PDA Plan Improvements	-	-	37.8/D	46.6/D
13. Commerce Boulevard/Enterprise Drive	13.6/B	7.8/A	14.1/B	8.2/A
14. Enterprise Drive/Hunter Drive	7.4/A	9.3/A	7.7/A	10.4/B
With PDA Plan Improvements	-	-	7.6/A	10.7/B
15. Enterprise Drive/State Farm Drive	10.7/B	31.1/D	17.0/C	90.7/F
With PDA Plan Improvements	-	-	6.9/A	10.6/B

Table 16
Future and Future plus Project Intersection Levels of Service

Study Intersection <i>Approach</i>	Future		Future plus Project	
	AM Peak	PM Peak	AM Peak	PM Peak
16. Enterprise Drive/Seed Farm Drive <i>Southbound Approach</i>	1.4/A <i>12.0/B</i>	1.0/A <i>13.4/B</i>	1.2/A <i>13.6/B</i>	1.0/A <i>16.3/C</i>
17. State Farm Drive/Town Center <i>Eastbound Approach</i>	1.2/A <i>13.7/B</i>	6.2/A <i>33.6/D</i>	5.3/A <i>43.5/E</i>	**/F **/F
<i>Westbound Approach</i>	9.3/A	14.3/B	16.6/C	33.6/D
With PDA Plan Improvements	-	-	17.3/B	18.0/B

Notes: Results shown as Delay/LOS; Delay is measured in average seconds per vehicle; LOS = Level of Service; Results for minor approaches to two-way stop-controlled intersections are indicated in *italics*; ** = delay greater than 120 seconds; **Bold** text = deficient operation

Finding: With buildout of the PDA plan and its improvements, and in consideration of policy TR-1 of the City's General Plan, all 17 study intersections are projected to operate acceptably under Future plus Project conditions.

Future plus Project Freeway Operation

Under future plus project conditions, the addition of traffic associated with buildout of the PDA would lead to further degradation of two freeway segments already projected to operate unacceptably at LOS F without the project. On the segment of northbound US 101 between Golf Course Drive and Santa Rosa Avenue, the project would be responsible for an increase in the volume-to-capacity ratio of 0.04 during the p.m. peak hour, which is considered to be cumulatively significant. On the segment of southbound US 101 between Todd Road and Golf Course Drive, the project would be responsible for volume-to-capacity ratio increases of 0.04 during the a.m. peak hour and 0.03 during the p.m. peak hour, both of which are also considered to be cumulatively significant. On the remaining freeway segments the project would not be expected to cause operation to fall below LOS E during either peak hour.

A summary of freeway facility levels of service is shown for the a.m. and p.m. peak hours in Table 17 and Table 18, respectively, and calculation worksheets are provided in Appendix E.

Table 17
Future and Future plus Project AM Peak Hour Freeway Levels of Service

US 101 Freeway Segment Direction	Future			Future plus Project			Δ
	V/C	Density	LOS	V/C	Density	LOS	V/C
Northbound							
SR 116 off-ramp to on-ramp	0.51	17.6	B	0.54	18.4	C	0.03
SR 116 on-ramp to RPX off-ramp	0.63	21.6	C	0.66	22.5	C	0.03
RPX off-ramp to RPX EB on-ramp	0.65	22.9	C	0.66	23.0	C	0.01
RPX EB on-ramp	0.71	28.7	D	0.71	28.8	D	0.00
RPX EB on-ramp to RPX WB on-ramp	0.71	25.5	C	0.71	25.6	C	0.00
RPX WB on-ramp to Golf Course Dr. off-ramp	0.68	26.0	C	0.70	27.0	C	0.02
Golf Course Dr. off-ramp to on-ramp	0.81	30.7	D	0.83	31.9	D	0.02
Golf Course Dr. on to Santa Rosa Ave. off-ramp	0.66	26.6	C	0.68	27.4	C	0.02
Santa Rosa Ave. off-ramp to Todd Rd. off-ramp	0.84	32.6	D	0.87	34.0	D	0.03
Southbound							
Todd Rd. on-ramp to Golf Course Dr. off-ramp	1.08	44.7	F	1.12	44.7	F	0.04
Golf Course Dr. off-ramp	1.08	41.6	F	1.12	41.7	F	0.04
Golf Course Dr. off-ramp to on-ramp	0.89	31.1	D	0.92	31.1	D	0.03
Golf Course Dr. on-ramp to RPX off-ramp	0.76	35.2	E	0.79	35.6	E	0.03
RPX off-ramp to RPX WB on-ramp	0.83	28.3	D	0.83	27.7	D	0.00
RPX WB on-ramp	0.90	36.7	E	0.92	36.7	E	0.02
RPX EB on-ramp to SR 116 off-ramp	0.75	24.5	C	0.76	24.1	C	0.01
SR 116 off-ramp to SR 116 on-ramp	0.84	29.6	D	0.86	29.7	D	0.02

Notes: V/C = volume to capacity ratio; Density is measured in passenger cars per mile per lane (pc/mi/ln)
LOS = Level of Service; RPX=Rohnert Park Expressway; EB=Eastbound; WB=Westbound;
Δ V/C = increase in v/c ratio that is attributable to the project

Table 18
Future and Future plus Project PM Peak Hour Freeway Levels of Service

US 101 Freeway Segment Direction	Future			Future plus Project			Δ
	V/C	Density	LOS	V/C	Density	LOS	V/C
Northbound							
SR 116 off-ramp to on-ramp	0.56	19.3	C	0.58	20.0	C	0.02
SR 116 on-ramp to RPX off-ramp	0.71	29.6	D	0.73	33.5	D	0.02
RPX off-ramp to RPX EB on-ramp	0.84	31.9	D	0.84	32.7	D	0.00
RPX EB on-ramp	0.93	42.0	E	0.93	42.0	E	0.00
RPX EB on-ramp to RPX WB on-ramp	0.93	39.0	E	0.93	39.0	E	0.00
RPX WB on-ramp to Golf Course Dr. off-ramp	0.77	31.8	D	0.81	44.9	D	0.04
Golf Course Dr. off-ramp to on-ramp	0.93	44.6	E	0.96	53.0	E	0.03
Golf Course Dr. on to Santa Rosa Ave. off-ramp	0.86	69.2	F	0.90	76.0	F	0.04
Santa Rosa Ave. off-ramp to Todd Rd. off-ramp	1.10	44.5	F	1.16	44.5	F	0.04
Southbound							
Todd Rd. on-ramp to Golf Course Dr. off-ramp	1.05	44.7	F	1.08	44.7	F	0.03
Golf Course Dr. off-ramp	1.05	41.7	F	1.08	41.7	F	0.03
Golf Course Dr. off-ramp to on-ramp	0.84	30.4	D	0.88	30.4	D	0.04
Golf Course Dr. on-ramp to RPX off-ramp	0.75	36.0	E	0.79	36.7	E	0.04
RPX off-ramp to RPX WB on-ramp	0.79	27.7	D	0.79	27.1	D	0.00
RPX WB on-ramp	0.83	34.4	D	0.87	34.4	D	0.04
RPX EB on-ramp to SR 116 off-ramp	0.65	21.9	C	0.67	22.8	C	0.02
SR 116 off-ramp to SR 116 on-ramp	0.74	25.8	C	0.77	26.4	D	0.03

Notes: V/C = volume to capacity ratio; Density is measured in passenger cars per mile per lane (pc/mi/ln)
LOS = Level of Service; RPX=Rohnert Park Expressway; EB=Eastbound; WB=Westbound

The projected unacceptable operation on US 101 could be mitigated by widening the freeway to include additional through lanes in each direction. Further widening of US 101 is not included in the SCTA's Comprehensive Transportation Plan, nor do any financing mechanisms currently exist to fund such a widening project. Widening the freeway would require major reconstruction of multiple freeway structures, right-of-way acquisition including many homes and businesses, potential relocation of city streets paralleling the freeway corridor (including Redwood Boulevard and Commerce Boulevard), and the likely creation of additional secondary environmental impacts. The environmental, social, and financial impacts render such a widening project infeasible.

The MTC, County of Sonoma, City of Rohnert Park, and SCTA recognize that US 101 will experience congestion into the foreseeable future, and that there will be no further major capacity enhancements such as expansions or new freeways. All four agencies concur in various planning and policy documents that long-range solutions to regional mobility must focus on better land use planning that supports transit and alternative transportation modes; stronger jobs-housing balances; and increased support of transportation demand measures. The creation of designated PDA areas by MTC and ABAG, including

the Central Rohnert Park PDA that is the subject of this analysis, is intended to further these goals and minimize impacts created by regional traffic demands.

Finding: Future development permitted under the PDA Plan would contribute to LOS F operation on mainline US 101 to the north of Golf Course Drive in both the northbound and southbound directions, increasing these segments' volume-to-capacity ratio by greater than 0.01, which is considered to be cumulatively significant.

DRAFT

Analysis of Non-Automobile Modes

Pedestrian and Bicycle Facilities

A major goal of the PDA plan is to enhance pedestrian and bicycle circulation, expanding and improving current networks to make walking and bicycling a preferred mode of travel for residents, employees, and visitors to central Rohnert Park. The pedestrian and bicycle enhancements identified in the Plan have also been crafted to create convenient connections to the SMART rail station and SMART corridor regional multi-use path.

Improvements Included in Plan

Following is a brief summary of future improvements included in the plan.

New and Enhanced Off-Street Linkages

- Create new east-west pedestrian connections in the Triangle Business District linking Commerce Boulevard to State Farm Drive
- Create a north-south pedestrian and bicycle “paseo” through the Triangle Business District linking Professional Drive to Cascade Court
- Fill gaps in the trail network along Hinebaugh Creek
- Extend the Commerce Boulevard bike path/trail northward from Enterprise Drive to Rohnert Park Expressway
- Make improvements and add connections to Rohnert Park Expressway bike paths/trails

On-Street Bicycle Facility Enhancements

- Fill bicycle lane gaps on Commerce Boulevard
- Improve bicycle facilities along Professional Center Drive, creating a strong bike connection between Commerce Boulevard and the SMART corridor multi-use pathway
- Implement bicycle facility enhancements on State Farm Drive
- Implement bicycle boulevards on streets within the Station Center District that enhance bicycle connectivity to the SMART station
- Add bicycle lanes on Hunter Drive and Enterprise Drive

Pedestrian Walkways

- Add new sidewalks and paths in the City Center district, including new links between Rohnert Park Expressway and Hinebaugh Creek
- Establish a robust network of pedestrian walkway improvements within the Central Commercial District including new and/or enhanced north-south and east-west connections

Pedestrian and Bicycle Crossings

- Implement pedestrian crossing improvements at intersections throughout the Plan area
- Establish two new signalized pedestrian crossings on Rohnert Park Expressway, one serving the SMART multi-use path and the other creating a pedestrian linkage between the City Center and Station Center Districts at Lynne Conde Way
- Plan for a future bicycle/pedestrian bridge over Rohnert Park Expressway to the east of the SMART rail corridor, linking the Station Center District to the City Center District

- Establish a pedestrian crossing on Enterprise Drive between the Station Center District and the existing trail linkage leading to the Copeland Creek trails, potentially at a mid-block location and/or with a pedestrian signal such as a HAWK if appropriate

Assessment of Planned Pedestrian and Bicycle Improvements

The new and enhanced on- and off-street pedestrian and bicycle improvements identified in the Plan build upon (and are consistent with) facilities identified in the *Rohnert Park Bicycle and Pedestrian Master Plan*. The creation of new pedestrian and bicycle connections reduces the effective block sizes within the PDA area, minimizing the distances pedestrians and cyclists must traverse when traveling from one point to another, including the SMART rail station. The need to make such trips by automobile is thereby reduced both at the local level and at the regional level by making pedestrian and bicycle connections to transit more convenient.

An integral component to improving pedestrian and bicycle connectivity is creating public street crossings that are both comfortable to use and carefully designed to accommodate all users in a safe manner. At the intersections identified in the Plan as having intersection crossing enhancements, improvements could include those that increase driver awareness of crossing areas (high-visibility markings and pedestrian/bicyclist-activated warning lights), reduce pedestrian crossing distances (bulb-outs and median refuges), or increase the feeling of safety (pedestrian-scale lighting). These types of improvements can significantly enhance pedestrian and bicyclist safety while causing minimal impacts to motor vehicle modes.

New Crossings on Rohnert Park Expressway

The new pedestrian crossings identified on Rohnert Park Expressway would need to be carefully designed to achieve the desired results of improved pedestrian connectivity, minimized disruption to through traffic, and user safety. Both locations would be designed primarily for pedestrians, with no provisions for passenger vehicle left-turns from Rohnert Park Expressway onto side streets and vice versa. Given the traffic levels on Rohnert Park Expressway, it is necessary for these crossings to be signalized, using either conventional traffic signals or a newer type of device called a pedestrian hybrid beacon, also referred to as a “HAWK” signal. Both types of devices can be integrated into the coordinated signal timing that exists on Rohnert Park Expressway, effectively minimizing disruption to through traffic by activating pedestrian crossings to occur in between the “platoons” of through traffic created by signal coordination. A conventional traffic signal would be active at all times, whereas a HAWK signal would only activate when a pedestrian or bicyclist wishes to cross the corridor. Both devices can also be designed to communicate with railroad crossing signaling systems to ensure that any queues downstream of the rail crossing are cleared prior to arrival of a train, and both can also be programmed to accommodate emergency vehicle preemption. Both of these parameters are particularly important at these locations on Rohnert Park Expressway given the proximity of the SMART rail corridor and existing fire station emergency signal.

With respect to traffic flow on Rohnert Park Expressway, implementation of the two potential pedestrian signals was tested assuming full coordination with adjacent signals, with resulting operation at each signal found to be in the LOS A-B range under buildout conditions during both the a.m. and p.m. peak hours.

The choice of signalization option (conventional versus HAWK) as well as a more detailed evaluation of appropriate signal timing and preemption schemes for these two signals will need to be completed prior to installation, and preferably once detailed development details for future development in the Station Center District are known.

New Crossing on Enterprise Drive

The new pedestrian crossing on Enterprise Drive identified in the Plan would be located adjacent to an existing pathway that links the south side of the street to pathways on Copeland Creek. How this new crossing should be accommodated is dependent on how the property on the north side of the street (the Station Center District) ultimately develops. If the Station Center District development includes a public street at this location, the crossing would not be considered “mid-block” and could effectively accommodate pedestrians and cyclists using components such as bulbouts, median refuge areas, high-visibility pavement parking, and if warranted, pedestrian warning lights or signals. If the crossing ends up occurring at a mid-block location, similar techniques may be used, though the potential need to include warning lights or a signal becomes more likely. In either case it will be necessary to evaluate the types of crossing amenities that are warranted at such time as a development proposal moves forward and the surrounding circulation context is known.

Finding: The pedestrian and bicycle facilities identified in the PDA plan will encourage travel by non-auto modes and help to support future growth in Central Rohnert Park.

Finding: The new pedestrian and bicycle crossings identified in the Plan can be designed to enhance pedestrian and bicycle circulation in a manner that does not adversely affect traffic flow or safety at the SMART rail crossing.

Transit Facilities

The PDA is served by several Sonoma County Transit bus routes that provide local service as well as service to adjacent Sonoma County communities. Regional bus service connecting communities from Santa Rosa to San Francisco is also provided by Golden Gate Transit. All transit routes serve the Central Commercial District with stops on Commerce Boulevard and/or Enterprise Drive, and several Sonoma County Transit routes also operate on Rohnert Park Expressway and State Farm Drive. The plan identifies several locations where new transit stops would be beneficial, and identifies a potential new bus circulator route serving the SMART station via new streets in the Station Center District. The circulator route could be utilized by diverting existing routes once the SMART station and development in the Station Center District are complete. The street network depicted for the Station Center District allows considerable flexibility for transit operators in determining routing, including the ability to continue serving existing stops in the vicinity.

In addition to concentrating future development around the SMART rail station, the PDA plan would also focus development in an area that has an existing concentration of local and regional bus routes with timed stops on Commerce Boulevard and Hunter Drive.

Finding: The PDA plan would support and encourage use of transit through concentrating development around existing bus facilities and the planned SMART rail station, and by accommodating new or diverted bus routes that directly interface with the SMART station.

Conclusions

- The PDA plan identifies multimodal improvements to the circulation network including new pedestrian-bicycle linkages and identification of intersection improvements needed to support future growth.
- The plan would allow for construction of approximately 835 new residential units and approximately 823,000 square feet of additional non-residential uses including commercial, office, and light industrial among five “districts”.
- Future development permitted under the proposed land uses contained within the PDA could result in a total of 27,777 added trips per day, including 1,352 during the AM peak hour and 1,973 during the PM peak hour.
- The PDA plan includes roadway and intersection improvements that are intended to “self-mitigate” potential traffic impacts.
- The intersections at Rohnert Park Expressway/Commerce Boulevard and Rohnert Park Expressway/State Farm Drive are currently operating at LOS D during the p.m. peak hour, which is considered unacceptable since the City’s standard for these locations is LOS C.
- Upon the addition of project-related traffic to existing volumes and with incorporation of the intersection improvements included in the plan, the intersections at Rohnert Park Expressway/Commerce Boulevard and Rohnert Park Expressway/State Farm Drive are expected to operate at LOS D. Because these two intersections already operate at LOS D without the project, and the project would not further degrade LOS, this is considered to be acceptable per General Plan Policy TR-I.
- Under year 2040 buildout conditions without the project, the intersections at Commerce Boulevard/State Farm Drive, Rohnert Park Expressway/Commerce Boulevard, and Enterprise Drive/State Farm Drive are projected to operate at unacceptable levels of service.
- Upon the addition of project-related traffic to future volumes and with incorporation of the intersection improvements included in the PDA Plan, the intersections at Rohnert Park Expressway/Commerce Boulevard and Rohnert Park Expressway/State Farm Drive are projected to operate at LOS D. Buildout of the PDA Plan and its associated improvements would not cause LOS to further degrade.
- With buildout of the PDA plan and its improvements, and in consideration of policy TR-I of the City’s General Plan, all 17 study intersections are projected to operate acceptably under Existing plus Project and Future plus Project conditions.
- US 101 freeway facilities between the State Route 116 and Todd Road freeway interchanges are currently operating acceptably at LOS E or better.
- US 101 is projected to continue operating acceptably under Existing plus Project conditions.
- Under year 2040 buildout conditions without the project, the US 101 freeway segment between Todd Road and Golf Course Drive is projected to operate unacceptably at LOS F.
- Under future plus project conditions, buildout of the PDA would add traffic to two freeway segments already projected to operate unacceptably at LOS F without the project (northbound

between Golf Course Drive and Santa Rosa Avenue and southbound between Todd Road and Golf Course Drive). Increases in the freeway volume-to-capacity ratios on affected segments would range from 0.03 to 0.04, which is considered to be cumulatively significant.

- Future LOS F operation on US 101 could be mitigated by widening the freeway, though the environmental, social, and financial impacts render such a widening project infeasible. The creation of designated PDA areas by MTC and ABAG, including the Central Rohnert Park PDA, is intended to manage regional growth in an efficient manner that supports non-auto modes and minimizes vehicular impacts.
- The pedestrian and bicycle improvements identified in the Plan expand upon those identified in the *Rohnert Park Bicycle and Pedestrian Master Plan*, emphasizing the use of non-auto modes in Central Rohnert Park and enhancing connectivity to transit including the SMART rail station.
- The new pedestrian and bicycle crossings identified in the Plan can be designed to enhance pedestrian and bicycle circulation in a manner that does not adversely affect traffic flow or safety at the SMART rail crossing.
- The PDA plan would support and encourage use of transit through concentrating development around existing bus facilities and the planned SMART rail station, and by accommodating new or diverted bus routes that directly interface with SMART.

Study Participants and References

Study Participants

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RPA064

Appendix A

Existing Intersection LOS Calculations

HCM Signalized Intersection Capacity Analysis

1: US 101 South Ramps & Golf Course Drive West/Golf Course Dr

3/31/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕↕	↗	↖↖	↕↕					↖	↗	
Volume (vph)	0	204	90	261	238	0	0	0	0	342	117	317
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	3.0	4.0					3.0	3.0	3.0
Lane Util. Factor		0.95	1.00	0.97	0.95					0.95	0.95	1.00
Flt		1.00	0.85	1.00	1.00					1.00	1.00	0.85
Flt Protected		1.00	1.00	0.95	1.00					0.95	0.98	1.00
Satd. Flow (prot)		3539	1583	3433	3539					1681	1727	1583
Flt Permitted		1.00	1.00	0.95	1.00					0.95	0.98	1.00
Satd. Flow (perm)		3539	1583	3433	3539					1681	1727	1583
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	0	232	102	297	270	0	0	0	0	389	133	360
RTOR Reduction (vph)	0	0	45	0	0	0	0	0	0	0	0	276
Lane Group Flow (vph)	0	232	57	297	270	0	0	0	0	257	265	84
Turn Type		NA	Perm	Prot	NA					Split	NA	Perm
Protected Phases		6		5	2					8	8	
Permitted Phases			6									8
Actuated Green, G (s)		61.3	61.3	13.0	77.3					25.7	25.7	25.7
Effective Green, g (s)		61.3	61.3	13.0	77.3					25.7	25.7	25.7
Actuated g/C Ratio		0.56	0.56	0.12	0.70					0.23	0.23	0.23
Clearance Time (s)		4.0	4.0	3.0	4.0					3.0	3.0	3.0
Vehicle Extension (s)		1.5	1.5	1.0	1.5					1.5	1.5	1.5
Lane Grp Cap (vph)		1972	882	405	2486					392	403	369
v/s Ratio Prot		c0.07		c0.09	0.08					0.15	c0.15	
v/s Ratio Perm			0.04									0.05
v/c Ratio		0.12	0.06	0.73	0.11					0.66	0.66	0.23
Uniform Delay, d1		11.5	11.2	46.8	5.3					38.1	38.2	34.1
Progression Factor		0.49	0.74	1.00	1.00					1.00	1.00	1.00
Incremental Delay, d2		0.1	0.1	5.8	0.1					3.0	2.9	0.1
Delay (s)		5.8	8.4	52.7	5.4					41.1	41.1	34.2
Level of Service		A	A	D	A					D	D	C
Approach Delay (s)		6.6			30.1			0.0			38.3	
Approach LOS		A			C			A			D	
Intersection Summary												
HCM 2000 Control Delay	29.8			HCM 2000 Level of Service					C			
HCM 2000 Volume to Capacity ratio	0.34											
Actuated Cycle Length (s)	110.0			Sum of lost time (s)					10.0			
Intersection Capacity Utilization	35.6%			ICU Level of Service					A			
Analysis Period (min)	15											
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: Commerce Blvd & Golf Course Drive

3/31/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		  		  	  				  	  	  	  
Volume (vph)	11	201	306	373	421	67	89	69	171	52	78	18
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	12	12	13	12	12	12
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	0.91	1.00	0.97	0.95		0.97	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5085	1583	3433	3453		3433	1863	1636	1770	1806	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	5085	1583	3433	3453		3433	1863	1636	1770	1806	
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	12	221	336	410	463	74	98	76	188	57	86	20
RTOR Reduction (vph)	0	0	198	0	9	0	0	0	123	0	7	0
Lane Group Flow (vph)	12	221	138	410	528	0	98	76	65	57	99	0
Confl. Peds. (#/hr)						5						1
Confl. Bikes (#/hr)						1						
Turn Type	Prot	NA	pm+ov	Prot	NA		Split	NA	pm+ov	Split	NA	
Protected Phases	1	6	4	5	2		4	4	5	3	3	
Permitted Phases	6											
Actuated Green, G (s)	0.7	17.8	29.1	13.4	30.5		11.3	11.3	24.7	12.5	12.5	
Effective Green, g (s)	0.7	17.8	29.1	13.4	30.5		11.3	11.3	24.7	12.5	12.5	
Actuated g/C Ratio	0.01	0.25	0.41	0.19	0.43		0.16	0.16	0.35	0.18	0.18	
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	1.0	1.5	1.5	1.0	1.5		1.5	1.5	1.0	1.5	1.5	
Lane Grp Cap (vph)	17	1274	648	647	1483		546	296	661	311	317	
v/s Ratio Prot	0.01	0.04	0.03	c0.12	c0.15		0.03	c0.04	0.02	0.03	c0.05	
v/s Ratio Perm			0.05						0.02			
v/c Ratio	0.71	0.17	0.21	0.63	0.36		0.18	0.26	0.10	0.18	0.31	
Uniform Delay, d1	35.0	20.8	13.5	26.5	13.6		25.8	26.2	15.6	24.9	25.5	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	72.3	0.0	0.1	1.5	0.1		0.1	0.2	0.0	0.1	0.2	
Delay (s)	107.4	20.9	13.6	28.0	13.7		25.9	26.3	15.7	25.0	25.7	
Level of Service	F	C	B	C	B		C	C	B	C	C	
Approach Delay (s)	18.4			19.9				20.7			25.5	
Approach LOS	B			B				C			C	
Intersection Summary												
HCM 2000 Control Delay	20.1			HCM 2000 Level of Service					C			
HCM 2000 Volume to Capacity ratio	0.41											
Actuated Cycle Length (s)	71.0			Sum of lost time (s)					16.0			
Intersection Capacity Utilization	49.6%			ICU Level of Service					A			
Analysis Period (min)	15											
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis 3: Commerce Blvd & US 101 North Ramps

3/31/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱	↰	↰	↱	↱	↰	↱	↱	↰	↱	↱
Volume (vph)	180	2	21	1	0	1	75	152	4	2	391	358
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	14	12	16	12	12	12	12	12	12	12	12	12
Total Lost time (s)	4.0	4.0	3.0		3.0		3.0	4.0		3.0	4.0	4.0
Lane Util. Factor	0.95	0.95	1.00		1.00		1.00	0.95		1.00	0.95	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85		0.93		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	0.95	1.00		0.98		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1793	1687	1794		1695		1770	3524		1770	3539	1583
Flt Permitted	0.95	0.95	1.00		0.98		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1793	1687	1794		1695		1770	3524		1770	3539	1583
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	186	2	22	1	0	1	77	157	4	2	403	369
RTOR Reduction (vph)	0	0	17	0	2	0	0	1	0	0	0	0
Lane Group Flow (vph)	95	93	5	0	0	0	77	160	0	2	403	369
Confl. Peds. (#/hr)									2			
Turn Type	Split	NA	pm+ov	Split	NA		Prot	NA		Prot	NA	Free
Protected Phases	8	8	1	7	7		1	6		5	2	
Permitted Phases			8									Free
Actuated Green, G (s)	6.0	6.0	9.9		0.7		3.9	23.3		0.6	20.0	44.6
Effective Green, g (s)	6.0	6.0	9.9		0.7		3.9	23.3		0.6	20.0	44.6
Actuated g/C Ratio	0.13	0.13	0.22		0.02		0.09	0.52		0.01	0.45	1.00
Clearance Time (s)	4.0	4.0	3.0		3.0		3.0	4.0		3.0	4.0	
Vehicle Extension (s)	2.0	2.0	2.0		4.0		2.0	2.0		2.0	4.0	
Lane Grp Cap (vph)	241	226	398		26		154	1841		23	1586	1583
v/s Ratio Prot	0.05	c0.06	0.00		0.00		c0.04	0.05		0.00	0.11	
v/s Ratio Perm			0.00									c0.23
v/c Ratio	0.39	0.41	0.01		0.00		0.50	0.09		0.09	0.25	0.23
Uniform Delay, d1	17.6	17.7	13.5		21.6		19.4	5.3		21.7	7.7	0.0
Progression Factor	1.00	1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.4	0.4	0.0		0.0		0.9	0.0		0.6	0.1	0.3
Delay (s)	18.0	18.1	13.5		21.6		20.4	5.3		22.3	7.8	0.3
Level of Service	B	B	B		C		C	A		C	A	A
Approach Delay (s)		17.6			21.6			10.2			4.3	
Approach LOS		B			C			B			A	
Intersection Summary												
HCM 2000 Control Delay		7.7										
HCM 2000 Volume to Capacity ratio		0.36										
Actuated Cycle Length (s)		44.6						14.0				
Intersection Capacity Utilization		33.8%										
Analysis Period (min)		15										
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis 4: Commerce Blvd & State Farm Dr

3/31/2015

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↰	↱	↰	↱
Volume (veh/h)	12	115	114	19	275	217
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.87	0.87	0.87	0.87	0.87	0.87
Hourly flow rate (vph)	14	132	131	22	316	249
Pedestrians	5		5			5
Lane Width (ft)	12.0		12.0			12.0
Walking Speed (ft/s)	4.0		4.0			4.0
Percent Blockage	0		0			0
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1034	152			158	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1034	152			158	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	93	85			78	
cM capacity (veh/h)	198	887			1416	
Direction, Lane #						
Volume Total	146	153	316	249		
Volume Left	14	0	316	0		
Volume Right	132	22	0	0		
cSH	668	1700	1416	1700		
Volume to Capacity	0.22	0.09	0.22	0.15		
Queue Length 95th (ft)	21	0	21	0		
Control Delay (s)	11.9	0.0	8.3	0.0		
Lane LOS	B		A			
Approach Delay (s)	11.9	0.0	4.6			
Approach LOS	B					
Intersection Summary						
Average Delay			5.0			
Intersection Capacity Utilization			42.4%		ICU Level of Service	A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
5: State Farm Dr & Professional Center Dr

3/31/2015

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations													
Volume (veh/h)	12	7	14	15	2	4	36	124	25	18	194	15	
Sign Control	Stop				Stop			Free			Free		
Grade	0%				0%			0%			0%		
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	
Hourly flow rate (vph)	13	8	15	16	2	4	39	133	27	19	209	16	
Pedestrians	5				5			5			5		
Lane Width (ft)	12.0				12.0			12.0			12.0		
Walking Speed (ft/s)	4.0				4.0			4.0			4.0		
Percent Blockage	0				0			0			0		
Right turn flare (veh)													
Median type							None			None			
Median storage (veh)													
Upstream signal (ft)													
pX, platoon unblocked													
vC, conflicting volume	415	503	122	396	498	90	230			165			
vC1, stage 1 conf vol													
vC2, stage 2 conf vol													
vCu, unblocked vol	415	503	122	396	498	90	230			165			
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1			
tC, 2 stage (s)													
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2			
p0 queue free %	97	98	98	97	100	100	97			99			
cM capacity (veh/h)	493	446	898	498	449	942	1330			1405			
Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3				
Volume Total	13	23	23	39	89	71	19	139	86				
Volume Left	13	0	16	39	0	0	19	0	0				
Volume Right	0	15	4	0	0	27	0	0	16				
cSH	493	671	541	1330	1700	1700	1405	1700	1700				
Volume to Capacity	0.03	0.03	0.04	0.03	0.05	0.04	0.01	0.08	0.05				
Queue Length 95th (ft)	2	3	3	2	0	0	1	0	0				
Control Delay (s)	12.5	10.6	11.9	7.8	0.0	0.0	7.6	0.0	0.0				
Lane LOS	B	B	B	A			A						
Approach Delay (s)	11.3		11.9	1.5			0.6						
Approach LOS	B		B										
Intersection Summary													
Average Delay			2.2										
Intersection Capacity Utilization			29.1%		ICU Level of Service		A						
Analysis Period (min)			15										

HCM Unsignalized Intersection Capacity Analysis
6: Commerce Blvd & Professional Center Dr

3/31/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	39	167	0	4	148	73	0	0	2	12	0	14
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	44	190	0	5	168	83	0	0	2	14	0	16
Pedestrians		5			5			5			5	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		4.0			4.0			4.0			4.0	
Percent Blockage		0			0			0			0	
Right turn flare (veh)												
Median type	None			TWLTL								
Median storage (veh)	2											
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	256			195			482	549	200	509	507	220
vC1, stage 1 conf vol							283	283		224	224	
vC2, stage 2 conf vol							198	265		286	283	
vCu, unblocked vol	256			195			482	549	200	509	507	220
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)							6.1	5.5		6.1	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			100			100	100	100	98	100	98
cM capacity (veh/h)	1303			1373			616	558	834	617	584	813
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1	SB 2					
Volume Total	44	190	5	251	2	14	16					
Volume Left	44	0	5	0	0	14	0					
Volume Right	0	0	0	83	2	0	16					
cSH	1303	1700	1373	1700	834	617	813					
Volume to Capacity	0.03	0.11	0.00	0.15	0.00	0.02	0.02					
Queue Length 95th (ft)	3	0	0	0	0	2	1					
Control Delay (s)	7.9	0.0	7.6	0.0	9.3	11.0	9.5					
Lane LOS	A		A		A	B	A					
Approach Delay (s)	1.5		0.1		9.3	10.2						
Approach LOS					A	B						
Intersection Summary												
Average Delay			1.4									
Intersection Capacity Utilization			34.1%		ICU Level of Service		A					
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis

7: Commerce Blvd & Padre Pkwy

3/31/2015

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Movement												
Lane Configurations		↔			↔		↔	↔		↔	↔	
Volume (veh/h)	18	3	39	43	3	12	27	209	39	8	160	9
Sign Control	Stop			Stop			Free			Free		
Grade	0%			0%			0%			0%		
Peak Hour Factor	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Hourly flow rate (vph)	22	4	47	52	4	14	33	252	47	10	193	11
Pedestrians		5			5			5			5	
Lane Width (ft)	12.0			12.0			12.0			12.0		
Walking Speed (ft/s)	4.0			4.0			4.0			4.0		
Percent Blockage	0			0			0			0		
Right turn flare (veh)												
Median type							TWLT			TWLT		
Median storage (veh)							2			2		
Upstream signal (ft)							480					
pX, platoon unblocked												
vC, conflicting volume	435	591	112	515	573	159	209			304		
vC1, stage 1 conf vol	222	222		345	345							
vC2, stage 2 conf vol	212	369		169	228							
vCu, unblocked vol	435	591	112	515	573	159	209			304		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)	6.5	5.5		6.5	5.5							
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	97	99	95	91	99	98	98			99		
cM capacity (veh/h)	633	543	912	563	550	850	1354			1249		
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3				
Volume Total	72	70	33	168	131	10	129	75				
Volume Left	22	52	33	0	0	10	0	0				
Volume Right	47	14	0	0	47	0	0	11				
cSH	782	605	1354	1700	1700	1249	1700	1700				
Volume to Capacity	0.09	0.12	0.02	0.10	0.08	0.01	0.08	0.04				
Queue Length 95th (ft)	8	10	2	0	0	1	0	0				
Control Delay (s)	10.1	11.7	7.7	0.0	0.0	7.9	0.0	0.0				
Lane LOS	B	B	A			A						
Approach Delay (s)	10.1	11.7	0.8			0.4						
Approach LOS	B	B										
Intersection Summary												
Average Delay			2.7									
Intersection Capacity Utilization			29.6%		ICU Level of Service			A				
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis

8: State Farm Dr & City Center Dr

3/31/2015

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Movement												
Lane Configurations		↔			↔		↔	↔		↔	↔	
Volume (veh/h)	7	1	23	26	3	12	23	308	20	24	126	9
Sign Control	Stop			Stop			Free			Free		
Grade	0%			0%			0%			0%		
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	7	1	24	27	3	12	24	321	21	25	131	9
Pedestrians		5			5			5			5	
Lane Width (ft)	12.0			12.0			12.0			12.0		
Walking Speed (ft/s)	4.0			4.0			4.0			4.0		
Percent Blockage	0			0			0			0		
Right turn flare (veh)												
Median type							None			None		
Median storage (veh)												
Upstream signal (ft)							456					
pX, platoon unblocked												
vC, conflicting volume	418	586	80	529	580	181	146			347		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	418	586	80	529	580	181	146			347		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	99	100	97	93	99	98	98			98		
cM capacity (veh/h)	486	402	956	403	405	824	1428			1204		
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3		
Volume Total	8	24	27	16	24	214	128	25	88	53		
Volume Left	7	0	27	0	24	0	0	25	0	0		
Volume Right	0	24	0	12	0	0	21	0	0	9		
cSH	480	928	403	683	1428	1700	1700	1204	1700	1700		
Volume to Capacity	0.02	0.03	0.07	0.02	0.02	0.13	0.08	0.02	0.05	0.03		
Queue Length 95th (ft)	1	2	5	2	1	0	0	2	0	0		
Control Delay (s)	12.6	9.0	14.6	10.4	7.6	0.0	0.0	8.1	0.0	0.0		
Lane LOS	B	A	B	B	A			A				
Approach Delay (s)	9.9		13.0		0.5			1.2				
Approach LOS	A		B									
Intersection Summary												
Average Delay			2.1									
Intersection Capacity Utilization			32.1%		ICU Level of Service			A				
Analysis Period (min)			15									

HCM Signalized Intersection Capacity Analysis
9: US 101 SB Ramps & Rohnert Park Expressway

3/31/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑↑↑	↑	↑	↑	↑↑↑	↑	↑	↑	↑	↑	↑	↑
Volume (vph)	0	560	161	12	556	0	1	0	0	527	0	323
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	11	12	12	12	12	12	12	12	12	12
Total Lost time (s)		4.5	4.5	3.5	4.5		4.0			4.0		4.0
Lane Util. Factor		0.91	1.00	1.00	0.91		1.00			0.97		1.00
Flpb, ped/bikes		1.00	0.98	1.00	1.00		1.00			1.00		1.00
Flpb, ped/bikes		1.00	1.00	1.00	1.00		1.00			1.00		1.00
Frt		1.00	0.85	1.00	1.00		1.00			1.00		0.85
Flt Protected		1.00	1.00	0.95	1.00		0.95			0.95		1.00
Satd. Flow (prot)		5085	1495	1770	5085		1770			3433		1583
Flt Permitted		1.00	1.00	0.95	1.00		0.95			0.95		1.00
Satd. Flow (perm)		5085	1495	1770	5085		1770			3433		1583
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	0	583	168	12	579	0	1	0	0	549	0	336
RTOR Reduction (vph)	0	0	96	0	0	0	0	0	0	0	0	177
Lane Group Flow (vph)	0	583	72	12	579	0	1	0	0	549	0	159
Confl. Peds. (#/hr)			4			4						
Turn Type	NA	Perm	Prot	NA	Prot	Prot	Prot	Prot	Prot	Perm		
Protected Phases	2		1	6		3		3		4		
Permitted Phases		2									4	
Actuated Green, G (s)	64.6	64.6	2.7	70.8	1.2					65.5		65.5
Effective Green, g (s)	64.6	64.6	2.7	70.8	1.2					65.5		65.5
Actuated g/C Ratio	0.43	0.43	0.02	0.47	0.01					0.44		0.44
Clearance Time (s)	4.5	4.5	3.5	4.5	4.0					4.0		4.0
Vehicle Extension (s)	4.0	4.0	2.0	4.0	3.0					2.0		2.0
Lane Grp Cap (vph)	2189	643	31	2400	14					1499		691
v/s Ratio Prot	c0.11		c0.01	0.11	c0.00					c0.16		
v/s Ratio Perm		0.05									0.10	
v/c Ratio	0.27	0.11	0.39	0.24	0.07					0.37		0.23
Uniform Delay, d1	27.5	25.5	72.8	23.6	73.8					28.3		26.5
Progression Factor	0.36	0.24	1.09	0.89	1.00					1.00		1.00
Incremental Delay, d2	0.3	0.3	2.9	0.2	2.2					0.1		0.1
Delay (s)	10.2	6.6	82.2	21.2	76.0					28.4		26.5
Level of Service	B	A	F	C	E					C		C
Approach Delay (s)	9.4			22.4		76.0				27.7		
Approach LOS	A			C		E				C		
Intersection Summary												
HCM 2000 Control Delay		20.1				HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio		0.32										
Actuated Cycle Length (s)		150.0				Sum of lost time (s)				16.0		
Intersection Capacity Utilization		53.8%				ICU Level of Service				A		
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis
10: US 101 NB Ramps & Rohnert Park Expressway

3/31/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑↑↑			↑↑↑	↑	↑	↑	↑	↑	↑	↑
Volume (vph)	11	850	0	0	717	622	164	14	239	1	0	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0			5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	1.00	0.86			0.91	1.00	0.95	0.95	0.88	1.00		1.00
Flpb, ped/bikes	1.00	1.00			1.00	0.98	1.00	1.00	1.00	1.00		1.00
Flpb, ped/bikes	1.00	1.00			1.00	1.00	1.00	1.00	1.00	1.00		1.00
Frt	1.00	1.00			1.00	0.85	1.00	1.00	0.85	1.00		0.85
Flt Protected		0.95	1.00		1.00	1.00	0.95	0.96	1.00	0.95		1.00
Satd. Flow (prot)		1770	6408		5085	1550	1681	1698	2787	1770		1583
Flt Permitted		0.95	1.00		1.00	1.00	0.95	0.96	1.00	0.95		1.00
Satd. Flow (perm)		1770	6408		5085	1550	1681	1698	2787	1770		1583
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	12	904	0	0	763	662	174	15	254	1	0	9
RTOR Reduction (vph)	0	0	0	0	0	172	0	0	230	0	0	9
Lane Group Flow (vph)	12	904	0	0	763	490	94	95	24	1	0	0
Confl. Peds. (#/hr)			4			4						
Turn Type	Prot	NA			NA	Perm	Split	NA	Perm	Prot		Perm
Protected Phases	5	2			6		3	3		4		
Permitted Phases						6			3			4
Actuated Green, G (s)	2.9	118.0			111.1	111.1	14.2	14.2	14.2	2.8		2.8
Effective Green, g (s)	2.9	118.0			111.1	111.1	14.2	14.2	14.2	2.8		2.8
Actuated g/C Ratio	0.02	0.79			0.74	0.74	0.09	0.09	0.09	0.02		0.02
Clearance Time (s)	4.0	5.0			5.0	5.0	5.0	5.0	5.0	5.0		5.0
Vehicle Extension (s)	2.0	4.0			2.0	2.0	2.0	2.0	2.0	4.0		4.0
Lane Grp Cap (vph)	34	5040			3766	1148	159	160	263	33		29
v/s Ratio Prot	c0.01	0.14			0.15		0.06	c0.06		c0.00		
v/s Ratio Perm						c0.32			0.01			0.00
v/c Ratio	0.35	0.18			0.20	0.43	0.59	0.59	0.09	0.03		0.01
Uniform Delay, d1	72.6	4.0			5.9	7.4	65.1	65.1	62.0	72.3		72.2
Progression Factor	1.11	0.44			0.72	6.29	1.00	1.00	1.00	1.00		1.00
Incremental Delay, d2	2.2	0.1			0.1	1.1	3.9	3.9	0.1	0.5		0.1
Delay (s)	82.6	1.8			4.4	47.5	69.0	69.0	62.1	72.8		72.3
Level of Service	F	A			A	D	E	E	E	E		E
Approach Delay (s)		2.9			24.4			65.0		72.4		
Approach LOS		A			C			E		E		
Intersection Summary												
HCM 2000 Control Delay		24.0				HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio		0.43										
Actuated Cycle Length (s)		150.0				Sum of lost time (s)				19.0		
Intersection Capacity Utilization		63.9%				ICU Level of Service				B		
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis
11: Commerce Blvd & Rohnert Park Expressway

3/31/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Volume (vph)	167	614	312	79	839	56	349	125	104	38	82	142
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.91		0.97	1.00	1.00	0.91	0.91	1.00
Flpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	1.00	0.98	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1559	1770	5030		3433	1863	1552	1610	3383	1557
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1559	1770	5030		3433	1863	1552	1610	3383	1557
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	178	653	332	84	893	60	371	133	111	40	87	151
RTOR Reduction (vph)	0	0	106	0	3	0	0	0	93	0	0	79
Lane Group Flow (vph)	178	653	226	84	950	0	371	133	18	36	91	72
Confl. Peds. (#/hr)			7			6			7			13
Confl. Bikes (#/hr)						3						3
Turn Type	Prot	NA	pm+ov	Prot	NA		Split	NA	Perm	Split	NA	pm+ov
Protected Phases	5	2	3	1	6		3	3		4	4	5
Permitted Phases			2						3			4
Actuated Green, G (s)	11.6	78.3	102.0	11.2	77.9		23.7	23.7	23.7	16.8	16.8	28.4
Effective Green, g (s)	11.6	78.3	102.0	11.2	77.9		23.7	23.7	23.7	16.8	16.8	28.4
Actuated g/C Ratio	0.08	0.52	0.68	0.07	0.52		0.16	0.16	0.16	0.11	0.11	0.19
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Vehicle Extension (s)	1.0	1.0	1.5	1.0	1.0		1.5	1.5	1.5	1.0	1.0	1.0
Lane Grp Cap (vph)	265	1847	1112	132	2612		542	294	245	180	378	294
v/s Ratio Prot	c0.05	0.18	0.03	c0.05	c0.19		c0.11	0.07		0.02	0.03	c0.02
v/s Ratio Perm			0.11						0.01			0.03
v/c Ratio	0.67	0.35	0.20	0.64	0.36		0.68	0.45	0.07	0.20	0.24	0.25
Uniform Delay, d1	67.3	21.0	8.9	67.4	21.4		59.6	57.3	53.8	60.5	60.8	51.7
Progression Factor	0.95	0.97	2.32	0.82	0.48		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	5.1	0.5	0.0	6.7	0.4		2.9	0.4	0.0	0.2	0.1	0.2
Delay (s)	69.2	20.9	20.7	61.8	10.7		62.5	57.7	53.8	60.7	60.9	51.9
Level of Service	E	C	C	E	B		E	E	D	E	E	D
Approach Delay (s)		28.2			14.8			59.9			56.0	
Approach LOS		C			B			E			E	
Intersection Summary												
HCM 2000 Control Delay		32.5			HCM 2000 Level of Service				C			
HCM 2000 Volume to Capacity ratio		0.45										
Actuated Cycle Length (s)		150.0			Sum of lost time (s)			20.0				
Intersection Capacity Utilization		74.2%			ICU Level of Service			D				
Analysis Period (min)		15										
c Critical Lane Group												

Rohnert Park PDA Plan
AM Peak Hour - Existing Conditions

Synchro 8 Report
W-Trans

HCM Signalized Intersection Capacity Analysis
12: State Farm Dr & Rohnert Park Expressway

3/31/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Volume (vph)	89	581	33	158	869	173	100	65	101	47	32	48
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.91	0.91	1.00	0.91	0.91	
Flpb, ped/bikes	1.00	1.00	0.98	1.00	1.00	0.99	1.00	1.00	0.98	1.00	0.99	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.92	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.98	1.00	0.95	1.00	
Satd. Flow (prot)	1770	3539	1548	1770	3539	1560	1610	3321	1553	1610	3065	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.98	1.00	0.95	1.00	
Satd. Flow (perm)	1770	3539	1548	1770	3539	1560	1610	3321	1553	1610	3065	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	94	612	35	166	915	182	105	68	106	49	34	51
RTOR Reduction (vph)	0	0	18	0	0	55	0	0	94	0	45	0
Lane Group Flow (vph)	94	612	17	166	915	127	57	116	12	44	45	0
Confl. Peds. (#/hr)			8			2			5			2
Confl. Bikes (#/hr)									1			1
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Split	NA	Perm	Split	NA	
Protected Phases	5	2		1	6		3	3		4	4	
Permitted Phases			2			6			3			
Actuated Green, G (s)	11.8	74.8	74.8	21.0	84.0	84.0	17.2	17.2	17.2	17.0	17.0	
Effective Green, g (s)	11.8	74.8	74.8	21.0	84.0	84.0	17.2	17.2	17.2	17.0	17.0	
Actuated g/C Ratio	0.08	0.50	0.50	0.14	0.56	0.56	0.11	0.11	0.11	0.11	0.11	
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
Lane Grp Cap (vph)	139	1764	771	247	1981	873	184	380	178	182	347	
v/s Ratio Prot	0.05	0.17		c0.09	c0.26		c0.04	0.03		c0.03	0.01	
v/s Ratio Perm			0.01			0.08			0.01			
v/c Ratio	0.68	0.35	0.02	0.67	0.46	0.15	0.31	0.31	0.07	0.24	0.13	
Uniform Delay, d1	67.2	22.8	19.1	61.2	19.6	15.8	61.0	60.9	59.3	60.6	59.8	
Progression Factor	0.87	1.11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.03	1.05	
Incremental Delay, d2	9.4	0.5	0.1	5.6	0.8	0.4	0.4	0.2	0.1	0.3	0.1	
Delay (s)	68.0	25.9	19.1	66.8	20.4	16.2	61.3	61.1	59.3	62.4	62.6	
Level of Service	E	C	B	E	C	B	E	E	E	E	E	
Approach Delay (s)		30.9			25.9			60.5			62.6	
Approach LOS		C			C			E			E	
Intersection Summary												
HCM 2000 Control Delay		33.4			HCM 2000 Level of Service				C			
HCM 2000 Volume to Capacity ratio		0.46										
Actuated Cycle Length (s)		150.0			Sum of lost time (s)			20.0				
Intersection Capacity Utilization		65.6%			ICU Level of Service			C				
Analysis Period (min)		15										
c Critical Lane Group												

Rohnert Park PDA Plan
AM Peak Hour - Existing Conditions

Synchro 8 Report
W-Trans

HCM Signalized Intersection Capacity Analysis 13: Commerce Blvd & Enterprise Dr

3/31/2015

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↔↔	↔	↕↕		↕	↕↕
Volume (vph)	54	24	446	53	19	289
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	0.97	1.00	0.95		1.00	0.95
Flpb, ped/bikes	1.00	0.98	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	0.85	0.98		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	3433	1547	3477		1770	3539
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	3433	1547	3477		1770	3539
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	56	25	465	55	20	301
RTOR Reduction (vph)	0	22	13	0	0	0
Lane Group Flow (vph)	56	3	507	0	20	301
Confl. Peds. (#/hr)		5		5		
Confl. Bikes (#/hr)		5		5		
Turn Type	Prot	Perm	NA		Prot	NA
Protected Phases	8		2		1	6
Permitted Phases		8				
Actuated Green, G (s)	3.1	3.1	10.8		0.3	15.1
Effective Green, g (s)	3.1	3.1	10.8		0.3	15.1
Actuated g/C Ratio	0.12	0.12	0.41		0.01	0.58
Clearance Time (s)	4.0	4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	406	183	1433		20	2039
v/s Ratio Prot	c0.02		c0.15		c0.01	0.09
v/s Ratio Perm		0.00				
v/c Ratio	0.14	0.02	0.35		1.00	0.15
Uniform Delay, d1	10.4	10.2	5.3		12.9	2.6
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	0.2	0.0	0.2		201.2	0.0
Delay (s)	10.5	10.2	5.5		214.2	2.6
Level of Service	B	B	A		F	A
Approach Delay (s)	10.4		5.5			15.8
Approach LOS	B		A			B
Intersection Summary						
HCM 2000 Control Delay			9.5		HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio			0.32			
Actuated Cycle Length (s)			26.2		Sum of lost time (s)	12.0
Intersection Capacity Utilization			28.5%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						

HCM Unsignalized Intersection Capacity Analysis 14: Enterprise Dr & Hunter Dr

3/31/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕↕			↕↕			↕↕			↕↕	
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	13	63	0	3	92	89	1	2	0	49	0	4
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Hourly flow rate (vph)	14	69	0	3	101	98	1	2	0	54	0	4
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1						
Volume Total (vph)	49	35	54	148	3	58						
Volume Left (vph)	14	0	3	0	1	54						
Volume Right (vph)	0	0	0	98	0	4						
Hadj (s)	0.18	0.03	0.06	-0.43	0.10	0.17						
Departure Headway (s)	5.0	4.8	4.8	4.3	4.7	4.7						
Degree Utilization, x	0.07	0.05	0.07	0.18	0.00	0.08						
Capacity (veh/h)	708	723	740	818	717	718						
Control Delay (s)	7.1	6.9	7.0	7.0	7.7	8.1						
Approach Delay (s)	7.0		7.0		7.7	8.1						
Approach LOS	A		A		A	A						
Intersection Summary												
Delay					7.2							
Level of Service					A							
Intersection Capacity Utilization				25.9%		ICU Level of Service				A		
Analysis Period (min)					15							

HCM Unsignalized Intersection Capacity Analysis
15: Enterprise Dr & State Farm Dr

3/31/2015

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Stop	Stop		Stop	Stop
Volume (vph)	45	61	109	207	94	61
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89
Hourly flow rate (vph)	51	69	122	233	106	69
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total (vph)	51	69	82	273	106	69
Volume Left (vph)	51	0	0	0	106	0
Volume Right (vph)	0	0	0	233	0	69
Hadj (s)	0.53	0.03	0.03	-0.56	0.53	-0.67
Departure Headway (s)	5.9	5.4	5.2	4.6	6.1	4.9
Degree Utilization, x	0.08	0.10	0.12	0.35	0.18	0.09
Capacity (veh/h)	582	640	668	763	556	681
Control Delay (s)	8.2	7.8	7.7	8.8	9.2	7.2
Approach Delay (s)	8.0		8.5		8.4	
Approach LOS	A		A		A	
Intersection Summary						
Delay			8.4			
Level of Service			A			
Intersection Capacity Utilization			30.3%		ICU Level of Service	A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
16: Enterprise Dr/Seed Farm Dr

3/31/2015

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	2	143	274	1	2	1
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	2	159	304	1	2	1
Pedestrians		5	5		5	
Lane Width (ft)		12.0	12.0		12.0	
Walking Speed (ft/s)		4.0	4.0		4.0	
Percent Blockage		0	0		0	
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	311				478	315
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	311				478	315
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	100
cM capacity (veh/h)	1245				540	719
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	161	306	3			
Volume Left	2	0	2			
Volume Right	0	1	1			
cSH	1245	1700	589			
Volume to Capacity	0.00	0.18	0.01			
Queue Length 95th (ft)	0	0	0			
Control Delay (s)	0.1	0.0	11.1			
Lane LOS	A		B			
Approach Delay (s)	0.1	0.0	11.1			
Approach LOS			B			
Intersection Summary						
Average Delay			0.1			
Intersection Capacity Utilization			26.0%	ICU Level of Service	A	
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

17: State Farm Dr & Town Center

3/31/2015

	↖	→	↗	↙	←	↖	↗	↖	↗	↖	↗	↖	↗
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations		↔			↔		↖	↗		↖	↗		
Volume (veh/h)	35	0	8	0	0	1	19	225	0	1	175	15	
Sign Control		Stop			Stop			Free			Free		
Grade		0%			0%			0%			0%		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	
Hourly flow rate (vph)	38	0	9	0	0	1	21	245	0	1	190	16	
Pedestrians													
Lane Width (ft)													
Walking Speed (ft/s)													
Percent Blockage													
Right turn flare (veh)													
Median type							None			None			
Median storage (veh)													
Upstream signal (ft)											561		
pX, platoon unblocked													
vC, conflicting volume	365	486	103	392	495	122	207			245			
vC1, stage 1 conf vol													
vC2, stage 2 conf vol													
vCu, unblocked vol	365	486	103	392	495	122	207			245			
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1			
tC, 2 stage (s)													
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2			
p0 queue free %	93	100	99	100	100	100	98			100			
cM capacity (veh/h)	558	472	932	530	467	906	1362			1319			
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3					
Volume Total	47	1	21	163	82	1	127	80					
Volume Left	38	0	21	0	0	1	0	0					
Volume Right	9	1	0	0	0	0	0	16					
cSH	603	906	1362	1700	1700	1319	1700	1700					
Volume to Capacity	0.08	0.00	0.02	0.10	0.05	0.00	0.07	0.05					
Queue Length 95th (ft)	6	0	1	0	0	0	0	0					
Control Delay (s)	11.5	9.0	7.7	0.0	0.0	7.7	0.0	0.0					
Lane LOS	B	A	A			A							
Approach Delay (s)	11.5	9.0	0.6			0.0							
Approach LOS	B	A											
Intersection Summary													
Average Delay			1.4										
Intersection Capacity Utilization			28.6%		ICU Level of Service			A					
Analysis Period (min)			15										

HCM Signalized Intersection Capacity Analysis

1: US 101 South Ramps & Golf Course Dr

3/31/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↑	↑	↑↑					↑	↑	↑
Volume (vph)	0	618	212	148	390	0	0	0	0	420	165	485
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	3.0	4.0					3.0	3.0	3.0
Lane Util. Factor		0.95	1.00	0.97	0.95					0.95	0.95	1.00
Frpb, ped/bikes		1.00	0.97	1.00	1.00					1.00	1.00	0.97
Flpb, ped/bikes		1.00	1.00	1.00	1.00					1.00	1.00	1.00
Frt		1.00	0.85	1.00	1.00					1.00	1.00	0.85
Flt Protected		1.00	1.00	0.95	1.00					0.95	0.98	1.00
Satd. Flow (prot)		3539	1532	3433	3539					1681	1731	1540
Flt Permitted		1.00	1.00	0.95	1.00					0.95	0.98	1.00
Satd. Flow (perm)		3539	1532	3433	3539					1681	1731	1540
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	0	637	219	153	402	0	0	0	0	433	170	500
RTOR Reduction (vph)	0	0	102	0	0	0	0	0	0	0	0	252
Lane Group Flow (vph)	0	637	117	153	402	0	0	0	0	299	304	248
Confl. Peds. (#/hr)			10									10
Confl. Bikes (#/hr)			10									10
Turn Type	NA	Perm	Prot	NA						Split	NA	Perm
Protected Phases	6		5	2						8	8	
Permitted Phases		6										8
Actuated Green, G (s)		58.9	58.9	9.3	71.2					31.8	31.8	31.8
Effective Green, g (s)		58.9	58.9	9.3	71.2					31.8	31.8	31.8
Actuated g/C Ratio		0.54	0.54	0.08	0.65					0.29	0.29	0.29
Clearance Time (s)		4.0	4.0	3.0	4.0					3.0	3.0	3.0
Vehicle Extension (s)		2.0	2.0	2.0	2.0					2.0	2.0	2.0
Lane Grp Cap (vph)	1894	820	290	2290						485	500	445
v/s Ratio Prot	c0.18		c0.04	0.11						c0.18	0.18	
v/s Ratio Perm		0.08										0.16
v/c Ratio	0.34	0.14	0.53	0.18						0.62	0.61	0.56
Uniform Delay, d1	14.5	12.9	48.2	7.7						33.8	33.7	33.1
Progression Factor	0.54	0.47	1.00	1.00						1.00	1.00	1.00
Incremental Delay, d2	0.4	0.3	0.8	0.2						1.6	1.4	0.9
Delay (s)	8.3	6.3	49.0	7.9						35.5	35.2	34.0
Level of Service	A	A	D	A						D	D	C
Approach Delay (s)	7.8			19.2			0.0				34.7	
Approach LOS	A			B			A				C	
Intersection Summary												
HCM 2000 Control Delay		22.1		HCM 2000 Level of Service			C					
HCM 2000 Volume to Capacity ratio		0.44										
Actuated Cycle Length (s)		110.0		Sum of lost time (s)			10.0					
Intersection Capacity Utilization		52.4%		ICU Level of Service			A					
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: Commerce Blvd & Golf Course Dr

3/31/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑	↑	↑	↑↑					↑	↑	↑
Volume (vph)	26	569	410	289	311	77	242	174	478	183	198	14
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	12	12	13	12	12	12
Total Lost time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.0	4.5	4.5	
Lane Util. Factor	1.00	0.91	1.00	0.97	0.95		0.97	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00	0.99	1.00	0.99		1.00	1.00	0.99	1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.97		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5085	1562	3433	3403		3433	1863	1619	1770	1840	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	5085	1562	3433	3403		3433	1863	1619	1770	1840	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	27	593	427	301	324	80	252	181	498	191	206	15
RTOR Reduction (vph)	0	0	215	0	16	0	0	0	214	0	2	0
Lane Group Flow (vph)	27	593	212	301	388	0	252	181	284	191	219	0
Confl. Peds. (#/hr)			10			10			10			10
Confl. Bikes (#/hr)			10			10			10			10
Turn Type	Prot	NA	pm+ov	Prot	NA		Split	NA	pm+ov	Split	NA	
Protected Phases	1	6	4	5	2		4	4	5	3	3	
Permitted Phases			6						4			
Actuated Green, G (s)	2.5	19.8	33.8	11.9	29.2		14.0	14.0	25.9	16.6	16.6	
Effective Green, g (s)	2.5	19.8	33.8	11.9	29.2		14.0	14.0	25.9	16.6	16.6	
Actuated g/C Ratio	0.03	0.25	0.42	0.15	0.37		0.18	0.18	0.32	0.21	0.21	
Clearance Time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.0	4.5	4.5	
Vehicle Extension (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0	2.0	2.0	2.0	
Lane Grp Cap (vph)	55	1261	661	511	1245		602	326	525	368	382	
v/s Ratio Prot	0.02	c0.12	0.06	c0.09	0.11		0.07	c0.10	0.08	0.11	c0.12	
v/s Ratio Perm			0.08						0.09			
v/c Ratio	0.49	0.47	0.32	0.59	0.31		0.42	0.56	0.54	0.52	0.57	
Uniform Delay, d1	38.0	25.5	15.3	31.7	18.1		29.3	30.1	22.1	28.1	28.4	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	2.5	0.1	0.1	1.1	0.1		0.2	1.2	0.6	0.5	1.3	
Delay (s)	40.5	25.6	15.4	32.8	18.2		29.5	31.2	22.7	28.6	29.7	
Level of Service	D	C	B	C	B		C	C	C	C	C	
Approach Delay (s)		21.9			24.4			26.2			29.2	
Approach LOS		C			C			C			C	
Intersection Summary												
HCM 2000 Control Delay		24.7		HCM 2000 Level of Service			C					
HCM 2000 Volume to Capacity ratio		0.54										
Actuated Cycle Length (s)		79.8		Sum of lost time (s)			17.5					
Intersection Capacity Utilization		67.4%		ICU Level of Service			C					
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis 3: Commerce Blvd & US 101 North Ramps

3/31/2015

	↖	→	↗	↖	←	↖	↖	↑	↗	↖	↓	↗
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↖	↖		↖		↖	↖		↖	↖	↖
Volume (vph)	411	0	15	3	4	1	254	450	1	4	409	461
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	14	12	16	12	12	12	12	12	12	12	12	12
Total Lost time (s)	4.0	4.0	3.0		3.0		3.0	4.0		3.0	4.0	4.0
Lane Util. Factor	0.95	0.95	1.00		1.00		1.00	0.95		1.00	0.95	1.00
Flpb, ped/bikes	1.00	1.00	1.00		0.98		1.00	1.00		1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85		0.98		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	0.95	1.00		0.98		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1793	1681	1794		1759		1770	3538		1770	3539	1546
Flt Permitted	0.95	0.95	1.00		0.98		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1793	1681	1794		1759		1770	3538		1770	3539	1546
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	433	0	16	3	4	1	267	474	1	4	431	485
RTOR Reduction (vph)	0	0	9	0	1	0	0	0	0	0	0	0
Lane Group Flow (vph)	216	217	7	0	7	0	267	475	0	4	431	485
Confl. Peds. (#/hr)						10			10			
Confl. Bikes (#/hr)									10			10
Turn Type	Split	NA	pm+ov	Split	NA		Prot	NA		Prot	NA	Free
Protected Phases	8	8	1	7	7		1	6		5	2	
Permitted Phases			8									Free
Actuated Green, G (s)	11.5	11.5	23.3		0.6		11.8	27.6		0.6	16.4	54.3
Effective Green, g (s)	11.5	11.5	23.3		0.6		11.8	27.6		0.6	16.4	54.3
Actuated g/C Ratio	0.21	0.21	0.43		0.01		0.22	0.51		0.01	0.30	1.00
Clearance Time (s)	4.0	4.0	3.0		3.0		3.0	4.0		3.0	4.0	
Vehicle Extension (s)	2.0	2.0	2.0		2.0		2.0	4.0		2.0	4.0	
Lane Grp Cap (vph)	379	356	769		19		384	1798		19	1068	1546
v/s Ratio Prot	0.12	c0.13	0.00		0.00		c0.15	0.13		0.00	c0.12	
v/s Ratio Perm			0.00									c0.31
v/c Ratio	0.57	0.61	0.01		0.37		0.70	0.26		0.21	0.40	0.31
Uniform Delay, d1	19.2	19.4	8.9		26.7		19.6	7.6		26.6	15.1	0.0
Progression Factor	1.00	1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	1.2	2.0	0.0		4.4		4.4	0.1		2.0	0.3	0.5
Delay (s)	20.4	21.4	8.9		31.0		24.0	7.7		28.6	15.4	0.5
Level of Service	C	C	A		C		C	A		C	B	A
Approach Delay (s)		20.5			31.0			13.5			7.6	
Approach LOS		C			C			B			A	
Intersection Summary												
HCM 2000 Control Delay		12.5			HCM 2000 Level of Service			B				
HCM 2000 Volume to Capacity ratio		0.58										
Actuated Cycle Length (s)		54.3			Sum of lost time (s)			14.0				
Intersection Capacity Utilization		53.4%			ICU Level of Service			A				
Analysis Period (min)		15										
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis 4: Commerce Blvd & State Farm Dr

3/31/2015

	↖	↖	↑	↗	↖	↓
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↖	↖	↖		↖	↖
Volume (veh/h)	17	343	389	9	182	261
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	19	390	442	10	207	297
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1157	447			452	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1157	447			452	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	89	36			81	
cM capacity (veh/h)	176	611			1108	
Direction, Lane #						
	WB 1	NB 1	SB 1	SB 2		
Volume Total	409	452	207	297		
Volume Left	19	0	207	0		
Volume Right	390	10	0	0		
cSH	548	1700	1108	1700		
Volume to Capacity	0.75	0.27	0.19	0.17		
Queue Length 95th (ft)	161	0	17	0		
Control Delay (s)	28.5	0.0	9.0	0.0		
Lane LOS	D		A			
Approach Delay (s)	28.5	0.0	3.7			
Approach LOS	D					
Intersection Summary						
Average Delay			9.9			
Intersection Capacity Utilization			63.3%		ICU Level of Service	B
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
5: State Farm Dr & Professional Center Dr

3/31/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	9	12	30	39	9	31	56	246	22	13	213	16
Sign Control	Stop				Stop			Free			Free	
Grade	0%				0%			0%			0%	
Peak Hour Factor	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Hourly flow rate (vph)	11	15	37	48	11	38	68	300	27	16	260	20
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type									None		None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	631	765	140	655	761	163	279			327		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	631	765	140	655	761	163	279			327		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	97	95	96	85	96	96	95			99		
cM capacity (veh/h)	323	310	883	308	312	852	1280			1230		
Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3			
Volume Total	11	51	96	68	200	127	16	173	106			
Volume Left	11	0	48	68	0	0	16	0	0			
Volume Right	0	37	38	0	0	27	0	0	20			
cSH	323	578	412	1280	1700	1700	1230	1700	1700			
Volume to Capacity	0.03	0.09	0.23	0.05	0.12	0.07	0.01	0.10	0.06			
Queue Length 95th (ft)	3	7	22	4	0	0	1	0	0			
Control Delay (s)	16.5	11.8	16.4	8.0	0.0	0.0	8.0	0.0	0.0			
Lane LOS	C	B	C	A			A					
Approach Delay (s)	12.7		16.4	1.4			0.4					
Approach LOS	B		C									
Intersection Summary												
Average Delay			3.6									
Intersection Capacity Utilization			32.0%		ICU Level of Service				A			
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis
6: Commerce Blvd & Professional Center Dr

3/31/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	12	279	4	6	313	33	1	0	8	65	1	59
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Hourly flow rate (vph)	15	340	5	7	382	40	1	0	10	79	1	72
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			TWLT							
Median storage (veh)					2							
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	422			345			841	809	343	796	791	402
vC1, stage 1 conf vol							372	372		416	416	
vC2, stage 2 conf vol							469	437		379	374	
vCu, unblocked vol	422			345			841	809	343	796	791	402
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)							6.1	5.5		6.1	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			99			100	100	99	84	100	89
cM capacity (veh/h)	1137			1214			435	480	700	496	490	648
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1	SB 2					
Volume Total	15	345	7	422	11	79	73					
Volume Left	15	0	7	0	1	79	0					
Volume Right	0	5	0	40	10	0	72					
cSH	1137	1700	1214	1700	656	496	645					
Volume to Capacity	0.01	0.20	0.01	0.25	0.02	0.16	0.11					
Queue Length 95th (ft)	1	0	0	0	1	14	10					
Control Delay (s)	8.2	0.0	8.0	0.0	10.6	13.6	11.3					
Lane LOS	A		A		B	B	B					
Approach Delay (s)	0.3		0.1		10.6	12.5						
Approach LOS					B	B						
Intersection Summary												
Average Delay			2.3									
Intersection Capacity Utilization			35.4%		ICU Level of Service				A			
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis
7: Commerce Blvd & Padre Pkwy

3/31/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	6	5	36	118	4	38	36	318	122	35	341	5
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Hourly flow rate (vph)	7	6	40	133	4	43	40	357	137	39	383	6
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								TWLTL			TWLTL	
Median storage (veh)								2			2	
Upstream signal (ft)								480				
pX, platoon unblocked												
vC, conflicting volume	769	1040	194	820	974	247	389			494		
vC1, stage 1 conf vol	465	465		507	507							
vC2, stage 2 conf vol	304	575		313	467							
vCu, unblocked vol	769	1040	194	820	974	247	389			494		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)	6.5	5.5		6.5	5.5							
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	98	99	95	68	99	94	97			96		
cM capacity (veh/h)	440	383	814	421	407	753	1166			1066		
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3				
Volume Total	53	180	40	238	256	39	255	133				
Volume Left	7	133	40	0	0	39	0	0				
Volume Right	40	43	0	0	137	0	0	6				
cSH	663	470	1166	1700	1700	1066	1700	1700				
Volume to Capacity	0.08	0.38	0.03	0.14	0.15	0.04	0.15	0.08				
Queue Length 95th (ft)	6	44	3	0	0	3	0	0				
Control Delay (s)	10.9	17.3	8.2	0.0	0.0	8.5	0.0	0.0				
Lane LOS	B	C	A			A						
Approach Delay (s)	10.9	17.3	0.6			0.8						
Approach LOS	B	C										
Intersection Summary												
Average Delay				3.6								
Intersection Capacity Utilization				41.8%		ICU Level of Service			A			
Analysis Period (min)				15								

HCM Unsignalized Intersection Capacity Analysis
8: State Farm Dr & City Center Dr

3/31/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		  		  	  		  	  		  	  	
Volume (veh/h)	22	10	112	79	6	25	55	222	27	24	370	29
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	24	11	124	88	7	28	61	247	30	27	411	32
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)								456				
pX, platoon unblocked												
vC, conflicting volume	757	879	222	773	881	138	443			277		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	757	879	222	773	881	138	443			277		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	91	96	84	60	97	97	95			98		
cM capacity (veh/h)	266	263	782	222	263	885	1113			1283		
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3		
Volume Total	30	130	88	34	61	164	112	27	274	169		
Volume Left	24	0	88	0	61	0	0	27	0	0		
Volume Right	0	124	0	28	0	0	30	0	0	32		
cSH	265	721	222	607	1113	1700	1700	1283	1700	1700		
Volume to Capacity	0.11	0.18	0.40	0.06	0.05	0.10	0.07	0.02	0.16	0.10		
Queue Length 95th (ft)	9	16	44	5	4	0	0	2	0	0		
Control Delay (s)	20.3	11.1	31.5	11.3	8.4	0.0	0.0	7.9	0.0	0.0		
Lane LOS	C	B	D	B	A			A				
Approach Delay (s)	12.8		25.8		1.5			0.4				
Approach LOS	B		D									
Intersection Summary												
Average Delay				5.4								
Intersection Capacity Utilization			36.7%		ICU Level of Service				A			
Analysis Period (min)			15									

HCM Signalized Intersection Capacity Analysis
9: US 101 SB Ramps & Rohnert Park Expressway

3/31/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑↑↑	↑	↑	↑	↑↑↑		↑		↑	↑		↑
Volume (vph)	0	1123	321	37	943	0	4	0	19	721	0	287
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	11	12	12	12	12	12	12	12	12	12
Total Lost time (s)		4.5	4.5	3.5	4.5		4.0		4.0	4.0		4.0
Lane Util. Factor		0.91	1.00	1.00	0.91		1.00		1.00	0.97		1.00
Frt		1.00	0.85	1.00	1.00		1.00		0.85	1.00		0.85
Flt Protected		1.00	1.00	0.95	1.00		0.95		1.00	0.95		1.00
Satd. Flow (prot)		5085	1531	1770	5085		1770		1583	3433		1583
Flt Permitted		1.00	1.00	0.95	1.00		0.95		1.00	0.95		1.00
Satd. Flow (perm)		5085	1531	1770	5085		1770		1583	3433		1583
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	0	1170	334	39	982	0	4	0	20	751	0	299
RTOR Reduction (vph)	0	0	95	0	0	0	0	0	19	0	0	119
Lane Group Flow (vph)	0	1170	239	39	982	0	4	0	1	751	0	180
Turn Type	NA	Perm	Prot	NA	Prot		Prot		Prot	Perm		Perm
Protected Phases	2		1	6		3		3	4			4
Permitted Phases		2										
Actuated Green, G (s)	79.3	79.3	6.8	89.6		3.8		3.8	44.1			44.1
Effective Green, g (s)	79.3	79.3	6.8	89.6		3.8		3.8	44.1			44.1
Actuated g/C Ratio	0.53	0.53	0.05	0.60		0.03		0.03	0.29			0.29
Clearance Time (s)	4.5	4.5	3.5	4.5		4.0		4.0	4.0			4.0
Vehicle Extension (s)	4.0	4.0	2.0	4.0		3.0		3.0	2.0			2.0
Lane Grp Cap (vph)	2688	809	80	3037		44		40	1009			465
v/s Ratio Prot	c0.23		c0.02	0.19		c0.00		0.00	c0.22			0.11
v/s Ratio Perm		0.16										0.11
v/c Ratio	0.44	0.30	0.49	0.32		0.09		0.01	0.74			0.39
Uniform Delay, d1	21.6	19.7	69.9	15.1		71.4		71.3	47.9			42.2
Progression Factor	1.00	1.00	1.07	0.66		1.00		1.00	1.00			1.00
Incremental Delay, d2	0.5	0.9	1.6	0.3		0.9		0.1	2.6			0.2
Delay (s)	22.2	20.7	76.4	10.2		72.3		71.4	50.5			42.4
Level of Service	C	C	E	B		E		E	D			D
Approach Delay (s)	21.8			12.7			71.6			48.2		
Approach LOS	C			B			E			D		
Intersection Summary												
HCM 2000 Control Delay		27.3				HCM 2000 Level of Service			C			
HCM 2000 Volume to Capacity ratio		0.53										
Actuated Cycle Length (s)		150.0				Sum of lost time (s)			16.0			
Intersection Capacity Utilization		56.0%				ICU Level of Service			B			
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis
10: US 101 NB Ramps & Rohnert Park Expressway

3/31/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑↑↑		↑	↑↑↑	↑	↑	↑	↑	↑	↑	↑
Volume (vph)	43	1410	0	0	947	491	297	18	339	11	0	14
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	6.0		6.0	6.0	5.0	5.0	5.0	5.0	5.0		5.0
Lane Util. Factor	1.00	0.86		0.91	1.00	0.95	0.95	0.88	1.00			1.00
Frt	1.00	1.00		1.00	0.85	1.00	1.00	0.85	1.00			0.85
Flt Protected	0.95	1.00		1.00	1.00	0.95	0.96	1.00	0.95			1.00
Satd. Flow (prot)	1770	6408		5085	1583	1681	1695	2787	1770			1583
Flt Permitted	0.95	1.00		1.00	1.00	0.95	0.96	1.00	0.95			1.00
Satd. Flow (perm)	1770	6408		5085	1583	1681	1695	2787	1770			1583
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	45	1469	0	0	986	511	309	19	353	11	0	15
RTOR Reduction (vph)	0	0	0	0	0	183	0	0	138	0	0	15
Lane Group Flow (vph)	45	1469	0	0	986	328	164	164	215	11	0	0
Turn Type	Prot	NA		NA	Perm	Split	NA	Perm	Prot			Perm
Protected Phases	5	2		6		3	3		4			4
Permitted Phases					6				3			
Actuated Green, G (s)	7.3	108.7		96.4	96.4	21.8	21.8	21.8	3.5			3.5
Effective Green, g (s)	7.3	108.7		96.4	96.4	21.8	21.8	21.8	3.5			3.5
Actuated g/C Ratio	0.05	0.72		0.64	0.64	0.15	0.15	0.15	0.02			0.02
Clearance Time (s)	5.0	6.0		6.0	6.0	5.0	5.0	5.0	5.0			5.0
Vehicle Extension (s)	2.0	4.0		4.0	4.0	2.0	2.0	2.0	2.0			2.0
Lane Grp Cap (vph)	86	4643		3267	1017	244	246	405	41			36
v/s Ratio Prot	c0.03	c0.23		0.19		c0.10	0.10		c0.01			0.00
v/s Ratio Perm					0.21			0.08				0.00
v/c Ratio	0.52	0.32		0.30	0.32	0.67	0.67	0.53	0.27			0.01
Uniform Delay, d1	69.7	7.4		11.9	12.1	60.7	60.7	59.4	72.0			71.6
Progression Factor	1.15	1.37		0.66	2.33	1.00	1.00	1.00	1.00			1.00
Incremental Delay, d2	2.3	0.2		0.2	0.8	5.6	5.2	0.6	1.3			0.0
Delay (s)	82.1	10.2		8.0	28.9	66.3	65.9	59.9	73.3			71.6
Level of Service	F	B		A	C	E	E	E	E			E
Approach Delay (s)		12.4			15.1		62.9			72.3		
Approach LOS		B			B		E			E		
Intersection Summary												
HCM 2000 Control Delay		23.2				HCM 2000 Level of Service			C			
HCM 2000 Volume to Capacity ratio		0.39										
Actuated Cycle Length (s)		150.0				Sum of lost time (s)			21.0			
Intersection Capacity Utilization		58.3%				ICU Level of Service			B			
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis
11: Commerce Blvd & Rohnert Park Expressway

3/31/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔		↔	↔	↔	↔	↔	↔
Volume (vph)	184	913	693	174	718	30	496	205	245	81	199	215
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.91		0.97	1.00	1.00	0.91	0.91	1.00
Flpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	1.00	0.98	1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1556	1770	5050		3433	1863	1547	1610	3384	1562
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1556	1770	5050		3433	1863	1547	1610	3384	1562
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	192	951	722	181	748	31	517	214	255	84	207	224
RTOR Reduction (vph)	0	0	139	0	2	0	0	0	203	0	0	70
Lane Group Flow (vph)	192	951	583	181	777	0	517	214	52	76	215	154
Confl. Peds. (#/hr)			13			10			5			7
Confl. Bikes (#/hr)						2			5			2
Turn Type	Prot	NA	pm+ov	Prot	NA		Split	NA	Perm	Split	NA	pm+ov
Protected Phases	5	2	3	1	6		3	3		4	4	5
Permitted Phases			2						3			4
Actuated Green, G (s)	11.0	57.4	87.8	23.6	70.0		30.4	30.4	30.4	18.6	18.6	29.6
Effective Green, g (s)	11.0	57.4	87.8	23.6	70.0		30.4	30.4	30.4	18.6	18.6	29.6
Actuated g/C Ratio	0.07	0.38	0.59	0.16	0.47		0.20	0.20	0.20	0.12	0.12	0.20
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Vehicle Extension (s)	1.0	1.0	1.5	1.0	1.0		1.5	1.5	1.5	1.0	1.0	1.0
Lane Grp Cap (vph)	251	1354	962	278	2356		695	377	313	199	419	308
v/s Ratio Prot	0.06	c0.27	c0.12	c0.10	0.15		c0.15	0.11		0.05	c0.06	0.04
v/s Ratio Perm			0.25						0.03			0.06
v/c Ratio	0.76	0.70	0.61	0.65	0.33		0.74	0.57	0.17	0.38	0.51	0.50
Uniform Delay, d1	68.2	39.1	20.0	59.3	25.2		56.1	53.9	49.3	60.4	61.5	53.6
Progression Factor	0.79	0.65	1.13	1.12	1.29		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	11.3	2.9	0.7	3.7	0.3		3.8	1.2	0.1	0.4	0.4	0.5
Delay (s)	65.5	28.5	23.3	70.2	32.9		59.9	55.1	49.4	60.9	61.9	54.1
Level of Service	E	C	C	E	C		E	E	D	E	E	D
Approach Delay (s)		30.3			39.9			56.2			58.3	
Approach LOS		C			D			E			E	
Intersection Summary												
HCM 2000 Control Delay		41.7										
HCM 2000 Volume to Capacity ratio		0.68										
Actuated Cycle Length (s)		150.0							20.0			
Intersection Capacity Utilization		84.2%							E			
Analysis Period (min)		15										
c Critical Lane Group												

Rohnert Park PDA Plan
PM Peak Hour - Existing Conditions

Synchro 8 Report
W-Trans

HCM Signalized Intersection Capacity Analysis
12: State Farm Dr & Rohnert Park Expressway

3/31/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔		↔	↔	↔	↔	↔	↔
Volume (vph)	119	768	88	222	748	81	159	98	182	205	157	124
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.91	0.91	1.00	0.91	0.91	
Flpb, ped/bikes	1.00	1.00	0.97	1.00	1.00	0.98	1.00	1.00	0.98	1.00	0.99	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.94	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.98	1.00	0.95	0.99	
Satd. Flow (prot)	1770	3539	1539	1770	3539	1553	1610	3318	1548	1610	3152	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.98	1.00	0.95	0.99	
Satd. Flow (perm)	1770	3539	1539	1770	3539	1553	1610	3318	1548	1610	3152	
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	135	873	100	252	850	92	181	111	207	233	178	141
RTOR Reduction (vph)	0	0	67	0	0	47	0	0	182	0	64	0
Lane Group Flow (vph)	135	873	33	252	850	45	96	196	25	186	302	0
Confl. Peds. (#/hr)			12			5			10			4
Confl. Bikes (#/hr)			1			1						1
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Split	NA	Perm	Split	NA	
Protected Phases	5	2		1	6		3	3		4	4	
Permitted Phases			2			6			3			
Actuated Green, G (s)	16.4	48.9	48.9	36.2	68.7	68.7	18.2	18.2	18.2	26.7	26.7	
Effective Green, g (s)	16.4	48.9	48.9	36.2	68.7	68.7	18.2	18.2	18.2	26.7	26.7	
Actuated g/C Ratio	0.11	0.33	0.33	0.24	0.46	0.46	0.12	0.12	0.12	0.18	0.18	
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
Lane Grp Cap (vph)	193	1153	501	427	1620	711	195	402	187	286	561	
v/s Ratio Prot	c0.08	c0.25		c0.14	0.24		c0.06	0.06		c0.12	0.10	
v/s Ratio Perm			0.02			0.03			0.02			
v/c Ratio	0.70	0.76	0.07	0.59	0.52	0.06	0.49	0.49	0.13	0.65	0.54	
Uniform Delay, d1	64.4	45.2	34.8	50.3	29.0	22.7	61.6	61.5	58.9	57.3	56.0	
Progression Factor	1.44	0.43	0.10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	6.9	3.7	0.2	1.5	1.2	0.2	0.7	0.3	0.1	4.0	0.5	
Delay (s)	99.7	23.3	3.5	51.8	30.2	22.9	62.3	61.9	59.0	61.3	56.5	
Level of Service	F	C	A	D	C	C	E	E	E	E	E	
Approach Delay (s)		30.9			34.2		60.8				58.1	
Approach LOS		C			C		E				E	
Intersection Summary												
HCM 2000 Control Delay		41.0										
HCM 2000 Volume to Capacity ratio		0.65										
Actuated Cycle Length (s)		150.0							20.0			
Intersection Capacity Utilization		87.3%							E			
Analysis Period (min)		15										
c Critical Lane Group												

Rohnert Park PDA Plan
PM Peak Hour - Existing Conditions

Synchro 8 Report
W-Trans

HCM Signalized Intersection Capacity Analysis 13: Commerce Blvd & Enterprise Dr

3/31/2015

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↔↔	↔	↕↕		↔	↕↕
Volume (vph)	150	52	586	69	42	651
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	0.97	1.00	0.95		1.00	0.95
Frt	1.00	0.85	0.98		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	3433	1583	3484		1770	3539
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	3433	1583	3484		1770	3539
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	160	55	623	73	45	693
RTOR Reduction (vph)	0	44	12	0	0	0
Lane Group Flow (vph)	160	11	684	0	45	693
Turn Type	Prot	Perm	NA		Prot	NA
Protected Phases	8		2		1	6
Permitted Phases		8				
Actuated Green, G (s)	7.4	7.4	15.8		1.1	20.9
Effective Green, g (s)	7.4	7.4	15.8		1.1	20.9
Actuated g/C Ratio	0.20	0.20	0.44		0.03	0.58
Clearance Time (s)	4.0	4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	699	322	1516		53	2037
v/s Ratio Prot	c0.05		c0.20		c0.03	0.20
v/s Ratio Perm		0.01				
v/c Ratio	0.23	0.03	0.45		0.85	0.34
Uniform Delay, d1	12.1	11.6	7.2		17.5	4.1
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	0.2	0.0	0.2		70.0	0.1
Delay (s)	12.2	11.6	7.4		87.5	4.2
Level of Service	B	B	A		F	A
Approach Delay (s)	12.1		7.4			9.2
Approach LOS	B		A			A
Intersection Summary						
HCM 2000 Control Delay			8.8		HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio			0.40			
Actuated Cycle Length (s)			36.3		Sum of lost time (s)	12.0
Intersection Capacity Utilization			36.0%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						

HCM Unsignalized Intersection Capacity Analysis 14: Enterprise Dr & Hunter Dr

3/31/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕↕			↕↕			↕↕			↕↕	
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	2	115	2	7	149	106	2	3	0	176	2	30
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	2	121	2	7	157	112	2	3	0	185	2	32
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1						
Volume Total (vph)	63	63	86	190	5	219						
Volume Left (vph)	2	0	7	0	2	185						
Volume Right (vph)	0	2	0	112	0	32						
Hadj (s)	0.05	0.01	0.08	-0.38	0.11	0.12						
Departure Headway (s)	5.4	5.4	5.3	4.9	5.3	4.9						
Degree Utilization, x	0.09	0.09	0.13	0.26	0.01	0.30						
Capacity (veh/h)	622	631	645	709	620	685						
Control Delay (s)	7.8	7.8	7.9	8.3	8.3	10.1						
Approach Delay (s)	7.8		8.2		8.3	10.1						
Approach LOS	A		A		A	B						
Intersection Summary												
Delay					8.8							
Level of Service					A							
Intersection Capacity Utilization				36.1%		ICU Level of Service				A		
Analysis Period (min)					15							

HCM Unsignalized Intersection Capacity Analysis
15: Enterprise Dr & State Farm Dr

3/31/2015

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑	↱		↰	↱
Sign Control		Stop	Stop		Stop	
Volume (vph)	84	193	134	197	381	129
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	90	208	144	212	410	139
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total (vph)	90	208	96	260	410	139
Volume Left (vph)	90	0	0	0	410	0
Volume Right (vph)	0	0	0	212	0	139
Hadj (s)	0.53	0.03	0.03	-0.54	0.53	-0.67
Departure Headway (s)	7.4	6.9	6.8	6.3	6.9	5.7
Degree Utilization, x	0.19	0.40	0.18	0.45	0.78	0.22
Capacity (veh/h)	460	498	497	550	512	609
Control Delay (s)	10.9	13.1	10.2	13.1	29.1	9.1
Approach Delay (s)	12.4		12.3		24.0	
Approach LOS	B		B		C	
Intersection Summary						
Delay			17.7			
Level of Service			C			
Intersection Capacity Utilization			45.8%		ICU Level of Service	A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
16: Enterprise Dr/Seed Farm Dr

3/31/2015

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰	↱		↰	↱
Volume (veh/h)	1	529	281	0	1	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1	575	305	0	1	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	305				883	305
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	305				883	305
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	100
cM capacity (veh/h)	1255				316	734
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	576	305	1			
Volume Left	1	0	1			
Volume Right	0	0	0			
cSH	1255	1700	316			
Volume to Capacity	0.00	0.18	0.00			
Queue Length 95th (ft)	0	0	0			
Control Delay (s)	0.0	0.0	16.4			
Lane LOS	A		C			
Approach Delay (s)	0.0	0.0	16.4			
Approach LOS			C			
Intersection Summary						
Average Delay			0.0			
Intersection Capacity Utilization			38.6%		ICU Level of Service	A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

17: State Farm Dr & Town Center

3/31/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔		↔	↔		↔	↔	
Volume (veh/h)	128	0	58	0	0	0	28	287	1	2	416	85
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	139	0	63	0	0	0	30	312	1	2	452	92
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type							None			None		
Median storage (veh)												
Upstream signal (ft)											575	
pX, platoon unblocked												
vC, conflicting volume	720	877	272	667	922	157	545			313		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	720	877	272	667	922	157	545			313		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	55	100	91	100	100	100	97			100		
cM capacity (veh/h)	308	277	725	307	260	861	1021			1244		
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3				
Volume Total	202	0	30	208	105	2	301	243				
Volume Left	139	0	30	0	0	2	0	0				
Volume Right	63	0	0	0	1	0	0	92				
cSH	375	1700	1021	1700	1700	1244	1700	1700				
Volume to Capacity	0.54	0.00	0.03	0.12	0.06	0.00	0.18	0.14				
Queue Length 95th (ft)	77	0	2	0	0	0	0	0				
Control Delay (s)	25.2	0.0	8.6	0.0	0.0	7.9	0.0	0.0				
Lane LOS	D	A	A			A						
Approach Delay (s)	25.2	0.0	0.8			0.0						
Approach LOS	D	A										
Intersection Summary												
Average Delay			4.9									
Intersection Capacity Utilization			38.2%		ICU Level of Service					A		
Analysis Period (min)			15									

Appendix B

Future Intersection LOS Calculations

HCM Signalized Intersection Capacity Analysis

1: US 101 South Ramps & Golf Course Drive West/Golf Course Dr

3/31/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↑	↑	↑↑					↑	↑	↑
Volume (vph)	0	454	259	297	837	0	0	0	0	389	133	521
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	3.0	4.0					3.0	3.0	3.0
Lane Util. Factor		0.95	1.00	0.97	0.95					1.00	0.95	0.95
Flt		1.00	0.85	1.00	1.00					1.00	0.91	0.85
Flt Protected		1.00	1.00	0.95	1.00					0.95	1.00	1.00
Satd. Flow (prot)		3539	1583	3433	3539					1770	1609	1504
Flt Permitted		1.00	1.00	0.95	1.00					0.95	1.00	1.00
Satd. Flow (perm)		3539	1583	3433	3539					1770	1609	1504
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	478	273	313	881	0	0	0	0	409	140	548
RTOR Reduction (vph)	0	0	145	0	0	0	0	0	0	0	61	66
Lane Group Flow (vph)	0	478	128	313	881	0	0	0	0	409	293	268
Turn Type	NA	Perm	Perm	Prot	NA					Split	NA	Perm
Protected Phases	6			5	2					8	8	
Permitted Phases			6									8
Actuated Green, G (s)	52.6	52.6	13.6	69.2						35.8	35.8	35.8
Effective Green, g (s)	52.6	52.6	13.6	69.2						35.8	35.8	35.8
Actuated g/C Ratio	0.47	0.47	0.12	0.62						0.32	0.32	0.32
Clearance Time (s)	4.0	4.0	3.0	4.0						3.0	3.0	3.0
Vehicle Extension (s)	1.5	1.5	1.0	1.5						1.5	1.5	1.5
Lane Grp Cap (vph)	1662	743	416	2186						565	514	480
v/s Ratio Prot	0.14		c0.09	c0.25						c0.23	0.18	
v/s Ratio Perm		0.08										0.18
v/c Ratio	0.29	0.17	0.75	0.40						0.72	0.57	0.56
Uniform Delay, d1	18.2	17.1	47.6	10.9						33.7	31.7	31.6
Progression Factor	0.66	0.99	1.00	1.00						1.00	1.00	1.00
Incremental Delay, d2	0.4	0.5	6.7	0.6						3.9	0.9	0.8
Delay (s)	12.5	17.4	54.3	11.4						37.6	32.6	32.4
Level of Service	B	B	D	B						D	C	C
Approach Delay (s)	14.2			22.7			0.0			34.4		
Approach LOS	B			C			A			C		
Intersection Summary												
HCM 2000 Control Delay		24.8					HCM 2000 Level of Service			C		
HCM 2000 Volume to Capacity ratio		0.57										
Actuated Cycle Length (s)		112.0					Sum of lost time (s)		10.0			
Intersection Capacity Utilization		52.6%					ICU Level of Service		A			
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: Commerce Blvd & Golf Course Drive

3/31/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑	↑	↑	↑↑					↑	↑	↑
Volume (vph)	56	259	511	424	638	76	433	79	195	59	89	35
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	12	12	13	12	12	12
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	0.91	1.00	0.97	0.95		0.97	1.00	1.00	1.00	1.00	
Flrb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Flt	1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85	1.00	0.96	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5085	1583	3433	3472		3433	1863	1636	1770	1777	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	5085	1583	3433	3472		3433	1863	1636	1770	1777	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	59	273	538	446	672	80	456	83	205	62	94	37
RTOR Reduction (vph)	0	0	311	0	7	0	0	0	121	0	13	0
Lane Group Flow (vph)	59	273	227	446	745	0	456	83	84	62	118	0
Confl. Peds. (#/hr)						5						1
Confl. Bikes (#/hr)						1						
Turn Type	Prot	NA	pm+ov	Prot	NA		Split	NA	pm+ov	Split	NA	
Protected Phases	1	6	4	5	2		4	4	5	3	3	
Permitted Phases			6						4			
Actuated Green, G (s)	6.0	17.0	35.0	16.0	27.0		18.0	18.0	34.0	15.8	15.8	
Effective Green, g (s)	6.0	17.0	35.0	16.0	27.0		18.0	18.0	34.0	15.8	15.8	
Actuated g/C Ratio	0.07	0.21	0.42	0.19	0.33		0.22	0.22	0.41	0.19	0.19	
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	1.0	1.5	1.5	1.0	1.5		1.5	1.5	1.0	1.5	1.5	
Lane Grp Cap (vph)	128	1044	669	663	1132		746	405	750	337	339	
v/s Ratio Prot	0.03	0.05	0.07	c0.13	c0.21		c0.13	0.04	0.02	0.04	c0.07	
v/s Ratio Perm			0.07						0.03			
v/c Ratio	0.46	0.26	0.34	0.67	0.66		0.61	0.20	0.11	0.18	0.35	
Uniform Delay, d1	36.8	27.6	16.1	31.0	23.9		29.2	26.5	15.1	28.1	29.0	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	1.0	0.0	0.1	2.1	1.1		1.0	0.1	0.0	0.1	0.2	
Delay (s)	37.8	27.7	16.2	33.1	25.0		30.3	26.6	15.1	28.2	29.3	
Level of Service	D	C	B	C	C		C	C	B	C	C	
Approach Delay (s)		21.3			28.0			25.7			28.9	
Approach LOS		C			C			C			C	
Intersection Summary												
HCM 2000 Control Delay		25.5					HCM 2000 Level of Service			C		
HCM 2000 Volume to Capacity ratio		0.60										
Actuated Cycle Length (s)		82.8					Sum of lost time (s)		16.0			
Intersection Capacity Utilization		63.8%					ICU Level of Service		B			
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis 3: Commerce Blvd & US 101 North Ramps

3/31/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱	↰	↰	↱	↱	↰	↱	↱	↰	↱	↱
Volume (vph)	354	4	51	1	1	2	161	354	5	4	562	441
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	14	12	16	12	12	12	12	12	12	12	12	12
Total Lost time (s)	4.0	4.0	3.0		3.0		3.0	4.0		3.0	4.0	4.0
Lane Util. Factor	0.95	0.95	1.00		1.00		1.00	0.95		1.00	0.95	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85		0.93		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	0.95	1.00		0.99		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1793	1687	1794		1716		1770	3531		1770	3539	1583
Flt Permitted	0.95	0.95	1.00		0.99		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1793	1687	1794		1716		1770	3531		1770	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	373	4	54	1	1	2	169	373	5	4	592	464
RTOR Reduction (vph)	0	0	37	0	2	0	0	1	0	0	0	0
Lane Group Flow (vph)	190	187	17	0	2	0	169	377	0	4	592	464
Confl. Peds. (#/hr)									2			
Turn Type	Split	NA	pm+ov	Split	NA		Prot	NA		Prot	NA	Free
Protected Phases	8	8	1	7	7		1	6		5	2	
Permitted Phases			8									Free
Actuated Green, G (s)	8.1	8.1	15.2		0.6		7.1	26.0		0.6	19.5	49.3
Effective Green, g (s)	8.1	8.1	15.2		0.6		7.1	26.0		0.6	19.5	49.3
Actuated g/C Ratio	0.16	0.16	0.31		0.01		0.14	0.53		0.01	0.40	1.00
Clearance Time (s)	4.0	4.0	3.0		3.0		3.0	4.0		3.0	4.0	
Vehicle Extension (s)	2.0	2.0	2.0		4.0		2.0	2.0		2.0	4.0	
Lane Grp Cap (vph)	294	277	553		20		254	1862		21	1399	1583
v/s Ratio Prot	0.11	c0.11	0.00		0.00		c0.10	0.11		0.00	c0.17	
v/s Ratio Perm			0.00									c0.29
v/c Ratio	0.65	0.68	0.03		0.10		0.67	0.20		0.19	0.42	0.29
Uniform Delay, d1	19.3	19.4	11.9		24.1		20.0	6.2		24.1	10.8	0.0
Progression Factor	1.00	1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	3.6	5.0	0.0		3.0		5.0	0.0		1.6	0.3	0.5
Delay (s)	22.9	24.4	11.9		27.1		25.0	6.2		25.7	11.1	0.5
Level of Service	C	C	B		C		C	A		C	B	A
Approach Delay (s)		22.2			27.1			12.0			6.5	
Approach LOS		C			C			B			A	
Intersection Summary												
HCM 2000 Control Delay		11.3										
HCM 2000 Volume to Capacity ratio		0.56										
Actuated Cycle Length (s)		49.3						14.0				
Intersection Capacity Utilization		51.0%						A				
Analysis Period (min)		15										
c Critical Lane Group												

Rohnert Park PDA Plan
AM Peak Hour - Future Conditions (No Project)

Synchro 8 Report
W-Trans

HCM Unsignalized Intersection Capacity Analysis 4: Commerce Blvd & State Farm Dr

3/31/2015

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↰	↱	↰	↱
Volume (veh/h)	14	371	130	22	367	247
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	15	391	137	23	386	260
Pedestrians	5		5		5	
Lane Width (ft)	12.0		12.0		12.0	
Walking Speed (ft/s)	4.0		4.0		4.0	
Percent Blockage	0		0		0	
Right turn flare (veh)						
Median type			None		None	
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1191	158			165	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1191	158			165	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	90	56			73	
cM capacity (veh/h)	149	880			1407	
Direction, Lane #						
Volume Total	405	160	386	260		
Volume Left	15	0	386	0		
Volume Right	391	23	0	0		
cSH	746	1700	1407	1700		
Volume to Capacity	0.54	0.09	0.27	0.15		
Queue Length 95th (ft)	83	0	28	0		
Control Delay (s)	15.4	0.0	8.5	0.0		
Lane LOS	C		A			
Approach Delay (s)	15.4	0.0	5.1			
Approach LOS	C					
Intersection Summary						
Average Delay			7.9			
Intersection Capacity Utilization			63.6%		ICU Level of Service	B
Analysis Period (min)			15			

Rohnert Park PDA Plan
AM Peak Hour - Future Conditions (No Project)

Synchro 8 Report
W-Trans

HCM Unsignalized Intersection Capacity Analysis
5: State Farm Dr & Professional Center Dr

3/31/2015

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Volume (veh/h)	33	10	26	17	2	5	41	339	28	20	307	17
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
Grade	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	35	11	27	18	2	5	43	357	29	21	323	18
Pedestrians		5			5			5			5	
Lane Width (ft)	12.0				12.0			12.0			12.0	
Walking Speed (ft/s)	4.0				4.0			4.0			4.0	
Percent Blockage	0				0			0			0	
Right turn flare (veh)												
Median type							None			None		
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	655	857	181	704	851	203	346			391		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	655	857	181	704	851	203	346			391		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	89	96	97	94	99	99	96			98		
cM capacity (veh/h)	328	275	824	287	278	797	1205			1159		
Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3			
Volume Total	35	38	25	43	238	148	21	215	126			
Volume Left	35	0	18	43	0	0	21	0	0			
Volume Right	0	27	5	0	0	29	0	0	18			
cSH	328	531	330	1205	1700	1700	1159	1700	1700			
Volume to Capacity	0.11	0.07	0.08	0.04	0.14	0.09	0.02	0.13	0.07			
Queue Length 95th (ft)	9	6	6	3	0	0	1	0	0			
Control Delay (s)	17.3	12.3	16.8	8.1	0.0	0.0	8.2	0.0	0.0			
Lane LOS	C	B	C	A			A					
Approach Delay (s)	14.7		16.8	0.8			0.5					
Approach LOS	B		C									
Intersection Summary												
Average Delay			2.3									
Intersection Capacity Utilization			33.0%		ICU Level of Service				A			
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis
6: Commerce Blvd & Professional Center Dr

3/31/2015

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Volume (veh/h)	45	200	0	5	178	84	0	0	2	34	0	16
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
Grade	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	47	211	0	5	187	88	0	0	2	36	0	17
Pedestrians		5			5			5			5	
Lane Width (ft)	12.0				12.0			12.0			12.0	
Walking Speed (ft/s)	4.0				4.0			4.0			4.0	
Percent Blockage	0				0			0			0	
Right turn flare (veh)												
Median type		None			TWTLT							
Median storage (veh)					2							
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	281			216			530	602	221	559	557	242
vC1, stage 1 conf vol							310	310		247	247	
vC2, stage 2 conf vol							220	291		312	310	
vCu, unblocked vol	281			216			530	602	221	559	557	242
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)							6.1	5.5		6.1	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	96			100			100	100	100	94	100	98
cM capacity (veh/h)	1276			1349			589	535	812	590	562	791
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1	SB 2					
Volume Total	47	211	5	276	2	36	17					
Volume Left	47	0	5	0	0	36	0					
Volume Right	0	0	0	88	2	0	17					
cSH	1276	1700	1349	1700	812	590	791					
Volume to Capacity	0.04	0.12	0.00	0.16	0.00	0.06	0.02					
Queue Length 95th (ft)	3	0	0	0	0	5	2					
Control Delay (s)	7.9	0.0	7.7	0.0	9.4	11.5	9.7					
Lane LOS	A		A		A	B	A					
Approach Delay (s)	1.5		0.1		9.4	10.9						
Approach LOS					A	B						
Intersection Summary												
Average Delay				1.7								
Intersection Capacity Utilization			37.3%		ICU Level of Service				A			
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis

7: Commerce Blvd & Padre Pkwy

3/31/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	20	5	44	63	3	14	31	268	122	20	206	10
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	21	5	46	66	3	15	33	282	128	21	217	11
Pedestrians		5			5			5			5	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		4.0			4.0			4.0			4.0	
Percent Blockage		0			0			0			0	
Right turn flare (veh)												
Median type								TW	TL		TW	TL
Median storage (veh)								2			2	
Upstream signal (ft)								480				
pX, platoon unblocked												
vC, conflicting volume	497	750	124	621	691	215	232			416		
vC1, stage 1 conf vol	269	269		417	417							
vC2, stage 2 conf vol	228	481		204	274							
vCu, unblocked vol	497	750	124	621	691	215	232			416		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)	6.5	5.5		6.5	5.5							
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	96	99	95	87	99	98	98			98		
cM capacity (veh/h)	591	472	896	506	503	783	1327			1135		
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3				
Volume Total	73	84	33	188	222	21	145	83				
Volume Left	21	66	33	0	0	21	0	0				
Volume Right	46	15	0	0	128	0	0	11				
cSH	738	539	1327	1700	1700	1135	1700	1700				
Volume to Capacity	0.10	0.16	0.02	0.11	0.13	0.02	0.09	0.05				
Queue Length 95th (ft)	8	14	2	0	0	1	0	0				
Control Delay (s)	10.4	12.9	7.8	0.0	0.0	8.2	0.0	0.0				
Lane LOS	B	B	A			A						
Approach Delay (s)	10.4	12.9	0.6			0.7						
Approach LOS	B	B										
Intersection Summary												
Average Delay	2.7											
Intersection Capacity Utilization	36.1%			ICU Level of Service					A			
Analysis Period (min)	15											

HCM Unsignalized Intersection Capacity Analysis

8: State Farm Dr & City Center Dr

3/31/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔↔		↔	↔		↔	↔↔		↔	↔↔	
Volume (veh/h)	15	10	73	44	3	31	26	474	79	43	169	10
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	16	11	77	46	3	33	27	499	83	45	178	11
Pedestrians		5			5			5			5	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		4.0			4.0			4.0			4.0	
Percent Blockage		0			0			0			0	
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)								456				
pX, platoon unblocked	1.00	1.00		1.00	1.00	1.00				1.00		
vC, conflicting volume	622	921	104	867	884	301	193			587		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	622	920	104	867	884	301	193			587		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	95	96	92	77	99	95	98			95		
cM capacity (veh/h)	328	250	923	205	262	689	1371			980		
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3		
Volume Total	21	82	46	36	27	333	249	45	119	70		
Volume Left	16	0	46	0	27	0	0	45	0	0		
Volume Right	0	77	0	33	0	0	83	0	0	11		
cSH	304	787	205	603	1371	1700	1700	980	1700	1700		
Volume to Capacity	0.07	0.10	0.23	0.06	0.02	0.20	0.15	0.05	0.07	0.04		
Queue Length 95th (ft)	6	9	21	5	2	0	0	4	0	0		
Control Delay (s)	17.7	10.1	27.6	11.3	7.7	0.0	0.0	8.9	0.0	0.0		
Lane LOS	C	B	D	B	A			A				
Approach Delay (s)	11.7		20.5		0.3			1.7				
Approach LOS	B		C									
Intersection Summary												
Average Delay	3.4											
Intersection Capacity Utilization	38.8%			ICU Level of Service					A			
Analysis Period (min)	15											

HCM Signalized Intersection Capacity Analysis
9: US 101 SB Ramps & Rohnert Park Expressway

3/31/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑↑↑	↑	↑	↑↑↑	↑	↑	↑	↑	↑	↑	↑	↑
Volume (vph)	0	749	310	14	633	0	1	0	0	623	0	369
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	11	12	12	12	12	12	12	12	12	12
Total Lost time (s)		4.5	4.5	3.5	4.5		4.0			4.0		4.0
Lane Util. Factor		0.91	*0.75	1.00	0.91		1.00			0.97		1.00
Flpb, ped/bikes		1.00	0.92	1.00	1.00		1.00			1.00		1.00
Flpb, ped/bikes		1.00	1.00	1.00	1.00		1.00			1.00		1.00
Frt		1.00	0.85	1.00	1.00		1.00			1.00		0.85
Flt Protected		1.00	1.00	0.95	1.00		0.95			0.95		1.00
Satd. Flow (prot)		5085	1061	1770	5085		1770			3433		1583
Flt Permitted		1.00	1.00	0.95	1.00		0.95			0.95		1.00
Satd. Flow (perm)		5085	1061	1770	5085		1770			3433		1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	788	326	15	666	0	1	0	0	656	0	388
RTOR Reduction (vph)	0	0	171	0	0	0	0	0	0	0	0	169
Lane Group Flow (vph)	0	788	155	15	666	0	1	0	0	656	0	219
Confl. Peds. (#/hr)			20			20						
Confl. Bikes (#/hr)			20			20						
Turn Type	NA	Perm	Prot	NA	Prot		Prot		Prot		Perm	
Protected Phases	2		1	6		3		3		4		
Permitted Phases		2										4
Actuated Green, G (s)	69.2	69.2	4.6	77.3		1.2				59.0		59.0
Effective Green, g (s)	69.2	69.2	4.6	77.3		1.2				59.0		59.0
Actuated g/C Ratio	0.46	0.46	0.03	0.52		0.01				0.39		0.39
Clearance Time (s)	4.5	4.5	3.5	4.5		4.0				4.0		4.0
Vehicle Extension (s)	4.0	4.0	2.0	4.0		3.0				2.0		2.0
Lane Grp Cap (vph)	2345	489	54	2620		14				1350		622
v/s Ratio Prot	c0.15		0.01	c0.13		c0.00				c0.19		
v/s Ratio Perm		0.15										0.14
v/c Ratio	0.34	0.32	0.28	0.25		0.07				0.49		0.35
Uniform Delay, d1	25.8	25.5	71.1	20.3		73.8				34.1		32.0
Progression Factor	0.24	1.26	0.81	0.66		1.00				1.00		1.00
Incremental Delay, d2	0.4	1.6	1.0	0.2		2.2				0.1		0.1
Delay (s)	6.6	33.7	58.4	13.5		76.0				34.2		32.2
Level of Service	A	C	E	B		E				C		C
Approach Delay (s)	14.6			14.5		76.0				33.5		
Approach LOS	B			B		E				C		
Intersection Summary												
HCM 2000 Control Delay		21.5				HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio		0.40										
Actuated Cycle Length (s)		150.0				Sum of lost time (s)				16.0		
Intersection Capacity Utilization		56.6%				ICU Level of Service				B		
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis
10: US 101 NB Ramps & Rohnert Park Expressway

3/31/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑↑↑			↑↑↑	↑	↑	↑	↑	↑	↑	↑
Volume (vph)	24	1145	0	0	816	845	187	19	289	1	0	9
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0			5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	1.00	0.86			0.91	1.00	0.95	0.95	0.88	1.00		1.00
Flrb, ped/bikes	1.00	1.00			1.00	0.98	1.00	1.00	1.00	1.00		1.00
Flpb, ped/bikes	1.00	1.00			1.00	1.00	1.00	1.00	1.00	1.00		1.00
Frt	1.00	1.00			1.00	0.85	1.00	1.00	0.85	1.00		0.85
Flt Protected		0.95	1.00		1.00	1.00	0.95	0.96	1.00	0.95		1.00
Satd. Flow (prot)	1770	6408			5085	1550	1681	1700	2787	1770		1583
Flt Permitted		0.95	1.00		1.00	1.00	0.95	0.96	1.00	0.95		1.00
Satd. Flow (perm)	1770	6408			5085	1550	1681	1700	2787	1770		1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	25	1205	0	0	859	889	197	20	304	1	0	9
RTOR Reduction (vph)	0	0	0	0	0	226	0	0	241	0	0	9
Lane Group Flow (vph)	25	1205	0	0	859	663	108	109	63	1	0	0
Confl. Peds. (#/hr)			4			4						
Turn Type	Prot	NA			NA	Perm	Split	NA	Perm	Prot		Perm
Protected Phases	5	2			6		3	3		4		
Permitted Phases						6			3			4
Actuated Green, G (s)	4.8	118.9			110.1	110.1	14.9	14.9	14.9	1.2		1.2
Effective Green, g (s)	4.8	118.9			110.1	110.1	14.9	14.9	14.9	1.2		1.2
Actuated g/C Ratio	0.03	0.79			0.73	0.73	0.10	0.10	0.10	0.01		0.01
Clearance Time (s)	4.0	5.0			5.0	5.0	5.0	5.0	5.0	5.0		5.0
Vehicle Extension (s)	2.0	4.0			2.0	2.0	2.0	2.0	2.0	4.0		4.0
Lane Grp Cap (vph)	56	5079			3732	1137	166	168	276	14		12
v/s Ratio Prot	c0.01	0.19			0.17		c0.06	0.06		c0.00		
v/s Ratio Perm						c0.43			0.02			0.00
v/c Ratio	0.45	0.24			0.23	0.58	0.65	0.65	0.23	0.07		0.01
Uniform Delay, d1	71.3	4.0			6.4	9.3	65.0	65.0	62.2	73.8		73.8
Progression Factor	1.27	1.86			0.65	7.68	1.00	1.00	1.00	1.00		1.00
Incremental Delay, d2	1.9	0.1			0.1	1.9	6.8	6.3	0.2	2.9		0.3
Delay (s)	92.6	7.5			4.2	73.2	71.8	71.4	62.4	76.8		74.1
Level of Service	F	A			A	E	E	E	E	E		E
Approach Delay (s)		9.2			39.3			66.2		74.4		
Approach LOS		A			D			E		E		
Intersection Summary												
HCM 2000 Control Delay		32.9				HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio		0.58										
Actuated Cycle Length (s)		150.0				Sum of lost time (s)				19.0		
Intersection Capacity Utilization		77.8%				ICU Level of Service				D		
Analysis Period (min)		15										

HCM Signalized Intersection Capacity Analysis
11: Commerce Blvd & Rohnert Park Expressway

3/31/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Volume (vph)	227	853	355	90	1088	73	397	145	131	51	93	176
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.91		0.97	1.00	1.00	0.91	0.91	1.00
Frpb, ped/bikes	1.00	1.00	0.97	1.00	1.00		1.00	1.00	0.95	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1538	1770	5023		3433	1863	1508	1610	3382	1546
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1538	1770	5023		3433	1863	1508	1610	3382	1546
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	239	898	374	95	1145	77	418	153	138	54	98	185
RTOR Reduction (vph)	0	0	121	0	3	0	0	0	115	0	0	69
Lane Group Flow (vph)	239	898	253	95	1219	0	418	153	23	49	103	116
Confl. Peds. (#/hr)			20			20			20			20
Confl. Bikes (#/hr)			10			10			10			10
Turn Type	Prot	NA	pm+ov	Prot	NA		Split	NA	Perm	Split	NA	pm+ov
Protected Phases	5	2	3	1	6		3	3		4	4	5
Permitted Phases			2						3			4
Actuated Green, G (s)	13.6	76.3	101.5	11.7	74.4		25.2	25.2	25.2	16.8	16.8	30.4
Effective Green, g (s)	13.6	76.3	101.5	11.7	74.4		25.2	25.2	25.2	16.8	16.8	30.4
Actuated g/C Ratio	0.09	0.51	0.68	0.08	0.50		0.17	0.17	0.17	0.11	0.11	0.20
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Vehicle Extension (s)	1.0	1.0	1.5	1.0	1.0		1.5	1.5	1.5	1.0	1.0	1.0
Lane Grp Cap (vph)	311	1800	1091	138	2491		576	312	253	180	378	313
v/s Ratio Prot	c0.07	c0.25	0.04	c0.05	0.24		c0.12	0.08		0.03	0.03	c0.03
v/s Ratio Perm			0.13						0.02			0.04
v/c Ratio	0.77	0.50	0.23	0.69	0.49		0.73	0.49	0.09	0.27	0.27	0.37
Uniform Delay, d1	66.7	24.3	9.3	67.4	25.2		59.1	56.6	52.7	61.0	61.0	51.5
Progression Factor	0.68	0.41	2.35	1.11	1.07		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	9.6	1.0	0.0	9.7	0.6		3.8	0.4	0.1	0.3	0.1	0.3
Delay (s)	54.7	10.9	21.9	84.4	27.6		63.0	57.0	52.8	61.3	61.1	51.8
Level of Service	D	B	C	F	C		E	E	D	E	E	D
Approach Delay (s)		20.5			31.7			59.7			56.0	
Approach LOS		C			C			E			E	
Intersection Summary												
HCM 2000 Control Delay		34.6			HCM 2000 Level of Service			C				
HCM 2000 Volume to Capacity ratio		0.56										
Actuated Cycle Length (s)		150.0			Sum of lost time (s)			20.0				
Intersection Capacity Utilization		82.3%			ICU Level of Service			E				
Analysis Period (min)		15										
c Critical Lane Group												

Rohnert Park PDA Plan
AM Peak Hour - Future Conditions (No Project)

Synchro 8 Report
W-Trans

HCM Signalized Intersection Capacity Analysis
12: State Farm Dr & Rohnert Park Expressway

3/31/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Volume (vph)	175	763	58	189	1004	334	123	131	130	112	82	108
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.91	0.91	1.00	0.91	0.91	
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00	0.99	1.00	1.00	0.98	1.00	0.99	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.92	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.99	1.00	0.95	1.00	
Satd. Flow (prot)	1770	3539	1548	1770	3539	1560	1610	3350	1553	1610	3081	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.99	1.00	0.95	1.00	
Satd. Flow (perm)	1770	3539	1548	1770	3539	1560	1610	3350	1553	1610	3081	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	184	803	61	199	1057	352	129	138	137	118	86	114
RTOR Reduction (vph)	0	0	32	0	93	0	0	121	0	100	0	0
Lane Group Flow (vph)	184	803	29	199	1057	259	86	181	16	106	112	0
Confl. Peds. (#/hr)			8			2			5			2
Confl. Bikes (#/hr)									1			1
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Split	NA	Perm	Split	NA	
Protected Phases	5	2		1	6		3	3		4	4	
Permitted Phases			2			6			3			
Actuated Green, G (s)	11.0	71.5	71.5	22.1	82.6	82.6	17.9	17.9	17.9	18.5	18.5	
Effective Green, g (s)	11.0	71.5	71.5	22.1	82.6	82.6	17.9	17.9	17.9	18.5	18.5	
Actuated g/C Ratio	0.07	0.48	0.48	0.15	0.55	0.55	0.12	0.12	0.12	0.12	0.12	
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
Lane Grp Cap (vph)	129	1686	737	260	1948	859	192	399	185	198	379	
v/s Ratio Prot	c0.10	0.23		c0.11	c0.30		0.05	c0.05		c0.07	0.04	
v/s Ratio Perm			0.02			0.17			0.01			
v/c Ratio	1.43	0.48	0.04	0.77	0.54	0.30	0.45	0.45	0.09	0.54	0.30	
Uniform Delay, d1	69.5	26.6	20.9	61.5	21.6	18.2	61.5	61.5	58.8	61.7	59.8	
Progression Factor	0.96	0.30	0.13	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.00	
Incremental Delay, d2	227.6	0.9	0.1	11.4	1.1	0.9	0.6	0.3	0.1	1.4	0.2	
Delay (s)	294.5	8.8	2.8	72.9	22.7	19.1	62.1	61.8	58.9	63.5	60.2	
Level of Service	F	A	A	E	C	B	E	E	E	E	E	
Approach Delay (s)		58.6			28.1		60.9				61.3	
Approach LOS		E			C		E				E	
Intersection Summary												
HCM 2000 Control Delay		44.6			HCM 2000 Level of Service			D				
HCM 2000 Volume to Capacity ratio		0.62										
Actuated Cycle Length (s)		150.0			Sum of lost time (s)			20.0				
Intersection Capacity Utilization		80.2%			ICU Level of Service			D				
Analysis Period (min)		15										
c Critical Lane Group												

Rohnert Park PDA Plan
AM Peak Hour - Future Conditions (No Project)

Synchro 8 Report
W-Trans

HCM Signalized Intersection Capacity Analysis 13: Commerce Blvd & Enterprise Dr

3/31/2015

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↔↔	↔	↕↕		↕	↕↕
Volume (vph)	71	55	537	60	22	329
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	0.97	1.00	0.95		1.00	0.95
Flpb, ped/bikes	1.00	0.98	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	0.85	0.98		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	3433	1550	3480		1770	3539
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	3433	1550	3480		1770	3539
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	75	58	565	63	23	346
RTOR Reduction (vph)	0	49	11	0	0	0
Lane Group Flow (vph)	75	9	617	0	23	346
Confl. Peds. (#/hr)		5		5		
Confl. Bikes (#/hr)		5		5		
Turn Type	Prot	Perm	NA		Prot	NA
Protected Phases	8		2		1	6
Permitted Phases		8				
Actuated Green, G (s)	4.9	4.9	15.4		0.3	19.7
Effective Green, g (s)	4.9	4.9	15.4		0.3	19.7
Actuated g/C Ratio	0.15	0.15	0.47		0.01	0.60
Clearance Time (s)	4.0	4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	516	232	1643		16	2138
v/s Ratio Prot	c0.02		c0.18		c0.01	0.10
v/s Ratio Perm		0.01				
v/c Ratio	0.15	0.04	0.38		1.44	0.16
Uniform Delay, d1	12.0	11.8	5.5		16.2	2.8
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	0.1	0.1	0.1		385.6	0.0
Delay (s)	12.2	11.9	5.7		401.8	2.9
Level of Service	B	B	A		F	A
Approach Delay (s)	12.0		5.7			27.7
Approach LOS	B		A			C
Intersection Summary						
HCM 2000 Control Delay			13.6		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.34			
Actuated Cycle Length (s)			32.6		Sum of lost time (s)	12.0
Intersection Capacity Utilization			31.1%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						

HCM Unsignalized Intersection Capacity Analysis 14: Enterprise Dr & Hunter Dr

3/31/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕↕			↕↕			↕↕			↕↕	
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	15	72	0	3	120	101	1	2	0	56	0	5
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	16	76	0	3	126	106	1	2	0	59	0	5
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1						
Volume Total (vph)	54	38	66	169	3	64						
Volume Left (vph)	16	0	3	0	1	59						
Volume Right (vph)	0	0	0	106	0	5						
Hadj (s)	0.18	0.03	0.06	-0.41	0.10	0.17						
Departure Headway (s)	5.0	4.9	4.8	4.3	4.8	4.8						
Degree Utilization, x	0.08	0.05	0.09	0.20	0.00	0.09						
Capacity (veh/h)	700	715	727	809	699	703						
Control Delay (s)	7.2	6.9	7.1	7.3	7.8	8.2						
Approach Delay (s)	7.1		7.2		7.8	8.2						
Approach LOS	A		A		A	A						
Intersection Summary												
Delay					7.4							
Level of Service					A							
Intersection Capacity Utilization				28.2%		ICU Level of Service				A		
Analysis Period (min)				15								

HCM Unsignalized Intersection Capacity Analysis
15: Enterprise Dr & State Farm Dr

3/31/2015

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑	↱		↰	↱
Sign Control		Stop	Stop		Stop	
Volume (vph)	51	77	124	285	216	76
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	54	81	131	300	227	80
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total (vph)	54	81	87	344	227	80
Volume Left (vph)	54	0	0	0	227	0
Volume Right (vph)	0	0	0	300	0	80
Hadj (s)	0.53	0.03	0.03	-0.58	0.53	-0.67
Departure Headway (s)	6.5	6.0	5.7	5.1	6.4	5.2
Degree Utilization, x	0.10	0.14	0.14	0.48	0.40	0.12
Capacity (veh/h)	520	566	604	688	527	646
Control Delay (s)	9.0	8.7	8.4	11.5	12.5	7.7
Approach Delay (s)	8.8		10.9		11.3	
Approach LOS	A		B		B	
Intersection Summary						
Delay			10.7			
Level of Service			B			
Intersection Capacity Utilization			38.6%		ICU Level of Service	A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
16: Enterprise Dr/Seed Farm Dr

3/31/2015

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰	↱		↰	↱
Volume (veh/h)	64	203	370	12	5	17
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	67	214	389	13	5	18
Pedestrians		5	5		5	
Lane Width (ft)		12.0	12.0		12.0	
Walking Speed (ft/s)		4.0	4.0		4.0	
Percent Blockage		0	0		0	
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	407				754	406
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	407				754	406
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	94				99	97
cM capacity (veh/h)	1147				352	640
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	281	402	23			
Volume Left	67	0	5			
Volume Right	0	13	18			
cSH	1147	1700	539			
Volume to Capacity	0.06	0.24	0.04			
Queue Length 95th (ft)	5	0	3			
Control Delay (s)	2.4	0.0	12.0			
Lane LOS	A		B			
Approach Delay (s)	2.4	0.0	12.0			
Approach LOS			B			
Intersection Summary						
Average Delay			1.4			
Intersection Capacity Utilization			49.3%		ICU Level of Service	A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

17: State Farm Dr & Town Center

3/31/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔		↔	↔		↔	↔	
Volume (veh/h)	40	0	9	0	0	1	22	326	0	1	290	17
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	42	0	9	0	0	1	23	343	0	1	305	18
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type							None			None		
Median storage (veh)												
Upstream signal (ft)											561	
pX, platoon unblocked												
vC, conflicting volume	535	706	162	554	715	172	323			343		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	535	706	162	554	715	172	323			343		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	90	100	99	100	100	100	98			100		
cM capacity (veh/h)	421	352	855	405	348	842	1233			1213		
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3				
Volume Total	52	1	23	229	114	1	204	120				
Volume Left	42	0	23	0	0	1	0	0				
Volume Right	9	1	0	0	0	0	0	18				
cSH	464	842	1233	1700	1700	1213	1700	1700				
Volume to Capacity	0.11	0.00	0.02	0.13	0.07	0.00	0.12	0.07				
Queue Length 95th (ft)	9	0	1	0	0	0	0	0				
Control Delay (s)	13.7	9.3	8.0	0.0	0.0	8.0	0.0	0.0				
Lane LOS	B	A	A			A						
Approach Delay (s)	13.7	9.3	0.5			0.0						
Approach LOS	B	A										
Intersection Summary												
Average Delay			1.2									
Intersection Capacity Utilization			31.8%		ICU Level of Service					A		
Analysis Period (min)			15									

HCM Signalized Intersection Capacity Analysis

1: US 101 South Ramps & Golf Course Dr

4/6/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↑	↑	↑↑					↑	↑	↑
Volume (vph)	0	1249	769	168	1177	0	0	0	0	445	202	1246
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5	4.5	4.5	4.5					4.5	4.5	4.5
Lane Util. Factor		0.95	1.00	0.97	0.95					1.00	0.95	0.95
Frpb, ped/bikes		1.00	0.96	1.00	1.00					1.00	0.98	0.97
Flpb, ped/bikes		1.00	1.00	1.00	1.00					1.00	1.00	1.00
Frt		1.00	0.85	1.00	1.00					1.00	0.89	0.85
Flt Protected		1.00	1.00	0.95	1.00					0.95	1.00	1.00
Satd. Flow (prot)		3539	1526	3433	3539					1770	1543	1460
Flt Permitted		1.00	1.00	0.95	1.00					0.95	1.00	1.00
Satd. Flow (perm)		3539	1526	3433	3539					1770	1543	1460
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	0	1274	785	171	1201	0	0	0	0	454	206	1271
RTOR Reduction (vph)	0	0	332	0	0	0	0	0	0	0	17	34
Lane Group Flow (vph)	0	1274	453	171	1201	0	0	0	0	454	736	690
Confl. Peds. (#/hr)			10									10
Confl. Bikes (#/hr)			10									10
Turn Type	NA	Perm	Prot	NA						Split	NA	Perm
Protected Phases	6		5	2						8	8	
Permitted Phases		6										8
Actuated Green, G (s)	39.1	39.1	4.9	48.5						48.5	48.5	48.5
Effective Green, g (s)	39.1	39.1	4.9	48.5						48.5	48.5	48.5
Actuated g/C Ratio	0.37	0.37	0.05	0.46						0.46	0.46	0.46
Clearance Time (s)	4.5	4.5	4.5	4.5						4.5	4.5	4.5
Vehicle Extension (s)	1.5	1.5	1.0	1.5						1.5	1.5	1.5
Lane Grp Cap (vph)	1305	562	158	1619						809	705	668
v/s Ratio Prot	c0.36		0.05	c0.34						0.26	c0.48	
v/s Ratio Perm		0.30										0.47
v/c Ratio	0.98	0.81	1.08	0.74						0.56	1.04	1.03
Uniform Delay, d1	33.0	30.0	50.5	23.6						21.0	28.8	28.8
Progression Factor	0.60	0.27	0.94	0.84						1.00	1.00	1.00
Incremental Delay, d2	14.6	7.5	86.1	2.4						0.5	46.0	43.7
Delay (s)	34.4	15.7	133.5	22.2						21.5	74.7	72.5
Level of Service	C	B	F	C						C	E	E
Approach Delay (s)	27.3			36.0			0.0				61.4	
Approach LOS	C			D			A				E	
Intersection Summary												
HCM 2000 Control Delay		41.8		HCM 2000 Level of Service			D					
HCM 2000 Volume to Capacity ratio		1.02										
Actuated Cycle Length (s)		106.0		Sum of lost time (s)			13.5					
Intersection Capacity Utilization		101.5%		ICU Level of Service			G					
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: Commerce Blvd & Golf Course Dr

4/6/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑	↑	↑	↑↑					↑	↑	↑
Volume (vph)	29	721	944	369	409	112	909	192	613	208	271	27
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	12	12	13	12	12	12
Total Lost time (s)	3.5	4.1	4.1	4.1	4.1		4.1	4.1	4.1	4.1	4.1	
Lane Util. Factor	1.00	0.91	1.00	0.97	0.95		0.97	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00	0.99	1.00	0.99		1.00	1.00	0.99	1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.97		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5085	1572	3433	3381		3433	1863	1616	1770	1831	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	5085	1572	3433	3381		3433	1863	1616	1770	1831	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	30	736	963	377	417	114	928	196	626	212	277	28
RTOR Reduction (vph)	0	0	24	0	23	0	0	0	42	0	3	0
Lane Group Flow (vph)	30	736	939	377	508	0	928	196	584	212	302	0
Confl. Peds. (#/hr)			10			10			10			10
Confl. Bikes (#/hr)			10			10			10			10
Turn Type	Prot	NA	pm+ov	Prot	NA		Split	NA	pm+ov	Split	NA	
Protected Phases	1	6	4	5	2		4	4	5	3	3	
Permitted Phases			6						4			
Actuated Green, G (s)	4.3	15.6	59.5	14.0	25.9		43.9	43.9	57.9	16.1	16.1	
Effective Green, g (s)	4.3	15.6	59.5	14.0	25.9		43.9	43.9	57.9	16.1	16.1	
Actuated g/C Ratio	0.04	0.15	0.56	0.13	0.24		0.41	0.41	0.55	0.15	0.15	
Clearance Time (s)	3.5	4.1	4.1	4.1	4.1		4.1	4.1	4.1	4.1	4.1	
Vehicle Extension (s)	1.0	1.5	1.5	1.0	1.5		1.5	1.5	1.0	1.5	1.5	
Lane Grp Cap (vph)	71	748	943	453	826		1421	771	882	268	278	
v/s Ratio Prot	0.02	0.14	c0.41	c0.11	0.15		0.27	0.11	0.09	0.12	c0.16	
v/s Ratio Perm			0.19						0.27			
v/c Ratio	0.42	0.98	1.00	0.83	0.62		0.65	0.25	0.66	0.79	1.08	
Uniform Delay, d1	49.6	45.1	23.1	44.9	35.6		24.9	20.3	17.1	43.3	44.9	
Progression Factor	0.66	0.87	0.66	0.76	0.67		0.80	0.85	0.63	1.00	1.00	
Incremental Delay, d2	0.7	19.1	19.0	11.1	3.2		0.6	0.0	1.1	13.8	78.5	
Delay (s)	33.6	58.1	34.3	45.2	27.0		20.5	17.2	11.8	57.1	123.4	
Level of Service	C	E	C	D	C		C	B	B	E	F	
Approach Delay (s)		44.4			34.5			17.0			96.2	
Approach LOS		D			C			B			F	
Intersection Summary												
HCM 2000 Control Delay		38.3		HCM 2000 Level of Service			D					
HCM 2000 Volume to Capacity ratio		1.03										
Actuated Cycle Length (s)		106.0		Sum of lost time (s)			16.4					
Intersection Capacity Utilization		98.8%		ICU Level of Service			F					
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis 3: Commerce Blvd & US 101 North Ramps

4/6/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱	↰	↰	↱	↱	↰	↱	↱	↰	↱	↱
Volume (vph)	984	2	57	4	5	13	469	717	2	8	730	846
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	14	12	16	12	12	12	12	12	12	12	12	12
Total Lost time (s)	4.0	4.0	3.5		3.5		3.5	4.0		3.5	4.0	4.0
Lane Util. Factor	0.95	0.95	1.00		1.00		1.00	0.95		1.00	0.95	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00		1.00	1.00		1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85		0.92		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	0.95	1.00		0.99		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1793	1686	1794		1699		1770	3538		1770	3539	1546
Flt Permitted	0.95	0.95	1.00		0.99		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1793	1686	1794		1699		1770	3538		1770	3539	1546
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	1004	2	58	4	5	13	479	732	2	8	745	863
RTOR Reduction (vph)	0	0	23	0	13	0	0	0	0	0	0	0
Lane Group Flow (vph)	502	504	35	0	9	0	479	734	0	8	745	863
Confl. Bikes (#/hr)												10
Turn Type	Split	NA	pm+ov	Split	NA		Prot	NA		Prot	NA	Free
Protected Phases	8	8	1	7	7		1	6		5	2	
Permitted Phases			8									Free
Actuated Green, G (s)	33.4	33.4	63.2		1.6		29.8	55.2		0.8	26.2	106.0
Effective Green, g (s)	33.4	33.4	63.2		1.6		29.8	55.2		0.8	26.2	106.0
Actuated g/C Ratio	0.32	0.32	0.60		0.02		0.28	0.52		0.01	0.25	1.00
Clearance Time (s)	4.0	4.0	3.5		3.5		3.5	4.0		3.5	4.0	
Vehicle Extension (s)	1.5	1.5	1.0		1.0		1.0	1.5		1.0	1.5	
Lane Grp Cap (vph)	564	531	1069		25		497	1842		13	874	1546
v/s Ratio Prot	0.28	c0.30	0.01		0.01		c0.27	0.21		0.00	c0.21	
v/s Ratio Perm			0.01									c0.56
v/c Ratio	0.89	0.95	0.03		0.37		0.96	0.40		0.62	0.85	0.56
Uniform Delay, d1	34.6	35.5	8.8		51.7		37.6	15.4		52.4	38.1	0.0
Progression Factor	1.00	1.00	1.00		1.00		1.00	1.00		1.01	0.98	1.00
Incremental Delay, d2	18.7	28.3	0.0		3.3		30.9	0.1		5.4	0.8	0.1
Delay (s)	53.3	63.8	8.8		55.0		68.5	15.4		58.1	37.9	0.1
Level of Service	D	E	A		E		E	B		E	D	A
Approach Delay (s)		55.8			55.0			36.4			17.8	
Approach LOS		E			E			D			B	
Intersection Summary												
HCM 2000 Control Delay		34.1										
HCM 2000 Volume to Capacity ratio		0.95										
Actuated Cycle Length (s)		106.0						15.0				
Intersection Capacity Utilization		90.1%						E				
Analysis Period (min)		15										
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis 4: Commerce Blvd & State Farm Dr

4/6/2015

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↰	↱	↰	↱
Volume (veh/h)	19	562	504	12	353	347
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	19	573	514	12	360	354
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1595	520			527	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1595	520			527	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	75	0			65	
cM capacity (veh/h)	77	556			1040	
Direction, Lane #						
	WB 1	NB 1	SB 1	SB 2		
Volume Total	593	527	360	354		
Volume Left	19	0	360	0		
Volume Right	573	12	0	0		
cSH	462	1700	1040	1700		
Volume to Capacity	1.28	0.31	0.35	0.21		
Queue Length 95th (ft)	630	0	39	0		
Control Delay (s)	169.4	0.0	10.3	0.0		
Lane LOS	F		B			
Approach Delay (s)	169.4	0.0	5.2			
Approach LOS	F					
Intersection Summary						
Average Delay		56.8				
Intersection Capacity Utilization		92.6%		ICU Level of Service		F
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
5: State Farm Dr & Professional Center Dr

4/6/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	10	14	34	44	10	35	64	356	25	15	302	18
Sign Control	Stop			Stop			Free			Free		
Grade	0%			0%			0%			0%		
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	10	14	35	45	10	36	65	363	26	15	308	18
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type							None			None		
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	701	867	163	733	864	194	327				389	
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	701	867	163	733	864	194	327				389	
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1				4.1	
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2				2.2	
p0 queue free %	96	95	96	83	96	96	95				99	
cM capacity (veh/h)	287	270	853	270	272	814	1230				1166	
Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3			
Volume Total	10	49	91	65	242	147	15	205	121			
Volume Left	10	0	45	65	0	0	15	0	0			
Volume Right	0	35	36	0	0	26	0	0	18			
cSH	287	524	367	1230	1700	1700	1166	1700	1700			
Volume to Capacity	0.04	0.09	0.25	0.05	0.14	0.09	0.01	0.12	0.07			
Queue Length 95th (ft)	3	8	24	4	0	0	1	0	0			
Control Delay (s)	18.0	12.6	18.0	8.1	0.0	0.0	8.1	0.0	0.0			
Lane LOS	C	B	C	A	A							
Approach Delay (s)	13.5	18.0		1.2	0.4							
Approach LOS	B	C										
Intersection Summary												
Average Delay				3.3								
Intersection Capacity Utilization				35.7%	ICU Level of Service			A				
Analysis Period (min)				15								

HCM Unsignalized Intersection Capacity Analysis
6: Commerce Blvd & Professional Center Dr

4/6/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	14	335	5	7	376	38	1	0	9	75	1	68
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	14	342	5	7	384	39	1	0	9	77	1	69
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			TWLTL							
Median storage (veh)		2										
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	422			347			841	810	344	797	793	403
vC1, stage 1 conf vol							373	373		417	417	
vC2, stage 2 conf vol							468	437		380	376	
vCu, unblocked vol	422			347			841	810	344	797	793	403
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)							6.1	5.5		6.1	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			99			100	100	99	85	100	89
cM capacity (veh/h)	1137			1212			437	480	698	496	489	647
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1	SB 2					
Volume Total	14	347	7	422	10	77	70					
Volume Left	14	0	7	0	1	77	0					
Volume Right	0	5	0	39	9	0	69					
cSH	1137	1700	1212	1700	659	496	644					
Volume to Capacity	0.01	0.20	0.01	0.25	0.02	0.15	0.11					
Queue Length 95th (ft)	1	0	0	0	1	14	9					
Control Delay (s)	8.2	0.0	8.0	0.0	10.5	13.6	11.3					
Lane LOS	A		A		B	B	B					
Approach Delay (s)	0.3		0.1		10.5	12.5						
Approach LOS					B	B						
Intersection Summary												
Average Delay				2.2								
Intersection Capacity Utilization				39.6%	ICU Level of Service			A				
Analysis Period (min)				15								

HCM Unsignalized Intersection Capacity Analysis
7: Commerce Blvd & Padre Pkwy

4/6/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔		↔	↔		↔	↔	
Volume (veh/h)	7	6	41	190	5	43	41	408	202	40	388	6
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	7	6	42	194	5	44	42	416	206	41	396	6
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								TWLTL			TWLTL	
Median storage (veh)								2			2	
Upstream signal (ft)								480				
pX, platoon unblocked												
vC, conflicting volume	819	1187	201	928	1087	311	402			622		
vC1, stage 1 conf vol	481	481		603	603							
vC2, stage 2 conf vol	338	706		324	484							
vCu, unblocked vol	819	1187	201	928	1087	311	402			622		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)	6.5	5.5		6.5	5.5							
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	98	98	95	48	99	94	96			96		
cM capacity (veh/h)	417	335	806	376	375	685	1153			954		
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3				
Volume Total	55	243	42	278	345	41	264	138				
Volume Left	7	194	42	0	0	41	0	0				
Volume Right	42	44	0	0	206	0	0	6				
cSH	631	409	1153	1700	1700	954	1700	1700				
Volume to Capacity	0.09	0.59	0.04	0.16	0.20	0.04	0.16	0.08				
Queue Length 95th (ft)	7	93	3	0	0	3	0	0				
Control Delay (s)	11.2	25.9	8.2	0.0	0.0	8.9	0.0	0.0				
Lane LOS	B	D	A			A						
Approach Delay (s)	11.2	25.9	0.5			0.8						
Approach LOS	B	D										
Intersection Summary												
Average Delay			5.4									
Intersection Capacity Utilization			51.2%		ICU Level of Service				A			
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis
8: State Farm Dr & City Center Dr

4/6/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔		↔	↔		↔	↔	
Volume (veh/h)	25	33	127	87	7	30	64	367	47	107	434	33
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	26	34	130	89	7	31	65	374	48	109	443	34
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)								456				
pX, platoon unblocked												
vC, conflicting volume	1030	1231	238	1115	1224	211	477			422		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1030	1231	238	1115	1224	211	477			422		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	83	77	83	10	95	96	94			90		
cM capacity (veh/h)	154	149	763	99	151	794	1082			1133		
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3		
Volume Total	42	146	89	38	65	250	173	109	295	181		
Volume Left	26	0	89	0	65	0	0	109	0	0		
Volume Right	0	130	0	31	0	0	48	0	0	34		
cSH	152	518	99	440	1082	1700	1700	1133	1700	1700		
Volume to Capacity	0.28	0.28	0.90	0.09	0.06	0.15	0.10	0.10	0.17	0.11		
Queue Length 95th (ft)	27	29	129	7	5	0	0	8	0	0		
Control Delay (s)	37.6	14.7	141.3	14.0	8.5	0.0	0.0	8.5	0.0	0.0		
Lane LOS	E	B	F	B	A			A				
Approach Delay (s)	19.8		103.3		1.1			1.6				
Approach LOS	C		F									
Intersection Summary												
Average Delay			13.2									
Intersection Capacity Utilization			41.5%		ICU Level of Service				A			
Analysis Period (min)			15									

HCM Signalized Intersection Capacity Analysis
9: US 101 SB Ramps & Rohnert Park Expressway

4/6/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑↑↑	↑	↘	↘	↑↑↑		↘		↘	↘		↘
Volume (vph)	0	1344	646	42	1550	0	5	0	41	811	0	384
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	11	12	12	12	12	12	12	12	12	12
Total Lost time (s)		4.5	4.5	3.5	4.5		4.0		4.0	4.0		4.0
Lane Util. Factor		0.91	1.00	1.00	0.91		1.00		1.00	0.97		1.00
Frt		1.00	0.85	1.00	1.00		1.00		0.85	1.00		0.85
Flt Protected		1.00	1.00	0.95	1.00		0.95		1.00	0.95		1.00
Satd. Flow (prot)		5085	1531	1770	5085		1770		1583	3433		1583
Flt Permitted		1.00	1.00	0.95	1.00		0.95		1.00	0.95		1.00
Satd. Flow (perm)		5085	1531	1770	5085		1770		1583	3433		1583
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	0	1371	659	43	1582	0	5	0	42	828	0	392
RTOR Reduction (vph)	0	0	181	0	0	0	0	0	41	0	0	58
Lane Group Flow (vph)	0	1371	478	43	1582	0	5	0	1	828	0	334
Turn Type	NA	Perm	Prot	NA	Prot	Prot	Prot	Prot	Perm	Prot	Perm	Prot
Protected Phases	2		1	6		3		3	4			
Permitted Phases		2									4	
Actuated Green, G (s)	81.6	81.6	7.6	92.7		4.7		4.7	48.1		48.1	
Effective Green, g (s)	81.6	81.6	7.6	92.7		4.7		4.7	48.1		48.1	
Actuated g/C Ratio	0.52	0.52	0.05	0.59		0.03		0.03	0.30		0.30	
Clearance Time (s)	4.5	4.5	3.5	4.5		4.0		4.0	4.0		4.0	
Vehicle Extension (s)	4.0	4.0	2.0	4.0		3.0		3.0	2.0		2.0	
Lane Grp Cap (vph)	2626	790	85	2983		52		47	1045		481	
v/s Ratio Prot	0.27		0.02	c0.31		c0.00		0.00	c0.24			
v/s Ratio Perm		c0.31									0.21	
v/c Ratio	0.52	0.61	0.51	0.53		0.10		0.03	0.79		0.69	
Uniform Delay, d1	25.3	26.9	73.4	19.6		74.6		74.4	50.4		48.5	
Progression Factor	0.36	0.36	0.83	0.42		1.00		1.00	1.00		1.00	
Incremental Delay, d2	0.5	2.2	1.5	0.6		0.8		0.2	3.9		3.5	
Delay (s)	9.6	11.9	62.4	8.8		75.4		74.7	54.3		52.0	
Level of Service	A	B	E	A		E		E	D		D	
Approach Delay (s)	10.3			10.2		74.7					53.5	
Approach LOS	B			B		E					D	
Intersection Summary												
HCM 2000 Control Delay		21.6		HCM 2000 Level of Service		C						
HCM 2000 Volume to Capacity ratio		0.65										
Actuated Cycle Length (s)		158.0		Sum of lost time (s)		16.0						
Intersection Capacity Utilization		67.5%		ICU Level of Service		C						
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis
10: US 101 NB Ramps & Rohnert Park Expressway

4/6/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↘	↑↑↑		↘	↑↑↑	↘	↘	↘	↘	↘	↘	↘
Volume (vph)	49	1714	0	0	1203	632	604	16	454	29	0	16
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	6.0			6.0	6.0	5.0	5.0	5.0	5.0		5.0
Lane Util. Factor	1.00	0.86			0.91	1.00	0.95	0.95	0.88	1.00		1.00
Frt	1.00	1.00			1.00	0.85	1.00	1.00	0.85	1.00		0.85
Flt Protected	0.95	1.00			1.00	1.00	0.95	0.95	1.00	0.95		1.00
Satd. Flow (prot)	1770	6408			5085	1583	1681	1689	2787	1770		1583
Flt Permitted	0.95	1.00			1.00	1.00	0.95	0.95	1.00	0.95		1.00
Satd. Flow (perm)	1770	6408			5085	1583	1681	1689	2787	1770		1583
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	50	1749	0	0	1228	645	616	16	463	30	0	16
RTOR Reduction (vph)	0	0	0	0	0	305	0	0	72	0	0	15
Lane Group Flow (vph)	50	1749	0	0	1228	340	314	318	391	30	0	1
Turn Type	Prot	NA			NA	Perm	Split	NA	Perm	Prot		Perm
Protected Phases	5	2			6		3	3		4		
Permitted Phases						6			3			4
Actuated Green, G (s)	8.0	96.4			83.4	83.4	40.2	40.2	40.2	5.4		5.4
Effective Green, g (s)	8.0	96.4			83.4	83.4	40.2	40.2	40.2	5.4		5.4
Actuated g/C Ratio	0.05	0.61			0.53	0.53	0.25	0.25	0.25	0.03		0.03
Clearance Time (s)	5.0	6.0			6.0	6.0	5.0	5.0	5.0	5.0		5.0
Vehicle Extension (s)	2.0	4.0			4.0	4.0	2.0	2.0	2.0	2.0		2.0
Lane Grp Cap (vph)	89	3909			2684	835	427	429	709	60		54
v/s Ratio Prot	c0.03	c0.27			0.24		0.19	c0.19		c0.02		
v/s Ratio Perm						0.22			0.14			0.00
v/c Ratio	0.56	0.45			0.46	0.41	0.74	0.74	0.55	0.50		0.01
Uniform Delay, d1	73.3	16.5			23.2	22.4	54.0	54.1	51.1	75.0		73.7
Progression Factor	0.89	0.48			0.81	3.51	1.00	1.00	1.00	1.00		1.00
Incremental Delay, d2	3.9	0.3			0.5	1.2	5.6	5.9	0.5	2.4		0.0
Delay (s)	69.3	8.2			19.3	79.9	59.6	60.1	51.6	77.3		73.7
Level of Service	E	A			B	E	E	E	D	E		E
Approach Delay (s)		9.9			40.2			56.4		76.1		
Approach LOS		A			D			E		E		
Intersection Summary												
HCM 2000 Control Delay		32.9			HCM 2000 Level of Service		C					
HCM 2000 Volume to Capacity ratio		0.55										
Actuated Cycle Length (s)		158.0			Sum of lost time (s)		21.0					
Intersection Capacity Utilization		75.5%			ICU Level of Service		D					
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis
11: Commerce Blvd & Rohnert Park Expressway

4/6/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Volume (vph)	315	1047	789	208	1033	68	564	239	279	108	226	265
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.91		0.97	1.00	1.00	0.91	0.91	1.00
Flpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	1.00	0.98	1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1556	1770	5030		3433	1863	1547	1610	3383	1565
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1556	1770	5030		3433	1863	1547	1610	3383	1565
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	321	1068	805	212	1054	69	576	244	285	110	231	270
RTOR Reduction (vph)	0	0	117	0	3	0	0	0	223	0	0	64
Lane Group Flow (vph)	321	1068	688	212	1120	0	576	244	62	99	242	206
Confl. Peds. (#/hr)			13			10			5			7
Confl. Bikes (#/hr)						2			5			2
Turn Type	Prot	NA	pm+ov	Prot	NA		Split	NA	Perm	Split	NA	pm+ov
Protected Phases	5	2	3	1	6		3	3		4	4	5
Permitted Phases			2						3			4
Actuated Green, G (s)	16.0	55.9	90.3	27.9	67.8		34.4	34.4	34.4	19.8	19.8	35.8
Effective Green, g (s)	16.0	55.9	90.3	27.9	67.8		34.4	34.4	34.4	19.8	19.8	35.8
Actuated g/C Ratio	0.10	0.35	0.57	0.18	0.43		0.22	0.22	0.22	0.13	0.13	0.23
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Vehicle Extension (s)	1.0	1.0	1.5	1.0	1.0		1.5	1.5	1.5	1.0	1.0	1.0
Lane Grp Cap (vph)	347	1252	889	312	2158		747	405	336	201	423	404
v/s Ratio Prot	0.09	c0.30	c0.17	c0.12	0.22		0.17	0.13		0.06	0.07	c0.05
v/s Ratio Perm			0.27						0.04			0.08
v/c Ratio	0.93	0.85	0.77	0.68	0.52		0.77	0.60	0.18	0.49	0.57	0.51
Uniform Delay, d1	70.4	47.2	26.0	60.9	33.1		58.1	55.6	50.4	64.4	65.1	53.4
Progression Factor	0.71	0.58	1.52	0.71	0.62		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	27.4	6.9	3.5	3.4	0.7		4.5	1.7	0.1	0.7	1.2	0.4
Delay (s)	77.6	34.3	43.0	46.3	21.2		62.6	57.4	50.5	65.1	66.3	53.8
Level of Service	E	C	D	D	C		E	E	D	E	E	D
Approach Delay (s)		43.8			25.2			58.3			60.6	
Approach LOS		D			C			E			E	
Intersection Summary												
HCM 2000 Control Delay		44.1			HCM 2000 Level of Service			D				
HCM 2000 Volume to Capacity ratio		0.76										
Actuated Cycle Length (s)		158.0			Sum of lost time (s)			20.0				
Intersection Capacity Utilization		90.0%			ICU Level of Service			E				
Analysis Period (min)		15										
c Critical Lane Group												

Rohnert Park PDA Plan
PM Peak Hour - Future Conditions (No Project)

Synchro 8 Report
W-Trans

HCM Signalized Intersection Capacity Analysis
12: State Farm Dr & Rohnert Park Expressway

4/6/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Volume (vph)	227	954	181	253	993	181	200	118	211	313	178	201
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.91	0.91	1.00	0.91	0.91	
Flpb, ped/bikes	1.00	1.00	0.97	1.00	1.00	0.98	1.00	1.00	0.98	1.00	0.99	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.93	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.98	1.00	0.95	0.99	
Satd. Flow (prot)	1770	3539	1538	1770	3539	1552	1610	3316	1547	1610	3116	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.98	1.00	0.95	0.99	
Satd. Flow (perm)	1770	3539	1538	1770	3539	1552	1610	3316	1547	1610	3116	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	232	973	185	258	1013	185	204	120	215	319	182	205
RTOR Reduction (vph)	0	0	99	0	0	70	0	0	189	0	98	0
Lane Group Flow (vph)	232	973	86	258	1013	115	106	218	26	239	369	0
Confl. Peds. (#/hr)			12			5			10			4
Confl. Bikes (#/hr)			1			1						1
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Split	NA	Perm	Split	NA	
Protected Phases	5	2		1	6		3	3		4	4	
Permitted Phases			2			6			3			
Actuated Green, G (s)	31.7	72.9	72.9	16.0	57.2	57.2	19.1	19.1	19.1	30.0	30.0	
Effective Green, g (s)	31.7	72.9	72.9	16.0	57.2	57.2	19.1	19.1	19.1	30.0	30.0	
Actuated g/C Ratio	0.20	0.46	0.46	0.10	0.36	0.36	0.12	0.12	0.12	0.19	0.19	
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
Lane Grp Cap (vph)	355	1632	709	179	1281	561	194	400	187	305	591	
v/s Ratio Prot	c0.13	0.27		c0.15	c0.29		c0.07	0.07		c0.15	0.12	
v/s Ratio Perm			0.06			0.07			0.02			
v/c Ratio	0.65	0.60	0.12	1.44	0.79	0.20	0.55	0.55	0.14	0.78	0.62	
Uniform Delay, d1	58.1	31.6	24.3	71.0	45.1	34.7	65.4	65.4	62.1	60.9	58.8	
Progression Factor	0.54	0.63	1.30	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	2.2	1.1	0.2	227.3	5.0	0.8	1.7	0.8	0.1	11.5	1.5	
Delay (s)	33.6	21.2	31.7	298.3	50.1	35.6	67.1	66.2	62.2	72.4	60.3	
Level of Service	C	C	C	F	D	D	E	E	E	E	E	
Approach Delay (s)		24.6			92.2		64.8			64.4		
Approach LOS		C			F		E			E		
Intersection Summary												
HCM 2000 Control Delay		60.8			HCM 2000 Level of Service			E				
HCM 2000 Volume to Capacity ratio		0.78										
Actuated Cycle Length (s)		158.0			Sum of lost time (s)			20.0				
Intersection Capacity Utilization		92.7%			ICU Level of Service			F				
Analysis Period (min)		15										
c Critical Lane Group												

Rohnert Park PDA Plan
PM Peak Hour - Future Conditions (No Project)

Synchro 8 Report
W-Trans

HCM Signalized Intersection Capacity Analysis 13: Commerce Blvd & Enterprise Dr

4/6/2015

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↔↔	↔	↔↔		↔	↔↔
Volume (vph)	171	59	667	81	71	741
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	0.97	1.00	0.95		1.00	0.95
Frt	1.00	0.85	0.98		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	3433	1583	3482		1770	3539
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	3433	1583	3482		1770	3539
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	174	60	681	83	72	756
RTOR Reduction (vph)	0	49	13	0	0	0
Lane Group Flow (vph)	174	11	751	0	72	756
Turn Type	Prot	Perm	NA		Prot	NA
Protected Phases	8		2		1	6
Permitted Phases		8				
Actuated Green, G (s)	7.4	7.4	16.9		2.9	23.8
Effective Green, g (s)	7.4	7.4	16.9		2.9	23.8
Actuated g/C Ratio	0.19	0.19	0.43		0.07	0.61
Clearance Time (s)	4.0	4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	648	298	1501		130	2148
v/s Ratio Prot	c0.05		c0.22		c0.04	0.21
v/s Ratio Perm		0.01				
v/c Ratio	0.27	0.04	0.50		0.55	0.35
Uniform Delay, d1	13.6	13.0	8.1		17.5	3.8
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	0.2	0.1	0.3		5.0	0.1
Delay (s)	13.8	13.0	8.4		22.6	3.9
Level of Service	B	B	A		C	A
Approach Delay (s)	13.6		8.4			5.6
Approach LOS	B		A			A
Intersection Summary						
HCM 2000 Control Delay			7.8		HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio			0.44			
Actuated Cycle Length (s)			39.2		Sum of lost time (s)	12.0
Intersection Capacity Utilization			39.8%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						

HCM Unsignalized Intersection Capacity Analysis 14: Enterprise Dr & Hunter Dr

4/6/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔↔			↔↔			↔↔			↔↔	
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	2	156	2	8	178	121	2	3	0	200	2	34
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	2	159	2	8	182	123	2	3	0	204	2	35
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1						
Volume Total (vph)	82	82	99	214	5	241						
Volume Left (vph)	2	0	8	0	2	204						
Volume Right (vph)	0	2	0	123	0	35						
Hadj (s)	0.05	0.02	0.08	-0.37	0.11	0.12						
Departure Headway (s)	5.6	5.5	5.5	5.0	5.5	5.1						
Degree Utilization, x	0.13	0.13	0.15	0.30	0.01	0.34						
Capacity (veh/h)	607	614	629	689	585	660						
Control Delay (s)	8.2	8.1	8.2	8.9	8.6	10.8						
Approach Delay (s)	8.2		8.7		8.6	10.8						
Approach LOS	A		A		A	B						
Intersection Summary												
Delay					9.3							
Level of Service					A							
Intersection Capacity Utilization			41.5%		ICU Level of Service					A		
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis
15: Enterprise Dr & State Farm Dr

4/6/2015

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑	↱		↰	↱
Sign Control		Stop	Stop		Stop	
Volume (vph)	107	220	152	321	463	147
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	109	224	155	328	472	150
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total (vph)	109	224	103	379	472	150
Volume Left (vph)	109	0	0	0	472	0
Volume Right (vph)	0	0	0	328	0	150
Hadj (s)	0.53	0.03	0.03	-0.57	0.53	-0.67
Departure Headway (s)	8.1	7.5	7.3	6.7	7.4	6.2
Degree Utilization, x	0.24	0.47	0.21	0.71	0.97	0.26
Capacity (veh/h)	444	477	487	530	483	566
Control Delay (s)	12.5	15.9	11.1	23.2	60.0	10.1
Approach Delay (s)	14.8		20.6		48.0	
Approach LOS	B		C		E	
Intersection Summary						
Delay			31.1			
Level of Service			D			
Intersection Capacity Utilization			56.1%		ICU Level of Service	B
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
16: Enterprise Dr/Seed Farm Dr

4/6/2015

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰	↱		↰	↱
Volume (veh/h)	18	714	379	12	10	52
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	18	729	387	12	10	53
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	399				1158	393
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	399				1158	393
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	98				95	92
cM capacity (veh/h)	1160				213	656
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	747	399	63			
Volume Left	18	0	10			
Volume Right	0	12	53			
cSH	1160	1700	491			
Volume to Capacity	0.02	0.23	0.13			
Queue Length 95th (ft)	1	0	11			
Control Delay (s)	0.4	0.0	13.4			
Lane LOS	A		B			
Approach Delay (s)	0.4	0.0	13.4			
Approach LOS			B			
Intersection Summary						
Average Delay			1.0			
Intersection Capacity Utilization			62.5%		ICU Level of Service	B
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

17: State Farm Dr & Town Center

4/6/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	146	0	66	1	0	1	32	380	1	2	473	97
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	149	0	67	1	0	1	33	388	1	2	483	99
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)											575	
pX, platoon unblocked												
vC, conflicting volume	796	990	291	766	1039	194	582			389		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	796	990	291	766	1039	194	582			389		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	45	100	90	100	100	100	97			100		
cM capacity (veh/h)	270	236	706	257	221	814	989			1166		
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3				
Volume Total	216	2	33	259	130	2	322	260				
Volume Left	149	1	33	0	0	2	0	0				
Volume Right	67	1	0	0	1	0	0	99				
cSH	334	391	989	1700	1700	1166	1700	1700				
Volume to Capacity	0.65	0.01	0.03	0.15	0.08	0.00	0.19	0.15				
Queue Length 95th (ft)	107	0	3	0	0	0	0	0				
Control Delay (s)	33.6	14.3	8.8	0.0	0.0	8.1	0.0	0.0				
Lane LOS	D	B	A			A						
Approach Delay (s)	33.6	14.3	0.7			0.0						
Approach LOS	D	B										
Intersection Summary												
Average Delay	6.2											
Intersection Capacity Utilization	46.9%			ICU Level of Service					A			
Analysis Period (min)	15											

Appendix C

Existing plus Project Intersection LOS Calculations

HCM Signalized Intersection Capacity Analysis

1: US 101 South Ramps & Golf Course Drive West/Golf Course Dr

4/15/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕↕	↗	↖↗	↕↕					↖	↗	
Volume (vph)	0	225	90	264	251	0	0	0	0	398	117	317
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	3.0	4.0					3.0	3.0	3.0
Lane Util. Factor		0.95	1.00	0.97	0.95					0.95	0.95	1.00
Flt		1.00	0.85	1.00	1.00					1.00	1.00	0.85
Flt Protected		1.00	1.00	0.95	1.00					0.95	0.97	1.00
Satd. Flow (prot)		3539	1583	3433	3539					1681	1722	1583
Flt Permitted		1.00	1.00	0.95	1.00					0.95	0.97	1.00
Satd. Flow (perm)		3539	1583	3433	3539					1681	1722	1583
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	0	256	102	300	285	0	0	0	0	452	133	360
RTOR Reduction (vph)	0	0	47	0	0	0	0	0	0	0	0	270
Lane Group Flow (vph)	0	256	55	300	285	0	0	0	0	289	296	90
Turn Type		NA	Perm	Prot	NA					Split	NA	Perm
Protected Phases		6		5	2					8	8	
Permitted Phases			6									8
Actuated Green, G (s)		59.3	59.3	13.1	75.4					27.6	27.6	27.6
Effective Green, g (s)		59.3	59.3	13.1	75.4					27.6	27.6	27.6
Actuated g/C Ratio		0.54	0.54	0.12	0.69					0.25	0.25	0.25
Clearance Time (s)		4.0	4.0	3.0	4.0					3.0	3.0	3.0
Vehicle Extension (s)		1.5	1.5	1.0	1.5					1.5	1.5	1.5
Lane Grp Cap (vph)	1907	853	408	2425						421	432	397
v/s Ratio Prot	c0.07			c0.09	0.08					c0.17	0.17	
v/s Ratio Perm			0.03									0.06
v/c Ratio	0.13	0.06		0.74	0.12					0.69	0.69	0.23
Uniform Delay, d1	12.6	12.1		46.8	5.9					37.3	37.3	32.7
Progression Factor	0.52	0.81		1.00	1.00					1.00	1.00	1.00
Incremental Delay, d2	0.1	0.1		5.8	0.1					3.7	3.6	0.1
Delay (s)	6.6	10.0		52.6	6.0					41.0	40.8	32.8
Level of Service	A	B		D	A					D	D	C
Approach Delay (s)	7.6			29.9			0.0			37.8		
Approach LOS	A			C			A			D		
Intersection Summary												
HCM 2000 Control Delay	29.6			HCM 2000 Level of Service					C			
HCM 2000 Volume to Capacity ratio	0.36											
Actuated Cycle Length (s)	110.0			Sum of lost time (s)					10.0			
Intersection Capacity Utilization	37.8%			ICU Level of Service					A			
Analysis Period (min)	15											
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: Commerce Blvd & Golf Course Drive

4/15/2015

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations		  			 						 		
Volume (vph)	11	201	383	403	421	67	105	77	189	52	93	18	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Lane Width	12	12	12	12	12	12	12	12	13	12	12	12	
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0		
Lane Util. Factor	1.00	0.91	1.00	0.97	0.95		0.97	1.00	1.00	1.00	1.00		
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00		
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00		
Frt	1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85	1.00	0.98		
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00		
Satd. Flow (prot)	1770	5085	1583	3433	3452		3433	1863	1636	1770	1813		
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00		
Satd. Flow (perm)	1770	5085	1583	3433	3452		3433	1863	1636	1770	1813		
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	
Adj. Flow (vph)	12	221	421	443	463	74	115	85	208	57	102	20	
RTOR Reduction (vph)	0	0	259	0	9	0	0	0	139	0	6	0	
Lane Group Flow (vph)	12	221	162	443	528	0	115	85	69	57	116	0	
Confl. Peds. (#/hr)						5						1	
Confl. Bikes (#/hr)						1							
Turn Type	Prot	NA	pm+ov	Prot	NA		Split	NA	pm+ov	Split	NA		
Protected Phases	1	6	4	5	2		4	4	5	3	3		
Permitted Phases	6												
Actuated Green, G (s)	0.7	17.4	28.5	13.5	30.2		11.1	11.1	24.6	15.9	15.9		
Effective Green, g (s)	0.7	17.4	28.5	13.5	30.2		11.1	11.1	24.6	15.9	15.9		
Actuated g/C Ratio	0.01	0.24	0.39	0.18	0.41		0.15	0.15	0.33	0.22	0.22		
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0		
Vehicle Extension (s)	1.0	1.5	1.5	1.0	1.5		1.5	1.5	1.0	1.5	1.5		
Lane Grp Cap (vph)	16	1197	610	627	1410		515	279	633	380	390		
v/s Ratio Prot	0.01	0.04	0.04	c0.13	c0.15		0.03	c0.05	0.02	0.03	c0.06		
v/s Ratio Perm			0.06						0.02				
v/c Ratio	0.75	0.18	0.27	0.71	0.37		0.22	0.30	0.11	0.15	0.30		
Uniform Delay, d1	36.5	22.6	15.5	28.3	15.3		27.6	28.0	17.1	23.5	24.3		
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00		
Incremental Delay, d2	97.6	0.0	0.1	3.0	0.1		0.1	0.2	0.0	0.1	0.2		
Delay (s)	134.1	22.6	15.6	31.3	15.3		27.7	28.2	17.1	23.6	24.5		
Level of Service	F	C	B	C	B		C	C	B	C	C		
Approach Delay (s)	20.2			22.5			22.4			24.2			
Approach LOS	C			C			C			C			
Intersection Summary													
HCM 2000 Control Delay	21.9			HCM 2000 Level of Service					C				
HCM 2000 Volume to Capacity ratio	0.43												
Actuated Cycle Length (s)	73.9			Sum of lost time (s)					16.0				
Intersection Capacity Utilization	55.3%			ICU Level of Service					B				
Analysis Period (min)	15												
c Critical Lane Group													

HCM Signalized Intersection Capacity Analysis 3: Commerce Blvd & US 101 North Ramps

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	→	↱	↰	↱	→	↰	↱	→	↰	↱	↱
Volume (vph)	180	2	33	1	0	1	90	194	4	2	512	358
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	14	12	16	12	12	12	12	12	12	12	12	12
Total Lost time (s)	4.0	4.0	3.0		3.0		3.0	4.0		3.0	4.0	4.0
Lane Util. Factor	0.95	0.95	1.00		1.00		1.00	0.95		1.00	0.95	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85		0.93		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	0.95	1.00		0.98		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1793	1687	1794		1695		1770	3527		1770	3539	1583
Flt Permitted	0.95	0.95	1.00		0.98		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1793	1687	1794		1695		1770	3527		1770	3539	1583
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	186	2	34	1	0	1	93	200	4	2	528	369
RTOR Reduction (vph)	0	0	25	0	2	0	0	1	0	0	0	0
Lane Group Flow (vph)	95	93	9	0	0	0	93	203	0	2	528	369
Confl. Peds. (#/hr)									2			
Turn Type	Split	NA	pm+ov	Split	NA		Prot	NA		Prot	NA	Free
Protected Phases	8	8	1	7	7		1	6		5	2	
Permitted Phases			8									Free
Actuated Green, G (s)	7.6	7.6	13.8		0.8		6.2	26.9		0.7	21.4	50.0
Effective Green, g (s)	7.6	7.6	13.8		0.8		6.2	26.9		0.7	21.4	50.0
Actuated g/C Ratio	0.15	0.15	0.28		0.02		0.12	0.54		0.01	0.43	1.00
Clearance Time (s)	4.0	4.0	3.0		3.0		3.0	4.0		3.0	4.0	
Vehicle Extension (s)	2.0	2.0	2.0		4.0		2.0	2.0		2.0	4.0	
Lane Grp Cap (vph)	272	256	495		27		219	1897		24	1514	1583
v/s Ratio Prot	0.05	c0.06	0.00		0.00		c0.05	0.06		0.00	c0.15	
v/s Ratio Perm			0.00									c0.23
v/c Ratio	0.35	0.36	0.02		0.00		0.42	0.11		0.08	0.35	0.23
Uniform Delay, d1	19.0	19.0	13.2		24.2		20.3	5.7		24.3	9.6	0.0
Progression Factor	1.00	1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.3	0.3	0.0		0.0		0.5	0.0		0.5	0.2	0.3
Delay (s)	19.3	19.3	13.2		24.2		20.7	5.7		24.9	9.8	0.3
Level of Service	B	B	B		C		C	A		C	A	A
Approach Delay (s)		18.4			24.2			10.4			6.0	
Approach LOS		B			C			B			A	
Intersection Summary												
HCM 2000 Control Delay		8.8			HCM 2000 Level of Service			A				
HCM 2000 Volume to Capacity ratio		0.39										
Actuated Cycle Length (s)		50.0			Sum of lost time (s)			14.0				
Intersection Capacity Utilization		38.0%			ICU Level of Service			A				
Analysis Period (min)		15										
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis 4: Commerce Blvd & State Farm Dr

4/15/2015

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↰	↱	↰	↱
Volume (veh/h)	15	146	162	28	318	279
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.87	0.87	0.87	0.87	0.87	0.87
Hourly flow rate (vph)	17	168	186	32	366	321
Pedestrians	5		5			5
Lane Width (ft)	12.0		12.0			12.0
Walking Speed (ft/s)	4.0		4.0			4.0
Percent Blockage	0		0			0
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1264	212			223	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1264	212			223	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	87	80			73	
cM capacity (veh/h)	135	821			1340	
Direction, Lane #						
	WB 1	NB 1	SB 1	SB 2		
Volume Total	185	218	366	321		
Volume Left	17	0	366	0		
Volume Right	168	32	0	0		
cSH	557	1700	1340	1700		
Volume to Capacity	0.33	0.13	0.27	0.19		
Queue Length 95th (ft)	36	0	28	0		
Control Delay (s)	14.6	0.0	8.7	0.0		
Lane LOS	B		A			
Approach Delay (s)	14.6	0.0	4.6			
Approach LOS	B					
Intersection Summary						
Average Delay			5.4			
Intersection Capacity Utilization			49.2%		ICU Level of Service	A
Analysis Period (min)			15			

HCM Signalized Intersection Capacity Analysis 4: Commerce Blvd & State Farm Dr

4/16/2015

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↰	↰		↰	↰
Volume (vph)	15	146	162	28	318	279
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5		4.5	4.5
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	0.99	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	0.85	0.98		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	1575	1817		1770	1863
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1770	1575	1817		1770	1863
Peak-hour factor, PHF	0.87	0.87	0.87	0.87	0.87	0.87
Adj. Flow (vph)	17	168	186	32	366	321
RTOR Reduction (vph)	0	96	10	0	0	0
Lane Group Flow (vph)	17	72	208	0	366	321
Confl. Peds. (#/hr)	5	5		5	5	
Confl. Bikes (#/hr)		5		5		
Turn Type	Prot	pm+ov	NA		Prot	NA
Protected Phases	8	1	2		1	6
Permitted Phases		8				
Actuated Green, G (s)	3.4	19.0	11.8		15.6	31.9
Effective Green, g (s)	3.4	19.0	11.8		15.6	31.9
Actuated g/C Ratio	0.08	0.43	0.27		0.35	0.72
Clearance Time (s)	4.5	4.5	4.5		4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	135	835	483		623	1341
v/s Ratio Prot	0.01	c0.03	c0.11		c0.21	0.17
v/s Ratio Perm		0.02				
v/c Ratio	0.13	0.09	0.43		0.59	0.24
Uniform Delay, d1	19.1	7.5	13.5		11.7	2.1
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	0.4	0.0	0.6		1.4	0.1
Delay (s)	19.5	7.5	14.1		13.1	2.2
Level of Service	B	A	B		B	A
Approach Delay (s)	8.6		14.1			8.0
Approach LOS	A		B			A
Intersection Summary						
HCM 2000 Control Delay			9.3		HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio			0.48			
Actuated Cycle Length (s)			44.3		Sum of lost time (s)	13.5
Intersection Capacity Utilization			45.7%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						

Rohnert Park PDA Plan
AM Peak Hour - Existing plus Project (Mitigated)

Synchro 8 Report
W-Trans

HCM Unsignalized Intersection Capacity Analysis 5: State Farm Dr & Professional Center Dr

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↰			↰		↰	↰		↰	↰	↰
Volume (veh/h)	13	7	22	15	2	4	58	165	25	18	220	16
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	14	8	24	16	2	4	62	177	27	19	237	17
Pedestrians		5			5			5			5	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		4.0			4.0			4.0			4.0	
Percent Blockage		0			0			0			0	
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	513	623	137	510	618	112	259			209		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	513	623	137	510	618	112	259			209		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	97	98	97	96	99	100	95			99		
cM capacity (veh/h)	413	373	879	402	375	912	1297			1353		
Direction, Lane #												
Volume Total	14	31	23	62	118	86	19	158	96			
Volume Left	14	0	16	62	0	0	19	0	0			
Volume Right	0	24	4	0	0	27	0	0	17			
cSH	413	662	446	1297	1700	1700	1353	1700	1700			
Volume to Capacity	0.03	0.05	0.05	0.05	0.07	0.05	0.01	0.09	0.06			
Queue Length 95th (ft)	3	4	4	4	0	0	1	0	0			
Control Delay (s)	14.0	10.7	13.5	7.9	0.0	0.0	7.7	0.0	0.0			
Lane LOS	B	B	B	A			A					
Approach Delay (s)	11.7		13.5	1.9			0.5					
Approach LOS	B		B									
Intersection Summary												
Average Delay				2.4								
Intersection Capacity Utilization				29.8%			ICU Level of Service			A		
Analysis Period (min)				15								

Rohnert Park PDA Plan
AM Peak Hour - Existing plus Project

Synchro 8 Report
W-Trans

HCM Unsignalized Intersection Capacity Analysis
5: State Farm Dr & Professional Center Dr

4/16/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	13	7	22	15	2	4	58	165	25	18	220	16
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	14	8	24	16	2	4	62	177	27	19	237	17
Pedestrians		5			5			5			5	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		4.0			4.0			4.0			4.0	
Percent Blockage		0			0			0			0	
Right turn flare (veh)												
Median type									None		None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	601	623	255	628	618	201	259			209		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	601	623	255	628	618	201	259			209		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	96	98	97	95	99	99	95			99		
cM capacity (veh/h)	383	374	777	354	377	833	1300			1356		
Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2	SB 1	SB 2					
Volume Total	14	31	23	62	204	19	254					
Volume Left	14	0	16	62	0	19	0					
Volume Right	0	24	4	0	27	0	17					
cSH	383	617	401	1300	1700	1356	1700					
Volume to Capacity	0.04	0.05	0.06	0.05	0.12	0.01	0.15					
Queue Length 95th (ft)	3	4	4	4	0	1	0					
Control Delay (s)	14.8	11.1	14.5	7.9	0.0	7.7	0.0					
Lane LOS	B	B	B	A		A						
Approach Delay (s)	12.3		14.5	1.8		0.5						
Approach LOS	B		B									
Intersection Summary												
Average Delay				2.5								
Intersection Capacity Utilization	34.8%			ICU Level of Service				A				
Analysis Period (min)	15											

HCM Unsignalized Intersection Capacity Analysis
6: Commerce Blvd & Professional Center Dr

4/15/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	39	167	0	21	148	80	0	50	62	43	34	14
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	44	190	0	24	168	91	0	57	70	49	39	16
Pedestrians		5			5			5			5	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		4.0			4.0			4.0			4.0	
Percent Blockage		0			0			0			0	
Right turn flare (veh)												
Median type		None			TW/TL							
Median storage (veh)					2							
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	264			195			540	595	200	649	550	224
vC1, stage 1 conf vol							283	283		266	266	
vC2, stage 2 conf vol							256	312		382	283	
vCu, unblocked vol	264			195			540	595	200	649	550	224
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)							6.1	5.5		6.1	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			98			100	89	92	89	93	98
cM capacity (veh/h)	1295			1373			559	532	834	457	557	809
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1	SB 2					
Volume Total	44	190	24	259	127	49	55					
Volume Left	44	0	24	0	0	49	0					
Volume Right	0	0	0	91	70	0	16					
cSH	1295	1700	1373	1700	666	457	613					
Volume to Capacity	0.03	0.11	0.02	0.15	0.19	0.11	0.09					
Queue Length 95th (ft)	3	0	1	0	18	9	7					
Control Delay (s)	7.9	0.0	7.7	0.0	11.7	13.8	11.5					
Lane LOS	A		A		B	B	B					
Approach Delay (s)	1.5		0.6		11.7	12.6						
Approach LOS					B	B						
Intersection Summary												
Average Delay			4.4									
Intersection Capacity Utilization			36.0%		ICU Level of Service		A					
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis

7: Commerce Blvd & Padre Pkwy

4/15/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	20	3	54	56	3	14	53	383	74	13	212	12
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Hourly flow rate (vph)	24	4	65	67	4	17	64	461	89	16	255	14
Pedestrians		5			5			5			5	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		4.0			4.0			4.0			4.0	
Percent Blockage		0			0			0			0	
Right turn flare (veh)												
Median type								TWLT			TWLT	
Median storage (veh)								2			2	
Upstream signal (ft)								480				
pX, platoon unblocked												
vC, conflicting volume	681	982	145	870	945	285	275			556		
vC1, stage 1 conf vol	299	299		639	639							
vC2, stage 2 conf vol	382	683		231	306							
vCu, unblocked vol	681	982	145	870	945	285	275			556		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)	6.5	5.5		6.5	5.5							
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	95	99	93	82	99	98	95			98		
cM capacity (veh/h)	484	379	869	372	397	706	1280			1007		
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3				
Volume Total	93	88	64	308	243	16	170	100				
Volume Left	24	67	64	0	0	16	0	0				
Volume Right	65	17	0	0	89	0	0	14				
cSH	691	410	1280	1700	1700	1007	1700	1700				
Volume to Capacity	0.13	0.21	0.05	0.18	0.14	0.02	0.10	0.06				
Queue Length 95th (ft)	12	20	4	0	0	1	0	0				
Control Delay (s)	11.0	16.2	8.0	0.0	0.0	8.6	0.0	0.0				
Lane LOS	B	C	A			A						
Approach Delay (s)	11.0	16.2	0.8			0.5						
Approach LOS	B	C										
Intersection Summary												
Average Delay	2.9											
Intersection Capacity Utilization	37.2%			ICU Level of Service					A			
Analysis Period (min)	15											

HCM Signalized Intersection Capacity Analysis

7: Commerce Blvd & Padre Pkwy

4/16/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔		↔	↑	↑	↔	↔	
Volume (vph)	20	3	54	56	3	14	53	383	74	13	212	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5			4.5			4.5			4.5		
Lane Util. Factor	1.00			1.00			1.00			1.00		
Flrb, ped/bikes	0.98			0.99			1.00			0.97		
Flpb, ped/bikes	1.00			1.00			1.00			1.00		
Frt	0.91			0.97			1.00			0.85		
Flt Protected	0.99			0.96			0.95			1.00		
Satd. Flow (prot)	1631			1731			1770			1863		
Flt Permitted	0.90			0.81			0.95			1.00		
Satd. Flow (perm)	1483			1458			1770			1863		
Peak-hour factor, PHF	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Adj. Flow (vph)	24	4	65	67	4	17	64	461	89	16	255	14
RTOR Reduction (vph)	0	54	0	0	14	0	0	0	38	0	2	0
Lane Group Flow (vph)	0	39	0	0	74	0	64	461	51	16	267	0
Confl. Peds. (#/hr)	5		5		5		5		5		5	
Confl. Bikes (#/hr)	5		5		5		5		5		5	
Turn Type	Perm	NA	Perm		NA	Prot		NA	Perm	Prot	NA	
Protected Phases	4		8		5		2		1		6	
Permitted Phases	4		8		5		2		1		6	
Actuated Green, G (s)	8.7		8.7		3.4		30.9		0.6		28.1	
Effective Green, g (s)	8.7		8.7		3.4		30.9		0.6		28.1	
Actuated g/C Ratio	0.16		0.16		0.06		0.58		0.01		0.52	
Clearance Time (s)	4.5		4.5		4.5		4.5		4.5		4.5	
Vehicle Extension (s)	3.0		3.0		3.0		3.0		3.0		3.0	
Lane Grp Cap (vph)	240		236		112		1072		19		965	
v/s Ratio Prot					c0.04		c0.25		0.01		0.14	
v/s Ratio Perm	0.03		c0.05				0.03					
v/c Ratio	0.16		0.31		0.57		0.43		0.06		0.28	
Uniform Delay, d1	19.4		19.9		24.4		6.4		5.0		7.1	
Progression Factor	1.00		1.00		1.00		1.00		1.00		1.00	
Incremental Delay, d2	0.3		0.8		6.9		1.3		0.1		131.7	
Delay (s)	19.7		20.6		31.3		7.7		5.1		158.2	
Level of Service	B		C		C		A		A		F	
Approach Delay (s)	19.7		20.6		9.8						16.3	
Approach LOS	B		C		A						B	
Intersection Summary												
HCM 2000 Control Delay	13.2		HCM 2000 Level of Service				B					
HCM 2000 Volume to Capacity ratio	0.44											
Actuated Cycle Length (s)	53.7		Sum of lost time (s)				13.5					
Intersection Capacity Utilization	46.3%		ICU Level of Service				A					
Analysis Period (min)	15											
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis
8: State Farm Dr & City Center Dr

4/15/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	8	1	35	72	4	19	57	363	83	30	152	12
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	8	1	36	75	4	20	59	378	86	31	158	12
Pedestrians		5			5			5			5	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		4.0			4.0			4.0			4.0	
Percent Blockage		0			0			0			0	
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)								456				
pX, platoon unblocked												
vC, conflicting volume	567	820	95	729	783	242	176			470		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	567	820	95	729	783	242	176			470		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	98	100	96	73	99	97	96			97		
cM capacity (veh/h)	365	284	935	278	298	752	1392			1084		
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3		
Volume Total	9	37	75	24	59	252	212	31	106	65		
Volume Left	8	0	75	0	59	0	0	31	0	0		
Volume Right	0	36	0	20	0	0	86	0	0	12		
cSH	359	905	278	595	1392	1700	1700	1084	1700	1700		
Volume to Capacity	0.02	0.04	0.27	0.04	0.04	0.15	0.13	0.03	0.06	0.04		
Queue Length 95th (ft)	2	3	27	3	3	0	0	2	0	0		
Control Delay (s)	15.3	9.1	22.7	11.3	7.7	0.0	0.0	8.4	0.0	0.0		
Lane LOS	C	A	C	B	A			A				
Approach Delay (s)	10.3		19.9		0.9			1.3				
Approach LOS	B		C									
Intersection Summary												
Average Delay			3.6									
Intersection Capacity Utilization			37.3%		ICU Level of Service					A		
Analysis Period (min)			15									

HCM Signalized Intersection Capacity Analysis
8: State Farm Dr & City Center Dr

4/16/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	8	1	35	72	4	19	57	363	83	30	152	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5		4.5	4.5	4.5	4.5	4.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	0.96	1.00	0.97			1.00	1.00	0.97	1.00	1.00	
Flpb, ped/bikes	0.99	1.00	0.99	1.00			1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.85	1.00	0.88			1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.96	1.00	0.95	1.00			0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1773	1527	1757	1582			1770	1863	1535	1770	1839	
Flt Permitted	0.85	1.00	0.75	1.00			0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1576	1527	1391	1582			1770	1863	1535	1770	1839	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	8	1	36	75	4	20	59	378	86	31	158	12
RTOR Reduction (vph)	0	0	28	0	16	0	0	0	40	0	3	0
Lane Group Flow (vph)	0	9	8	75	8	0	59	378	46	31	167	0
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Confl. Bikes (#/hr)			5			5			5			5
Turn Type	Perm	NA	Perm	Perm	NA		Prot	NA	Perm	Prot	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8					2			
Actuated Green, G (s)		13.4	13.4	13.4	13.4		3.5	33.7	33.7	2.0	32.2	
Effective Green, g (s)		13.4	13.4	13.4	13.4		3.5	33.7	33.7	2.0	32.2	
Actuated g/C Ratio		0.21	0.21	0.21	0.21		0.06	0.54	0.54	0.03	0.51	
Clearance Time (s)		4.5	4.5	4.5	4.5		4.5	4.5	4.5	4.5	4.5	
Vehicle Extension (s)		3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		337	326	297	338		98	1002	826	56	945	
v/s Ratio Prot					0.01		c0.03	c0.20		0.02	0.09	
v/s Ratio Perm		0.01	0.01	c0.05					0.03			
v/c Ratio		0.03	0.02	0.25	0.02		0.60	0.38	0.06	0.55	0.18	
Uniform Delay, d1		19.4	19.4	20.4	19.4		28.9	8.4	6.9	29.9	8.1	
Progression Factor		1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		0.0	0.0	0.4	0.0		10.0	1.1	0.1	11.3	0.4	
Delay (s)		19.5	19.5	20.9	19.5		38.9	9.5	7.0	41.2	8.5	
Level of Service		B	B	C	B		D	A	A	D	A	
Approach Delay (s)		19.5			20.5			12.4			13.6	
Approach LOS		B			C			B			B	
Intersection Summary												
HCM 2000 Control Delay		13.9			HCM 2000 Level of Service				B			
HCM 2000 Volume to Capacity ratio		0.37										
Actuated Cycle Length (s)		62.6			Sum of lost time (s)				13.5			
Intersection Capacity Utilization		45.5%			ICU Level of Service				A			
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis
9: US 101 SB Ramps & Rohnert Park Expressway

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑↑↑	↑	↘	↘	↑↑↑	↘	↘	↘	↘	↘	↘	↘
Volume (vph)	0	683	161	12	638	0	1	0	0	650	0	323
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	11	12	12	12	12	12	12	12	12	12
Total Lost time (s)		4.5	4.5	3.5	4.5		4.0			4.0		4.0
Lane Util. Factor		0.91	1.00	1.00	0.91		1.00			0.97		1.00
Flpb, ped/bikes		1.00	0.98	1.00	1.00		1.00			1.00		1.00
Flpb, ped/bikes		1.00	1.00	1.00	1.00		1.00			1.00		1.00
Frt		1.00	0.85	1.00	1.00		1.00			1.00		0.85
Flt Protected		1.00	1.00	0.95	1.00		0.95			0.95		1.00
Satd. Flow (prot)		5085	1495	1770	5085		1770			3433		1583
Flt Permitted		1.00	1.00	0.95	1.00		0.95			0.95		1.00
Satd. Flow (perm)		5085	1495	1770	5085		1770			3433		1583
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	0	711	168	12	665	0	1	0	0	677	0	336
RTOR Reduction (vph)	0	0	96	0	0	0	0	0	0	0	0	152
Lane Group Flow (vph)	0	711	72	12	665	0	1	0	0	677	0	184
Confl. Peds. (#/hr)			4			4						
Turn Type	NA	Perm	Prot	NA	Prot	Prot	Prot	Prot	Prot	Perm		
Protected Phases	2		1	6		3		3	4			
Permitted Phases		2								4		
Actuated Green, G (s)	64.1	64.1	2.7	70.3	1.2					66.0		66.0
Effective Green, g (s)	64.1	64.1	2.7	70.3	1.2					66.0		66.0
Actuated g/C Ratio	0.43	0.43	0.02	0.47	0.01					0.44		0.44
Clearance Time (s)	4.5	4.5	3.5	4.5	4.0					4.0		4.0
Vehicle Extension (s)	4.0	4.0	2.0	4.0	3.0					2.0		2.0
Lane Grp Cap (vph)	2172	638	31	2383	14					1510		696
v/s Ratio Prot	c0.14		0.01	c0.13	c0.00					c0.20		
v/s Ratio Perm		0.05										0.12
v/c Ratio	0.33	0.11	0.39	0.28	0.07					0.45		0.26
Uniform Delay, d1	28.6	25.8	72.8	24.4	73.8					29.3		26.6
Progression Factor	0.39	0.25	1.10	0.99	1.00					1.00		1.00
Incremental Delay, d2	0.4	0.3	2.9	0.3	2.2					0.1		0.1
Delay (s)	11.6	6.7	83.2	24.4	76.0					29.4		26.7
Level of Service	B	A	F	C	E					C		C
Approach Delay (s)	10.7			25.5		76.0				28.5		
Approach LOS	B			C		E				C		
Intersection Summary												
HCM 2000 Control Delay		21.6		HCM 2000 Level of Service		C						
HCM 2000 Volume to Capacity ratio		0.39										
Actuated Cycle Length (s)		150.0		Sum of lost time (s)		16.0						
Intersection Capacity Utilization		53.8%		ICU Level of Service		A						
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis
10: US 101 NB Ramps & Rohnert Park Expressway

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↘	↑↑↑	↘	↘	↑↑↑	↘	↘	↘	↘	↘	↘	↘
Volume (vph)	11	1096	0	0	868	715	164	14	333	1	0	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0			5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	1.00	0.86			0.91	1.00	0.95	0.95	0.88	1.00		1.00
Flpb, ped/bikes	1.00	1.00			1.00	0.98	1.00	1.00	1.00	1.00		1.00
Flpb, ped/bikes	1.00	1.00			1.00	1.00	1.00	1.00	1.00	1.00		1.00
Frt	1.00	1.00			1.00	0.85	1.00	1.00	0.85	1.00		0.85
Flt Protected		0.95	1.00		1.00	1.00	0.95	0.96	1.00	0.95		1.00
Satd. Flow (prot)		1770	6408		5085	1550	1681	1698	2787	1770		1583
Flt Permitted		0.95	1.00		1.00	1.00	0.95	0.96	1.00	0.95		1.00
Satd. Flow (perm)		1770	6408		5085	1550	1681	1698	2787	1770		1583
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	12	1166	0	0	923	761	174	15	354	1	0	9
RTOR Reduction (vph)	0	0	0	0	0	200	0	0	279	0	0	9
Lane Group Flow (vph)	12	1166	0	0	923	561	94	95	75	1	0	0
Confl. Peds. (#/hr)			4			4						
Turn Type	Prot	NA			NA	Perm	Split	NA	Perm	Prot		Perm
Protected Phases	5	2			6		3	3		4		
Permitted Phases						6			3			4
Actuated Green, G (s)	2.9	117.4			110.5	110.5	14.8	14.8	14.8	2.8		2.8
Effective Green, g (s)	2.9	117.4			110.5	110.5	14.8	14.8	14.8	2.8		2.8
Actuated g/C Ratio	0.02	0.78			0.74	0.74	0.10	0.10	0.10	0.02		0.02
Clearance Time (s)	4.0	5.0			5.0	5.0	5.0	5.0	5.0	5.0		5.0
Vehicle Extension (s)	2.0	4.0			2.0	2.0	2.0	2.0	2.0	4.0		4.0
Lane Grp Cap (vph)	34	5015			3745	1141	165	167	274	33		29
v/s Ratio Prot	0.01	c0.18			0.18		0.06	c0.06		c0.00		
v/s Ratio Perm						c0.36			0.03			0.00
v/c Ratio	0.35	0.23			0.25	0.49	0.57	0.57	0.28	0.03		0.01
Uniform Delay, d1	72.6	4.3			6.4	8.2	64.6	64.6	62.6	72.3		72.2
Progression Factor	1.08	0.44			1.49	12.66	1.00	1.00	1.00	1.00		1.00
Incremental Delay, d2	2.2	0.1			0.1	1.4	2.7	2.6	0.2	0.5		0.1
Delay (s)	80.3	2.0			9.6	104.6	67.2	67.2	62.8	72.8		72.3
Level of Service	F	A			A	F	E	E	E	E		E
Approach Delay (s)		2.8			52.5			64.4		72.4		
Approach LOS		A			D			E		E		
Intersection Summary												
HCM 2000 Control Delay		37.3			HCM 2000 Level of Service		D					
HCM 2000 Volume to Capacity ratio		0.49										
Actuated Cycle Length (s)		150.0			Sum of lost time (s)		19.0					
Intersection Capacity Utilization		69.7%			ICU Level of Service		C					
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis
11: Commerce Blvd & Rohnert Park Expressway

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Volume (vph)	289	819	326	86	1036	115	358	179	108	63	100	180
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.91		0.97	1.00	1.00	0.91	0.91	1.00
Flpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	1.00	0.98	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1559	1770	4998		3433	1863	1552	1610	3374	1559
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1559	1770	4998		3433	1863	1552	1610	3374	1559
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	307	871	347	91	1102	122	381	190	115	67	106	191
RTOR Reduction (vph)	0	0	112	0	6	0	0	0	97	0	0	72
Lane Group Flow (vph)	307	871	235	91	1218	0	381	190	18	56	117	119
Confl. Peds. (#/hr)			7			6			7			13
Confl. Bikes (#/hr)						3						3
Turn Type	Prot	NA	pm+ov	Prot	NA		Split	NA	Perm	Split	NA	pm+ov
Protected Phases	5	2	3	1	6		3	3		4	4	5
Permitted Phases			2						3			4
Actuated Green, G (s)	13.7	77.6	101.6	11.5	75.4		24.0	24.0	24.0	16.9	16.9	30.6
Effective Green, g (s)	13.7	77.6	101.6	11.5	75.4		24.0	24.0	24.0	16.9	16.9	30.6
Actuated g/C Ratio	0.09	0.52	0.68	0.08	0.50		0.16	0.16	0.16	0.11	0.11	0.20
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Vehicle Extension (s)	1.0	1.0	1.5	1.0	1.0		1.5	1.5	1.5	1.0	1.0	1.0
Lane Grp Cap (vph)	313	1830	1107	135	2512		549	298	248	181	380	318
v/s Ratio Prot	c0.09	0.25	0.03	c0.05	c0.24		c0.11	0.10		0.03	0.03	c0.03
v/s Ratio Perm			0.12						0.01			0.04
v/c Ratio	0.98	0.48	0.21	0.67	0.48		0.69	0.64	0.07	0.31	0.31	0.38
Uniform Delay, d1	68.0	23.2	9.1	67.4	24.5		59.5	58.9	53.6	61.2	61.2	51.5
Progression Factor	1.02	1.07	2.02	0.94	0.67		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	44.8	0.9	0.0	8.8	0.6		3.1	3.3	0.0	0.4	0.2	0.3
Delay (s)	114.2	25.7	18.5	72.0	17.0		62.6	62.2	53.6	61.5	61.3	51.7
Level of Service	F	C	B	E	B		E	E	D	E	E	D
Approach Delay (s)		41.9			20.8			61.0			56.3	
Approach LOS		D			C			E			E	
Intersection Summary												
HCM 2000 Control Delay		39.5			HCM 2000 Level of Service				D			
HCM 2000 Volume to Capacity ratio		0.57										
Actuated Cycle Length (s)		150.0			Sum of lost time (s)			20.0				
Intersection Capacity Utilization		83.4%			ICU Level of Service			E				
Analysis Period (min)		15										
c Critical Lane Group												

Rohnert Park PDA Plan
AM Peak Hour - Existing plus Project

Synchro 8 Report
W-Trans

HCM Signalized Intersection Capacity Analysis
11: Commerce Blvd & Rohnert Park Expressway

4/16/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Volume (vph)	289	819	326	86	1036	115	358	179	108	63	100	180
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0	5.0		5.0	4.0	5.0	4.0	5.0	5.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.91		0.97	1.00	1.00	1.00	0.95	1.00
Flpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	1.00	0.98	1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1557	1770	4999		3433	1863	1550	1770	3539	1562
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1557	1770	4999		3433	1863	1550	1770	3539	1562
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	307	871	347	91	1102	122	381	190	115	67	106	191
RTOR Reduction (vph)	0	0	114	0	8	0	0	0	69	0	0	72
Lane Group Flow (vph)	307	871	233	91	1216	0	381	190	46	67	106	119
Confl. Peds. (#/hr)			7			6			7			13
Confl. Bikes (#/hr)						3						3
Turn Type	Prot	NA	pm+ov	Prot	NA		Prot	NA	pm+ov	Prot	NA	pm+ov
Protected Phases	5	2	3	1	6		3	8	1	7	4	5
Permitted Phases			2						8			4
Actuated Green, G (s)	14.5	68.0	87.2	9.5	63.0		19.2	21.7	31.2	12.8	13.3	27.8
Effective Green, g (s)	14.5	68.0	87.2	9.5	63.0		19.2	21.7	31.2	12.8	13.3	27.8
Actuated g/C Ratio	0.11	0.52	0.67	0.07	0.48		0.15	0.17	0.24	0.10	0.10	0.21
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0		5.0	4.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	1.0	1.0	1.5	1.0	1.0		1.5	3.0	1.0	3.0	1.0	1.0
Lane Grp Cap (vph)	382	1851	1104	129	2422		507	310	431	174	362	394
v/s Ratio Prot	c0.09	0.25	0.03	0.05	c0.24		c0.11	c0.10	0.01	0.04	0.03	0.03
v/s Ratio Perm			0.12						0.02			0.04
v/c Ratio	0.80	0.47	0.21	0.71	0.50		0.75	0.61	0.11	0.39	0.29	0.30
Uniform Delay, d1	56.4	19.6	8.2	58.9	22.8		53.1	50.3	38.5	54.9	54.0	42.9
Progression Factor	0.90	0.56	0.20	0.92	0.28		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	10.7	0.8	0.0	11.2	0.6		5.5	3.6	0.0	1.4	0.2	0.2
Delay (s)	61.2	11.9	1.6	65.5	7.1		58.6	53.8	38.6	56.3	54.2	43.1
Level of Service	E	B	A	E	A		E	D	D	E	D	D
Approach Delay (s)		19.5			11.1			53.9			48.8	
Approach LOS		B			B			D			D	
Intersection Summary												
HCM 2000 Control Delay		25.5			HCM 2000 Level of Service				C			
HCM 2000 Volume to Capacity ratio		0.61										
Actuated Cycle Length (s)		130.0			Sum of lost time (s)			20.0				
Intersection Capacity Utilization		73.6%			ICU Level of Service			D				
Analysis Period (min)		15										
c Critical Lane Group												

Rohnert Park PDA Plan
AM Peak Hour - Existing plus Project (Mitigated)

Synchro 8 Report
W-Trans

HCM Signalized Intersection Capacity Analysis 12: State Farm Dr & Rohnert Park Expressway

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↰	↰	↰	↰	↰	↰	↰	↰	↰	↰	↰
Volume (vph)	160	627	150	196	936	190	263	129	126	61	70	80
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.91	0.91	1.00	0.91	0.91	0.91
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00	0.99	1.00	1.00	0.98	1.00	0.99	0.99
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.92	0.92
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.98	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3539	1548	1770	3539	1560	1610	3307	1553	1610	3098	3098
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.98	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	3539	1548	1770	3539	1560	1610	3307	1553	1610	3098	3098
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	168	660	158	206	985	200	277	136	133	64	74	84
RTOR Reduction (vph)	0	0	90	0	0	68	0	0	115	0	74	0
Lane Group Flow (vph)	168	660	68	206	985	132	138	275	18	58	90	0
Confl. Peds. (#/hr)			8			2			5			2
Confl. Bikes (#/hr)									1			1
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Split	NA	Perm	Split	NA	
Protected Phases	5	2		1	6		3	3		4	4	
Permitted Phases			2		6			3				
Actuated Green, G (s)	22.4	64.3	64.3	28.1	70.0	70.0	20.6	20.6	20.6	17.0	17.0	
Effective Green, g (s)	22.4	64.3	64.3	28.1	70.0	70.0	20.6	20.6	20.6	17.0	17.0	
Actuated g/C Ratio	0.15	0.43	0.43	0.19	0.47	0.47	0.14	0.14	0.14	0.11	0.11	
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
Lane Grp Cap (vph)	264	1517	663	331	1651	728	221	454	213	182	351	
v/s Ratio Prot	0.09	0.19		c0.12	c0.28		c0.09	0.08		c0.04	0.03	
v/s Ratio Perm			0.04		0.08			0.01				
v/c Ratio	0.64	0.44	0.10	0.62	0.60	0.18	0.62	0.61	0.09	0.32	0.26	
Uniform Delay, d1	60.0	30.1	25.6	56.1	29.6	23.3	61.0	60.9	56.5	61.2	60.7	
Progression Factor	0.83	1.14	3.11	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.02	
Incremental Delay, d2	3.4	0.8	0.3	2.6	1.6	0.5	3.9	1.6	0.1	0.4	0.1	
Delay (s)	53.0	35.2	79.8	58.7	31.2	23.9	65.0	62.4	56.5	62.3	62.1	
Level of Service	D	D	E	E	C	C	E	E	E	E	E	
Approach Delay (s)		45.4			34.2			61.6			62.1	
Approach LOS		D			C			E			E	
Intersection Summary												
HCM 2000 Control Delay			44.4		HCM 2000 Level of Service					D		
HCM 2000 Volume to Capacity ratio			0.58									
Actuated Cycle Length (s)			150.0		Sum of lost time (s)					20.0		
Intersection Capacity Utilization			80.6%		ICU Level of Service					D		
Analysis Period (min)			15									
c Critical Lane Group												

Rohnert Park PDA Plan
AM Peak Hour - Existing plus Project

Synchro 8 Report
W-Trans

HCM Signalized Intersection Capacity Analysis 12: State Farm Dr & Rohnert Park Expressway

4/16/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↰	↰	↰	↰	↰	↰	↰	↰	↰	↰	↰
Volume (vph)	160	627	150	196	936	190	263	129	126	61	70	80
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	12	12	12	12	11	11
Total Lost time (s)	5.0	5.0	4.0	5.0	5.0	4.0	4.0	4.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00	0.97	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.97	1.00	1.00	0.98	1.00	1.00	0.99	1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3539	1539	1770	3539	1552	3433	1863	1569	3319	1801	1518
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	3539	1539	1770	3539	1552	3433	1863	1569	3319	1801	1518
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	168	660	158	206	985	200	277	136	133	64	74	84
RTOR Reduction (vph)	0	0	74	0	0	78	0	0	39	0	0	62
Lane Group Flow (vph)	168	660	84	206	985	122	277	136	94	64	74	22
Confl. Peds. (#/hr)			8			2			5			2
Confl. Bikes (#/hr)									1			1
Turn Type	Prot	NA	pm+ov	Prot	NA	pm+ov	Prot	NA	pm+ov	Prot	NA	pm+ov
Protected Phases	5	2	3	1	6	7	3	8	1	7	4	5
Permitted Phases			2		6			8				4
Actuated Green, G (s)	14.6	53.7	68.8	22.6	61.7	74.8	15.1	22.6	45.2	13.1	19.6	34.2
Effective Green, g (s)	14.6	53.7	68.8	22.6	61.7	74.8	15.1	22.6	45.2	13.1	19.6	34.2
Actuated g/C Ratio	0.11	0.41	0.53	0.17	0.47	0.58	0.12	0.17	0.35	0.10	0.15	0.26
Clearance Time (s)	5.0	5.0	4.0	5.0	5.0	4.0	4.0	4.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	1.0	1.0	3.0	1.0	1.0	3.0	3.0	3.0	1.0	3.0	1.0	1.0
Lane Grp Cap (vph)	198	1461	861	307	1679	940	398	323	605	334	271	457
v/s Ratio Prot	c0.09	0.19	0.01	c0.12	c0.28	0.01	c0.08	c0.07	0.03	0.02	0.04	0.01
v/s Ratio Perm			0.04			0.07			0.03			0.01
v/c Ratio	0.85	0.45	0.10	0.67	0.59	0.13	0.70	0.42	0.16	0.19	0.27	0.05
Uniform Delay, d1	56.6	27.5	15.2	50.2	24.9	12.7	55.2	47.9	29.2	53.6	48.9	35.8
Progression Factor	0.88	1.09	3.23	0.72	0.60	0.19	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	24.5	0.9	0.0	4.0	1.3	0.1	5.2	0.9	0.0	0.3	0.2	0.0
Delay (s)	74.1	30.9	49.1	40.2	16.3	2.5	60.5	48.8	29.3	53.9	49.1	35.8
Level of Service	E	C	D	D	B	A	E	D	C	D	D	D
Approach Delay (s)		41.2			17.8			50.0			45.4	
Approach LOS		D			B			D			D	
Intersection Summary												
HCM 2000 Control Delay			32.7		HCM 2000 Level of Service					C		
HCM 2000 Volume to Capacity ratio			0.62									
Actuated Cycle Length (s)			130.0		Sum of lost time (s)					19.0		
Intersection Capacity Utilization			71.5%		ICU Level of Service					C		
Analysis Period (min)			15									
c Critical Lane Group												

Rohnert Park PDA Plan
AM Peak Hour - Existing plus Project (Mitigated)

Synchro 8 Report
W-Trans

HCM Signalized Intersection Capacity Analysis 13: Commerce Blvd & Enterprise Dr

4/15/2015

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↔↔	↔	↕↕		↕	↕↕
Volume (vph)	76	26	468	71	20	298
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	0.97	1.00	0.95		1.00	0.95
Flpb, ped/bikes	1.00	0.98	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	0.85	0.98		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	3433	1552	3462		1770	3539
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	3433	1552	3462		1770	3539
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	79	27	488	74	21	310
RTOR Reduction (vph)	0	22	18	0	0	0
Lane Group Flow (vph)	79	5	544	0	21	310
Confl. Peds. (#/hr)		5		5		
Confl. Bikes (#/hr)		5		5		
Turn Type	Prot	Perm	NA		Prot	NA
Protected Phases	8		2		1	6
Permitted Phases		8				
Actuated Green, G (s)	4.8	4.8	10.7		0.3	15.0
Effective Green, g (s)	4.8	4.8	10.7		0.3	15.0
Actuated g/C Ratio	0.17	0.17	0.38		0.01	0.54
Clearance Time (s)	4.0	4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	592	267	1332		19	1909
v/s Ratio Prot	c0.02		c0.16		c0.01	0.09
v/s Ratio Perm		0.00				
v/c Ratio	0.13	0.02	0.41		1.11	0.16
Uniform Delay, d1	9.7	9.5	6.2		13.8	3.2
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	0.1	0.0	0.2		242.0	0.0
Delay (s)	9.8	9.6	6.4		255.8	3.3
Level of Service	A	A	A		F	A
Approach Delay (s)	9.8		6.4			19.3
Approach LOS	A		A			B
Intersection Summary						
HCM 2000 Control Delay			11.1		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.34			
Actuated Cycle Length (s)			27.8		Sum of lost time (s)	12.0
Intersection Capacity Utilization			29.3%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						

HCM Unsignalized Intersection Capacity Analysis 14: Enterprise Dr & Hunter Dr

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕↕			↕↕			↕↕			↕↕	
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	13	82	0	3	116	125	1	2	0	61	0	4
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Hourly flow rate (vph)	14	90	0	3	127	137	1	2	0	67	0	4
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1						
Volume Total (vph)	59	45	67	201	3	71						
Volume Left (vph)	14	0	3	0	1	67						
Volume Right (vph)	0	0	0	137	0	4						
Hadj (s)	0.15	0.03	0.06	-0.44	0.10	0.18						
Departure Headway (s)	5.1	4.9	4.8	4.3	4.9	4.9						
Degree Utilization, x	0.08	0.06	0.09	0.24	0.00	0.10						
Capacity (veh/h)	695	706	721	810	679	685						
Control Delay (s)	7.3	7.1	7.1	7.5	7.9	8.4						
Approach Delay (s)	7.2		7.4		7.9	8.4						
Approach LOS	A		A		A	A						
Intersection Summary												
Delay					7.5							
Level of Service					A							
Intersection Capacity Utilization				28.5%		ICU Level of Service				A		
Analysis Period (min)				15								

HCM Unsignalized Intersection Capacity Analysis

14: Enterprise Dr & Hunter Dr

4/16/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control	Stop			Stop			Stop			Stop		
Volume (vph)	13	82	0	3	116	125	1	2	0	61	0	4
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Hourly flow rate (vph)	14	90	0	3	127	137	1	2	0	67	0	4
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1						
Volume Total (vph)	14	90	131	137	3	71						
Volume Left (vph)	14	0	3	0	1	67						
Volume Right (vph)	0	0	0	137	0	4						
Hadj (s)	0.53	0.03	0.05	-0.67	0.10	0.18						
Departure Headway (s)	5.4	4.9	4.8	4.1	4.9	4.9						
Degree Utilization, x	0.02	0.12	0.18	0.16	0.00	0.10						
Capacity (veh/h)	646	707	724	852	681	686						
Control Delay (s)	7.4	7.4	7.7	6.7	7.9	8.4						
Approach Delay (s)	7.4		7.2		7.9	8.4						
Approach LOS	A		A		A	A						
Intersection Summary												
Delay				7.4								
Level of Service				A								
Intersection Capacity Utilization				29.6%	ICU Level of Service			A				
Analysis Period (min)				15								

HCM Unsignalized Intersection Capacity Analysis

15: Enterprise Dr & State Farm Dr

4/15/2015

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↱	↰	↱	↰	↱
Sign Control	Stop		Stop		Stop	
Volume (vph)	61	76	149	312	187	81
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89
Hourly flow rate (vph)	69	85	167	351	210	91
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total (vph)	69	85	112	406	210	91
Volume Left (vph)	69	0	0	0	210	0
Volume Right (vph)	0	0	0	351	0	91
Hadj (s)	0.53	0.03	0.03	-0.57	0.53	-0.67
Departure Headway (s)	6.6	6.1	5.7	5.1	6.6	5.5
Degree Utilization, x	0.13	0.14	0.18	0.58	0.39	0.14
Capacity (veh/h)	513	557	603	687	506	616
Control Delay (s)	9.4	8.9	8.7	13.6	12.6	8.1
Approach Delay (s)	9.1		12.6		11.2	
Approach LOS	A		B		B	
Intersection Summary						
Delay			11.6			
Level of Service			B			
Intersection Capacity Utilization			38.7%	ICU Level of Service		A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
16: Enterprise Dr/Seed Farm Dr

4/15/2015

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↔	↔		↔	↔
Volume (veh/h)	2	225	383	1	2	1
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	2	250	426	1	2	1
Pedestrians		5	5		5	
Lane Width (ft)		12.0	12.0		12.0	
Walking Speed (ft/s)		4.0	4.0		4.0	
Percent Blockage		0	0		0	
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	432				691	436
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	432				691	436
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				99	100
cM capacity (veh/h)	1123				406	615
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	252	427	3			
Volume Left	2	0	2			
Volume Right	0	1	1			
cSH	1123	1700	458			
Volume to Capacity	0.00	0.25	0.01			
Queue Length 95th (ft)	0	0	1			
Control Delay (s)	0.1	0.0	12.9			
Lane LOS	A		B			
Approach Delay (s)	0.1	0.0	12.9			
Approach LOS			B			
Intersection Summary						
Average Delay			0.1			
Intersection Capacity Utilization			31.8%		ICU Level of Service	A
Analysis Period (min)			15			

HCM Signalized Intersection Capacity Analysis
15: Enterprise Dr & State Farm Dr

4/16/2015

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔
Volume (vph)	61	76	149	312	187	81
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	0.97	1.00	0.97
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1766	1863	1863	1540	1770	1539
Flt Permitted	0.65	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1211	1863	1863	1540	1770	1539
Peak-hour factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	69	85	167	351	210	91
RTOR Reduction (vph)	0	0	0	227	0	60
Lane Group Flow (vph)	69	85	167	124	210	31
Confl. Peds. (#/hr)	5			5	5	5
Confl. Bikes (#/hr)				5		5
Turn Type	Perm	NA	NA	Perm	Prot	Perm
Protected Phases		2	6		4	
Permitted Phases	2			6		4
Actuated Green, G (s)	9.1	9.1	9.1	9.1	8.7	8.7
Effective Green, g (s)	9.1	9.1	9.1	9.1	8.7	8.7
Actuated g/C Ratio	0.35	0.35	0.35	0.35	0.34	0.34
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	427	657	657	543	596	518
v/s Ratio Prot		0.05	c0.09		c0.12	
v/s Ratio Perm	0.06			0.08		0.02
v/c Ratio	0.16	0.13	0.25	0.23	0.35	0.06
Uniform Delay, d1	5.7	5.7	5.9	5.9	6.4	5.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.2	0.1	0.2	0.2	0.4	0.0
Delay (s)	5.9	5.8	6.1	6.1	6.8	5.8
Level of Service	A	A	A	A	A	A
Approach Delay (s)		5.8	6.1		6.5	
Approach LOS		A	A		A	
Intersection Summary						
HCM 2000 Control Delay			6.2		HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio			0.30			
Actuated Cycle Length (s)			25.8		Sum of lost time (s)	8.0
Intersection Capacity Utilization			38.1%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						

HCM Unsignalized Intersection Capacity Analysis
17: State Farm Dr & Town Center

4/15/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	47	4	10	24	5	115	22	350	17	106	246	32
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	51	4	11	26	5	125	24	380	18	115	267	35
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)											561	
pX, platoon unblocked												
vC, conflicting volume	881	962	151	815	970	199	302			399		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	881	962	151	815	970	199	302			399		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	72	98	99	89	98	85	98			90		
cM capacity (veh/h)	182	225	868	239	222	808	1256			1156		
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3				
Volume Total	66	157	24	254	145	115	178	124				
Volume Left	51	26	24	0	0	115	0	0				
Volume Right	11	125	0	0	18	0	0	35				
cSH	212	543	1256	1700	1700	1156	1700	1700				
Volume to Capacity	0.31	0.29	0.02	0.15	0.09	0.10	0.10	0.07				
Queue Length 95th (ft)	32	30	1	0	0	8	0	0				
Control Delay (s)	29.5	14.3	7.9	0.0	0.0	8.5	0.0	0.0				
Lane LOS	D	B	A			A						
Approach Delay (s)	29.5	14.3	0.4			2.3						
Approach LOS	D	B										
Intersection Summary												
Average Delay			5.0									
Intersection Capacity Utilization			36.2%		ICU Level of Service				A			
Analysis Period (min)			15									

HCM Signalized Intersection Capacity Analysis
17: State Farm Dr & Town Center

4/16/2015

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations													
Volume (vph)	47	4	10	24	5	115	22	350	17	106	246	32	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	0.85	
Flt Protected	0.96	1.00		0.96	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	
Satd. Flow (prot)	1780	1583		1788	1583	1770	1863	1583	1770	1863	1583	1583	
Flt Permitted	0.73	1.00		0.77	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	
Satd. Flow (perm)	1364	1583		1439	1583	1770	1863	1583	1770	1863	1583	1583	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	
Adj. Flow (vph)	51	4	11	26	5	125	24	380	18	115	267	35	
RTOR Reduction (vph)	0	0	9	0	0	102	0	0	10	0	0	16	
Lane Group Flow (vph)	0	55	2	0	31	23	24	380	8	115	267	19	
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Prot	NA	Perm	Prot	NA	Perm	
Protected Phases	4				8		5		2		1		6
Permitted Phases	4		8		8				2				6
Actuated Green, G (s)	8.5		8.5		8.5		8.5		0.5		20.1		24.9
Effective Green, g (s)	8.5		8.5		8.5		8.5		0.5		20.1		24.9
Actuated g/C Ratio	0.19		0.19		0.19		0.19		0.01		0.44		0.54
Clearance Time (s)	4.0		4.0		4.0		4.0		4.0		4.0		4.0
Vehicle Extension (s)	3.0		3.0		3.0		3.0		3.0		3.0		3.0
Lane Grp Cap (vph)	252		293		266		293		19		815		858
v/s Ratio Prot							0.01		c0.20		c0.06		0.14
v/s Ratio Perm	c0.04		0.00		0.02		0.01				0.00		0.01
v/c Ratio	0.22		0.01		0.12		0.08		1.26		0.47		0.02
Uniform Delay, d1	15.9		15.3		15.6		15.5		22.7		9.1		4.9
Progression Factor	1.00		1.00		1.00		1.00		1.00		1.00		1.00
Incremental Delay, d2	0.4		0.0		0.2		0.1		298.7		0.4		0.0
Delay (s)	16.3		15.3		15.8		15.6		321.4		9.5		4.9
Level of Service	B		B		B		B		F		A		A
Approach Delay (s)	16.1				15.6				27.2				10.4
Approach LOS	B				B				C				B
Intersection Summary													
HCM 2000 Control Delay			18.2		HCM 2000 Level of Service				B				
HCM 2000 Volume to Capacity ratio			0.42										
Actuated Cycle Length (s)			45.9		Sum of lost time (s)				12.0				
Intersection Capacity Utilization			43.8%		ICU Level of Service				A				
Analysis Period (min)			15										
c Critical Lane Group													

HCM Signalized Intersection Capacity Analysis

1: US 101 South Ramps & Golf Course Dr

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↑	↑	↑↑					↑	↑	↑
Volume (vph)	0	638	212	166	420	0	0	0	0	455	165	485
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	3.0	4.0					3.0	3.0	3.0
Lane Util. Factor		0.95	1.00	0.97	0.95					0.95	0.95	1.00
Frpb, ped/bikes		1.00	0.97	1.00	1.00					1.00	1.00	0.97
Flpb, ped/bikes		1.00	1.00	1.00	1.00					1.00	1.00	1.00
Frt		1.00	0.85	1.00	1.00					1.00	1.00	0.85
Flt Protected		1.00	1.00	0.95	1.00					0.95	0.98	1.00
Satd. Flow (prot)		3539	1532	3433	3539					1681	1728	1540
Flt Permitted		1.00	1.00	0.95	1.00					0.95	0.98	1.00
Satd. Flow (perm)		3539	1532	3433	3539					1681	1728	1540
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	0	658	219	171	433	0	0	0	0	469	170	500
RTOR Reduction (vph)	0	0	106	0	0	0	0	0	0	0	0	226
Lane Group Flow (vph)	0	658	113	171	433	0	0	0	0	314	325	274
Confl. Peds. (#/hr)			10									10
Confl. Bikes (#/hr)			10									10
Turn Type	NA	Perm	Prot	NA						Split	NA	Perm
Protected Phases	6		5	2						8	8	
Permitted Phases		6										8
Actuated Green, G (s)		56.8	56.8	9.8	69.6					33.4	33.4	33.4
Effective Green, g (s)		56.8	56.8	9.8	69.6					33.4	33.4	33.4
Actuated g/C Ratio		0.52	0.52	0.09	0.63					0.30	0.30	0.30
Clearance Time (s)		4.0	4.0	3.0	4.0					3.0	3.0	3.0
Vehicle Extension (s)		2.0	2.0	2.0	2.0					2.0	2.0	2.0
Lane Grp Cap (vph)	1827	791	305	2239						510	524	467
v/s Ratio Prot	c0.19		c0.05	0.12						0.19	c0.19	
v/s Ratio Perm		0.07										0.18
v/c Ratio	0.36	0.14	0.56	0.19						0.62	0.62	0.59
Uniform Delay, d1	15.8	13.9	48.0	8.5						32.8	32.9	32.4
Progression Factor	0.52	0.51	1.00	1.00						1.00	1.00	1.00
Incremental Delay, d2	0.5	0.3	1.4	0.2						1.6	1.6	1.2
Delay (s)	8.7	7.3	49.4	8.6						34.4	34.5	33.7
Level of Service	A	A	D	A						C	C	C
Approach Delay (s)	8.4			20.2			0.0				34.1	
Approach LOS	A			C			A				C	
Intersection Summary												
HCM 2000 Control Delay		22.3		HCM 2000 Level of Service			C					
HCM 2000 Volume to Capacity ratio		0.47										
Actuated Cycle Length (s)		110.0		Sum of lost time (s)			10.0					
Intersection Capacity Utilization		54.2%		ICU Level of Service			A					
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: Commerce Blvd & Golf Course Dr

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑	↑	↑	↑↑					↑	↑	↑
Volume (vph)	26	569	465	319	311	77	290	195	520	183	212	14
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	12	12	13	12	12	12
Total Lost time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.0	4.5	4.5	
Lane Util. Factor	1.00	0.91	1.00	0.97	0.95		0.97	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00	0.99	1.00	0.99		1.00	1.00	0.99	1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.97		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5085	1562	3433	3402		3433	1863	1619	1770	1842	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	5085	1562	3433	3402		3433	1863	1619	1770	1842	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	27	593	484	332	324	80	302	203	542	191	221	15
RTOR Reduction (vph)	0	0	201	0	16	0	0	0	212	0	2	0
Lane Group Flow (vph)	27	593	283	332	388	0	302	203	330	191	234	0
Confl. Peds. (#/hr)			10			10			10			10
Confl. Bikes (#/hr)			10			10			10			10
Turn Type	Prot	NA	pm+ov	Prot	NA		Split	NA	pm+ov	Split	NA	
Protected Phases	1	6	4	5	2		4	4	5	3	3	
Permitted Phases			6						4			
Actuated Green, G (s)	2.6	19.9	35.1	11.8	29.1		15.2	15.2	27.0	17.3	17.3	
Effective Green, g (s)	2.6	19.9	35.1	11.8	29.1		15.2	15.2	27.0	17.3	17.3	
Actuated g/C Ratio	0.03	0.24	0.43	0.14	0.36		0.19	0.19	0.33	0.21	0.21	
Clearance Time (s)	4.0	4.5	4.5	4.0	4.5		4.5	4.5	4.0	4.5	4.5	
Vehicle Extension (s)	2.0	2.0	2.0	2.0	2.0		2.0	2.0	2.0	2.0	2.0	
Lane Grp Cap (vph)	56	1238	671	495	1211		638	346	535	374	390	
v/s Ratio Prot	0.02	c0.12	0.08	c0.10	0.11		0.09	0.11	c0.09	0.11	c0.13	
v/s Ratio Perm			0.10						0.11			
v/c Ratio	0.48	0.48	0.42	0.67	0.32		0.47	0.59	0.62	0.51	0.60	
Uniform Delay, d1	38.9	26.5	16.2	33.1	19.1		29.7	30.4	23.0	28.5	29.1	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	2.4	0.1	0.2	2.8	0.1		0.2	1.6	1.5	0.5	1.7	
Delay (s)	41.3	26.6	16.4	35.9	19.2		29.9	32.0	24.5	29.0	30.7	
Level of Service	D	C	B	D	B		C	C	C	C	C	
Approach Delay (s)		22.5		26.7				27.5			29.9	
Approach LOS		C		C				C			C	
Intersection Summary												
HCM 2000 Control Delay		26.0		HCM 2000 Level of Service			C					
HCM 2000 Volume to Capacity ratio		0.58										
Actuated Cycle Length (s)		81.7		Sum of lost time (s)			17.5					
Intersection Capacity Utilization		70.0%		ICU Level of Service			C					
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis 3: Commerce Blvd & US 101 North Ramps

4/15/2015

	↖	→	↗	↖	←	↖	↖	↑	↗	↘	↓	↘
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↖	↗		↗		↖	↗		↖	↗	↗
Volume (vph)	411	0	24	3	4	1	331	561	1	4	508	461
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	14	12	16	12	12	12	12	12	12	12	12	12
Total Lost time (s)	4.0	4.0	3.0		3.0		3.0	4.0		3.0	4.0	4.0
Lane Util. Factor	0.95	0.95	1.00		1.00		1.00	0.95		1.00	0.95	1.00
Flpb, ped/bikes	1.00	1.00	1.00		0.98		1.00	1.00		1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85		0.98		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	0.95	1.00		0.98		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1793	1681	1794		1756		1770	3538		1770	3539	1546
Flt Permitted	0.95	0.95	1.00		0.98		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1793	1681	1794		1756		1770	3538		1770	3539	1546
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	433	0	25	3	4	1	348	591	1	4	535	485
RTOR Reduction (vph)	0	0	14	0	1	0	0	0	0	0	0	0
Lane Group Flow (vph)	216	217	11	0	7	0	348	592	0	4	535	485
Confl. Peds. (#/hr)						10			10			
Confl. Bikes (#/hr)									10			10
Turn Type	Split	NA	pm+ov	Split	NA		Prot	NA		Prot	NA	Free
Protected Phases	8	8	1	7	7		1	6		5	2	
Permitted Phases			8									Free
Actuated Green, G (s)	11.8	11.8	26.4		0.6		14.6	31.9		0.6	17.9	58.9
Effective Green, g (s)	11.8	11.8	26.4		0.6		14.6	31.9		0.6	17.9	58.9
Actuated g/C Ratio	0.20	0.20	0.45		0.01		0.25	0.54		0.01	0.30	1.00
Clearance Time (s)	4.0	4.0	3.0		3.0		3.0	4.0		3.0	4.0	
Vehicle Extension (s)	2.0	2.0	2.0		2.0		2.0	4.0		2.0	4.0	
Lane Grp Cap (vph)	359	336	804		17		438	1916		18	1075	1546
v/s Ratio Prot	0.12	c0.13	0.00		0.00		c0.20	0.17		0.00	c0.15	
v/s Ratio Perm			0.00									c0.31
v/c Ratio	0.60	0.65	0.01		0.41		0.79	0.31		0.22	0.50	0.31
Uniform Delay, d1	21.4	21.6	9.0		29.0		20.7	7.4		28.9	16.8	0.0
Progression Factor	1.00	1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	1.9	3.2	0.0		5.8		9.0	0.1		2.3	0.5	0.5
Delay (s)	23.4	24.8	9.0		34.8		29.7	7.6		31.2	17.3	0.5
Level of Service	C	C	A		C		C	A		C	B	A
Approach Delay (s)		23.3			34.8			15.8			9.4	
Approach LOS		C			C			B			A	
Intersection Summary												
HCM 2000 Control Delay		14.6			HCM 2000 Level of Service			B				
HCM 2000 Volume to Capacity ratio		0.66										
Actuated Cycle Length (s)		58.9			Sum of lost time (s)			14.0				
Intersection Capacity Utilization		60.4%			ICU Level of Service			B				
Analysis Period (min)		15										
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis 4: Commerce Blvd & State Farm Dr

4/15/2015

	↖	↖	↑	↗	↘	↓
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↖	↖	↖	↖	↖	↖
Volume (veh/h)	32	404	483	16	230	343
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	36	459	549	18	261	390
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1470	558			567	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1470	558			567	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	65	13			74	
cM capacity (veh/h)	104	529			1005	
Direction, Lane #						
	WB 1	NB 1	SB 1	SB 2		
Volume Total	495	567	261	390		
Volume Left	36	0	261	0		
Volume Right	459	18	0	0		
cSH	407	1700	1005	1700		
Volume to Capacity	1.22	0.33	0.26	0.23		
Queue Length 95th (ft)	507	0	26	0		
Control Delay (s)	148.2	0.0	9.8	0.0		
Lane LOS	F		A			
Approach Delay (s)	148.2	0.0	3.9			
Approach LOS	F					
Intersection Summary						
Average Delay			44.3			
Intersection Capacity Utilization			75.9%		ICU Level of Service	D
Analysis Period (min)			15			

HCM Signalized Intersection Capacity Analysis 4: Commerce Blvd & State Farm Dr

4/16/2015

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↰		↰	↱
Volume (vph)	32	404	483	16	230	343
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5		4.5	4.5
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frt	1.00	0.85	1.00		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	1583	1855		1770	1863
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1770	1583	1855		1770	1863
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	36	459	549	18	261	390
RTOR Reduction (vph)	0	127	1	0	0	0
Lane Group Flow (vph)	36	332	566	0	261	390
Turn Type	Prot	pm+ov	NA		Prot	NA
Protected Phases	8	1	2		1	6
Permitted Phases		8				
Actuated Green, G (s)	6.5	22.2	25.9		15.7	46.1
Effective Green, g (s)	6.5	22.2	25.9		15.7	46.1
Actuated g/C Ratio	0.11	0.36	0.42		0.25	0.75
Clearance Time (s)	4.5	4.5	4.5		4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	186	686	779		451	1394
v/s Ratio Prot	0.02	c0.12	c0.31		c0.15	0.21
v/s Ratio Perm		0.09				
v/c Ratio	0.19	0.48	0.73		0.58	0.28
Uniform Delay, d1	25.2	15.3	14.9		20.1	2.5
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	0.5	0.5	3.4		1.8	0.1
Delay (s)	25.7	15.8	18.3		21.9	2.6
Level of Service	C	B	B		C	A
Approach Delay (s)	16.5		18.3		10.3	
Approach LOS	B		B		B	
Intersection Summary						
HCM 2000 Control Delay		14.7		HCM 2000 Level of Service		B
HCM 2000 Volume to Capacity ratio		0.67				
Actuated Cycle Length (s)		61.6		Sum of lost time (s)	13.5	
Intersection Capacity Utilization		58.9%		ICU Level of Service		B
Analysis Period (min)		15				
c Critical Lane Group						

HCM Unsignalized Intersection Capacity Analysis 5: State Farm Dr & Professional Center Dr

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱		↰	↱	
Volume (veh/h)	11	12	58	39	9	31	71	287	22	13	269	18
Sign Control	Stop			Stop			Free			Free		
Grade	0%			0%			0%			0%		
Peak Hour Factor	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Hourly flow rate (vph)	13	15	71	48	11	38	87	350	27	16	328	22
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	762	921	175	810	918	188	350			377		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	762	921	175	810	918	188	350			377		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	95	94	92	79	96	95	93			99		
cM capacity (veh/h)	254	246	838	222	247	821	1206			1178		
Direction, Lane #												
Volume Total	13	85	96	87	233	143	16	219	131			
Volume Left	13	0	48	87	0	0	16	0	0			
Volume Right	0	71	38	0	0	27	0	0	22			
cSH	254	594	316	1206	1700	1700	1178	1700	1700			
Volume to Capacity	0.05	0.14	0.30	0.07	0.14	0.08	0.01	0.13	0.08			
Queue Length 95th (ft)	4	12	31	6	0	0	1	0	0			
Control Delay (s)	20.0	12.1	21.3	8.2	0.0	0.0	8.1	0.0	0.0			
Lane LOS	C	B	C	A			A					
Approach Delay (s)	13.2		21.3	1.5			0.4					
Approach LOS	B		C									
Intersection Summary												
Average Delay			4.1									
Intersection Capacity Utilization			33.2%				ICU Level of Service			A		
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis
5: State Farm Dr & Professional Center Dr

4/16/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	11	12	58	39	9	31	71	287	22	13	269	18
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Hourly flow rate (vph)	13	15	71	48	11	38	87	350	27	16	328	22
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	937	921	339	974	918	363	350			377		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	937	921	339	974	918	363	350			377		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	94	94	90	74	96	94	93			99		
cM capacity (veh/h)	209	248	703	186	249	681	1209			1182		
Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2	SB 1	SB 2					
Volume Total	13	85	96	87	377	16	350					
Volume Left	13	0	48	87	0	16	0					
Volume Right	0	71	38	0	27	0	22					
cSH	209	535	271	1209	1700	1182	1700					
Volume to Capacity	0.06	0.16	0.36	0.07	0.22	0.01	0.21					
Queue Length 95th (ft)	5	14	39	6	0	1	0					
Control Delay (s)	23.4	13.0	25.5	8.2	0.0	8.1	0.0					
Lane LOS	C	B	D	A		A						
Approach Delay (s)	14.4		25.5	1.5		0.4						
Approach LOS	B		D									
Intersection Summary												
Average Delay				4.6								
Intersection Capacity Utilization	41.0%			ICU Level of Service				A				
Analysis Period (min)	15											

HCM Unsignalized Intersection Capacity Analysis
6: Commerce Blvd & Professional Center Dr

4/15/2015

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations													
Volume (veh/h)	12	279	4	83	313	72	1	61	44	82	81	59	
Sign Control		Free			Free			Stop			Stop		
Grade		0%			0%			0%			0%		
Peak Hour Factor	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	
Hourly flow rate (vph)	15	340	5	101	382	88	1	74	54	100	99	72	
Pedestrians													
Lane Width (ft)													
Walking Speed (ft/s)													
Percent Blockage													
Right turn flare (veh)													
Median type		None			TW/TL								
Median storage (veh)					2								
Upstream signal (ft)													
pX, platoon unblocked													
vC, conflicting volume	470			345			1077	1044	343	1088	1002	426	
vC1, stage 1 conf vol							372	372		628	628		
vC2, stage 2 conf vol							705	672		460	374		
vCu, unblocked vol	470			345			1077	1044	343	1088	1002	426	
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2	
tC, 2 stage (s)							6.1	5.5		6.1	5.5		
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3	
p0 queue free %	99			92			99	80	92	67	74	89	
cM capacity (veh/h)	1092			1214			242	367	700	300	374	629	
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1	SB 2						
Volume Total	15	345	101	470	129	100	171						
Volume Left	15	0	101	0	1	100	0						
Volume Right	0	5	0	88	54	0	72						
cSH	1092	1700	1214	1700	454	300	451						
Volume to Capacity	0.01	0.20	0.08	0.28	0.28	0.33	0.38						
Queue Length 95th (ft)	1	0	7	0	29	35	44						
Control Delay (s)	8.3	0.0	8.2	0.0	16.1	22.9	17.8						
Lane LOS	A		A		C	C	C						
Approach Delay (s)	0.3		1.5		16.1	19.6							
Approach LOS					C	C							
Intersection Summary													
Average Delay			6.3										
Intersection Capacity Utilization			45.4%		ICU Level of Service		A						
Analysis Period (min)			15										

HCM Unsignalized Intersection Capacity Analysis

7: Commerce Blvd & Padre Pkwy

4/15/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	13	5	102	163	4	45	87	431	149	39	571	11
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Hourly flow rate (vph)	15	6	115	183	4	51	98	484	167	44	642	12
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								TWLT		TWLT		
Median storage (veh)								2		2		
Upstream signal (ft)								480				
pX, platoon unblocked												
vC, conflicting volume	1226	1583	327	1289	1505	326	654			652		
vC1, stage 1 conf vol	735	735		763	763							
vC2, stage 2 conf vol	490	847		526	742							
vCu, unblocked vol	1226	1583	327	1289	1505	326	654			652		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)	6.5	5.5		6.5	5.5							
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	95	98	83	20	98	92	89			95		
cM capacity (veh/h)	278	246	669	229	248	670	929			931		
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3				
Volume Total	135	238	98	323	329	44	428	226				
Volume Left	15	183	98	0	0	44	0	0				
Volume Right	115	51	0	0	167	0	0	12				
cSH	546	266	929	1700	1700	931	1700	1700				
Volume to Capacity	0.25	0.89	0.11	0.19	0.19	0.05	0.25	0.13				
Queue Length 95th (ft)	24	196	9	0	0	4	0	0				
Control Delay (s)	13.7	72.2	9.3	0.0	0.0	9.1	0.0	0.0				
Lane LOS	B	F	A			A						
Approach Delay (s)	13.7	72.2	1.2			0.6						
Approach LOS	B	F										
Intersection Summary												
Average Delay			11.2									
Intersection Capacity Utilization			49.6%		ICU Level of Service		A					
Analysis Period (min)			15									

HCM Signalized Intersection Capacity Analysis

7: Commerce Blvd & Padre Pkwy

4/16/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔		↔	↑	↗	↗	↗	
Volume (vph)	13	5	102	163	4	45	87	431	149	39	571	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5				4.5		4.5		4.5		4.5	
Lane Util. Factor	1.00				1.00		1.00		1.00		1.00	
Frt	0.89				0.97		1.00		0.85		1.00	
Flt Protected	0.99				0.96		0.95		1.00		0.95	
Satd. Flow (prot)	1641				1742		1770		1863		1770	
Flt Permitted	0.96				0.70		0.95		1.00		0.95	
Satd. Flow (perm)	1579				1273		1770		1863		1770	
Peak-hour factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	15	6	115	183	4	51	98	484	167	44	642	12
RTOR Reduction (vph)	0	87	0	0	15	0	0	0	81	0	1	0
Lane Group Flow (vph)	0	49	0	0	223	0	98	484	86	44	653	0
Turn Type	Perm	NA		Perm	NA		Prot	NA	Perm	Prot	NA	
Protected Phases	4				8		5		2		1	
Permitted Phases	4		8						2			
Actuated Green, G (s)	15.9				15.9		4.2		33.7		2.3	
Effective Green, g (s)	15.9				15.9		4.2		33.7		2.3	
Actuated g/C Ratio	0.24				0.24		0.06		0.52		0.04	
Clearance Time (s)	4.5				4.5		4.5		4.5		4.5	
Vehicle Extension (s)	3.0				3.0		3.0		3.0		3.0	
Lane Grp Cap (vph)	383				309		113		959		815	
v/s Ratio Prot							c0.06		0.26		0.02	
v/s Ratio Perm	0.03				c0.18				0.05			
v/c Ratio	0.13				0.72		0.87		0.50		0.11	
Uniform Delay, d1	19.3				22.7		30.3		10.4		8.1	
Progression Factor	1.00				1.00		1.00		1.00		1.00	
Incremental Delay, d2	0.2				8.0		45.7		1.9		31.0	
Delay (s)	19.5				30.8		76.1		12.3		62.2	
Level of Service	B				C		E		B		A	
Approach Delay (s)	19.5				30.8				19.8		21.1	
Approach LOS	B				C				B		C	
Intersection Summary												
HCM 2000 Control Delay			21.7		HCM 2000 Level of Service		C					
HCM 2000 Volume to Capacity ratio			0.73									
Actuated Cycle Length (s)			65.4		Sum of lost time (s)		13.5					
Intersection Capacity Utilization			65.4%		ICU Level of Service		C					
Analysis Period (min)			15									
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis
8: State Farm Dr & City Center Dr

4/15/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	25	11	156	123	6	31	81	269	98	32	444	31
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	28	12	173	137	7	34	90	299	109	36	493	34
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)								456				
pX, platoon unblocked												
vC, conflicting volume	949	1169	264	1031	1132	204	528			408		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	949	1169	264	1031	1132	204	528			408		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	85	93	76	0	96	96	91			97		
cM capacity (veh/h)	182	170	735	124	178	803	1035			1147		
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3		
Volume Total	34	179	137	41	90	199	209	36	329	199		
Volume Left	28	0	137	0	90	0	0	36	0	0		
Volume Right	0	173	0	34	0	0	109	0	0	34		
cSH	180	660	124	512	1035	1700	1700	1147	1700	1700		
Volume to Capacity	0.19	0.27	1.11	0.08	0.09	0.12	0.12	0.03	0.19	0.12		
Queue Length 95th (ft)	17	28	201	7	7	0	0	2	0	0		
Control Delay (s)	29.6	12.5	180.9	12.6	8.8	0.0	0.0	8.2	0.0	0.0		
Lane LOS	D	B	F	B	A			A				
Approach Delay (s)	15.2		142.0		1.6			0.5				
Approach LOS	C		F									
Intersection Summary												
Average Delay	20.4											
Intersection Capacity Utilization	44.0%			ICU Level of Service						A		
Analysis Period (min)	15											

HCM Signalized Intersection Capacity Analysis
8: State Farm Dr & City Center Dr

4/16/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔		↔	↔		↔	↔		↔	↔	
Volume (vph)	25	11	156	123	6	31	81	269	98	32	444	31
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5		4.5	4.5	4.5	4.5	4.5	
Lane Util. Factor		1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt		1.00	0.85	1.00	0.88		1.00	1.00	0.85	1.00	0.99	
Flt Protected		0.97	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1800	1583	1770	1631		1770	1863	1583	1770	1845	
Flt Permitted		0.83	1.00	0.73	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)		1537	1583	1362	1631		1770	1863	1583	1770	1845	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	28	12	173	137	7	34	90	299	109	36	493	34
RTOR Reduction (vph)	0	0	135	0	26	0	0	0	52	0	3	0
Lane Group Flow (vph)	0	40	38	137	15	0	90	299	57	36	524	0
Turn Type	Perm	NA	Perm	Perm	NA		Prot	NA	Perm	Prot	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8					2			
Actuated Green, G (s)		13.7	13.7	13.7	13.7		4.6	32.6	32.6	2.0	30.0	
Effective Green, g (s)		13.7	13.7	13.7	13.7		4.6	32.6	32.6	2.0	30.0	
Actuated g/C Ratio		0.22	0.22	0.22	0.22		0.07	0.53	0.53	0.03	0.49	
Clearance Time (s)		4.5	4.5	4.5	4.5		4.5	4.5	4.5	4.5	4.5	
Vehicle Extension (s)		3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		340	350	301	361		131	982	835	57	895	
v/s Ratio Prot					0.01		c0.05	c0.16		0.02	c0.28	
v/s Ratio Perm		0.03	0.02	c0.10					0.04			
v/c Ratio		0.12	0.11	0.46	0.04		0.69	0.30	0.07	0.63	0.59	
Uniform Delay, d1		19.2	19.2	20.8	18.9		27.9	8.2	7.2	29.5	11.4	
Progression Factor		1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		0.2	0.1	1.1	0.0		13.9	0.8	0.2	20.6	2.8	
Delay (s)		19.4	19.3	21.9	18.9		41.8	9.0	7.3	50.1	14.2	
Level of Service		B	B	C	B		D	A	A	D	B	
Approach Delay (s)		19.3			21.2			14.6			16.5	
Approach LOS		B			C			B			B	
Intersection Summary												
HCM 2000 Control Delay			16.8		HCM 2000 Level of Service				B			
HCM 2000 Volume to Capacity ratio			0.55									
Actuated Cycle Length (s)			61.8		Sum of lost time (s)				13.5			
Intersection Capacity Utilization			54.5%		ICU Level of Service				A			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis
9: US 101 SB Ramps & Rohnert Park Expressway

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑↑↑	↑	↑	↑↑↑	↑	↑	↑	↑	↑	↑	↑	↑
Volume (vph)	0	1252	321	37	1118	0	4	0	19	865	0	287
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	11	12	12	12	12	12	12	12	12	12
Total Lost time (s)		4.5	4.5	3.5	4.5		4.0		4.0	4.0		4.0
Lane Util. Factor		0.91	1.00	1.00	0.91		1.00		1.00	0.97		1.00
Frt		1.00	0.85	1.00	1.00		1.00		0.85	1.00		0.85
Flt Protected		1.00	1.00	0.95	1.00		0.95		1.00	0.95		1.00
Satd. Flow (prot)		5085	1531	1770	5085		1770		1583	3433		1583
Flt Permitted		1.00	1.00	0.95	1.00		0.95		1.00	0.95		1.00
Satd. Flow (perm)		5085	1531	1770	5085		1770		1583	3433		1583
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	0	1304	334	39	1165	0	4	0	20	901	0	299
RTOR Reduction (vph)	0	0	93	0	0	0	0	0	19	0	0	94
Lane Group Flow (vph)	0	1304	241	39	1165	0	4	0	1	901	0	205
Turn Type	NA	Perm	Prot	NA	Prot	Prot	Prot	Prot	Perm	Prot	Perm	Prot
Protected Phases	2		1	6		3		3	4			
Permitted Phases		2										4
Actuated Green, G (s)	72.8	72.8	6.8	83.1		3.8		3.8	50.6			50.6
Effective Green, g (s)	72.8	72.8	6.8	83.1		3.8		3.8	50.6			50.6
Actuated g/C Ratio	0.49	0.49	0.05	0.55		0.03		0.03	0.34			0.34
Clearance Time (s)	4.5	4.5	3.5	4.5		4.0		4.0	4.0			4.0
Vehicle Extension (s)	4.0	4.0	2.0	4.0		3.0		3.0	2.0			2.0
Lane Grp Cap (vph)	2467	743	80	2817		44		40	1158			533
v/s Ratio Prot	c0.26		c0.02	0.23		c0.00		0.00	c0.26			
v/s Ratio Perm		0.16										0.13
v/c Ratio	0.53	0.32	0.49	0.41		0.09		0.01	0.78			0.38
Uniform Delay, d1	26.7	23.6	69.9	19.4		71.4		71.3	44.7			37.8
Progression Factor	1.00	1.00	1.02	0.71		1.00		1.00	1.00			1.00
Incremental Delay, d2	0.8	1.2	1.6	0.4		0.9		0.1	3.1			0.2
Delay (s)	27.5	24.7	73.0	14.2		72.3		71.4	47.7			38.0
Level of Service	C	C	E	B		E		E	D			D
Approach Delay (s)	27.0			16.1		71.6			45.3			
Approach LOS	C			B		E			D			
Intersection Summary												
HCM 2000 Control Delay		29.4		HCM 2000 Level of Service		C						
HCM 2000 Volume to Capacity ratio		0.61										
Actuated Cycle Length (s)		150.0		Sum of lost time (s)		16.0						
Intersection Capacity Utilization		62.6%		ICU Level of Service		B						
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis
10: US 101 NB Ramps & Rohnert Park Expressway

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑↑↑			↑↑↑	↑	↑	↑	↑	↑	↑	↑
Volume (vph)	43	1683	0	0	1256	668	297	18	442	11	0	14
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	6.0			6.0	6.0	5.0	5.0	5.0	5.0		5.0
Lane Util. Factor	1.00	0.86			0.91	1.00	0.95	0.95	0.88	1.00		1.00
Frt	1.00	1.00			1.00	0.85	1.00	1.00	0.85	1.00		0.85
Flt Protected	0.95	1.00			1.00	1.00	0.95	0.96	1.00	0.95		1.00
Satd. Flow (prot)	1770	6408			5085	1583	1681	1695	2787	1770		1583
Flt Permitted	0.95	1.00			1.00	1.00	0.95	0.96	1.00	0.95		1.00
Satd. Flow (perm)	1770	6408			5085	1583	1681	1695	2787	1770		1583
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	45	1753	0	0	1308	696	309	19	460	11	0	15
RTOR Reduction (vph)	0	0	0	0	0	270	0	0	103	0	0	15
Lane Group Flow (vph)	45	1753	0	0	1308	426	164	164	357	11	0	0
Turn Type	Prot	NA			NA	Perm	Split	NA	Perm	Prot		Perm
Protected Phases	5	2			6		3	3		4		
Permitted Phases						6			3			4
Actuated Green, G (s)	7.3	104.2			91.9	91.9	26.3	26.3	26.3	3.5		3.5
Effective Green, g (s)	7.3	104.2			91.9	91.9	26.3	26.3	26.3	3.5		3.5
Actuated g/C Ratio	0.05	0.69			0.61	0.61	0.18	0.18	0.18	0.02		0.02
Clearance Time (s)	5.0	6.0			6.0	6.0	5.0	5.0	5.0	5.0		5.0
Vehicle Extension (s)	2.0	4.0			4.0	4.0	2.0	2.0	2.0	2.0		2.0
Lane Grp Cap (vph)	86	4451			3115	969	294	297	488	41		36
v/s Ratio Prot	0.03	c0.27			0.26		0.10	0.10		c0.01		
v/s Ratio Perm						c0.27			c0.13			0.00
v/c Ratio	0.52	0.39			0.42	0.44	0.56	0.55	0.73	0.27		0.01
Uniform Delay, d1	69.7	9.6			15.1	15.4	56.5	56.5	58.5	72.0		71.6
Progression Factor	1.12	1.23			0.84	3.49	1.00	1.00	1.00	1.00		1.00
Incremental Delay, d2	2.2	0.2			0.3	1.1	1.3	1.3	4.8	1.3		0.0
Delay (s)	80.3	12.0			13.0	54.9	57.8	57.7	63.3	73.3		71.6
Level of Service	F	B			B	D	E	E	E	E		E
Approach Delay (s)	13.7				27.6			61.0		72.3		
Approach LOS	B				C			E		E		
Intersection Summary												
HCM 2000 Control Delay		28.1			HCM 2000 Level of Service		C					
HCM 2000 Volume to Capacity ratio		0.50										
Actuated Cycle Length (s)		150.0			Sum of lost time (s)		21.0					
Intersection Capacity Utilization		69.2%			ICU Level of Service		C					
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis
11: Commerce Blvd & Rohnert Park Expressway

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔		↔	↔	↔	↔	↔	↔
Volume (vph)	281	1169	716	182	998	82	524	248	255	165	277	393
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.91		0.97	1.00	1.00	0.91	0.91	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	1.00	0.98	1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1558	1770	5017		3433	1863	1547	1610	3378	1561
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1558	1770	5017		3433	1863	1547	1610	3378	1561
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	293	1218	746	190	1040	85	546	258	266	172	289	409
RTOR Reduction (vph)	0	0	105	0	5	0	0	0	209	0	0	68
Lane Group Flow (vph)	293	1218	641	190	1120	0	546	258	57	150	311	341
Confl. Peds. (#/hr)			13			10			5			7
Confl. Bikes (#/hr)						2			5			2
Turn Type	Prot	NA	pm+ov	Prot	NA		Split	NA	Perm	Split	NA	pm+ov
Protected Phases	5	2	3	1	6		3	3		4	4	5
Permitted Phases			2						3			4
Actuated Green, G (s)	11.0	50.4	82.7	25.3	64.7		32.3	32.3	32.3	22.0	22.0	33.0
Effective Green, g (s)	11.0	50.4	82.7	25.3	64.7		32.3	32.3	32.3	22.0	22.0	33.0
Actuated g/C Ratio	0.07	0.34	0.55	0.17	0.43		0.22	0.22	0.22	0.15	0.15	0.22
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Vehicle Extension (s)	1.0	1.0	1.5	1.0	1.0		1.5	1.5	1.5	1.0	1.0	1.0
Lane Grp Cap (vph)	251	1189	910	298	2163		739	401	333	236	495	343
v/s Ratio Prot	0.09	c0.34	c0.15	c0.11	0.22		0.16	0.14		0.09	0.09	c0.07
v/s Ratio Perm			0.26						0.04			0.15
v/c Ratio	1.17	1.02	0.70	0.64	0.52		0.74	0.64	0.17	0.64	0.63	0.99
Uniform Delay, d1	69.5	49.8	24.7	58.1	31.2		54.9	53.6	48.0	60.2	60.2	58.4
Progression Factor	0.80	0.71	1.10	0.85	1.49		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	107.5	31.4	1.9	2.3	0.6		3.3	2.6	0.1	4.1	1.8	46.8
Delay (s)	163.3	66.8	29.0	51.6	47.1		58.3	56.2	48.0	64.3	62.0	105.2
Level of Service	F	E	C	D	D		E	E	D	E	E	F
Approach Delay (s)		66.8			47.7			55.2			82.7	
Approach LOS		E			D			E			F	
Intersection Summary												
HCM 2000 Control Delay		62.5										
HCM 2000 Volume to Capacity ratio		0.88										
Actuated Cycle Length (s)		150.0							20.0			
Intersection Capacity Utilization		90.9%							E			
Analysis Period (min)		15										
c Critical Lane Group												

Rohnert Park PDA Plan
PM Peak Hour - Existing plus Project

Synchro 8 Report
W-Trans

HCM Signalized Intersection Capacity Analysis
11: Commerce Blvd & Rohnert Park Expressway

4/16/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔		↔	↔	↔	↔	↔	↔
Volume (vph)	281	1169	716	182	998	82	524	248	255	165	277	393
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0	5.0		5.0	4.0	5.0	4.0	5.0	5.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.91		0.97	1.00	1.00	1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	1.00	0.98	1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1553	1770	5017		3433	1863	1551	1770	3539	1565
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1553	1770	5017		3433	1863	1551	1770	3539	1565
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	293	1218	746	190	1040	85	546	258	266	172	289	409
RTOR Reduction (vph)	0	0	77	0	6	0	0	0	64	0	0	71
Lane Group Flow (vph)	293	1218	669	190	1119	0	546	258	202	172	289	338
Confl. Peds. (#/hr)			13			10			5			7
Confl. Bikes (#/hr)						2			5			2
Turn Type	Prot	NA	pm+ov	Prot	NA		Prot	NA	pm+ov	Prot	NA	pm+ov
Protected Phases	5	2	3	1	6		3	8	1	7	4	5
Permitted Phases			2						8			4
Actuated Green, G (s)	16.5	54.4	85.6	14.0	51.9		31.2	33.6	47.6	18.0	18.4	34.9
Effective Green, g (s)	16.5	54.4	85.6	14.0	51.9		31.2	33.6	47.6	18.0	18.4	34.9
Actuated g/C Ratio	0.12	0.39	0.62	0.10	0.38		0.23	0.24	0.34	0.13	0.13	0.25
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0		5.0	4.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	1.0	1.0	1.5	1.0	1.0		1.5	3.0	1.0	3.0	1.0	1.0
Lane Grp Cap (vph)	410	1395	1019	179	1886		776	453	534	230	471	395
v/s Ratio Prot	0.09	c0.34	c0.15	c0.11	0.22		0.16	0.14	0.04	0.10	0.08	c0.10
v/s Ratio Perm			0.28						0.09			0.11
v/c Ratio	0.71	0.87	0.66	1.06	0.59		0.70	0.57	0.38	0.75	0.61	0.86
Uniform Delay, d1	58.5	38.6	16.8	62.0	34.6		49.1	45.8	34.1	57.8	56.4	49.2
Progression Factor	0.95	0.61	0.55	0.69	0.53		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.5	7.2	1.1	73.3	1.0		2.4	1.6	0.2	12.5	1.7	15.9
Delay (s)	60.3	30.9	10.3	116.2	19.5		51.5	47.5	34.2	70.3	58.1	65.0
Level of Service	E	C	B	F	B		D	D	C	E	E	E
Approach Delay (s)		27.9			33.4			46.3			63.8	
Approach LOS		C			C			D			E	
Intersection Summary												
HCM 2000 Control Delay		38.5								D		
HCM 2000 Volume to Capacity ratio		0.85										
Actuated Cycle Length (s)		138.0							20.0			
Intersection Capacity Utilization		86.5%							E			
Analysis Period (min)		15										
c Critical Lane Group												

Rohnert Park PDA Plan
PM Peak Hour - Existing plus Project (Mitigated)

Synchro 8 Report
W-Trans

HCM Signalized Intersection Capacity Analysis 12: State Farm Dr & Rohnert Park Expressway

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱	↱	↰	↱	↱	↰	↱	↱	↰	↱	↱
Volume (vph)	187	882	256	274	807	95	384	160	216	231	235	181
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.91	0.91	1.00	0.91	0.91	0.91
Frpb, ped/bikes	1.00	1.00	0.97	1.00	1.00	0.98	1.00	1.00	0.98	1.00	0.99	0.99
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.94	0.94
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.97	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3539	1539	1770	3539	1553	1610	3300	1548	1610	3149	3149
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.97	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	3539	1539	1770	3539	1553	1610	3300	1548	1610	3149	3149
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	212	1002	291	311	917	108	436	182	245	262	267	206
RTOR Reduction (vph)	0	0	222	0	0	61	0	0	202	0	80	0
Lane Group Flow (vph)	212	1002	69	311	917	47	218	400	43	236	419	0
Confl. Peds. (#/hr)			12			5			10			4
Confl. Bikes (#/hr)			1			1						1
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Split	NA	Perm	Split	NA	
Protected Phases	5	2		1	6		3	3		4	4	
Permitted Phases			2			6			3			
Actuated Green, G (s)	29.6	35.4	35.4	38.9	44.7	44.7	26.4	26.4	26.4	29.3	29.3	
Effective Green, g (s)	29.6	35.4	35.4	38.9	44.7	44.7	26.4	26.4	26.4	29.3	29.3	
Actuated g/C Ratio	0.20	0.24	0.24	0.26	0.30	0.30	0.18	0.18	0.18	0.20	0.20	
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
Lane Grp Cap (vph)	349	835	363	459	1054	462	283	580	272	314	615	
v/s Ratio Prot	0.12	c0.28		c0.18	c0.26		c0.14	0.12		c0.15	0.13	
v/s Ratio Perm			0.05			0.03			0.03			
v/c Ratio	0.61	1.20	0.19	0.68	0.87	0.10	0.77	0.69	0.16	0.75	0.68	
Uniform Delay, d1	54.9	57.3	45.8	49.9	49.9	38.1	58.9	58.0	52.4	56.9	56.0	
Progression Factor	1.57	0.46	0.36	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	1.0	95.9	0.6	3.1	9.8	0.4	11.2	2.7	0.1	8.7	2.5	
Delay (s)	87.1	122.3	16.9	53.0	59.7	38.6	70.1	60.7	52.5	65.6	58.5	
Level of Service	F	F	B	D	E	D	E	D	E	E	E	
Approach Delay (s)		97.0			56.4			60.7			60.8	
Approach LOS		F			E			E			E	
Intersection Summary												
HCM 2000 Control Delay		71.7			HCM 2000 Level of Service			E				
HCM 2000 Volume to Capacity ratio		0.86										
Actuated Cycle Length (s)		150.0			Sum of lost time (s)			20.0				
Intersection Capacity Utilization		94.0%			ICU Level of Service			F				
Analysis Period (min)		15										
c Critical Lane Group												

Rohnert Park PDA Plan
PM Peak Hour - Existing plus Project

Synchro 8 Report
W-Trans

HCM Signalized Intersection Capacity Analysis 12: State Farm Dr & Rohnert Park Expressway

4/16/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱	↱	↰	↱	↱	↰	↱	↱	↰	↱	↱
Volume (vph)	187	882	256	274	807	95	384	160	216	231	235	181
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	12	12	12	12	12	12	12	12	12	11	11	11
Lane Width	12	12	12	12	12	12	12	12	12	12	11	11
Total Lost time (s)	5.0	5.0	4.0	5.0	5.0	4.0	4.0	4.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00	0.97	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.97	1.00	1.00	0.98	1.00	1.00	0.99	1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3539	1534	1770	3539	1550	3433	1863	1565	3319	1801	1516
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	3539	1534	1770	3539	1550	3433	1863	1565	3319	1801	1516
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	212	1002	291	311	917	108	436	182	245	262	267	206
RTOR Reduction (vph)	0	0	116	0	0	50	0	0	30	0	0	31
Lane Group Flow (vph)	212	1002	175	311	917	58	436	182	215	262	267	175
Confl. Peds. (#/hr)			12			5			10			4
Confl. Bikes (#/hr)			1			1						1
Turn Type	Prot	NA	pm+ov	Prot	NA	pm+ov	Prot	NA	pm+ov	Prot	NA	pm+ov
Protected Phases	5	2	3	1	6	7	3	8	1	7	4	5
Permitted Phases			2			6			8			4
Actuated Green, G (s)	21.0	45.7	67.6	24.0	48.7	74.3	21.9	24.7	48.7	25.6	27.4	48.4
Effective Green, g (s)	21.0	45.7	67.6	24.0	48.7	74.3	21.9	24.7	48.7	25.6	27.4	48.4
Actuated g/C Ratio	0.15	0.33	0.49	0.17	0.35	0.54	0.16	0.18	0.35	0.19	0.20	0.35
Clearance Time (s)	5.0	5.0	4.0	5.0	5.0	4.0	4.0	4.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	1.0	1.0	3.0	1.0	1.0	3.0	3.0	3.0	1.0	3.0	1.0	1.0
Lane Grp Cap (vph)	269	1171	795	307	1248	879	544	333	608	615	357	586
v/s Ratio Prot	0.12	c0.28	0.03	c0.18	0.26	0.01	c0.13	0.10	0.06	c0.08	c0.15	0.05
v/s Ratio Perm			0.08			0.03			0.08			0.07
v/c Ratio	0.79	0.86	0.22	1.01	0.73	0.07	0.80	0.55	0.35	0.43	0.75	0.30
Uniform Delay, d1	56.4	43.1	20.1	57.0	39.0	15.2	56.0	51.6	33.0	49.7	52.0	32.5
Progression Factor	0.83	0.64	0.39	0.76	0.67	0.22	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	8.3	5.1	0.1	53.1	3.6	0.0	8.3	1.8	0.1	0.5	7.3	0.1
Delay (s)	55.3	32.6	8.0	96.2	29.6	3.3	64.3	53.4	33.1	50.2	59.4	32.6
Level of Service	E	C	A	F	C	A	E	D	C	D	E	C
Approach Delay (s)		31.1			43.0			53.1			48.6	
Approach LOS		C			D			D			D	
Intersection Summary												
HCM 2000 Control Delay		41.8			HCM 2000 Level of Service			D				
HCM 2000 Volume to Capacity ratio		0.85										
Actuated Cycle Length (s)		138.0			Sum of lost time (s)			19.0				
Intersection Capacity Utilization		83.4%			ICU Level of Service			E				
Analysis Period (min)		15										
c Critical Lane Group												

Rohnert Park PDA Plan
PM Peak Hour - Existing plus Project (Mitigated)

Synchro 8 Report
W-Trans

HCM Signalized Intersection Capacity Analysis 13: Commerce Blvd & Enterprise Dr

4/15/2015

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↔↔	↔	↔↔		↔	↔↔
Volume (vph)	175	56	605	94	48	682
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	0.97	1.00	0.95		1.00	0.95
Frt	1.00	0.85	0.98		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	3433	1583	3468		1770	3539
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	3433	1583	3468		1770	3539
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	186	60	644	100	51	726
RTOR Reduction (vph)	0	48	17	0	0	0
Lane Group Flow (vph)	186	12	727	0	51	726
Turn Type	Prot	Perm	NA		Prot	NA
Protected Phases	8		2		1	6
Permitted Phases		8				
Actuated Green, G (s)	7.7	7.7	16.8		1.1	21.9
Effective Green, g (s)	7.7	7.7	16.8		1.1	21.9
Actuated g/C Ratio	0.20	0.20	0.45		0.03	0.58
Clearance Time (s)	4.0	4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	703	324	1549		51	2061
v/s Ratio Prot	c0.05		c0.21		c0.03	0.21
v/s Ratio Perm		0.01				
v/c Ratio	0.26	0.04	0.47		1.00	0.35
Uniform Delay, d1	12.6	12.0	7.3		18.2	4.1
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	0.2	0.0	0.2		126.0	0.1
Delay (s)	12.8	12.0	7.5		144.3	4.2
Level of Service	B	B	A		F	A
Approach Delay (s)	12.6		7.5			13.4
Approach LOS	B		A			B
Intersection Summary						
HCM 2000 Control Delay			10.8		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.43			
Actuated Cycle Length (s)			37.6		Sum of lost time (s)	12.0
Intersection Capacity Utilization			38.0%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						

HCM Unsignalized Intersection Capacity Analysis 14: Enterprise Dr & Hunter Dr

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔↔			↔↔			↔↔			↔↔	
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	2	146	2	7	179	132	2	3	0	223	2	30
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	2	154	2	7	188	139	2	3	0	235	2	32
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1						
Volume Total (vph)	79	79	102	233	5	268						
Volume Left (vph)	2	0	7	0	2	235						
Volume Right (vph)	0	2	0	139	0	32						
Hadj (s)	0.05	0.02	0.07	-0.38	0.11	0.14						
Departure Headway (s)	5.7	5.7	5.6	5.1	5.6	5.2						
Degree Utilization, x	0.13	0.12	0.16	0.33	0.01	0.39						
Capacity (veh/h)	590	597	618	678	571	653						
Control Delay (s)	8.3	8.3	8.4	9.4	8.7	11.5						
Approach Delay (s)	8.3		9.1		8.7	11.5						
Approach LOS	A		A		A	B						
Intersection Summary												
Delay					9.8							
Level of Service					A							
Intersection Capacity Utilization				42.1%		ICU Level of Service				A		
Analysis Period (min)					15							

HCM Unsignalized Intersection Capacity Analysis
14: Enterprise Dr & Hunter Dr

4/16/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control	Stop				Stop			Stop			Stop	
Volume (vph)	2	146	2	7	179	132	2	3	0	223	2	30
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	2	154	2	7	188	139	2	3	0	235	2	32
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1						
Volume Total (vph)	2	156	196	139	5	268						
Volume Left (vph)	2	0	7	0	2	235						
Volume Right (vph)	0	2	0	139	0	32						
Hadj (s)	0.53	0.02	0.05	-0.67	0.11	0.14						
Departure Headway (s)	6.2	5.7	5.5	4.8	5.7	5.2						
Degree Utilization, x	0.00	0.25	0.30	0.19	0.01	0.39						
Capacity (veh/h)	544	598	622	713	567	650						
Control Delay (s)	8.0	9.3	9.7	7.7	8.7	11.5						
Approach Delay (s)	9.3		8.9		8.7	11.5						
Approach LOS	A		A		A	B						
Intersection Summary												
Delay			9.9									
Level of Service			A									
Intersection Capacity Utilization			42.7%		ICU Level of Service				A			
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis
15: Enterprise Dr & State Farm Dr

4/15/2015

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↱	↰	↱	↰	↱
Sign Control	Stop		Stop		Stop	
Volume (vph)	107	248	167	318	528	152
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	115	267	180	342	568	163
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total (vph)	115	267	120	402	568	163
Volume Left (vph)	115	0	0	0	568	0
Volume Right (vph)	0	0	0	342	0	163
Hadj (s)	0.53	0.03	0.03	-0.56	0.53	-0.67
Departure Headway (s)	8.0	7.5	7.3	6.8	7.6	6.4
Degree Utilization, x	0.26	0.56	0.24	0.75	1.0	0.29
Capacity (veh/h)	440	463	480	523	479	550
Control Delay (s)	12.5	18.3	11.5	26.4	132.0	10.8
Approach Delay (s)	16.6		23.0		104.9	
Approach LOS	C		C		F	
Intersection Summary						
Delay			58.1			
Level of Service			F			
Intersection Capacity Utilization			60.0%		ICU Level of Service	
Analysis Period (min)			15		B	

HCM Signalized Intersection Capacity Analysis
15: Enterprise Dr & State Farm Dr

4/16/2015

	EBL	EBT	WBT	WBR	SBL	SBR
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑	↑	↱	↰	↱
Volume (vph)	107	248	167	318	528	152
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Flt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1863	1863	1583	1770	1583
Flt Permitted	0.64	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1199	1863	1863	1583	1770	1583
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	115	267	180	342	568	163
RTOR Reduction (vph)	0	0	0	233	0	86
Lane Group Flow (vph)	115	267	180	109	568	77
Turn Type	Perm	NA	NA	Perm	Prot	Perm
Protected Phases		2	6		4	
Permitted Phases	2			6		4
Actuated Green, G (s)	12.1	12.1	12.1	12.1	17.9	17.9
Effective Green, g (s)	12.1	12.1	12.1	12.1	17.9	17.9
Actuated g/C Ratio	0.32	0.32	0.32	0.32	0.47	0.47
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	381	593	593	504	833	745
v/s Ratio Prot		c0.14	0.10		c0.32	
v/s Ratio Perm	0.10			0.07		0.05
v/c Ratio	0.30	0.45	0.30	0.22	0.68	0.10
Uniform Delay, d1	9.8	10.3	9.8	9.5	7.8	5.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.4	0.5	0.3	0.2	2.3	0.1
Delay (s)	10.2	10.8	10.1	9.7	10.1	5.6
Level of Service	B	B	B	A	B	A
Approach Delay (s)		10.7	9.8		9.1	
Approach LOS		B	A		A	
Intersection Summary						
HCM 2000 Control Delay		9.7		HCM 2000 Level of Service		A
HCM 2000 Volume to Capacity ratio		0.59				
Actuated Cycle Length (s)		38.0		Sum of lost time (s)		8.0
Intersection Capacity Utilization		54.0%		ICU Level of Service		A
Analysis Period (min)		15				
c Critical Lane Group						

HCM Unsignalized Intersection Capacity Analysis
16: Enterprise Dr/Seed Farm Dr

4/15/2015

	EBL	EBT	WBT	WBR	SBL	SBR
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰	↱		↰	↱
Volume (veh/h)	1	685	401	0	1	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1	745	436	0	1	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	436				1183	436
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	436				1183	436
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				99	100
cM capacity (veh/h)	1124				209	620
Direction, Lane #						
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	746	436	1			
Volume Left	1	0	1			
Volume Right	0	0	0			
cSH	1124	1700	209			
Volume to Capacity	0.00	0.26	0.01			
Queue Length 95th (ft)	0	0	0			
Control Delay (s)	0.0	0.0	22.3			
Lane LOS	A		C			
Approach Delay (s)	0.0	0.0	22.3			
Approach LOS			C			
Intersection Summary						
Average Delay		0.0				
Intersection Capacity Utilization		46.8%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
17: State Farm Dr & Town Center

4/15/2015

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Movement												
Lane Configurations		↔			↔			↕			↕	
Volume (veh/h)	159	6	65	26	6	148	33	428	28	149	539	113
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	173	7	71	28	7	161	36	465	30	162	586	123
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)											575	
pX, platoon unblocked												
vC, conflicting volume	1440	1539	354	1243	1585	248	709			496		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1440	1539	354	1243	1585	248	709			496		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	93	89	70	93	79	96			85		
cM capacity (veh/h)	59	93	642	95	87	752	886			1064		
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3				
Volume Total	250	196	36	310	186	162	391	318				
Volume Left	173	28	36	0	0	162	0	0				
Volume Right	71	161	0	0	30	0	0	123				
cSH	81	333	886	1700	1700	1064	1700	1700				
Volume to Capacity	3.09	0.59	0.04	0.18	0.11	0.15	0.23	0.19				
Queue Length 95th (ft)	Err	89	3	0	0	13	0	0				
Control Delay (s)	Err	30.1	9.2	0.0	0.0	9.0	0.0	0.0				
Lane LOS	F	D	A			A						
Approach Delay (s)	Err	30.1	0.6			1.7						
Approach LOS	F	D										
Intersection Summary												
Average Delay			1357.0									
Intersection Capacity Utilization			59.1%		ICU Level of Service				B			
Analysis Period (min)			15									

HCM Signalized Intersection Capacity Analysis
17: State Farm Dr & Town Center

4/16/2015

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Movement												
Lane Configurations		↔	↔		↔	↔		↕			↕	
Volume (vph)	159	6	65	26	6	148	33	428	28	149	539	113
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0
Lane Util. Factor		1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00
Frt		1.00	0.85		1.00	0.85		1.00	1.00	0.85	1.00	0.85
Flt Protected		0.95	1.00		0.96	1.00		0.95	1.00	1.00	0.95	1.00
Satd. Flow (prot)		1777	1583		1791	1583		1770	1863	1583	1770	1863
Flt Permitted		0.71	1.00		0.74	1.00		0.95	1.00	1.00	0.95	1.00
Satd. Flow (perm)		1320	1583		1386	1583		1770	1863	1583	1770	1863
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	173	7	71	28	7	161	36	465	30	162	586	123
RTOR Reduction (vph)	0	0	56	0	0	126	0	0	18	0	0	45
Lane Group Flow (vph)	0	180	15	0	35	35	36	465	12	162	586	78
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8		2				6
Actuated Green, G (s)		11.4	11.4		11.4	11.4	1.3	21.7	21.7	7.6	28.0	28.0
Effective Green, g (s)		11.4	11.4		11.4	11.4	1.3	21.7	21.7	7.6	28.0	28.0
Actuated g/C Ratio		0.22	0.22		0.22	0.22	0.02	0.41	0.41	0.14	0.53	0.53
Clearance Time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)		285	342		299	342	43	767	651	255	989	841
v/s Ratio Prot							0.02	0.25		c0.09	c0.31	
v/s Ratio Perm		c0.14	0.01		0.03	0.02			0.01			0.05
v/c Ratio		0.63	0.04		0.12	0.10	0.84	0.61	0.02	0.64	0.59	0.09
Uniform Delay, d1		18.7	16.3		16.6	16.5	25.6	12.2	9.2	21.2	8.4	6.1
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		4.5	0.1		0.2	0.1	76.6	1.4	0.0	5.1	1.0	0.0
Delay (s)		23.3	16.4		16.8	16.7	102.2	13.5	9.2	26.3	9.4	6.1
Level of Service		C	B		B	B	F	B	A	C	A	A
Approach Delay (s)		21.3			16.7			19.3			12.1	
Approach LOS		C			B			B			B	
Intersection Summary												
HCM 2000 Control Delay		15.9					HCM 2000 Level of Service		B			
HCM 2000 Volume to Capacity ratio		0.65										
Actuated Cycle Length (s)		52.7					Sum of lost time (s)		12.0			
Intersection Capacity Utilization		57.5%					ICU Level of Service		B			
Analysis Period (min)		15										
c Critical Lane Group												

Appendix D

Future plus Project Intersection LOS Calculations

HCM Signalized Intersection Capacity Analysis

1: US 101 South Ramps & Golf Course Drive West/Golf Course Dr

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↑	↑	↑↑					↑	↑	↑
Volume (vph)	0	475	259	300	850	0	0	0	0	445	133	521
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	3.0	4.0					3.0	3.0	3.0
Lane Util. Factor		0.95	1.00	0.97	0.95					1.00	0.95	0.95
Flt		1.00	0.85	1.00	1.00					1.00	0.91	0.85
Flt Protected		1.00	1.00	0.95	1.00					0.95	1.00	1.00
Satd. Flow (prot)		3539	1583	3433	3539					1770	1609	1504
Flt Permitted		1.00	1.00	0.95	1.00					0.95	1.00	1.00
Satd. Flow (perm)		3539	1583	3433	3539					1770	1609	1504
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	500	273	316	895	0	0	0	0	468	140	548
RTOR Reduction (vph)	0	0	155	0	0	0	0	0	0	0	58	60
Lane Group Flow (vph)	0	500	118	316	895	0	0	0	0	468	296	274
Turn Type	NA	Perm	Perm	Prot	NA					Split	NA	Perm
Protected Phases	6			5	2					8	8	
Permitted Phases			6									8
Actuated Green, G (s)	48.6	48.6	13.7	65.3						39.7	39.7	39.7
Effective Green, g (s)	48.6	48.6	13.7	65.3						39.7	39.7	39.7
Actuated g/C Ratio	0.43	0.43	0.12	0.58						0.35	0.35	0.35
Clearance Time (s)	4.0	4.0	3.0	4.0						3.0	3.0	3.0
Vehicle Extension (s)	1.5	1.5	1.0	1.5						1.5	1.5	1.5
Lane Grp Cap (vph)	1535	686	419	2063						627	570	533
v/s Ratio Prot	0.14		c0.09	c0.25						c0.26	0.18	
v/s Ratio Perm		0.07										0.18
v/c Ratio	0.33	0.17	0.75	0.43						0.75	0.52	0.51
Uniform Delay, d1	20.9	19.4	47.5	13.0						31.7	28.6	28.5
Progression Factor	0.70	1.33	1.00	1.00						1.00	1.00	1.00
Incremental Delay, d2	0.5	0.5	6.7	0.7						4.2	0.3	0.3
Delay (s)	15.1	26.2	54.2	13.7						36.0	28.9	28.9
Level of Service	B	C	D	B						D	C	C
Approach Delay (s)	19.0			24.3			0.0			31.8		
Approach LOS	B			C			A			C		
Intersection Summary												
HCM 2000 Control Delay		25.7										C
HCM 2000 Volume to Capacity ratio		0.61										
Actuated Cycle Length (s)		112.0					10.0					
Intersection Capacity Utilization		56.3%										B
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: Commerce Blvd & Golf Course Drive

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑	↑	↑	↑↑					↑	↑	↑
Volume (vph)	56	259	588	454	638	76	449	87	213	59	104	35
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	12	12	13	12	12	12
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	0.91	1.00	0.97	0.95		0.97	1.00	1.00	1.00	1.00	
Flrb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Flt	1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85	1.00	0.96	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5085	1583	3433	3472		3433	1863	1636	1770	1786	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	5085	1583	3433	3472		3433	1863	1636	1770	1786	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	59	273	619	478	672	80	473	92	224	62	109	37
RTOR Reduction (vph)	0	0	324	0	7	0	0	0	131	0	11	0
Lane Group Flow (vph)	59	273	295	478	745	0	473	92	93	62	135	0
Confl. Peds. (#/hr)						5						1
Confl. Bikes (#/hr)						1						
Turn Type	Prot	NA	pm+ov	Prot	NA		Split	NA	pm+ov	Split	NA	
Protected Phases	1	6	4	5	2		4	4	5	3	3	
Permitted Phases			6						4			
Actuated Green, G (s)	6.0	17.0	35.9	15.9	26.9		18.9	18.9	34.8	16.0	16.0	
Effective Green, g (s)	6.0	17.0	35.9	15.9	26.9		18.9	18.9	34.8	16.0	16.0	
Actuated g/C Ratio	0.07	0.20	0.43	0.19	0.32		0.23	0.23	0.42	0.19	0.19	
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	1.0	1.5	1.5	1.0	1.5		1.5	1.5	1.0	1.5	1.5	
Lane Grp Cap (vph)	126	1031	678	651	1114		774	420	757	337	341	
v/s Ratio Prot	0.03	0.05	0.10	c0.14	c0.21		c0.14	0.05	0.02	0.04	c0.08	
v/s Ratio Perm			0.09						0.03			
v/c Ratio	0.47	0.26	0.43	0.73	0.67		0.61	0.22	0.12	0.18	0.39	
Uniform Delay, d1	37.4	28.1	16.8	32.0	24.6		29.1	26.4	15.1	28.4	29.7	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	1.0	0.1	0.2	3.7	1.2		1.0	0.1	0.0	0.1	0.3	
Delay (s)	38.4	28.2	17.0	35.7	25.8		30.2	26.5	15.1	28.5	29.9	
Level of Service	D	C	B	D	C		C	C	B	C	C	
Approach Delay (s)		21.5			29.6			25.5			29.5	
Approach LOS		C			C			C			C	
Intersection Summary												
HCM 2000 Control Delay		26.2										C
HCM 2000 Volume to Capacity ratio		0.63										
Actuated Cycle Length (s)		83.8							16.0			
Intersection Capacity Utilization		69.4%										C
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis 3: Commerce Blvd & US 101 North Ramps

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱	↲	↰	↱	↲	↰	↱	↲	↰	↱	↲
Volume (vph)	354	4	63	1	1	2	176	396	5	4	683	441
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	14	12	16	12	12	12	12	12	12	12	12	12
Total Lost time (s)	4.0	4.0	3.0		3.0		3.0	4.0		3.0	4.0	4.0
Lane Util. Factor	0.95	0.95	1.00		1.00		1.00	0.95		1.00	0.95	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85		0.93		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	0.95	1.00		0.99		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1793	1687	1794		1716		1770	3532		1770	3539	1583
Flt Permitted	0.95	0.95	1.00		0.99		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1793	1687	1794		1716		1770	3532		1770	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	373	4	66	1	1	2	185	417	5	4	719	464
RTOR Reduction (vph)	0	0	46	0	2	0	0	1	0	0	0	0
Lane Group Flow (vph)	190	187	20	0	2	0	185	421	0	4	719	464
Confl. Peds. (#/hr)									2			
Turn Type	Split	NA	pm+ov	Split	NA		Prot	NA		Prot	NA	Free
Protected Phases	8	8	1	7	7		1	6		5	2	
Permitted Phases			8									Free
Actuated Green, G (s)	8.0	8.0	15.5		0.6		7.5	28.4		0.6	21.5	51.6
Effective Green, g (s)	8.0	8.0	15.5		0.6		7.5	28.4		0.6	21.5	51.6
Actuated g/C Ratio	0.16	0.16	0.30		0.01		0.15	0.55		0.01	0.42	1.00
Clearance Time (s)	4.0	4.0	3.0		3.0		3.0	4.0		3.0	4.0	
Vehicle Extension (s)	2.0	2.0	2.0		4.0		2.0	2.0		2.0	4.0	
Lane Grp Cap (vph)	277	261	538		19		257	1943		20	1474	1583
v/s Ratio Prot	0.11	c0.11	0.01		0.00		c0.10	0.12		0.00	c0.20	
v/s Ratio Perm			0.01									c0.29
v/c Ratio	0.69	0.72	0.04		0.11		0.72	0.22		0.20	0.49	0.29
Uniform Delay, d1	20.6	20.7	12.8		25.2		21.0	5.9		25.3	11.0	0.0
Progression Factor	1.00	1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	5.5	7.6	0.0		3.4		7.8	0.0		1.8	0.3	0.5
Delay (s)	26.1	28.3	12.8		28.6		28.8	5.9		27.1	11.4	0.5
Level of Service	C	C	B		C		C	A		C	B	A
Approach Delay (s)		25.1			28.6			12.9			7.2	
Approach LOS		C			C			B			A	
Intersection Summary												
HCM 2000 Control Delay		12.3										
HCM 2000 Volume to Capacity ratio		0.61										
Actuated Cycle Length (s)		51.6						14.0				
Intersection Capacity Utilization		55.2%						B				
Analysis Period (min)		15										
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis 4: Commerce Blvd & State Farm Dr

4/15/2015

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↲	↲	↰	↱
Volume (veh/h)	17	402	178	31	410	309
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	18	423	187	33	432	325
Pedestrians	5		5			5
Lane Width (ft)	12.0		12.0			12.0
Walking Speed (ft/s)	4.0		4.0			4.0
Percent Blockage	0		0			0
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1402	214			225	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1402	214			225	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	83	48			68	
cM capacity (veh/h)	104	819			1338	
Direction, Lane #						
Volume Total	441	220	432	325		
Volume Left	18	0	432	0		
Volume Right	423	33	0	0		
cSH	640	1700	1338	1700		
Volume to Capacity	0.69	0.13	0.32	0.19		
Queue Length 95th (ft)	136	0	35	0		
Control Delay (s)	22.1	0.0	9.0	0.0		
Lane LOS	C		A			
Approach Delay (s)	22.1	0.0	5.1			
Approach LOS	C					
Intersection Summary						
Average Delay		9.6				
Intersection Capacity Utilization		70.7%			ICU Level of Service	C
Analysis Period (min)		15				

HCM Signalized Intersection Capacity Analysis 4: Commerce Blvd & State Farm Dr

4/15/2015

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↰	↰		↰	↰
Volume (vph)	17	402	178	31	410	309
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5		4.5	4.5
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Flt	1.00	0.85	0.98		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	1583	1825		1770	1863
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1770	1583	1825		1770	1863
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	18	423	187	33	432	325
RTOR Reduction (vph)	0	233	9	0	0	0
Lane Group Flow (vph)	18	190	211	0	432	325
Turn Type	Prot	pm+ov	NA		Prot	NA
Protected Phases	8	1	2		1	6
Permitted Phases		8				
Actuated Green, G (s)	3.3	21.1	12.4		17.8	34.7
Effective Green, g (s)	3.3	21.1	12.4		17.8	34.7
Actuated g/C Ratio	0.07	0.45	0.26		0.38	0.74
Clearance Time (s)	4.5	4.5	4.5		4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	124	862	481		670	1375
v/s Ratio Prot	0.01	c0.08	c0.12		c0.24	0.17
v/s Ratio Perm		0.04				
v/c Ratio	0.15	0.22	0.44		0.64	0.24
Uniform Delay, d1	20.5	7.9	14.4		12.0	1.9
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	0.5	0.1	0.6		2.1	0.1
Delay (s)	21.1	8.0	15.0		14.1	2.0
Level of Service	C	A	B		B	A
Approach Delay (s)	8.6		15.0			8.9
Approach LOS	A		B			A
Intersection Summary						
HCM 2000 Control Delay			9.8		HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio			0.54			
Actuated Cycle Length (s)			47.0		Sum of lost time (s)	13.5
Intersection Capacity Utilization			48.5%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						

HCM Unsignalized Intersection Capacity Analysis 5: State Farm Dr & Professional Center Dr

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↰	↰	↰	↰	↰	↰	↰	↰	↰	↰	↰
Volume (veh/h)	34	10	34	17	2	5	63	380	28	20	333	18
Sign Control	Stop			Stop			Free			Free		
Grade	0%			0%			0%			0%		
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	36	11	36	18	2	5	66	400	29	21	351	19
Pedestrians		5			5			5			5	
Lane Width (ft)	12.0			12.0			12.0			12.0		
Walking Speed (ft/s)	4.0			4.0			4.0			4.0		
Percent Blockage	0			0			0			0		
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	751	974	195	816	969	225	374			434		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	751	974	195	816	969	225	374			434		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	87	95	96	92	99	99	94			98		
cM capacity (veh/h)	275	230	807	231	231	772	1176			1117		
Direction, Lane #												
Volume Total	36	46	25	66	267	163	21	234	136			
Volume Left	36	0	18	66	0	0	21	0	0			
Volume Right	0	36	5	0	0	29	0	0	19			
cSH	275	514	270	1176	1700	1700	1117	1700	1700			
Volume to Capacity	0.13	0.09	0.09	0.06	0.16	0.10	0.02	0.14	0.08			
Queue Length 95th (ft)	11	7	8	4	0	0	1	0	0			
Control Delay (s)	20.1	12.7	19.7	8.2	0.0	0.0	8.3	0.0	0.0			
Lane LOS	C	B	C	A			A					
Approach Delay (s)	15.9		19.7	1.1			0.4					
Approach LOS	C		C									
Intersection Summary												
Average Delay			2.5									
Intersection Capacity Utilization			34.0%				ICU Level of Service			A		
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis
5: State Farm Dr & Professional Center Dr

4/15/2015

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱		↰	↱	
Volume (veh/h)	34	10	34	17	2	5	63	380	28	20	333	18
Sign Control	Stop			Stop			Free			Free		
Grade	0%			0%			0%			0%		
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	36	11	36	18	2	5	66	400	29	21	351	19
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type							None			None		
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	941	964	360	981	959	415	369			429		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	941	964	360	981	959	415	369			429		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	84	96	95	91	99	99	94			98		
cM capacity (veh/h)	226	236	684	198	238	638	1189			1130		
Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2	SB 1	SB 2					
Volume Total	36	46	25	66	429	21	369					
Volume Left	36	0	18	66	0	21	0					
Volume Right	0	36	5	0	29	0	19					
cSH	226	478	235	1189	1700	1130	1700					
Volume to Capacity	0.16	0.10	0.11	0.06	0.25	0.02	0.22					
Queue Length 95th (ft)	14	8	9	4	0	1	0					
Control Delay (s)	23.9	13.3	22.2	8.2	0.0	8.2	0.0					
Lane LOS	C	B	C	A		A						
Approach Delay (s)	17.9		22.2	1.1		0.4						
Approach LOS	C		C									
Intersection Summary												
Average Delay			2.8									
Intersection Capacity Utilization			43.0%		ICU Level of Service		A					
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis
6: Commerce Blvd & Professional Center Dr

4/15/2015

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱		↰	↱	
Volume (veh/h)	45	200	0	22	178	91	0	50	62	65	34	16
Sign Control	Free			Free			Stop			Stop		
Grade	0%			0%			0%			0%		
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	47	211	0	23	187	96	0	53	65	68	36	17
Pedestrians		5			5			5			5	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		4.0			4.0			4.0			4.0	
Percent Blockage		0			0			0			0	
Right turn flare (veh)												
Median type		None			TWLT							
Median storage (veh)					2							
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	288			216			584	645	221	688	597	245
vC1, stage 1 conf vol							310	310		287	287	
vC2, stage 2 conf vol							273	334		402	310	
vCu, unblocked vol	288			216			584	645	221	688	597	245
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)							6.1	5.5		6.1	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	96			98			100	90	92	85	93	98
cM capacity (veh/h)	1268			1349			537	512	812	446	538	787
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1	SB 2					
Volume Total	47	211	23	283	118	68	53					
Volume Left	47	0	23	0	0	68	0					
Volume Right	0	0	0	96	65	0	17					
cSH	1268	1700	1349	1700	644	446	598					
Volume to Capacity	0.04	0.12	0.02	0.17	0.18	0.15	0.09					
Queue Length 95th (ft)	3	0	1	0	17	13	7					
Control Delay (s)	7.9	0.0	7.7	0.0	11.8	14.5	11.6					
Lane LOS	A		A		B	B	B					
Approach Delay (s)	1.5		0.6		11.8	13.3						
Approach LOS					B	B						
Intersection Summary												
Average Delay			4.4									
Intersection Capacity Utilization			39.2%		ICU Level of Service		A					
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis
7: Commerce Blvd & Padre Pkwy

4/15/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	22	5	59	76	3	16	57	442	157	25	258	13
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	23	5	62	80	3	17	60	465	165	26	272	14
Pedestrians		5			5			5			5	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		4.0			4.0			4.0			4.0	
Percent Blockage		0			0			0			0	
Right turn flare (veh)												
Median type								TWLT			TWLT	
Median storage (veh)								2			2	
Upstream signal (ft)								480				
pX, platoon unblocked												
vC, conflicting volume	712	1092	153	931	1016	325	290			636		
vC1, stage 1 conf vol	336	336		673	673							
vC2, stage 2 conf vol	376	756		258	343							
vCu, unblocked vol	712	1092	153	931	1016	325	290			636		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)	6.5	5.5		6.5	5.5							
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	95	98	93	77	99	97	95			97		
cM capacity (veh/h)	469	341	859	352	379	665	1263			940		
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3				
Volume Total	91	100	60	310	320	26	181	104				
Volume Left	23	80	60	0	0	26	0	0				
Volume Right	62	17	0	0	165	0	0	14				
cSH	660	383	1263	1700	1700	940	1700	1700				
Volume to Capacity	0.14	0.26	0.05	0.18	0.19	0.03	0.11	0.06				
Queue Length 95th (ft)	12	26	4	0	0	2	0	0				
Control Delay (s)	11.3	17.7	8.0	0.0	0.0	8.9	0.0	0.0				
Lane LOS	B	C	A			A						
Approach Delay (s)	11.3	17.7	0.7			0.8						
Approach LOS	B	C										
Intersection Summary												
Average Delay	2.9											
Intersection Capacity Utilization	43.0%			ICU Level of Service					A			
Analysis Period (min)	15											

HCM Signalized Intersection Capacity Analysis
7: Commerce Blvd & Padre Pkwy

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔		↔	↑	↗	↖	↗	↖
Volume (vph)	22	5	59	76	3	16	57	442	157	25	258	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5			4.5			4.5			4.5		
Lane Util. Factor	1.00			1.00			1.00			1.00		
Flpb, ped/bikes	0.92			0.98			1.00			0.89		
Flpb, ped/bikes	0.99			0.98			1.00			1.00		
Frt	0.91			0.98			1.00			0.85		
Flt Protected	0.99			0.96			0.95			1.00		
Satd. Flow (prot)	1512			1673			1770			1863		
Flt Permitted	0.90			0.79			0.95			1.00		
Satd. Flow (perm)	1375			1381			1770			1863		
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	23	5	62	80	3	17	60	465	165	26	272	14
RTOR Reduction (vph)	0	51	0	0	14	0	0	0	76	0	2	0
Lane Group Flow (vph)	0	39	0	0	86	0	60	465	89	26	284	0
Confl. Peds. (#/hr)	50		50		50		50		50		50	
Confl. Bikes (#/hr)	20		20		20		20		20		20	
Turn Type	Perm	NA		Perm	NA		Prot	NA	Perm	Prot	NA	
Protected Phases	4		8		8		5		2		1	
Permitted Phases	4		8		8		2		2		6	
Actuated Green, G (s)	8.8		8.8		8.8		1.9		27.5		1.2	
Effective Green, g (s)	8.8		8.8		8.8		1.9		27.5		1.2	
Actuated g/C Ratio	0.17		0.17		0.17		0.04		0.54		0.02	
Clearance Time (s)	4.5		4.5		4.5		4.5		4.5		4.5	
Vehicle Extension (s)	3.0		3.0		3.0		3.0		3.0		3.0	
Lane Grp Cap (vph)	237		238		238		65		1004		762	
v/s Ratio Prot							c0.03		c0.25		0.01	
v/s Ratio Perm	0.03		c0.06		c0.06				0.06			
v/c Ratio	0.16		0.36		0.36		0.92		0.46		0.12	
Uniform Delay, d1	18.0		18.6		18.6		24.5		7.2		5.8	
Progression Factor	1.00		1.00		1.00		1.00		1.00		1.00	
Incremental Delay, d2	0.3		0.9		0.9		84.3		1.5		0.3	
Delay (s)	18.3		19.6		19.6		108.8		8.8		6.1	
Level of Service	B		B		B		F		A		D	
Approach Delay (s)	18.3		19.6		19.6		16.8		16.8		11.3	
Approach LOS	B		B		B		B		B		B	
Intersection Summary												
HCM 2000 Control Delay	15.7		15.7		15.7		15.7		15.7		B	
HCM 2000 Volume to Capacity ratio	0.47		0.47		0.47		0.47		0.47		0.47	
Actuated Cycle Length (s)	51.0		51.0		51.0		51.0		51.0		13.5	
Intersection Capacity Utilization	55.1%		55.1%		55.1%		55.1%		55.1%		B	
Analysis Period (min)	15		15		15		15		15		15	
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis
8: State Farm Dr & City Center Dr

4/15/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	16	10	85	90	4	38	60	529	142	49	195	13
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	17	11	89	95	4	40	63	557	149	52	205	14
Pedestrians		5			5			5			5	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		4.0			4.0			4.0			4.0	
Percent Blockage		0			0			0			0	
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)								456				
pX, platoon unblocked												
vC, conflicting volume	772	1158	119	1068	1090	363	224			711		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	772	1158	119	1068	1090	363	224			711		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	93	94	90	31	98	94	95			94		
cM capacity (veh/h)	242	173	902	137	190	628	1336			880		
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3		
Volume Total	22	95	95	44	63	371	335	52	137	82		
Volume Left	17	0	95	0	63	0	0	52	0	0		
Volume Right	0	89	0	40	0	0	149	0	0	14		
cSH	221	731	137	515	1336	1700	1700	880	1700	1700		
Volume to Capacity	0.10	0.13	0.69	0.09	0.05	0.22	0.20	0.06	0.08	0.05		
Queue Length 95th (ft)	8	11	97	7	4	0	0	5	0	0		
Control Delay (s)	23.1	10.7	75.6	12.6	7.8	0.0	0.0	9.3	0.0	0.0		
Lane LOS	C	B	F	B	A			A				
Approach Delay (s)	13.0		55.5		0.6			1.8				
Approach LOS	B		F									
Intersection Summary												
Average Delay	7.9											
Intersection Capacity Utilization	44.5%			ICU Level of Service						A		
Analysis Period (min)	15											

HCM Signalized Intersection Capacity Analysis
8: State Farm Dr & City Center Dr

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	16	10	85	90	4	38	60	529	142	49	195	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5		4.5	4.5	4.5	4.5	4.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	0.88	1.00	0.89			1.00	1.00	0.90	1.00	0.99	
Flpb, ped/bikes	0.96	1.00	0.93	1.00			1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.85	1.00	0.86			1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.97	1.00	0.95	1.00			0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1738	1398	1654	1437			1770	1863	1425	1770	1833	
Flt Permitted	0.86	1.00	0.74	1.00			0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1542	1398	1287	1437			1770	1863	1425	1770	1833	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	17	11	89	95	4	40	63	557	149	52	205	14
RTOR Reduction (vph)	0	0	69	0	31	0	0	0	72	0	3	0
Lane Group Flow (vph)	0	28	20	95	13	0	63	557	77	52	216	0
Confl. Peds. (#/hr)	50		50	50		50			50			50
Confl. Bikes (#/hr)			20			20			20			20
Turn Type	Perm	NA	Perm	Perm	NA		Prot	NA	Perm	Prot	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8					2			
Actuated Green, G (s)		13.4	13.4	13.4	13.4		2.4	30.7	30.7	2.1	30.4	
Effective Green, g (s)		13.4	13.4	13.4	13.4		2.4	30.7	30.7	2.1	30.4	
Actuated g/C Ratio		0.22	0.22	0.22	0.22		0.04	0.51	0.51	0.04	0.51	
Clearance Time (s)		4.5	4.5	4.5	4.5		4.5	4.5	4.5	4.5	4.5	
Vehicle Extension (s)		3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		346	313	288	322		71	958	732	62	933	
v/s Ratio Prot					0.01		c0.04	c0.30		0.03	0.12	
v/s Ratio Perm		0.02	0.01	c0.07					0.05			
v/c Ratio		0.08	0.06	0.33	0.04		0.89	0.58	0.10	0.84	0.23	
Uniform Delay, d1		18.3	18.2	19.4	18.1		28.5	10.0	7.4	28.6	8.2	
Progression Factor		1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		0.1	0.1	0.7	0.1		68.6	2.6	0.3	60.1	0.6	
Delay (s)		18.4	18.3	20.1	18.2		97.1	12.6	7.7	88.7	8.7	
Level of Service		B	B	C	B		F	B	A	F	A	
Approach Delay (s)		18.3			19.5			18.6			24.1	
Approach LOS		B			B			B			C	
Intersection Summary												
HCM 2000 Control Delay			19.8		HCM 2000 Level of Service				B			
HCM 2000 Volume to Capacity ratio			0.53									
Actuated Cycle Length (s)			59.7		Sum of lost time (s)				13.5			
Intersection Capacity Utilization			62.2%		ICU Level of Service				B			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis
9: US 101 SB Ramps & Rohnert Park Expressway

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑	↑		↑↑↑		↑		↑	↑↑		↑
Volume (vph)	0	872	310	14	715	0	1	0	0	746	0	369
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	11	12	12	12	12	12	12	12	12	12
Total Lost time (s)		4.5	4.5	3.5	4.5		4.0			4.0		4.0
Lane Util. Factor		0.91	*0.75	1.00	0.91		1.00			0.97		1.00
Flpb, ped/bikes		1.00	0.92	1.00	1.00		1.00			1.00		1.00
Flpb, ped/bikes		1.00	1.00	1.00	1.00		1.00			1.00		1.00
Frt		1.00	0.85	1.00	1.00		1.00			1.00		0.85
Flt Protected		1.00	1.00	0.95	1.00		0.95			0.95		1.00
Satd. Flow (prot)		5085	1061	1770	5085		1770			3433		1583
Flt Permitted		1.00	1.00	0.95	1.00		0.95			0.95		1.00
Satd. Flow (perm)		5085	1061	1770	5085		1770			3433		1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	918	326	15	753	0	1	0	0	785	0	388
RTOR Reduction (vph)	0	0	147	0	0	0	0	0	0	0	0	147
Lane Group Flow (vph)	0	918	179	15	753	0	1	0	0	785	0	241
Confl. Peds. (#/hr)			20			20						
Confl. Bikes (#/hr)			20			20						
Turn Type	NA	Perm	Prot	NA	Prot		Prot		Prot		Perm	
Protected Phases	2		1	6		3		3		4		
Permitted Phases		2									4	
Actuated Green, G (s)	69.2	69.2	4.6	77.3		1.2				59.0		59.0
Effective Green, g (s)	69.2	69.2	4.6	77.3		1.2				59.0		59.0
Actuated g/C Ratio	0.46	0.46	0.03	0.52		0.01				0.39		0.39
Clearance Time (s)	4.5	4.5	3.5	4.5		4.0				4.0		4.0
Vehicle Extension (s)	4.0	4.0	2.0	4.0		3.0				2.0		2.0
Lane Grp Cap (vph)	2345	489	54	2620		14				1350		622
v/s Ratio Prot	c0.18		0.01	c0.15		c0.00				c0.23		
v/s Ratio Perm		0.17									0.15	
v/c Ratio	0.39	0.37	0.28	0.29		0.07				0.58		0.39
Uniform Delay, d1	26.6	26.2	71.1	20.7		73.8				35.8		32.6
Progression Factor	0.21	0.62	0.79	0.62		1.00				1.00		1.00
Incremental Delay, d2	0.4	1.9	1.0	0.3		2.2				0.4		0.1
Delay (s)	6.1	18.1	57.1	13.0		76.0				36.2		32.7
Level of Service	A	B	E	B		E				D		C
Approach Delay (s)	9.2			13.9		76.0				35.0		
Approach LOS	A			B		E				D		
Intersection Summary												
HCM 2000 Control Delay		19.9				HCM 2000 Level of Service				B		
HCM 2000 Volume to Capacity ratio		0.47										
Actuated Cycle Length (s)		150.0				Sum of lost time (s)				16.0		
Intersection Capacity Utilization		56.6%				ICU Level of Service				B		
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis
10: US 101 NB Ramps & Rohnert Park Expressway

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑			↑↑↑		↑		↑	↑↑		↑
Volume (vph)	24	1391	0	0	967	938	187	19	383	1	0	9
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0			5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	1.00	0.86			0.91	1.00	0.95	0.95	0.88	1.00		1.00
Flrb, ped/bikes	1.00	1.00			1.00	0.98	1.00	1.00	1.00	1.00		1.00
Flrb, ped/bikes	1.00	1.00			1.00	1.00	1.00	1.00	1.00	1.00		1.00
Frt	1.00	1.00			1.00	0.85	1.00	1.00	0.85	1.00		0.85
Flt Protected		0.95	1.00		1.00	1.00	0.95	0.96	1.00	0.95		1.00
Satd. Flow (prot)		1770	6408		5085	1550	1681	1700	2787	1770		1583
Flt Permitted		0.95	1.00		1.00	1.00	0.95	0.96	1.00	0.95		1.00
Satd. Flow (perm)		1770	6408		5085	1550	1681	1700	2787	1770		1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	25	1464	0	0	1018	987	197	20	403	1	0	9
RTOR Reduction (vph)	0	0	0	0	0	236	0	0	164	0	0	9
Lane Group Flow (vph)	25	1464	0	0	1018	751	108	109	239	1	0	0
Confl. Peds. (#/hr)			4			4						
Turn Type	Prot	NA			NA	Perm	Split	NA	Perm	Prot		Perm
Protected Phases	5	2			6		3	3		4		
Permitted Phases						6			3			4
Actuated Green, G (s)	4.8	117.1			108.3	108.3	16.7	16.7	16.7	1.2		1.2
Effective Green, g (s)	4.8	117.1			108.3	108.3	16.7	16.7	16.7	1.2		1.2
Actuated g/C Ratio	0.03	0.78			0.72	0.72	0.11	0.11	0.11	0.01		0.01
Clearance Time (s)	4.0	5.0			5.0	5.0	5.0	5.0	5.0	5.0		5.0
Vehicle Extension (s)	2.0	4.0			2.0	2.0	2.0	2.0	2.0	4.0		4.0
Lane Grp Cap (vph)	56	5002			3671	1119	187	189	310	14		12
v/s Ratio Prot	c0.01	0.23			0.20		0.06	0.06		c0.00		
v/s Ratio Perm						c0.48			c0.09			0.00
v/c Ratio	0.45	0.29			0.28	0.67	0.58	0.58	0.77	0.07		0.01
Uniform Delay, d1	71.3	4.7			7.2	11.2	63.3	63.3	64.8	73.8		73.8
Progression Factor	1.25	1.77			0.63	4.98	1.00	1.00	1.00	1.00		1.00
Incremental Delay, d2	1.9	0.1			0.2	2.7	2.7	2.6	9.9	2.9		0.3
Delay (s)	90.9	8.4			4.7	58.6	66.0	65.9	74.7	76.8		74.1
Level of Service	F	A			A	E	E	E	E	E		E
Approach Delay (s)		9.8			31.2			71.6		74.4		
Approach LOS		A			C			E		E		
Intersection Summary												
HCM 2000 Control Delay		29.7				HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio		0.67										
Actuated Cycle Length (s)		150.0				Sum of lost time (s)				19.0		
Intersection Capacity Utilization		83.5%				ICU Level of Service				E		
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis
11: Commerce Blvd & Rohnert Park Expressway

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Volume (vph)	349	1058	369	97	1285	132	406	199	135	76	111	214
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.91		0.97	1.00	1.00	0.91	0.91	1.00
Frpb, ped/bikes	1.00	1.00	0.97	1.00	1.00		1.00	1.00	0.95	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	0.99	1.00
Satd. Flow (prot)	3433	3539	1539	1770	4994		3433	1863	1509	1610	3370	1541
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	0.99	1.00
Satd. Flow (perm)	3433	3539	1539	1770	4994		3433	1863	1509	1610	3370	1541
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	367	1114	388	102	1353	139	427	209	142	80	117	225
RTOR Reduction (vph)	0	0	112	0	5	0	0	0	118	0	0	71
Lane Group Flow (vph)	367	1114	276	102	1487	0	427	209	24	64	133	154
Confl. Peds. (#/hr)			20			20			20			20
Confl. Bikes (#/hr)			10			10			10			10
Turn Type	Prot	NA	pm+ov	Prot	NA		Split	NA	Perm	Split	NA	pm+ov
Protected Phases	5	2	3	1	6		3	3		4	4	5
Permitted Phases			2						3			4
Actuated Green, G (s)	11.0	75.1	100.8	12.1	76.2		25.7	25.7	25.7	17.1	17.1	28.1
Effective Green, g (s)	11.0	75.1	100.8	12.1	76.2		25.7	25.7	25.7	17.1	17.1	28.1
Actuated g/C Ratio	0.07	0.50	0.67	0.08	0.51		0.17	0.17	0.17	0.11	0.11	0.19
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Vehicle Extension (s)	1.0	1.0	1.5	1.0	1.0		1.5	1.5	1.5	1.0	1.0	1.0
Lane Grp Cap (vph)	251	1771	1085	142	2536		588	319	258	183	384	288
v/s Ratio Prot	c0.11	c0.31	0.04	c0.06	0.30		c0.12	0.11		0.04	0.04	c0.04
v/s Ratio Perm			0.14						0.02			0.06
v/c Ratio	1.46	0.63	0.25	0.72	0.59		0.73	0.66	0.09	0.35	0.35	0.54
Uniform Delay, d1	69.5	27.3	9.7	67.3	25.9		58.8	58.0	52.3	61.3	61.3	55.1
Progression Factor	0.72	0.40	1.72	1.14	1.05		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	227.4	1.6	0.0	11.6	0.9		3.8	3.7	0.1	0.4	0.2	1.0
Delay (s)	277.3	12.5	16.8	88.1	28.1		62.6	61.7	52.4	61.7	61.5	56.0
Level of Service	F	B	B	F	C		E	E	D	E	E	E
Approach Delay (s)		65.4			31.9			60.5			58.6	
Approach LOS		E			C			E			E	
Intersection Summary												
HCM 2000 Control Delay		52.5			HCM 2000 Level of Service			D				
HCM 2000 Volume to Capacity ratio		0.70										
Actuated Cycle Length (s)		150.0			Sum of lost time (s)			20.0				
Intersection Capacity Utilization		93.3%			ICU Level of Service			F				
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis
11: Commerce Blvd & Rohnert Park Expressway

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Volume (vph)	349	1058	369	97	1285	132	406	199	135	76	111	214
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0	5.0		5.0	4.0	5.0	4.0	5.0	5.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.91		0.97	1.00	1.00	1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	1.00	0.98	1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1548	1770	5002		3433	1863	1549	1770	3539	1568
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1548	1770	5002		3433	1863	1549	1770	3539	1568
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	367	1114	388	102	1353	139	427	209	142	80	117	225
RTOR Reduction (vph)	0	0	119	0	7	0	0	0	77	0	0	73
Lane Group Flow (vph)	367	1114	269	102	1485	0	427	209	65	80	117	152
Confl. Peds. (#/hr)			13			10			5			7
Confl. Bikes (#/hr)						2			5			2
Turn Type	Prot	NA	pm+ov	Prot	NA		Prot	NA	pm+ov	Prot	NA	pm+ov
Protected Phases	5	2	3	1	6		3	8	1	7	4	5
Permitted Phases			2						8			4
Actuated Green, G (s)	15.0	69.2	90.1	8.0	62.2		20.9	23.0	31.0	11.8	11.9	26.9
Effective Green, g (s)	15.0	69.2	90.1	8.0	62.2		20.9	23.0	31.0	11.8	11.9	26.9
Actuated g/C Ratio	0.12	0.53	0.69	0.06	0.48		0.16	0.18	0.24	0.09	0.09	0.21
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0		5.0	4.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	1.0	1.0	1.5	1.0	1.0		1.5	3.0	1.0	3.0	1.0	1.0
Lane Grp Cap (vph)	396	1883	1132	108	2393		551	329	428	160	323	384
v/s Ratio Prot	c0.11	0.31	0.04	0.06	c0.30		c0.12	c0.11	0.01	0.05	0.03	0.05
v/s Ratio Perm			0.14						0.03			0.05
v/c Ratio	0.93	0.59	0.24	0.94	0.62		0.77	0.64	0.15	0.50	0.36	0.40
Uniform Delay, d1	57.0	20.8	7.3	60.8	25.1		52.3	49.6	39.1	56.3	55.5	44.5
Progression Factor	0.92	0.65	0.44	0.83	0.30		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	26.0	1.3	0.0	55.2	0.9		6.2	4.0	0.1	2.4	0.3	0.2
Delay (s)	78.4	14.8	3.2	105.6	8.3		58.4	53.6	39.2	58.7	55.7	44.8
Level of Service	E	B	A	F	A		E	D	D	E	E	D
Approach Delay (s)		24.9			14.5			53.6			50.5	
Approach LOS		C			B			D			D	
Intersection Summary												
HCM 2000 Control Delay		28.5			HCM 2000 Level of Service			C				
HCM 2000 Volume to Capacity ratio		0.71										
Actuated Cycle Length (s)		130.0			Sum of lost time (s)			20.0				
Intersection Capacity Utilization		76.4%			ICU Level of Service			D				
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis
12: State Farm Dr & Rohnert Park Expressway

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↰	↰	↰	↰	↰	↰	↰	↰	↰	↰	↰
Volume (vph)	246	809	175	227	1071	351	286	195	155	126	120	140
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.91	0.91	1.00	0.91	0.91	0.91
Flpb, ped/bikes	1.00	1.00	0.98	1.00	1.00	0.99	1.00	1.00	0.98	1.00	0.99	0.99
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.92	0.92
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.98	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3539	1548	1770	3539	1560	1610	3324	1554	1610	3096	3096
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.98	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	3539	1548	1770	3539	1560	1610	3324	1554	1610	3096	3096
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	259	852	184	239	1127	369	301	205	163	133	126	147
RTOR Reduction (vph)	0	0	97	0	0	99	0	0	138	0	128	0
Lane Group Flow (vph)	259	852	87	239	1127	270	166	340	25	120	158	0
Confl. Peds. (#/hr)			8			2			5			2
Confl. Bikes (#/hr)									1			1
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Split	NA	Perm	Split	NA	
Protected Phases	5	2		1	6		3	3		4	4	
Permitted Phases			2			6			3			
Actuated Green, G (s)	11.0	71.2	71.2	16.8	77.0	77.0	22.8	22.8	22.8	19.2	19.2	
Effective Green, g (s)	11.0	71.2	71.2	16.8	77.0	77.0	22.8	22.8	22.8	19.2	19.2	
Actuated g/C Ratio	0.07	0.47	0.47	0.11	0.51	0.51	0.15	0.15	0.15	0.13	0.13	
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
Lane Grp Cap (vph)	129	1679	734	198	1816	800	244	505	236	206	396	
v/s Ratio Prot	c0.15	0.24		c0.14	c0.32		c0.10	0.10		c0.07	0.05	
v/s Ratio Perm			0.06			0.17			0.02			
v/c Ratio	2.01	0.51	0.12	1.21	0.62	0.34	0.68	0.67	0.10	0.58	0.40	
Uniform Delay, d1	69.5	27.3	21.9	66.6	26.1	21.5	60.2	60.1	54.8	61.6	60.1	
Progression Factor	0.99	0.35	0.24	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	475.6	0.9	0.3	130.9	1.6	1.1	6.1	2.8	0.1	2.7	0.2	
Delay (s)	544.7	10.5	5.6	197.5	27.7	22.6	66.2	62.9	54.9	64.6	60.4	
Level of Service	F	B	A	F	C	C	E	E	D	E	E	
Approach Delay (s)		116.6			50.0			61.8			61.6	
Approach LOS		F			D			E			E	
Intersection Summary												
HCM 2000 Control Delay		74.1			HCM 2000 Level of Service			E				
HCM 2000 Volume to Capacity ratio		0.76										
Actuated Cycle Length (s)		150.0			Sum of lost time (s)			20.0				
Intersection Capacity Utilization		83.8%			ICU Level of Service			E				
Analysis Period (min)		15										
c Critical Lane Group												

Rohnert Park PDA Plan
AM Peak Hour - Future plus Project

Synchro 8 Report
W-Trans

HCM Signalized Intersection Capacity Analysis
12: State Farm Dr & Rohnert Park Expressway

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↰	↰	↰	↰	↰	↰	↰	↰	↰	↰	↰
Volume (vph)	246	809	175	227	1071	351	286	195	155	126	120	140
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	12	12	12	12	12	12	12	12	12	11	11	11
Lane Width	12	12	12	12	12	12	12	12	12	12	11	11
Total Lost time (s)	5.0	5.0	4.0	5.0	5.0	4.0	4.0	4.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00	0.97	1.00	1.00
Flpb, ped/bikes	1.00	1.00	0.96	1.00	1.00	0.97	1.00	1.00	0.99	1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3539	1528	1770	3539	1541	3433	1863	1563	3319	1801	1517
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	3539	1528	1770	3539	1541	3433	1863	1563	3319	1801	1517
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	259	852	184	239	1127	369	301	205	163	133	126	147
RTOR Reduction (vph)	0	0	86	0	0	154	0	0	58	0	0	63
Lane Group Flow (vph)	259	852	98	239	1127	216	301	205	105	133	126	84
Confl. Peds. (#/hr)			12			5			10			4
Confl. Bikes (#/hr)			1			1			1			1
Turn Type	Prot	NA	pm+ov	Prot	NA	pm+ov	Prot	NA	pm+ov	Prot	NA	pm+ov
Protected Phases	5	2	3	1	6	7	3	8	1	7	4	5
Permitted Phases			2			6			8			4
Actuated Green, G (s)	19.0	54.4	69.2	19.7	55.1	65.0	14.8	28.0	47.7	9.9	22.1	41.1
Effective Green, g (s)	19.0	54.4	69.2	19.7	55.1	65.0	14.8	28.0	47.7	9.9	22.1	41.1
Actuated g/C Ratio	0.15	0.42	0.53	0.15	0.42	0.50	0.11	0.22	0.37	0.08	0.17	0.32
Clearance Time (s)	5.0	5.0	4.0	5.0	5.0	4.0	4.0	4.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	1.0	1.0	3.0	1.0	1.0	3.0	3.0	3.0	1.0	3.0	1.0	1.0
Lane Grp Cap (vph)	258	1480	813	268	1499	770	390	401	573	252	306	537
v/s Ratio Prot	c0.15	0.24	0.01	c0.14	c0.32	0.02	c0.09	c0.11	0.03	c0.04	0.07	0.02
v/s Ratio Perm			0.05			0.12			0.04			0.03
v/c Ratio	1.00	0.58	0.12	0.89	0.75	0.28	0.77	0.51	0.18	0.53	0.41	0.16
Uniform Delay, d1	55.5	29.0	15.2	54.1	31.7	18.9	56.0	45.0	27.9	57.8	48.1	32.0
Progression Factor	0.88	0.74	1.24	1.10	0.71	0.78	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	52.5	1.4	0.1	23.7	2.8	0.2	9.1	1.1	0.1	2.0	0.3	0.0
Delay (s)	101.1	22.9	18.9	83.1	25.2	14.9	65.1	46.1	28.0	59.8	48.5	32.0
Level of Service	F	C	B	F	C	B	E	D	C	E	D	C
Approach Delay (s)		38.0			31.0			50.2			46.2	
Approach LOS		D			C			D			D	
Intersection Summary												
HCM 2000 Control Delay		37.8			HCM 2000 Level of Service			D				
HCM 2000 Volume to Capacity ratio		0.75										
Actuated Cycle Length (s)		130.0			Sum of lost time (s)			19.0				
Intersection Capacity Utilization		79.2%			ICU Level of Service			D				
Analysis Period (min)		15										
c Critical Lane Group												

Rohnert Park PDA Plan
AM Peak Hour - Future plus Project (Mitigated)

Synchro 8 Report
W-Trans

HCM Signalized Intersection Capacity Analysis 13: Commerce Blvd & Enterprise Dr

4/15/2015

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↔	↔	↕	↕	↕	↕
Volume (vph)	93	57	559	78	23	338
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	0.97	1.00	0.95		1.00	0.95
Flpb, ped/bikes	1.00	0.98	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	0.85	0.98		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	3433	1550	3467		1770	3539
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	3433	1550	3467		1770	3539
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	98	60	588	82	24	356
RTOR Reduction (vph)	0	51	14	0	0	0
Lane Group Flow (vph)	98	9	656	0	24	356
Confl. Peds. (#/hr)		5		5		
Confl. Bikes (#/hr)		5		5		
Turn Type	Prot	Perm	NA		Prot	NA
Protected Phases	8		2		1	6
Permitted Phases		8				
Actuated Green, G (s)	5.0	5.0	15.7		0.3	20.0
Effective Green, g (s)	5.0	5.0	15.7		0.3	20.0
Actuated g/C Ratio	0.15	0.15	0.48		0.01	0.61
Clearance Time (s)	4.0	4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	520	234	1649		16	2144
v/s Ratio Prot	c0.03		c0.19		c0.01	0.10
v/s Ratio Perm		0.01				
v/c Ratio	0.19	0.04	0.40		1.50	0.17
Uniform Delay, d1	12.2	11.9	5.6		16.4	2.8
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	0.2	0.1	0.2		410.1	0.0
Delay (s)	12.4	12.0	5.8		426.5	2.9
Level of Service	B	B	A		F	A
Approach Delay (s)	12.3		5.8			29.6
Approach LOS	B		A			C
Intersection Summary						
HCM 2000 Control Delay			14.1		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.36			
Actuated Cycle Length (s)			33.0		Sum of lost time (s)	12.0
Intersection Capacity Utilization			32.3%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						

HCM Unsignalized Intersection Capacity Analysis 14: Enterprise Dr & Hunter Dr

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	15	91	0	3	144	137	1	2	0	68	0	5
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	16	96	0	3	152	144	1	2	0	72	0	5
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1						
Volume Total (vph)	64	48	79	220	3	77						
Volume Left (vph)	16	0	3	0	1	72						
Volume Right (vph)	0	0	0	144	0	5						
Hadj (s)	0.16	0.03	0.05	-0.42	0.10	0.18						
Departure Headway (s)	5.1	5.0	4.9	4.4	5.0	5.0						
Degree Utilization, x	0.09	0.07	0.11	0.27	0.00	0.11						
Capacity (veh/h)	687	699	718	802	664	673						
Control Delay (s)	7.4	7.1	7.2	7.8	8.0	8.5						
Approach Delay (s)	7.3		7.6		8.0	8.5						
Approach LOS	A		A		A	A						
Intersection Summary												
Delay					7.7							
Level of Service					A							
Intersection Capacity Utilization				30.9%		ICU Level of Service				A		
Analysis Period (min)				15								

HCM Unsignalized Intersection Capacity Analysis

14: Enterprise Dr & Hunter Dr

4/15/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control	Stop				Stop			Stop			Stop	
Volume (vph)	15	91	0	3	144	137	1	2	0	68	0	5
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	16	96	0	3	152	144	1	2	0	72	0	5
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1						
Volume Total (vph)	16	96	155	144	3	77						
Volume Left (vph)	16	0	3	0	1	72						
Volume Right (vph)	0	0	0	144	0	5						
Hadj (s)	0.53	0.03	0.04	-0.67	0.10	0.18						
Departure Headway (s)	5.5	5.0	4.9	4.1	5.0	4.9						
Degree Utilization, x	0.02	0.13	0.21	0.17	0.00	0.11						
Capacity (veh/h)	640	699	721	846	666	675						
Control Delay (s)	7.4	7.5	7.9	6.8	8.0	8.5						
Approach Delay (s)	7.5		7.4		8.0	8.5						
Approach LOS	A		A		A	A						
Intersection Summary												
Delay			7.6									
Level of Service			A									
Intersection Capacity Utilization	28.8%				ICU Level of Service				A			
Analysis Period (min)	15											

HCM Unsignalized Intersection Capacity Analysis

15: Enterprise Dr & State Farm Dr

4/15/2015

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↱	↰	↱	↰	↱
Sign Control	Stop		Stop		Stop	
Volume (vph)	67	92	164	390	309	96
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	71	97	173	411	325	101
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total (vph)	71	97	115	468	325	101
Volume Left (vph)	71	0	0	0	325	0
Volume Right (vph)	0	0	0	411	0	101
Hadj (s)	0.53	0.03	0.03	-0.58	0.53	-0.67
Departure Headway (s)	7.3	6.8	6.2	5.6	7.0	5.8
Degree Utilization, x	0.14	0.18	0.20	0.73	0.63	0.16
Capacity (veh/h)	461	497	552	620	495	591
Control Delay (s)	10.3	10.1	9.6	21.2	19.8	8.7
Approach Delay (s)	10.2		18.9		17.2	
Approach LOS	B		C		C	
Intersection Summary						
Delay			17.0			
Level of Service			C			
Intersection Capacity Utilization	48.3%				ICU Level of Service	
Analysis Period (min)	15					

HCM Signalized Intersection Capacity Analysis
15: Enterprise Dr & State Farm Dr

4/15/2015

	EBL	EBT	WBT	WBR	SBL	SBR
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑	↑	↰	↰	↰
Volume (vph)	67	92	164	390	309	96
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1863	1863	1583	1770	1583
Flt Permitted	0.65	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1207	1863	1863	1583	1770	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	71	97	173	411	325	101
RTOR Reduction (vph)	0	0	0	269	0	63
Lane Group Flow (vph)	71	97	173	142	325	38
Turn Type	Perm	NA	NA	Perm	Prot	Perm
Protected Phases		2	6		4	
Permitted Phases	2			6		4
Actuated Green, G (s)	9.8	9.8	9.8	9.8	10.6	10.6
Effective Green, g (s)	9.8	9.8	9.8	9.8	10.6	10.6
Actuated g/C Ratio	0.35	0.35	0.35	0.35	0.37	0.37
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	416	642	642	546	660	590
v/s Ratio Prot		0.05	c0.09		c0.18	
v/s Ratio Perm	0.06			0.09		0.02
v/c Ratio	0.17	0.15	0.27	0.26	0.49	0.06
Uniform Delay, d1	6.5	6.4	6.7	6.7	6.8	5.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.2	0.1	0.2	0.3	0.6	0.0
Delay (s)	6.7	6.5	6.9	6.9	7.4	5.8
Level of Service	A	A	A	A	A	A
Approach Delay (s)		6.6	6.9		7.0	
Approach LOS		A	A		A	
Intersection Summary						
HCM 2000 Control Delay			6.9		HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio			0.38			
Actuated Cycle Length (s)			28.4		Sum of lost time (s)	8.0
Intersection Capacity Utilization			41.6%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						

HCM Unsignalized Intersection Capacity Analysis
16: Enterprise Dr/Seed Farm Dr

4/15/2015

	EBL	EBT	WBT	WBR	SBL	SBR
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↰	↰	↰	↰	↰
Volume (veh/h)	64	285	479	12	5	17
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	67	300	504	13	5	18
Pedestrians		5	5		5	
Lane Width (ft)	12.0	12.0			12.0	
Walking Speed (ft/s)		4.0	4.0		4.0	
Percent Blockage		0	0		0	
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	522				955	521
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	522				955	521
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	94				98	97
cM capacity (veh/h)	1040				266	551
Direction, Lane #						
Volume Total	367	517	23			
Volume Left	67	0	5			
Volume Right	0	13	18			
cSH	1040	1700	443			
Volume to Capacity	0.06	0.30	0.05			
Queue Length 95th (ft)	5	0	4			
Control Delay (s)	2.2	0.0	13.6			
Lane LOS	A		B			
Approach Delay (s)	2.2	0.0	13.6			
Approach LOS			B			
Intersection Summary						
Average Delay			1.2			
Intersection Capacity Utilization			59.4%		ICU Level of Service	B
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
17: State Farm Dr & Town Center

4/15/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	52	4	11	24	5	115	25	451	17	106	361	34
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	55	4	12	25	5	121	26	475	18	112	380	36
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)											561	
pX, platoon unblocked												
vC, conflicting volume	1035	1166	208	963	1175	246	416			493		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1035	1166	208	963	1175	246	416			493		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	60	97	99	86	97	84	98			90		
cM capacity (veh/h)	138	168	798	184	166	754	1140			1067		
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3				
Volume Total	71	152	26	316	176	112	253	162				
Volume Left	55	25	26	0	0	112	0	0				
Volume Right	12	121	0	0	18	0	0	36				
cSH	162	460	1140	1700	1700	1067	1700	1700				
Volume to Capacity	0.44	0.33	0.02	0.19	0.10	0.10	0.15	0.10				
Queue Length 95th (ft)	49	36	2	0	0	9	0	0				
Control Delay (s)	43.5	16.6	8.2	0.0	0.0	8.8	0.0	0.0				
Lane LOS	E	C	A			A						
Approach Delay (s)	43.5	16.6	0.4			1.9						
Approach LOS	E	C										
Intersection Summary												
Average Delay			5.3									
Intersection Capacity Utilization			39.3%		ICU Level of Service				A			
Analysis Period (min)			15									

HCM Signalized Intersection Capacity Analysis
17: State Farm Dr & Town Center

4/15/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	52	4	11	24	5	115	25	451	17	106	361	34
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Flpb, ped/bikes	1.00	0.90		1.00	0.90	1.00	1.00	1.00	0.90	1.00	1.00	0.90
Flpb, ped/bikes	0.96	1.00		0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85		1.00	0.85	1.00	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.96	1.00		0.96	1.00	0.95	1.00	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1712	1422		1730	1422	1770	1863	1428	1770	1863	1432	1432
Flt Permitted	0.73	1.00		0.77	1.00	0.95	1.00	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1301	1422		1392	1422	1770	1863	1428	1770	1863	1432	1432
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	55	4	12	25	5	121	26	475	18	112	380	36
RTOR Reduction (vph)	0	0	10	0	0	100	0	0	9	0	0	16
Lane Group Flow (vph)	0	59	2	0	30	21	26	475	9	112	380	20
Confl. Peds. (#/hr)	50		50	50		50			50		50	50
Confl. Bikes (#/hr)			20			20			20			20
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)		8.7	8.7		8.7	8.7	0.6	23.4	23.4	5.2	28.0	28.0
Effective Green, g (s)		8.7	8.7		8.7	8.7	0.6	23.4	23.4	5.2	28.0	28.0
Actuated g/C Ratio		0.18	0.18		0.18	0.18	0.01	0.47	0.47	0.11	0.57	0.57
Clearance Time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)		229	250		245	250	21	884	677	186	1058	813
v/s Ratio Prot							0.01	c0.26		c0.06	0.20	
v/s Ratio Perm		c0.05	0.00		0.02	0.02			0.01			0.01
v/c Ratio		0.26	0.01		0.12	0.09	1.24	0.54	0.01	0.60	0.36	0.03
Uniform Delay, d1		17.5	16.7		17.1	17.0	24.3	9.1	6.8	21.1	5.8	4.7
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		0.6	0.0		0.2	0.1	278.6	0.6	0.0	5.4	0.2	0.0
Delay (s)		18.1	16.8		17.3	17.1	302.9	9.8	6.9	26.5	6.0	4.7
Level of Service		B	B		B	B	F	A	A	C	A	A
Approach Delay (s)		17.9			17.2			24.3			10.2	
Approach LOS		B			B			C			B	
Intersection Summary												
HCM 2000 Control Delay				17.3	HCM 2000 Level of Service			B				
HCM 2000 Volume to Capacity ratio				0.48								
Actuated Cycle Length (s)				49.3	Sum of lost time (s)			12.0				
Intersection Capacity Utilization				75.7%	ICU Level of Service			D				
Analysis Period (min)				15								
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis
61: Lynn Conde Way & Rohnert Park Expressway

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑			↑↑	↑			↑			↑
Volume (vph)	0	1059	31	0	1627	5	0	0	15	0	0	22
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0	5.0			3.0			3.0
Lane Util. Factor		0.95			0.95	1.00			1.00			1.00
Frt		1.00			1.00	0.85			0.86			0.86
Flt Protected		1.00			1.00	1.00			1.00			1.00
Satd. Flow (prot)		3524			3539	1583			1611			1611
Flt Permitted		1.00			1.00	1.00			1.00			1.00
Satd. Flow (perm)		3524			3539	1583			1611			1611
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	0	1081	32	0	1660	5	0	0	15	0	0	22
RTOR Reduction (vph)	0	1	0	0	0	1	0	0	12	0	0	17
Lane Group Flow (vph)	0	1112	0	0	1660	4	0	0	3	0	0	5
Turn Type		NA			NA	Perm			Perm			Perm
Protected Phases		2			6							
Permitted Phases						6			8			8
Actuated Green, G (s)		93.9			93.9	93.9			28.1			28.1
Effective Green, g (s)		93.9			93.9	93.9			28.1			28.1
Actuated g/C Ratio		0.72			0.72	0.72			0.22			0.22
Clearance Time (s)		5.0			5.0	5.0			3.0			3.0
Vehicle Extension (s)		3.0			3.0	3.0			3.0			3.0
Lane Grp Cap (vph)		2545			2556	1143			348			348
v/s Ratio Prot		0.32			c0.47							
v/s Ratio Perm						0.00			0.00			c0.00
v/c Ratio		0.44			0.65	0.00			0.01			0.01
Uniform Delay, d1		7.3			9.4	5.0			40.0			40.1
Progression Factor		1.12			0.03	0.00			1.00			1.00
Incremental Delay, d2		0.5			1.0	0.0			0.0			0.0
Delay (s)		8.7			1.3	0.0			40.0			40.1
Level of Service		A			A	A			D			D
Approach Delay (s)		8.7			1.3			40.0			40.1	
Approach LOS		A			A			D			D	
Intersection Summary												
HCM 2000 Control Delay		4.7			HCM 2000 Level of Service			A				
HCM 2000 Volume to Capacity ratio		0.50										
Actuated Cycle Length (s)		130.0			Sum of lost time (s)			8.0				
Intersection Capacity Utilization		55.8%			ICU Level of Service			B				
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis
64: SMART midblock & Rohnert Park Expressway

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑			↑↑							
Volume (vph)	0	1074	0	0	1632	0	0	0	0	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0							
Lane Util. Factor		0.95			0.95							
Frt		1.00			1.00							
Flt Protected		1.00			1.00							
Satd. Flow (prot)		3539			3539							
Flt Permitted		1.00			1.00							
Satd. Flow (perm)		3539			3539							
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	0	1096	0	0	1665	0	0	0	0	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	1096	0	0	1665	0	0	0	0	0	0	0
Turn Type		NA			NA							
Protected Phases		2			6							
Permitted Phases												
Actuated Green, G (s)		95.0			95.0							
Effective Green, g (s)		95.0			95.0							
Actuated g/C Ratio		0.73			0.73							
Clearance Time (s)		5.0			5.0							
Vehicle Extension (s)		3.0			3.0							
Lane Grp Cap (vph)		2586			2586							
v/s Ratio Prot		0.31			c0.47							
v/s Ratio Perm												
v/c Ratio		0.42			0.64							
Uniform Delay, d1		6.8			8.9							
Progression Factor		1.14			1.00							
Incremental Delay, d2		0.5			1.2							
Delay (s)		8.3			10.1							
Level of Service		A			B							
Approach Delay (s)		8.3			10.1			0.0			0.0	
Approach LOS		A			B			A			A	
Intersection Summary												
HCM 2000 Control Delay		9.4			HCM 2000 Level of Service			A				
HCM 2000 Volume to Capacity ratio		0.50										
Actuated Cycle Length (s)		130.0			Sum of lost time (s)			8.0				
Intersection Capacity Utilization		49.3%			ICU Level of Service			A				
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

1: US 101 South Ramps & Golf Course Dr

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↑	↑	↑↑					↑	↑	↑
Volume (vph)	0	1269	769	186	1207	0	0	0	0	480	202	1246
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.5	4.5	4.5	4.5					4.5	4.5	4.5
Lane Util. Factor		0.95	1.00	0.97	0.95					1.00	0.95	0.95
Flt		1.00	0.85	1.00	1.00					1.00	0.89	0.85
Flt Protected		1.00	1.00	0.95	1.00					0.95	1.00	1.00
Satd. Flow (prot)		3539	1583	3433	3539					1770	1577	1504
Flt Permitted		1.00	1.00	0.95	1.00					0.95	1.00	1.00
Satd. Flow (perm)		3539	1583	3433	3539					1770	1577	1504
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	0	1295	785	190	1232	0	0	0	0	490	206	1271
RTOR Reduction (vph)	0	0	330	0	0	0	0	0	0	0	19	35
Lane Group Flow (vph)	0	1295	455	190	1232	0	0	0	0	490	734	689
Turn Type		NA	Perm	Prot	NA					Split	NA	Perm
Protected Phases		6		5	2					8	8	
Permitted Phases			6									8
Actuated Green, G (s)		39.5	39.5	6.5	50.5					46.5	46.5	46.5
Effective Green, g (s)		39.5	39.5	6.5	50.5					46.5	46.5	46.5
Actuated g/C Ratio		0.37	0.37	0.06	0.48					0.44	0.44	0.44
Clearance Time (s)		4.5	4.5	4.5	4.5					4.5	4.5	4.5
Vehicle Extension (s)		1.5	1.5	1.0	1.5					1.5	1.5	1.5
Lane Grp Cap (vph)		1318	589	210	1686					776	691	659
v/s Ratio Prot		c0.37		0.06	c0.35					0.28	c0.47	
v/s Ratio Perm			0.29									0.46
v/c Ratio		0.98	0.77	0.90	0.73					0.63	1.06	1.05
Uniform Delay, d1		32.9	29.3	49.4	22.3					23.1	29.8	29.8
Progression Factor		0.59	0.41	0.93	0.79					1.00	1.00	1.00
Incremental Delay, d2		13.0	4.4	29.3	2.1					1.2	52.2	47.6
Delay (s)		32.4	16.3	75.1	19.8					24.3	81.9	77.4
Level of Service		C	B	E	B					C	F	E
Approach Delay (s)		26.4			27.2			0.0			65.9	
Approach LOS		C			C			A			E	
Intersection Summary												
HCM 2000 Control Delay		40.8				HCM 2000 Level of Service		D				
HCM 2000 Volume to Capacity ratio		1.02										
Actuated Cycle Length (s)		106.0				Sum of lost time (s)		13.5				
Intersection Capacity Utilization		100.3%				ICU Level of Service		G				
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: Commerce Blvd & Golf Course Dr

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑	↑	↑	↑↑					↑	↑	↑
Volume (vph)	29	721	999	399	409	112	957	213	655	208	285	27
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	12	12	13	12	12	12
Total Lost time (s)	3.5	4.1	4.1	4.1	4.1		4.1	4.1	4.1	4.1	4.1	
Lane Util. Factor	1.00	0.91	1.00	0.97	0.95		0.97	1.00	1.00	1.00	1.00	
Flt	1.00	1.00	0.85	1.00	0.97		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5085	1583	3433	3425		3433	1863	1636	1770	1838	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	5085	1583	3433	3425		3433	1863	1636	1770	1838	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	30	736	1019	407	417	114	977	217	668	212	291	28
RTOR Reduction (vph)	0	0	24	0	23	0	0	0	42	0	3	0
Lane Group Flow (vph)	30	736	995	407	508	0	977	217	626	212	316	0
Turn Type	Prot	NA	pm+ov	Prot	NA		Split	NA	pm+ov	Split	NA	
Protected Phases	1	6	4	5	2		4	4	5	3	3	
Permitted Phases			6						4			
Actuated Green, G (s)	4.3	15.1	59.0	14.7	26.1		43.9	43.9	58.6	15.9	15.9	
Effective Green, g (s)	4.3	15.1	59.0	14.7	26.1		43.9	43.9	58.6	15.9	15.9	
Actuated g/C Ratio	0.04	0.14	0.56	0.14	0.25		0.41	0.41	0.55	0.15	0.15	
Clearance Time (s)	3.5	4.1	4.1	4.1	4.1		4.1	4.1	4.1	4.1	4.1	
Vehicle Extension (s)	1.0	1.5	1.5	1.0	1.5		1.5	1.5	1.0	1.5	1.5	
Lane Grp Cap (vph)	71	724	942	476	843		1421	771	904	265	275	
v/s Ratio Prot	0.02	0.14	c0.44	c0.12	0.15		0.28	0.12	0.10	0.12	c0.17	
v/s Ratio Perm			0.19						0.29			
v/c Ratio	0.42	1.02	1.06	0.86	0.60		0.69	0.28	0.69	0.80	1.15	
Uniform Delay, d1	49.6	45.5	23.5	44.6	35.4		25.4	20.6	17.2	43.5	45.0	
Progression Factor	0.65	0.85	0.66	0.77	0.68		0.89	0.99	0.86	1.00	1.00	
Incremental Delay, d2	0.7	26.4	36.3	12.8	3.0		0.8	0.1	1.4	14.9	100.2	
Delay (s)	32.9	65.2	51.7	47.0	26.9		23.6	20.4	16.3	58.4	145.2	
Level of Service	C	E	D	D	C		C	C	B	E	F	
Approach Delay (s)		57.0		35.6				20.6			110.6	
Approach LOS		E		D				C			F	
Intersection Summary												
HCM 2000 Control Delay		45.4				HCM 2000 Level of Service		D				
HCM 2000 Volume to Capacity ratio		1.09										
Actuated Cycle Length (s)		106.0				Sum of lost time (s)		16.4				
Intersection Capacity Utilization		100.1%				ICU Level of Service		G				
Analysis Period (min)		15										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis 3: Commerce Blvd & US 101 North Ramps

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↰	↰	↰	↰	↰	↰	↰	↰	↰	↰	↰
Volume (vph)	984	2	66	4	5	13	546	828	2	8	829	846
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	14	12	16	12	12	12	12	12	12	12	12	12
Total Lost time (s)	4.0	4.0	3.5		3.5		3.5	4.0		3.5	4.0	4.0
Lane Util. Factor	0.95	0.95	1.00		1.00		1.00	0.95		1.00	0.95	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00		1.00	1.00		1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00		1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85		0.92		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	0.95	1.00		0.99		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1793	1686	1794		1699		1770	3538		1770	3539	1546
Flt Permitted	0.95	0.95	1.00		0.99		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1793	1686	1794		1699		1770	3538		1770	3539	1546
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	1004	2	67	4	5	13	557	845	2	8	846	863
RTOR Reduction (vph)	0	0	27	0	13	0	0	0	0	0	0	0
Lane Group Flow (vph)	502	504	40	0	9	0	557	847	0	8	846	863
Confl. Bikes (#/hr)												10
Turn Type	Split	NA	pm+ov	Split	NA		Prot	NA		Prot	NA	Free
Protected Phases	8	8	1	7	7		1	6		5	2	
Permitted Phases			8									Free
Actuated Green, G (s)	32.1	32.1	63.6		1.6		31.5	56.5		0.8	25.8	106.0
Effective Green, g (s)	32.1	32.1	63.6		1.6		31.5	56.5		0.8	25.8	106.0
Actuated g/C Ratio	0.30	0.30	0.60		0.02		0.30	0.53		0.01	0.24	1.00
Clearance Time (s)	4.0	4.0	3.5		3.5		3.5	4.0		3.5	4.0	
Vehicle Extension (s)	1.5	1.5	1.0		1.0		1.0	1.5		1.0	1.5	
Lane Grp Cap (vph)	542	510	1076		25		525	1885		13	861	1546
v/s Ratio Prot	0.28	c0.30	0.01		0.01		c0.31	0.24		0.00	c0.24	
v/s Ratio Perm			0.01									c0.56
v/c Ratio	0.93	0.99	0.04		0.37		1.06	0.45		0.62	0.98	0.56
Uniform Delay, d1	35.8	36.8	8.7		51.7		37.2	15.2		52.4	39.9	0.0
Progression Factor	1.00	1.00	1.00		1.00		1.00	1.00		1.05	0.91	1.00
Incremental Delay, d2	24.1	37.1	0.0		3.3		56.4	0.1		5.4	5.9	0.1
Delay (s)	59.9	73.8	8.7		55.0		93.7	15.3		60.6	42.3	0.1
Level of Service	E	E	A		E		F	B		E	D	A
Approach Delay (s)		63.3			55.0			46.4			21.2	
Approach LOS		E			E			D			C	
Intersection Summary												
HCM 2000 Control Delay			40.5									D
HCM 2000 Volume to Capacity ratio			1.03									
Actuated Cycle Length (s)			106.0									15.0
Intersection Capacity Utilization			97.1%									F
Analysis Period (min)			15									
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis 4: Commerce Blvd & State Farm Dr

4/15/2015

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↰	↰	↰	↰	↰
Volume (veh/h)	34	623	598	19	401	429
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	35	636	610	19	409	438
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1876	620			630	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1876	620			630	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	23	0			57	
cM capacity (veh/h)	45	488			953	
Direction, Lane #						
Volume Total	670	630			409	438
Volume Left	35	0			409	0
Volume Right	636	19			0	0
cSH	323	1700			953	1700
Volume to Capacity	2.08	0.37			0.43	0.26
Queue Length 95th (ft)	1215	0			55	0
Control Delay (s)	520.7	0.0			11.6	0.0
Lane LOS	F				B	
Approach Delay (s)	520.7	0.0			5.6	
Approach LOS	F					
Intersection Summary						
Average Delay			164.8			
Intersection Capacity Utilization			105.3%		ICU Level of Service	G
Analysis Period (min)			15			

HCM Signalized Intersection Capacity Analysis 4: Commerce Blvd & State Farm Dr

4/15/2015

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↰		↰	↱
Volume (vph)	34	623	598	19	401	429
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5		4.5	4.5
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frt	1.00	0.85	1.00		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1770	1583	1855		1770	1863
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1770	1583	1855		1770	1863
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	35	636	610	19	409	438
RTOR Reduction (vph)	0	76	1	0	0	0
Lane Group Flow (vph)	35	560	628	0	409	438
Turn Type	Prot	pm+ov	NA		Prot	NA
Protected Phases	8	1	2		1	6
Permitted Phases		8				
Actuated Green, G (s)	7.3	30.1	29.4		22.8	56.7
Effective Green, g (s)	7.3	30.1	29.4		22.8	56.7
Actuated g/C Ratio	0.10	0.41	0.40		0.31	0.78
Clearance Time (s)	4.5	4.5	4.5		4.5	4.5
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	177	750	747		552	1447
v/s Ratio Prot	0.02	c0.23	c0.34		0.23	0.24
v/s Ratio Perm		0.12				
v/c Ratio	0.20	0.75	0.84		0.74	0.30
Uniform Delay, d1	30.2	18.2	19.7		22.5	2.4
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	0.6	4.1	8.4		5.3	0.1
Delay (s)	30.7	22.3	28.1		27.8	2.5
Level of Service	C	C	C		C	A
Approach Delay (s)	22.7		28.1			14.7
Approach LOS	C		C			B
Intersection Summary						
HCM 2000 Control Delay			21.1		HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio			0.85			
Actuated Cycle Length (s)			73.0		Sum of lost time (s)	13.5
Intersection Capacity Utilization			78.7%		ICU Level of Service	D
Analysis Period (min)			15			
c Critical Lane Group						

HCM Unsignalized Intersection Capacity Analysis 5: State Farm Dr & Professional Center Dr

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↱		↰	↱		↰	↱		↰	↱	
Volume (veh/h)	12	14	62	44	10	35	79	397	25	15	358	20
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	12	14	63	45	10	36	81	405	26	15	365	20
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	811	998	193	863	995	215	386			431		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	811	998	193	863	995	215	386			431		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	95	94	92	78	95	95	93			99		
cM capacity (veh/h)	234	223	816	205	223	789	1169			1125		
Direction, Lane #												
Volume Total	12	78	91	81	270	161	15	244	142			
Volume Left	12	0	45	81	0	0	15	0	0			
Volume Right	0	63	36	0	0	26	0	0	20			
cSH	234	547	293	1169	1700	1700	1125	1700	1700			
Volume to Capacity	0.05	0.14	0.31	0.07	0.16	0.09	0.01	0.14	0.08			
Queue Length 95th (ft)	4	12	32	6	0	0	1	0	0			
Control Delay (s)	21.2	12.7	22.7	8.3	0.0	0.0	8.2	0.0	0.0			
Lane LOS	C	B	C	A			A					
Approach Delay (s)	13.8		22.7	1.3			0.3					
Approach LOS	B		C									
Intersection Summary												
Average Delay			3.8									
Intersection Capacity Utilization			36.9%				ICU Level of Service			A		
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis
5: State Farm Dr & Professional Center Dr

4/15/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	12	14	62	44	10	35	79	397	25	15	358	20
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	12	14	63	45	10	36	81	405	26	15	365	20
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1013	998	376	1045	995	418	386			431		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1013	998	376	1045	995	418	386			431		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	93	94	91	73	95	94	93			99		
cM capacity (veh/h)	186	224	671	167	225	635	1173			1129		
Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2	SB 1	SB 2					
Volume Total	12	78	91	81	431	15	386					
Volume Left	12	0	45	81	0	15	0					
Volume Right	0	63	36	0	26	0	20					
cSH	186	491	245	1173	1700	1129	1700					
Volume to Capacity	0.07	0.16	0.37	0.07	0.25	0.01	0.23					
Queue Length 95th (ft)	5	14	41	6	0	1	0					
Control Delay (s)	25.7	13.7	28.1	8.3	0.0	8.2	0.0					
Lane LOS	D	B	D	A		A						
Approach Delay (s)	15.4		28.1	1.3		0.3						
Approach LOS	C		D									
Intersection Summary												
Average Delay				4.3								
Intersection Capacity Utilization				47.5%	ICU Level of Service			A				
Analysis Period (min)				15								

HCM Unsignalized Intersection Capacity Analysis
6: Commerce Blvd & Professional Center Dr

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR				
Lane Configurations																
Volume (veh/h)	14	335	5	84	376	77	1	61	45	92	81	68				
Sign Control		Free			Free			Stop			Stop					
Grade		0%			0%			0%			0%					
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98				
Hourly flow rate (vph)	14	342	5	86	384	79	1	62	46	94	83	69				
Pedestrians																
Lane Width (ft)																
Walking Speed (ft/s)																
Percent Blockage																
Right turn flare (veh)																
Median type	None			TWLTL												
Median storage (veh)	2															
Upstream signal (ft)																
pX, platoon unblocked																
vC, conflicting volume	462			347				1039	1007	344	1042	970	423			
vC1, stage 1 conf vol										373	373	594	594			
vC2, stage 2 conf vol										666	634	447	376			
vCu, unblocked vol	462			347				1039	1007	344	1042	970	423			
tC, single (s)	4.1			4.1				7.1	6.5	6.2	7.1	6.5	6.2			
tC, 2 stage (s)										6.1	5.5	6.1	5.5			
tF (s)	2.2			2.2				3.5	4.0	3.3	3.5	4.0	3.3			
p0 queue free %	99			93				100	84	93	71	79	89			
cM capacity (veh/h)	1099			1212				274	385	698	329	391	631			
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1	SB 2									
Volume Total	14	347	86	462	109	94	152									
Volume Left	14	0	86	0	1	94	0									
Volume Right	0	5	0	79	46	0	69									
cSH	1099	1700	1212	1700	472	329	473									
Volume to Capacity	0.01	0.20	0.07	0.27	0.23	0.29	0.32									
Queue Length 95th (ft)	1	0	6	0	22	29	34									
Control Delay (s)	8.3	0.0	8.2	0.0	14.9	20.2	16.2									
Lane LOS	A		A		B	C	C									
Approach Delay (s)	0.3			1.3			14.9			17.7						
Approach LOS					B		C									
Intersection Summary																
Average Delay				5.4												
Intersection Capacity Utilization				49.6%		ICU Level of Service		A								
Analysis Period (min)				15												

HCM Unsignalized Intersection Capacity Analysis

7: Commerce Blvd & Padre Pkwy

4/15/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	14	6	107	235	5	50	92	521	229	44	618	12
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	14	6	109	240	5	51	94	532	234	45	631	12
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								TW	TL		TW	TL
Median storage (veh)								2			2	
Upstream signal (ft)								480				
pX, platoon unblocked												
vC, conflicting volume	1234	1680	321	1354	1569	383	643			765		
vC1, stage 1 conf vol	727	727		836	836							
vC2, stage 2 conf vol	507	953		517	733							
vCu, unblocked vol	1234	1680	321	1354	1569	383	643			765		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)	6.5	5.5		6.5	5.5							
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	95	97	84	0	98	92	90			95		
cM capacity (veh/h)	274	223	674	220	241	615	938			844		
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3				
Volume Total	130	296	94	354	411	45	420	222				
Volume Left	14	240	94	0	0	45	0	0				
Volume Right	109	51	0	0	234	0	0	12				
cSH	537	248	938	1700	1700	844	1700	1700				
Volume to Capacity	0.24	1.19	0.10	0.21	0.24	0.05	0.25	0.13				
Queue Length 95th (ft)	23	348	8	0	0	4	0	0				
Control Delay (s)	13.8	160.8	9.3	0.0	0.0	9.5	0.0	0.0				
Lane LOS	B	F	A			A						
Approach Delay (s)	13.8	160.8	1.0			0.6						
Approach LOS	B	F										
Intersection Summary												
Average Delay	25.7											
Intersection Capacity Utilization	58.1%			ICU Level of Service				B				
Analysis Period (min)	15											

HCM Signalized Intersection Capacity Analysis

7: Commerce Blvd & Padre Pkwy

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔		↖	↗	↖	↖	↗	
Volume (vph)	14	6	107	235	5	50	92	521	229	44	618	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5			4.5			4.5			4.5		
Lane Util. Factor	1.00			1.00			1.00			1.00		
Flrb, ped/bikes	0.93			0.98			1.00			0.87		
Flpb, ped/bikes	1.00			0.97			1.00			1.00		
Frt	0.89			0.98			1.00			0.85		
Flt Protected	0.99			0.96			0.95			1.00		
Satd. Flow (prot)	1524			1662			1770			1863		
Flt Permitted	0.95			0.71			0.95			1.00		
Satd. Flow (perm)	1460			1223			1770			1863		
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	14	6	109	240	5	51	94	532	234	45	631	12
RTOR Reduction (vph)	0	79	0	0	12	0	0	0	120	0	1	0
Lane Group Flow (vph)	0	50	0	0	284	0	94	532	114	45	642	0
Confl. Peds. (#/hr)	50		50	50		50			50			50
Confl. Bikes (#/hr)			20			20			20			20
Turn Type	Perm	NA		Perm	NA		Prot	NA	Perm	Prot	NA	
Protected Phases	4			8			5	2	2		1	6
Permitted Phases	4		8						2			
Actuated Green, G (s)	18.7			18.7			4.2	32.7	32.7	2.3	30.8	
Effective Green, g (s)	18.7			18.7			4.2	32.7	32.7	2.3	30.8	
Actuated g/C Ratio	0.28			0.28			0.06	0.49	0.49	0.03	0.46	
Clearance Time (s)	4.5			4.5			4.5	4.5	4.5	4.5	4.5	
Vehicle Extension (s)	3.0			3.0			3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	406			340			110	906	670	60	849	
v/s Ratio Prot							c0.05	0.29		0.03	c0.35	
v/s Ratio Perm	0.03			c0.23					0.08			
v/c Ratio	0.12			0.84			0.85	0.59	0.17	0.75	0.76	
Uniform Delay, d1	18.1			22.8			31.2	12.4	9.7	32.2	15.1	
Progression Factor	1.00			1.00			1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.1			16.2			43.8	2.8	0.5	40.4	6.2	
Delay (s)	18.3			39.0			75.0	15.2	10.2	72.6	21.3	
Level of Service	B			D			E	B	B	E	C	
Approach Delay (s)	18.3			39.0			20.4			24.7		
Approach LOS	B			D			C			C		
Intersection Summary												
HCM 2000 Control Delay	24.5			HCM 2000 Level of Service					C			
HCM 2000 Volume to Capacity ratio	0.79											
Actuated Cycle Length (s)	67.2			Sum of lost time (s)					13.5			
Intersection Capacity Utilization	73.4%			ICU Level of Service					D			
Analysis Period (min)	15											
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis
8: State Farm Dr & City Center Dr

4/15/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	28	34	171	131	7	36	90	414	118	115	508	35
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	29	35	174	134	7	37	92	422	120	117	518	36
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)								456				
pX, platoon unblocked												
vC, conflicting volume	1206	1497	277	1352	1455	271	554			543		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1206	1497	277	1352	1455	271	554			543		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	73	64	76	0	93	95	91			89		
cM capacity (veh/h)	107	98	720	51	104	726	1012			1022		
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3		
Volume Total	46	192	134	44	92	282	261	117	346	209		
Volume Left	29	0	134	0	92	0	0	117	0	0		
Volume Right	0	174	0	37	0	0	120	0	0	36		
cSH	103	457	51	367	1012	1700	1700	1022	1700	1700		
Volume to Capacity	0.45	0.42	2.61	0.12	0.09	0.17	0.15	0.11	0.20	0.12		
Queue Length 95th (ft)	48	51	348	10	7	0	0	10	0	0		
Control Delay (s)	65.4	18.5	900.2	16.1	8.9	0.0	0.0	9.0	0.0	0.0		
Lane LOS	F	C	F	C	A			A				
Approach Delay (s)	27.5		681.7		1.3			1.6				
Approach LOS	D		F									
Intersection Summary												
Average Delay				75.2								
Intersection Capacity Utilization				49.5%	ICU Level of Service			A				
Analysis Period (min)				15								

HCM Signalized Intersection Capacity Analysis
8: State Farm Dr & City Center Dr

4/15/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	28	34	171	131	7	36	90	414	118	115	508	35
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5		4.5	4.5	4.5	4.5	4.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	0.88	1.00	0.90			1.00	1.00	0.90	1.00	0.99	
Flpb, ped/bikes	0.97	1.00	0.94	1.00			1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.85	1.00	0.87			1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.98	1.00	0.95	1.00			0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1768	1398	1659	1467			1770	1863	1423	1770	1832	
Flt Permitted	0.88	1.00	0.72	1.00			0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1583	1398	1249	1467			1770	1863	1423	1770	1832	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	29	35	174	134	7	37	92	422	120	117	518	36
RTOR Reduction (vph)	0	0	134	0	29	0	0	0	63	0	3	0
Lane Group Flow (vph)	0	64	40	134	15	0	92	422	57	117	551	0
Confl. Peds. (#/hr)	50		50	50		50			50			50
Confl. Bikes (#/hr)			20			20			20			20
Turn Type	Perm	NA	Perm	Perm	NA		Prot	NA	Perm	Prot	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8					2			
Actuated Green, G (s)		13.8	13.8	13.8	13.8		4.2	28.7	28.7	4.2	28.7	
Effective Green, g (s)		13.8	13.8	13.8	13.8		4.2	28.7	28.7	4.2	28.7	
Actuated g/C Ratio		0.23	0.23	0.23	0.23		0.07	0.48	0.48	0.07	0.48	
Clearance Time (s)		4.5	4.5	4.5	4.5		4.5	4.5	4.5	4.5	4.5	
Vehicle Extension (s)		3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		362	320	286	336		123	888	678	123	873	
v/s Ratio Prot					0.01		0.05	0.23		c0.07	c0.30	
v/s Ratio Perm		0.04	0.03	c0.11					0.04			
v/c Ratio		0.18	0.12	0.47	0.05		0.75	0.48	0.08	0.95	0.63	
Uniform Delay, d1		18.6	18.4	20.0	18.1		27.5	10.7	8.6	27.9	11.8	
Progression Factor		1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		0.2	0.2	1.2	0.1		21.7	1.8	0.2	65.7	3.5	
Delay (s)		18.9	18.6	21.2	18.1		49.2	12.5	8.8	93.6	15.2	
Level of Service		B	B	C	B		D	B	A	F	B	
Approach Delay (s)		18.7			20.5			17.1			28.9	
Approach LOS		B			C			B			C	
Intersection Summary												
HCM 2000 Control Delay			22.3		HCM 2000 Level of Service				C			
HCM 2000 Volume to Capacity ratio			0.61									
Actuated Cycle Length (s)			60.2		Sum of lost time (s)				13.5			
Intersection Capacity Utilization			74.2%		ICU Level of Service				D			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis
9: US 101 SB Ramps & Rohnert Park Expressway

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑	↑	↑	↑↑↑		↑		↑	↑		↑
Volume (vph)	0	1473	646	42	1725	0	5	0	41	955	0	384
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	11	12	12	12	12	12	12	12	12	12
Total Lost time (s)		4.5	4.5	3.5	4.5		4.0		4.0	4.0		4.0
Lane Util. Factor		0.91	1.00	1.00	0.91		1.00		1.00	0.97		1.00
Frt		1.00	0.85	1.00	1.00		1.00		0.85	1.00		0.85
Flt Protected		1.00	1.00	0.95	1.00		0.95		1.00	0.95		1.00
Satd. Flow (prot)		5085	1531	1770	5085		1770		1583	3433		1583
Flt Permitted		1.00	1.00	0.95	1.00		0.95		1.00	0.95		1.00
Satd. Flow (perm)		5085	1531	1770	5085		1770		1583	3433		1583
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	0	1503	659	43	1760	0	5	0	42	974	0	392
RTOR Reduction (vph)	0	0	170	0	0	0	0	0	41	0	0	46
Lane Group Flow (vph)	0	1503	489	43	1760	0	5	0	1	974	0	346
Turn Type		NA	Perm	Prot	NA		Prot		Prot	Prot		Perm
Protected Phases		2		1	6		3		3	4		
Permitted Phases			2									4
Actuated Green, G (s)		78.0	78.0	6.8	88.3		4.0		4.0	53.2		53.2
Effective Green, g (s)		78.0	78.0	6.8	88.3		4.0		4.0	53.2		53.2
Actuated g/C Ratio		0.49	0.49	0.04	0.56		0.03		0.03	0.34		0.34
Clearance Time (s)		4.5	4.5	3.5	4.5		4.0		4.0	4.0		4.0
Vehicle Extension (s)		4.0	4.0	2.0	4.0		3.0		3.0	2.0		2.0
Lane Grp Cap (vph)		2510	755	76	2841		44		40	1155		533
v/s Ratio Prot		0.30		0.02	c0.35		c0.00		0.00	c0.28		
v/s Ratio Perm			c0.32									0.22
v/c Ratio		0.60	0.65	0.57	0.62		0.11		0.03	0.84		0.65
Uniform Delay, d1		28.8	29.8	74.2	23.5		75.3		75.1	48.5		44.5
Progression Factor		0.36	0.24	0.82	0.50		1.00		1.00	1.00		1.00
Incremental Delay, d2		0.8	3.0	4.9	0.9		1.2		0.3	5.5		2.1
Delay (s)		11.1	10.1	65.5	12.7		76.4		75.4	54.1		46.5
Level of Service		B	B	E	B		E		E	D		D
Approach Delay (s)		10.8			13.9			75.5			51.9	
Approach LOS		B			B			E			D	
Intersection Summary												
HCM 2000 Control Delay	22.9			HCM 2000 Level of Service				C				
HCM 2000 Volume to Capacity ratio	0.71											
Actuated Cycle Length (s)	158.0			Sum of lost time (s)				16.0				
Intersection Capacity Utilization	70.9%			ICU Level of Service				C				
Analysis Period (min)	15											
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis
10: US 101 NB Ramps & Rohnert Park Expressway

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	49	1987	0	0	1512	809	604	16	557	29	0	16
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	6.0			6.0	6.0	5.0	5.0	5.0	5.0		5.0
Lane Util. Factor	1.00	0.86			0.91	1.00	0.95	0.95	0.88	1.00		1.00
Frt	1.00	1.00			1.00	0.85	1.00	1.00	0.85	1.00		0.85
Flt Protected	0.95	1.00			1.00	1.00	0.95	0.95	1.00	0.95		1.00
Satd. Flow (prot)	1770	6408			5085	1583	1681	1689	2787	1770		1583
Flt Permitted	0.95	1.00			1.00	1.00	0.95	0.95	1.00	0.95		1.00
Satd. Flow (perm)	1770	6408			5085	1583	1681	1689	2787	1770		1583
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	50	2028	0	0	1543	826	616	16	568	30	0	16
RTOR Reduction (vph)	0	0	0	0	0	331	0	0	73	0	0	15
Lane Group Flow (vph)	50	2028	0	0	1543	495	314	318	495	30	0	1
Turn Type	Prot	NA			NA	Perm	Split	NA	Perm	Prot		Perm
Protected Phases	5	2			6		3	3		4		
Permitted Phases						6			3			4
Actuated Green, G (s)	8.0	97.8			84.8	84.8	38.8	38.8	38.8	5.4		5.4
Effective Green, g (s)	8.0	97.8			84.8	84.8	38.8	38.8	38.8	5.4		5.4
Actuated g/C Ratio	0.05	0.62			0.54	0.54	0.25	0.25	0.25	0.03		0.03
Clearance Time (s)	5.0	6.0			6.0	6.0	5.0	5.0	5.0	5.0		5.0
Vehicle Extension (s)	2.0	4.0			4.0	4.0	2.0	2.0	2.0	2.0		2.0
Lane Grp Cap (vph)	89	3966			2729	849	412	414	684	60		54
v/s Ratio Prot	0.03	c0.32			0.30		0.19	c0.19		c0.02		
v/s Ratio Perm						c0.31			0.18			0.00
v/c Ratio	0.56	0.51			0.57	0.58	0.76	0.77	0.72	0.50		0.01
Uniform Delay, d1	73.3	16.8			24.3	24.7	55.3	55.4	54.7	75.0		73.7
Progression Factor	0.85	0.48			0.66	0.79	1.00	1.00	1.00	1.00		1.00
Incremental Delay, d2	3.9	0.4			0.5	1.8	7.3	7.5	3.2	2.4		0.0
Delay (s)	66.0	8.5			16.5	21.3	62.7	62.9	57.9	77.3		73.7
Level of Service	E	A			B	C	E	E	E	E		E
Approach Delay (s)		9.9			18.2			60.5			76.1	
Approach LOS		A			B			E			E	
Intersection Summary												
HCM 2000 Control Delay	24.5			HCM 2000 Level of Service				C				
HCM 2000 Volume to Capacity ratio	0.63											
Actuated Cycle Length (s)	158.0			Sum of lost time (s)				21.0				
Intersection Capacity Utilization	86.4%			ICU Level of Service				E				
Analysis Period (min)	15											
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis
11: Commerce Blvd & Rohnert Park Expressway

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Volume (vph)	412	1303	812	216	1313	120	592	282	289	192	304	443
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.91		0.97	1.00	1.00	0.91	0.91	1.00
Frpb, ped/bikes	1.00	1.00	0.99	1.00	1.00		1.00	1.00	0.98	1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1560	1770	5010		3433	1863	1548	1610	3375	1562
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1560	1770	5010		3433	1863	1548	1610	3375	1562
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	420	1330	829	220	1340	122	604	288	295	196	310	452
RTOR Reduction (vph)	0	0	89	0	5	0	0	0	190	0	0	64
Lane Group Flow (vph)	420	1330	740	220	1457	0	604	288	105	165	341	388
Confl. Peds. (#/hr)			13			10			5			7
Confl. Bikes (#/hr)						2			5			2
Turn Type	Prot	NA	pm+ov	Prot	NA		Split	NA	Perm	Split	NA	pm+ov
Protected Phases	5	2	3	1	6		3	3		4	4	5
Permitted Phases			2						3			4
Actuated Green, G (s)	13.0	44.9	84.6	29.7	61.6		39.7	39.7	39.7	23.7	23.7	36.7
Effective Green, g (s)	13.0	44.9	84.6	29.7	61.6		39.7	39.7	39.7	23.7	23.7	36.7
Actuated g/C Ratio	0.08	0.28	0.54	0.19	0.39		0.25	0.25	0.25	0.15	0.15	0.23
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Vehicle Extension (s)	1.0	1.0	1.5	1.0	1.0		1.5	1.5	1.5	1.0	1.0	1.0
Lane Grp Cap (vph)	282	1005	835	332	1953		862	468	388	241	506	412
v/s Ratio Prot	0.12	c0.38	c0.22	0.12	c0.29		0.18	0.15		0.10	0.10	c0.08
v/s Ratio Perm			0.25						0.07			0.17
v/c Ratio	1.49	1.32	0.89	0.66	0.75		0.70	0.62	0.27	0.68	0.67	0.94
Uniform Delay, d1	72.5	56.5	32.5	59.5	41.5		53.8	52.4	47.5	63.6	63.5	59.6
Progression Factor	0.80	0.75	1.75	0.54	0.66		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	235.6	151.5	9.5	1.2	0.8		2.1	1.7	0.1	6.3	2.8	29.7
Delay (s)	293.9	193.8	66.4	33.6	28.3		55.9	54.1	47.7	69.9	66.3	89.3
Level of Service	F	F	E	C	C		E	D	D	E	E	F
Approach Delay (s)		169.1			29.0			53.4			77.8	
Approach LOS		F			C			D			E	
Intersection Summary												
HCM 2000 Control Delay			97.2									
HCM 2000 Volume to Capacity ratio			1.04									
Actuated Cycle Length (s)			158.0						20.0			
Intersection Capacity Utilization			98.9%						F			
ICU Level of Service												
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis
11: Commerce Blvd & Rohnert Park Expressway

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Volume (vph)	412	1303	812	216	1313	120	592	282	289	192	304	443
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0	5.0		5.0	4.0	5.0	4.0	5.0	5.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.91		0.97	1.00	1.00	1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	1.00	0.98	1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1547	1770	5010		3433	1863	1553	1770	3539	1565
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1547	1770	5010		3433	1863	1553	1770	3539	1565
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	420	1330	829	220	1340	122	604	288	295	196	310	452
RTOR Reduction (vph)	0	0	65	0	7	0	0	0	62	0	0	37
Lane Group Flow (vph)	420	1330	764	220	1455	0	604	288	233	196	310	415
Confl. Peds. (#/hr)			13			10			5			7
Confl. Bikes (#/hr)						2			5			2
Turn Type	Prot	NA	pm+ov	Prot	NA		Prot	NA	pm+ov	Prot	NA	pm+ov
Protected Phases	5	2	3	1	6		3	8	1	7	4	5
Permitted Phases			2						8			4
Actuated Green, G (s)	20.0	64.0	88.0	16.0	60.0		24.0	29.0	45.0	21.0	24.0	44.0
Effective Green, g (s)	20.0	64.0	88.0	16.0	60.0		24.0	29.0	45.0	21.0	24.0	44.0
Actuated g/C Ratio	0.14	0.43	0.59	0.11	0.41		0.16	0.20	0.30	0.14	0.16	0.30
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0		5.0	4.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	1.0	1.0	1.5	1.0	1.0		1.5	3.0	1.0	3.0	1.0	1.0
Lane Grp Cap (vph)	463	1530	919	191	2031		556	365	472	251	573	465
v/s Ratio Prot	c0.12	c0.38	0.13	c0.12	0.29		c0.18	c0.15	0.05	0.11	0.09	0.12
v/s Ratio Perm			0.36						0.10			0.14
v/c Ratio	0.91	0.87	0.83	1.15	0.72		1.09	0.79	0.49	0.78	0.54	0.89
Uniform Delay, d1	63.1	38.2	24.1	66.0	36.9		62.0	56.6	42.2	61.3	56.9	49.8
Progression Factor	0.88	0.60	1.11	0.81	0.43		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	18.3	6.0	5.3	97.9	1.3		63.7	10.8	0.3	14.5	0.6	18.7
Delay (s)	73.9	29.0	32.0	151.5	17.2		125.7	67.4	42.5	75.8	57.5	68.5
Level of Service	E	C	C	F	B		F	E	D	E	E	E
Approach Delay (s)		37.3			34.8			90.9			66.4	
Approach LOS		D			C			F			E	
Intersection Summary												
HCM 2000 Control Delay			50.9							D		
HCM 2000 Volume to Capacity ratio			0.95									
Actuated Cycle Length (s)			148.0						20.0			
Intersection Capacity Utilization			94.6%						F			
ICU Level of Service												
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis
12: State Farm Dr & Rohnert Park Expressway

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↰	↰	↰	↰	↰	↰	↰	↰	↰	↰	↰
Volume (vph)	295	1068	349	305	1052	195	425	180	245	339	256	258
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.91	0.91	1.00	0.91	0.91	0.91
Frpb, ped/bikes	1.00	1.00	0.97	1.00	1.00	0.98	1.00	1.00	0.98	1.00	0.99	0.99
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.93	0.93
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.97	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3539	1538	1770	3539	1552	1610	3301	1547	1610	3118	3118
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	0.97	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	3539	1538	1770	3539	1552	1610	3301	1547	1610	3118	3118
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	301	1090	356	311	1073	199	434	184	250	346	261	263
RTOR Reduction (vph)	0	0	192	0	0	84	0	0	199	0	105	0
Lane Group Flow (vph)	301	1090	164	311	1073	115	217	401	51	298	467	0
Confl. Peds. (#/hr)			12			5			10			4
Confl. Bikes (#/hr)			1			1						1
Turn Type	Prot	NA	Perm	Prot	NA	Perm	Split	NA	Perm	Split	NA	
Protected Phases	5	2		1	6		3	3		4	4	
Permitted Phases			2			6			3			
Actuated Green, G (s)	38.4	61.5	61.5	16.0	39.1	39.1	27.1	27.1	27.1	33.4	33.4	
Effective Green, g (s)	38.4	61.5	61.5	16.0	39.1	39.1	27.1	27.1	27.1	33.4	33.4	
Actuated g/C Ratio	0.24	0.39	0.39	0.10	0.25	0.25	0.17	0.17	0.17	0.21	0.21	
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
Lane Grp Cap (vph)	430	1377	598	179	875	384	276	566	265	340	659	
v/s Ratio Prot	0.17	c0.31		c0.18	c0.30		c0.13	0.12		c0.19	0.15	
v/s Ratio Perm			0.11			0.07			0.03			
v/c Ratio	0.70	0.79	0.27	1.74	1.23	0.30	0.79	0.71	0.19	0.88	0.71	
Uniform Delay, d1	54.5	42.6	33.0	71.0	59.5	48.3	62.7	61.7	56.1	60.3	57.8	
Progression Factor	0.47	0.37	0.71	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.4	0.4	0.1	354.0	112.0	2.0	12.7	3.3	0.1	20.9	2.9	
Delay (s)	26.1	16.2	23.7	425.0	171.4	50.3	75.4	65.0	56.2	81.2	60.7	
Level of Service	C	B	C	F	F	D	E	E	E	F	E	
Approach Delay (s)		19.4			206.0			65.1			67.7	
Approach LOS		B			F			E			E	
Intersection Summary												
HCM 2000 Control Delay		93.8			HCM 2000 Level of Service			F				
HCM 2000 Volume to Capacity ratio		0.98										
Actuated Cycle Length (s)		158.0			Sum of lost time (s)			20.0				
Intersection Capacity Utilization		100.5%			ICU Level of Service			G				
Analysis Period (min)		15										
c Critical Lane Group												

Rohnert Park PDA Plan
PM Peak Hour - Future plus Project

Synchro 8 Report
W-Trans

HCM Signalized Intersection Capacity Analysis
12: State Farm Dr & Rohnert Park Expressway

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↰	↰	↰	↰	↰	↰	↰	↰	↰	↰	↰
Volume (vph)	295	1068	349	305	1052	195	425	180	245	339	256	258
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	12	12	12	12	12	12	12	12	12	12	11	11
Lane Width	12	12	12	12	12	12	12	12	12	12	11	11
Total Lost time (s)	5.0	5.0	4.0	5.0	5.0	4.0	4.0	4.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00	0.97	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.97	1.00	1.00	0.98	1.00	1.00	0.99	1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3539	1531	1770	3539	1549	3433	1863	1566	3319	1801	1517
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	3539	1531	1770	3539	1549	3433	1863	1566	3319	1801	1517
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	301	1090	356	311	1073	199	434	184	250	346	261	263
RTOR Reduction (vph)	0	0	107	0	0	74	0	0	51	0	0	52
Lane Group Flow (vph)	301	1090	249	311	1073	125	434	184	199	346	261	211
Confl. Peds. (#/hr)			12			5			10			4
Confl. Bikes (#/hr)			1			1						1
Turn Type	Prot	NA	pm+ov	Prot	NA	pm+ov	Prot	NA	pm+ov	Prot	NA	pm+ov
Protected Phases	5	2	3	1	6	7	3	8	1	7	4	5
Permitted Phases			2			6			8			4
Actuated Green, G (s)	26.0	49.6	72.2	28.9	52.5	78.7	22.6	25.3	54.2	26.2	27.9	53.9
Effective Green, g (s)	26.0	49.6	72.2	28.9	52.5	78.7	22.6	25.3	54.2	26.2	27.9	53.9
Actuated g/C Ratio	0.18	0.34	0.49	0.20	0.35	0.53	0.15	0.17	0.37	0.18	0.19	0.36
Clearance Time (s)	5.0	5.0	4.0	5.0	5.0	4.0	4.0	4.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	1.0	1.0	3.0	1.0	1.0	3.0	3.0	3.0	1.0	3.0	1.0	1.0
Lane Grp Cap (vph)	310	1186	746	345	1255	865	524	318	573	587	339	603
v/s Ratio Prot	0.17	c0.31	0.05	0.18	c0.30	0.03	c0.13	0.10	0.07	c0.10	c0.14	0.06
v/s Ratio Perm			0.11			0.05			0.06			0.08
v/c Ratio	0.97	0.92	0.33	0.90	0.85	0.14	0.83	0.58	0.35	0.59	0.77	0.35
Uniform Delay, d1	60.6	47.3	23.2	58.2	44.2	17.6	60.8	56.4	34.0	56.0	57.0	34.3
Progression Factor	0.71	0.64	0.38	1.12	0.75	0.99	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	31.4	8.2	0.2	21.0	6.1	0.1	10.4	2.5	0.1	1.5	9.1	0.1
Delay (s)	74.5	38.3	9.1	86.3	39.3	17.5	71.2	59.0	34.2	57.5	66.1	34.4
Level of Service	E	D	A	F	D	B	E	C	E	E	E	C
Approach Delay (s)		38.6			45.8			58.0			53.1	
Approach LOS		D			D			E			D	
Intersection Summary												
HCM 2000 Control Delay		46.6			HCM 2000 Level of Service			D				
HCM 2000 Volume to Capacity ratio		0.87										
Actuated Cycle Length (s)		148.0			Sum of lost time (s)			19.0				
Intersection Capacity Utilization		90.1%			ICU Level of Service			E				
Analysis Period (min)		15										
c Critical Lane Group												

Rohnert Park PDA Plan
PM Peak Hour - Future plus Project (Mitigated)

Synchro 8 Report
W-Trans

HCM Signalized Intersection Capacity Analysis 13: Commerce Blvd & Enterprise Dr

4/15/2015

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↔↔	↔	↕↕		↕	↕↕
Volume (vph)	196	63	686	106	77	772
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	0.97	1.00	0.95		1.00	0.95
Frt	1.00	0.85	0.98		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	3433	1583	3468		1770	3539
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	3433	1583	3468		1770	3539
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	200	64	700	108	79	788
RTOR Reduction (vph)	0	52	17	0	0	0
Lane Group Flow (vph)	200	12	791	0	79	788
Turn Type	Prot	Perm	NA		Prot	NA
Protected Phases	8		2		1	6
Permitted Phases		8				
Actuated Green, G (s)	7.7	7.7	18.4		2.9	25.3
Effective Green, g (s)	7.7	7.7	18.4		2.9	25.3
Actuated g/C Ratio	0.19	0.19	0.45		0.07	0.62
Clearance Time (s)	4.0	4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	644	297	1556		125	2183
v/s Ratio Prot	c0.06		c0.23		c0.04	0.22
v/s Ratio Perm		0.01				
v/c Ratio	0.31	0.04	0.51		0.63	0.36
Uniform Delay, d1	14.4	13.6	8.1		18.5	3.9
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	0.3	0.1	0.3		10.0	0.1
Delay (s)	14.6	13.7	8.3		28.5	4.0
Level of Service	B	B	A		C	A
Approach Delay (s)	14.4		8.3			6.2
Approach LOS	B		A			A
Intersection Summary						
HCM 2000 Control Delay			8.2		HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio			0.47			
Actuated Cycle Length (s)			41.0		Sum of lost time (s)	12.0
Intersection Capacity Utilization			42.2%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						

HCM Unsignalized Intersection Capacity Analysis 14: Enterprise Dr & Hunter Dr

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔↔			↔↔			↔↔			↔↔	
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	2	187	2	8	208	147	2	3	0	247	2	34
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	2	191	2	8	212	150	2	3	0	252	2	35
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1						
Volume Total (vph)	97	97	114	256	5	289						
Volume Left (vph)	2	0	8	0	2	252						
Volume Right (vph)	0	2	0	150	0	35						
Hadj (s)	0.04	0.02	0.07	-0.38	0.11	0.14						
Departure Headway (s)	5.9	5.8	5.7	5.2	5.9	5.4						
Degree Utilization, x	0.16	0.16	0.18	0.37	0.01	0.43						
Capacity (veh/h)	576	581	603	659	528	632						
Control Delay (s)	8.8	8.7	8.7	10.1	9.0	12.4						
Approach Delay (s)	8.7		9.7		9.0	12.4						
Approach LOS	A		A		A	B						
Intersection Summary												
Delay			10.4									
Level of Service			B									
Intersection Capacity Utilization			45.7%	ICU Level of Service		A						
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis

14: Enterprise Dr & Hunter Dr

4/15/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control	Stop			Stop			Stop			Stop		
Volume (vph)	2	187	2	8	208	147	2	3	0	247	2	34
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	2	191	2	8	212	150	2	3	0	252	2	35
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1						
Volume Total (vph)	2	193	220	150	5	289						
Volume Left (vph)	2	0	8	0	2	252						
Volume Right (vph)	0	2	0	150	0	35						
Hadj (s)	0.53	0.03	0.05	-0.67	0.11	0.14						
Departure Headway (s)	6.4	5.9	5.7	5.0	5.9	5.4						
Degree Utilization, x	0.00	0.31	0.35	0.21	0.01	0.43						
Capacity (veh/h)	531	583	606	692	522	627						
Control Delay (s)	8.2	10.3	10.5	8.0	9.0	12.5						
Approach Delay (s)	10.3		9.5		9.0	12.5						
Approach LOS	B		A		A	B						
Intersection Summary												
Delay	10.7											
Level of Service	B											
Intersection Capacity Utilization	46.6%			ICU Level of Service			A					
Analysis Period (min)	15											

HCM Unsignalized Intersection Capacity Analysis

15: Enterprise Dr & State Farm Dr

4/15/2015

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↱	↰	↱	↰	↱
Sign Control		Stop	Stop		Stop	
Volume (vph)	130	275	185	442	610	170
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	133	281	189	451	622	173
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total (vph)	133	281	126	514	622	173
Volume Left (vph)	133	0	0	0	622	0
Volume Right (vph)	0	0	0	451	0	173
Hadj (s)	0.53	0.03	0.03	-0.58	0.53	-0.67
Departure Headway (s)	8.2	7.7	7.4	6.8	8.0	6.7
Degree Utilization, x	0.30	0.60	0.26	0.97	1.0	0.32
Capacity (veh/h)	430	452	475	514	463	528
Control Delay (s)	13.6	20.5	11.8	57.8	203.7	11.7
Approach Delay (s)	18.3		48.8		161.9	
Approach LOS	C		E		F	
Intersection Summary						
Delay			90.7			
Level of Service			F			
Intersection Capacity Utilization			70.4%		ICU Level of Service	
Analysis Period (min)			15		C	

HCM Signalized Intersection Capacity Analysis
15: Enterprise Dr & State Farm Dr

4/15/2015

	EBL	EBT	WBT	WBR	SBL	SBR
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑	↑	↱	↰	↱
Volume (vph)	130	275	185	442	610	170
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Flt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1863	1863	1583	1770	1583
Flt Permitted	0.64	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1189	1863	1863	1583	1770	1583
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	133	281	189	451	622	173
RTOR Reduction (vph)	0	0	0	310	0	88
Lane Group Flow (vph)	133	281	189	141	622	85
Turn Type	Perm	NA	NA	Perm	Prot	Perm
Protected Phases		2	6		4	
Permitted Phases	2			6		4
Actuated Green, G (s)	12.7	12.7	12.7	12.7	19.8	19.8
Effective Green, g (s)	12.7	12.7	12.7	12.7	19.8	19.8
Actuated g/C Ratio	0.31	0.31	0.31	0.31	0.49	0.49
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	372	584	584	496	865	773
v/s Ratio Prot		c0.15	0.10		c0.35	
v/s Ratio Perm	0.11			0.09		0.05
v/c Ratio	0.36	0.48	0.32	0.29	0.72	0.11
Uniform Delay, d1	10.7	11.2	10.6	10.5	8.2	5.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.6	0.6	0.3	0.3	2.9	0.1
Delay (s)	11.3	11.9	10.9	10.8	11.0	5.7
Level of Service	B	B	B	B	B	A
Approach Delay (s)		11.7	10.8		9.9	
Approach LOS		B	B		A	
Intersection Summary						
HCM 2000 Control Delay		10.6		HCM 2000 Level of Service		B
HCM 2000 Volume to Capacity ratio		0.63				
Actuated Cycle Length (s)		40.5		Sum of lost time (s)		8.0
Intersection Capacity Utilization		60.7%		ICU Level of Service		B
Analysis Period (min)		15				
c Critical Lane Group						

HCM Unsignalized Intersection Capacity Analysis
16: Enterprise Dr/Seed Farm Dr

4/15/2015

	EBL	EBT	WBT	WBR	SBL	SBR
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↱	↰	↱	↰	↱
Volume (veh/h)	18	870	499	12	10	52
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	18	888	509	12	10	53
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	521				1440	515
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	521				1440	515
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	98				93	91
cM capacity (veh/h)	1045				144	560
Direction, Lane #						
	EB 1	WB 1	SB 1			
Volume Total	906	521	63			
Volume Left	18	0	10			
Volume Right	0	12	53			
cSH	1045	1700	381			
Volume to Capacity	0.02	0.31	0.17			
Queue Length 95th (ft)	1	0	15			
Control Delay (s)	0.5	0.0	16.3			
Lane LOS	A		C			
Approach Delay (s)	0.5	0.0	16.3			
Approach LOS			C			
Intersection Summary						
Average Delay		1.0				
Intersection Capacity Utilization		70.7%		ICU Level of Service		C
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis 17: State Farm Dr & Town Center

4/15/2015

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	177	6	73	26	6	148	37	521	28	149	596	125
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Hourly flow rate (vph)	181	6	74	27	6	151	38	532	29	152	608	128
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)											575	
pX, platoon unblocked												
vC, conflicting volume	1471	1612	368	1307	1661	280	736			560		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1471	1612	368	1307	1661	280	736			560		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	93	88	68	92	79	96			85		
cM capacity (veh/h)	56	84	629	84	78	717	866			1007		
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3				
Volume Total	261	184	38	354	206	152	405	330				
Volume Left	181	27	38	0	0	152	0	0				
Volume Right	74	151	0	0	29	0	0	128				
cSH	77	303	866	1700	1700	1007	1700	1700				
Volume to Capacity	3.40	0.61	0.04	0.21	0.12	0.15	0.24	0.19				
Queue Length 95th (ft)	Err	92	3	0	0	13	0	0				
Control Delay (s)	Err	33.6	9.3	0.0	0.0	9.2	0.0	0.0				
Lane LOS	F	D	A			A						
Approach Delay (s)	Err	33.6	0.6			1.6						
Approach LOS	F	D										
Intersection Summary												
Average Delay				1357.0								
Intersection Capacity Utilization				62.6%			ICU Level of Service			B		
Analysis Period (min)				15								

HCM Signalized Intersection Capacity Analysis 17: State Farm Dr & Town Center

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔	↗		↔	↗	↖	↖	↖	↖	↖	↖
Volume (vph)	177	6	73	26	6	148	37	521	28	149	596	125
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Flpb, ped/bikes	1.00	0.90		1.00	0.90	1.00	1.00	1.00	0.89	1.00	1.00	0.89
Flpb, ped/bikes	0.95	1.00		0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85		1.00	0.85	1.00	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.96	1.00	0.95	1.00	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1697	1432		1735	1432	1770	1863	1409	1770	1863	1415	
Flt Permitted	0.71	1.00		0.76	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1261	1432		1375	1432	1770	1863	1409	1770	1863	1415	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	181	6	74	27	6	151	38	532	29	152	608	128
RTOR Reduction (vph)	0	0	55	0	0	112	0	0	17	0	0	48
Lane Group Flow (vph)	0	187	19	0	33	39	38	532	12	152	608	80
Confl. Peds. (#/hr)	50		50	50		50			50		50	
Confl. Bikes (#/hr)			20			20			20		20	
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)		14.5	14.5		14.5	14.5	1.4	22.9	22.9	7.2	28.7	28.7
Effective Green, g (s)		14.5	14.5		14.5	14.5	1.4	22.9	22.9	7.2	28.7	28.7
Actuated g/C Ratio		0.26	0.26		0.26	0.26	0.02	0.40	0.40	0.13	0.51	0.51
Clearance Time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)		323	366		352	366	43	753	570	225	944	717
v/s Ratio Prot							0.02	0.29		c0.09	c0.33	
v/s Ratio Perm		c0.15	0.01		0.02	0.03			0.01			0.06
v/c Ratio		0.58	0.05		0.09	0.11	0.88	0.71	0.02	0.68	0.64	0.11
Uniform Delay, d1		18.4	15.9		16.0	16.1	27.5	14.0	10.1	23.6	10.2	7.3
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		2.5	0.1		0.1	0.1	92.7	3.0	0.0	7.8	1.5	0.1
Delay (s)		20.9	15.9		16.2	16.2	120.2	17.1	10.1	31.4	11.7	7.4
Level of Service		C	B		B	B	F	B	B	C	B	A
Approach Delay (s)		19.5			16.2			23.3			14.5	
Approach LOS		B			B			C			B	
Intersection Summary												
HCM 2000 Control Delay	18.0			HCM 2000 Level of Service				B				
HCM 2000 Volume to Capacity ratio	0.66											
Actuated Cycle Length (s)	56.6			Sum of lost time (s)				12.0				
Intersection Capacity Utilization	82.8%			ICU Level of Service				E				
Analysis Period (min)	15											
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis
60: Lynn Conde Way & Rohnert Park Expressway

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔	↗			↗			↗
Volume (vph)	0	1609	43	0	1531	6	0	0	19	0	0	21
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0	5.0			3.0			3.0
Lane Util. Factor		0.95			0.95	1.00			1.00			1.00
Frt		1.00			1.00	0.85			0.86			0.86
Flt Protected		1.00			1.00	1.00			1.00			1.00
Satd. Flow (prot)		3525			3539	1583			1611			1611
Flt Permitted		1.00			1.00	1.00			1.00			1.00
Satd. Flow (perm)		3525			3539	1583			1611			1611
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	0	1642	44	0	1562	6	0	0	19	0	0	21
RTOR Reduction (vph)	0	1	0	0	0	1	0	0	14	0	0	16
Lane Group Flow (vph)	0	1685	0	0	1562	5	0	0	5	0	0	5
Turn Type	NA			NA	Perm			Perm			Perm	
Protected Phases	2			6								
Permitted Phases					6			8				8
Actuated Green, G (s)	104.0			104.0	104.0			36.0				36.0
Effective Green, g (s)	104.0			104.0	104.0			36.0				36.0
Actuated g/C Ratio	0.70			0.70	0.70			0.24				0.24
Clearance Time (s)	5.0			5.0	5.0			3.0				3.0
Vehicle Extension (s)	3.0			3.0	3.0			3.0				3.0
Lane Grp Cap (vph)	2477			2486	1112			391				391
v/s Ratio Prot	c0.48			0.44								
v/s Ratio Perm					0.00			0.00				c0.00
v/c Ratio	0.68			0.63	0.00			0.01				0.01
Uniform Delay, d1	12.5			11.7	6.6			42.5				42.5
Progression Factor	0.60			0.01	0.00			1.00				1.00
Incremental Delay, d2	0.9			1.0	0.0			0.0				0.0
Delay (s)	8.5			1.1	0.0			42.5				42.5
Level of Service	A			A	A			D				D
Approach Delay (s)	8.5			1.1			42.5			42.5		
Approach LOS	A			A			D			D		
Intersection Summary												
HCM 2000 Control Delay	5.4			HCM 2000 Level of Service			A					
HCM 2000 Volume to Capacity ratio	0.51											
Actuated Cycle Length (s)	148.0			Sum of lost time (s)			8.0					
Intersection Capacity Utilization	56.7%			ICU Level of Service			B					
Analysis Period (min)	15											
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis
63: SMART midblock & Rohnert Park Expressway

4/15/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔							
Volume (vph)	0	1628	0	0	1537	0	0	0	0	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0							
Lane Util. Factor		0.95			0.95							
Frt		1.00			1.00							
Flt Protected		1.00			1.00							
Satd. Flow (prot)		3539			3539							
Flt Permitted		1.00			1.00							
Satd. Flow (perm)		3539			3539							
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	0	1661	0	0	1568	0	0	0	0	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	1661	0	0	1568	0	0	0	0	0	0	0
Turn Type	NA			NA								
Protected Phases	2			6								
Permitted Phases												
Actuated Green, G (s)	104.0			104.0								
Effective Green, g (s)	104.0			104.0								
Actuated g/C Ratio	0.70			0.70								
Clearance Time (s)	5.0			5.0								
Vehicle Extension (s)	3.0			3.0								
Lane Grp Cap (vph)	2486			2486								
v/s Ratio Prot	c0.47			0.44								
v/s Ratio Perm												
v/c Ratio	0.67			0.63								
Uniform Delay, d1	12.3			11.7								
Progression Factor	0.73			1.00								
Incremental Delay, d2	1.1			1.2								
Delay (s)	10.1			13.0								
Level of Service	B			B								
Approach Delay (s)	10.1			13.0			0.0			0.0		
Approach LOS	B			B			A			A		
Intersection Summary												
HCM 2000 Control Delay	11.5			HCM 2000 Level of Service			B					
HCM 2000 Volume to Capacity ratio	0.50											
Actuated Cycle Length (s)	148.0			Sum of lost time (s)			8.0					
Intersection Capacity Utilization	49.2%			ICU Level of Service			A					
Analysis Period (min)	15											
c Critical Lane Group												

Appendix E

Freeway LOS Calculations

HCS 2010 Freeway Facilities

Project Properties

Analyst	W-Trans	Freeway Name	US 101	Analysis Period	AM Peak
Analysis Date	3/31/2015 4:53:13 PM	From	Railroad Ave	Version Date	10/10/2012
Agency		To	Todd Rd		
Location	Sonoma County, CA	Analysis Direction	Northbound		
User Notes	Central Rohnert Park PDA Plan - AM Peak Hour Existing Conditions - Northbound Direction				
File Name	C:\Users\zmatley\AppData\Local\Temp\preview.xml				

Facility-wide Values

Jam Density (pc/h/ln)	190	Time Period Duration (min)	15	Facility Length (mi)	3.78800

Segment Input Data

Time Period 1

Mainline Data										
Seg #	From	To	Type	Length	Terrain	Adj. Demand	% Trucks	% RVs	# Lanes	FFS
1	SR 116 Off	SR 116 On	Basic Segment	2375	Level	2190	4.00	1.00	2	70
2	SR 116	RP Expressway	Weaving	4370	Level	3017	4.00	0.73	3	70
3	RP Expressway Off	RP Expressway EB On	Basic Segment	1065	Level	2604	4.32	0.84	2	70
4	RP Expressway EB On		On Ramp	1500	Level	2834	4.13	0.77	2	70
5	RP Expressway EB On	RP Expressway WB On	Basic Segment	450	Level	2834	4.13	0.77	2	70
6	RP Expressway	Commerce Blvd	Weaving	2315	Level	3481	3.73	0.63	3	70
7	Commerce Off	Commerce On	Basic Segment	650	Level	3278	3.84	0.67	2	70
8	Commerce Blvd	Santa Rosa Ave	Weaving	3000	Level	3711	3.63	0.59	3	70
9	Santa Rosa Ave	Todd Rd	Basic Segment	4275	Level	3471	3.74	0.63	2	70

RampData							
Seg #	Type	Adj. Demand	% Trucks	% RVs	Lanes	Accel/Decel Length	FFS
4	On Ramp	230	2.00	0.00	1	765	40

Weaving Segment Data											
Seg #	Ramp to Ramp Prop.	On-Ramp					Off-Ramp				
		Adj. Demand	% Trucks	% RVs	Lanes	FFS	Adj. Demand	% Trucks	% RVs	Lanes	FFS
2	0.050	827	4.00	0.00	1	40	413	2.00	0.00	1	50
6	0.050	647	2.00	0.00	1	40	203	2.00	0.00	1	40
8	0.050	433	2.00	0.00	1	40	240	2.00	0.00	1	40

Time Period Independent Weaving Segment Data

Seg #	Configuration	Short Length	# Weaving Lanes	Min. Lane Changes Freeway-Ramp	Min. Lane Changes Ramp-Freeway	Min. Lane Changes Ramp-Ramp
2	3000	2	1	1	0	
6	1782	2	1	1	0	
8	3000	2	1	1	0	

Time Period Results

Time Period 1

Seg #	From	To	Type	Adj. Demand	Vol. Served	Capacity (pc/h)	Capacity (veh/h)	d/c Ratio	v/c ratio	Queue Length (ft)	Avg. Speed (mi/h)	Density (pc/mi/in)	Density (veh/mi/in)	Avg. Travel Time (min/veh)	Free-Flow Travel Time (min/veh)	Mainline Delay (min/veh)	System Delay (min/veh)	VMT Demand (veh-min)	VMT Volume (veh-min)	VHT (veh-hrs)	VHD (veh-hrs)	LOS

1	SR 116 Off	SR 116 On	Basic Segment	2190	2190	4800	4697	0.47	0.47	0	70.0	16.0	15.6	0.39	0.39	0.0	0.0	246.3	246.3	3.5	0.0	B
2	SR 116	RP Expressway	Weaving	3017	3017	6290	6158	0.49	0.49	0	57.9	17.8	17.4	0.86	0.71	0.1	0.1	624.3	624.3	10.8	1.9	B
3	RP Expressway Off	RP Expressway EB On	Basic Segment	2604	2604	4800	4691	0.56	0.56	0	69.8	19.1	18.7	0.17	0.17	0.0	0.0	131.3	131.3	1.9	0.0	C
4	RP Expressway EB On		On Ramp	2834	2834	4800	4696	0.60	0.60	0	60.8	23.8	23.3	0.28	0.24	0.0	0.0	201.3	201.3	3.3	0.4	C
5	RP Expressway EB On	RP Expressway WB On	Basic Segment	2834	2834	4800	4696	0.60	0.60	0	68.1	21.3	20.8	0.08	0.07	0.0	0.0	60.4	60.4	0.9	0.0	C
6	RP Expressway	Commerce Blvd	Weaving	3481	3481	6513	6386	0.55	0.55	0	58.7	20.1	19.8	0.45	0.38	0.1	0.1	381.6	381.6	6.5	1.0	C
7	Commerce Off	Commerce On	Basic Segment	3278	3278	4800	4703	0.70	0.70	0	67.4	24.8	24.3	0.11	0.11	0.0	0.0	100.9	100.9	1.5	0.1	C
8	Commerce Blvd	Santa Rosa Ave	Weaving	3711	3711	6922	6791	0.55	0.55	0	59.6	21.2	20.8	0.57	0.49	0.1	0.1	527.1	527.1	8.8	1.3	C
9	Santa Rosa Ave	Todd Rd	Basic Segment	3471	3471	4800	4706	0.74	0.74	0	66.2	26.7	26.2	0.73	0.69	0.0	0.0	702.6	702.6	10.6	0.6	D

Overall Results

Segment	Segment Type	Maximum d/c Ratio	Avg. Speed (mi/h)	Density (pc/mi/in)	Density (veh/mi/in)	Avg. Travel Time (min/veh)	Free-Flow Travel Time (min/veh)	VMT Demand (veh-min)	VMT Volume (veh-min)	VHT (veh-hrs)	VHD (veh-hrs)
SR 116 Off-SR 116 On	Basic	0.47	70.0	16.0	15.6	0.39	0.39	0,246.3	0,246.3	3.52	0.00
SR 116-RP Expressway	Weaving	0.49	57.9	17.8	17.4	0.86	0.71	0,624.3	0,624.3	10.79	1.87
RP Expressway Off-RP Expressway EB On	Basic	0.56	69.8	19.1	18.7	0.17	0.17	0,131.3	0,131.3	1.88	0.01
RP Expressway EB On-	OnRamp	0.60	60.8	23.8	23.3	0.28	0.24	0,201.3	0,201.3	3.31	0.44
RP Expressway EB On-RP Expressway WB On	Basic	0.60	68.1	21.3	20.8	0.08	0.07	0,060.4	0,060.4	0.89	0.02
RP Expressway-Commerce Blvd	Weaving	0.55	58.7	20.1	19.8	0.45	0.38	0,381.6	0,381.6	6.50	1.05
Commerce Off-Commerce On	Basic	0.70	67.4	24.8	24.3	0.11	0.11	0,100.9	0,100.9	1.50	0.06
Commerce Blvd-Santa Rosa Ave	Weaving	0.55	59.6	21.2	20.8	0.57	0.49	0,527.1	0,527.1	8.85	1.32
Santa Rosa Ave-Todd Rd	Basic	0.74	66.2	26.7	26.2	0.73	0.69	0,702.6	0,702.6	10.61	0.57
Freeway			62.2	20.8	20.3	3.64	3.25	2,975.7	2,975.7	0,047.8	0,005.3

HCS 2010 Freeway Facilities

Project Properties

Analyst	W-Trans	Freeway Name	US101	Analysis Period	AM Peak
Analysis Date	3/31/2015 10:36:29 AM	From	Todd Rd	Version Date	10/10/2012
Agency		To	Railroad Ave		
Location	Sonoma County, CA	Analysis Direction	Southbound		
User Notes	Central Rohnert Park PDA Plan - AM Peak Hour Existing Conditions - Southbound Direction				
File Name	C:\Users\zmatley\AppData\Local\Temp\preview.xml				

Facility-wide Values

Jam Density (pc/h/ln)	190	Time Period Duration (min)	15	Facility Length (mi)	3.75600

Segment Input Data

Time Period 1

Mainline Data										
Seg #	From	To	Type	Length	Terrain	Adj. Demand	% Trucks	% RVs	# Lanes	FFS
1	Todd Rd	Golf Course Dr	Basic Segment	2500	Level	3689	4.00	1.00	2	70
2	Golf Course Off		Off Ramp	1500	Level	3689	4.00	1.00	2	70
3	Golf Course Off	Golf Course On	Basic Segment	3840	Level	3030	4.43	1.22	2	70
4	Golf Course Dr	RP Expressway	Weaving	3225	Level	3498	4.11	1.05	3	70
5	RP Expressway Off	RP Expressway WB On	Basic Segment	1560	Level	2648	4.79	1.39	2	70
6	RP Expressway WB On		On Ramp	545	Level	2971	4.48	1.24	2	70
7	RP Expressway	SR 116	Weaving	4580	Level	3144	4.35	1.17	3	70
8	SR 116 Off	SR 116 On	Basic Segment	2080	Level	2653	4.41	1.39	2	70

RampData							
Seg #	Type	Adj. Demand	% Trucks	% RVs	Lanes	Accel/Decel Length	FFS
2	Off Ramp	659	2.00	0.00	1	200	50
6	On Ramp	323	2.00	0.00	1	200	40

Weaving Segment Data											
Seg #	Ramp to Ramp Prop.	On-Ramp					Off-Ramp				
		Adj. Demand	% Trucks	% RVs	Lanes	FFS	Adj. Demand	% Trucks	% RVs	Lanes	FFS
4	0.050	468	2.00	0.00	1	40	850	2.00	0.00	1	40
7	0.050	173	2.00	0.00	1	40	491	4.00	0.00	1	40

Time Period Independent Weaving Segment Data

Seg #	Configuration	Short Length	# Weaving Lanes	Min. Lane Changes Freeway-Ramp	Min. Lane Changes Ramp-Freeway	Min. Lane Changes Ramp-Ramp
4	3000	2	1	1	0	
7	300	2	1	1	0	

Time Period Results

Time Period 1

Seg #	From	To	Type	Adj. Demand	Vol. Served	Capacity (pc/h)	Capacity (veh/h)	d/c Ratio	v/c ratio	Queue Length (ft)	Avg. Speed (mi/h)	Density (pc/mi/in)	Density (veh/mi/in)	Avg. Travel Time (min/veh)	Free-Flow Travel Time (min/veh)	Mainline Delay (min/veh)	System Delay (min/veh)	VMT Demand (veh-min)	VMT Volume (veh-min)	VHT (veh-hrs)	VHD (veh-hrs)	LOS
1	Todd Rd	Golf Course Dr	Basic Segment	3689	3689	4800	4697	0.79	0.79	0	64.6	29.2	28.6	0.44	0.41	0.0	0.0	436.7	436.7	6.8	0.5	D
2	Golf Course		Off Ramp	3689	3689	4800	4697	0.79	0.79	0	61.8	30.5	29.8	0.28	0.24	0.0	0.0	262.0	262.0	4.2	0.5	D

	Off																					
3	Golf Course Off	Golf Course On	Basic Segment	3030	3030	4800	4685	0.65	0.65	0	68.6	22.6	22.1	0.64	0.62	0.0	0.0	550.9	550.9	8.0	0.2	C
4	Golf Course Dr	RP Expressway	Weaving	3498	3498	6461	6318	0.55	0.55	0	56.6	21.1	20.6	0.65	0.52	0.1	0.1	534.1	534.1	9.4	1.8	C
5	RP Expressway Off	RP Expressway WB On	Basic Segment	2648	2648	4800	4675	0.57	0.57	0	69.7	19.5	19.0	0.25	0.25	0.0	0.0	195.6	195.6	2.8	0.0	C
6	RP Expressway WB On		On Ramp	2971	2971	4800	4683	0.63	0.63	0	59.2	25.7	25.1	0.10	0.09	0.0	0.0	76.7	76.7	1.3	0.2	C
7	RP Expressway	SR 116	Weaving	3144	3144	6219	6073	0.52	0.52	0	58.3	18.4	18.0	0.89	0.74	0.1	0.1	681.8	681.8	11.7	2.0	B
8	SR 116 Off	SR 116 On	Basic Segment	2653	2653	4800	4684	0.57	0.57	0	69.7	19.5	19.0	0.34	0.34	0.0	0.0	261.3	261.3	3.7	0.0	C

Overall Results

Segment	Segment Type	Maximum d/c Ratio	Avg. Speed (mi/h)	Density (pc/mi/in)	Density (veh/mi/in)	Avg. Travel Time (min/veh)	Free-Flow Travel Time (min/veh)	VMT Demand (veh-min)	VMT Volume (veh-min)	VHT (veh-hrs)	VHD (veh-hrs)
Todd Rd-Golf Course Dr	Basic	0.79	64.6	29.2	28.6	0.44	0.41	0,436.7	0,436.7	6.76	0.53
Golf Course Off-	OffRamp	0.79	61.8	30.5	29.8	0.28	0.24	0,262.0	0,262.0	4.24	0.50
Golf Course Off-Golf Course On	Basic	0.65	68.6	22.6	22.1	0.64	0.62	0,550.9	0,550.9	8.04	0.17
Golf Course Dr-RP Expressway	Weaving	0.55	56.6	21.1	20.6	0.65	0.52	0,534.1	0,534.1	9.44	1.81
RP Expressway Off-RP Expressway WB On	Basic	0.57	69.7	19.5	19.0	0.25	0.25	0,195.6	0,195.6	2.81	0.01
RP Expressway WB On-	OnRamp	0.63	59.2	25.7	25.1	0.10	0.09	0,076.7	0,076.7	1.30	0.20
RP Expressway-SR 116	Weaving	0.52	58.3	18.4	18.0	0.89	0.74	0,681.8	0,681.8	11.69	1.95
SR 116 Off-SR 116 On	Basic	0.57	69.7	19.5	19.0	0.34	0.34	0,261.3	0,261.3	3.75	0.02
Freeway			62.5	21.9	21.4	3.59	3.22	2,999.1	2,999.1	0,048.0	0,005.2

HCS 2010 Freeway Facilities

Project Properties

Analyst	W-Trans	Freeway Name	US 101	Analysis Period	PM Peak
Analysis Date	3/31/2015 4:53:13 PM	From	Railroad Ave	Version Date	10/10/2012
Agency		To	Todd Rd		
Location	Sonoma County, CA	Analysis Direction	Northbound		
User Notes	Central Rohnert Park PDA Plan - PM Peak Hour Existing Conditions - Northbound Direction				
File Name	C:\Users\zmatley\AppData\Local\Temp\preview.xml				

Facility-wide Values

Jam Density (pc/h/ln)	190	Time Period Duration (min)	15	Facility Length (mi)	3.78800

Segment Input Data

Time Period 1

Mainline Data										
Seg #	From	To	Type	Length	Terrain	Adj. Demand	% Trucks	% RVs	# Lanes	FFS
1	SR 116 Off	SR 116 On	Basic Segment	2375	Level	3711	4.00	1.00	2	70
2	SR 116	RP Expressway	Weaving	4370	Level	4336	4.00	0.86	3	70
3	RP Expressway Off	RP Expressway EB On	Basic Segment	1065	Level	3520	4.46	1.05	2	70
4	RP Expressway EB On	RP Expressway WB On	On Ramp	1500	Level	3881	4.23	0.96	2	70
5	RP Expressway EB On		Basic Segment	450	Level	3881	4.23	0.96	2	70
6	RP Expressway	Commerce Blvd	Weaving	2315	Level	4412	3.97	0.84	3	70
7	Commerce Off	Commerce On	Basic Segment	650	Level	3794	4.29	0.98	2	70
8	Commerce Blvd	Santa Rosa Ave	Weaving	3000	Level	4729	3.83	0.78	3	70
9	Santa Rosa Ave	Todd Rd	Basic Segment	4275	Level	4401	3.97	0.84	2	70

RampData							
Seg #	Type	Adj. Demand	% Trucks	% RVs	Lanes	Accel/Decel Length	FFS
4	On Ramp	361	2.00	0.00	1	765	40

Weaving Segment Data											
Seg #	Ramp to Ramp Prop.	On-Ramp					Off-Ramp				
		Adj. Demand	% Trucks	% RVs	Lanes	FFS	Adj. Demand	% Trucks	% RVs	Lanes	FFS
2	0.050	625	4.00	0.00	1	40	816	2.00	0.00	1	50
6	0.050	531	2.00	0.00	1	40	618	2.00	0.00	1	40
8	0.050	935	2.00	0.00	1	40	328	2.00	0.00	1	40

Time Period Independent Weaving Segment Data

Seg #	Configuration	Short Length	# Weaving Lanes	Min. Lane Changes Freeway-Ramp	Min. Lane Changes Ramp-Freeway	Min. Lane Changes Ramp-Ramp
2	3000	2	1	1	0	
6	1782	2	1	1	0	
8	3000	2	1	1	0	

Time Period Results

Time Period 1

Seg #	From	To	Type	Adj. Demand	Vol. Served	Capacity (pc/h)	Capacity (veh/h)	d/c Ratio	v/c ratio	Queue Length (ft)	Avg. Speed (mi/h)	Density (pc/mi/in)	Density (veh/mi/in)	Avg. Travel Time (min/veh)	Free-Flow Travel Time (min/veh)	Mainline Delay (min/veh)	System Delay (min/veh)	VTM Demand (veh-min)	VTM Volume (veh-min)	VHT (veh-hrs)	VHD (veh-hrs)	LOS

1	SR 116 Off	SR 116 On	Basic Segment	3711	3711	4800	4697	0.79	0.79	0	64.4	29.5	28.8	0.42	0.39	0.0	0.0	417.3	417.3	6.5	0.5	D
2	SR 116	RP Expressway	Weaving	4336	4336	6569	6429	0.67	0.67	0	54.7	27.0	26.4	0.91	0.71	0.2	0.2	897.2	897.2	16.4	3.6	C
3	RP Expressway Off	RP Expressway EB On	Basic Segment	3520	3520	4800	4686	0.75	0.75	0	65.8	27.4	26.8	0.18	0.17	0.0	0.0	177.5	177.5	2.7	0.2	D
4	RP Expressway EB On		On Ramp	3881	3881	4800	4692	0.83	0.83	0	57.0	34.8	34.0	0.30	0.24	0.1	0.1	275.6	275.6	4.8	0.9	D
5	RP Expressway EB On	RP Expressway WB On	Basic Segment	3881	3881	4800	4692	0.83	0.83	0	62.8	31.6	30.9	0.08	0.07	0.0	0.0	82.7	82.7	1.3	0.1	D
6	RP Expressway	Commerce Blvd	Weaving	4412	4412	6460	6324	0.70	0.70	0	55.5	27.1	26.5	0.47	0.38	0.1	0.1	483.6	483.6	8.7	1.8	C
7	Commerce Off	Commerce On	Basic Segment	3794	3794	4800	4690	0.81	0.81	0	63.6	30.5	29.8	0.12	0.11	0.0	0.0	116.8	116.8	1.8	0.2	D
8	Commerce Blvd	Santa Rosa Ave	Weaving	4729	4729	6742	6605	0.72	0.72	0	55.0	29.2	28.7	0.62	0.49	0.1	0.1	671.7	671.7	12.2	2.6	D
9	Santa Rosa Ave	Todd Rd	Basic Segment	4401	4401	4800	4699	0.94	0.94	0	57.3	39.3	38.4	0.85	0.69	0.2	0.2	890.8	890.8	15.6	2.8	E

Overall Results

Segment	Segment Type	Maximum d/c Ratio	Avg. Speed (mi/h)	Density (pc/mi/in)	Density (veh/mi/in)	Avg. Travel Time (min/veh)	Free-Flow Travel Time (min/veh)	VMT Demand (veh-min)	VMT Volume (veh-min)	VHT (veh-hrs)	VHD (veh-hrs)
SR 116 Off-SR 116 On	Basic	0.79	64.4	29.5	28.8	0.42	0.39	0,417.3	0,417.3	6.48	0.52
SR 116-RP Expressway	Weaving	0.67	54.7	27.0	26.4	0.91	0.71	0,897.2	0,897.2	16.41	3.60
RP Expressway Off-RP Expressway EB On	Basic	0.75	65.8	27.4	26.8	0.18	0.17	0,177.5	0,177.5	2.70	0.16
RP Expressway EB On-	OnRamp	0.83	57.0	34.8	34.0	0.30	0.24	0,275.6	0,275.6	4.84	0.90
RP Expressway EB On-RP Expressway WB On	Basic	0.83	62.8	31.6	30.9	0.08	0.07	0,082.7	0,082.7	1.32	0.13
RP Expressway-Commerce Blvd	Weaving	0.70	55.5	27.1	26.5	0.47	0.38	0,483.6	0,483.6	8.71	1.81
Commerce Off-Commerce On	Basic	0.81	63.6	30.5	29.8	0.12	0.11	0,116.8	0,116.8	1.84	0.17
Commerce Blvd-Santa Rosa Ave	Weaving	0.72	55.0	29.2	28.7	0.62	0.49	0,671.7	0,671.7	12.21	2.61
Santa Rosa Ave-Todd Rd	Basic	0.94	57.3	39.3	38.4	0.85	0.69	0,890.8	0,890.8	15.56	2.83
Freeway			57.3	30.4	29.8	3.95	3.25	4,013.3	4,013.3	0,070.1	0,012.7

HCS 2010 Freeway Facilities

Project Properties

Analyst	W-Trans	Freeway Name	US101	Analysis Period	PM Peak
Analysis Date	3/31/2015 10:36:29 AM	From	Todd Rd	Version Date	10/10/2012
Agency		To	Railroad Ave		
Location	Sonoma County, CA	Analysis Direction	Southbound		
User Notes	Central Rohnert Park PDA Plan - PM Peak Hour Existing Conditions - Southbound Direction				
File Name	C:\Users\zmatley\AppData\Local\Temp\preview.xml				

Facility-wide Values

Jam Density (pc/h/ln)	190	Time Period Duration (min)	15	Facility Length (mi)	3.75600

Segment Input Data

Time Period 1

Mainline Data										
Seg #	From	To	Type	Length	Terrain	Adj. Demand	% Trucks	% RVs	# Lanes	FFS
1	Todd Rd	Golf Course Dr	Basic Segment	2500	Level	3699	4.00	1.00	2	70
2	Golf Course Off		Off Ramp	1500	Level	3699	4.00	1.00	2	70
3	Golf Course Off	Golf Course On	Basic Segment	3840	Level	2932	4.52	1.26	2	70
4	Golf Course Dr	RP Expressway	Weaving	3225	Level	3592	4.06	1.03	3	70
5	RP Expressway Off	RP Expressway WB On	Basic Segment	1560	Level	2563	4.89	1.44	2	70
6	RP Expressway WB On		On Ramp	545	Level	2782	4.66	1.33	2	70
7	RP Expressway	SR 116	Weaving	4580	Level	3254	4.27	1.14	3	70
8	SR 116 Off	SR 116 On	Basic Segment	2080	Level	2490	4.36	1.49	2	70

RampData							
Seg #	Type	Adj. Demand	% Trucks	% RVs	Lanes	Accel/Decel Length	FFS
2	Off Ramp	767	2.00	0.00	1	200	50
6	On Ramp	219	2.00	0.00	1	200	40

Weaving Segment Data											
Seg #	Ramp to Ramp Prop.	On-Ramp					Off-Ramp				
		Adj. Demand	% Trucks	% RVs	Lanes	FFS	Adj. Demand	% Trucks	% RVs	Lanes	FFS
4	0.050	660	2.00	0.00	1	40	1029	2.00	0.00	1	40
7	0.050	472	2.00	0.00	1	40	764	4.00	0.00	1	40

Time Period Independent Weaving Segment Data

Seg #	Configuration	Short Length	# Weaving Lanes	Min. Lane Changes Freeway-Ramp	Min. Lane Changes Ramp-Freeway	Min. Lane Changes Ramp-Ramp
4	3000	2	1	1	0	
7	300	2	1	1	0	

Time Period Results

Time Period 1

Seg #	From	To	Type	Adj. Demand	Vol. Served	Capacity (pc/h)	Capacity (veh/h)	d/c Ratio	v/c ratio	Queue Length (ft)	Avg. Speed (mi/h)	Density (pc/mi/in)	Density (veh/mi/in)	Avg. Travel Time (min/veh)	Free-Flow Travel Time (min/veh)	Mainline Delay (min/veh)	System Delay (min/veh)	VMT Demand (veh-min)	VMT Volume (veh-min)	VHT (veh-hrs)	VHD (veh-hrs)	LOS
1	Todd Rd	Golf Course Dr	Basic Segment	3699	3699	4800	4697	0.79	0.79	0	64.5	29.3	28.7	0.44	0.41	0.0	0.0	437.9	437.9	6.8	0.5	D
2	Golf Course		Off Ramp	3699	3699	4800	4697	0.79	0.79	0	61.5	30.7	30.1	0.28	0.24	0.0	0.0	262.7	262.7	4.3	0.5	D

	Off																					
3	Golf Course Off	Golf Course On	Basic Segment	2932	2932	4800	4682	0.63	0.63	0	68.9	21.8	21.3	0.63	0.62	0.0	0.0	533.1	533.1	7.7	0.1	C
4	Golf Course Dr	RP Expressway	Weaving	3592	3592	5379	5261	0.68	0.68	0	55.1	22.2	21.7	0.66	0.52	0.1	0.1	548.5	548.5	10.0	2.1	C
5	RP Expressway Off	RP Expressway WB On	Basic Segment	2563	2563	4800	4672	0.55	0.55	0	69.7	18.9	18.4	0.25	0.25	0.0	0.0	189.3	189.3	2.7	0.0	C
6	RP Expressway WB On		On Ramp	2782	2782	4800	4679	0.59	0.59	0	59.6	23.9	23.3	0.10	0.09	0.0	0.0	71.8	71.8	1.2	0.2	C
7	RP Expressway	SR 116	Weaving	3254	3254	5832	5697	0.57	0.57	0	52.6	21.1	20.6	0.99	0.74	0.2	0.2	705.6	705.6	13.4	3.3	C
8	SR 116 Off	SR 116 On	Basic Segment	2490	2490	4800	4684	0.53	0.53	0	69.9	18.2	17.8	0.34	0.34	0.0	0.0	245.2	245.2	3.5	0.0	C

Overall Results

Segment	Segment Type	Maximum d/c Ratio	Avg. Speed (mi/h)	Density (pc/mi/in)	Density (veh/mi/in)	Avg. Travel Time (min/veh)	Free-Flow Travel Time (min/veh)	VMT Demand (veh-min)	VMT Volume (veh-min)	VHT (veh-hrs)	VHD (veh-hrs)
Todd Rd-Golf Course Dr	Basic	0.79	64.5	29.3	28.7	0.44	0.41	0,437.9	0,437.9	6.79	0.54
Golf Course Off-	OffRamp	0.79	61.5	30.7	30.1	0.28	0.24	0,262.7	0,262.7	4.27	0.52
Golf Course Off-Golf Course On	Basic	0.63	68.9	21.8	21.3	0.63	0.62	0,533.1	0,533.1	7.73	0.12
Golf Course Dr-RP Expressway	Weaving	0.68	55.1	22.2	21.7	0.66	0.52	0,548.5	0,548.5	9.95	2.12
RP Expressway Off-RP Expressway WB On	Basic	0.55	69.7	18.9	18.4	0.25	0.25	0,189.3	0,189.3	2.72	0.01
RP Expressway WB On-	OnRamp	0.59	59.6	23.9	23.3	0.10	0.09	0,071.8	0,071.8	1.21	0.18
RP Expressway-SR 116	Weaving	0.57	52.6	21.1	20.6	0.99	0.74	0,705.6	0,705.6	13.41	3.33
SR 116 Off-SR 116 On	Basic	0.53	69.9	18.2	17.8	0.34	0.34	0,245.2	0,245.2	3.51	0.00
Freeway			60.4	22.6	22.1	3.70	3.22	2,994.1	2,994.1	0,049.6	0,006.8

HCS 2010 Freeway Facilities

Project Properties

Analyst	W-Trans	Freeway Name	US 101	Analysis Period	AM Peak
Analysis Date	3/31/2015 4:53:13 PM	From	Railroad Ave	Version Date	10/10/2012
Agency		To	Todd Rd		
Location	Sonoma County, CA	Analysis Direction	Northbound		
User Notes	Central Rohnert Park PDA Plan - AM Peak Hour Existing plus Project - Northbound Direction				
File Name	C:\Users\zmatley\AppData\Local\Temp\preview.xml				

Facility-wide Values

Jam Density (pc/h/ln)	190	Time Period Duration (min)	15	Facility Length (mi)	3.78800

Segment Input Data

Time Period 1

Mainline Data										
Seg #	From	To	Type	Length	Terrain	Adj. Demand	% Trucks	% RVs	# Lanes	FFS
1	SR 116 Off	SR 116 On	Basic Segment	2375	Level	2296	4.00	1.00	2	70
2	SR 116	RP Expressway	Weaving	4370	Level	3123	4.00	0.74	3	70
3	RP Expressway Off	RP Expressway EB On	Basic Segment	1065	Level	2616	4.39	0.88	2	70
4	RP Expressway EB On		On Ramp	1500	Level	2846	4.19	0.81	2	70
5	RP Expressway EB On	RP Expressway WB On	Basic Segment	450	Level	2846	4.19	0.81	2	70
6	RP Expressway	Commerce Blvd	Weaving	2315	Level	3586	3.74	0.64	3	70
7	Commerce Off	Commerce On	Basic Segment	650	Level	3371	3.85	0.68	2	70
8	Commerce Blvd	Santa Rosa Ave	Weaving	3000	Level	3819	3.64	0.60	3	70
9	Santa Rosa Ave	Todd Rd	Basic Segment	4275	Level	3579	3.75	0.64	2	70

RampData							
Seg #	Type	Adj. Demand	% Trucks	% RVs	Lanes	Accel/Decel Length	FFS
4	On Ramp	230	2.00	0.00	1	765	40

Weaving Segment Data											
Seg #	Ramp to Ramp Prop.	On-Ramp					Off-Ramp				
		Adj. Demand	% Trucks	% RVs	Lanes	FFS	Adj. Demand	% Trucks	% RVs	Lanes	FFS
2	0.050	827	4.00	0.00	1	40	507	2.00	0.00	1	50
6	0.050	740	2.00	0.00	1	40	215	2.00	0.00	1	40
8	0.050	448	2.00	0.00	1	40	240	2.00	0.00	1	40

Time Period Independent Weaving Segment Data

Seg #	Configuration	Short Length	# Weaving Lanes	Min. Lane Changes Freeway-Ramp	Min. Lane Changes Ramp-Freeway	Min. Lane Changes Ramp-Ramp
2	3000	2	1	1	0	
6	1782	2	1	1	0	
8	3000	2	1	1	0	

Time Period Results

Time Period 1

Seg #	From	To	Type	Adj. Demand	Vol. Served	Capacity (pc/h)	Capacity (veh/h)	d/c Ratio	v/c ratio	Queue Length (ft)	Avg. Speed (mi/h)	Density (pc/mi/in)	Density (veh/mi/in)	Avg. Travel Time (min/veh)	Free-Flow Travel Time (min/veh)	Mainline Delay (min/veh)	System Delay (min/veh)	VMT Demand (veh-min)	VMT Volume (veh-min)	VHT (veh-hrs)	VHD (veh-hrs)	LOS

1	SR 116 Off	SR 116 On	Basic Segment	2296	2296	4800	4697	0.49	0.49	0	70.0	16.8	16.4	0.39	0.39	0.0	0.0	258.2	258.2	3.7	0.0	B
2	SR 116	RP Expressway	Weaving	3123	3123	6025	5898	0.53	0.53	0	57.3	18.6	18.2	0.87	0.71	0.2	0.2	646.2	646.2	11.3	2.0	B
3	RP Expressway Off	RP Expressway EB On	Basic Segment	2616	2616	4800	4689	0.56	0.56	0	69.8	19.2	18.7	0.17	0.17	0.0	0.0	131.9	131.9	1.9	0.0	C
4	RP Expressway EB On		On Ramp	2846	2846	4800	4694	0.61	0.61	0	60.7	23.9	23.4	0.28	0.24	0.0	0.0	202.1	202.1	3.3	0.4	C
5	RP Expressway EB On	RP Expressway WB On	Basic Segment	2846	2846	4800	4694	0.61	0.61	0	68.1	21.4	20.9	0.08	0.07	0.0	0.0	60.6	60.6	0.9	0.0	C
6	RP Expressway	Commerce Blvd	Weaving	3586	3586	6466	6339	0.57	0.57	0	58.0	21.0	20.6	0.45	0.38	0.1	0.1	393.1	393.1	6.8	1.2	C
7	Commerce Off	Commerce On	Basic Segment	3371	3371	4800	4703	0.72	0.72	0	66.9	25.7	25.2	0.11	0.11	0.0	0.0	103.7	103.7	1.6	0.1	C
8	Commerce Blvd	Santa Rosa Ave	Weaving	3819	3819	6925	6793	0.56	0.56	0	59.3	21.9	21.5	0.57	0.49	0.1	0.1	542.5	542.5	9.1	1.4	C
9	Santa Rosa Ave	Todd Rd	Basic Segment	3579	3579	4800	4706	0.76	0.76	0	65.5	27.9	27.3	0.74	0.69	0.0	0.0	724.4	724.4	11.1	0.7	D

Overall Results

Segment	Segment Type	Maximum d/c Ratio	Avg. Speed (mi/h)	Density (pc/mi/in)	Density (veh/mi/in)	Avg. Travel Time (min/veh)	Free-Flow Travel Time (min/veh)	VMT Demand (veh-min)	VMT Volume (veh-min)	VHT (veh-hrs)	VHD (veh-hrs)
SR 116 Off-SR 116 On	Basic	0.49	70.0	16.8	16.4	0.39	0.39	0,258.2	0,258.2	3.69	0.00
SR 116-RP Expressway	Weaving	0.53	57.3	18.6	18.2	0.87	0.71	0,646.2	0,646.2	11.28	2.05
RP Expressway Off-RP Expressway EB On	Basic	0.56	69.8	19.2	18.7	0.17	0.17	0,131.9	0,131.9	1.89	0.01
RP Expressway EB On-	OnRamp	0.61	60.7	23.9	23.4	0.28	0.24	0,202.1	0,202.1	3.33	0.44
RP Expressway EB On-RP Expressway WB On	Basic	0.61	68.1	21.4	20.9	0.08	0.07	0,060.6	0,060.6	0.89	0.02
RP Expressway-Commerce Blvd	Weaving	0.57	58.0	21.0	20.6	0.45	0.38	0,393.1	0,393.1	6.78	1.16
Commerce Off-Commerce On	Basic	0.72	66.9	25.7	25.2	0.11	0.11	0,103.7	0,103.7	1.55	0.07
Commerce Blvd-Santa Rosa Ave	Weaving	0.56	59.3	21.9	21.5	0.57	0.49	0,542.5	0,542.5	9.14	1.39
Santa Rosa Ave-Todd Rd	Basic	0.76	65.5	27.9	27.3	0.74	0.69	0,724.4	0,724.4	11.07	0.72
Freeway			61.7	21.5	21.1	3.66	3.25	3,062.8	3,062.8	0,049.6	0,005.9

HCS 2010 Freeway Facilities

Project Properties

Analyst	W-Trans	Freeway Name	US101	Analysis Period	AM Peak
Analysis Date	3/31/2015 10:36:29 AM	From	Todd Rd	Version Date	10/10/2012
Agency		To	Railroad Ave		
Location	Sonoma County, CA	Analysis Direction	Southbound		
User Notes	Central Rohnert Park PDA Plan - AM Peak Hour Existing plus Project - Southbound Direction				
File Name	C:\Users\zmatley\AppData\Local\Temp\preview.xml				

Facility-wide Values

Jam Density (pc/h/ln)	190	Time Period Duration (min)	15	Facility Length (mi)	3.75600

Segment Input Data

Time Period 1

Mainline Data										
Seg #	From	To	Type	Length	Terrain	Adj. Demand	% Trucks	% RVs	# Lanes	FFS
1	Todd Rd	Golf Course Dr	Basic Segment	2500	Level	3868	4.00	1.00	2	70
2	Golf Course Off		Off Ramp	1500	Level	3868	4.00	1.00	2	70
3	Golf Course Off	Golf Course On	Basic Segment	3840	Level	3153	4.45	1.23	2	70
4	Golf Course Dr	RP Expressway	Weaving	3225	Level	3624	4.13	1.07	3	70
5	RP Expressway Off	RP Expressway WB On	Basic Segment	1560	Level	2651	4.92	1.46	2	70
6	RP Expressway WB On		On Ramp	545	Level	3043	4.54	1.27	2	70
7	RP Expressway	SR 116	Weaving	4580	Level	3216	4.41	1.20	3	70
8	SR 116 Off	SR 116 On	Basic Segment	2080	Level	2725	4.48	1.42	2	70

RampData							
Seg #	Type	Adj. Demand	% Trucks	% RVs	Lanes	Accel/Decel Length	FFS
2	Off Ramp	715	2.00	0.00	1	200	50
6	On Ramp	392	2.00	0.00	1	200	40

Weaving Segment Data											
Seg #	Ramp to Ramp Prop.	On-Ramp					Off-Ramp				
		Adj. Demand	% Trucks	% RVs	Lanes	FFS	Adj. Demand	% Trucks	% RVs	Lanes	FFS
4	0.050	471	2.00	0.00	1	40	973	2.00	0.00	1	40
7	0.050	173	2.00	0.00	1	40	491	4.00	0.00	1	40

Time Period Independent Weaving Segment Data

Seg #	Configuration	Short Length	# Weaving Lanes	Min. Lane Changes Freeway-Ramp	Min. Lane Changes Ramp-Freeway	Min. Lane Changes Ramp-Ramp
4	3000	2	1	1	0	
7	300	2	1	1	0	

Time Period Results

Time Period 1

Seg #	From	To	Type	Adj. Demand	Vol. Served	Capacity (pc/h)	Capacity (veh/h)	d/c Ratio	v/c ratio	Queue Length (ft)	Avg. Speed (mi/h)	Density (pc/mi/in)	Density (veh/mi/in)	Avg. Travel Time (min/veh)	Free-Flow Travel Time (min/veh)	Mainline Delay (min/veh)	System Delay (min/veh)	VMT Demand (veh-min)	VMT Volume (veh-min)	VHT (veh-hrs)	VHD (veh-hrs)	LOS
1	Todd Rd	Golf Course Dr	Basic Segment	3868	3868	4800	4697	0.82	0.82	0	63.0	31.4	30.7	0.45	0.41	0.0	0.0	457.9	457.9	7.3	0.7	D
2	Golf Course		Off Ramp	3868	3868	4800	4697	0.82	0.82	0	61.7	32.1	31.4	0.28	0.24	0.0	0.0	274.7	274.7	4.5	0.5	D

	Off																					
3	Golf Course Off	Golf Course On	Basic Segment	3153	3153	4800	4684	0.67	0.67	0	68.0	23.8	23.2	0.64	0.62	0.0	0.0	573.3	573.3	8.4	0.2	C
4	Golf Course Dr	RP Expressway	Weaving	3624	3624	6311	6170	0.59	0.59	0	55.9	22.1	21.6	0.66	0.52	0.1	0.1	553.4	553.4	9.9	2.0	C
5	RP Expressway Off	RP Expressway WB On	Basic Segment	2651	2651	4800	4671	0.57	0.57	0	69.7	19.5	19.0	0.25	0.25	0.0	0.0	195.8	195.8	2.8	0.0	C
6	RP Expressway WB On		On Ramp	3043	3043	4800	4682	0.65	0.65	0	59.0	26.4	25.8	0.10	0.09	0.0	0.0	78.5	78.5	1.3	0.2	C
7	RP Expressway	SR 116	Weaving	3216	3216	6230	6081	0.53	0.53	0	58.2	18.9	18.4	0.89	0.74	0.2	0.2	697.4	697.4	12.0	2.0	B
8	SR 116 Off	SR 116 On	Basic Segment	2725	2725	4800	4682	0.58	0.58	0	69.6	20.1	19.6	0.34	0.34	0.0	0.0	268.4	268.4	3.9	0.0	C

Overall Results

Segment	Segment Type	Maximum d/c Ratio	Avg. Speed (mi/h)	Density (pc/mi/in)	Density (veh/mi/in)	Avg. Travel Time (min/veh)	Free-Flow Travel Time (min/veh)	VMT Demand (veh-min)	VMT Volume (veh-min)	VHT (veh-hrs)	VHD (veh-hrs)
Todd Rd-Golf Course Dr	Basic	0.82	63.0	31.4	30.7	0.45	0.41	0,457.9	0,457.9	7.27	0.73
Golf Course Off-	OffRamp	0.82	61.7	32.1	31.4	0.28	0.24	0,274.7	0,274.7	4.46	0.53
Golf Course Off-Golf Course On	Basic	0.67	68.0	23.8	23.2	0.64	0.62	0,573.3	0,573.3	8.43	0.24
Golf Course Dr-RP Expressway	Weaving	0.59	55.9	22.1	21.6	0.66	0.52	0,553.4	0,553.4	9.90	2.00
RP Expressway Off-RP Expressway WB On	Basic	0.57	69.7	19.5	19.0	0.25	0.25	0,195.8	0,195.8	2.81	0.01
RP Expressway WB On-	OnRamp	0.65	59.0	26.4	25.8	0.10	0.09	0,078.5	0,078.5	1.33	0.21
RP Expressway-SR 116	Weaving	0.53	58.2	18.9	18.4	0.89	0.74	0,697.4	0,697.4	11.98	2.01
SR 116 Off-SR 116 On	Basic	0.58	69.6	20.1	19.6	0.34	0.34	0,268.4	0,268.4	3.86	0.02
Freeway			61.9	22.8	22.3	3.62	3.22	3,099.3	3,099.3	0,050.0	0,005.8

HCS 2010 Freeway Facilities

Project Properties

Analyst	W-Trans	Freeway Name	US 101	Analysis Period	PM Peak
Analysis Date	3/31/2015 4:53:13 PM	From	Railroad Ave	Version Date	10/10/2012
Agency		To	Todd Rd		
Location	Sonoma County, CA	Analysis Direction	Northbound		
User Notes	Central Rohnert Park PDA Plan - PM Peak Hour Existing + Project - Northbound Direction				
File Name	C:\Users\zmatley\AppData\Local\Temp\preview.xml				

Facility-wide Values

Jam Density (pc/h/ln)	190	Time Period Duration (min)	15	Facility Length (mi)	3.78800

Segment Input Data

Time Period 1

Mainline Data										
Seg #	From	To	Type	Length	Terrain	Adj. Demand	% Trucks	% RVs	# Lanes	FFS
1	SR 116 Off	SR 116 On	Basic Segment	2375	Level	3823	4.00	1.00	2	70
2	SR 116	RP Expressway	Weaving	4370	Level	4448	4.00	0.86	3	70
3	RP Expressway Off	RP Expressway EB On	Basic Segment	1065	Level	3529	4.52	1.08	2	70
4	RP Expressway EB On	RP Expressway WB On	On Ramp	1500	Level	3890	4.29	0.98	2	70
5	RP Expressway EB On		Basic Segment	450	Level	3890	4.29	0.98	2	70
6	RP Expressway	Commerce Blvd	Weaving	2315	Level	4598	3.93	0.83	3	70
7	Commerce Off	Commerce On	Basic Segment	650	Level	3971	4.24	0.96	2	70
8	Commerce Blvd	Santa Rosa Ave	Weaving	3000	Level	4983	3.79	0.77	3	70
9	Santa Rosa Ave	Todd Rd	Basic Segment	4275	Level	4655	3.91	0.82	2	70

RampData							
Seg #	Type	Adj. Demand	% Trucks	% RVs	Lanes	Accel/Decel Length	FFS
4	On Ramp	361	2.00	0.00	1	765	40

Weaving Segment Data											
Seg #	Ramp to Ramp Prop.	On-Ramp					Off-Ramp				
		Adj. Demand	% Trucks	% RVs	Lanes	FFS	Adj. Demand	% Trucks	% RVs	Lanes	FFS
2	0.050	625	4.00	0.00	1	40	919	2.00	0.00	1	50
6	0.050	708	2.00	0.00	1	40	627	2.00	0.00	1	40
8	0.050	1012	2.00	0.00	1	40	328	2.00	0.00	1	40

Time Period Independent Weaving Segment Data

Seg #	Configuration	Short Length	# Weaving Lanes	Min. Lane Changes Freeway-Ramp	Min. Lane Changes Ramp-Freeway	Min. Lane Changes Ramp-Ramp
2	3000	2	1	1	0	
6	1782	2	1	1	0	
8	3000	2	1	1	0	

Time Period Results

Time Period 1

Seg #	From	To	Type	Adj. Demand	Vol. Served	Capacity (pc/h)	Capacity (veh/h)	d/c Ratio	v/c ratio	Queue Length (ft)	Avg. Speed (mi/h)	Density (pc/mi/ln)	Density (veh/mi/ln)	Avg. Travel Time (min/veh)	Free-Flow Travel Time (min/veh)	Mainline Delay (min/veh)	System Delay (min/veh)	VTM Demand (veh-min)	VTM Volume (veh-min)	VHT (veh-hrs)	VHD (veh-hrs)	LOS

1	SR 116 Off	SR 116 On	Basic Segment	3823	3823	4800	4697	0.81	0.81	0	63.4	30.8	30.1	0.43	0.39	0.0	0.0	429.9	429.9	6.8	0.6	D
2	SR 116	RP Expressway	Weaving	4448	4448	6532	6393	0.70	0.70	0	54.0	28.0	27.4	0.92	0.71	0.2	0.2	920.3	920.3	17.0	3.9	D
3	RP Expressway Off	RP Expressway EB On	Basic Segment	3529	3529	4800	4684	0.75	0.75	0	65.7	27.5	26.9	0.18	0.17	0.0	0.0	178.0	178.0	2.7	0.2	D
4	RP Expressway EB On		On Ramp	3890	3890	4800	4690	0.83	0.83	0	56.9	35.0	34.2	0.30	0.24	0.1	0.1	276.3	276.3	4.9	0.9	D
5	RP Expressway EB On	RP Expressway WB On	Basic Segment	3890	3890	4800	4690	0.83	0.83	0	62.8	31.7	31.0	0.08	0.07	0.0	0.0	82.9	82.9	1.3	0.1	D
6	RP Expressway	Commerce Blvd	Weaving	4598	4598	6397	6263	0.73	0.73	0	54.3	28.8	28.2	0.48	0.38	0.1	0.1	504.0	504.0	9.3	2.1	D
7	Commerce Off	Commerce On	Basic Segment	3971	3971	4800	4692	0.85	0.85	0	62.0	32.8	32.0	0.12	0.11	0.0	0.0	122.2	122.2	2.0	0.2	D
8	Commerce Blvd	Santa Rosa Ave	Weaving	4983	4983	6739	6604	0.75	0.75	0	54.3	31.2	30.6	0.63	0.49	0.1	0.1	707.8	707.8	13.0	2.9	D
9	Santa Rosa Ave	Todd Rd	Basic Segment	4655	4655	4800	4700	0.99	0.99	0	53.9	44.1	43.2	0.90	0.69	0.2	0.2	942.2	942.2	17.5	4.0	E

Overall Results

Segment	Segment Type	Maximum d/c Ratio	Avg. Speed (mi/h)	Density (pc/mi/in)	Density (veh/mi/in)	Avg. Travel Time (min/veh)	Free-Flow Travel Time (min/veh)	VMT Demand (veh-min)	VMT Volume (veh-min)	VHT (veh-hrs)	VHD (veh-hrs)
SR 116 Off-SR 116 On	Basic	0.81	63.4	30.8	30.1	0.43	0.39	0,429.9	0,429.9	6.78	0.64
SR 116-RP Expressway	Weaving	0.70	54.0	28.0	27.4	0.92	0.71	0,920.3	0,920.3	17.04	3.89
RP Expressway Off-RP Expressway EB On	Basic	0.75	65.7	27.5	26.9	0.18	0.17	0,178.0	0,178.0	2.71	0.17
RP Expressway EB On-	OnRamp	0.83	56.9	35.0	34.2	0.30	0.24	0,276.3	0,276.3	4.86	0.91
RP Expressway EB On-RP Expressway WB On	Basic	0.83	62.8	31.7	31.0	0.08	0.07	0,082.9	0,082.9	1.32	0.14
RP Expressway-Commerce Blvd	Weaving	0.73	54.3	28.8	28.2	0.48	0.38	0,504.0	0,504.0	9.28	2.08
Commerce Off-Commerce On	Basic	0.85	62.0	32.8	32.0	0.12	0.11	0,122.2	0,122.2	1.97	0.23
Commerce Blvd-Santa Rosa Ave	Weaving	0.75	54.3	31.2	30.6	0.63	0.49	0,707.8	0,707.8	13.05	2.94
Santa Rosa Ave-Todd Rd	Basic	0.99	53.9	44.1	43.2	0.90	0.69	0,942.2	0,942.2	17.47	4.01
Freeway			55.9	32.3	31.7	4.04	3.25	4,163.6	4,163.6	0,074.5	0,015.0

HCS 2010 Freeway Facilities

Project Properties

Analyst	W-Trans	Freeway Name	US101	Analysis Period	PM Peak
Analysis Date	3/31/2015 10:36:29 AM	From	Todd Rd	Version Date	10/10/2012
Agency		To	Railroad Ave		
Location	Sonoma County, CA	Analysis Direction	Southbound		
User Notes	Central Rohnert Park PDA Plan - PM Peak Hour Existing + Project - Southbound Direction				
File Name	C:\Users\zmatley\AppData\Local\Temp\preview.xml				

Facility-wide Values

Jam Density (pc/h/ln)	190	Time Period Duration (min)	15	Facility Length (mi)	3.75600

Segment Input Data

Time Period 1

Mainline Data										
Seg #	From	To	Type	Length	Terrain	Adj. Demand	% Trucks	% RVs	# Lanes	FFS
1	Todd Rd	Golf Course Dr	Basic Segment	2500	Level	3878	4.00	1.00	2	70
2	Golf Course Off		Off Ramp	1500	Level	3878	4.00	1.00	2	70
3	Golf Course Off	Golf Course On	Basic Segment	3840	Level	3076	4.52	1.26	2	70
4	Golf Course Dr	RP Expressway	Weaving	3225	Level	3754	4.07	1.03	3	70
5	RP Expressway Off	RP Expressway WB On	Basic Segment	1560	Level	2581	5.01	1.50	2	70
6	RP Expressway WB On		On Ramp	545	Level	2934	4.64	1.32	2	70
7	RP Expressway	SR 116	Weaving	4580	Level	3406	4.28	1.14	3	70
8	SR 116 Off	SR 116 On	Basic Segment	2080	Level	2642	4.36	1.47	2	70

RampData							
Seg #	Type	Adj. Demand	% Trucks	% RVs	Lanes	Accel/Decel Length	FFS
2	Off Ramp	802	2.00	0.00	1	200	50
6	On Ramp	353	2.00	0.00	1	200	40

Weaving Segment Data											
Seg #	Ramp to Ramp Prop.	On-Ramp					Off-Ramp				
		Adj. Demand	% Trucks	% RVs	Lanes	FFS	Adj. Demand	% Trucks	% RVs	Lanes	FFS
4	0.050	678	2.00	0.00	1	40	1173	2.00	0.00	1	40
7	0.050	472	2.00	0.00	1	40	764	4.00	0.00	1	40

Time Period Independent Weaving Segment Data

Seg #	Configuration	Short Length	# Weaving Lanes	Min. Lane Changes Freeway-Ramp	Min. Lane Changes Ramp-Freeway	Min. Lane Changes Ramp-Ramp
4	3000	2	1	1	0	
7	300	2	1	1	0	

Time Period Results

Time Period 1

Seg #	From	To	Type	Adj. Demand	Vol. Served	Capacity (pc/h)	Capacity (veh/h)	d/c Ratio	v/c ratio	Queue Length (ft)	Avg. Speed (mi/h)	Density (pc/mi/in)	Density (veh/mi/in)	Avg. Travel Time (min/veh)	Free-Flow Travel Time (min/veh)	Mainline Delay (min/veh)	System Delay (min/veh)	VTM Demand (veh-min)	VTM Volume (veh-min)	VHT (veh-hrs)	VHD (veh-hrs)	LOS
1	Todd Rd	Golf Course Dr	Basic Segment	3878	3878	4800	4697	0.83	0.83	0	62.9	31.5	30.8	0.45	0.41	0.0	0.0	459.0	459.0	7.3	0.7	D
2	Golf Course		Off Ramp	3878	3878	4800	4697	0.83	0.83	0	61.4	32.3	31.6	0.28	0.24	0.0	0.0	275.4	275.4	4.5	0.5	D

	Off																					
3	Golf Course Off	Golf Course On	Basic Segment	3076	3076	4800	4682	0.66	0.66	0	68.4	23.1	22.5	0.64	0.62	0.0	0.0	559.3	559.3	8.2	0.2	C
4	Golf Course Dr	RP Expressway	Weaving	3754	3754	5118	5006	0.75	0.75	0	54.3	23.6	23.1	0.68	0.52	0.2	0.2	573.2	573.2	10.6	2.4	C
5	RP Expressway Off	RP Expressway WB On	Basic Segment	2581	2581	4800	4669	0.55	0.55	0	69.7	19.0	18.5	0.25	0.25	0.0	0.0	190.6	190.6	2.7	0.0	C
6	RP Expressway WB On		On Ramp	2934	2934	4800	4679	0.63	0.63	0	59.3	25.4	24.7	0.10	0.09	0.0	0.0	75.7	75.7	1.3	0.2	C
7	RP Expressway	SR 116	Weaving	3406	3406	5872	5736	0.59	0.59	0	52.5	22.1	21.6	0.99	0.74	0.2	0.2	738.6	738.6	14.1	3.5	C
8	SR 116 Off	SR 116 On	Basic Segment	2642	2642	4800	4684	0.56	0.56	0	69.7	19.4	18.9	0.34	0.34	0.0	0.0	260.2	260.2	3.7	0.0	C

Overall Results

Segment	Segment Type	Maximum d/c Ratio	Avg. Speed (mi/h)	Density (pc/mi/in)	Density (veh/mi/in)	Avg. Travel Time (min/veh)	Free-Flow Travel Time (min/veh)	VMT Demand (veh-min)	VMT Volume (veh-min)	VHT (veh-hrs)	VHD (veh-hrs)
Todd Rd-Golf Course Dr	Basic	0.83	62.9	31.5	30.8	0.45	0.41	0,459.0	0,459.0	7.30	0.74
Golf Course Off-	OffRamp	0.83	61.4	32.3	31.6	0.28	0.24	0,275.4	0,275.4	4.48	0.55
Golf Course Off-Golf Course On	Basic	0.66	68.4	23.1	22.5	0.64	0.62	0,559.3	0,559.3	8.18	0.19
Golf Course Dr-RP Expressway	Weaving	0.75	54.3	23.6	23.1	0.68	0.52	0,573.2	0,573.2	10.56	2.37
RP Expressway Off-RP Expressway WB On	Basic	0.55	69.7	19.0	18.5	0.25	0.25	0,190.6	0,190.6	2.74	0.01
RP Expressway WB On-	OnRamp	0.63	59.3	25.4	24.7	0.10	0.09	0,075.7	0,075.7	1.28	0.20
RP Expressway-SR 116	Weaving	0.59	52.5	22.1	21.6	0.99	0.74	0,738.6	0,738.6	14.07	3.52
SR 116 Off-SR 116 On	Basic	0.56	69.7	19.4	18.9	0.34	0.34	0,260.2	0,260.2	3.73	0.01
Freeway			59.8	23.8	23.3	3.73	3.22	3,132.1	3,132.1	0,052.3	0,007.6

HCS 2010 Freeway Facilities

Project Properties

Analyst	W-Trans	Freeway Name	US 101	Analysis Period	AM Peak
Analysis Date	3/31/2015 4:53:13 PM	From	Railroad Ave	Version Date	10/10/2012
Agency		To	Todd Rd		
Location	Sonoma County, CA	Analysis Direction	Northbound		
User Notes	Central Rohnert Park PDA Plan - AM Peak Hour Future Conditions - Northbound Direction				
File Name	C:\Users\zmatley\AppData\Local\Temp\preview.xml				

Facility-wide Values

Jam Density (pc/h/ln)	190	Time Period Duration (min)	15	Facility Length (mi)	3.78800

Segment Input Data

Time Period 1

Mainline Data										
Seg #	From	To	Type	Length	Terrain	Adj. Demand	% Trucks	% RVs	# Lanes	FFS
1	SR 116 Off	SR 116 On	Basic Segment	2375	Level	2410	4.00	1.00	2	70
2	SR 116	RP Expressway	Weaving	4370	Level	3532	4.00	0.68	3	70
3	RP Expressway Off	RP Expressway EB On	Basic Segment	1065	Level	3065	4.30	0.79	2	70
4	RP Expressway EB On		On Ramp	1500	Level	3340	4.11	0.72	2	70
5	RP Expressway EB On	RP Expressway WB On	Basic Segment	450	Level	3340	4.11	0.72	2	70
6	RP Expressway	Commerce Blvd	Weaving	2315	Level	4228	3.67	0.57	3	70
7	Commerce Off	Commerce On	Basic Segment	650	Level	3819	3.85	0.63	2	70
8	Commerce Blvd	Santa Rosa Ave	Weaving	3000	Level	4422	3.60	0.55	3	70
9	Santa Rosa Ave	Todd Rd	Basic Segment	4275	Level	3967	3.78	0.61	2	70

RampData							
Seg #	Type	Adj. Demand	% Trucks	% RVs	Lanes	Accel/Decel Length	FFS
4	On Ramp	275	2.00	0.00	1	765	40

Weaving Segment Data											
Seg #	Ramp to Ramp Prop.	On-Ramp					Off-Ramp				
		Adj. Demand	% Trucks	% RVs	Lanes	FFS	Adj. Demand	% Trucks	% RVs	Lanes	FFS
2	0.050	1122	4.00	0.00	1	40	467	2.00	0.00	1	50
6	0.050	888	2.00	0.00	1	40	409	2.00	0.00	1	40
8	0.050	603	2.00	0.00	1	40	455	2.00	0.00	1	40

Time Period Independent Weaving Segment Data

Seg #	Configuration	Short Length	# Weaving Lanes	Min. Lane Changes Freeway-Ramp	Min. Lane Changes Ramp-Freeway	Min. Lane Changes Ramp-Ramp
2	3000	2	1	1	0	
6	1782	2	1	1	0	
8	3000	2	1	1	0	

Time Period Results

Time Period 1

Seg #	From	To	Type	Adj. Demand	Vol. Served	Capacity (pc/h)	Capacity (veh/h)	d/c Ratio	v/c ratio	Queue Length (ft)	Avg. Speed (mi/h)	Density (pc/mi/ln)	Density (veh/mi/ln)	Avg. Travel Time (min/veh)	Free-Flow Travel Time (min/veh)	Mainline Delay (min/veh)	System Delay (min/veh)	VMT Demand (veh-min)	VMT Volume (veh-min)	VHT (veh-hrs)	VHD (veh-hrs)	LOS

1	SR 116 Off	SR 116 On	Basic Segment	2410	2410	4800	4697	0.51	0.51	0	70.0	17.6	17.2	0.39	0.39	0.0	0.0	271.0	271.0	3.9	0.0	B
2	SR 116	RP Expressway	Weaving	3532	3532	5769	5648	0.63	0.63	0	55.7	21.6	21.1	0.89	0.71	0.2	0.2	730.8	730.8	13.1	2.7	C
3	RP Expressway Off	RP Expressway EB On	Basic Segment	3065	3065	4800	4692	0.65	0.65	0	68.4	22.9	22.4	0.18	0.17	0.0	0.0	154.6	154.6	2.3	0.1	C
4	RP Expressway EB On		On Ramp	3340	3340	4800	4697	0.71	0.71	0	59.4	28.7	28.1	0.29	0.24	0.0	0.0	237.2	237.2	4.0	0.6	D
5	RP Expressway EB On	RP Expressway WB On	Basic Segment	3340	3340	4800	4697	0.71	0.71	0	67.0	25.5	24.9	0.08	0.07	0.0	0.0	71.2	71.2	1.1	0.0	C
6	RP Expressway	Commerce Blvd	Weaving	4228	4228	6370	6248	0.68	0.68	0	55.2	26.0	25.5	0.48	0.38	0.1	0.1	463.4	463.4	8.4	1.8	C
7	Commerce Off	Commerce On	Basic Segment	3819	3819	4800	4704	0.81	0.81	0	63.5	30.7	30.1	0.12	0.11	0.0	0.0	117.5	117.5	1.9	0.2	D
8	Commerce Blvd	Santa Rosa Ave	Weaving	4422	4422	6792	6665	0.66	0.66	0	56.4	26.6	26.1	0.60	0.49	0.1	0.1	628.1	628.1	11.1	2.2	C
9	Santa Rosa Ave	Todd Rd	Basic Segment	3967	3967	4800	4705	0.84	0.84	0	62.1	32.6	31.9	0.78	0.69	0.1	0.1	803.0	803.0	12.9	1.5	D

Overall Results

Segment	Segment Type	Maximum d/c Ratio	Avg. Speed (mi/h)	Density (pc/mi/in)	Density (veh/mi/in)	Avg. Travel Time (min/veh)	Free-Flow Travel Time (min/veh)	VMT Demand (veh-min)	VMT Volume (veh-min)	VHT (veh-hrs)	VHD (veh-hrs)
SR 116 Off-SR 116 On	Basic	0.51	70.0	17.6	17.2	0.39	0.39	0,271.0	0,271.0	3.87	0.00
SR 116-RP Expressway	Weaving	0.63	55.7	21.6	21.1	0.89	0.71	0,730.8	0,730.8	13.12	2.68
RP Expressway Off-RP Expressway EB On	Basic	0.65	68.4	22.9	22.4	0.18	0.17	0,154.6	0,154.6	2.26	0.05
RP Expressway EB On-	OnRamp	0.71	59.4	28.7	28.1	0.29	0.24	0,237.2	0,237.2	3.99	0.60
RP Expressway EB On-RP Expressway WB On	Basic	0.71	67.0	25.5	24.9	0.08	0.07	0,071.2	0,071.2	1.06	0.05
RP Expressway-Commerce Blvd	Weaving	0.68	55.2	26.0	25.5	0.48	0.38	0,463.4	0,463.4	8.40	1.78
Commerce Off-Commerce On	Basic	0.81	63.5	30.7	30.1	0.12	0.11	0,117.5	0,117.5	1.85	0.17
Commerce Blvd-Santa Rosa Ave	Weaving	0.66	56.4	26.6	26.1	0.60	0.49	0,628.1	0,628.1	11.14	2.16
Santa Rosa Ave-Todd Rd	Basic	0.84	62.1	32.6	31.9	0.78	0.69	0,803.0	0,803.0	12.92	1.45
Freeway			59.3	25.4	24.9	3.80	3.25	3,476.8	3,476.8	0,058.6	0,008.9

HCS 2010 Freeway Facilities

Project Properties

Analyst	W-Trans	Freeway Name	US101	Analysis Period	AM Peak
Analysis Date	3/31/2015 10:36:29 AM	From	Todd Rd	Version Date	10/10/2012
Agency		To	Railroad Ave		
Location	Sonoma County, CA	Analysis Direction	Southbound		
User Notes	Central Rohnert Park PDA Plan - AM Peak Hour Future Conditions - Southbound Direction				
File Name	C:\Users\zmatley\AppData\Local\Temp\preview.xml				

Facility-wide Values

Jam Density (pc/h/ln)	190	Time Period Duration (min)	15	Facility Length (mi)	3.75600

Segment Input Data

Time Period 1

Mainline Data										
Seg #	From	To	Type	Length	Terrain	Adj. Demand	% Trucks	% RVs	# Lanes	FFS
1	Todd Rd	Golf Course Dr	Basic Segment	2500	Level	5093	4.00	1.00	2	70
2	Golf Course Off		Off Ramp	1500	Level	5093	4.00	1.00	2	70
3	Golf Course Off	Golf Course On	Basic Segment	3840	Level	4183	4.44	1.22	2	70
4	Golf Course Dr	RP Expressway	Weaving	3225	Level	4872	4.09	1.05	3	70
5	RP Expressway Off	RP Expressway WB On	Basic Segment	1560	Level	3880	4.63	1.31	2	70
6	RP Expressway WB On		On Ramp	545	Level	4230	4.41	1.20	2	70
7	RP Expressway	SR 116	Weaving	4580	Level	4554	4.24	1.12	3	70
8	SR 116 Off	SR 116 On	Basic Segment	2080	Level	3937	4.27	1.29	2	70

RampData							
Seg #	Type	Adj. Demand	% Trucks	% RVs	Lanes	Accel/Decel Length	FFS
2	Off Ramp	910	2.00	0.00	1	200	50
6	On Ramp	350	2.00	0.00	1	200	40

Weaving Segment Data											
Seg #	Ramp to Ramp Prop.	On-Ramp					Off-Ramp				
		Adj. Demand	% Trucks	% RVs	Lanes	FFS	Adj. Demand	% Trucks	% RVs	Lanes	FFS
4	0.050	689	2.00	0.00	1	40	992	2.00	0.00	1	40
7	0.050	324	2.00	0.00	1	40	617	4.00	0.00	1	40

Time Period Independent Weaving Segment Data

Seg #	Configuration	Short Length	# Weaving Lanes	Min. Lane Changes Freeway-Ramp	Min. Lane Changes Ramp-Freeway	Min. Lane Changes Ramp-Ramp
4	3000	2	1	1	0	
7	300	2	1	1	0	

Time Period Results

Time Period 1

Seg #	From	To	Type	Adj. Demand	Vol. Served	Capacity (pc/h)	Capacity (veh/h)	d/c Ratio	v/c ratio	Queue Length (ft)	Avg. Speed (mi/h)	Density (pc/mi/in)	Density (veh/mi/in)	Avg. Travel Time (min/veh)	Free-Flow Travel Time (min/veh)	Mainline Delay (min/veh)	System Delay (min/veh)	VMT Demand (veh-min)	VMT Volume (veh-min)	VHT (veh-hrs)	VHD (veh-hrs)	LOS
1	Todd Rd	Golf Course Dr	Basic Segment	5093	4680	4800	4697	1.08	1.00	0	53.5	44.7	43.7	0.53	0.41	0.1	0.1	602.9	554.0	10.3	2.4	E
2	Golf Course		Off Ramp	5093	4680	4800	4697	1.08	1.00	0	57.5	41.6	40.7	0.30	0.24	0.1	0.1	361.7	332.4	5.8	1.0	E

	Off																					
3	Golf Course Off	Golf Course On	Basic Segment	4183	3840	4800	4685	0.89	0.82	0	63.2	31.1	30.4	0.69	0.62	0.1	0.1	760.5	698.2	11.1	1.1	D
4	Golf Course Dr	RP Expressway	Weaving	4872	4560	6542	6398	0.76	0.71	0	51.8	35.2	34.5	0.71	0.52	0.2	0.2	743.9	696.3	13.4	3.5	E
5	RP Expressway Off	RP Expressway WB On	Basic Segment	3880	3600	4800	4679	0.83	0.77	0	65.2	28.3	27.6	0.27	0.25	0.0	0.0	286.6	265.9	4.1	0.3	D
6	RP Expressway WB On		On Ramp	4230	3960	4800	4685	0.90	0.85	0	55.2	36.7	35.8	0.11	0.09	0.0	0.0	109.2	102.2	1.9	0.4	E
7	RP Expressway	SR 116	Weaving	4554	4320	6233	6090	0.75	0.71	0	54.7	24.5	24.0	0.95	0.74	0.2	0.2	987.6	936.8	17.1	3.8	C
8	SR 116 Off	SR 116 On	Basic Segment	3937	3720	4800	4688	0.84	0.79	0	64.2	29.6	29.0	0.37	0.34	0.0	0.0	387.7	366.4	5.7	0.5	D

Overall Results

Segment	Segment Type	Maximum d/c Ratio	Avg. Speed (mi/h)	Density (pc/mi/in)	Density (veh/mi/in)	Avg. Travel Time (min/veh)	Free-Flow Travel Time (min/veh)	VMT Demand (veh-min)	VMT Volume (veh-min)	VHT (veh-hrs)	VHD (veh-hrs)
Todd Rd-Golf Course Dr	Basic	1.08	53.5	44.7	43.7	0.53	0.41	0,602.9	0,554.0	10.35	2.43
Golf Course Off-	OffRamp	1.08	57.5	41.6	40.7	0.30	0.24	0,361.7	0,332.4	5.78	1.03
Golf Course Off-Golf Course On	Basic	0.89	63.2	31.1	30.4	0.69	0.62	0,760.5	0,698.2	11.05	1.08
Golf Course Dr-RP Expressway	Weaving	0.76	51.8	35.2	34.5	0.71	0.52	0,743.9	0,696.3	13.43	3.49
RP Expressway Off-RP Expressway WB On	Basic	0.83	65.2	28.3	27.6	0.27	0.25	0,286.6	0,265.9	4.08	0.28
RP Expressway WB On-	OnRamp	0.90	55.2	36.7	35.8	0.11	0.09	0,109.2	0,102.2	1.85	0.39
RP Expressway-SR 116	Weaving	0.75	54.7	24.5	24.0	0.95	0.74	0,987.6	0,936.8	17.13	3.75
SR 116 Off-SR 116 On	Basic	0.84	64.2	29.6	29.0	0.37	0.34	0,387.7	0,366.4	5.70	0.47
Freeway			57.0	32.0	31.2	3.93	3.22	4,240.1	3,952.1	0,069.4	0,012.9

HCS 2010 Freeway Facilities

Project Properties

Analyst		Freeway Name	US 101	Analysis Period	PM Peak
Analysis Date	4/7/2015 4:53:13 PM	From	Railroad Ave	Version Date	10/10/2012
Agency		To	Todd Rd		
Location	Sonoma County, CA	Analysis Direction	Northbound		
User Notes	Central Rohnert Park PDA Plan - PM Peak Hour Future Conditions - Northbound Direction				
File Name	C:\Users\zmatley\AppData\Local\Temp\preview.xml				

Facility-wide Values

Jam Density (pc/h/ln)	190	Time Period Duration (min)	15	Facility Length (mi)	3.69300

Segment Input Data

Time Period 1

Mainline Data										
Seg #	From	To	Type	Length	Terrain	Adj. Demand	% Trucks	% RVs	# Lanes	FFS
1	SR 116 Off	SR 116 On	Basic Segment	2375	Level	3955	4.00	1.00	3	70
2	SR 116	RP Expressway	Weaving	4370	Level	4636	4.00	0.85	3	70
3	RP Expressway Off	RP Expressway EB On	Basic Segment	1065	Level	3925	4.36	1.01	2	70
4	RP Expressway EB On		On Ramp	1500	Level	4358	4.13	0.91	2	70
5	RP Expressway EB On	RP Expressway WB On	Basic Segment	450	Level	4358	4.13	0.91	2	70
6	RP Expressway	Commerce Blvd	Weaving	2315	Level	4931	3.88	0.80	3	70
7	Commerce Off	Commerce On	Basic Segment	650	Level	4350	4.13	0.91	2	70
8	Commerce Blvd	Santa Rosa Ave	Weaving	3000	Level	5605	3.65	0.71	3	70
9	Santa Rosa Ave	Todd Rd	Basic Segment	3775	Level	5185	3.79	0.76	2	70

RampData							
Seg #	Type	Adj. Demand	% Trucks	% RVs	Lanes	Accel/Decel Length	FFS
4	On Ramp	433	2.00	0.00	1	765	40

Weaving Segment Data											
Seg #	Ramp to Ramp Prop.	On-Ramp					Off-Ramp				
		Adj. Demand	% Trucks	% RVs	Lanes	FFS	Adj. Demand	% Trucks	% RVs	Lanes	FFS
2	0.050	681	4.00	0.00	1	40	711	2.00	0.00	1	50
6	0.050	573	2.00	0.00	1	40	581	2.00	0.00	1	40
8	0.050	1255	2.00	0.00	1	40	420	2.00	0.00	1	40

Time Period Independent Weaving Segment Data

Seg #	Configuration	Short Length	# Weaving Lanes	Min. Lane Changes Freeway-Ramp	Min. Lane Changes Ramp-Freeway	Min. Lane Changes Ramp-Ramp
2	3000	2	1	0	0	
6	1782	2	1	1	0	
8	3000	2	1	1	0	

Time Period Results

Time Period 1

Seg #	From	To	Type	Adj. Demand	Vol. Served	Capacity (pc/h)	Capacity (veh/h)	d/c Ratio	v/c ratio	Queue Length (ft)	Avg. Speed (mi/h)	Density (pc/mi/ln)	Density (veh/mi/ln)	Avg. Travel Time (min/veh)	Free-Flow Travel Time (min/veh)	Mainline Delay (min/veh)	System Delay (min/veh)	VTM Demand (veh-min)	VTM Volume (veh-min)	VHT (veh-hrs)	VHD (veh-hrs)	LOS

1	SR 116 Off	SR 116 On	Basic Segment	3955	3960	7200	7045	0.56	0.56	0	69.7	19.3	18.9	0.39	0.39	0.0	0.0	444.8	445.3	6.4	0.0	C
2	SR 116	RP Expressway	Weaving	4636	4620	6648	6507	0.71	0.71	0	57.8	29.6	29.0	0.86	0.71	0.1	0.1	959.2	955.9	16.5	2.9	D
3	RP Expressway Off	RP Expressway EB On	Basic Segment	3925	3900	4800	4688	0.84	0.83	0	62.6	31.9	31.1	0.19	0.17	0.0	0.0	197.9	196.7	3.1	0.3	D
4	RP Expressway EB On		On Ramp	4358	4380	4800	4695	0.93	0.93	0	53.2	42.0	41.1	0.32	0.24	0.1	0.1	309.5	311.1	5.8	1.4	E
5	RP Expressway EB On	RP Expressway WB On	Basic Segment	4358	4380	4800	4695	0.93	0.93	0	57.5	39.0	38.1	0.09	0.07	0.0	0.0	92.9	93.3	1.6	0.3	E
6	RP Expressway	Commerce Blvd	Weaving	4931	4877	6522	6388	0.77	0.76	402	51.1	31.8	31.2	0.51	0.38	0.1	0.1	540.5	534.6	10.5	2.8	D
7	Commerce Off	Commerce On	Basic Segment	4350	4271	4800	4694	0.93	0.91	650	47.9	44.6	43.6	0.15	0.11	0.0	0.0	133.9	131.4	2.7	0.9	E
8	Commerce Blvd	Santa Rosa Ave	Weaving	5605	5098	6672	6543	0.86	0.78	3000	24.6	69.2	67.8	1.39	0.49	0.9	1.5	796.2	724.1	29.5	19.1	F
9	Santa Rosa Ave	Todd Rd	Basic Segment	5185	4680	4800	4704	1.10	0.99	0	53.6	44.5	43.6	0.80	0.61	0.2	0.2	926.8	836.5	15.6	3.6	E

Overall Results

Segment	Segment Type	Maximum d/c Ratio	Avg. Speed (mi/h)	Density (pc/mi/in)	Density (veh/mi/in)	Avg. Travel Time (min/veh)	Free-Flow Travel Time (min/veh)	VMT Demand (veh-min)	VMT Volume (veh-min)	VHT (veh-hrs)	VHD (veh-hrs)
SR 116 Off-SR 116 On	Basic	0.56	69.7	19.3	18.9	0.39	0.39	0,444.8	0,445.3	6.39	0.02
SR 116-RP Expressway	Weaving	0.71	57.8	29.6	29.0	0.86	0.71	0,959.2	0,955.9	16.53	2.87
RP Expressway Off-RP Expressway EB On	Basic	0.84	62.6	31.9	31.1	0.19	0.17	0,197.9	0,196.7	3.14	0.33
RP Expressway EB On-	OnRamp	0.93	53.2	42.0	41.1	0.32	0.24	0,309.5	0,311.1	5.85	1.40
RP Expressway EB On-RP Expressway WB On	Basic	0.93	57.5	39.0	38.1	0.09	0.07	0,092.9	0,093.3	1.62	0.29
RP Expressway-Commerce Blvd	Weaving	0.77	51.1	31.8	31.2	0.51	0.38	0,540.5	0,534.6	10.47	2.83
Commerce Off-Commerce On	Basic	0.93	47.9	44.6	43.6	0.15	0.11	0,133.9	0,131.4	2.75	0.87
Commerce Blvd-Santa Rosa Ave	Weaving	0.86	24.6	69.2	67.8	1.39	0.49	0,796.2	0,724.1	29.48	19.13
Santa Rosa Ave-Todd Rd	Basic	1.10	53.6	44.5	43.6	0.80	0.61	0,926.8	0,836.5	15.60	3.65
Freeway			46.1	39.0	38.2	4.71	3.17	4,401.6	4,229.0	0,091.8	0,031.4

HCS 2010 Freeway Facilities

Project Properties

Analyst		Freeway Name	US101	Analysis Period	PM Peak
Analysis Date	4/7/2015 10:36:29 AM	From	Todd Rd	Version Date	10/10/2012
Agency		To	Railroad Ave		
Location	Sonoma County, CA	Analysis Direction	Southbound		
User Notes	Central Rohnert Park PDA Plan - PM Peak Hour Future Conditions - Southbound Direction				
File Name	C:\Users\zmatley\AppData\Local\Temp\preview.xml				

Facility-wide Values

Jam Density (pc/h/in)	190	Time Period Duration (min)	15	Facility Length (mi)	3.75600

Segment Input Data

Time Period 1

Mainline Data										
Seg #	From	To	Type	Length	Terrain	Adj. Demand	% Trucks	% RVs	# Lanes	FFS
1	Todd Rd	Golf Course Dr	Basic Segment	2500	Level	4916	4.00	1.00	2	70
2	Golf Course Off		Off Ramp	1500	Level	4916	4.00	1.00	2	70
3	Golf Course Off	Golf Course On	Basic Segment	3840	Level	3954	4.49	1.24	2	70
4	Golf Course Dr	RP Expressway	Weaving	3225	Level	4710	4.09	1.04	3	70
5	RP Expressway Off	RP Expressway WB On	Basic Segment	1560	Level	3681	4.67	1.34	2	70
6	RP Expressway WB On		On Ramp	545	Level	3900	4.52	1.26	2	70
7	RP Expressway	SR 116	Weaving	4580	Level	4264	4.31	1.15	3	70
8	SR 116 Off	SR 116 On	Basic Segment	2080	Level	3477	4.38	1.41	2	70

RampData							
Seg #	Type	Adj. Demand	% Trucks	% RVs	Lanes	Accel/Decel Length	FFS
2	Off Ramp	962	2.00	0.00	1	200	50
6	On Ramp	219	2.00	0.00	1	200	40

Weaving Segment Data											
Seg #	Ramp to Ramp Prop.	On-Ramp					Off-Ramp				
		Adj. Demand	% Trucks	% RVs	Lanes	FFS	Adj. Demand	% Trucks	% RVs	Lanes	FFS
4	0.050	756	2.00	0.00	1	40	1029	2.00	0.00	1	40
7	0.050	364	2.00	0.00	1	40	787	4.00	0.00	1	40

Time Period Independent Weaving Segment Data

Seg #	Configuration	Short Length	# Weaving Lanes	Min. Lane Changes Freeway-Ramp	Min. Lane Changes Ramp-Freeway	Min. Lane Changes Ramp-Ramp
4	3000	2	1	1	0	
7	3000	2	1	0	0	

Time Period Results

Time Period 1

Seg #	From	To	Type	Adj. Demand	Vol. Served	Capacity (pc/h)	Capacity (veh/h)	d/c Ratio	v/c ratio	Queue Length (ft)	Avg. Speed (mi/h)	Density (pc/mi/in)	Density (veh/mi/in)	Avg. Travel Time (min/veh)	Free-Flow Travel Time (min/veh)	Mainline Delay (min/veh)	System Delay (min/veh)	VT Demand (veh-min)	VT Volume (veh-min)	VHT (veh-hrs)	VHD (veh-hrs)	LOS
1	Todd Rd	Golf Course Dr	Basic Segment	4916	4680	4800	4697	1.05	1.00	0	53.5	44.7	43.7	0.53	0.41	0.1	0.1	581.9	554.0	10.3	2.4	E
2	Golf Course		Off Ramp	4916	4680	4800	4697	1.05	1.00	0	57.4	41.7	40.8	0.30	0.24	0.1	0.1	349.1	332.4	5.8	1.0	E

	Off																					
3	Golf Course Off	Golf Course On	Basic Segment	3954	3780	4800	4683	0.84	0.81	0	63.7	30.4	29.7	0.69	0.62	0.1	0.1	718.9	687.3	10.8	1.0	D
4	Golf Course Dr	RP Expressway	Weaving	4710	4560	6462	6320	0.75	0.72	0	51.3	36.0	35.3	0.71	0.52	0.2	0.2	719.2	696.3	13.6	3.6	E
5	RP Expressway Off	RP Expressway WB On	Basic Segment	3681	3540	4800	4678	0.79	0.76	0	65.6	27.7	27.0	0.27	0.25	0.0	0.0	271.9	261.5	4.0	0.3	D
6	RP Expressway WB On		On Ramp	3900	3780	4800	4682	0.83	0.81	0	56.2	34.4	33.6	0.11	0.09	0.0	0.0	100.6	97.5	1.7	0.3	D
7	RP Expressway	SR 116	Weaving	4264	4140	6706	6550	0.65	0.63	0	61.2	21.9	21.4	0.85	0.74	0.1	0.1	924.7	897.8	14.7	1.8	C
8	SR 116 Off	SR 116 On	Basic Segment	3477	3360	4800	4684	0.74	0.72	0	66.8	25.8	25.1	0.35	0.34	0.0	0.0	342.4	330.9	5.0	0.2	C

Overall Results

Segment	Segment Type	Maximum d/c Ratio	Avg. Speed (mi/h)	Density (pc/mi/in)	Density (veh/mi/in)	Avg. Travel Time (min/veh)	Free-Flow Travel Time (min/veh)	VMT Demand (veh-min)	VMT Volume (veh-min)	VHT (veh-hrs)	VHD (veh-hrs)
Todd Rd-Golf Course Dr	Basic	1.05	53.5	44.7	43.7	0.53	0.41	0,581.9	0,554.0	10.35	2.43
Golf Course Off-	OffRamp	1.05	57.4	41.7	40.8	0.30	0.24	0,349.1	0,332.4	5.79	1.04
Golf Course Off-Golf Course On	Basic	0.84	63.7	30.4	29.7	0.69	0.62	0,718.9	0,687.3	10.79	0.97
Golf Course Dr-RP Expressway	Weaving	0.75	51.3	36.0	35.3	0.71	0.52	0,719.2	0,696.3	13.58	3.63
RP Expressway Off-RP Expressway WB On	Basic	0.79	65.6	27.7	27.0	0.27	0.25	0,271.9	0,261.5	3.99	0.25
RP Expressway WB On-	OnRamp	0.83	56.2	34.4	33.6	0.11	0.09	0,100.6	0,097.5	1.73	0.34
RP Expressway-SR 116	Weaving	0.65	61.2	21.9	21.4	0.85	0.74	0,924.7	0,897.8	14.67	1.85
SR 116 Off-SR 116 On	Basic	0.74	66.8	25.8	25.1	0.35	0.34	0,342.4	0,330.9	4.95	0.22
Freeway			58.6	30.8	30.1	3.81	3.22	4,008.8	3,857.7	0,065.8	0,010.7

HCS 2010 Freeway Facilities

Project Properties

Analyst	W-Trans	Freeway Name	US 101	Analysis Period	AM Peak
Analysis Date	3/31/2015 4:53:13 PM	From	Railroad Ave	Version Date	10/10/2012
Agency		To	Todd Rd		
Location	Sonoma County, CA	Analysis Direction	Northbound		
User Notes	Central Rohnert Park PDA Plan - AM Peak Hour Future plus Project - Northbound Direction				
File Name	C:\Users\zmatley\AppData\Local\Temp\preview.xml				

Facility-wide Values

Jam Density (pc/h/ln)	190	Time Period Duration (min)	15	Facility Length (mi)	3.78800

Segment Input Data

Time Period 1

Mainline Data										
Seg #	From	To	Type	Length	Terrain	Adj. Demand	% Trucks	% RVs	# Lanes	FFS
1	SR 116 Off	SR 116 On	Basic Segment	2375	Level	2516	4.00	1.00	2	70
2	SR 116	RP Expressway	Weaving	4370	Level	3638	4.00	0.69	3	70
3	RP Expressway Off	RP Expressway EB On	Basic Segment	1065	Level	3077	4.36	0.82	2	70
4	RP Expressway EB On		On Ramp	1500	Level	3352	4.17	0.75	2	70
5	RP Expressway EB On	RP Expressway WB On	Basic Segment	450	Level	3352	4.17	0.75	2	70
6	RP Expressway	Commerce Blvd	Weaving	2315	Level	4333	3.68	0.58	3	70
7	Commerce Off	Commerce On	Basic Segment	650	Level	3912	3.86	0.64	2	70
8	Commerce Blvd	Santa Rosa Ave	Weaving	3000	Level	4530	3.61	0.56	3	70
9	Santa Rosa Ave	Todd Rd	Basic Segment	4275	Level	4075	3.79	0.62	2	70

RampData							
Seg #	Type	Adj. Demand	% Trucks	% RVs	Lanes	Accel/Decel Length	FFS
4	On Ramp	275	2.00	0.00	1	765	40

Weaving Segment Data											
Seg #	Ramp to Ramp Prop.	On-Ramp					Off-Ramp				
		Adj. Demand	% Trucks	% RVs	Lanes	FFS	Adj. Demand	% Trucks	% RVs	Lanes	FFS
2	0.050	1122	4.00	0.00	1	40	561	2.00	0.00	1	50
6	0.050	981	2.00	0.00	1	40	421	2.00	0.00	1	40
8	0.050	618	2.00	0.00	1	40	455	2.00	0.00	1	40

Time Period Independent Weaving Segment Data

Seg #	Configuration	Short Length	# Weaving Lanes	Min. Lane Changes Freeway-Ramp	Min. Lane Changes Ramp-Freeway	Min. Lane Changes Ramp-Ramp
2	3000	2	1	1	0	
6	1782	2	1	1	0	
8	3000	2	1	1	0	

Time Period Results

Time Period 1

Seg #	From	To	Type	Adj. Demand	Vol. Served	Capacity (pc/h)	Capacity (veh/h)	d/c Ratio	v/c ratio	Queue Length (ft)	Avg. Speed (mi/h)	Density (pc/mi/ln)	Density (veh/mi/ln)	Avg. Travel Time (min/veh)	Free-Flow Travel Time (min/veh)	Mainline Delay (min/veh)	System Delay (min/veh)	VMT Demand (veh-min)	VMT Volume (veh-min)	VHT (veh-hrs)	VHD (veh-hrs)	LOS

1	SR 116 Off	SR 116 On	Basic Segment	2516	2516	4800	4697	0.54	0.54	0	69.9	18.4	18.0	0.39	0.39	0.0	0.0	282.9	282.9	4.0	0.0	C
2	SR 116	RP Expressway	Weaving	3638	3638	5589	5472	0.66	0.66	0	55.2	22.5	22.0	0.90	0.71	0.2	0.2	752.7	752.7	13.6	2.9	C
3	RP Expressway Off	RP Expressway EB On	Basic Segment	3077	3077	4800	4690	0.66	0.66	0	68.4	23.0	22.5	0.18	0.17	0.0	0.0	155.2	155.2	2.3	0.1	C
4	RP Expressway EB On		On Ramp	3352	3352	4800	4695	0.71	0.71	0	59.4	28.8	28.2	0.29	0.24	0.0	0.0	238.1	238.1	4.0	0.6	D
5	RP Expressway EB On	RP Expressway WB On	Basic Segment	3352	3352	4800	4695	0.71	0.71	0	66.9	25.6	25.0	0.08	0.07	0.0	0.0	71.4	71.4	1.1	0.0	C
6	RP Expressway	Commerce Blvd	Weaving	4333	4333	6333	6212	0.70	0.70	0	54.5	27.0	26.5	0.48	0.38	0.1	0.1	474.9	474.9	8.7	1.9	C
7	Commerce Off	Commerce On	Basic Segment	3912	3912	4800	4703	0.83	0.83	0	62.6	31.9	31.2	0.12	0.11	0.0	0.0	120.4	120.4	1.9	0.2	D
8	Commerce Blvd	Santa Rosa Ave	Weaving	4530	4530	6798	6670	0.68	0.68	0	56.2	27.4	26.9	0.61	0.49	0.1	0.1	643.5	643.5	11.5	2.3	C
9	Santa Rosa Ave	Todd Rd	Basic Segment	4075	4075	4800	4705	0.87	0.87	0	61.0	34.0	33.4	0.80	0.69	0.1	0.1	824.8	824.8	13.5	1.7	D

Overall Results

Segment	Segment Type	Maximum d/c Ratio	Avg. Speed (mi/h)	Density (pc/mi/in)	Density (veh/mi/in)	Avg. Travel Time (min/veh)	Free-Flow Travel Time (min/veh)	VMT Demand (veh-min)	VMT Volume (veh-min)	VHT (veh-hrs)	VHD (veh-hrs)
SR 116 Off-SR 116 On	Basic	0.54	69.9	18.4	18.0	0.39	0.39	0,282.9	0,282.9	4.05	0.00
SR 116-RP Expressway	Weaving	0.66	55.2	22.5	22.0	0.90	0.71	0,752.7	0,752.7	13.65	2.89
RP Expressway Off-RP Expressway EB On	Basic	0.66	68.4	23.0	22.5	0.18	0.17	0,155.2	0,155.2	2.27	0.05
RP Expressway EB On-	OnRamp	0.71	59.4	28.8	28.2	0.29	0.24	0,238.1	0,238.1	4.01	0.61
RP Expressway EB On-RP Expressway WB On	Basic	0.71	66.9	25.6	25.0	0.08	0.07	0,071.4	0,071.4	1.07	0.05
RP Expressway-Commerce Blvd	Weaving	0.70	54.5	27.0	26.5	0.48	0.38	0,474.9	0,474.9	8.71	1.93
Commerce Off-Commerce On	Basic	0.83	62.6	31.9	31.2	0.12	0.11	0,120.4	0,120.4	1.92	0.20
Commerce Blvd-Santa Rosa Ave	Weaving	0.68	56.2	27.4	26.9	0.61	0.49	0,643.5	0,643.5	11.46	2.26
Santa Rosa Ave-Todd Rd	Basic	0.87	61.0	34.0	33.4	0.80	0.69	0,824.8	0,824.8	13.51	1.73
Freeway			58.8	26.3	25.8	3.83	3.25	3,564.0	3,564.0	0,060.6	0,009.7

HCS 2010 Freeway Facilities

Project Properties

Analyst	W-Trans	Freeway Name	US101	Analysis Period	AM Peak
Analysis Date	3/31/2015 10:36:29 AM	From	Todd Rd	Version Date	10/10/2012
Agency		To	Railroad Ave		
Location	Sonoma County, CA	Analysis Direction	Southbound		
User Notes	Central Rohnert Park PDA Plan - AM Peak Hour Future plus Project - Southbound Direction				
File Name	C:\Users\zmatley\AppData\Local\Temp\preview.xml				

Facility-wide Values

Jam Density (pc/h/ln)	190	Time Period Duration (min)	15	Facility Length (mi)	3.75600

Segment Input Data

Time Period 1

Mainline Data										
Seg #	From	To	Type	Length	Terrain	Adj. Demand	% Trucks	% RVs	# Lanes	FFS
1	Todd Rd	Golf Course Dr	Basic Segment	2500	Level	5271	4.00	1.00	2	70
2	Golf Course Off		Off Ramp	1500	Level	5271	4.00	1.00	2	70
3	Golf Course Off	Golf Course On	Basic Segment	3840	Level	4305	4.45	1.22	2	70
4	Golf Course Dr	RP Expressway	Weaving	3225	Level	4997	4.11	1.05	3	70
5	RP Expressway Off	RP Expressway WB On	Basic Segment	1560	Level	3882	4.72	1.36	2	70
6	RP Expressway WB On		On Ramp	545	Level	4301	4.45	1.23	2	70
7	RP Expressway	SR 116	Weaving	4580	Level	4625	4.28	1.14	3	70
8	SR 116 Off	SR 116 On	Basic Segment	2080	Level	4008	4.32	1.32	2	70

RampData							
Seg #	Type	Adj. Demand	% Trucks	% RVs	Lanes	Accel/Decel Length	FFS
2	Off Ramp	966	2.00	0.00	1	200	50
6	On Ramp	419	2.00	0.00	1	200	40

Weaving Segment Data											
Seg #	Ramp to Ramp Prop.	On-Ramp					Off-Ramp				
		Adj. Demand	% Trucks	% RVs	Lanes	FFS	Adj. Demand	% Trucks	% RVs	Lanes	FFS
4	0.050	692	2.00	0.00	1	40	1115	2.00	0.00	1	40
7	0.050	324	2.00	0.00	1	40	617	4.00	0.00	1	40

Time Period Independent Weaving Segment Data

Seg #	Configuration	Short Length	# Weaving Lanes	Min. Lane Changes Freeway-Ramp	Min. Lane Changes Ramp-Freeway	Min. Lane Changes Ramp-Ramp
4	3000	2	1	1	0	
7	300	2	1	1	0	

Time Period Results

Time Period 1

Seg #	From	To	Type	Adj. Demand	Vol. Served	Capacity (pc/h)	Capacity (veh/h)	d/c Ratio	v/c ratio	Queue Length (ft)	Avg. Speed (mi/h)	Density (pc/mi/in)	Density (veh/mi/in)	Avg. Travel Time (min/veh)	Free-Flow Travel Time (min/veh)	Mainline Delay (min/veh)	System Delay (min/veh)	VMT Demand (veh-min)	VMT Volume (veh-min)	VHT (veh-hrs)	VHD (veh-hrs)	LOS
1	Todd Rd	Golf Course Dr	Basic Segment	5271	4680	4800	4697	1.12	1.00	0	53.5	44.7	43.7	0.53	0.41	0.1	0.1	623.9	554.0	10.3	2.4	E
2	Golf Course		Off Ramp	5271	4680	4800	4697	1.12	1.00	0	57.4	41.7	40.8	0.30	0.24	0.1	0.1	374.4	332.4	5.8	1.0	E

	Off																					
3	Golf Course Off	Golf Course On	Basic Segment	4305	3840	4800	4684	0.92	0.82	0	63.2	31.1	30.4	0.69	0.62	0.1	0.1	782.7	698.2	11.1	1.1	D
4	Golf Course Dr	RP Expressway	Weaving	4997	4500	6500	6356	0.79	0.71	0	51.3	35.6	34.8	0.71	0.52	0.2	0.2	763.0	687.1	13.4	3.6	E
5	RP Expressway Off	RP Expressway WB On	Basic Segment	3882	3540	4800	4677	0.83	0.76	0	65.6	27.7	27.0	0.27	0.25	0.0	0.0	286.7	261.5	4.0	0.3	D
6	RP Expressway WB On		On Ramp	4301	3960	4800	4684	0.92	0.85	0	55.2	36.7	35.8	0.11	0.09	0.0	0.0	111.0	102.2	1.9	0.4	E
7	RP Expressway	SR 116	Weaving	4625	4260	6240	6096	0.76	0.70	0	54.8	24.1	23.5	0.95	0.74	0.2	0.2	1003.0	923.8	16.9	3.7	C
8	SR 116 Off	SR 116 On	Basic Segment	4008	3720	4800	4686	0.86	0.79	0	64.2	29.7	29.0	0.37	0.34	0.0	0.0	394.7	366.4	5.7	0.5	D

Overall Results

Segment	Segment Type	Maximum d/c Ratio	Avg. Speed (mi/h)	Density (pc/mi/in)	Density (veh/mi/in)	Avg. Travel Time (min/veh)	Free-Flow Travel Time (min/veh)	VMT Demand (veh-min)	VMT Volume (veh-min)	VHT (veh-hrs)	VHD (veh-hrs)
Todd Rd-Golf Course Dr	Basic	1.12	53.5	44.7	43.7	0.53	0.41	0,623.9	0,554.0	10.35	2.43
Golf Course Off-	OffRamp	1.12	57.4	41.7	40.8	0.30	0.24	0,374.4	0,332.4	5.79	1.04
Golf Course Off-Golf Course On	Basic	0.92	63.2	31.1	30.4	0.69	0.62	0,782.7	0,698.2	11.05	1.08
Golf Course Dr-RP Expressway	Weaving	0.79	51.3	35.6	34.8	0.71	0.52	0,763.0	0,687.1	13.40	3.58
RP Expressway Off-RP Expressway WB On	Basic	0.83	65.6	27.7	27.0	0.27	0.25	0,286.7	0,261.5	3.99	0.25
RP Expressway WB On-	OnRamp	0.92	55.2	36.7	35.8	0.11	0.09	0,111.0	0,102.2	1.85	0.39
RP Expressway-SR 116	Weaving	0.76	54.8	24.1	23.5	0.95	0.74	1,003.0	0,923.8	16.87	3.67
SR 116 Off-SR 116 On	Basic	0.86	64.2	29.7	29.0	0.37	0.34	0,394.7	0,366.4	5.70	0.47
Freeway			56.9	31.9	31.1	3.93	3.22	4,339.5	3,925.5	0,069.0	0,012.9

HCS 2010 Freeway Facilities

Project Properties

Analyst		Freeway Name	US 101	Analysis Period	PM Peak
Analysis Date	4/7/2015 4:53:13 PM	From	Railroad Ave	Version Date	10/10/2012
Agency		To	Todd Rd		
Location	Sonoma County, CA	Analysis Direction	Northbound		
User Notes	Central Rohnert Park PDA Plan - PM Peak Hour Future plus Project - Northbound Direction				
File Name	C:\Users\zmatley\AppData\Local\Temp\preview.xml				

Facility-wide Values

Jam Density (pc/h/ln)	190	Time Period Duration (min)	15	Facility Length (mi)	3.69300

Segment Input Data

Time Period 1

Mainline Data									
Seg #	From	To	Type	Length	Terrain	Adj. Demand	% Trucks	% RVs	# Lanes
1	SR 116 Off	SR 116 On	Basic Segment	2375	Level	4067	4.00	1.00	3
2	SR 116	RP Expressway	Weaving	4370	Level	4748	4.00	0.86	3
3	RP Expressway Off	RP Expressway EB On	Basic Segment	1065	Level	3934	4.41	1.03	2
4	RP Expressway EB On		On Ramp	1500	Level	4367	4.17	0.93	2
5	RP Expressway EB On	RP Expressway WB On	Basic Segment	450	Level	4367	4.17	0.93	2
6	RP Expressway	Commerce Blvd	Weaving	2315	Level	5117	3.86	0.79	3
7	Commerce Off	Commerce On	Basic Segment	650	Level	4527	4.10	0.90	2
8	Commerce Blvd	Santa Rosa Ave	Weaving	3000	Level	5859	3.62	0.69	3
9	Santa Rosa Ave	Todd Rd	Basic Segment	3775	Level	5439	3.75	0.75	2

RampData							
Seg #	Type	Adj. Demand	% Trucks	% RVs	Lanes	Accel/Decel Length	FFS
4	On Ramp	433	2.00	0.00	1	765	40

Weaving Segment Data											
Seg #	Ramp to Ramp Prop.	On-Ramp					Off-Ramp				
		Adj. Demand	% Trucks	% RVs	Lanes	FFS	Adj. Demand	% Trucks	% RVs	Lanes	FFS
2	0.050	681	4.00	0.00	1	40	814	2.00	0.00	1	50
6	0.050	750	2.00	0.00	1	40	590	2.00	0.00	1	40
8	0.050	1332	2.00	0.00	1	40	420	2.00	0.00	1	40

Time Period Independent Weaving Segment Data

Seg #	Configuration	Short Length	# Weaving Lanes	Min. Lane Changes Freeway-Ramp	Min. Lane Changes Ramp-Freeway	Min. Lane Changes Ramp-Ramp
2	3000	2	1	1	0	
6	1782	2	1	1	0	
8	3000	2	1	1	0	

Time Period Results

Time Period 1

Seg #	From	To	Type	Adj. Demand	Vol. Served	Capacity (pc/h)	Capacity (veh/h)	d/c Ratio	v/c ratio	Queue Length (ft)	Avg. Speed (mi/h)	Density (pc/mi/in)	Density (veh/mi/in)	Avg. Travel Time (min/veh)	Free-Flow Travel Time (min/veh)	Mainline Delay (min/veh)	System Delay (min/veh)	VTM Demand (veh-min)	VTM Volume (veh-min)	VHT (veh-hrs)	VHD (veh-hrs)	LOS

1	SR 116 Off	SR 116 On	Basic Segment	4067	4080	7200	7045	0.58	0.58	0	69.6	20.0	19.5	0.39	0.39	0.0	0.0	457.3	458.8	6.6	0.0	C
2	SR 116	RP Expressway	Weaving	4748	4740	6612	6471	0.73	0.73	0	52.9	33.5	32.8	0.94	0.71	0.2	0.2	982.4	980.8	18.5	4.5	D
3	RP Expressway Off	RP Expressway EB On	Basic Segment	3934	3960	4800	4687	0.84	0.84	0	62.1	32.7	31.9	0.20	0.17	0.0	0.0	198.4	199.7	3.2	0.4	D
4	RP Expressway EB On		On Ramp	4367	4380	4800	4693	0.93	0.93	0	53.2	42.0	41.1	0.32	0.24	0.1	0.1	310.2	311.1	5.8	1.4	E
5	RP Expressway EB On	RP Expressway WB On	Basic Segment	4367	4380	4800	4693	0.93	0.93	0	57.5	39.0	38.1	0.09	0.07	0.0	0.0	93.0	93.3	1.6	0.3	E
6	RP Expressway	Commerce Blvd	Weaving	5117	4906	6463	6331	0.81	0.77	1924	36.4	44.9	44.0	0.72	0.38	0.3	0.3	560.9	537.8	14.8	7.1	E
7	Commerce Off	Commerce On	Basic Segment	4527	4286	4800	4695	0.96	0.91	650	40.5	53.0	51.8	0.18	0.11	0.1	0.1	139.3	131.9	3.3	1.4	F
8	Commerce Blvd	Santa Rosa Ave	Weaving	5859	5070	6672	6544	0.90	0.77	3000	22.2	76.0	74.5	1.53	0.49	1.0	2.5	832.2	720.2	32.4	22.1	F
9	Santa Rosa Ave	Todd Rd	Basic Segment	5439	4680	4800	4705	1.16	0.99	0	53.6	44.5	43.6	0.80	0.61	0.2	0.2	972.2	836.5	15.6	3.6	E

Overall Results

Segment	Segment Type	Maximum d/c Ratio	Avg. Speed (mi/h)	Density (pc/mi/in)	Density (veh/mi/in)	Avg. Travel Time (min/veh)	Free-Flow Travel Time (min/veh)	VMT Demand (veh-min)	VMT Volume (veh-min)	VHT (veh-hrs)	VHD (veh-hrs)
SR 116 Off-SR 116 On	Basic	0.58	69.6	20.0	19.5	0.39	0.39	0,457.3	0,458.8	6.59	0.04
SR 116-RP Expressway	Weaving	0.73	52.9	33.5	32.8	0.94	0.71	0,982.4	0,980.8	18.53	4.52
RP Expressway Off-RP Expressway EB On	Basic	0.84	62.1	32.7	31.9	0.20	0.17	0,198.4	0,199.7	3.22	0.37
RP Expressway EB On-	OnRamp	0.93	53.2	42.0	41.1	0.32	0.24	0,310.2	0,311.1	5.85	1.40
RP Expressway EB On-RP Expressway WB On	Basic	0.93	57.5	39.0	38.1	0.09	0.07	0,093.0	0,093.3	1.62	0.29
RP Expressway-Commerce Blvd	Weaving	0.81	36.4	44.9	44.0	0.72	0.38	0,560.9	0,537.8	14.77	7.09
Commerce Off-Commerce On	Basic	0.96	40.5	53.0	51.8	0.18	0.11	0,139.3	0,131.9	3.26	1.38
Commerce Blvd-Santa Rosa Ave	Weaving	0.90	22.2	76.0	74.5	1.53	0.49	0,832.2	0,720.2	32.38	22.09
Santa Rosa Ave-Todd Rd	Basic	1.16	53.6	44.5	43.6	0.80	0.61	0,972.2	0,836.5	15.59	3.64
Freeway			41.9	43.3	42.5	5.17	3.17	4,546.0	4,270.0	0,101.8	0,040.8

HCS 2010 Freeway Facilities

Project Properties

Analyst		Freeway Name	US101	Analysis Period	PM Peak
Analysis Date	4/7/2015 10:36:29 AM	From	Todd Rd	Version Date	10/10/2012
Agency		To	Railroad Ave		
Location	Sonoma County, CA	Analysis Direction	Southbound		
User Notes	Central Rohnert Park PDA Plan - PM Peak Hour Future plus Project - Southbound Direction				
File Name	C:\Users\zmatley\AppData\Local\Temp\preview.xml				

Facility-wide Values

Jam Density (pc/h/ln)	190	Time Period Duration (min)	15	Facility Length (mi)	3.75600

Segment Input Data

Time Period 1

Mainline Data										
Seg #	From	To	Type	Length	Terrain	Adj. Demand	% Trucks	% RVs	# Lanes	FFS
1	Todd Rd	Golf Course Dr	Basic Segment	2500	Level	5095	4.00	1.00	2	70
2	Golf Course Off		Off Ramp	1500	Level	5095	4.00	1.00	2	70
3	Golf Course Off	Golf Course On	Basic Segment	3840	Level	4098	4.49	1.24	2	70
4	Golf Course Dr	RP Expressway	Weaving	3225	Level	4872	4.09	1.05	3	70
5	RP Expressway Off	RP Expressway WB On	Basic Segment	1560	Level	3699	4.75	1.38	2	70
6	RP Expressway WB On		On Ramp	545	Level	4052	4.51	1.26	2	70
7	RP Expressway	SR 116	Weaving	4580	Level	4416	4.31	1.15	3	70
8	SR 116 Off	SR 116 On	Basic Segment	2080	Level	3629	4.37	1.40	2	70

RampData							
Seg #	Type	Adj. Demand	% Trucks	% RVs	Lanes	Accel/Decel Length	FFS
2	Off Ramp	997	2.00	0.00	1	200	50
6	On Ramp	353	2.00	0.00	1	200	40

Weaving Segment Data											
Seg #	Ramp to Ramp Prop.	On-Ramp					Off-Ramp				
		Adj. Demand	% Trucks	% RVs	Lanes	FFS	Adj. Demand	% Trucks	% RVs	Lanes	FFS
4	0.050	774	2.00	0.00	1	40	1173	2.00	0.00	1	40
7	0.050	364	2.00	0.00	1	40	787	4.00	0.00	1	40

Time Period Independent Weaving Segment Data

Seg #	Configuration	Short Length	# Weaving Lanes	Min. Lane Changes Freeway-Ramp	Min. Lane Changes Ramp-Freeway	Min. Lane Changes Ramp-Ramp
4	3000	2	1	1	0	
7	3000	2	1	1	0	

Time Period Results

Time Period 1

Seg #	From	To	Type	Adj. Demand	Vol. Served	Capacity (pc/h)	Capacity (veh/h)	d/c Ratio	v/c ratio	Queue Length (ft)	Avg. Speed (mi/h)	Density (pc/mi/in)	Density (veh/mi/in)	Avg. Travel Time (min/veh)	Free-Flow Travel Time (min/veh)	Mainline Delay (min/veh)	System Delay (min/veh)	VMT Demand (veh-min)	VMT Volume (veh-min)	VHT (veh-hrs)	VHD (veh-hrs)	LOS
1	Todd Rd	Golf Course Dr	Basic Segment	5095	4680	4800	4697	1.08	1.00	0	53.5	44.7	43.7	0.53	0.41	0.1	0.1	603.1	554.0	10.3	2.4	E
2	Golf Course		Off Ramp	5095	4680	4800	4697	1.08	1.00	0	57.3	41.7	40.8	0.30	0.24	0.1	0.1	361.9	332.4	5.8	1.1	E

	Off																					
3	Golf Course Off	Golf Course On	Basic Segment	4098	3780	4800	4683	0.88	0.81	0	63.7	30.4	29.7	0.69	0.62	0.1	0.1	745.1	687.3	10.8	1.0	D
4	Golf Course Dr	RP Expressway	Weaving	4872	4560	6336	6196	0.79	0.74	0	50.6	36.7	35.9	0.72	0.52	0.2	0.2	743.9	696.3	13.8	3.8	E
5	RP Expressway Off	RP Expressway WB On	Basic Segment	3699	3480	4800	4676	0.79	0.74	0	66.0	27.1	26.4	0.27	0.25	0.0	0.0	273.2	257.0	3.9	0.2	D
6	RP Expressway WB On		On Ramp	4052	3780	4800	4683	0.87	0.81	0	56.2	34.4	33.5	0.11	0.09	0.0	0.0	104.6	97.5	1.7	0.3	D
7	RP Expressway	SR 116	Weaving	4416	4200	6728	6571	0.67	0.64	0	56.8	22.8	22.2	0.92	0.74	0.2	0.2	957.6	910.8	16.0	3.0	C
8	SR 116 Off	SR 116 On	Basic Segment	3629	3420	4800	4684	0.77	0.73	0	66.5	26.4	25.7	0.36	0.34	0.0	0.0	357.4	336.8	5.1	0.3	D

Overall Results

Segment	Segment Type	Maximum d/c Ratio	Avg. Speed (mi/h)	Density (pc/mi/in)	Density (veh/mi/in)	Avg. Travel Time (min/veh)	Free-Flow Travel Time (min/veh)	VMT Demand (veh-min)	VMT Volume (veh-min)	VHT (veh-hrs)	VHD (veh-hrs)
Todd Rd-Golf Course Dr	Basic	1.08	53.5	44.7	43.7	0.53	0.41	0,603.1	0,554.0	10.35	2.43
Golf Course Off-	OffRamp	1.08	57.3	41.7	40.8	0.30	0.24	0,361.9	0,332.4	5.80	1.05
Golf Course Off-Golf Course On	Basic	0.88	63.7	30.4	29.7	0.69	0.62	0,745.1	0,687.3	10.79	0.97
Golf Course Dr-RP Expressway	Weaving	0.79	50.6	36.7	35.9	0.72	0.52	0,743.9	0,696.3	13.77	3.82
RP Expressway Off-RP Expressway WB On	Basic	0.79	66.0	27.1	26.4	0.27	0.25	0,273.2	0,257.0	3.89	0.22
RP Expressway WB On-	OnRamp	0.87	56.2	34.4	33.5	0.11	0.09	0,104.6	0,097.5	1.73	0.34
RP Expressway-SR 116	Weaving	0.67	56.8	22.8	22.2	0.92	0.74	0,957.6	0,910.8	16.04	3.03
SR 116 Off-SR 116 On	Basic	0.77	66.5	26.4	25.7	0.36	0.34	0,357.4	0,336.8	5.07	0.26
Freeway			57.4	31.2	30.5	3.89	3.22	4,146.8	3,872.1	0,067.4	0,012.1

Appendix F

NCHRP Internal Capture Calculation Worksheets

NCHRP 8-51 Internal Trip Capture Estimation Tool					
Project Name:	Rohnert Park PDA Plan			Organization:	W-Trans
Project Location:	Rohnert Park			Performed By:	
Scenario Description:				Date:	
Analysis Year:				Checked By:	
Analysis Period:	AM Street Peak Hour			Date:	2015

Table 1-A: Base Vehicle-Trip Generation Estimates (Single-Use Site Estimate)						
Land Use	Development Data (For Information Only)			Estimated Vehicle-Trips		
	ITE LUCs ¹	Quantity	Units	Total	Entering	Exiting
Office		710	98 ksf	153	135	18
Retail		826	249 ksf	220	136	84
Restaurant			ksf	0		
Cinema/Entertainment				0		
Residential		220	675 units	348	69	279
Hotel				0		
All Other Land Uses ²				0		
Total				721	340	381

Table 2-A: Mode Split and Vehicle Occupancy Estimates						
Land Use	Entering Trips			Exiting Trips		
	Veh. Occ.	% Transit	% Non-Motorized	Veh. Occ.	% Transit	% Non-Motorized
Office	1.09	2%	8%	1.09	2%	8%
Retail	1.30	2%	8%	1.30	2%	8%
Restaurant						
Cinema/Entertainment						
Residential	1.39	2%	8%	1.39	2%	8%
Hotel						
All Other Land Uses ²						

Table 3-A: Average Land Use Interchange Distances (Feet Walking Distance)						
Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office						
Retail						
Restaurant						
Cinema/Entertainment						
Residential						
Hotel						

Table 4-A: Internal Person-Trip Origin-Destination Matrix*						
Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		6	0	0	0	0
Retail	6		0	0	2	0
Restaurant	0	0		0	0	0
Cinema/Entertainment	0	0	0		0	0
Residential	4	4	0	0		0
Hotel	0	0	0	0	0	

Table 5-A: Computations Summary			
	Total	Entering	Exiting
All Person-Trips	937	420	517
Internal Capture Percentage	5%	5%	4%
External Vehicle-Trips ³	617	289	328
External Transit-Trips ⁴	18	8	10
External Non-Motorized Trips ⁴	71	32	39

Table 6-A: Internal Trip Capture Percentages by Land Use		
Land Use	Entering Trips	Exiting Trips
Office	7%	30%
Retail	6%	7%
Restaurant	N/A	N/A
Cinema/Entertainment	N/A	N/A
Residential	2%	2%
Hotel	N/A	N/A

¹ Land Use Codes (LUCs) from <i>Trip Generation Informational Report</i> , published by the Institute of Transportation Engineers.
² Total estimate for all other land uses at mixed-use development site-not subject to internal trip capture computations in this estimator
³ Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-A
⁴ Person-Trips
*Indicates computation that has been rounded to the nearest whole number.
<i>Estimation Tool Developed by the Texas Transportation Institute</i>

Project Name:	Rohnert Park PDA Plan
Analysis Period:	AM Street Peak Hour

Table 7-A: Conversion of Vehicle-Trip Ends to Person-Trip Ends					
Land Use	Table 7-A (D): Entering Trips			Table 7-A (O): Exiting Trips	
	Veh. Occ.	Vehicle-Trips	Person-Trips*	Veh. Occ.	Vehicle-Trips
Office	1.09	135	147	1.09	18
Retail	1.30	136	177	1.30	84
Restaurant	1.00	0	0	1.00	0
Cinema/Entertainment	1.00	0	0	1.00	0
Residential	1.39	69	96	1.39	279
Hotel	1.00	0	0	1.00	0

Table 8-A (O): Internal Person-Trip Origin-Destination Matrix (Computed at Origin)						
Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		6	13	0	0	0
Retail	32		14	0	15	0
Restaurant	0	0		0	0	0
Cinema/Entertainment	0	0	0		0	0
Residential	8	4	78	0		0
Hotel	0	0	0	0	0	

Table 8-A (D): Internal Person-Trip Origin-Destination Matrix (Computed at Destination)						
Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		57	0	0	0	0
Retail	6		0	0	2	0
Restaurant	21	14		0	5	0
Cinema/Entertainment	0	0	0		0	0
Residential	4	30	0	0		0
Hotel	4	7	0	0	0	

Table 9-A (D): Internal and External Trips Summary (Entering Trips)						
Destination Land Use	Person-Trip Estimates			External Trips by Mode*		
	Internal	External	Total	Vehicles ¹	Transit ²	Non-Motorized ²
Office	10	137	147	113	3	11
Retail	10	167	177	116	3	13
Restaurant	0	0	0	0	0	0
Cinema/Entertainment	0	0	0	0	0	0
Residential	2	94	96	60	2	8
Hotel	0	0	0	0	0	0
All Other Land Uses ³	0	0	0	0	0	0

Table 9-A (O): Internal and External Trips Summary (Exiting Trips)						
Origin Land Use	Person-Trip Estimates			External Trips by Mode*		
	Internal	External	Total	Vehicles ¹	Transit ²	Non-Motorized ²
Office	6	14	20	12		1
Retail	8	101	109	70	2	8
Restaurant	0	0	0	0	0	0
Cinema/Entertainment	0	0	0	0	0	0
Residential	8	380	388	246	8	30
Hotel	0	0	0	0	0	0
All Other Land Uses ³	0	0	0	0	0	0

¹ Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-A
² Person-Trips
³ Total estimate for all other land uses at mixed-use development site-not subject to internal trip capture computations in this estimator
⁴ Indicates computation that has been rounded to the nearest whole number.

NCHRP 8-51 Internal Trip Capture Estimation Tool					
Project Name:	Rohnert Park PDA Plan			Organization:	W-Trans
Project Location:	Rohnert Park			Performed By:	
Scenario Description:				Date:	
Analysis Year:				Checked By:	
Analysis Period:	PM Street Peak Hour			Date:	2015

Table 1-P: Base Vehicle-Trip Generation Estimates (Single-Use Site Estimate)						
Land Use	Development Data (For Information Only)			Estimated Vehicle-Trips		
	ITE LUCs ¹	Quantity	Units	Total	Entering	Exiting
Office	710	98	ksf	146	25	121
Retail	826	249	ksf	619	273	346
Restaurant				0		
Cinema/Entertainment				0		
Residential	220	675	units	418	272	146
Hotel				0		
All Other Land Uses ²				0		
Total				1183	570	613

Table 2-P: Mode Split and Vehicle Occupancy Estimates						
Land Use	Entering Trips			Exiting Trips		
	Veh. Occ.	% Transit	% Non-Motorized	Veh. Occ.	% Transit	% Non-Motorized
Office	1.09	2%	8%	1.09	2%	8%
Retail	1.30	2%	8%	1.30	2%	8%
Restaurant						
Cinema/Entertainment						
Residential	1.39	2%	8%	1.39	2%	8%
Hotel						
All Other Land Uses ²						

Table 3-P: Average Land Use Interchange Distances (Feet Walking Distance)						
Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		800	800		800	
Retail					800	
Restaurant						
Cinema/Entertainment						
Residential		800	800			
Hotel						

Table 4-P: Internal Person-Trip Origin-Destination Matrix*						
Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		22	0	0	3	0
Retail	8		0	0	116	0
Restaurant	0	0		0	0	0
Cinema/Entertainment	0	0	0		0	0
Residential	8	29	0	0		0
Hotel	0	0	0	0	0	

Table 5-P: Computations Summary			
	Total	Entering	Exiting
All Person-Trips	1,545	760	785
Internal Capture Percentage	24%	24%	24%
External Vehicle-Trips ³	809	388	421
External Transit-Trips ⁴	23	11	12
External Non-Motorized Trips ⁴	94	46	48

Table 6-P: Internal Trip Capture Percentages by Land Use		
Land Use	Entering Trips	Exiting Trips
Office	59%	19%
Retail	14%	28%
Restaurant	N/A	N/A
Cinema/Entertainment	N/A	N/A
Residential	31%	18%
Hotel	N/A	N/A

¹Land Use Codes (LUCs) from *Trip Generation Informational Report*, published by the Institute of Transportation Engineers.

²Total estimate for all other land uses at mixed-use development site-not subject to internal trip capture computations in this estimator

³Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-P

⁴Person-Trips

*Indicates computation that has been rounded to the nearest whole number.

Estimation Tool Developed by the Texas Transportation Institute

Project Name:	Rohnert Park PDA Plan
Analysis Period:	PM Street Peak Hour

Table 7-P: Conversion of Vehicle-Trip Ends to Person-Trip Ends					
Land Use	Table 7-P (D): Entering Trips			Table 7-P (O): Exiting Trips	
	Veh. Occ.	Vehicle-Trips	Person-Trips*	Veh. Occ.	Vehicle-Trips
Office	1.09	25	27	1.09	121
Retail	1.30	273	355	1.30	346
Restaurant	1.00	0	0	1.00	0
Cinema/Entertainment	1.00	0	0	1.00	0
Residential	1.39	272	378	1.39	146
Hotel	1.00	0	0	1.00	0

Table 8-P (O): Internal Person-Trip Origin-Destination Matrix (Computed at Origin)					
Origin (From)	Destination (To)				
	Office	Retail	Restaurant	Residential	Hotel
Office		22	4	0	3
Retail	9		131	18	116
Restaurant	0	0		0	0
Cinema/Entertainment	0	0	0	0	0
Residential	8	70	35	0	6
Hotel	0	0	0	0	

Table 8-P (D): Internal Person-Trip Origin-Destination Matrix (Computed at Destination)					
Origin (From)	Destination (To)				
	Office	Retail	Restaurant	Residential	Hotel
Office		23	0	0	15
Retail	8		0	0	174
Restaurant	8	178		0	60
Cinema/Entertainment	2	14	0	15	0
Residential	15	29	0	0	0
Hotel	0	7	0	0	

Table 9-P (D): Internal and External Trips Summary (Entering Trips)						
Destination Land Use	Person-Trip Estimates			External Trips by Mode*		
	Internal	External	Total	Vehicles ¹	Transit ²	Non-Motorized ²
Office	16	11	27	9	0	1
Retail	51	304	355	211	6	24
Restaurant	0	0	0	0	0	0
Cinema/Entertainment	0	0	0	0	0	0
Residential	119	259	378	168	5	21
Hotel	0	0	0	0	0	0
All Other Land Uses ³	0	0	0	0	0	0

Table 9-P (O): Internal and External Trips Summary (Exiting Trips)						
Origin Land Use	Person-Trip Estimates			External Trips by Mode*		
	Internal	External	Total	Vehicles ¹	Transit ²	Non-Motorized ²
Office	25	107	132	88	2	9
Retail	124	326	450	225	7	26
Restaurant	0	0	0	0	0	0
Cinema/Entertainment	0	0	0	0	0	0
Residential	37	166	203	108	3	13
Hotel	0	0	0	0	0	0
All Other Land Uses ³	0	0	0	0	0	0

*Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-P

¹Person-Trips

²Total estimate for all other land uses at mixed-use development site-not subject to internal trip capture computations in this estimator

³Indicates computation that has been rounded to the nearest whole number.

APPENDIX F

Water Supply Assessment

Water Supply Assessment for the Central Rohnert Park Priority Development Area

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1. INTRODUCTION

This Water Supply Assessment (WSA) has been prepared to assist the City of Rohnert Park (City) in satisfying the requirements of Water Code Section 10910 et. seq. - Water Supply Planning to Support Existing & Future Uses. The City is preparing the Central Rohnert Park Priority Development Area Plan (PDA Plan) and is the lead agency under the California Environmental Quality Act (CEQA) for the PDA Plan. Both CEQA and the California Water Code require a lead agency to consider water supply and demand as part of the development review process.

1.1 REQUIREMENTS FOR A WSA

The requirement to prepare a WSA was established in 2002 by Senate Bill (SB) 610, which emphasizes the interrelationships between land use and water supply planning, and requires the incorporation of water supply and demand analyses at the earliest possible stage in the land use planning process. The stated intent of SB 610 is to strengthen the process by which local agencies determine the adequacy and sufficiency of current and future water supplies to meet current and future demands.

SB 610 amended the California Public Resources Code to incorporate Water Code findings within the CEQA process for certain types of projects. SB 610 added Water Code Sections 10910, 10911, 10912, 10913, and 10915 (Water Supply Planning to Support Existing and Planned Future Uses), which describe when a WSA needs to be prepared and the required elements of that WSA. The WSA is then used as an informational document to support the CEQA process. SB 610 also amended Water Code Section 10631 (the Urban Water Management Planning Act) to create a clear relationship between an agency's Urban Water Management Plan (UWMP) and subsequent WSAs and to allow the UWMP to serve as a foundational document for the analysis in the WSA.

Water Code Section 10910 et. seq. defines the "projects" that require a WSA and the lead agency's responsibilities related to the WSA. A WSA is required for:

- A proposed residential development of more than 500 dwelling units;
- A proposed shopping center or business establishment employing more than 1,000 persons or having more than 500,000 square feet of floor space;
- A proposed commercial office building employing more than 1,000 persons or having more than 250,000 square feet of floor space;
- A proposed hotel or motel, or both, having more than 500 rooms;
- A proposed industrial, manufacturing, or processing plant, or industrial park planned to house more than 1,000 persons, occupying more than 40 acres of land, or having more than 650,000 square feet;
- A mixed-use development that includes one or more of the uses described above;
- A development that would demand an amount of water equivalent to or greater than the amount of water required by a 500-dwelling-unit project; and
- For lead agencies with fewer than 5,000 water service connections, any new development that will increase the number of water service connections in the service area by ten percent or more.

A WSA must provide:

- A description of all relevant water supply entitlements, water rights, and/or water contracts;
- A description of the available water supplies, in normal, dry and multiple dry years, and the infrastructure, either existing or proposed, to deliver the water; and
- An analysis of the demand placed on those supplies, by the project, and relevant existing and planned future uses in the area for at least a 20-year period.

The lead agency may incorporate the water suppliers' UWMP by reference, if the supplier included the proposed development's demands in the UWMP.

While water supply is clearly an important consideration in approval of a development, nothing in SB 610 prevents a lead agency from approving a proposed project even in the face of information concluding that there is not sufficient water supply for build-out of the project. However, where the description of existing water supply entitlements, water rights, and/or water contracts shows insufficient water supplies to serve the proposed project, as well as existing and planned uses over the 20-year planning horizon, additional information is required to describe how and where sufficient supplies may be obtained. Such information must include the estimated costs, financing methods, and regulatory approvals needed to obtain new supplies, as well as a projected time frame for obtaining them.

1.2 SUMMARY OF THE PROJECT

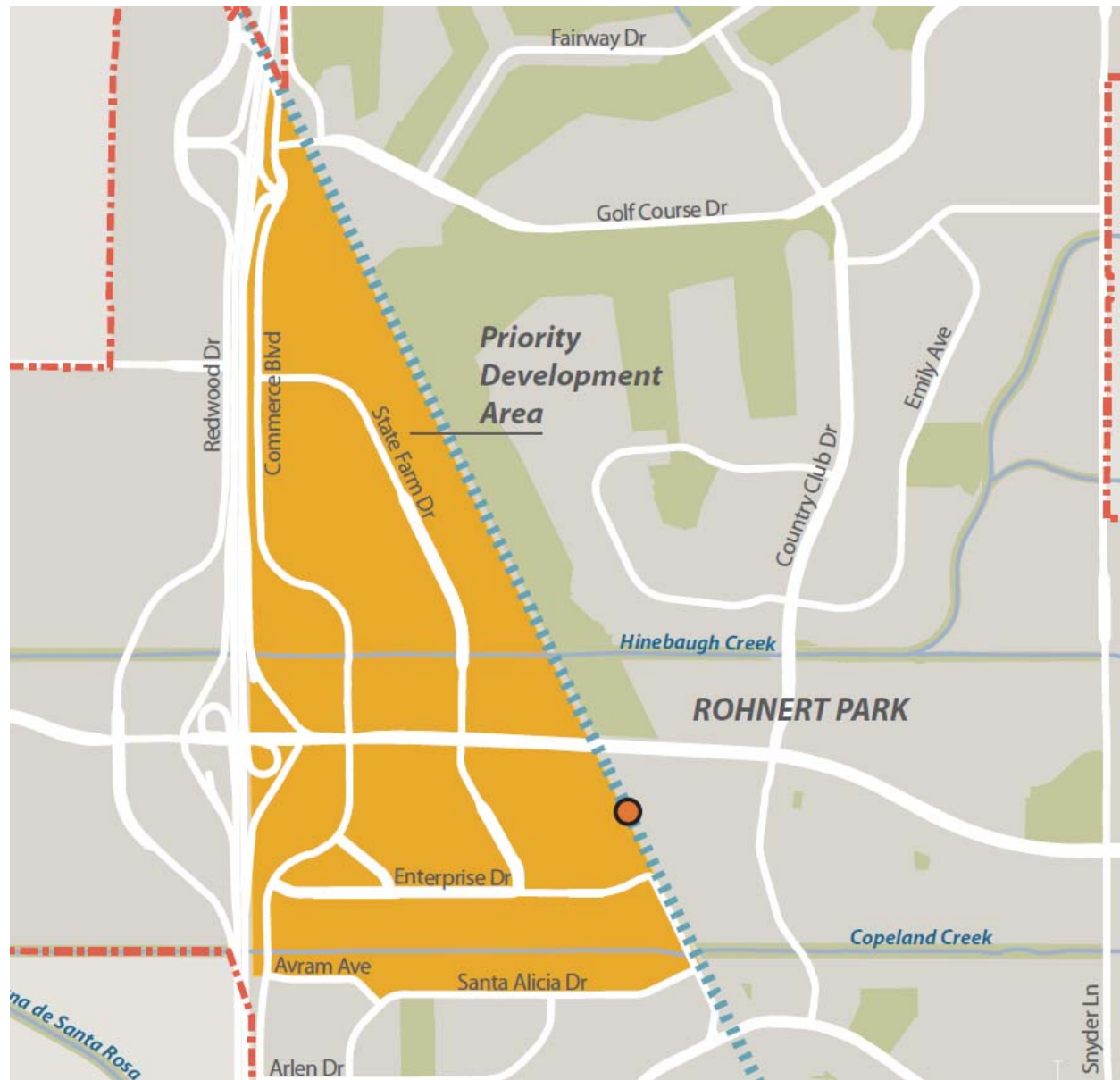
This WSA considers the proposed Central Rohnert Park Priority Development Area. The Project involves changes to the land use in an approximately 330 acre area within the central portion of Rohnert Park, bounded by US 101 to the west, the Sonoma Marin Area Rail Transit (SMART) right-of way to the east, Golf Course Drive to the north and Avram Avenue/Santa Alicia Drive to the south. The PDA Plan Area is illustrated in Figure 1. The existing and proposed land uses are summarized in Table 1 below.

TABLE 1 – PROPOSED LAND USE CHANGES IN THE PROPOSED CENTRAL ROHNERT PARK PDA

Land Use	EXISTING	PROJECT BUILD-OUT
Residential	1,390 units	2,225 units
Retail and Services*	700,700 sf	1,141,600 sf
Office	1,081,800 sf	987,900 sf
Public-Institutional	166,500 sf	222,100 sf
Industrial	768,400 sf	897,800 sf
Notes: sf = square feet		
*Also permits up to a 500-room hotel within the PDA.		

The City estimates that each additional housing unit within the PDA area will house 2 persons on average (the persons per household average for a multi-family dwelling in Rohnert Park). The corresponding population increase within the project area will be 1,670 persons .

Figure 1 central rohnert park Priority development area



1.3 SCOPE OF ANALYSIS

This WSA describes the relationship between the future demands associated with the PDA Plan and the availability of the City's water supply under different climatic conditions. This WSA has been prepared to assist the City in evaluating the impacts of the Project on the water supply. Specifically, this WSA:

- Provides information on the City's water supply that is consistent with Water Code Sections 10620 et. seq. (the Urban Water Management Act) and 10910 et. seq. (Water Supply Planning to Support Existing and Planned Future Uses);
- Provides information on current water demands and projected water demands associated with the Central Rohnert Park PDA; and
- Compares water supplies and water demands for the normal, single dry and multiple dry years.

1.3.1 URBAN WATER MANAGEMENT PLANS

The City adopted its "2010 UWMP" on June 14, 2011. The UWMP, which is incorporated by reference, can be found at <http://www.ci.rohnert-park.ca.us/gcsearch.aspx?q=2010+water+supply+assessment>. The UWMP conforms to the requirements of the Urban Water Management Planning Act and includes:

- A description of the water service area including climate, current and projected population and other demographic factors that affect water management planning;
- A description and quantification of the existing and planned water sources;
- A description of the reliability and vulnerability of the water supply to seasonal or climatic shortages in the average water year, single dry water year and multiple dry water year;
- Contingency plans including demand management and conjunctive use potential;
- A description of current and projected water demands among all user classes in 5-year increments; and
- A description of all water supply projects and water supply programs that may be undertaken by the City, its wholesale supplier the Sonoma County Water Agency and its wholesale recycled water supplier, the Santa Rosa Subregional System.

The 2010 UWMP concluded that the City's total projected water demand, including recycled water, would be 7,286 acre-feet per year (AFY) in the year 2035 (Table 3.15, 2010 UWMP). The 2010 UWMP concluded that the City had adequate supply, under all hydrologic conditions, to meet the demand. By way of comparison, the City's current total demand, including recycled water, is approximately 6,000 AFY (City of Rohnert Park production data).

In order to comply with the requirements of the Water Conservation Act of 2009 (SBx7-7) the 2010 UWMP includes a "baseline" water use and water use targets for 2015 and 2020. These targets, which are expressed as water use in gallons per capita per day (gpcd) will be used to validate the City's compliance with SBx7-7 requirements to reduce water use by 20 percent from the baseline by 2020. The targets, which are discussed in detail in Chapter 4 of this WSA, effectively serve to cap future demands.

1.3.2 PREVIOUS WATER SUPPLY ASSESSMENTS

Two previous WSAs have been prepared for the City. The City's 2004 Water Supply Assessment (the 2004 WSA) was developed to document the relationship between the City's water supply and the build-out of its

General Plan. The 2004 WSA included projected growth in the City's Northeast, Northwest, University District and Southeast Specific Plan Areas, Stadium Lands Planned Development Area and infill development. The 2004 WSA documented the City's total available water supply of 10,355 AFY from the City's Sonoma County Water Agency, groundwater and recycled water supplies. The 2004 documented a total anticipated water demand of 8,112 AFY in the year 2025 and concluded that the City has adequate water supply to manage its planned growth. Because of the City's ongoing water conservation efforts, subsequent Urban Water Management Plans have projected lower demands.

In July 2010, the City considered a Final Environmental Impact Report (EIR) for its Sonoma Mountain Village Planned Development Area, which was not included in the City's General Plan projections. This EIR included an updated Water Supply Assessment (SMV WSA) reflecting the land uses changes proposed by the Sonoma Mountain Village PDA. The SMV WSA documented a City's total available water supply 10,249 AFY, which is very similar to the 2004 WSA. Using a methodology similar to the 2004 WSA, the SMV WSA documented the total anticipated water demand, including the new Sonoma Mountain Village Project, to be 9,610 AFY in 2030 and it also concluded that the City had adequate water supply to manage its planned growth. As with the 2004 WSA, the demand projections in the SMV WSA do not reflect the effects of the City's water conservation efforts which have significantly reduced demand.

1.4 STRUCTURE OF THIS REPORT

This report is structured to facilitate the presentation of information required by the Water Code and to outline the analysis necessary to evaluate the sufficiency of water supply to meet planned growth. Table 2 below outlines where each element requirement under SB 610 is located in this report.

TABLE 2 – INDEX OF SB 610 REQUIREMENTS

Required Element	LOCATION IN DOCUMENT
Description of Service Area	Section 2
Population Projections in 5-year Increments	Table 3
Description and Quantification of Water Supplies	Section 3
Description of Supply Reliability to Climate Conditions	Section 3
Description of Contingency Plans	*
Description of Demand Management Potential	Section 4.1
Projection of Water Demands in 5-year Increments	Tables 7, 12, 13, and 14
Description of Projects & Programs Undertaken to Meet Demands	Section 5.1
Description of Demand Management Measures Employed	Appendix
Determination of Supply Sufficiency under Normal, Single & Multiple Dry Years	Section 5
Identification of Water Supply Entitlements & Rights and water received under rights	Section 3
Information related to capital outlay programs for financing delivery of water supply	Section 5.1
Information on permits needed and regulatory requirements associated with water supply	Section 5.1
* Demand Management and Contingency Planning is included in the City's 2010 Urban Water Management Plan and incorporated by reference	

2 WATER SERVICE AREA

The City of Rohnert Park is located in Central Sonoma County, approximately 50 miles north of San Francisco. The water service area under consideration in this WSA is bounded by the City's Sphere of Influence as outlined in its 2000 General Plan. The City's General Plan identified six major Specific Plan Areas (SPAs):

- Northeast SPA
- University District SPA
- Southeast SPA
- Canon Manor SPA
- Wilfred Dowdell SPA
- Northwest SPA

The City's General Plan anticipated annexation and development of all of the SPAs except Canon Manor. As described above, the City's 2004 WSA considered build-out of all the SPAs, except Canon Manor, as well as the Stadium Lands PD. The City's SMV WSA considered build-out of all the SPAs, except Canon Manor, and build-out of the Stadium Lands and Sonoma Mountain Village PDA. The City's 2010 UWMP also considered build-out of all the SPAs, except Canon Manor, along with Stadium Lands PD and the Sonoma Mountain Village PD. While both WSAs and the 2010 UWMP included the land area covered by the Central Rohnert Park PDA, these documents did not include the density of land uses proposed by the PDA Plan.

The City's water service area is approximately 6.4 square miles in area. The distribution system consists of approximately 115 miles of water distribution system mains and two pressure zones. Most of the distribution system mains are 6- to 8-inch diameter pipes with a small number in the 10- to 12-inch diameter range. The City's water system includes seven water storage tanks ranging in size from 300,000 gallons to 1.3 million gallons. The total storage available to the City's system is 4.2 million gallons.

The City also delivers tertiary treated recycled water to customers. The recycled water is produced by the Santa Rosa Subregional System. The Subregional System operates a low-pressure and a high-pressure distribution system. The low-pressure system is delivered through an 18-inch diameter pipeline that runs along Wilfred Avenue and Golf Course Drive and ends at Foxtail Golf Course near the northern city limits. This low-pressure system delivers approximately 500 acre-feet per year (AFY) to 5 customers. The high-pressure system begins at the Rohnert Park Pump Station, located at the intersection of Stony Point Road and Rohnert Park Expressway. The high-pressure system delivers 500 AFY to 27 customers.

Figure 2 illustrates the City's water service area.

Legend

- Sphere of Influence
- Specific Plan Areas

0 1,250 2,500 Feet

Source: Winzler & Kelly, 2005

2.1 POPULATION

In its 2010 UWMP, the City elected to use population and employment projections based on the 2009 Association of Bay Area Governments (ABAG) data. ABAG published the projections report in 2009, which includes population and employment estimates for each city in the Bay Area. Table 3 illustrates the population projections used in the 2010 UWMP, which include the anticipated development in the SPAs and PDs described above.

TABLE 3 – POPULATION PROJECTIONS FROM THE 2010 UWMP

	2010	2015	2020	2025	2030	2035	Data Source
Population	43,398	46,440	47,900	49,300	51,000	53,000	2009 ABAG

The City is in the process of preparing its 2015 UWMP and has already developed its population and employment projections based on ABAG's 2013 population report which anticipates the development of the Central Rohnert Park PDA. Table 4 illustrates the population projections that will be utilized in this WSA and the City's 2015 UWMP. The 2013 ABAG projections take into account the slow growth experienced during the recession period. The projections indicate that the City will recover from this slow growth trend by approximately 2030.

TABLE 4 - POPULATION PROJECTIONS FOR THE 2015 UWMP AND THIS WSA

	2015	2020	2025	2030	2035	2040	Data Source
Population	45,465	47,232	49,045	51,060	53,232	55,524	2013 ABAG Subregional

2.2 CLIMATE

The City is located in the Russian River watershed. The climate and hydrology of the Russian River watershed directly affect the City because its wholesale supply from the Sonoma County Water Agency is drawn from the Russian River. The climate of the Russian River watershed is tempered by its proximity to the Pacific Ocean and is characterized by seasonal rainfall patterns. Over 90 percent of the total annual precipitation falls between October and April, with a large percentage of the rainfall typically occurring during three or four major winter storms. The regional averages for rainfall, temperature and the rate of evapo-transpiration of common turf grass (ET_o) are summarized in Table 5.

TABLE 5 – CLIMATE DATA

	Average ETo (in)	Average Rainfall (in)	Average Temp ° F
January	1.2	6.25	47.0
February	1.7	5.32	50.5
March	2.8	4.09	52.8
April	3.7	2.06	55.8
May	5.0	0.97	59.8
June	6.0	0.26	64.6
July	6.1	0.03	66.5
August	5.9	0.08	66.6
September	4.5	0.38	65.9
October	2.9	1.60	61.2
November	1.5	3.64	53.4
December	0.7	5.50	47.6
Annual	42.0	30.18	57.6
Source: Western Regional Climate Center wrcc.dri.edu Santa Rosa Station			

3 WATER SUPPLY

This section provides an overview of the City’s water supply water, which has been documented extensively in the 2004 WSA, the SMV WSA, and the City’s 2005 and 2010 Urban Water Management Plans, all of which are incorporated by reference. The City of Rohnert Park has three sources of water: Sonoma County Water Agency (Agency) supply, local groundwater and recycled water. The City manages these supplies using a “conjunctive use” strategy, drawing on the Agency and recycled water supplies first and utilizing its local groundwater to manage peak demands. The total reliable supply available to the City through these three sources is 10,299 AFY, including 8,949 AFY of potable water and 1,350 AFY of recycled water. Table 6 summarizes the water supply available from each source. Due to the framework of the Sonoma County Water Agency’s existing water rights, the City’s reliable water supply remains the same under the normal, single dry and multiple-dry year conditions.

TABLE 6 – CITY OF ROHNERT PARK – WATER SUPPLY SOURCES IN AYF

Water Source	Normal Year Supply	Single Dry Year Supply	Multiple Dry Year Supply		
			Year 1	Year 2	Year 3
Sonoma County Water Agency	6,372	6,372	6,372	6,372	6,372
Groundwater	2,577	2,577	2,577	2,577	2,577
Recycled Water	1,350	1,350	1,350	1,350	1,350
Total	10,299	10,299	10,299	10,299	10,299
The City’s contract with the Sonoma County Water Agency provides for a supply of up to 7,500 AFY					

3.1 SONOMA COUNTY WATER AGENCY SUPPLY

This section describes the Agency supply, its hydrologic availability and the various contracts that affect this supply. This information is brought forward from the City’s previous WSAs and its 2005 and 2010 UWMPs and is used to project the Agency supply that is reasonably available to the City under all hydrologic conditions.

The City’s contract for water supply with Sonoma County Water Agency is the Restructured Agreement for Water Supply. Under this contract the City has access to as much as 7,500 acre feet per year (AFY). The water supply allocation in the Restructured Agreement, presumes the Agency is able to secure modifications to its water rights permits that will allow it to increase its diversions from 75,000 AFY to 101,000 AFY. (See Sections 3.1.1 and 3.1.2 for additional discussion of the Agency’s water rights and contracts). Over the past 10 years, the City has used between 2,500 and 5,000 AFY of Agency supply, which is significantly less than its maximum allocation. This WSA projects that up to 6,372 AFY of Agency supply will be available to the City based on analysis of the legal and hydrologic constraints on the Agency’s system. This projection is consistent with prior Water Supply Assessments and Urban Water Management Plans

The water supply available to the City from the Agency is measured in two ways, hydrologic availability, and legal availability. Hydrologic availability is a measure of how much water is available because of

rainfall, runoff, and storage in the Russian River watershed. Normal Year, Single Dry Year and Multiple Dry Year are ways to describe the hydrologic availability of water supply under a variety of rainfall conditions. The Agency's hydrologic models, (Sonoma County Water Agency 2005 Urban Water Management Plan) indicate that its water supply is most constrained under the Single Dry Year condition when between 85,000 and 86,000 acre feet per year (AFY) are available to the system.

Legal availability is a measure of how much water the Agency is allowed to divert under the water rights permits it receives from the State Water Resources Control Board (SWRCB). The Agency currently has permits to divert and re-divert 75,000 AFY. At the present time, legal availability is the largest constraint on the Agency supply because current water rights are less than even the Single Dry Year supply. This means that even in the driest of years, the Agency is not legally able to divert all the water that is available to its Russian River System.

Because legal availability, not hydrologic availability, presents the greatest constraint to the Agency's supply, the City has analyzed its Agency water supply using 75,000 AFY as the maximum available supply. This supply will be available under all hydrologic conditions because even in the driest years, there is more than 75,000 AFY in the Russian River system and available for diversion by the Agency.

3.1.1 AGENCY'S WATER RIGHTS

The Agency currently diverts and re-diverts water from the Russian River System under four permits issued by the SWRCB. These permits (Numbers 12947A, 12949, 12950 and 16596) provide the Agency with the rights to divert and re-divert up to 75,000 AFY, and to store water in Lake Mendocino and Lake Sonoma.

These permits also set minimum in-stream flow requirements to protect fish and wildlife and maintain recreation in the Russian River. The SWRCB's Decision 1610 provides for varying minimum in-stream flow requirements under different hydrologic cycles (i.e., in-stream flow requirements are lower in dry water years than in normal water years). The Agency works with the SWRCB on a regular basis to implement the various in-stream flow requirements of its permits based on hydrologic conditions at the time.

3.1.2 THE RESTRUCTURED AGREEMENT FOR WATER SUPPLY

The Restructured Agreement for Water Supply (the Restructured Agreement) is the contractual document that outlines how the Agency's proposed 101,000 AFY water right is allocated among the Agency's Contractors and other customers. The Restructured Agreement was executed on June 20, 2006 and has a term of at least forty years. The Restructured Agreement allocates 7,500 AFY to the City, with an average day maximum month pumping rate of 15.0 million gallons per day (mgd) under Normal Year conditions.

Section 3.5 of the Restructured Agreement (the Water Shortage Provisions) defines how the water supply and transmission system capacity would be allocated in case of shortage. On April 18, 2006, the Agency's Board of Directors adopted a Water Shortage Allocation Methodology that provides a mathematical quantification of the Water Shortage Provisions. This allows the Contractors to calculate their reasonably expected Agency allocation under a range of supply scenarios. Based on the Water Shortage Allocation Methodology, the City expects it can receive up to 6,372 AFY as long as the Agency's water rights are limited to 75,000 AFY.

3.2 Groundwater Supply

This section describes the City's groundwater supply, its hydrologic availability and the policies that affect its use. This WSA projects that 2,577 AFY of groundwater will be available to the City.

The City's local groundwater supply is from the Santa Rosa Plain Subbasin of the Santa Rosa Valley Groundwater Basin. The City has developed 42 groundwater wells, 29 of which are currently active. The active wells have a total rated production capacity of 6.3 mgd. The City's 2010 Urban Water Management Plan provides additional detail on the individual wells and their production capability.

The City manages its groundwater supply in accordance with its 2004 Water Policy Resolution which limits groundwater pumping to 2,577 AFY. The City's 2004 WSA and 2005 and 2010 UWMPs, which are incorporated by reference, provide the technical support for this maximum pumping rate, which can be sustained over all hydrologic conditions. Over the past 10 years the City has used between 350 and 1,600 AFY of groundwater, which is significantly less than its policy limitation on groundwater use.

The City supported the development the Santa Rosa Plain Watershed Groundwater Management Plan, which was adopted in the fall of 2014, and participates actively in the implementation of this Plan. Modeling and monitoring data collected by the City and others indicate that groundwater levels are generally rising around the City's well field, an indication of stable supply (Hydrologic and Geochemical characteristic of the Santa Rosa Plain Watershed).

The California Department of Water Resources defines the Santa Rosa Valley Groundwater Basin as a "medium priority basin". As a result, and in accordance with the requirements of the Groundwater Sustainability Act of 2014, the City is working with the County of Sonoma, the Sonoma County Water Agency, the cities of Cotati, Santa Rosa and Sebastopol and the Town of Windsor to form a Groundwater Sustainability Agency and develop a Groundwater Sustainability Plan. These agencies all expect that the Groundwater Sustainability Plan will build upon the adopted Groundwater Management Plan and continue to provide a strong framework for managing the groundwater supply.

3.3 RECYCLED WATER SUPPLY

The City's tertiary-treated recycled water supply is produced by the Santa Rosa Subregional Water Reclamation System. The City and the Subregional System have recently entered into a Producer Distributor Agreement that provides the City with access to 1,350 AFY of recycled water. The City uses recycled water primarily for irrigation purposes and recycled water demand has varied between 800 and 1,100 AFY over the past 10 years.

3.4 DROUGHT CONSIDERATIONS

The State of California is experiencing a serious drought with rainfall and especially snowpack being recorded as the lowest on record in 120 years. On January 17, 2014, Governor Brown declared a statewide drought emergency, which has been followed up with several subsequent Executive Orders and two rounds of emergency drought regulations issued by the State Water Resources Control Board. The City has responded to these requirements with its own emergency drought ordinances and is currently exceeding its required conservation savings of 16% over 2013 demands.

While the State Water Project, administered by the Department of Water Resources, is extremely stressed by the lack of snowpack, the Sonoma County Water Agency's rainfall based water system is experiencing significantly less stress. Currently the Agency's primary storage reservoir, Lake Sonoma, is a 70% capacity with enough water supply to serve the Agency's contractors for the next three to four years (Grant Davis, General Manager Sonoma County Water Agency, personal communication, November 2, 2015). While the City will continue to respond to state regulations and conservation requirements, these actions are driven by the State's regulatory mandates and not by significant water supply shortages in the Russian River Basin.

4 WATER DEMANDS

This section provides an overview of the City's projected water demands, including the demands associated with the Central Rohnert Park PDA. The City has recently completed its 2015 Urban Water Management Plan Water Demand and Water Conservation Measures Update (2015 Demand Update). The 2015 Demand Update is based on the Association of Bay Area Governments population and job projections, including both the Central Rohnert Park and Sonoma Mountain Village PDAs. The 2015 Demand Update projects that the City's potable water demands through 2040 will range between 5,600 and 6,100 AFY, depending on the level of water conservation undertaken by the City. This projected demand is significantly less than the City's available water supplies. The 2015 Demand Update indicates that the City has the potential to secure approximately 500 AFY (the difference between 5,600 and 6,100 AFY) by undertaking more aggressive water conservation activities.

4.1 2015 UWMP WATER DEMAND PROJECTIONS

To prepare for the submission of its 2015 Urban Water Management Plan, the City contracted with Maddaus Water Management, Inc. (MWM) to prepare the 2015 Demand Update in order to:

1. Update its potable water demand forecast for the years 2015 to 2040; and
2. Update the range of potable water conservation savings that could be achieved and the costs of those savings under three water conservation programs that could be implemented between the years 2015 to 2040.

The 2015 Demand Update focuses specifically on potable water demand and conservation projection. As described in Section 2, the analysis was based on Association of Bay Area Governments projections for population and job growth which includes the City's projected General Plan growth as well as development of the Central Rohnert Park and Sonoma Mountain Village PDAs. Table 7 below presents the results of this analysis and illustrates the City's projected range of water demands under several scenarios with an increasing emphasis on water conservation. In every case, projected demands are well below the City's available potable water supply. For the purposes of its 2015 UWMP, including its required reporting to the Agency, the City is reporting its projected demands based on implementation of Scenario 2 (Demand with Plumbing/Building Code Only). As illustrated in Table 7, the City has the option to increase its water conservation activities in order to further reduce demands by 384 to 556 AFY, providing it with the flexibility to use increased water conservation activity as a strategy for managing planned growth.

TABLE 7 - POTABLE WATER DEMAND PROJECTIONS (AFY)

Water Demand Scenario		Projected Water Demands (AFY)					
		2015	2020	2025	2030	2035	2040
1	Demand without Plumbing/Building Code Implementation	5,415	5,675	5,887	6,111	6,372	6,644
2	Demand with Plumbing/Building Code Implementation	5,415	5,605	5,729	5,817	5,960	6,129
3	Demand with Plumbing/Building Code Implementation and Conservation Program A	5,365	5,348	5,426	5,461	5,591	5,745
4	Demand with Plumbing/Building Code Implementation and Conservation Program B	5,361	5,309	5,310	5,337	5,459	5,605
5	Demand with Plumbing/Building Code Implementation and Conservation Program C	5,356	5,277	5,268	5,304	5,427	5,573

4.2 PROJECT SPECIFIC WATER DEMAND PROJECTIONS

While the City believes that the ABAG projections used in its 2015 Demand Update account for planned development including development within the Central Rohnert Park PDA, it has also analyzed the increase in water demand that will be created by the increased density within the PDA Plan area. Conceptual water demands were developed for each land use within the PDA based on current usage rates. These usage rates do not account for future reductions resulting from the City's water conservation activities. Water usage rates for new development in the PDA were calculated by applying the savings anticipated from the implementation of the CalGreen Building Code to the existing usage pattern (this is consistent with Scenario 2 in the 2015 Demand Update). Implementation of the CalGreen requirements will result of savings of approximately 18% for nonresidential uses and approximately 30% for residential uses. These water demand projections are illustrated in Table 8.

TABLE 8 – ESTIMATED WATER DEMANDS IN THE CENTRAL ROHNERT PARK PDA

	Residential	Retail	Office	Public	Industrial
Existing Development	129.6 gpd/unit	0.11 GPD/SF	0.04 GPD/SF	0.04 GPD/SF	0.62 GPD/SF
New Development	92 gpd/unit	0.09 gpd/sf	0.03 gpd/sf	0.03 gpd/sf	0.51 gpd/sf

Notes: gpd/sf = gallons per day per square foot; gpd/unit = gallons per day per unit
Consumption rates Appendix I "Utilities and Service System Data" of the City of Rohnert Park Northwest Specific Plan and generally following the City's 2010 Urban Water Management Plan and the AWWA Research Foundation "Commercial and End Uses of Water" (2000)

The increased water demand associated with the PDA land uses can be estimated by applying these water consumption rates outlined in Table 8 to the increased intensity of land use illustrated in Table 9. This results in relatively conservative water demand estimates for the build out of the PDA, because the estimates take into account the impacts of the CalGreen Building Code but do not account for efficiency improvements in the

existing development. Table 9 illustrates the results of this calculation and concludes that build-out of the Central Rohnert Park PDA could result in approximately 205 AFY of increased demand, above that projected in the 2015 Demand Update.

TABLE 9 – SUMMARY OF INCREASED LAND USE INTENSITY IN THE CENTRAL ROHNERT PARK PDA

Land Use	Existing Units / Building Area	Project Build-Out	Increase (Decrease)
Residential	1,390 units	2,225 units	835 Units
Retail & Services*	700,700 sf	1,141,600 sf	440,900 sf
Office	1,081,800 sf	987,900 sf	(93,900 sf)
Public – Institutional	166,500 sf	222,100 sf	55,600 sf
Industrial	768,400 sf	897,800 sf	129,400 sf
Notes: SF= Square Feet			
*Land Use also permits up to a 500-room hotel within the PDA.			

TABLE 10 – SUMMARY OF POTENTIAL INCREASED WATER DEMAND WITH BUILD OUT OF CENTRAL ROHNERT PARK PDA

Land Use	Increase/ (Decrease) Units / SF of Building Area	Demand per Unit / SF (gpd)	Total Increase/(Decrease) Demand (gpd)	Total Increase/(Decrease) Demand (AFY)
Residential	835 Units	92	76,820	86.05
Retail & Services	440,900 sf	0.09	39,681	44.45
Office	(93,900 sf)	0.03	(2,817)	(3.16)
Public – Institutional	55,600 sf	0.03	1,668	1.87
Industrial	129,400 sf	0.51	65,994	73.92
Totals			181,364	203.13

4.3 THE WATER CONSERVATION ACT OF 2009 AND WATER USE TARGETS

The Water Conservation Act of 2009 required that all urban water suppliers calculate and adopt 2015 and 2020 Water Use Targets as part of their 2010 Urban Water Management Plans. The City calculated and adopted a local 2015 target of 140 gallons per capita per day and a local 2020 target of 119 gallons per capita per day. The City also participated in a “regional alliance” which has adopted a 2015 water use target of 142 gallons per capita per day and a 2020 target of 129 gallons per capita per day. Under the requirements of the Water Conservation Act of 2009, if all members of the regional alliance meet the regional target, the group is in

compliance, otherwise the City will need to meet its locally adopted targets. As indicated in the 2015 Demand Update, the City is currently exceeding its 2020 target.

Because implementation of the PDA Plan could result in increased water demands, Table 11, provides a check on the City's compliance using the population projections presented in Section 2 and the water demands projected in the 2015 Demand Update together with the 205 AFY additional potential demand from the PDA Plan.

TABLE 11 – WATER CONSERVATION ACT OF 2009 TARGET CHECK

	2015	2020	2025	2030	2035	2040
Population	45,465	47,232	49,045	51,060	53,232	55,524
Water Demand (AFY)	5,620	5,810	5,934	6,022	6,150	6,334
Water Demand (gpd)	5,017,213	5,186,834	5,297,534	5,376,095	5,490,366	5,654,631
Per Capital Demand (gpcd)	110.35	109.82	108.01	105.29	103.14	101.84

In all cases, even with the additional demands from the PDA Plan, the City is able to meet its water use targets.

4.4 CONCLUSION

As illustrated in Table 10, implementing the PDA Plan has the potential to increase demands on the City's potable water supply by approximately 205 AFY. Under the City's Planning Scenario 2 (Plumbing/Building Code Implementation Only), 2040 demands would increase from 6,129 to 6,353 AFY. The City's 2015 Demand Analysis indicates that with additional conservation programs, the City could reduce its demand by 384 to 556 AFY, effectively counteracting the potential impact of increased development within the Central Rohnert Park PDA. This analysis also does not fully take into account efficiency measures that would result from improvements to existing buildings within the PDA. As the new plumbing/building code is implemented and older inefficient systems are replaced, future demand could be reduced further, but the impact of this activity cannot be quantified at this time.

5 SUFFICIENCY ANALYSIS & CONCLUSIONS

SB 610 requires that the Lead Agency make findings related to supply sufficiency under the normal, single dry and multiple dry year planning scenarios. As described in Section 3, because of the Agency's existing water rights are more constraining than hydrological conditions, the City's reliable water supply remains the same under the normal, single dry and multiple-dry year conditions. Hydrologic variability will change, should the Agency secure permitted rights of up to 101,000 AFY at some point in the future.

As described in Section 4, the demands associated with the PDA Plan likely fall within the ABAG projections used in the City's 2015 Demand Update. However, the City has also calculated the increased demands associated with the Central Rohnert Park PDA and acknowledges that the implementation of the PDA Plan may result in a demand of approximately 205 AFY above what is projected in its 2015 Demand Update. Because of that, this section assumes that the PDA will result in a net potable water demand increase of 205 AFY and the sufficiency analysis is based on these higher potable water demands.

Comparisons of supply and demand under normal, single dry and multiple dry years are included in Tables 11 through 13 below. These tables illustrate that the additional water demands associated with build out of the Central Rohnert Park PDA Project will have only a small effect on the difference between supply and demand and that the supply exceeds the demand in all cases. The City will not experience water shortages associated with PDA development.

TABLE 12 - CITY OF ROHNERT PARK SUPPLY & DEMAND COMPARISON – NORMAL YEAR WITH PDA BUILD OUT (AFY)

	Planning Year					
	2015	2020	2025	2030	2035	2040
Potable Water Supply	8,949	8,949	8,949	8,949	8,949	8,949
Potable Water Demand (2015 Demand Update)	5,415	5,605	5,729	5,817	5,960	6,129
Additional Project Potable Demand	205	205	205	205	205	205
Difference Potable Supply (Supply – Demand)	3,329	3,139	3,015	2,927	2,784	2,615
Difference % of Potable Demand	59.2%	54.0%	50.8%	48.6%	45.2%	41.3%
Difference % of Potable Supply	37.2%	35.1%	33.7%	32.7%	31.1%	29.2%
Recycled Water Supply	1,350	1,350	1,350	1,350	1,350	1,350
Recycled Water Demand	1,000	1,300	1,300	1,300	1,300	1,300
Difference Recycled Supply (Supply – Demand)	350	50	50	50	50	50
Difference % of Recycled Demand	35.0%	3.9%	3.9%	3.9%	3.9%	3.9%
Difference % of Recycled Supply	25.9%	3.7%	3.7%	3.7%	3.7%	3.7%
Total Difference (Supply – Demand)	3,679	3,189	3,065	2,977	2,834	2,665

TABLE 13 - CITY OF ROHNERT PARK SUPPLY & DEMAND COMPARISON – SINGLE DRY YEAR WITH PDA BUILD OUT (AFY)

	Planning Year					
	2015	2020	2025	2030	2035	2040
Potable Water Supply	8,949	8,949	8,949	8,949	2035	8,949
Potable Water Demand (2015 Demand Update)	5,415	5,605	5,729	5,817	8,949	6,129
Additional Project Potable Demand	205	205	205	205	5,960	205
Difference Potable Supply (Supply – Demand)	3,329	3,139	3,015	2,927	205	2,615
Difference % of Potable Demand	59.2%	54.0%	50.8%	48.6%	2,784	41.3%
Difference % of Potable Supply	37.2%	35.1%	33.7%	32.7%	45.2%	29.2%
Recycled Water Supply	1,350	1,350	1,350	1,350	31.1%	1,350
Recycled Water Demand	1,000	1,300	1,300	1,300	1,350	1,300
Difference Recycled Supply (Supply – Demand)	350	50	50	50	1,300	50
Difference % of Recycled Demand	35.0%	3.9%	3.9%	3.9%	50	3.9%
Difference % of Recycled Supply	25.9%	3.7%	3.7%	3.7%	3.9%	3.7%
Total Difference (Supply – Demand)	3,679	3,189	3,065	2,977	3.7%	2,665
					2,834	

TABLE 14 - CITY OF ROHNERT PARK SUPPLY & DEMAND COMPARISON – MULTIPLE DRY YEAR WITH PDA BUILD OUT (AFY)

	Planning Year					
	2015	2020	2025	2030	2035	2040
Potable Water Supply	8,949	8,949	8,949	8,949	8,949	8,949
Potable Water Demand (2015 Demand Update)	5,415	5,605	5,729	5,817	5,960	6,129
Additional Project Potable Demand	205	205	205	205	205	205
Difference Potable Supply (Supply – Demand)	3,329	3,139	3,015	2,927	2,784	2,615
Difference % of Potable Demand	59.2%	54.0%	50.8%	48.6%	45.2%	41.3%
Difference % of Potable Supply	37.2%	35.1%	33.7%	32.7%	31.1%	29.2%
Recycled Water Supply	1,350	1,350	1,350	1,350	1,350	1,350
Recycled Water Demand	1,000	1,300	1,300	1,300	1,300	1,300
Difference Recycled Supply (Supply – Demand)	350	50	50	50	50	50
Difference % of Recycled Demand	35.0%	3.9%	3.9%	3.9%	3.9%	3.9%
Difference % of Recycled Supply	25.9%	3.7%	3.7%	3.7%	3.7%	3.7%
Total Difference (Supply – Demand)	3,679	3,189	3,065	2,977	2,834	2,665

5.1 CAPITAL OUTLAY AND PERMITS NECESSARY TO SUPPORT PLANNED DEVELOPMENT

While the City's water supply is sufficient to support the proposed planned development, an improvement to the distribution system is necessary to better serve the Central Rohnert Park PDA. Within the Central Rohnert Park PDA, the water distribution system consists primarily of 6 and 8-inch water mains. The City has a planned Capital Improvement project that will parallel the 4-inch distribution mains at the north end of the Central Rohnert Park with an 8-inch distribution main to improve the overall performance of the distribution system.

5.2 SUMMARY

In general, the existing water supply sources and facilities are expected to be sufficient to provide an adequate supply of water to meet current and future demands within the PDA. A planned capital improvement project will remove the one restriction in the distribution system that serves the PDA. While the overall distribution system for both potable and recycled water is adequate, site specific improvements may be required to accommodate individual development proposals.

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APPENDIX G

Site Photos

Site Photo 1—Commerce Boulevard and Avram Avenue



This is a view of the southwest corner of the plan area looking north at the intersection of Commerce Boulevard and Avram Avenue. The west side of Commerce Boulevard is dominated by trees that buffer U.S. 101 (not pictured). Miscellaneous office buildings are east of the intersection. A traffic signal and street light can be seen at the intersection. The background is dominated by trees on the east side of Commerce Boulevard.

Site Photo 2—Seed Farm Drive and Santa Alicia Drive



This is a view near the intersection of Seed Farm Drive and Santa Alicia Drive, in the southeast corner of the plan area. A pedestrian walkway that crosses over the Northwest Pacific Railroad line is shown between Seed Farm Drive and the railroad. Residential high-density housing units (not pictured) are located along the west side of Seed Farm Drive. Trees are located along the west side of Seed Farm Drive and east of the railroad tracks.

Site Photo 3—State Farm Drive and Enterprise Drive



This is a view from the intersection of State Farm Drive and Enterprise Drive in the south-central portion of the plan area looking north from the intersection toward State Farm Drive. Parking associated with the eastern segment of the Altamont Senior Apartment complex is visible from the street to serve the apartments to the west. Redwood trees are prevalent along the east side of State Farm Drive.

Site Photo 4—Northwest Pacific Railroad



This is a view taken along the eastern boundary of the plan area, showing the Northwest Pacific Railroad tracks going north. The redwood trees west of the train tracks provide a buffer to the now-vacant State Farm complex. A mobile home park is located east of the plan area.

Site Photo 5—State Farm Drive and Rohnert Park Expressway



This is a view at the intersection of State Farm Drive and Rohnert Park Expressway, in the central portion of the plan area looking east toward the frontage of Rohnert Park Expressway and the vacant State Farm campus. A landscaped median with redwood trees separates the eastbound traffic from the westbound lanes (westbound traffic is not shown).

Site Photo 6—U.S. 101 and Rohnert Park Expressway



This view looks east along Rohnert Park Expressway, coming from the U.S. 101 off-ramp, in the west-central portion of the plan area. Various commercial businesses and streetlights are visible along the roadway. Trees are visible in the background and the hillsides east of Rohnert Park are visible in the distance.

Site Photo 7—City Center Drive



This is a view looking west from the plan area along City Center Drive. Residential development is located along the north side of the road; the Civic Center developments and plaza are located south of the road. The parking lot in the left foreground is shared by the adjacent City of Rohnert Park Public Safety Building and Rohnert Park–Cotati Regional Library (not pictured).

Site Photo 8—Commerce Boulevard and Professional Center Drive



This is a view facing west along Commerce Boulevard, at the intersection with Professional Center Drive in the west-central portion of the plan area. Commercial and office buildings are visible in the foreground, middleground, and background. An empty lot is visible north of the intersection. Trees are located along the street frontages on both sides of the roadway.

Site Photo 9—Professional Center Drive and State Farm Drive



This view looks east of the intersection of Professional Drive and State Farm Drive, in the north-central portion of the plan area. The office buildings are north of Professional Drive. Trees are located within a median, separating the east traffic lanes.

Site Photo 11—Commerce Boulevard and Golf Course Drive



This is a view just south of the intersection of Commerce Boulevard and Golf Course Drive, near the northern corner of the plan area. The U.S. 101 northbound lane is in the middleground. Various industrial businesses are east of Commerce Boulevard. Infrastructure including signal lights, lampposts, and street trees are visible along the roadway.

Site Photo 10—Commerce Boulevard and Cascade Court

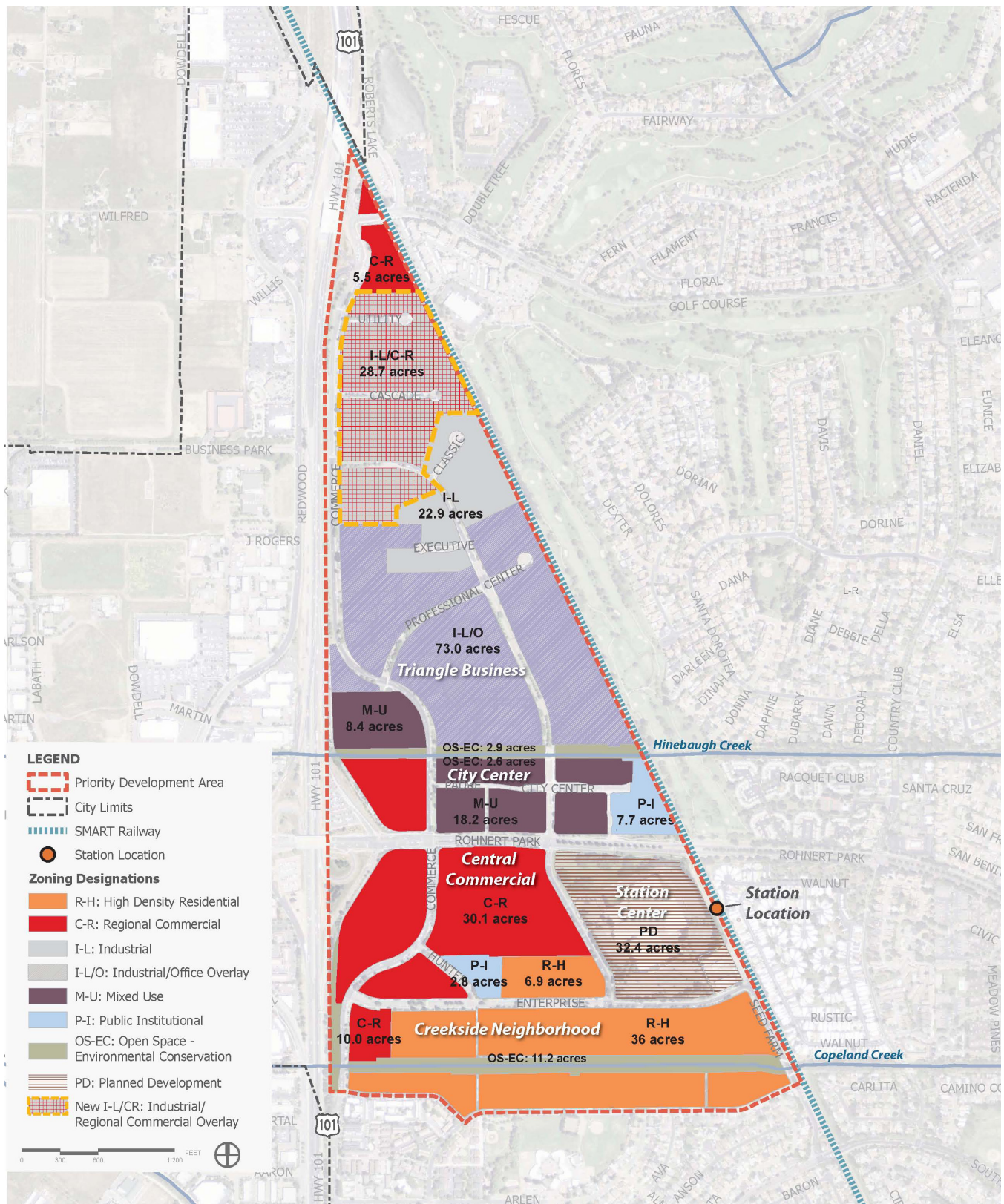


This is a view looking northeast of the intersection of Commerce Boulevard and Cascade Court, in the northwest portion of the plan area at the now-vacant, former Yardbird property. The middleground is dominated by an empty parking lot and leveled space associated with a razed building. Adjacent light industrial buildings can be seen in the background, looking to the hillsides to the northeast.

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APPENDIX H

Land Use Policy Consistency Table



Sources: City of Rohnert Park, 2015; AECOM, 2015

Figure H-1:

Proposed Zoning

Consistency of the Proposed Plan with the City of Rohnert Park General Plan

Policy Number	General Plan Policy	Proposed Plan Consistency
Land Use and Growth Management Element		
LU-2	Require sites designated as Mixed Use—University District, City Center, Southwest Shopping Center, and near Bodway Parkway/ Valley House Road—to be developed with a variety of residential and non-residential uses, in accordance with the delineated land use program for the Specific Plan areas in this chapter.	Consistent. As described in Chapter 2, “Project Description,” the proposed plan includes Mixed Use land use and zoning designations for the City Center subarea. The Mixed Use designation accommodates a variety of compatible businesses, stores, institutions, service organizations, and residences in a pedestrian-oriented setting. Allowable uses include multifamily residences, retail shops, financial, business and personal services, and restaurants.
LU-4	Develop the City Center and the Sonoma Mountain Village Planned Development as mixed-use, pedestrian-oriented areas.	Consistent. See consistency discussion for Policy LU-2, above.
LU-6	Locate new Medium- and High-Density Residential development adjacent to parks, creekways, or other open space, in order to maximize residents’ access to recreational uses, or adjacent to a Mixed-Use or Neighborhood Commercial Center, to maximize access to services.	Consistent. A total of 8.5 acres of public parks/open space uses are proposed for the plan area. Approximately 6 acres would be part of redevelopment in the Station Center subarea, and 2.5 acres of open space are suggested for an approximately 25-foot-wide paseo between Professional Drive and Utility Court and other open space, to improve bike and pedestrian access in the Triangle Business subarea. Other suggested parks and open space uses would be dispersed within the plan area (see Figure 2-7) in the Central Commercial and Station Center subareas in or adjacent to High Density Residential and Mixed Use areas.
LU-7	Encourage new neighborhood commercial facilities and supermarkets to be located to maximize accessibility to all residential areas.	Consistent. As shown in Table 2-3, the additional development potential of retail or service commercial would be approximately 430,000 square feet. Neighborhood commercial uses would be allowed at the ground level in the M-U zones (with residential above), which are primarily in the City Center and Station Center subareas, and would be accessible to residential areas.
LU-8	Require that residential development projects comply not only with the stipulated maximum density for the range, but the minimum density as well.	Consistent. Residential development in the plan area would comply and would have at least the permitted minimum density, and up to the maximum for the applicable subarea.
LU-10A	Coordinate the adoption of each specific plan and planned development in a manner that provides for the systematic implementation of the General Plan, as is consistent with the growth management and public facilities goals and policies of this General Plan. In order to carry out this policy, the City Council may elect to adopt one specific plan and/or planned development at a time, determine priorities for the adoption of each specific plan/ planned development, initiate the preparation of a specific plan and/or planned development, or otherwise take action to ensure that the adoption of specific plans and planned developments adhere to the growth management and public facilities goals and policies of this General Plan.	Consistent. Chapter 4 of the proposed plan provides a land use program and the maximum development for each land use type. Because the plan area includes existing development, no minimum standards have been set. Consistent. Section 3.16, “Transportation and Traffic,” of this draft IS/MND contains a summary of a detailed traffic study conducted by AECOM for the plan area. Consistent. As described in Chapter 2, “Project Description,” of this draft IS/MND, the proposed plan would include the necessary extensions from existing infrastructure systems to supply these utilities to future development in the plan area.

Consistency of the Proposed Plan with the City of Rohnert Park General Plan

Policy Number	General Plan Policy	Proposed Plan Consistency
	Require that all specific plans and planned developments prepared pursuant to this General Plan include the following components: • A land use program as specified for each Specific Plan and Planned Development area in the General Plan, including the maximum and minimum development for each land use type; and • A detailed traffic study, prepared by a City-approved traffic/transportation planner, and reasonable mitigation measures to mitigate traffic impacts resulting from the development; and • The proposed location and capacity of major infrastructure components, including wells, sewage, water, drainage, solid waste, disposal, energy, and other essential facilities proposed to be located within the area covered by the Specific Plan/Planned Development; and • A site-specific biological assessment of wetlands, habitat areas, and creeksides by a City-approved biologist, and a program for conservation/mitigation to the extent feasible; and • Survey for California tiger salamander (CTS), both in breeding habitat and adjacent upland estivation habitat, with appropriate mitigation, including avoidance and minimization measures; and • Program for conservation of the natural resources along creeks and standards for the conservation, development, and use of natural resources where applicable; and • Park and open space in accordance with the General Plan designation, including access and connections to the bicycle system shown on Figure 4-3; and • Hydrology and drainage for the area, with a goal to minimize runoff, and drainage practices to be incorporated as part of individual projects to meet the Specific Plan/Planned Development objectives; and	Consistent. Section 3.4, “Biological Resources,” of this draft IS/MND provides a biological assessment for the plan area. Consistent. Section 3.4, “Biological Resources,” of this draft IS/MND provides an analysis of potential impacts on the CTS. No breeding habitat or upland habitat for CTS is present in the plan area; however, because of the potential for dispersal into the plan area, Mitigation Measure 3.4-4 would require preconstruction surveys at active construction areas for special-status amphibian species. Consistent. Section 3.4, “Biological Resources,” and Section 3.9, “Hydrology and Water Quality,” of this draft IS/MND provide assessments of the natural resources and water quality in the plan area. Mitigation Measures 3.4-1 through 3.4-5 and 3.9-1 require measures to protect natural resources and the creeks and would reduce impacts to a less-than-significant level. Chapter 4, Goal L-7 of the proposed plan provides standards for the conservation, development, and use of natural resources (e.g., Hinebaugh and Copeland Creek ways). Consistent. As described in Chapter 2, “Project Description,” the proposed plan provides for approximately 8.5 acres of parks/open space in the plan area. Section 3.15, “Recreation,” provides an assessment of parks and open space in the plan area. Section 3.16, “Transportation and Traffic,” concludes that the proposed plan provides improvements consistent with the <i>Rohnert Park Bicycle and Pedestrian Master Plan</i>. The proposed plan would provide bicycle access through existing and planned improvements (see Figure 2-9). Consistent. Section 3.9, “Hydrology and Water Quality,” of this draft IS/MND provides an assessment of hydrology and water quality in the plan area. Mitigation Measures 3.9-1 through 3.9-4 require measures to minimize runoff and stormwater pollution, and would reduce impacts to a less-than-significant level. Chapter 7, Goal U-1 of the proposed plan provides hydrology and drainage standards and practices to be incorporated as part of the projects in the plan area. Consistent. Section 3.17, “Utilities and Service Systems,” of this draft IS/MND provides an analysis of water supply for the plan area. Section 3.17 concluded that there is adequate water supply to serve the plan area at buildout.

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	- Plan to prevent stormwater pollution, including measures to be incorporated as part of development on individual sites; and - Demonstration of adequate water supply.	
LU-10B	Include within each Specific Plan and Planned Development, standards and criteria by which development will be phased, and standards for the conservation, development, and use of natural resources.	Consistent. The proposed plan is intended to serve as the primary document and reference guide for future development in the plan area, and it provides a policy and regulatory framework for the review of future development projects and public improvements. Chapter 4 of the proposed plan includes permitted land uses, and the development standards for each land use designation.
LU-10C	Permit hospitals, schools, police and fire stations, parks and other facilities that serve a vital public interest, subject to findings and necessary environmental review, to be located in a Specific Plan/Planned Development area, even if a Specific Plan or Planned Development for the area has not been adopted.	Consistent. The proposed plan includes M-U and P-I zones, which both allow institutional uses. As described in Chapter 2, "Project Description," up to approximately 58,000 square feet of public institutional facilities is planned in the City Center and Central Commercial subareas.
LU-10D	As part of development of Specific Plans and Planned Developments, through site planning and other techniques, ensure adequate transitions between incompatible uses, while promoting the General Plan intent of integrated development of compatible uses.	Consistent. Chapter 5 of the proposed plan contains design guidelines to provide transitions to adjacent uses and transitions from public to private space. The design guidelines in the proposed plan supplement the Rohnert Park Design Guidelines, which includes standards for transition areas between uses.
LU-31	Allow, but do not require, mixed- or multi-use development.	Consistent. As described in Chapter 2, "Project Description," the proposed plan includes areas designated for M-U, which allows for a variety of uses. Multiple uses are not required in M-U zones, and would not preclude the construction of one type of allowed use in an M-U zone. Uses other than M-U are also planned within the plan area.
GM-16	As part of preparation and approval of specific plans and any other implementing ordinances, regulations, and development agreements, and allocation of development entitlements for areas of new development, balance non-residential development with residential development over the different phases, and require that the contemplated balance of housing types is attained at buildout.	Consistent. In addition, the proposed plan provides the policy and regulatory framework for the review of future development within the plan area to confirm that the new development would be consistent with the proposed plan, and within the balance of nonresidential and residential development at buildout. Chapter 4, Table 4.2 shows the balance between residential and nonresidential development.
Community Design Element		
CD-1	As part of preparation of specific plans, ordinances, capital improvements programs, design of public buildings, and other measures, ensure that the University District and the City Center are developed as citywide destinations and with a pedestrian orientation.	Consistent. The policies and design guidelines in the proposed plan for the City Center subarea would require pedestrian-oriented development, and would also be consistent with the City Center Concept Plan. As described in Chapter 2, "Project Description," one of the proposed plan's main objectives is to support the creation of a downtown for Central Rohnert Park in a pedestrian-oriented development pattern. Policy L-2.3 (Chapter 4) of the proposed plan encourages the development of the

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		City Center subarea as a citywide destination.
CD-2	Develop linkages between different parts of the city, and foster creation of unique elements that provide identity to the city and the neighborhoods and result in the creation of diverse and distinctive places.	Consistent. As described in Chapter 2, “Project Description,” the proposed plan would include a number of transportation and circulation improvements that would provide connections within the plan area and to the surrounding areas. Chapter 4, Goal L-1 and Chapter 5, Goal C-3 encourage the development of a complete community, with distinct mixed-use areas and places and support vehicular, bike, and pedestrian connections between the plan area and the rest of the city.
CD-19	As part of updating the City’s zoning regulations or applicable specific plans, adopt standards to foster pedestrian orientation of new development in Mixed-Use and Neighborhood Commercial areas by: • Developing a coherent set of standards for buildings, so that building façades and entrances <i>define</i> the streetscape and promote street activity; • Maintaining volumetric building standards that require buildings to be located at the street by <i>establishing</i> maximum setback or “build-to lines,” with appropriate step-backs for upper stories; • Ensuring that primary entrances of buildings face the street; • Requiring that parking is provided in the interior of the block, screened by the building or landscaping; • Requiring awnings and canopies for pedestrian comfort, where appropriate; and • Establishing building transparency from sidewalks.	Consistent. Chapter 3 of the proposed plan contains development standards and Chapter 5 contains community design guidelines to establish the urban form and expectations for streetscape, site planning, and general building design in the plan area. These standards supplement the Rohnert Park Design Guidelines. • Chapter 3.2.1 of the proposed plan includes an overview of the vision for the plan area, which would include distinctive architectural features, pedestrian-oriented identity, mixed-use development, and general accessibility. ○ Triangle Business subarea—Streetscape improvements; shared-use driveways; façade improvements. ○ City Center subarea—broad sidewalks, mixed-use and pedestrian-friendly. ○ Station Center subarea—Walkable street grid. • Central Commercial subarea—Parking lot landscaping and shading. Chapter 5.2.3 of the proposed plan includes the communitywide design guidelines, and Chapter 5.3.1 contains the subarea and neighborhood design guidelines, specifically for commercial and commercial mixed-use. These guidelines include standards for: ○ Building setbacks and guidelines that specify buildings should face the street with windows, entries, and other openings facing a public street. ○ Building orientation that would require architectural elements such as awnings, overhands, and arcades and buildings fronting the street. ○ Commercial frontages that should provide a transparent façade area along the street. ○ Locating parking within interior parcels, adjacent to service or parking alleys.

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CD-26	Design local streets to not only accommodate traffic, but also to serve as comfortable pedestrian environments. These should include, but not be limited to: • Street tree planting adjacent to curb and between the street and sidewalk to provide a buffer between the <i>pedestrian</i> and the automobile, where appropriate; • <i>See Figure 3.2-5 for an illustrative diagram.</i> • Minimum curb cuts along streets; and • Sidewalks on both <i>sides</i> of streets, where feasible.	Consistent. Chapters 5 and 6 of the proposed plan establish the standards for roadways and community design guidelines, respectively. The guidelines include: • reducing curb cuts, • minimum sidewalk width of 15 feet, and • tree planting and landscaped planting strips in the furnishing zone to provide a buffer between pedestrians and the road.
CD-40	Use an adopted City Center Concept Plan (Policy LU-30) as the basis for the development character of the area.	Consistent. The proposed plan contains policies and guidelines for the City Center subarea that build on the City Center Concept Plan.
CD-53	Ensure that new development in existing neighborhoods is respectful of the character of existing uses and causes minimal design intrusion.	Consistent. Chapter 6 of the proposed plan contains design guidelines to ensure that new development is compatible with existing uses.
CD-55	Require all development within commercial subareas to provide pedestrian amenities, including: • Pedestrian walkways through parking lots to connect buildings on opposite sides of parking areas; • Sidewalks wide enough to accommodate pedestrian use; • Sidewalk intersection bulbs, to reduce the walking distance across streets; • Pedestrian lighting, benches, street trees, and other sidewalk amenities; and • Landscaping that complements pedestrian circulation and eliminates barriers to pedestrian access.	Consistent. Chapter 6 of the proposed plan contains community design guidelines that address development within the commercial subarea, in addition to the requirements in the Rohnert Park Design Guidelines.
Housing Element		
HO-1	Promote residential development within the current city limits.	Consistent. The plan area is within current city limits.
HO-4	Promote a diversity of housing types, including single-family detached and attached residences, mobile homes, multi-family rental and ownership units, second units, and units combined with non-residential uses.	Consistent. The proposed plan envisions a range of housing types that include detached single-family homes, townhomes, mixed-use lofts, apartments, and condominiums.
HO-10	Preserve the affordability of the city's existing affordable housing stock.	Consistent. Policy L-5.1 (Chapter 4) of the proposed plan would require new affordable housing options in the City Center subarea. Existing affordable housing in the plan area would remain.

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Open Space and Public Facilities		
OS-7	Use creek protection zones (see Section 6.2) for permanent public open space and compatible purposes, including habitat conservation, bike and walking paths, wildlife habitat, and native plant landscaping. Creeks are located in close proximity to residential neighborhoods, providing accessible open space getaways for residents. Adverse impacts on ecologically sensitive habitat, wildlife, and wetlands should be minimized in the planning, construction, and maintenance of paths.	Consistent. Chapter 4 (Policies L-7.1 through L-7.4) of the proposed plan provides standards for the conservation, development, and use of natural resources and establishes creek protection zones (e.g., Hinebaugh and Copeland Creek ways). Section 3.4 of this draft IS/MND provides an assessment of biological resources in the plan area. Mitigation Measures 3.4-1 through 3.4-5 and 3.9-1 require measures to protect natural resources and the creeks, and would reduce impacts to a less-than-significant level.
OS-16	Expand the city's network of bike and pedestrian paths in areas of new development.	Consistent. As described in Chapter 2, "Project Description," the proposed plan would expand bike and pedestrian paths through existing and planned improvements within the plan area. These improvements include upgrades to existing bicycle facilities, adding new bike and pedestrian access, completing trail gaps along Hinebaugh Creek, adding bicycle connections through the Station Center subarea, adding a bike/pedestrian overcrossing of Rohnert Park Expressway to connect the City Center and Station Center subareas, and completing walkway improvements.
Environmental Conservation		
EC-2	Ensure the protection of known archaeological resources in the city by requiring a records review for any development proposed in areas that are considered archaeologically sensitive for Native American and/or historic remains. Require construction activities and development adjacent to sites of historic or archaeological resources to avoid degradation by: - Studying the potential effects of development and construction in the resource; - Requiring pre-construction surveys and monitoring during any ground disturbance for all development in areas of historical and archaeological sensitivity; and - Implementing appropriate measures to avoid the identified impacts.	Consistent. Section 3.5, "Cultural Resources," of this draft IS/MND provides an assessment of archaeological resources. A records review has been conducted per this policy to determine whether the plan area is an archaeologically sensitive area for Native Americans and/or historic remains. Mitigation Measures 3.5-1 and 3.5-2 would require the implementation of procedures for inadvertent discovery of cultural resources and/or the discovery of human remains, and would reduce impacts to a less-than-significant level.
EC-3	In accordance with the California Environmental Quality Act (CEQA) and the State Public Resources Code, require the preparation of a resource mitigation plan and monitoring program by a qualified archaeologist in the event that archaeological resources are discovered.	Consistent. Section 3.5, "Cultural Resources," of this draft IS/MND provides an assessment of archaeological resources. Mitigation Measures 3.5-1 and 3.5-2 would require the implementation of procedures for inadvertent discovery of cultural resources and/or the discovery of human remains, and would reduce impacts to a less-than-significant level.

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EC-4	Cooperate with state and federal agencies to ensure that development does not substantially affect special-status species appearing on any state or federal list of rare, endangered, or threatened species. Require assessments of biological resources prior to approval of any development within 300 feet of any creeks, high potential wetlands, or habitat areas of identified special-status species, as depicted on Figure 6.2-1.	Consistent. Section 3.4, “Biological Resources,” of this draft IS/MND provides an assessment of biological resources for the plan area, including a discussion of special-status species and sensitive habitats that have the potential to be within the plan area. Mitigation Measures 3.4-1 through 3.4-5 would require preconstruction surveys, erosion control measures, and a tree mitigation plan; and Mitigation Measure 3.9-1 would require a site-specific SWPPP (including erosion controls), which would reduce impacts on sensitive natural communities and special-status species to a less-than-significant level.
EC-7	Encourage planting of native vegetation in new development sites, parks, public areas, and open space.	Consistent. Policy L-7.4 (Chapter 4) of the proposed plan requires the use of native species in new development sites, parks, public areas, and open space. Chapter 5 of the proposed plan includes guidelines to use native tree species and drought-tolerant plant materials.
EC-12	Protect oaks and other native trees that are of significant size through the establishment of a Heritage Tree Preservation Ordinance.	Consistent. Section 3.4, “Biological Resources,” of this draft IS/MND provides an assessment of potential impacts on protected trees. Mitigation Measure 3.4-5 would require the preparation and implementation of a tree mitigation and replacement plan for trees proposed for removal that meet the definition of “protected tree” under the City’s Zoning Ordinance and Municipal Code.
EC-13	Maintain creek protection zones extending a minimum of 50 feet (measured from the tops of the banks and a strip of land extending laterally outward from the top of each bank) for creeks, with extended buffers where significant habitat areas or high potential wetlands exist (Figure 6.2-2). Where high potential wetland or other biological resources exist, require appropriately wide buffers to encompass and protect the resource. Development shall not occur within this zone, except as part of greenway enhancement (for example, trails and bikeways). Require City approval for the following activities within the creek protection zones: • Construction, alteration, or removal of any structure; • Excavation, filling, or grading; • Removal or planting of vegetation (except for removal of invasive plant species); or • Alteration of any embankment.	Consistent. Development under the proposed plan would not occur within the creek protection zones. See Policy LU-10A, above, regarding protection of biological resources, hydrology, and water quality.
EC-14	As part of specific plans, require evaluation and implementation of appropriate measures for creek bank stabilization, and any necessary steps to reduce erosion and sedimentation, but preserve natural creek channels and riparian vegetation.	Consistent. Section 3.9, “Hydrology and Water Quality,” of this draft IS/MND provides an assessment of potential impacts on existing creeks (Copeland and Hinebaugh Creeks) from erosion and sedimentation in the plan area. Development under the proposed plan would not occur within these established waterways. Mitigation Measure 3.9-2 would require all project construction to submit site-

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		specific erosion control plans before all grading activities that could contribute to any sedimentation.
EC-19	Require new construction to use site preparation, grading, and foundation designs for erosion control to prevent sedimentation and contamination of streams.	Consistent. Section 3.9, "Hydrology and Water Quality," of this draft IS/MND provides an assessment of construction activity and erosion control. Mitigation Measure 3.9-1 would require the preparation of a site-specific SWPPP for future development. Implementation of best management practices required by the SWPPP would reduce the potential of sedimentation and contamination of streams to a less-than-significant level.
EC-23	Use the City's development review process and CEQA regulations to evaluate and mitigate the local and cumulative effects of new development on air quality.	Consistent. Section 3.3, "Air Quality," of this draft IS/MND provides an assessment of project and cumulative impacts on air quality prepared per this policy.
Health and Safety		
HS-5	As part of the building permit process, require all development projects to comply with hydrology and drainage policies incorporated in the applicable Specific Plans. Require the project proponent to design and construct a storm drain system in accordance with the Sonoma County Water Agency (SCWA) Flood Control Design Criteria (latest revision), specific to the proposed plan. Encourage the use of environmentally sensitive drainage improvements, including flow reduction and flood bypass systems, in order to ensure protection of surface water quality and stream integrity.	Consistent. See consistency discussion in LU-10A, above.
HS-6	As part of the building permit process, require new development greater than 5 acres in size to prepare and implement an SWPPP that effectively reduces discharges of stormwater containing sediment and other pollutants resulting from site construction activities. In addition, require all projects, regardless of size, to comply with any other stormwater provisions of the specific plans for their respective areas.	Consistent. Section 3.9, "Hydrology and Water Quality," of this draft IS/MND provides an assessment of construction activity impacts on stormwater. Mitigation Measure 3.9-1 would require the preparation of a site-specific SWPPP for future development.
HS-11	In cooperation with the SCWA, maintain floodplain areas, drainage channels, and other drainage structures, and improve drainage channel capacity in ways that will preserve the natural character of habitat areas, riparian corridors, and waterways to the maximum extent feasible.	Consistent. Section 3.9, "Hydrology and Water Quality," of this draft IS/MND provides an analysis of hydrology and drainage impacts in the plan area. As shown in Section 3.9, impacts related to hydrology and water quality were found to be less than significant. The entire plan area is within FEMA flood hazard Zone X, which means that it is outside of both the 100-year and 500-year floodplains. Furthermore, General Plan Policy EC-13 requires maintaining creek protection zones extending a minimum of 50 feet; and Policy HS-5 requires the project proponent to design and construct a storm drain system in accordance with the SCWA Flood Control Design

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		Criteria specific to the proposed plan.
HS-15	Require new multi-family residential and all non-residential development to incorporate attractive and convenient interior and exterior storage areas for recyclables into new or remodeled buildings, to make recycling activities more convenient for those who use the buildings.	Consistent. Chapter 5, "Community Design Guidelines," includes standards for trash enclosures.
Housing		
HO-2	Facilitate residential development within the growth areas.	Consistent. The Central Rohnert Park plan area was identified as an area in which to concentrate future growth. The proposed plan establishes the policies, standards, and guidelines to facilitate the residential development within the plan area.
HO-3	Ensure that residential sites are served by adequate infrastructure and services.	Consistent. Section 3.14 "Public Services," Section 3.15, "Recreation," and Section 3.17, "Utilities and Service Systems," of this draft IS/MND provide an assessment of infrastructure and services for the plan area. These sections concluded that infrastructure and services are adequate for the plan area at buildout.
HO-4	Promote a diversity of housing types, including single-family detached and attached residences, mobile homes, multi-family rental and ownership units, second units, and units combined with non-residential uses.	Consistent. Policy L-4.1 (Chapter 4) of the proposed plan encourages a variety of housing types and mixed use in the plan area.
HO-9	Require the provision of affordable housing as part of residential development throughout the community.	Consistent. Policy L-5.1 and L-5.2 (Chapter 4) of the proposed plan would require new affordable housing options in the City Center subarea. Existing affordable housing in the plan area would remain.
HO-24	Promote the use of energy conservation features in the design of residential development.	Consistent: Policies L-8.1 and L-8.2 (Chapter 4) of the proposed plan require that future development under the proposed plan design for natural cooling and passive solar heating and support the use of green or sustainable building materials, including recycled-content materials. Chapter 5 of the proposed plan also includes guidelines to promote energy conservation in site, landscape, and building design.

Note: CTS = California tiger salamander; FEMA = Federal Emergency Management Agency; IS/MND = initial study/mitigated negative declaration; M-U = Mixed Use; P-I = Public/Institutional; Rohnert Park Design Guidelines = *City of Rohnert Park Design Guidelines for Commercial, Mixed-Use and Multi-family Buildings*; SCWA = Sonoma County Water Agency; SWPPP = storm water pollution prevention plan

Source: City of Rohnert Park, 2014 (originally adopted 2000); compiled by AECOM in 2015