APPENDIX 5.1B

Modeling Analysis

APPENDIX 5.1B

Modeling Analysis

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Figure 5.1B-6 Building Layout for GEP Analysis

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Attachment 5.1B-1: Modeling Protocol

Table 5.1B-1
TID Almond 2 Power Plant
Building Dimensions Used for Modeling

Structure	Dimensions (meters)		
	Height	**Length**	**Width**
New Structures			
SCR Casing1 (Stack 1), Tier 1	5.8	21	6
SCR Casing 1 (Stack 1), Tier 2	9.3	7	6
Inlet Filter 1 (Stack 1)	10.6	11	10
SCR Casing 2 (Stack 2), Tier 1	5.8	21	6
SCR Casing 2 (Stack 2), Tier 2	9.3	7	6
Inlet Filter 2 (Stack 2)	10.6	11	10
SCR Casing 3 (Stack 3), Tier 1	5.8	21	6
SCR Casing 3 (Stack 3), Tier 2	9.3	7	6
Inlet Filter 3 (Stack 3)	10.6	11	10
Fin fan coolers (3 units)	7.5	8	5
Expansion of Warehouse	7.3	16	14
Existing Structures			
Existing Warehouse	7.3	18	9
Existing Mechanical Shop	7.3	15	12
Existing Electrical Equipment	7.3	15	15
Existing Battery Room	7.3	8	5
Existing Combustion Turbine Hall, Tier 1	9.5	35	17
Existing Combustion Turbine Hall, Tier 2 (Inlet Filter)	13.5	10	10
Existing Control Room	4.7	12	9
Existing Office	8.1	12	11
Existing Water Treatment Building	8.1	32	20
Existing HRSG	24.6	28	4
Existing Cooling Tower	6.9	9	7
Fire Pump House	3.0	4	4
	Height	**Diameter**	
Contact Tank 1	11.0	4	
Contact Tank 2	11.0	4	
Fire Water Tank 1	10.0	13	
Fire Water Tank 2	11.0	12	
Fire Water Tank 3	11.0	12	
Fire Water Tank 4	11.0	12	
Waste Tank	8.1	8	

Table 5.1B-2a
TID Almond 2 Power Plant
Emissions and Stack Parameters for Screening Modeling: 790 deg design exhaust temperature

Turbine Case		Ambient		Stack	Stack Ht	Exhaust Temp	Exhaust Velocity	NOx, g/s	SO2, g/s	CO, g/s	PM10, g/s
Number	Condition	Temp	Load	Diam (m)	(m)	(deg K)	(m/s)	per turbine	per turbine	per turbine	per turbine
1	Cold Base	30.0	100%	3.66	24.384	694.111	32.625	0.633	1.966E-01	0.617	0.315
2	Cold Low	30.0	50%	3.66	24.384	694.111	20.985	0.363	1.129E-01	0.354	0.315
3	Avg. Base	60.0	100%	3.66	24.384	694.111	31.446	0.597	1.854E-01	0.581	0.315
4	Avg. Low	60.0	50%	3.66	24.384	694.111	21.126	0.349	1.085E-01	0.340	0.315
5	Hot Base	110.0	100%	3.66	24.384	694.111	30.025	0.551	1.711E-01	0.537	0.315
6	Hot Low	110.0	50%	3.66	24.384	694.111	21.505	0.325	1.009E-01	0.316	0.315
7	Average	68.0	100%	3.66	24.384	694.111	31.357	0.592	1.839E-01	0.577	0.315

Table 5.1B-2b
TID Almond 2 Power Plant
Emissions and Stack Parameters for Screening Modeling: 850 deg design exhaust temperature

Turbine Case		Ambient		Stack	Stack Ht	Exhaust Temp	Exhaust Velocity	NOx, g/s	SO2, g/s	CO, g/s	PM10, g/s
Number	Condition	Temp	Load	Diam (m)	(m)	(deg K)	(m/s)	per turbine	per turbine	per turbine	per turbine
1	Cold Base	30.0	100%	3.66	24.384	718.000	31.452	0.633	1.966E-01	0.617	0.315
2	Cold Low	30.0	50%	3.66	24.384	727.444	20.424	0.363	1.129E-01	0.354	0.315
3	Avg. Base	60.0	100%	3.66	24.384	727.444	30.249	0.597	1.854E-01	0.581	0.315
4	Avg. Low	60.0	50%	3.66	24.384	727.444	20.338	0.349	1.085E-01	0.340	0.315
5	Hot Base	110.0	100%	3.66	24.384	727.444	29.730	0.551	1.711E-01	0.537	0.315
6	Hot Low	110.0	50%	3.66	24.384	727.444	20.860	0.325	1.009E-01	0.316	0.315
7	Average	68.0	100%	3.66	24.384	727.444	30.171	0.592	1.839E-01	0.577	0.315

Table 5.1B-3a
TID Almond 2 Power Plant
Results of the CTG Screening Analysis
790 deg exhaust

Case	Condition	Max. Impact, ug/m3 per 3.0 g/s					Max. Impact, ug/m3 per 3.0 g/s				
		1-hr	3-hr	8-hr	24-hr	annual	1-hr	3-hr	8-hr	24-hr	annual
		2000 Met Data					2003 Met Data				
1	Cold Base	8.029	4.899	3.473	2.132	0.425	7.214	3.902	2.697	1.735	0.397
2	Cold Low	12.849	7.617	5.360	3.534	0.691	9.400	6.496	4.039	2.639	0.644
3	Avg. Base	8.147	5.011	3.599	2.209	0.444	7.413	4.069	2.780	1.806	0.414
4	Avg. Low	12.739	7.533	5.321	3.507	0.686	9.353	6.452	4.007	2.624	0.639
5	Hot Base	8.290	5.149	3.757	2.315	0.468	7.655	4.270	2.885	1.895	0.436
6	Hot Low	12.442	7.311	5.218	3.433	0.673	9.227	6.337	3.921	2.585	0.627
7	Average	8.156	5.019	3.608	2.215	0.445	7.428	4.081	2.786	1.812	0.415
		2001 Met Data					2004 Met Data				
1	Cold Base	8.065	4.834	3.548	2.444	0.423	7.567	4.884	3.029	1.767	0.418
2	Cold Low	11.495	7.279	5.571	3.750	0.690	10.117	7.350	4.669	2.853	0.684
3	Avg. Base	8.213	4.971	3.724	2.544	0.442	7.732	5.028	3.133	1.834	0.436
4	Avg. Low	11.350	7.245	5.544	3.717	0.685	10.040	7.306	4.640	2.833	0.679
5	Hot Base	8.392	5.263	3.949	2.672	0.466	7.932	5.206	3.267	1.917	0.460
6	Hot Low	10.967	7.154	5.472	3.629	0.673	9.835	7.189	4.560	2.783	0.666
7	Average	8.225	4.990	3.738	2.552	0.443	7.745	5.039	3.141	1.839	0.438
		Max, All Years									
1	Cold Base	8.065	4.899	3.548	2.444	0.425					
2	Cold Low	12.849	7.617	5.571	3.750	--					
3	Avg. Base	8.213	5.028	3.724	2.544	0.444					
4	Avg. Low	12.739	7.533	5.544	3.717	--					
5	Hot Base	8.392	5.263	3.949	2.672	0.468					
6	Hot Low	12.442	7.311	5.472	3.629	--					
7	Average	8.225	5.039	3.738	2.552	0.445					

Table 5.1B-3a
TID Almond 2 Power Plant
Results of the CTG Screening Analysis
790 deg exhaust
(cont'd)

Emission Rates for Screening Modeling (lb/hr)											
Turbine		NOx		SO2				CO		PM10	
Case		1-hr	annual avg	1-hr	3-hr	24-hr	annual avg	1-hr	8-hr	24-hr	annual avg
1	Cold Base	5.02	5.38	1.561	1.561	1.561	1.48	4.89	4.89	2.5	2.50
2	Cold Low	2.88	5.38	0.896	0.896	0.896	1.48	2.81	2.81	2.5	2.50
3	Avg. Base	4.74	5.38	1.471	1.471	1.471	1.48	4.61	4.61	2.5	2.50
4	Avg. Low	2.77	5.38	0.861	0.861	0.861	1.48	2.70	2.70	2.5	2.50
5	Hot Base	4.37	5.38	1.358	1.358	1.358	1.48	4.26	4.26	2.5	2.50
6	Hot Low	2.58	5.38	0.801	0.801	0.801	1.48	2.51	2.51	2.5	2.50
7	Average	4.70	5.38	1.460	1.460	1.409	1.48	4.58	4.58	2.5	2.50

Turbine Emission Rates for Screening Modeling (g/s)											
Turbine		NOx		SO2				CO		PM10	
Case	Condition	1-hr	annual avg	1-hr	3-hr	24-hr	annual avg	1-hr	8-hr	24-hr	annual avg
1	Cold Base	0.633	0.678	0.197	0.197	0.197	0.186	0.617	0.617	0.315	0.315
2	Cold Low	0.363	0.678	0.113	0.113	0.113	0.186	0.354	0.354	0.315	0.315
3	Avg. Base	0.597	0.678	0.185	0.185	0.185	0.186	0.581	0.581	0.315	0.315
4	Avg. Low	0.349	0.678	0.108	0.108	0.108	0.186	0.340	0.340	0.315	0.315
5	Hot Base	0.551	0.678	0.171	0.171	0.171	0.186	0.537	0.537	0.315	0.315
6	Hot Low	0.325	0.678	0.101	0.101	0.101	0.186	0.316	0.316	0.315	0.315
7	Average	0.592	0.678	0.184	0.184	0.178	0.186	0.577	0.577	0.315	0.315

		Modeled Impacts, ug/m3, by Pollutant and Averaging Period									
Turbine		NOx		SO2				CO		PM10	
Case	Condition	1-hr	Annual	1-hr	3-hr	24-hr	Annual	1-hr	8-hr	24-hr	Annual
1	Cold Base	**5.105**	0.289	**1.5859**	**0.963**	**0.4806**	0.0791	**4.974**	**2.188**	0.77	0.134
2	Cold Low	4.670	--	1.4506	0.860	0.4234	--	4.549	1.972	**1.18**	--
3	Avg. Base	4.902	0.301	1.5226	0.932	0.4717	0.0825	4.775	2.165	0.80	0.140
4	Avg. Low	4.449	--	1.3819	0.817	0.4032	--	4.334	1.886	1.17	--
5	Hot Base	4.623	**0.317**	1.4360	0.901	0.4572	**0.0869**	4.504	2.119	0.84	**0.147**
6	Hot Low	4.041	--	1.2551	0.738	0.3660	--	3.936	1.731	1.14	--
7	Average	4.870	0.302	1.5128	0.927	0.4531	0.0827	4.745	2.156	0.80	0.140

Table 5.1B-3b
TID Almond 2 Power Plant
Results of the CTG Screening Analysis
850 deg exhaust

Case	Condition	Max. Impact, ug/m3 per 3.0 g/s					Max. Impact, ug/m3 per 3.0 g/s				
		1-hr	3-hr	8-hr	24-hr	annual	1-hr	3-hr	8-hr	24-hr	annual
		2000 Met Data					2003 Met Data				
1	Cold Base	8.071	4.962	3.519	2.166	0.434	7.286	3.960	2.746	1.771	0.405
2	Cold Low	13.042	7.818	5.346	3.553	0.690	9.469	6.460	4.022	2.645	0.643
3	Avg. Base	8.167	5.061	3.624	2.232	0.450	7.448	4.097	2.822	1.832	0.420
4	Avg. Low	13.111	7.871	5.370	3.571	0.693	9.498	6.488	4.043	2.655	0.646
5	Hot Base	8.221	5.113	3.684	2.269	0.459	7.539	4.174	2.861	1.866	0.428
6	Hot Low	12.696	7.553	5.222	3.465	0.675	9.323	6.324	3.920	2.599	0.629
7	Average	8.176	5.069	3.633	2.237	0.452	7.462	4.108	2.828	1.837	0.421
		2001 Met Data					2004 Met Data				
1	Cold Base	8.123	4.891	3.616	2.493	0.432	7.625	4.935	3.098	1.796	0.427
2	Cold Low	11.760	7.248	5.556	3.791	0.690	10.236	7.343	4.655	2.851	0.683
3	Avg. Base	8.245	5.007	3.763	2.581	0.448	7.760	5.052	3.195	1.853	0.443
4	Avg. Low	11.850	7.269	5.573	3.812	0.693	10.284	7.371	4.673	2.862	0.686
5	Hot Base	8.313	5.120	3.848	2.628	0.457	7.835	5.119	3.244	1.884	0.452
6	Hot Low	11.305	7.140	5.471	3.685	0.674	9.996	7.204	4.560	2.792	0.668
7	Average	8.256	5.024	3.776	2.588	0.450	7.771	5.062	3.202	1.857	0.444
		Max, All Years									
1	Cold Base	8.123	4.962	3.616	2.493	0.434					
2	Cold Low	13.042	7.818	5.556	3.791	--					
3	Avg. Base	8.245	5.061	3.763	2.581	0.450					
4	Avg. Low	13.111	7.871	5.573	3.812	--					
5	Hot Base	8.313	5.120	3.848	2.628	0.459					
6	Hot Low	12.696	7.553	5.471	3.685	--					
7	Average	8.256	5.069	3.776	2.588	0.452					

Table 5.1B-3b
TID Almond 2 Power Plant
Results of the CTG Screening Analysis
850 deg exhaust
(cont'd)

Emission Rates for Screening Modeling (lb/hr)											
Turbine		NOx		SO2				CO		PM10	
Case		1-hr	annual avg	1-hr	3-hr	24-hr	annual avg	1-hr	8-hr	24-hr	annual avg
1	Cold Base	5.02	5.38	1.561	1.561	1.561	1.48	4.89	4.89	2.5	2.50
2	Cold Low	2.88	5.38	0.896	0.896	0.896	1.48	2.81	2.81	2.5	2.50
3	Avg. Base	2.77	5.38	0.861	1.471	0.861	1.48	4.61	4.61	2.5	2.50
4	Avg. Low	2.77	5.38	0.861	0.861	0.861	1.48	2.70	2.70	2.5	2.50
5	*Hot Base*	4.37	5.38	1.358	1.358	1.358	1.48	4.26	4.26	2.5	2.50
6	*Hot Low*	2.58	5.38	0.801	0.801	0.801	1.48	2.51	2.51	2.5	2.50
7	Average	4.70	5.38	1.460	1.460	1.409	1.48	4.58	4.58	2.5	2.50

Turbine Emission Rates for Screening Modeling (g/s)											
Turbine		NOx		SO2				CO		PM10	
Case	Condition	1-hr	annual avg	1-hr	3-hr	24-hr	annual avg	1-hr	8-hr	24-hr	annual avg
1	Cold Base	0.633	0.678	0.197	0.197	0.197	0.186	0.617	0.617	0.315	0.315
2	Cold Low	0.363	0.678	0.113	0.113	0.113	0.186	0.354	0.354	0.315	0.315
3	Avg. Base	0.349	0.678	0.108	0.185	0.108	0.186	0.581	0.581	0.315	0.315
4	Avg. Low	0.349	0.678	0.108	0.108	0.108	0.186	0.340	0.340	0.315	0.315
5	*Hot Base*	0.551	0.678	0.171	0.171	0.171	0.186	0.537	0.537	0.315	0.315
6	*Hot Low*	0.325	0.678	0.101	0.101	0.101	0.186	0.316	0.316	0.315	0.315
7	Average	0.592	0.678	0.184	0.184	0.178	0.186	0.577	0.577	0.315	0.315

		Modeled Impacts, ug/m3, by Pollutant and Averaging Period									
Turbine		NOx		SO2				CO		PM10	
Case	Condition	1-hr	Annual	1-hr	3-hr	24-hr	Annual	1-hr	8-hr	24-hr	Annual
1	Cold Base	**5.142**	0.295	**1.5973**	**0.976**	**0.4903**	0.0807	**5.009**	**2.230**	0.79	0.137
2	Cold Low	4.740	--	1.4724	0.883	0.4280	--	4.618	1.967	1.194	--
3	Avg. Base	2.880	0.305	0.8945	0.938	0.2800	0.0837	4.794	2.188	0.81	0.142
4	Avg. Low	4.579	--	1.4224	0.854	0.4135	--	4.461	1.896	**1.201**	--
5	*Hot Base*	4.579	**0.311**	1.4224	0.876	0.4497	**0.0853**	4.461	2.065	0.83	**0.145**
6	*Hot Low*	4.123	--	1.2807	0.762	0.3717	--	4.016	1.731	1.16	--
7	Average	4.889	0.306	1.5185	0.932	0.4594	0.0839	4.762	2.178	0.82	0.142

Table 5.1B-4
TID Almond 2 Power Plant
Emission Rates and Stack Parameters for Refined Modeling

	Stack Diam, m	Release Height m	Temp, deg K	Exhaust Flow, m3/s	Exhaust Velocity, m/s	Emission Rates, g/s			
						NOx	SO2	CO	PM10
Averaging Period: One hour									
Each Gas Turbine (Case 1)	3.658	24.384	718.00	330.467	31.452	0.6330	0.1966	0.617	n/a
Averaging Period: Three hours									
Each Gas Turbine (Case 1)	3.658	24.384	718.00	330.467	31.452	n/a	0.1966	n/a	n/a
Averaging Period: Eight hours									
Each Gas Turbine (Case 1)	3.658	24.384	718.00	330.467	31.452	n/a	n/a	1.7225	n/a
Averaging Period: 24-hours									
Each Gas Turbine (SO2, Case 1)	3.658	24.384	718.00	330.467	31.452	n/a	0.1966	n/a	n/a
Each Gas Turbine (PM10, Case 4)	3.658	24.384	727.44	213.693	20.338	n/a	n/a	n/a	0.3150
Averaging Period: Annual									
Each Gas Turbine (Case 5)	3.658	24.384	694.11	315.473	30.025	0.6783	0.1859	n/a	0.3150

Table 5.1B-5
TID Almond 2 Power Plant
Emission Rates and Stack Parameters for Modeling Startup Impacts

	Stack Diam, m	Stack Height, m	Exh Temp, Deg K	Exhaust Flow, m3/s	Exhaust Velocity, m/s	Em Rates, g/s	
						NOx	CO 1-hr
Each CTG	3.658	24.384	727.444	214.600	20.424	3.15	5.04

NOTES TO TABLE 5.1B-6

INVERSION BREAKUP FUMIGATION ANALYSIS

Inversion breakup fumigation is generally a short-term phenomenon and was evaluated here as persisting for up to 90 minutes. SCREEN3 was used to model 1-hour unit impacts from three CTGs under 2.5 m/s winds and F stability (for fumigation impacts) and under all meteorological conditions (shown in the table as "Inversion Breakup Modeling Results from SCREEN3").

For longer-term averaging periods, impacts were calculated using the highest modeled impact from SCREEN3 for the corresponding averaging period. A sample calculation for 24-hour average PM_{10} for Case 1, 850ºF exhaust temp, is as follows:

- For Case 1, 1-hour average unit impact under inversion breakup conditions = 0.9326 µg/m^3 per g/s.
- For Case 1, max. 1-hour average unit impact from SCREEN3 = 0.6002 µg/m^3 per g/s.
- The appropriate unit impact for the 24-hour averaging period is calculated as 1.5 hours of inversion breakup fumigation plus 22.5 hours of operation under typical conditions (from SCREEN3): [(1.5 * 0.9326 µg/m^3 per g/s) + (22.5 * 0.6002 µg/m^3 per g/s)] ÷ 24 hrs = 0.621 µg/m^3 per g/s.
- For an emission rate of 0.315 g/s per CTG, the total 24-hour average PM_{10} impact under inversion breakup fumigation conditions for three CTGs is: 0.621 µg/m^3 per g/s * 0.315 g/s * 0.4 [persistence factor for converting 1-hour average screening impact into 24-hour average concentration] * 3 CTGs = 0.235 µg/m^3.

Table 5.1B-6a
TID Almond 2 Power Plant
Calculation of Inversion Breakup Fumigation Impacts: 790 deg exhaust (cont'd)

Total Impacts for 3 CTGs

Case/Avg Period	NOx	SO2	CO	PM10
One-Hour				
1	1.7516	0.5441	1.7064	-
2	1.3716	0.4261	1.3362	-
3	1.6724	0.5195	1.6292	-
4	1.2950	0.4023	1.2615	-
5	1.5718	0.4882	1.5312	-
6	1.1720	0.3641	1.1417	-
7	1.6578	0.5150	1.6150	-
3 Hours				
1	-	0.4038	-	-
2	-	0.3242	-	-
3	-	0.3888	-	-
4	-	0.3123	-	-
5	-	0.3794	-	-
6	-	0.2920	-	-
7	-	0.3876	-	-
8 Hours				
1	-	-	0.8542	-
2	-	-	0.7004	-
3	-	-	0.8284	-
4	-	-	0.6859	-
5	-	-	0.8340	-
6	-	-	0.6579	-
7	-	-	0.8297	-
24 Hours				
1	-	0.1461	-	0.2341
2	-	0.1210	-	0.3377
3	-	0.1422	-	0.2416
4	-	0.1195	-	0.3469
5	-	0.1453	-	0.2674
6	-	0.1159	-	0.3620
7	-	0.1427	-	0.2445

Table 5.1B-6b
TID Almond 2 Power Plant
Calculation of Inversion Breakup Fumigation Impacts: 850 deg exhaust temperature

CTG Emission Rates, g/s

Case	NOx	SO2	CO	PM10
1	0.633	0.197	0.617	0.315
2	0.363	0.113	0.354	0.315
3	0.597	0.185	0.581	0.315
4	0.349	0.108	0.340	0.315
5	0.551	0.171	0.537	0.315
6	0.325	0.101	0.316	0.315
7	0.592	0.184	0.577	0.315

Inversion Breakup Modeling Results from SCREEN3

Case	Unit Impacts, ug/m3 per g/s	Maximum One-Hour Avg Impacts, ug/m3				Distance to Maximum (m)
		NOx	SO2	CO	PM10	
1	0.9326	0.5903	0.1834	0.5751	0.2938	19,981
2	1.257	0.4569	0.1419	0.4450	0.3960	16,059
3	0.9386	0.5602	0.1740	0.5457	0.2957	19,888
4	1.241	0.4334	0.1346	0.4222	0.3909	16,206
5	0.9325	0.5137	0.1596	0.5004	0.2937	19,983
6	1.197	0.3887	0.1207	0.3787	0.3771	16,640
7	0.9369	0.5548	0.1723	0.5405	0.2951	19,914

Flat Terrain Modeling Results from SCREEN3

Case	Unit Impacts, ug/m3 per g/s	Maximum One-Hour Avg Impacts, ug/m3				Distance to Maximum (m)
		NOx	SO2	CO	PM10	
1	0.6002	0.3799	0.1180	0.3701	0.1891	1,195
2	0.8675	0.3153	0.0979	0.3071	0.2733	1,125
3	0.6234	0.3721	0.1156	0.3624	0.1964	1,243
4	0.9012	0.3147	0.0978	0.3066	0.2839	1,112
5	0.6736	0.3711	0.1153	0.3615	0.2122	1,214
6	0.935	0.3036	0.0943	0.2958	0.2945	1,099
7	0.6309	0.3736	0.1160	0.3639	0.1987	1,238

Adjust unit impacts for longer averaging periods to account for 90-minute duration of fumigation

Case	1-hr unit	3-hr unit	8-hr unit	24-hr unit
1	0.933	0.766	0.663	0.621
2	1.257	1.062	0.941	0.892
3	0.939	0.781	0.683	0.643
4	1.241	1.071	0.965	0.922
5	0.933	0.803	0.722	0.690
6	1.197	1.066	0.984	0.951
7	0.937	0.784	0.688	0.650

Table 5.1B-6b
TID Almond 2 Power Plant
Calculation of Inversion Breakup Fumigation Impacts: 850 deg exhaust temp (cont'd)

Total Impacts for 3 CTGs

Case/Avg Period	NOx	SO2	CO	PM10
One-Hour				
1	1.7710	0.5501	1.7253	-
2	1.3706	0.4257	1.3351	-
3	1.6805	0.5220	1.6371	-
4	1.3002	0.4039	1.2666	-
5	1.5411	0.4787	1.5013	-
6	1.1662	0.3622	1.1360	-
7	1.6644	0.5170	1.6214	-
3 Hours				
1	-	0.4069	-	-
2	-	0.3238	-	-
3	-	0.3909	-	-
4	-	0.3137	-	-
5	-	0.3710	-	-
6	-	0.2903	-	-
7	-	0.3893	-	-
8 Hours				
1	-	-	0.8579	-
2	-	-	0.6993	-
3	-	-	0.8333	-
4	-	-	0.6894	-
5	-	-	0.8138	-
6	-	-	0.6538	-
7	-	-	0.8338	-
24 Hours				
1	-	0.1465	-	0.2347
2	-	0.1208	-	0.3371
3	-	0.1431	-	0.2431
4	-	0.1201	-	0.3487
5	-	0.1416	-	0.2607
6	-	0.1152	-	0.3596
7	-	0.1435	-	0.2457

Table 5.1B-7a
TID Almond 2 Power Plant
Gas Turbine Commissioning Profile

Operating Mode	Hours of Operation(1)	Fuel Use MMBtu/hr (2) (HHV)	Emission Factors (lbs/MMBtu) NOx(3)	CO(4)	VOC(5)	PM10(6)	SOx(7)	Hourly Emissions (lbs/hr) NOx	CO	VOC	PM10
Turbine 1 - FSNL	4	111.0	0.3640	0.2646	0.0758	n/a	0.0028	40.40	29.36	8.41	2.5
Turbine 2 - FSNL	4	111.0	0.3640	0.2646	0.0758	n/a	0.0028	40.40	29.36	8.41	2.5
Turbine 3 - FSNL	4	111.0	0.3640	0.2646	0.0758	n/a	0.0028	40.40	29.36	8.41	2.5
Turbine 1 - Min. Load, no SCR or ox cat	20	111.0	0.15288	0.1764	0.0202	n/a	0.0028	16.97	19.58	2.24	2.5
Turbine 2 - Min. Load, no SCR or ox cat	20	111.0	0.15288	0.1764	0.0202	n/a	0.0028	16.97	19.58	2.24	2.5
Turbine 3 - Min. Load, no SCR or ox cat	20	111.0	0.15288	0.1764	0.0202	n/a	0.0028	16.97	19.58	2.24	2.5
Turbine 1 - FSNL (if necessary)	24	111.0	0.3640	0.2646	0.0758	n/a	0.0028	40.40	29.36	8.41	2.5
Turbine 2 - FSNL (if necessary)	24	111.0	0.3640	0.2646	0.0758	n/a	0.0028	40.40	29.36	8.41	2.5
Turbine 3 - FSNL (if necessary)	24	111.0	0.3640	0.2646	0.0758	n/a	0.0028	40.40	29.36	8.41	2.5
Turbine 1 - Multiple Load - Full SCR/ox cat	48	554.9	0.05915	0.0088	0.0025	n/a	0.0028	32.82	4.89	1.40	2.5
Turbine 2 - Multiple Load - Full SCR/ox cat	48	554.9	0.05915	0.0088	0.0025	n/a	0.0028	32.82	4.89	1.40	2.5
Turbine 3 - Multiple Load - Full SCR/ox cat	48	554.9	0.05915	0.0088	0.0025	n/a	0.0028	32.82	4.89	1.40	2.5
Total =	288										

Notes:
(1) Hours of Operation - based on information supplied by MID for the Ripon project
(2) Fuel Use
- No Load test: Based on 20% of maximum heat input rating
- Minimum Load test: Based on 20% of maximum heat input rating
- Multiple Load test: Based on 100% of maximum heat input rating

(3) NOx Emission Factors
- No Load test: Based on 100 ppm @ 15% O2.
- Minimum Load test: Based on maximum uncontrolled emission rate of 42 ppm @ 15% O2
- Multiple Load Full SCR/ox cat test: Based on NOx emission levels at the midway point between 30 ppm and 2.5 ppm @ 15% O2

(4) CO Emission Factors
- No Load test: Based on maximum uncontrolled emission rate of 30 times controlled level, or 120 ppm @ 15% O2
- Minimum Load test: Based on maximum uncontrolled emission rate of 20 times controlled level, or 80 ppm @ 15% O2
- Multiple Load Full SCR/ox cat test: Based on unit meeting the project design level of 4 ppm @ 15% O2 with oxidation catalyst installed and operating

(5) VOC Emission Factors
- No Load test: Based on maximum uncontrolled emission rate of 30 times controlled level, or 60 ppm @ 15% O2
- Minimum Load test: Based on maximum uncontrolled emission rate of 8 times controlled level, or 16 ppm @ 15% O2
- Multiple Load Full SCR/ox cat test: Based on unit meeting the project design level of 2 ppm @ 15% O2 with oxidation catalyst installed and operating

(6) PM10 Emission Factors
- For all tests, based on project design PM10 level of 2.5 lbs/hr.

(7) SOx Emission Factors
- For all tests, based on annual average natural gas sulfur content of 1.0 gr/100 scf

Table 5.1B-7b
TID Almond 2 Power Plant
Emission Rates and Stack Parameters for Modeling Commissioning Impacts

		Stack Diam, m	Stack Height, m	Exh Temp, Deg K	Exhaust Flow, m3/s	Exhaust Velocity,	Em Rates, g/s		
							NOx	CO 1-hr	CO 8-hr
Each CTG		3.658	24.384	727.444	214.600	20.424	5.09	3.70	3.70

Table 5.1B-6a
TID Almond 2 Power Plant
Calculation of Inversion Breakup Fumigation Impacts: 790 deg exhaust temperature

CTG Emission Rates, g/s

Case	NOx	SO2	CO	PM10
1	0.633	0.197	0.617	0.315
2	0.363	0.113	0.354	0.315
3	0.597	0.185	0.581	0.315
4	0.349	0.108	0.340	0.315
5	0.551	0.171	0.537	0.315
6	0.325	0.101	0.316	0.315
7	0.592	0.184	0.577	0.315

Inversion Breakup Modeling Results from SCREEN3

Case	Unit Impacts, ug/m3 per g/s	Maximum One-Hour Avg Impacts, ug/m3				Distance to Maximum (m)
		NOx	SO2	CO	PM10	
1	0.9224	0.5839	0.1814	0.5688	0.2906	20,142
2	1.258	0.4572	0.1420	0.4454	0.3963	16,042
3	0.9341	0.5575	0.1732	0.5431	0.2942	19,958
4	1.236	0.4317	0.1341	0.4205	0.3893	16,255
5	0.9511	0.5239	0.1627	0.5104	0.2996	19,695
6	1.203	0.3907	0.1214	0.3806	0.3789	16,578
7	0.9332	0.5526	0.1717	0.5383	0.2940	19,972

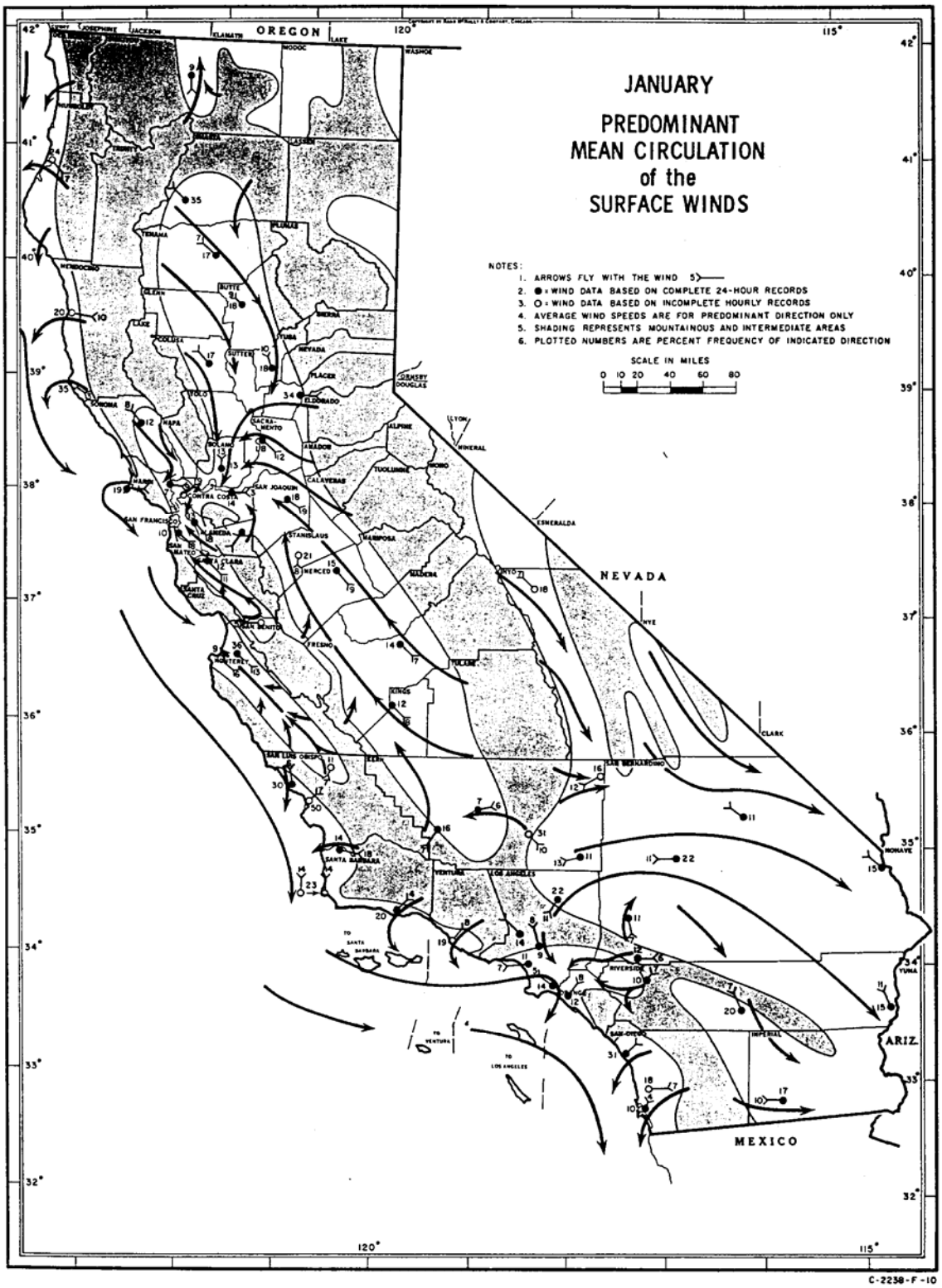
Flat Terrain Modeling Results from SCREEN3

Case	Unit Impacts, ug/m3 per g/s	Maximum One-Hour Avg Impacts, ug/m3				Distance to Maximum (m)
		NOx	SO2	CO	PM10	
1	0.599	0.3792	0.1178	0.3694	0.1887	1,196
2	0.8691	0.3159	0.0981	0.3077	0.2738	1,124
3	0.6195	0.3697	0.1148	0.3602	0.1951	1,245
4	0.8964	0.3131	0.0972	0.3050	0.2824	1,114
5	0.6913	0.3808	0.1183	0.3710	0.2178	1,205
6	0.9412	0.3057	0.0949	0.2978	0.2965	1,097
7	0.6276	0.3716	0.1154	0.3620	0.1977	1,240

Adjust unit impacts for longer averaging periods to account for 90-minute duration of fumigation

Case	1-hr unit	3-hr unit	8-hr unit	24-hr unit
1	0.922	0.761	0.660	0.619
2	1.258	1.064	0.942	0.893
3	0.934	0.777	0.678	0.639
4	1.236	1.066	0.960	0.918
5	0.951	0.821	0.740	0.708
6	1.203	1.072	0.990	0.958
7	0.933	0.780	0.685	0.647

FIGURE 5.1B-1a JANUARY PREDOMINANT MEAN CIRCULATION OF THE SURFACE WINDS



C-2238-F-10

FIGURE 5.1B-1b APRIL PREDOMINANT MEAN CIRCULATION OF THE SURFACE WINDS

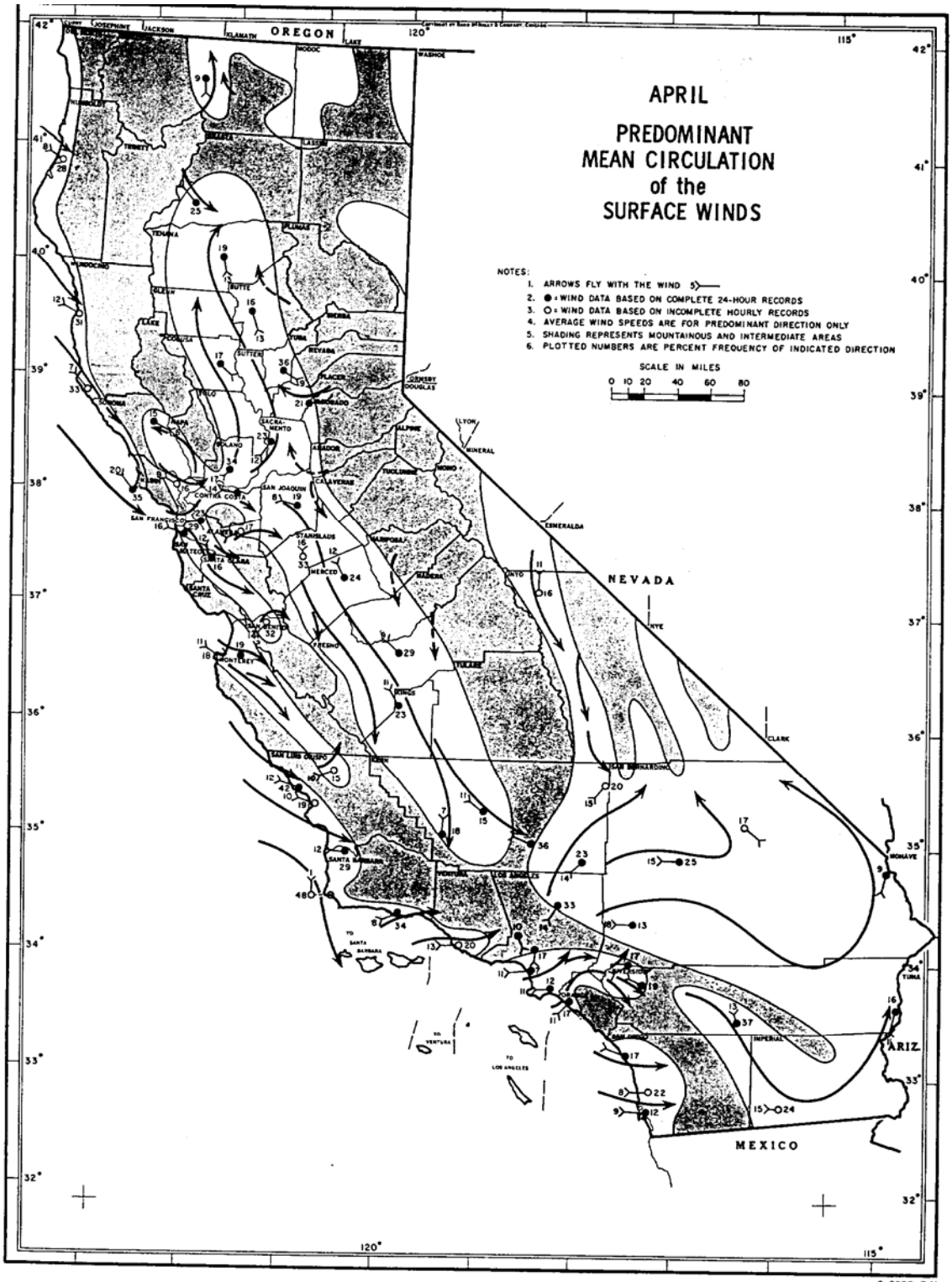


FIGURE 5.1B-1c JULY PREDOMINANT CIRCULATION OF THE SURFACE WINDS

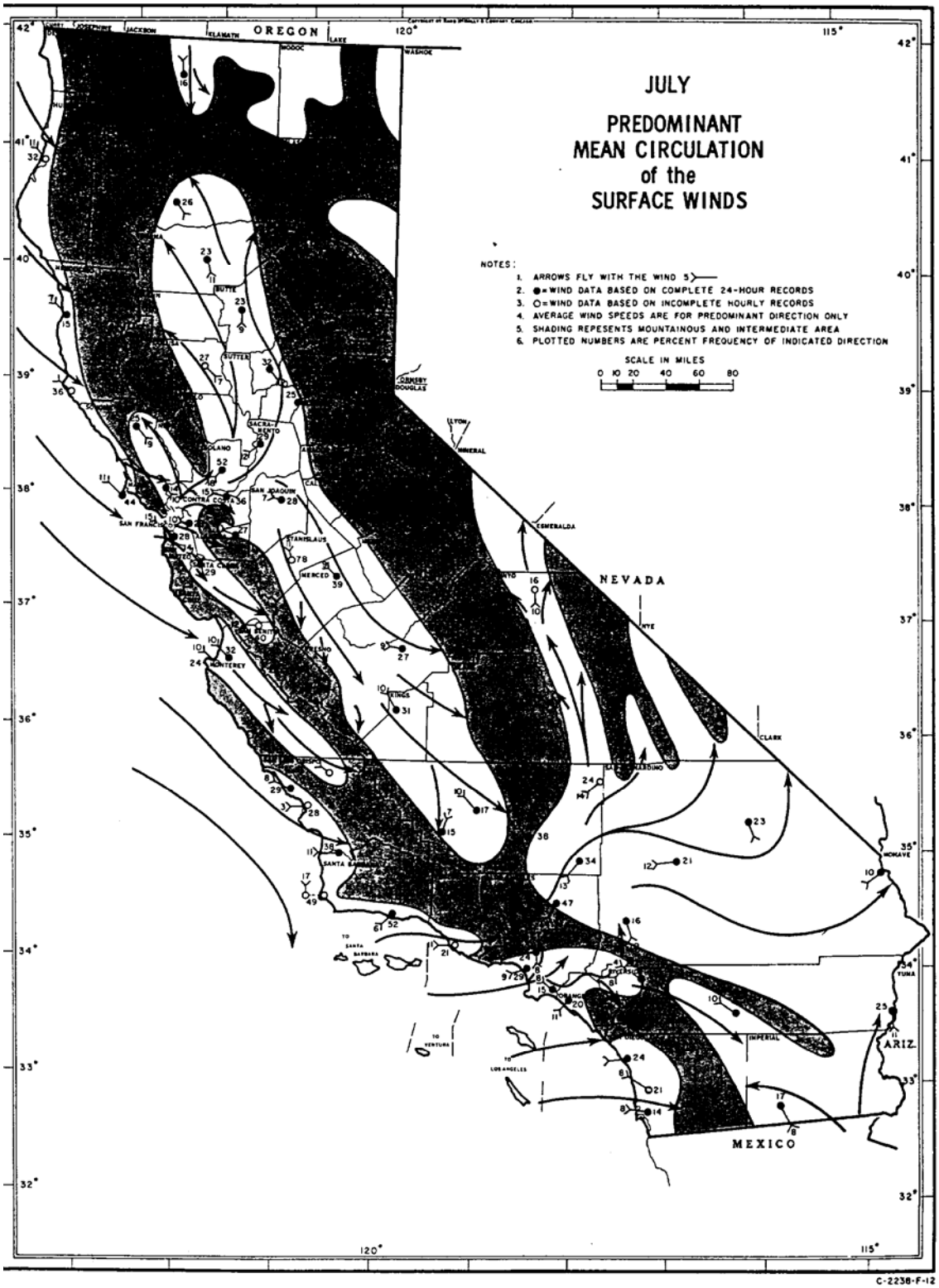


FIGURE 5.1B-1d OCTOBER PREDOMINANT MEAN CIRCULATION OF THE SURFACE WINDS

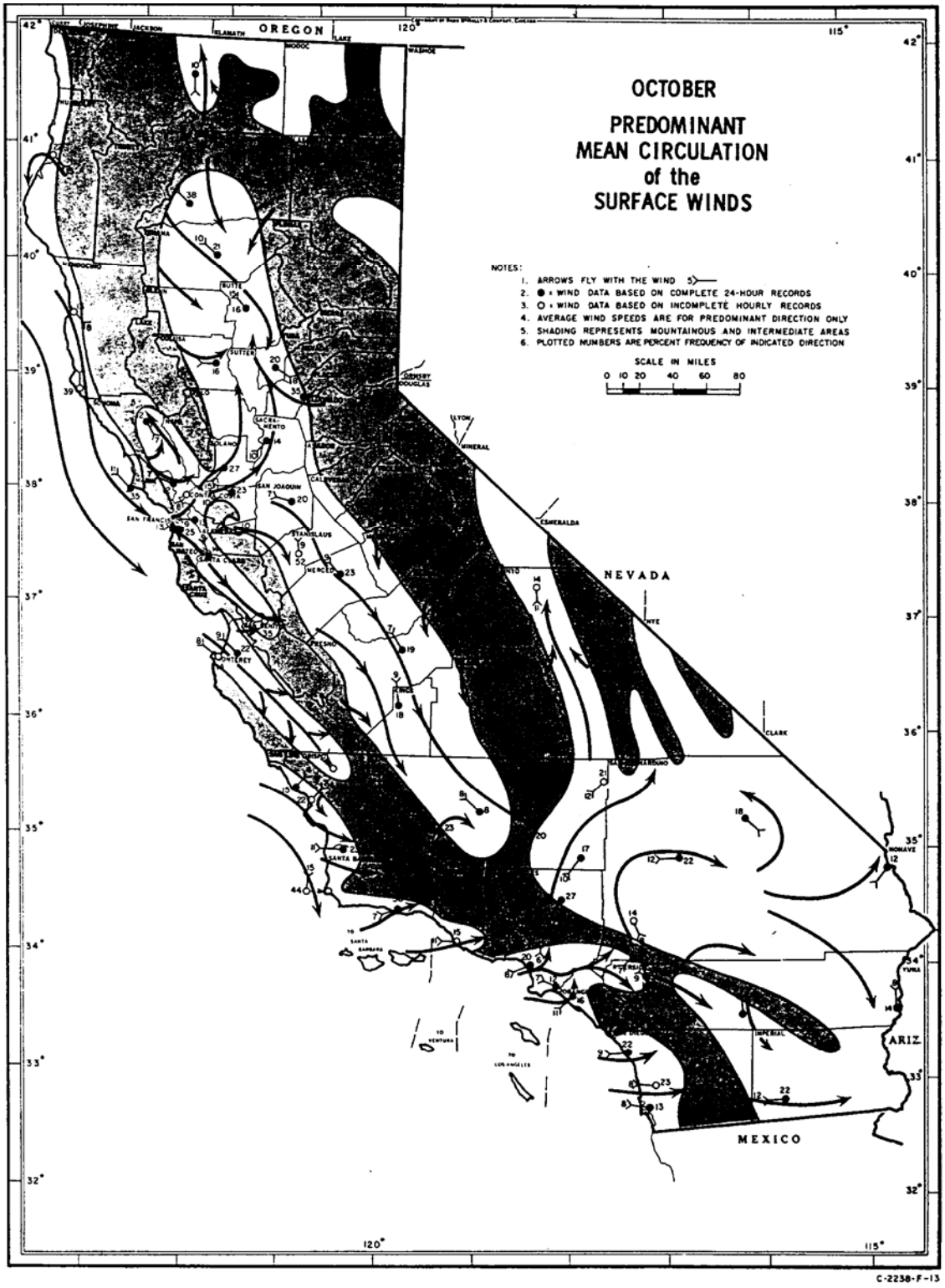


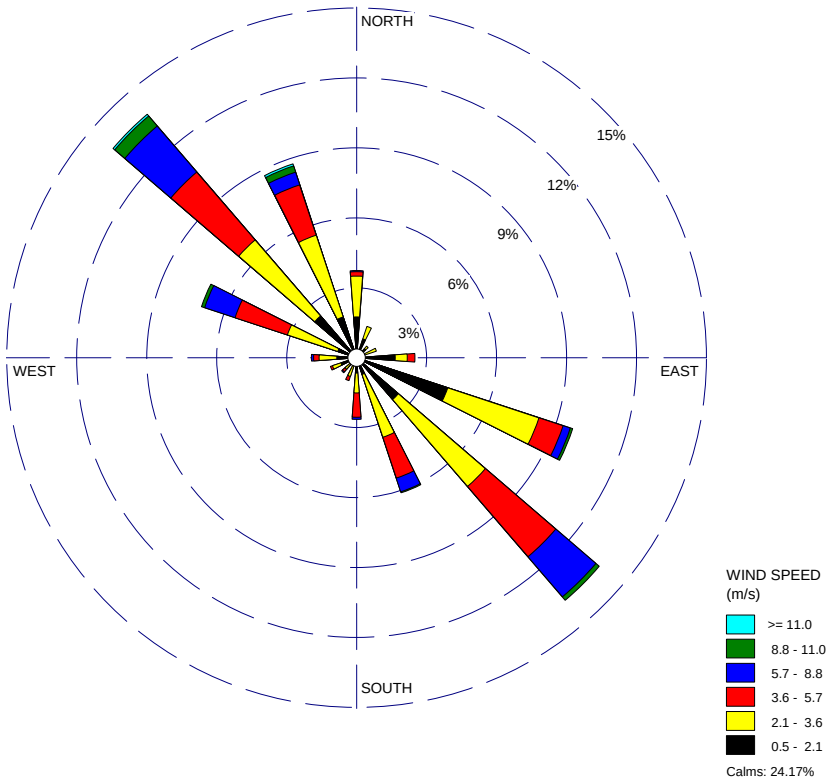
Figure 5.1B-2a 2000 1st Quarter Wind Rose, Modesto, CA

WIND ROSE PLOT:

Modesto, CA - First Quarter, 2000
January 1, 2000 through March 31, 2000

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	2000 **Jan 1 - Mar 31** **00:00 - 23:00**	MODELER:	
	CALM WINDS: **24.17%**	TOTAL COUNT: **2118 hrs.**	
	AVG. WIND SPEED: **2.76 m/s**	DATE: **1/6/2009**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

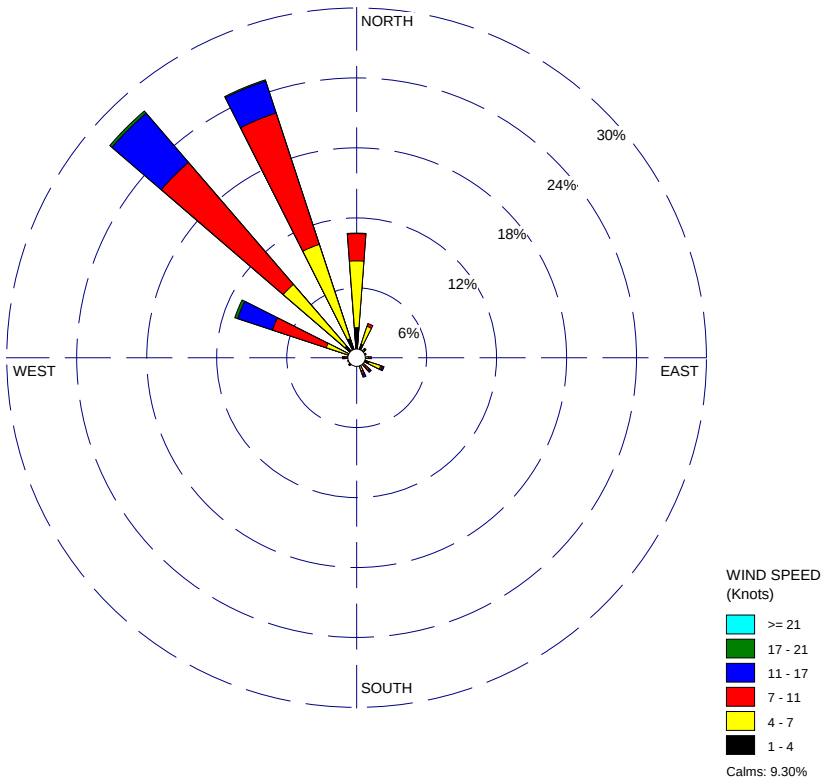
Figure 5.1B-2b 2000 2nd Quarter Wind Rose, Modesto, CA

WIND ROSE PLOT:

Modesto, CA - Second Quarter, 2000
Aprial 1, 2000 through June 30, 2000

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	2000 **Apr 1 - Jun 30** **00:00 - 23:00**	MODELER:	
	CALM WINDS: **9.30%**	TOTAL COUNT: **1978 hrs.**	
	AVG. WIND SPEED: **7.28 Knots**	DATE: **1/6/2009**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

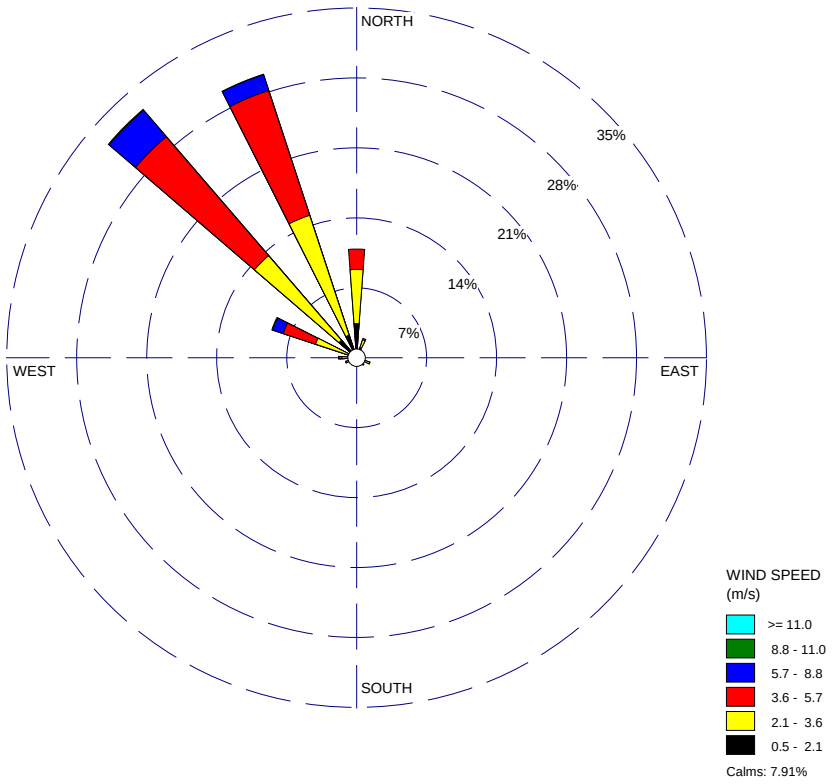
Figure 5.1B-2c 2000 3rd Quarter Wind Rose, Modesto, CA

WIND ROSE PLOT:

Modesto, CA - Third Quarter, 2000
July 1, 2000 through September 30, 2000

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	2000 **Jul 1 - Sep 30** **00:00 - 23:00**	MODELER:	
	CALM WINDS: **7.91%**	TOTAL COUNT: **2111 hrs.**	
	AVG. WIND SPEED: **3.50 m/s**	DATE: **1/6/2009**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

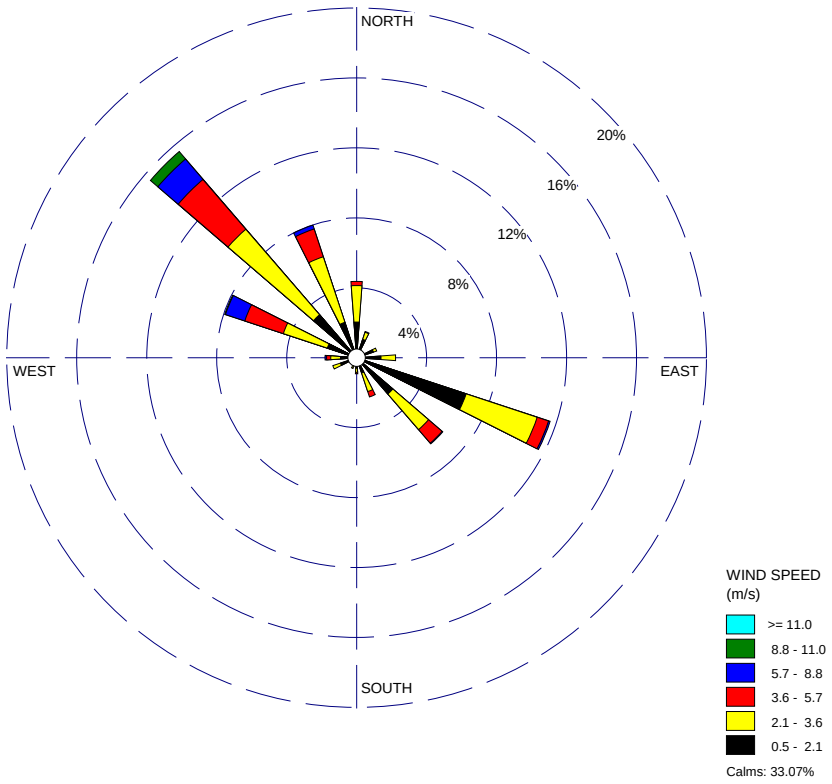
Figure 5.1B-2d 2000 4th Quarter Wind Rose, Modesto, CA

WIND ROSE PLOT:

Modesto, CA - Fourth Quarter, 2000
October 1, 2000 through December 31, 2000

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	2000 **Oct 1 - Dec 31** **00:00 - 23:00**	MODELER:	
	CALM WINDS: **33.07%**	TOTAL COUNT: **2159 hrs.**	
	AVG. WIND SPEED: **2.02 m/s**	DATE: **1/6/2009**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

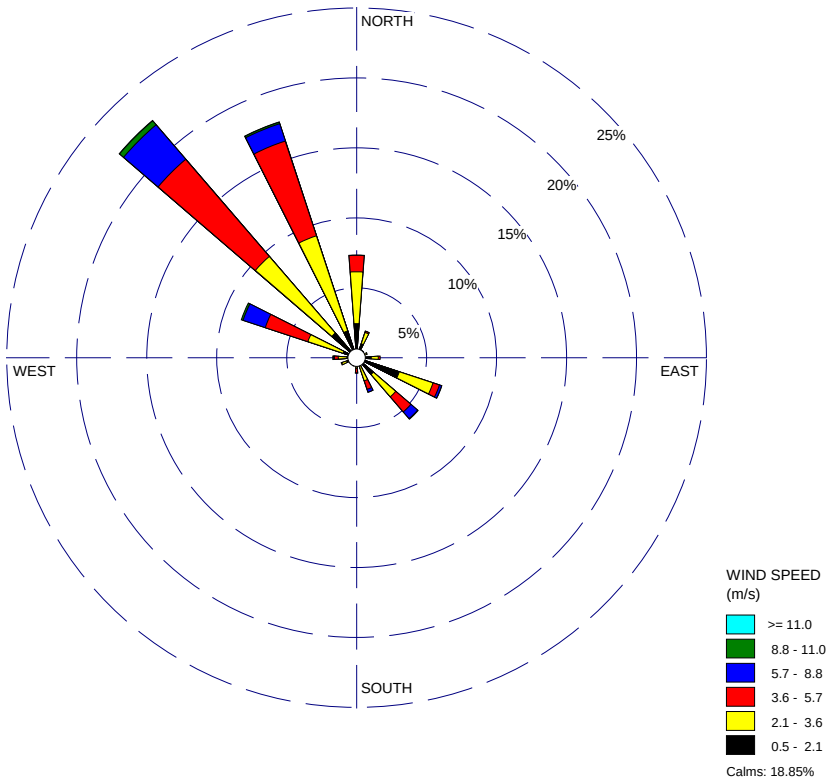
Figure 5.1B-2e 2000 Annual Wind Rose, Modesto, CA

WIND ROSE PLOT:

Modesto, CA - 2000
January 1, 2000 through December 31, 2000

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	2000 **Jan 1 - Dec 31** **00:00 - 23:00**	MODELER:	
	CALM WINDS: **18.85%**	TOTAL COUNT: **8366 hrs.**	
	AVG. WIND SPEED: **2.99 m/s**	DATE: **1/6/2009**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

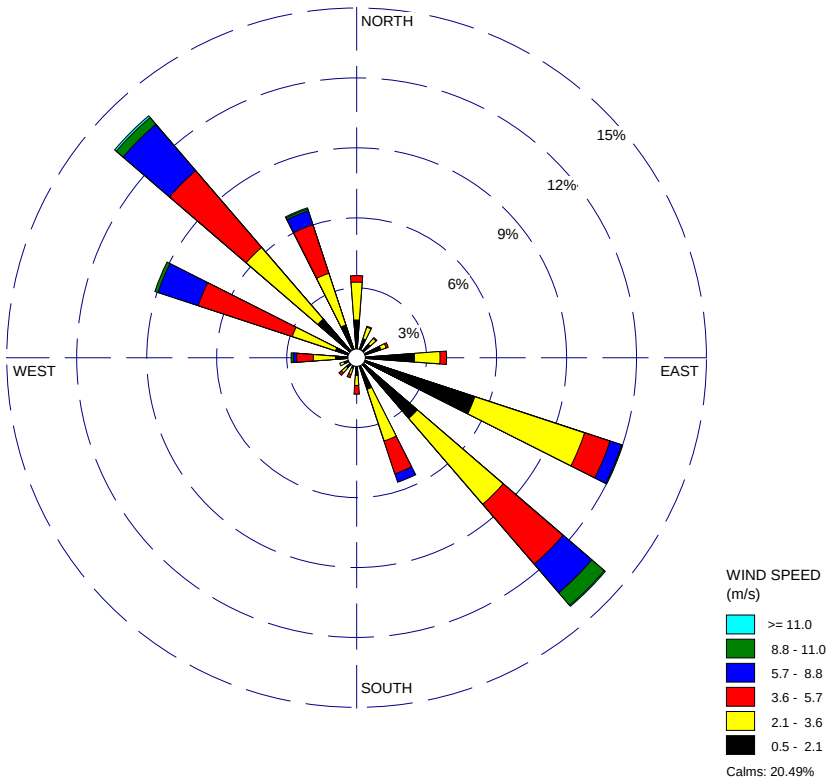
Figure 5.1B-3a 2001 1st Quarter Wind Rose, Modesto, CA

WIND ROSE PLOT:

Modesto, CA - First Quarter, 2001
January 1, 2001 through March 31, 2001

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	2001 **Jan 1 - Mar 31** **00:00 - 23:00**	MODELER:	
	CALM WINDS: **20.49%**	TOTAL COUNT: **2103 hrs.**	
	AVG. WIND SPEED: **2.85 m/s**	DATE: **1/6/2009**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

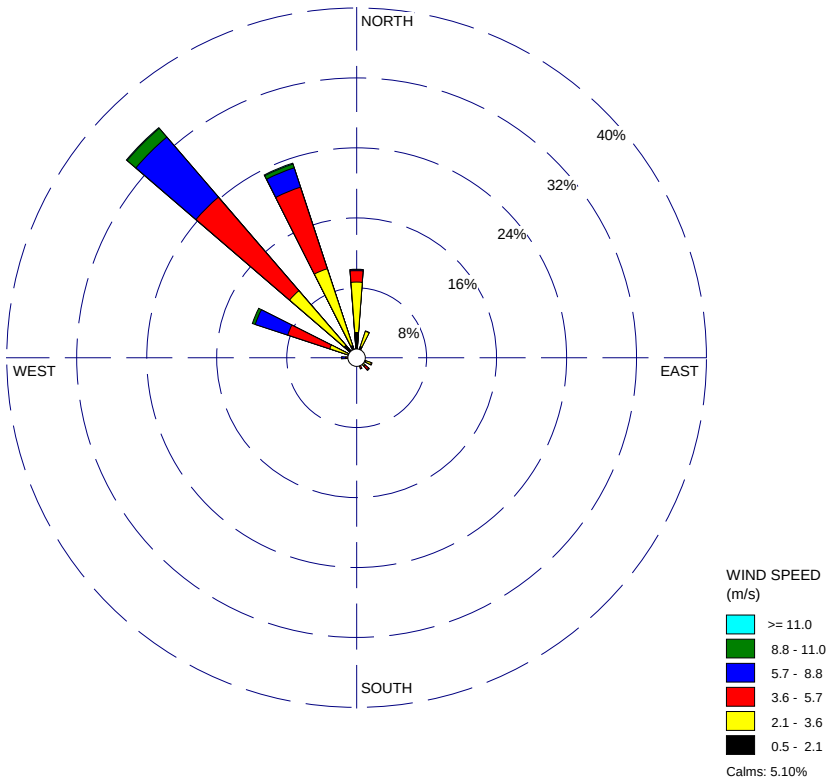
Figure 5.1B-3b 2001 2nd Quarter Wind Rose, Modesto, CA

WIND ROSE PLOT:

Modesto, CA - Second Quarter, 2001
Aprial 1, 2001 through June 30, 2001

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	2001 **Apr 1 - Jun 30** **00:00 - 23:00**	MODELER:	
	CALM WINDS: **5.10%**	TOTAL COUNT: **1981 hrs.**	
	AVG. WIND SPEED: **4.10 m/s**	DATE: **1/6/2009**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

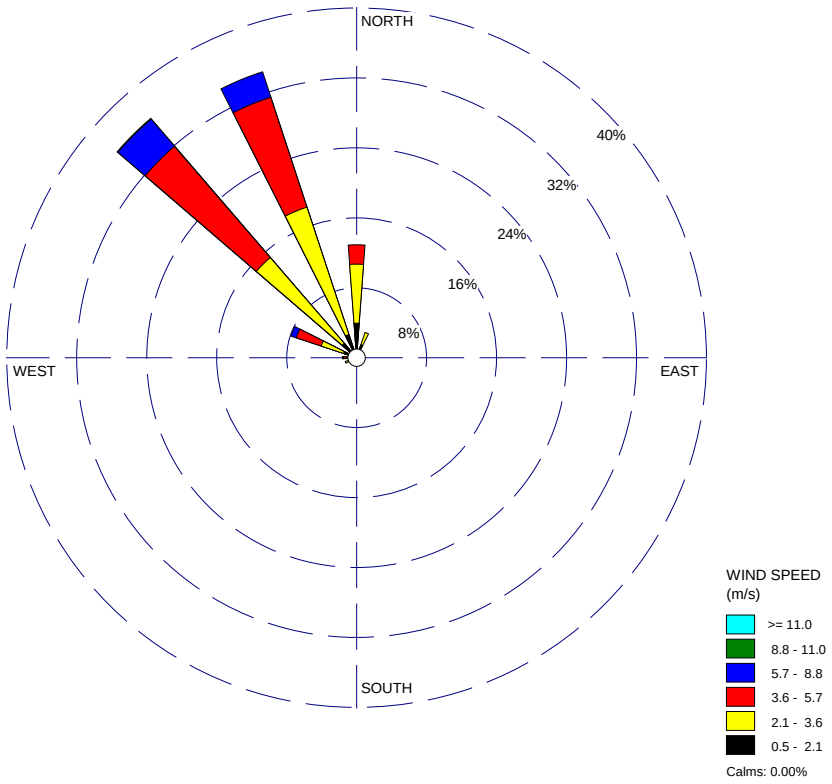
Figure 5.1B-3c 2001 3rd Quarter Wind Rose, Modesto, CA

WIND ROSE PLOT:

Modesto, CA - Third Quarter, 2001
July 1, 2001 through September 30, 2001

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	2001 **Jul 1 - Sep 30** **00:00 - 23:00**	MODELER:	
	CALM WINDS: **0.00%**	TOTAL COUNT: **1901 hrs.**	
	AVG. WIND SPEED: **3.77 m/s**	DATE: **1/6/2009**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

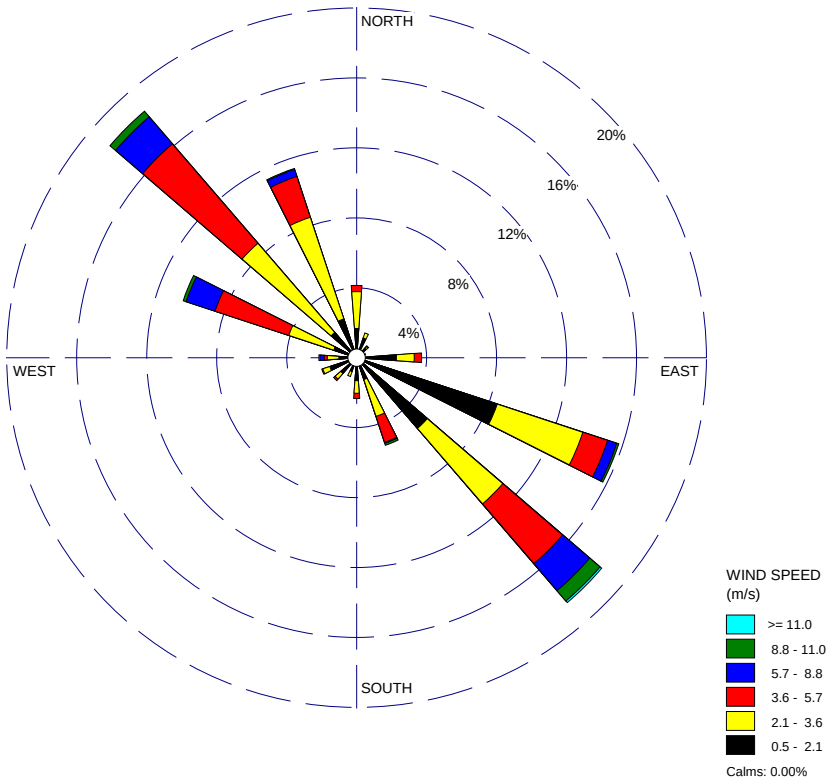
Figure 5.1B-3d 2001 4th Quarter Wind Rose, Modesto, CA

WIND ROSE PLOT:

Modesto, CA - Fourth Quarter, 2001
October 1, 2001 through December 31, 2001

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	2001 **Oct 1 - Dec 31** **00:00 - 23:00**	MODELER:	
	CALM WINDS: **0.00%**	TOTAL COUNT: **1671 hrs.**	
	AVG. WIND SPEED: **3.43 m/s**	DATE: **1/6/2009**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

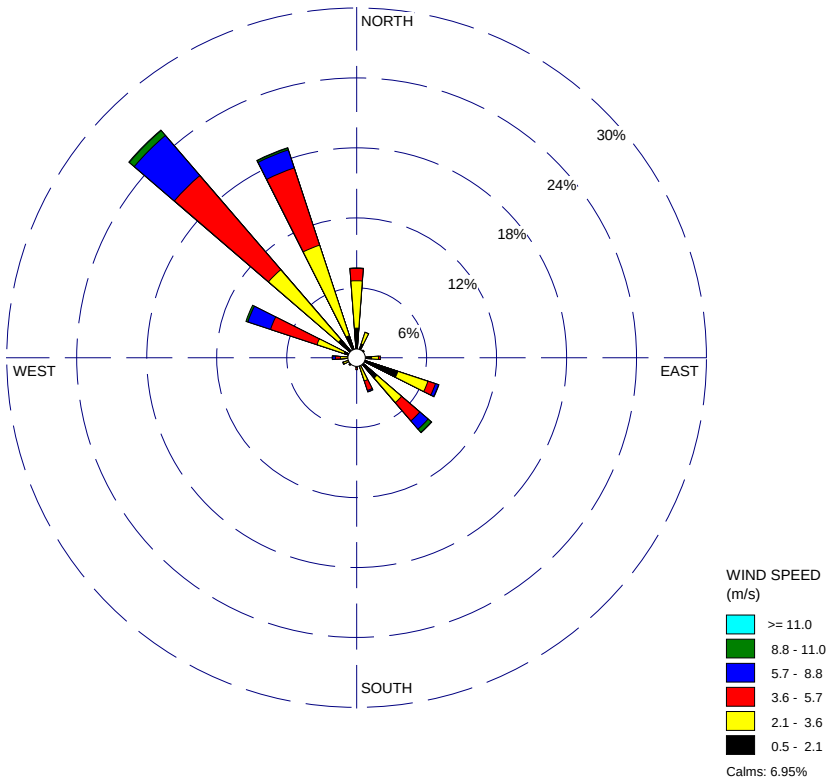
Figure 5.1B-3e 2001 Annual Wind Rose, Modesto, CA

WIND ROSE PLOT:

Modesto, CA - 2001
January 1, 2001 through December 31, 2001

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	2001 **Jan 1 - Dec 31** **00:00 - 23:00**	MODELER:	
	CALM WINDS: **6.95%**	TOTAL COUNT: **7656 hrs.**	
	AVG. WIND SPEED: **3.53 m/s**	DATE: **1/6/2009**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

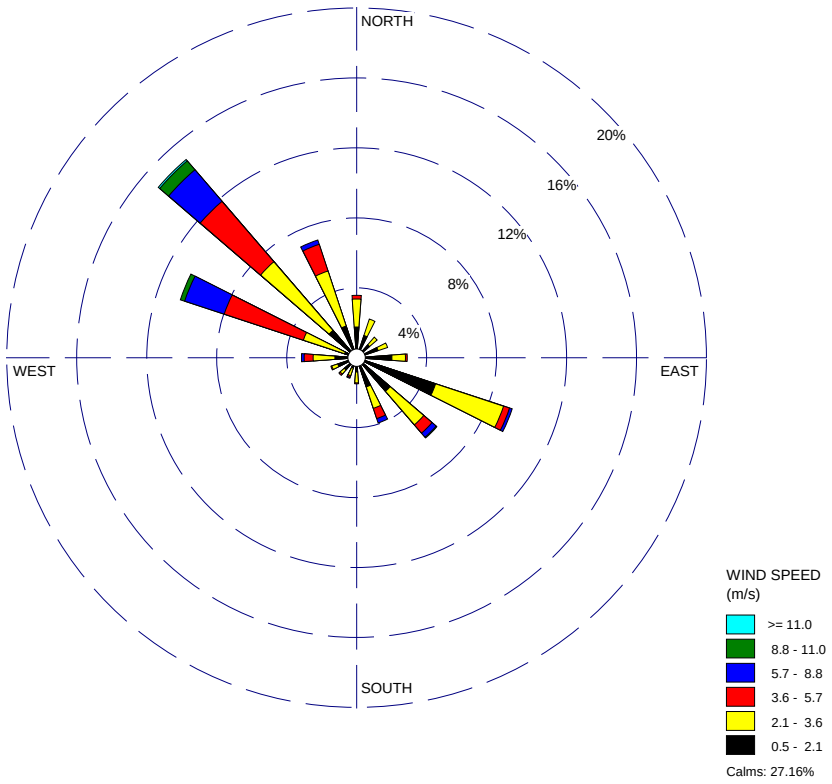
Figure 5.1B-4a 2003 1st Quarter Wind Rose, Modesto, CA

WIND ROSE PLOT:

Modesto, CA - First Quarter, 2003
January 1, 2003 through March 31, 2003

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	2003 **Jan 1 - Mar 31** **00:00 - 23:00**	MODELER:	
	CALM WINDS: **27.16%**	TOTAL COUNT: **1937 hrs.**	
	AVG. WIND SPEED: **2.43 m/s**	DATE: **1/6/2009**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

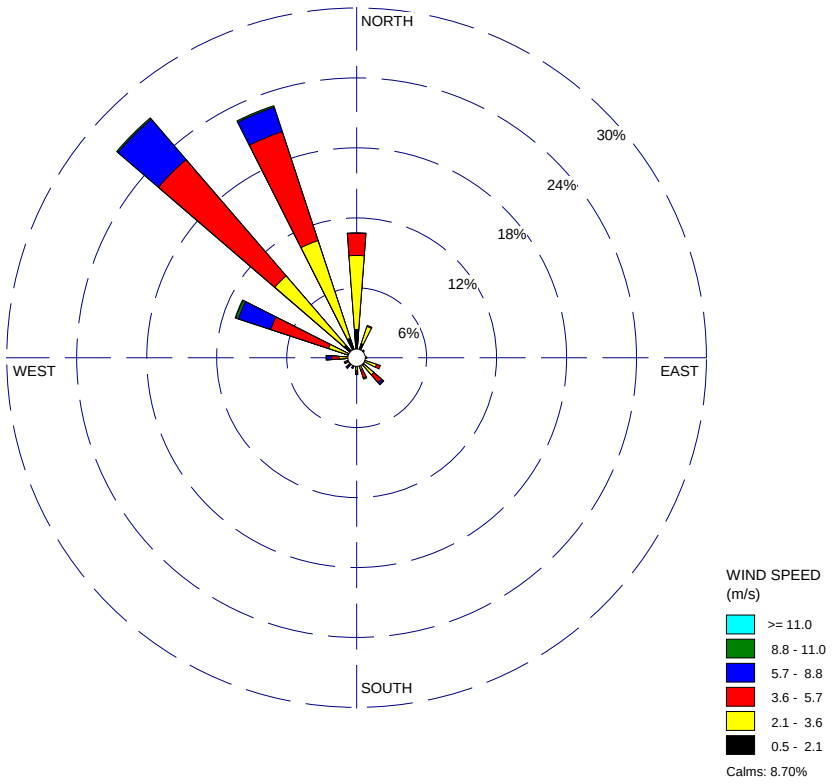
Figure 5.1B-4b 2003 2nd Quarter Wind Rose, Modesto, CA

WIND ROSE PLOT:

Modesto, CA - Second Quarter, 2003
Aprial 1, 2003 through June 30, 2003

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	2003 **Apr 1 - Jun 30** **00:00 - 23:00**	MODELER:	
	CALM WINDS: **8.70%**	TOTAL COUNT: **2057 hrs.**	
	AVG. WIND SPEED: **3.71 m/s**	DATE: **1/6/2009**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

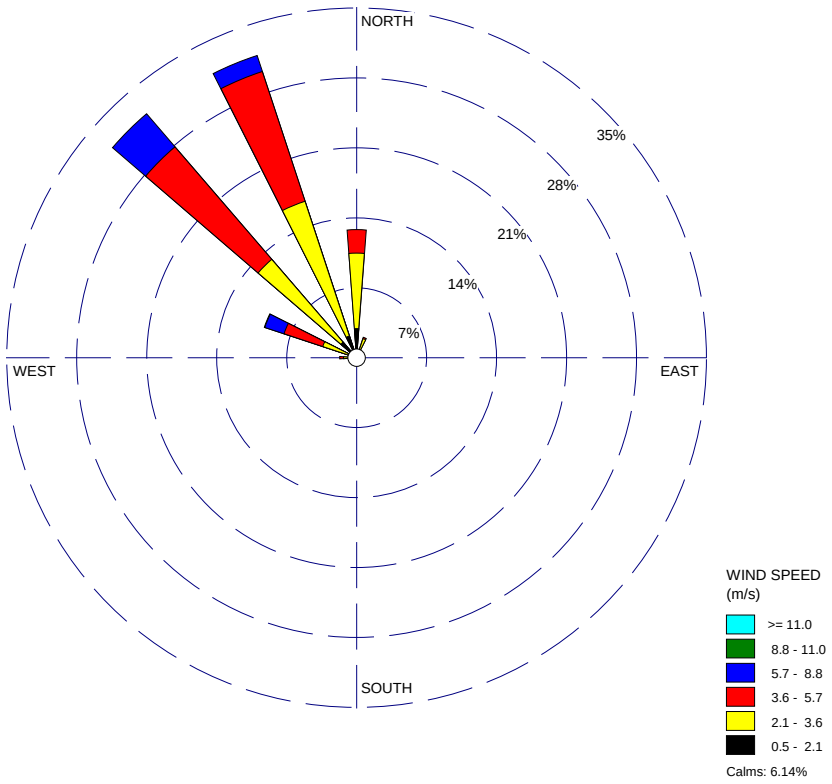
Figure 5.1B-4c 2003 3rd Quarter Wind Rose, Modesto, CA

WIND ROSE PLOT:

Modesto, CA - Third Quarter, 2003
July 1, 2003 through September 30, 2003

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	2003 **Jul 1 - Sep 30** **00:00 - 23:00**	MODELER:	
	CALM WINDS: **6.14%**	TOTAL COUNT: **2134 hrs.**	
	AVG. WIND SPEED: **3.65 m/s**	DATE: **1/6/2009**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

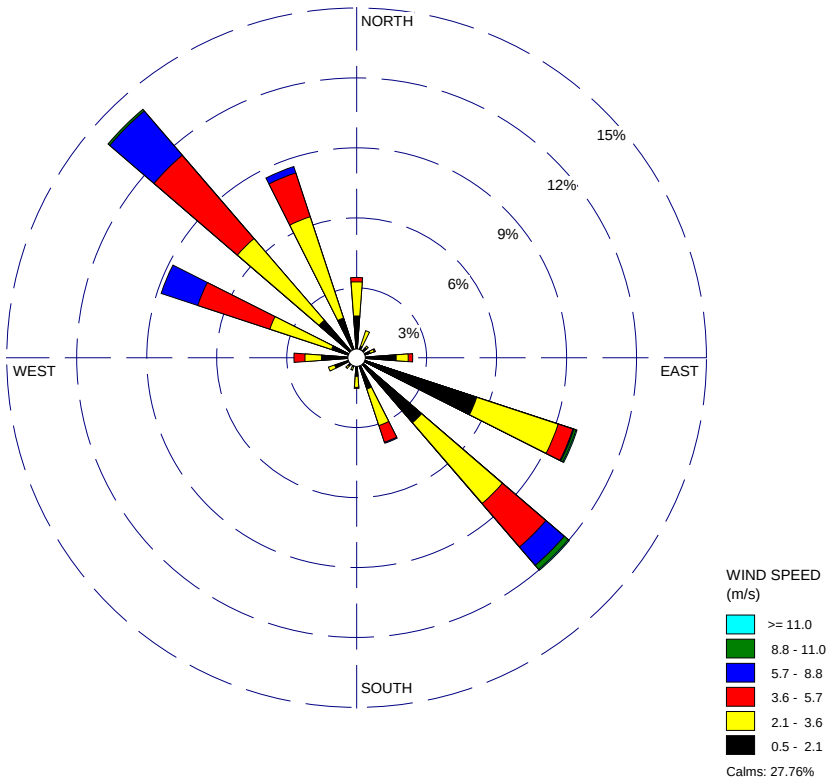
Figure 5.1B-4d 2003 4th Quarter Wind Rose, Modesto, CA

WIND ROSE PLOT:

Modesto, CA - Fourth Quarter, 2003
October 1, 2003 through December 31, 2003

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	2003 **Oct 1 - Dec 31** **00:00 - 23:00**	MODELER:	
	CALM WINDS: **27.76%**	TOTAL COUNT: **2125 hrs.**	
	AVG. WIND SPEED: **2.37 m/s**	DATE: **1/6/2009**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

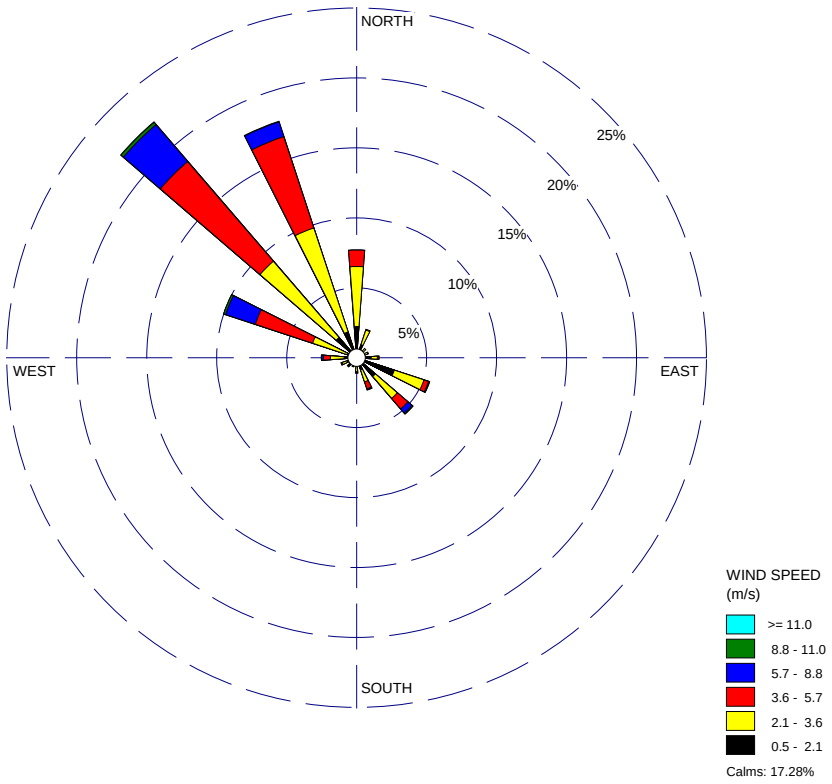
Figure 5.1B-4e 2003 Annual Wind Rose, Modesto, CA

WIND ROSE PLOT:

Modesto, CA - 2003
January 1, 2003 through December 31, 2003

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	2003 **Jan 1 - Dec 31** **00:00 - 23:00**	MODELER:	
	CALM WINDS: **17.28%**	TOTAL COUNT: **8253 hrs.**	
	AVG. WIND SPEED: **3.05 m/s**	DATE: **1/6/2009**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

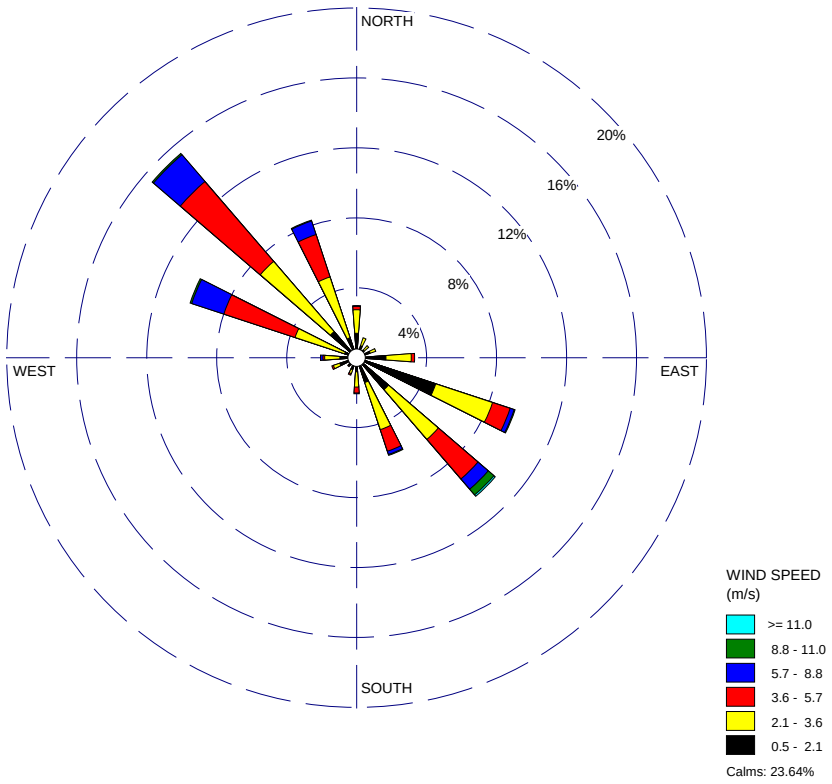
Figure 5.1B-5a 2004 1st Quarter Wind Rose, Modesto, CA

WIND ROSE PLOT:

Modesto, CA - First Quarter, 2004
January 1, 2004 through March 31, 2004

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	2004 **Jan 1 - Mar 31** **00:00 - 23:00**	MODELER:	
	CALM WINDS: **23.64%**	TOTAL COUNT: **2081 hrs.**	
	AVG. WIND SPEED: **2.67 m/s**	DATE: **1/6/2009**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

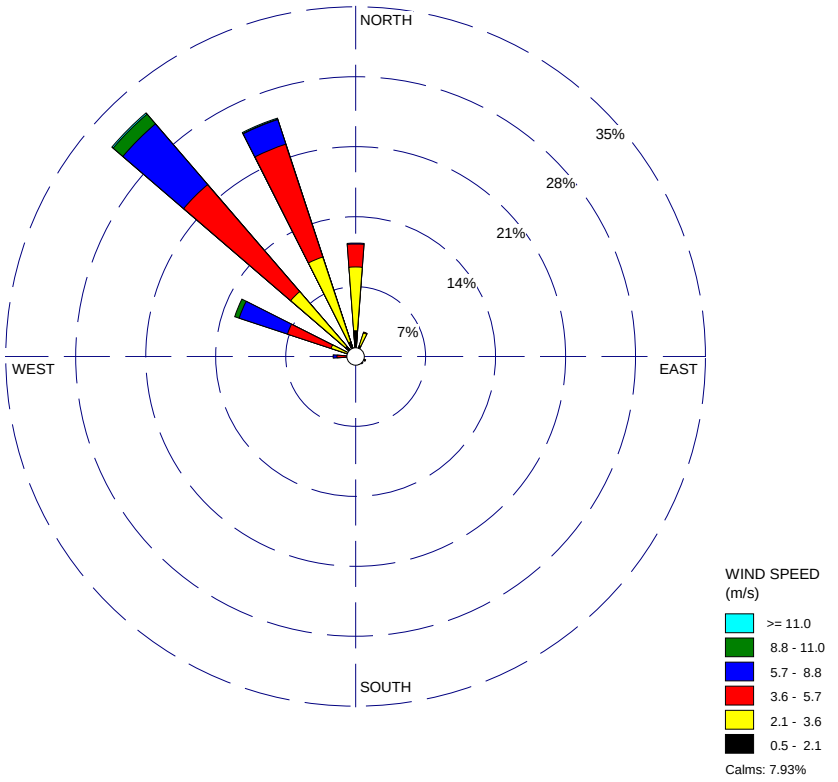
Figure 5.1B-5b 2004 2nd Quarter Wind Rose, Modesto, CA

WIND ROSE PLOT:

Modesto, CA - Second Quarter, 2004
Aprial 1, 2004 through June 30, 2004

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	2004 **Apr 1 - Jun 30** **00:00 - 23:00**	MODELER:	
	CALM WINDS: **7.93%**	TOTAL COUNT: **2092 hrs.**	
	AVG. WIND SPEED: **4.07 m/s**	DATE: **1/6/2009**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

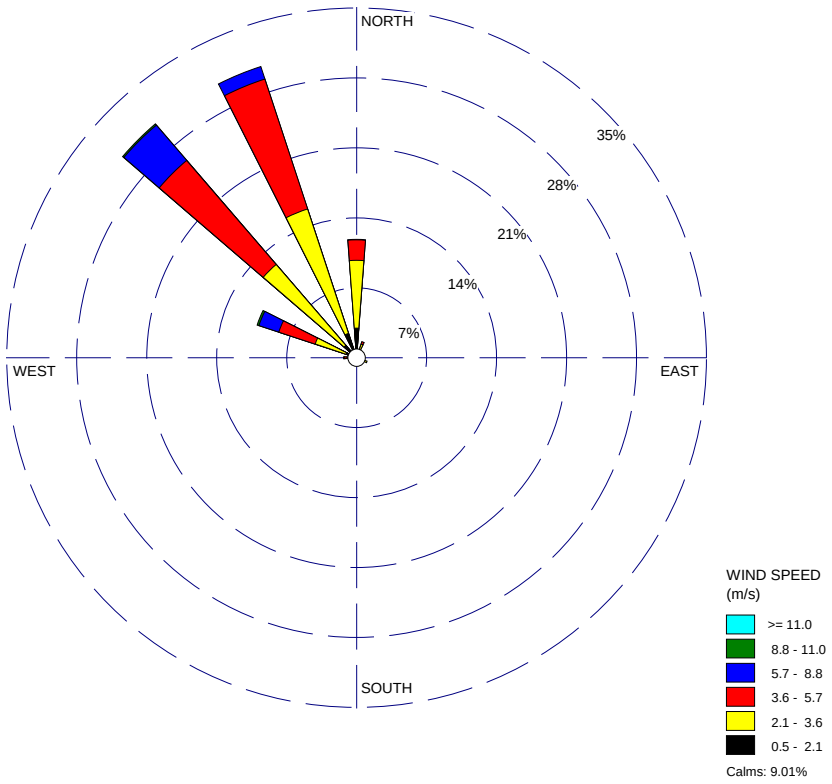
Figure 5.1B-5c 2004 3rd Quarter Wind Rose, Modesto, CA

WIND ROSE PLOT:

Modesto, CA - Third Quarter, 2004
July 1, 2004 through September 30, 2004

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	2004 **Jul 1 - Sep 30** **00:00 - 23:00**	MODELER:	
	CALM WINDS: **9.01%**	TOTAL COUNT: **2065 hrs.**	
	AVG. WIND SPEED: **3.55 m/s**	DATE: **1/6/2009**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

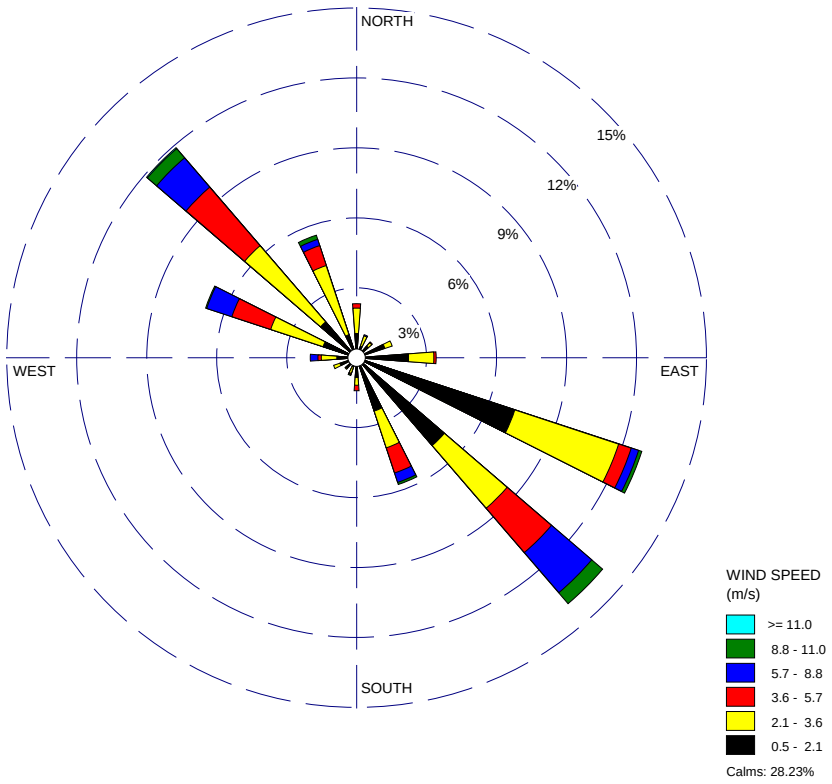
Figure 5.1B-5d 2004 4th Quarter Wind Rose, Modesto, CA

WIND ROSE PLOT:

Modesto, CA - Fourth Quarter, 2004
October 1, 2004 through December 31, 2004

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	2004 **Oct 1 - Dec 31** **00:00 - 23:00**	MODELER:	
	CALM WINDS: **28.23%**	TOTAL COUNT: **2118 hrs.**	
	AVG. WIND SPEED: **2.35 m/s**	DATE: **1/6/2009**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

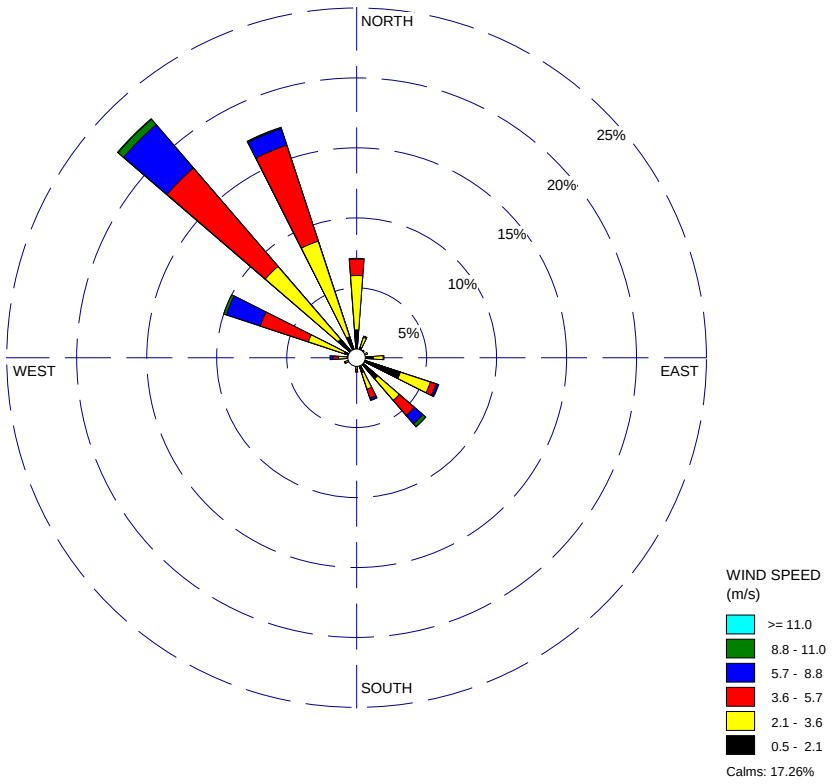
Figure 5.1B-5e 2004 Annual Wind Rose, Modesto, CA

WIND ROSE PLOT:

Modesto, CA - 2004
January 1, 2004 through December 31, 2004

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	2004 **Jan 1 - Dec 31** **00:00 - 23:00**	MODELER:	
	CALM WINDS: **17.26%**	TOTAL COUNT: **8356 hrs.**	
	AVG. WIND SPEED: **3.16 m/s**	DATE: **1/6/2009**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

TID ALMOND 2 POWER PLANT METEOROLOGICAL DATA:
MODESTO, CA: 2000, 2001, 2003 AND 2004
WIND FREQUENCY DISTRIBUTIONS

2000: ANNUAL
WIND SPEEDS AT 10METERS HEIGHT (m/s)

SECTOR	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	>=8	Total
N	1577	79	249	185	82	16	1	0	1	2190
NNE	4	32	90	33	4	4	1	0	0	168
NE	2	19	27	4	1	0	1	0	0	54
ENE	1	19	35	12	0	0	0	0	0	67
E	1	45	60	23	7	5	0	0	0	141
ESE	0	122	253	105	28	13	7	6	2	536
SE	0	66	138	104	69	50	34	13	10	484
SSE	0	20	66	60	40	13	12	6	1	218
S	0	18	28	18	22	5	1	1	0	93
SSW	0	14	21	12	4	2	0	0	0	53
SW	0	13	22	6	7	1	1	1	0	51
WSW	0	37	43	13	3	1	0	0	0	97
W	0	29	52	29	13	10	3	3	3	142
WNW	0	39	114	153	150	118	85	44	21	724
NW	0	66	279	453	442	323	170	82	52	1867
NNW	0	62	268	436	400	195	76	25	19	1481
Sub-Total:	1585	680	1745	1646	1272	756	392	181	109	8366

Average Wind Speed: 2.99 m/s

2000: FIRST QUARTER
WIND SPEEDS AT 10METERS HEIGHT (m/s)

SECTOR	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	>=8	Total
N	512	18	36	20	4	0	0	0	1	591
NNE	2	6	14	8	0	0	0	0	0	30
NE	1	6	6	1	0	0	0	0	0	14
ENE	0	2	9	8	0	0	0	0	0	19
E	0	15	25	6	4	3	0	0	0	53
ESE	0	38	88	48	15	8	4	3	2	206
SE	0	21	63	70	48	36	31	11	10	290
SSE	0	5	26	45	29	10	11	2	1	129
S	0	7	13	12	18	4	1	1	0	56
SSW	0	5	5	8	3	1	0	0	0	22
SW	0	3	10	1	2	1	0	1	0	18
WSW	0	7	14	2	1	1	0	0	0	25
W	0	8	17	9	3	2	2	0	0	41
WNW	0	9	24	33	32	18	14	12	6	148
NW	0	21	60	60	52	29	32	18	19	291
NNW	0	16	49	52	39	9	8	3	9	185
Sub-Total:	515	187	459	383	250	122	103	51	48	2118

Average Wind Speed: 2.76 m/s

2000: SECOND QUARTER
WIND SPEEDS AT 10METERS HEIGHT (m/s)

SECTOR	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	>=8	Total
N	184	18	70	76	38	8	1	0	0	395
NNE	1	10	27	18	2	3	0	0	0	61
NE	1	4	11	3	1	0	1	0	0	21
ENE	1	5	7	4	0	0	0	0	0	17
E	0	6	11	3	3	2	0	0	0	25
ESE	0	6	27	10	1	2	2	1	0	49
SE	0	7	7	6	5	4	3	1	0	33
SSE	0	7	13	4	5	1	1	4	0	35
S	0	2	4	4	0	0	0	0	0	10
SSW	0	2	6	2	1	0	0	0	0	11
SW	0	5	5	2	5	0	1	0	0	18
WSW	0	6	7	2	1	0	0	0	0	16
W	0	3	5	5	2	5	1	1	2	24
WNW	0	7	11	36	44	52	40	19	8	217
NW	0	5	48	111	144	128	71	33	11	551
NNW	0	17	50	135	153	81	41	14	4	495
Sub-Total:	187	110	309	421	405	286	162	73	25	1978

Average Wind Speed: 3.75 m/s

2000: THIRD QUARTER
WIND SPEEDS AT 10METERS HEIGHT (m/s)

SECTOR	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	>=8	Total
N	167	26	88	72	35	8	0	0	0	396
NNE	0	8	27	5	2	1	0	0	0	43
NE	0	3	6	0	0	0	0	0	0	9
ENE	0	1	4	0	0	0	0	0	0	5
E	1	8	5	1	0	0	0	0	0	15
ESE	0	9	17	3	0	0	0	1	0	30
SE	0	10	6	1	4	0	0	0	0	21
SSE	0	1	0	1	1	0	0	0	0	3
S	0	2	1	1	2	1	0	0	0	7
SSW	0	2	3	0	0	1	0	0	0	6
SW	0	3	2	1	0	0	0	0	0	6
WSW	0	9	9	6	1	0	0	0	0	25
W	0	10	10	11	6	0	0	0	1	38
WNW	0	6	33	52	49	23	13	7	5	188
NW	0	12	88	184	194	137	50	21	4	690
NNW	0	13	98	205	181	96	25	6	5	629
Sub-Total:	168	123	397	543	475	267	88	35	15	2111

Average Wind Speed: 3.5 m/s

2000: FOURTH QUARTER
WIND SPEEDS AT 10METERS HEIGHT (m/s)

SECTOR	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	>=8	Total
N	714	17	55	17	5	0	0	0	0	808
NNE	1	8	22	2	0	0	1	0	0	34
NE	0	6	4	0	0	0	0	0	0	10
ENE	0	11	15	0	0	0	0	0	0	26
E	0	16	19	13	0	0	0	0	0	48
ESE	0	69	121	44	12	3	1	1	0	251
SE	0	28	62	27	12	10	0	1	0	140
SSE	0	7	27	10	5	2	0	0	0	51
S	0	7	10	1	2	0	0	0	0	20
SSW	0	5	7	2	0	0	0	0	0	14
SW	0	2	5	2	0	0	0	0	0	9
WSW	0	15	13	3	0	0	0	0	0	31
W	0	8	20	4	2	3	0	2	0	39
WNW	0	17	46	32	25	25	18	6	2	171
NW	0	28	83	98	52	29	17	10	18	335
NNW	0	16	71	44	27	9	2	2	1	172
Sub-Total:	715	260	580	299	142	81	39	22	21	2159

Average Wind Speed: 2.02 m/s

2001: ANNUAL
WIND SPEEDS AT 10METERS HEIGHT (m/s)

SECTOR	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	>=8	Total
N	532	74	253	178	64	16	2	0	1	1120
NNE	0	35	107	33	2	0	0	0	0	177
NE	1	26	30	6	1	0	1	0	0	65
ENE	0	25	22	3	1	2	0	0	0	53
E	0	54	68	22	5	8	0	0	0	157
ESE	0	113	283	96	38	14	13	5	6	568
SE	0	78	169	142	97	60	41	20	41	648
SSE	0	31	56	74	49	16	4	4	3	237
S	0	20	32	13	8	6	0	0	0	79
SSW	0	18	13	14	3	2	0	0	0	50
SW	0	25	24	13	2	3	0	0	0	67
WSW	0	31	43	18	2	1	1	0	0	96
W	0	25	48	33	25	8	15	3	3	160
WNW	0	31	103	140	167	153	83	53	33	763
NW	0	53	266	443	462	351	232	86	75	1968
NNW	0	53	263	461	346	186	83	34	22	1448
Sub-Total:	533	692	1780	1689	1272	826	475	205	184	7656

Average Wind Speed: 3.53 m/s

2001: FIRST QUARTER
WIND SPEEDS AT 10METERS HEIGHT (m/s)

SECTOR	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	>=8	Total
N	431	19	26	23	5	1	0	0	0	505
NNE	0	7	14	8	1	0	0	0	0	30
NE	1	8	12	2	1	0	0	0	0	24
ENE	0	17	8	3	1	1	0	0	0	30
E	0	27	39	9	2	4	0	0	0	81
ESE	0	48	119	49	18	6	5	3	4	252
SE	0	31	74	69	43	28	15	12	23	295
SSE	0	16	31	32	25	6	3	4	1	118
S	0	9	10	6	6	2	0	0	0	33
SSW	0	5	6	5	3	0	0	0	0	19
SW	0	6	9	3	1	2	0	0	0	21
WSW	0	5	8	3	0	0	0	0	0	16
W	0	10	17	12	12	3	3	0	2	59
WNW	0	11	19	31	49	40	17	14	10	191
NW	0	17	50	64	56	35	31	19	15	287
NNW	0	12	40	28	29	17	4	7	5	142
Sub-Total:	432	248	482	347	252	145	78	59	60	2103

Average Wind Speed: 2.85m/s

2001: SECOND QUARTER
WIND SPEEDS AT 10METERS HEIGHT (m/s)

SECTOR	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	>=8	Total
N	101	18	86	67	16	10	2	0	1	301
NNE	0	7	41	15	1	0	0	0	0	64
NE	0	7	8	2	0	0	0	0	0	17
ENE	0	3	7	0	0	1	0	0	0	11
E	0	5	6	1	0	0	0	0	0	12
ESE	0	13	15	7	2	0	0	0	0	37
SE	0	8	9	9	7	3	2	0	0	38
SSE	0	4	6	10	5	2	0	0	0	27
S	0	0	2	1	0	1	0	0	0	4
SSW	0	1	3	2	0	2	0	0	0	8
SW	0	3	6	3	0	0	0	0	0	12
WSW	0	2	8	6	2	0	1	0	0	19
W	0	0	9	7	6	3	6	3	0	34
WNW	0	3	23	38	46	54	40	25	19	248
NW	0	12	71	117	127	152	113	49	45	686
NNW	0	9	62	141	121	73	27	14	16	463
Sub-Total:	101	95	362	426	333	301	191	91	81	1981

Average Wind Speed: 4.1 m/s

2001: THIRD QUARTER
WIND SPEEDS AT 10METERS HEIGHT (m/s)

SECTOR	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	>=8	Total
N	0	25	109	69	37	5	0	0	0	245
NNE	0	11	40	7	0	0	0	0	0	58
NE	0	5	2	2	0	0	0	0	0	9
ENE	0	2	1	0	0	0	0	0	0	3
E	0	0	1	1	0	0	0	0	0	2
ESE	0	6	7	1	0	1	1	0	0	16
SE	0	2	2	1	1	0	1	0	0	7
SSE	0	0	1	2	1	0	0	0	0	4
S	0	0	1	2	0	0	0	0	0	3
SSW	0	1	1	2	0	0	0	0	0	4
SW	0	1	2	2	0	0	0	0	0	5
WSW	0	7	13	6	0	0	0	0	0	26
W	0	4	10	9	5	1	2	0	0	31
WNW	0	7	39	35	30	27	8	4	0	150
NW	0	14	93	180	203	115	63	13	4	685
NNW	0	19	109	216	166	85	47	11	0	653
Sub-Total:	0	104	431	535	443	234	122	28	4	1901

Average Wind Speed: 3.77 m/s

2001: FOURTH QUARTER
WIND SPEEDS AT 10METERS HEIGHT (m/s)

SECTOR	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	>=8	Total
N	0	12	32	19	6	0	0	0	0	69
NNE	0	10	12	3	0	0	0	0	0	25
NE	0	6	8	0	0	0	1	0	0	15
ENE	0	3	6	0	0	0	0	0	0	9
E	0	22	22	11	3	4	0	0	0	62
ESE	0	46	142	39	18	7	7	2	2	263
SE	0	37	84	63	46	29	23	8	18	308
SSE	0	11	18	30	18	8	1	0	2	88
S	0	11	19	4	2	3	0	0	0	39
SSW	0	11	3	5	0	0	0	0	0	19
SW	0	15	7	5	1	1	0	0	0	29
WSW	0	17	14	3	0	1	0	0	0	35
W	0	11	12	5	2	1	4	0	1	36
WNW	0	10	22	36	42	32	18	10	4	174
NW	0	10	52	82	76	49	25	5	11	310
NNW	0	13	52	76	30	11	5	2	1	190
Sub-Total:	0	245	505	381	244	146	84	27	39	1671

Average Wind Speed: 3.43m/s

2003: ANNUAL
WIND SPEEDS AT 10METERS HEIGHT (m/s)

SECTOR	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	>=8	Total
N	1426	75	251	211	78	19	1	0	0	2061
NNE	0	33	97	42	4	1	0	0	0	177
NE	0	24	37	11	0	0	0	0	0	72
ENE	2	30	31	7	2	1	0	0	0	73
E	1	50	57	14	6	3	1	0	0	132
ESE	0	126	206	86	23	5	1	2	4	453
SE	0	71	146	99	48	34	15	15	10	438
SSE	0	36	66	48	29	14	4	1	3	201
S	0	25	41	17	5	1	2	0	1	92
SSW	0	15	17	12	7	2	5	0	0	58
SW	0	23	30	7	5	2	5	0	0	72
WSW	0	33	44	12	6	1	1	0	0	97
W	0	33	74	47	27	14	9	1	3	208
WNW	0	23	82	168	183	172	115	59	22	824
NW	0	50	256	444	430	344	187	86	33	1830
NNW	0	67	246	491	368	198	76	14	5	1465
Sub-Total:	1429	714	1681	1716	1221	811	422	178	81	8253

Average Wind Speed: 3.05 m/s

2003: FIRST QUARTER
WIND SPEEDS AT 10METERS HEIGHT (m/s)

SECTOR	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	>=8	Total
N	526	16	37	12	4	0	0	0	0	595
NNE	0	12	24	9	0	0	0	0	0	45
NE	0	12	15	3	0	0	0	0	0	30
ENE	1	14	18	3	0	0	0	0	0	36
E	0	21	27	6	2	0	0	0	0	56
ESE	0	51	87	33	5	2	1	1	1	181
SE	0	25	46	27	6	6	1	5	1	117
SSE	0	15	28	16	7	5	3	1	1	76
S	0	9	11	8	1	0	0	0	0	29
SSW	0	9	7	5	1	1	1	0	0	24
SW	0	10	12	2	1	1	0	0	0	26
WSW	0	8	21	0	0	1	0	0	0	30
W	0	15	15	18	7	3	2	1	0	61
WNW	0	7	20	35	46	46	21	20	10	205
NW	0	11	53	76	57	31	26	14	21	289
NNW	0	25	38	38	20	11	4	1	0	137
Sub-Total:	527	260	459	291	157	107	59	43	34	1937

Average Wind Speed: 2.43 m/s

2003: SECOND QUARTER
WIND SPEEDS AT 10METERS HEIGHT (m/s)

SECTOR	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	>=8	Total
N	179	23	73	84	29	10	1	0	0	399
NNE	0	6	38	14	2	0	0	0	0	60
NE	0	2	11	5	0	0	0	0	0	18
ENE	0	6	5	1	1	1	0	0	0	14
E	0	3	8	3	2	1	1	0	0	18
ESE	0	4	20	13	7	0	0	0	0	44
SE	0	10	18	12	11	7	0	3	2	63
SSE	0	3	9	11	10	5	0	0	2	40
S	0	5	12	6	3	1	2	0	1	30
SSW	0	2	2	5	6	1	4	0	0	20
SW	0	4	7	4	4	1	5	0	0	25
WSW	0	6	6	6	4	0	1	0	0	23
W	0	2	17	12	7	6	7	0	3	54
WNW	0	1	15	36	48	59	37	20	9	225
NW	0	11	51	128	148	122	55	36	6	557
NNW	0	11	60	146	114	88	37	7	4	467
Sub-Total:	179	99	352	486	396	302	150	66	27	2057

Average Wind Speed: 3.71 m/s

2003: THIRD QUARTER
WIND SPEEDS AT 10METERS HEIGHT (m/s)

SECTOR	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	>=8	Total
N	131	17	105	101	41	9	0	0	0	404
NNE	0	6	25	12	2	1	0	0	0	46
NE	0	3	6	1	0	0	0	0	0	10
ENE	0	3	0	2	0	0	0	0	0	5
E	0	5	2	0	0	0	0	0	0	7
ESE	0	5	9	3	0	0	0	0	0	17
SE	0	1	1	1	0	0	0	0	0	3
SSE	0	2	1	0	0	0	0	0	0	3
S	0	4	1	0	0	0	0	0	0	5
SSW	0	0	2	0	0	0	0	0	0	2
SW	0	2	6	0	0	0	0	0	0	8
WSW	0	4	7	4	2	0	0	0	0	17
W	0	3	17	8	7	1	0	0	0	36
WNW	0	2	21	53	50	37	29	14	1	207
NW	0	17	84	176	171	145	72	18	3	686
NNW	0	18	89	244	205	86	31	4	1	678
Sub-Total:	131	92	376	605	478	279	132	36	5	2134

Average Wind Speed: 3.65 m/s

2003: FOURTH QUARTER
WIND SPEEDS AT 10METERS HEIGHT (m/s)

SECTOR	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	>=8	Total
N	590	19	36	14	4	0	0	0	0	663
NNE	0	9	10	7	0	0	0	0	0	26
NE	0	7	5	2	0	0	0	0	0	14
ENE	1	7	8	1	1	0	0	0	0	18
E	1	21	20	5	2	2	0	0	0	51
ESE	0	66	90	37	11	3	0	1	3	211
SE	0	35	81	59	31	21	14	7	7	255
SSE	0	16	28	21	12	4	1	0	0	82
S	0	7	17	3	1	0	0	0	0	28
SSW	0	4	6	2	0	0	0	0	0	12
SW	0	7	5	1	0	0	0	0	0	13
WSW	0	15	10	2	0	0	0	0	0	27
W	0	13	25	9	6	4	0	0	0	57
WNW	0	13	26	44	39	30	28	5	2	187
NW	0	11	68	64	54	46	34	18	3	298
NNW	0	13	59	63	29	13	4	2	0	183
Sub-Total:	592	263	494	334	190	123	81	33	15	2125

Average Wind Speed: 2.37 m/s

2004: ANNUAL
WIND SPEEDS AT 10METERS HEIGHT (m/s)

SECTOR	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	>=8	Total
N	1442	57	222	211	81	17	3	1	0	2034
NNE	0	25	83	20	6	1	0	1	0	136
NE	1	23	26	7	1	1	0	0	0	59
ENE	2	28	34	5	0	0	0	0	0	69
E	0	54	78	26	6	0	0	0	0	164
ESE	0	135	239	89	28	8	8	3	5	515
SE	0	97	139	100	70	48	35	22	33	544
SSE	0	52	81	65	41	14	8	5	3	269
S	0	24	25	21	10	5	1	0	0	86
SSW	0	13	19	10	3	1	0	0	1	47
SW	0	19	18	2	1	0	0	0	0	40
WSW	0	29	32	12	4	0	0	0	0	77
W	0	29	48	31	24	8	10	7	2	159
WNW	0	35	102	166	147	154	124	67	39	834
NW	0	51	238	429	440	333	207	111	69	1878
NNW	0	44	262	425	403	199	73	29	10	1445
Sub-Total:	1445	715	1646	1619	1265	789	469	246	162	8356

Average Wind Speed: 3.16 m/s

2004: FIRST QUARTER
WIND SPEEDS AT 10METERS HEIGHT (m/s)

SECTOR	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	>=8	Total
N	492	15	27	15	3	1	0	1	0	554
NNE	0	8	15	2	0	0	0	0	0	25
NE	1	8	7	3	0	0	0	0	0	19
ENE	1	8	14	1	0	0	0	0	0	24
E	0	17	34	14	4	0	0	0	0	69
ESE	0	55	73	42	19	3	4	1	1	198
SE	0	28	56	44	37	25	8	4	15	217
SSE	0	20	32	38	21	6	2	2	1	122
S	0	7	16	12	4	3	1	0	0	43
SSW	0	8	9	3	1	1	0	0	0	22
SW	0	9	4	0	1	0	0	0	0	14
WSW	0	10	13	6	2	0	0	0	0	31
W	0	10	17	11	1	1	1	2	0	43
WNW	0	6	28	43	45	44	26	11	5	208
NW	0	16	51	84	70	55	25	16	3	320
NNW	0	13	45	43	33	20	10	7	1	172
Sub-Total:	494	238	441	361	241	159	77	44	26	2081

Average Wind Speed: 2.67 m/s

2004: SECOND QUARTER
WIND SPEEDS AT 10METERS HEIGHT (m/s)

SECTOR	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	>=8	Total
N	166	11	89	87	37	11	2	0	0	403
NNE	0	10	29	13	2	0	0	0	0	54
NE	0	5	6	0	0	0	0	0	0	11
ENE	0	2	6	2	0	0	0	0	0	10
E	0	5	5	1	0	0	0	0	0	11
ESE	0	5	13	2	1	1	0	0	0	22
SE	0	4	3	8	2	1	2	0	0	20
SSE	0	3	4	7	3	1	0	0	0	18
S	0	0	2	2	2	0	0	0	0	6
SSW	0	0	1	2	1	0	0	0	0	4
SW	0	2	5	2	0	0	0	0	0	9
WSW	0	4	7	3	2	0	0	0	0	16
W	0	3	7	8	16	5	4	2	2	47
WNW	0	0	15	39	39	57	52	38	26	266
NW	0	7	57	115	160	135	101	51	45	671
NNW	0	5	73	141	159	89	40	12	5	524
Sub-Total:	166	66	322	432	424	300	201	103	78	2092

Average Wind Speed: 4.07 m/s

2004: THIRD QUARTER
WIND SPEEDS AT 10METERS HEIGHT (m/s)

SECTOR	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	>=8	Total
N	186	17	92	92	38	4	1	0	0	430
NNE	0	1	25	4	4	1	0	0	0	35
NE	0	2	4	3	0	1	0	0	0	10
ENE	0	1	0	0	0	0	0	0	0	1
E	0	8	3	1	0	0	0	0	0	12
ESE	0	6	15	2	0	0	0	0	0	23
SE	0	4	8	1	0	0	0	0	0	13
SSE	0	2	6	0	0	0	0	0	0	8
S	0	3	1	2	1	0	0	0	0	7
SSW	0	1	2	1	0	0	0	0	0	4
SW	0	0	3	0	0	0	0	0	0	3
WSW	0	4	3	1	0	0	0	0	0	8
W	0	8	9	3	5	1	1	0	0	27
WNW	0	11	26	53	41	38	28	12	7	216
NW	0	15	68	171	160	123	64	29	6	636
NNW	0	15	98	210	197	85	22	5	0	632
Sub-Total:	186	98	363	544	446	253	116	46	13	2065

Average Wind Speed: 3.55 m/s

2004: FOURTH QUARTER
WIND SPEEDS AT 10METERS HEIGHT (m/s)

SECTOR	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	>=8	Total
N	598	14	14	17	3	1	0	0	0	647
NNE	0	6	14	1	0	0	0	1	0	22
NE	0	8	9	1	1	0	0	0	0	19
ENE	1	17	14	2	0	0	0	0	0	34
E	0	24	36	10	2	0	0	0	0	72
ESE	0	69	138	43	8	4	4	2	4	272
SE	0	61	72	47	31	22	25	18	18	294
SSE	0	27	39	20	17	7	6	3	2	121
S	0	14	6	5	3	2	0	0	0	30
SSW	0	4	7	4	1	0	0	0	1	17
SW	0	8	6	0	0	0	0	0	0	14
WSW	0	11	9	2	0	0	0	0	0	22
W	0	8	15	9	2	1	4	3	0	42
WNW	0	18	33	31	22	15	18	6	1	144
NW	0	13	62	59	50	20	17	15	15	251
NNW	0	11	46	31	14	5	1	5	4	117
Sub-Total:	599	313	520	282	154	77	75	53	45	2118

Average Wind Speed: 2.35 m/s

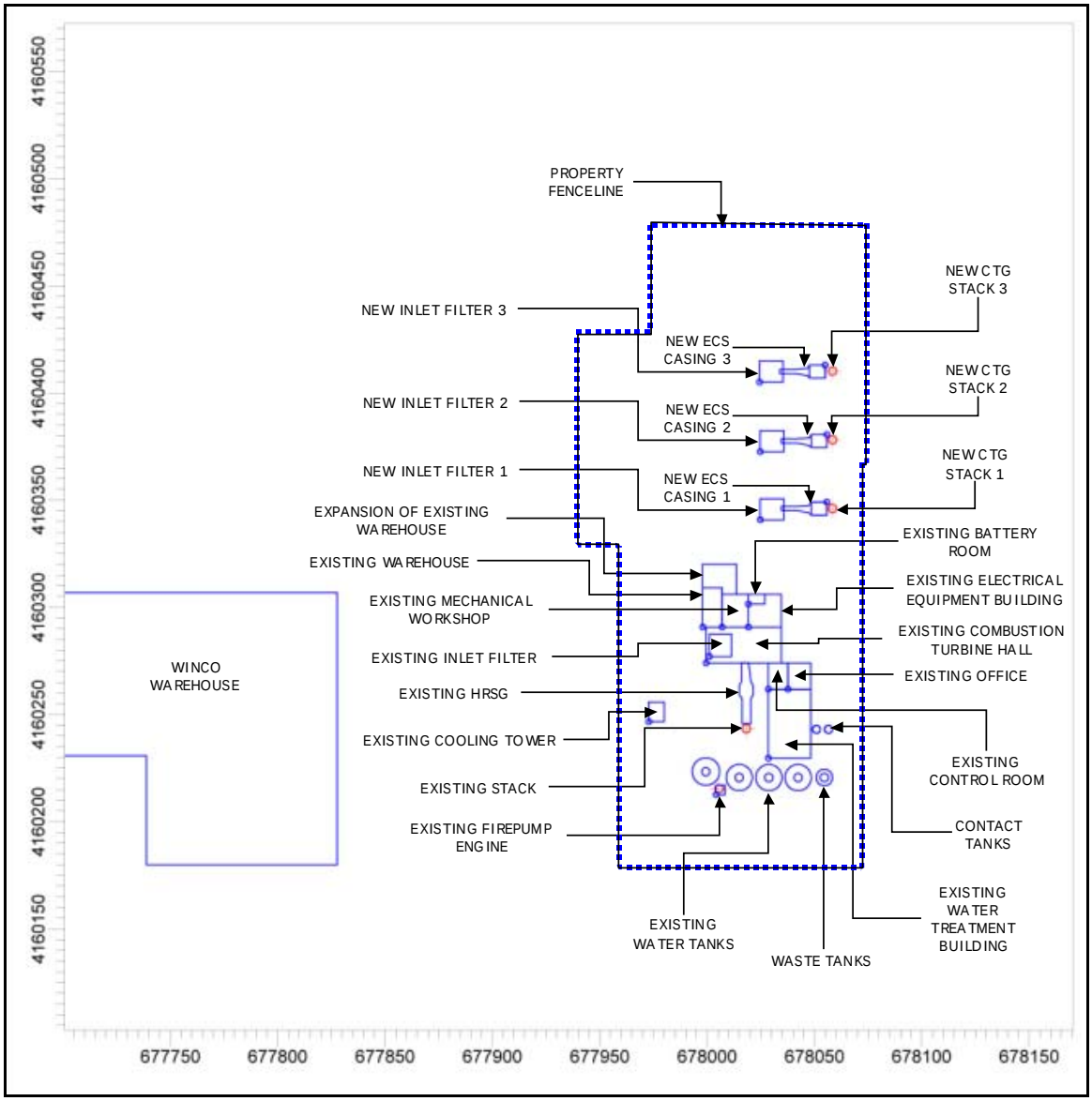


Figure 5.1B-6
Building Layout for the GEP Analysis

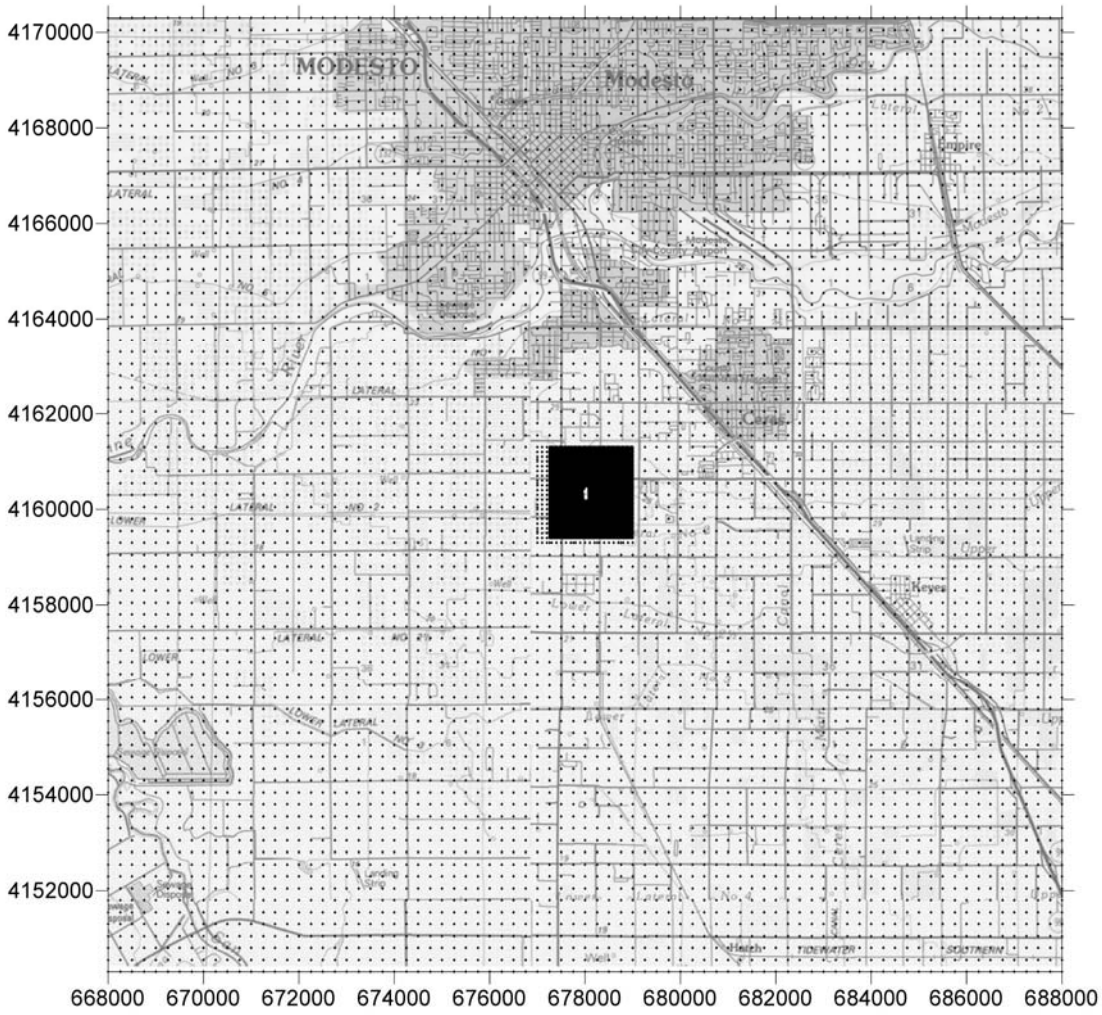


Figure 5.1B-7

Layout of the Receptor Grids

Attachment 5.1B-1
Modeling Protocol

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December 24, 2008

Mr. Leland Villalvazo
Technical Services Division
San Joaquin Valley Air Pollution Control District
1990 E. Gettysburg Avenue
Fresno, CA 93726-0244

Subject: Modeling Protocol for Turlock Irrigation District's Proposed New Almond 2 Power Plant in Ceres

Dear Mr. Villalvazo:

Please find attached the emissions modeling protocol for Turlock Irrigation District's (TID's) proposed Almond 2 Power Plant project to be located in Ceres. TID will be applying to the California Energy Commission for certification, to the San Joaquin Valley Air Pollution Control District for a Determination of Compliance, and, if necessary, to the U.S. Environmental Protection Agency for a Prevention of Significant Deterioration Permit. The project is expected to be subject to District requirements for air quality modeling analyses. Attached for your review and approval is a description of the analytical approach that we propose to use to comply with modeling requirements for the project. We intend to file an application with the District in mid-March 2009 and are requesting approval of the modeling protocol by January 15, 2009.

We would be pleased to meet with you and your staff to discuss this protocol if such a meeting would be useful. We look forward to working with you. If you have any questions about the protocol or any other aspect of the project, please do not hesitate to call Nancy Matthews or me. Thank you for your attention in this matter.

Sincerely,

Gabriel C. McAuliffe

for Jeffrey D. Adkins
Senior Partner

cc: Eric Knight, CEC
Randy Baysinger, TID
Susan Strachan
Scott Galati, Galati-Blek LLP

sierra research

Air Dispersion Modeling and Health Risk Assessment Protocol Turlock Irrigation District Almond 2 Power Plant Ceres, California

prepared for:

Turlock Irrigation District

December 2008

prepared by:

Sierra Research, Inc.
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Air Dispersion Modeling and Health Risk Assessment Protocol
Turlock Irrigation District Almond 2 Power Plant
Ceres, California

prepared for:

Turlock Irrigation District

December 2008

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Air Dispersion Modeling and Health Risk Assessment Protocol
Turlock Irrigation District Almond 2 Power Plant
Ceres, California

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1. INTRODUCTION

Turlock Irrigation District (TID) intends to submit an Application for Certification (AFC) to the California Energy Commission (CEC) and an Application for a Determination of Compliance to the San Joaquin Valley Air Pollution Control District (District) for a new simple-cycle power plant adjacent to TID's existing Almond Power Plant in Ceres, California. If necessary, TID will also submit an application to the U.S. Environmental Protection Agency (USEPA) for a federal Prevention of Significant Deterioration (PSD) Permit.[1] The proposed project will consist of three simple-cycle LM6000 PG Sprint combustion turbines (or equivalent), rated at 174 MW (nominal net, at site design conditions). Because the LM6000 PG Sprint model may use water-cooled generators, a small wet cooling tower will also be part of the project.

The location of the proposed project is shown in Figure 1.

Certification by the CEC will be required because the project will generate more than 50 MW of electric power. The project will be classified as a major modification under District New Source Review regulations (Rule 2201) because emissions of reactive organic compounds (ROC) and nitrogen oxides (NOx) are each expected to exceed 25 tons per year, and carbon monoxide (CO) emissions may exceed 100 tons per year.

The project may also be subject to federal PSD requirements (40 CFR 52.21). The existing Almond power plant is not a "major stationary source" because potential emissions of each attainment pollutant are below the 100 ton per year major source threshold. The emission increases from the proposed Almond 2 project are expected to be below the 250 ton per year major source threshold that is applicable to facilities of this type.[2] PSD applicability will be addressed in the application documents. If the project is subject to PSD review, a separate PSD application will be submitted to USEPA Region 9.

The applications that will be submitted to the District and the CEC (and, potentially, the USEPA) will include air quality impact analyses. Air dispersion modeling for these analyses will address criteria pollutants and toxic air contaminants (TACs) as required by District Regulation 2201; CEC requirements[3] for evaluation of project air quality and

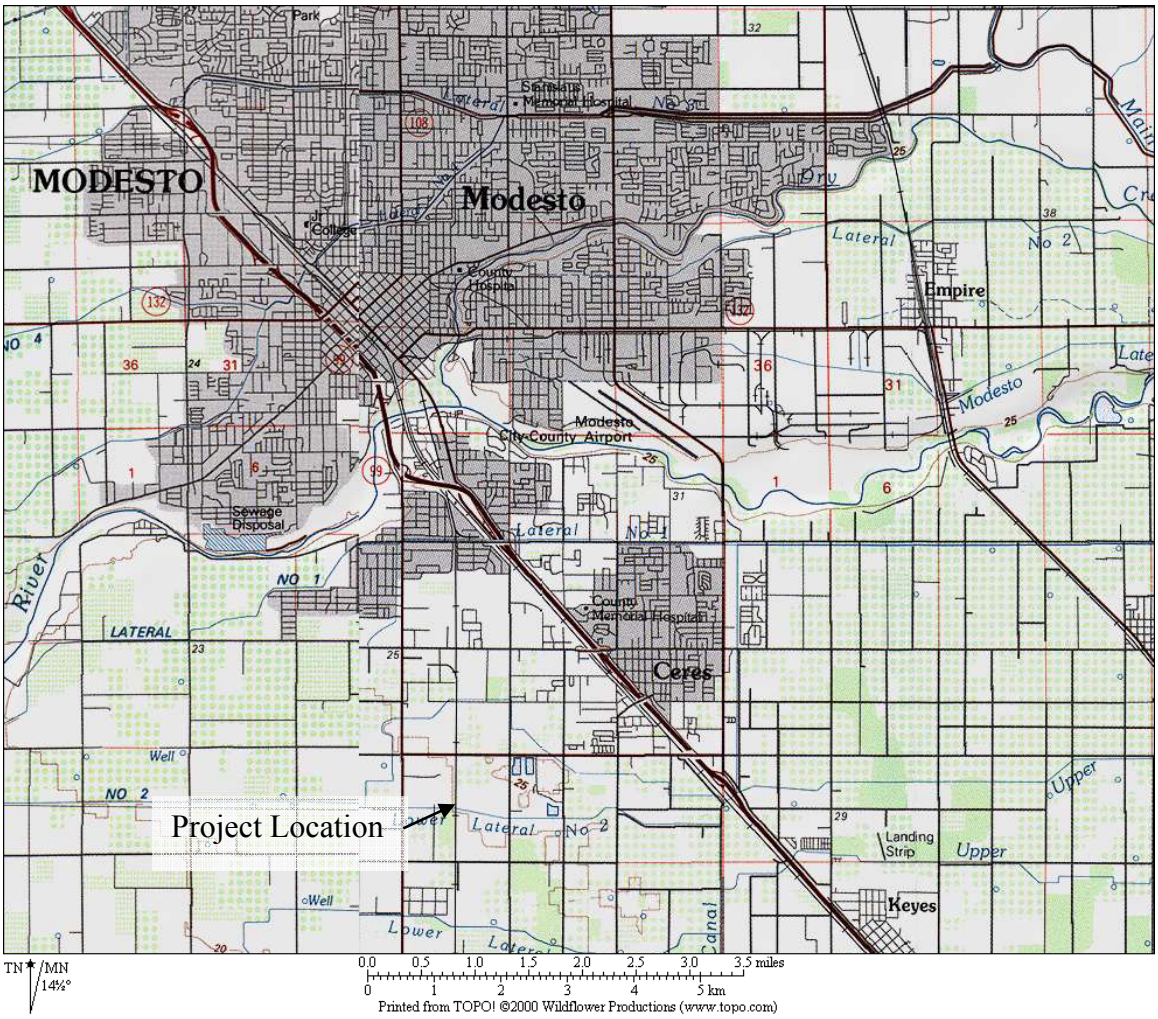
---

[1] It has not yet been determined whether the proposed project will require a PSD permit.

[2] Because the simple cycle turbines will not generate electricity using steam, they are not fossil fuel-fired steam electric plants and therefore are not subject to the 100 tpy major stationary source threshold in 40 CFR 52.21(b)(1)(i)(a).

[3] Summarized in CEC Data Adequacy Worksheets, revised March 28, 2007, and available at *http://www.energy.ca.gov/sitingcases/documents/index.html*.

Figure 1
Location of the Proposed Almond 2 Power Plant



public health impacts; and, if necessary, applicable USEPA requirements for PSD permits. The purpose of this document is to present the procedures for meeting District and CEC air quality modeling requirements for the proposed project.

This revised protocol describes the modeling procedures that will be used, which follow modeling guidance provided by the USEPA in its "*Guideline on Air Quality Models*" (USEPA 2005, including supplements), the National Park Service's "*Permit Application Guidance for New Air Pollution Sources*" (Bunyak, 1993), the "*Federal Land Managers' Air Quality Related Values Workgroup (FLAG) Phase I Report*" (U.S. Forest Service et al, December 2000), "*Interagency Workgroup on Air Quality Modeling (IWAQM) Phase II Recommendations*" (USEPA, 1998), and the District *Guidance for Air Dispersion Modeling, Rev 2.0* (January 2007).

Impacts from operation of the facility will be compared to the criteria shown in Table 1.

Table 1 **Air Quality Impact Analyses**					
Air Quality Criteria	VOC [a]	NO_2	$PM_{10}/PM_{2.5}$ [e]	CO	SO_2
PSD Significant Impact Levels [b]	NA[d]	√	√	√	√
PSD Monitoring Exemption Levels [b]	NA	√	√	NA	√
Ambient Air Quality Standards (AAQS)	NA	√	√	√	√
Class I and Class II Visibility [c]	NA	√	√	NA	√
Impacts to Soils and Vegetation [b,c]	NA	√	√	NA	NA
Class I Area Acid Deposition [c]	NA	√	√	NA	√

Notes:
a. VOC emissions are used as a surrogate for ozone impacts in the PSD review process; no ozone modeling will be performed.
b. For pollutants subject to PSD review.
c. If required; see Section 3.14.
d. NA: Not applicable.
e. USEPA guidance (71 FR 6727) provides that compliance with the $PM_{2.5}$ National Ambient Air Quality Standards (NAAQS) should be evaluated using the PM_{10} NAAQS and not modeled directly.

2. FACILITY DESCRIPTION AND SOURCE INFORMATION

The Almond 2 power plant will be located adjacent to the existing TID Almond power plant, which is located on Crows Landing Road in Ceres. Figure 2 shows the project site and its immediate surroundings, including the nearby cities of Modesto and Ceres and their neighboring communities.

TID is proposing to construct a simple-cycle power plant adjacent to the existing combustion turbine power plant. The project may include a small cooling tower. To provide maximum operational flexibility and system reliability, TID will model annual impacts based on 8760 hours of operation.

The new emitting units will utilize Best Available Control Technology (BACT) to minimize emissions of NOx, CO, VOC, and toxic air contaminants (TACs). All combustion devices in the power train will be fueled with California Public Utilities Commission (PUC)-quality natural gas to minimize emissions of SO_2 and PM_{10}.

Figure 2
Aerial View of the Immediate Vicinity
Around the Proposed Almond 2 Power Plant

3. DISPERSION MODEL PROCEDURES

3.1 AERMOD Modeling

The following USEPA air dispersion models are proposed for use to quantify pollutant impacts on the surrounding environment based on the emission sources' operating parameters and their locations:

- American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee (AERMIC) model, also known as AERMOD (Version 07026);
- Building Profile Input Program – Plume Rise Model Enhancements (BPIP-PRIME, Version 04274); and
- SCREEN3 (Version 96043).

The main air dispersion modeling will be conducted with AERMOD Version 07026. The air quality modeling analysis will follow the January 2008 USEPA AERMOD Implementation Guide, USEPA's "Guideline on Air Quality Models," and the District's "Guidance for Air Dispersion Modeling." USEPA default options will be used.

AERMOD can account for building downwash effects on dispersing plumes. Stack locations and heights and building locations and dimensions will be input to BPIP-PRIME. The first part of BPIP-PRIME determines and reports on whether a stack is being subjected to wake effects from a structure or structures. The second part calculates direction-specific building dimensions for each structure, which are used by AERMOD to evaluate wake effects. The BPIP-PRIME output is formatted for use in AERMOD input files.

Simple, Complex, and Intermediate Terrain Impacts – The AERMOD air dispersion model[4] to be used for simple, complex, and intermediate terrain is a steady-state, multiple-source, Gaussian dispersion model designed for use with stack emission sources situated in terrain where ground elevations can exceed the stack heights of the emission sources (i.e., complex terrain). The AERMOD model requires hourly meteorological data consisting of wind direction and speed (with reference height), temperature (with reference height), Monin-Obukhov length, surface roughness length, heights of the

[4] AERMOD has been adopted as a guideline model by USEPA as a replacement for ISCST3. AERMOD incorporates an improved downwash algorithm as compared to ISCST3 (Federal Register, November 9, 2005; Volume 70, Number 216, Pages 68218-68261).

mechanically and convectively generated boundary layers, surface friction velocity, convective velocity scale, and vertical potential temperature gradient in the 500-meter layer above the planetary boundary layer. AERMOD is considered a steady-state model because it assumes that there is no variability in meteorological parameters over a one-hour time period.

Standard AERMOD control parameters will be used, including stack tip downwash, non-screening mode, non-flat terrain, and sequential meteorological data check. The stack-tip downwash algorithm will be used to adjust the effective stack height downward following the methods of Briggs (1972) for cases where the stack exit velocity is less than 1.5 times the wind speed at stack top. The rural default option will be used by not invoking the URBANOPT option.

The District has prepared meteorological data sets applicable to most locations in the District and has processed them, using AERMET (Version 06341), into the format required by AERMOD. Four years of meteorological data (2000, 2001, 2003, and 2004) collected at Modesto will be used.[5] The surface characteristics appropriate to the land uses surrounding the meteorological station at Modesto (surface roughness length, albedo, and Bowen Ratio) were developed by the District for the met station site following the guidance published by USEPA in September 2005. Although this earlier guidance has been updated by USEPA with the development of AERSURFACE (Version 08009) software (released on January 9, 2008), the District staff believes that surface characteristics developed using AERSURFACE are not appropriate for use in the San Joaquin Valley. AERSURFACE obtains land use data from 1992 U.S. Geological Survey National Land Cover Data. Because of the large amount of development in the valley since 1992, the District staff believes that the land use data used by AERSURFACE are outdated. The District staff has indicated that the USEPA staff has agreed that the older guidance can continue to be used for projects in the San Joaquin Valley.[6]

If more detailed evaluation of impacts at receptors in terrain above stack-top height is required, the screening version of the USEPA guideline Complex Terrain Dispersion Model PLUS (CTDMPLUS), Complex Terrain Screening Model (CTSCREEN), would be used. The CTSCREEN model and the conditions under which CTSCREEN would be used are discussed in more detail in Appendix A. However, because there is no terrain above stack-top height within 10 miles of the plant site, it is very unlikely that this more refined analysis will be needed.

3.2 Ambient Ratio Method and Ozone Limiting Method

Annual NO_2 concentrations will be calculated using the Ambient Ratio Method (ARM), adopted in Supplement C to the Guideline on Air Quality Models (USEPA, 1995). The

[5] The representativeness of meteorological data collected at Modesto for the project site is discussed in more detail in Section 3.5.
[6] Villalvazo, Leland, personal communication with Eric Walther of Sierra Research, April 23, 2008.

Guideline allows a nationwide default of 75% for the conversion of nitric oxide (NO) to NO_2 on an annual basis and the calculation of NO_2/NOx ratios.

If NO_2 concentrations need to be examined in more detail, the Plume Volume Molar Ratio Method (PVMRM) adaptation of the Ozone Limiting Method (Cole and Summerhays, 1979) will be used. AERMOD PVMRM calculates the NO_2 concentration using hourly ozone data. Hourly ozone data collected at the 14th Street monitoring station in Modesto during the years 2000–2004 will be used in conjunction with PVMRM to calculate hourly NO_2 concentrations from hourly NOx concentrations. Missing hourly ozone data in these ozone data sets have been filled in by the District.

The PVMRM involves an initial comparison of the estimated maximum NOx concentration and the ambient O_3 concentration left in the plume after reaction of NO with O_3 to determine which is the limiting factor to NO_2 formation. If the remaining O_3 concentration is greater than the maximum NOx concentration, total conversion is assumed. If the NOx concentration is greater than the remaining O_3 concentration, the formation of NO_2 is limited by the remaining ambient O_3 concentration. In this case, the NO_2 concentration is set equal to the O_3 concentration plus a correction factor that accounts for in-stack and near-stack thermal conversion.

3.3 Fumigation Modeling

The SCREEN3 model will be used to evaluate inversion breakup fumigation impacts for short-term averaging periods (24 hours or less), as appropriate. The methodology in USEPA 1992b (Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised) will be followed for these analyses. Combined impacts for all sources under fumigation conditions will be evaluated, based on USEPA modeling guidelines.

3.4 Health Risk Modeling

A health risk assessment (HRA) will be performed according to the Office of Environmental Health Hazard Analysis "Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments" (August 2003) and the District's permitting guidance (January 2007). For the CEC AFC, a complete HRA will be performed. The HRA modeling will be prepared using the California Air Resources Board's (CARB's) Hotspots Analysis and Reporting Program (HARP) computer program (Version 1.4a, July 24, 2008) and AERMOD with the CARB "onramp."[7] HARP will be used to assess cancer risk as well as non-cancer chronic and acute health hazards. Because the TACs emitted by the project include polycyclic aromatic hydrocarbons (PAHs), the HRA will address not only the inhalation pathway, but also the following three pathways: dermal absorption, and soil and mother's milk ingestion. As requested by the

[7] HARP has not yet been revised to utilize AERMOD, but the CARB "onramp" software that allows HARP to incorporate AERMOD output files was recently converted from beta testing to initial release. Therefore, HARP is now compatible with AERMOD.

SJVAPCD staff for a similar project, the HRA will also address the home-grown vegetable pathway, and will utilize the derived (OEHHA) method for both residential and worker exposures.[8]

3.5 Meteorological Data

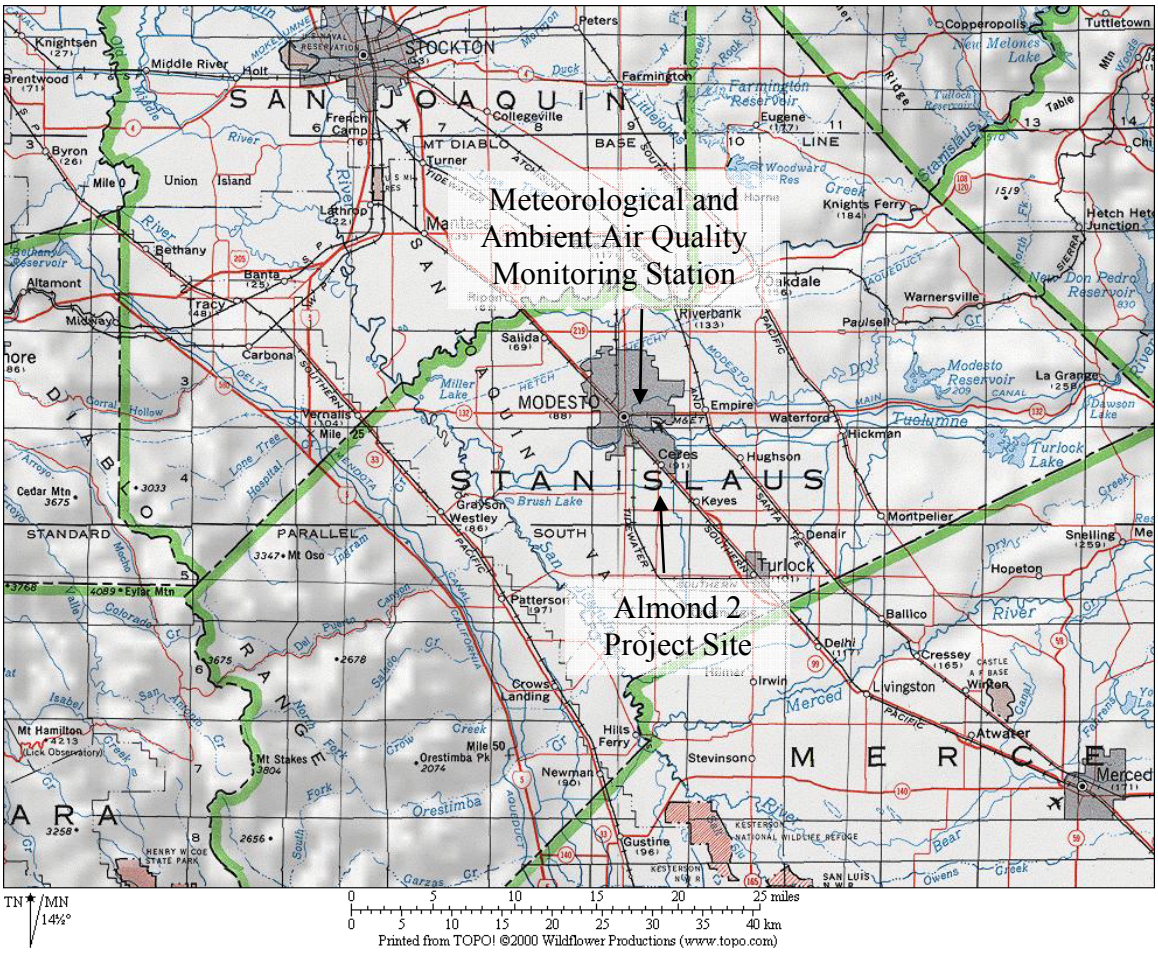
Hourly surface meteorological data (e.g., hourly wind speed and direction, temperature) for Modesto during the period 2000–2004 (excluding 2002) have been obtained from the District's modeling website.[9] The Modesto monitoring station is located approximately 5 miles north of the project site. Upper air data from the Oakland International Airport monitoring station located approximately 68 miles west of both the project site and the surface data station were used by the District in creating the model-ready data set.

USEPA requires the use of meteorological data that would be representative of atmospheric dispersion conditions at the source and at locations where the source may have a significant impact on air quality. Specifically, the meteorological data requirement originates in the Clean Air Act at Section 165(e)(1), which requires an analysis "of the ambient air quality at the proposed site and in areas which may be affected by emissions from such facility for each pollutant subject to regulation under [the Act] which will be emitted from such facility."

This requirement and USEPA's guidance on the use of on-site monitoring data are also outlined in the "*On-Site Meteorological Program Guidance for Regulatory Modeling Applications*" (1987b). The representativeness of the data depends on (a) the proximity of the meteorological monitoring site to the area under consideration, (b) the complexity of the topography of the area, (c) the exposure of the meteorological sensors, and (d) the period of time during which the data are collected. The District staff has determined that the Modesto meteorological data set is representative of conditions in the north-central portion of San Joaquin County.[10] This area includes the project site. The SJVAB consists of a continuous intermountain valley approximately 250 miles long and averaging 80 miles wide. On the western edge of the Valley is the Coast Mountain range, with peaks reaching over 5,000 feet, and on the east side is the Sierra Nevada range with some peaks exceeding 14,000 feet. The Tehachapi Mountains form the southern boundary of the Valley. Terrain is open only at the northern end of the valley. Both the project site and the monitoring site are located near the northern end of the San Joaquin Valley, in the broad, flat center of the valley (see Figure 3). There are no nearby large terrain features, such as hills or mountain ranges, to affect local wind flow patterns. Prevailing winds in the northern end of the valley are from the west through northwest on

[8] Personal communication from Cheryl Lawler, SJVAPCD, to Nancy Matthews, Sierra Research, dated June 5, 2008.
[9] http://www.valleyair.org/busind/pto/Tox_Resources/AirQualityMonitoring.htm
[10] SJVAPCD, "Guidance for Dispersion Modeling," Working Draft, Rev 2.0, January 2007, p. 49. Available at http://www.valleyair.org/busind/pto/Tox_Resources/Modeling%20Guidance%20W_O%20Pic.pdf

Figure 3
Topography of Project and Monitoring Station Areas



an annual basis, although there is a strong southeasterly component during the fall and winter months (see Appendix B for wind roses). Both the project site and the monitoring site are affected by the marine air that generally flows into the basin from the San Joaquin River Delta to the north. These factors support the District's conclusion that the wind direction and wind speed data collected at the Modesto meteorological monitoring stations are similar to the dispersion conditions at the project site and to the regional area. Thus, the Modesto meteorological data set satisfies the definition of representative data.

Representativeness has also been defined in the "*Workshop on the Representativeness of Meteorological Observations*" (Nappo et. al., 1982) as "the extent to which a set of measurements taken in a space-time domain reflects the actual conditions in the same or different space-time domain taken on a scale appropriate for a specific application." Representativeness is best evaluated when sites are climatologically similar, as are the project site and the Modesto meteorological monitoring station. Representativeness has additionally been defined in the PSD Monitoring Guideline (USEPA, 1987a) as data that characterize the air quality for the general area in which the proposed project would be constructed and operated. As discussed above, because of the relative proximity of the Modesto meteorological data site to the proposed project site, the same large-scale topographic features that influence the meteorological data monitoring station also influence the proposed project site in the same manner.

3.6 Receptor Grids

Receptor and source base elevations will be determined from USGS Digital Elevation Model (DEM) data using the 7½-minute format (10- to 30-meter spacing between grid nodes). All coordinates will be referenced to UTM North American Datum 1927 (NAD27), Zone 10. The AERMOD receptor elevations will be interpolated among the DEM nodes according to standard AERMAP procedure. For determining concentrations in elevated terrain, the AERMAP terrain preprocessor receptor-output (ROU) file option will be chosen. Hills will not be imported into AERMOD for CTDM-like processing.

Cartesian coordinate receptor grids will be used to provide adequate spatial coverage surrounding the project area for assessing ground-level pollution concentrations, to identify the extent of significant impacts, and to identify maximum impact locations. A 250-meter resolution coarse receptor grid will be developed and will extend outwards at least 10 km (or more as necessary to calculate the significant impact area).

In addition, a nested grid will be developed to efficiently identify the maximum impact area(s). This nested grid will have the following resolutions:

- 25-meter resolution along the facility fence line in a single tier of receptors composed of four segments extending out to 100 meters from the fence line;
- 100-meter resolution from 100 meters to 1,000 meters from the fence line; and
- 250-meter resolution from 1 km out to at least 10 km from the site.

When maximum impacts occur in the 100- or 250-meter spaced areas, an additional refined receptor grid with 25-meter resolution will be placed around each maximum coarse grid impact and extended out to a distance of two coarse grid spacings from the coarse grid maxima in all directions from that point of impact. Concentrations within the facility fence line will not be calculated.

The following 7.5-minute USGS Digital Elevation Model (DEM) quadrangles in California will be employed for modeling the project:

- Crows Landing;
- Hatch;
- Brush Lake;
- Ceres; and
- Patterson.

If more distant impacts are encountered in the AERMOD results, other quadrangles that may be needed include the following (listed from approximately nearest to farthest):

- Newman;
- Gustine;
- Westley;
- Turlock; and
- Denair.

3.7 Modeling Scenarios

The majority of the pollutant emissions to the atmosphere from the proposed project will occur from combustion of natural gas in the combustion turbines, with a small amount of additional particulate matter from cooling tower drift. The expected emission rates from all sources will be based on vendor data and additional conservative assumptions of equipment performance. Turbine emissions and stack parameters, such as flow rate and exit temperature, will exhibit some variation with ambient temperature. To calculate the maximum air quality impacts, a screening analysis will be performed to evaluate each operating scenario (e.g., minimum load and full-load operation at a range of ambient temperatures) on a pollutant-specific basis. Each of these operating conditions has unique performance characteristics that affect plume dispersion and thus predicted impacts. This screening analysis is most relevant to analyses for short-term impacts. The temperatures used for the short-term screening analysis (i.e., design cold ambient, annual average, and design hot ambient) will be selected to closely reflect the range of possible site conditions. The results of this screening analysis will be used to select the operational scenarios that produce the maximum ambient impacts in refined modeling.

Details of Operating Scenarios

Maximum emissions during normal operation would occur during periods of maximum fuel consumption, which would occur during full load, cold ambient temperature operation. Besides normal operation, three other operating modes will occur: commissioning (one initial period), startup, and shutdown. Table 2 gives more detail on all four operating modes.

Table 2
Operating Modes of the Combustion Gas Turbine

Mode	Description
Commissioning	The process of fine-tuning the turbines and associated emission control systems. The facility will follow a systematic approach to optimize performance of the turbines and the associated control equipment. NOx and CO emissions are expected to be greater during commissioning than during normal operation. This one-time mode affects only the initial year of operation.
Start-up	Startup NOx and CO emissions are higher because the combustors are not fully optimized, and catalyst systems have not reached optimal temperatures.
Normal Operation	Normal operation begins after the turbine and the control equipment are working optimally at their design conditions. Emissions may vary between the design hot, annual average, and design cold ambient conditions.
Shutdown	Shutdown occurs at the initiation of the turbine shutdown sequence and ends with the cessation of turbine firing. Typically, the shutdown process will emit less than the start-up process, and thus impacts in this mode will be represented by the analysis of start-up emissions.

3.8 Ambient Air Quality Data

The Modesto 14th Street station, located 5 miles north of the project site, is the closest standardized ambient monitoring station. For air quality data, the closest District-, state-, or federal-operated stations are used to provide the representative background ambient levels for the project site during 2005–2007. These representative background levels are shown in Table 3. Figure 3 shows the monitoring station locations.

Table 3 Background Concentrations, 2005-2007 (µg/m^3)[a] (maximum values shown in bold)				
Pollutant	Averaging Time	Years		
Modesto 14th Street		2003	2004	2005
NO_2	1-Hour (1st high) Annual	**171** **32**	122 28	135 26
		2005	2006	2007
CO	1-Hour 8-Hour (CA. 1st high)	4,625 3,211	**8,625** **4,144**	4,625 3,511
PM_{10}	24-Hour (CA. 1st high) Annual (CA)	97 29.7	**102** 31.9	87 **37.7**
$PM_{2.5}$	24-Hour (3-Year Avg 98th Percentile) Annual Arith. Mean (CA) Nat'l 3-Year Avg AAM [b]	55 14.5 13.9	52 15.9 14.8	**57.4** **16.0** **15.0**
Bethel Island		2005	2006	2007
SO_2	1-Hour 3-Hour 24-Hour (1st high) Annual	44 26 16 **5**	44 29 **18** **5**	**47** **34** 13 **5**

Notes:
[a] No NO_2 data at Modesto for 2006-2007.
[b] Annual arithmetic mean

For NO_2, SO_2, PM_{10}, annual average $PM_{2.5}$ and CO, the highest values monitored during the most recent available three-year period (shown in bold in Table 3) will be used to represent ambient background concentrations in the project area. For CEQA analyses of $PM_{2.5}$ 24-hour impacts, the three-year average of the 98th percentile 24-hour monitored levels for the period between 2005 and 2007 will be used to represent project background because this value corresponds to the method used for determining compliance with the federal 24-hour $PM_{2.5}$ standard.

3.9 Class I Area Impact Analysis and Class II PSD Significance Thresholds

In general, projects located within 100 km of Class I areas are required to evaluate impacts to visibility and other air quality-related values at those Class I areas as part of a PSD permit evaluation. The nearest Class I areas and their distances from the project are listed below.

- Yosemite National Park 98 km
- Emigrant Wilderness 104 km
- Pinnacles Wilderness 117 km
- Mokelumne Wilderness 123 km
- Desolation Wilderness 154 km
- Point Reyes National Seashore 165 km

Most of these areas are more than 100 km from the project site, so visibility and AQRV analyses would be required only for Yosemite National Park if the project is subject to PSD review. However, since the Emigrant Wilderness is only slightly more than 100 km away, an assessment might also be requested for that area. The Federal Land Managers (FLMs) have developed a screening methodology for determining whether a proposed project is likely to have a significant impact on a Class I area when located within, or near to, the 100 km threshold. Under this procedure, the estimated sum of maximum NOx, SOx, and PM_{10} emissions (in tons per year) from the project is divided by the distance of each Class I areas from the project (in km) (National Park Service, 2007). Because this quotient is expected to be substantially less than the FLM threshold level of 10, it is expected that even if the project is subject to PSD review it will not be required by the FLMs to evaluate impacts to visibility and other air quality related values at Class I areas.

The maximum ground-level concentrations of PSD pollutants are not expected to exceed the Class II PSD significance thresholds, and therefore analysis of PSD Class II increment consumption is not expected to be required. If PSD Class II increment consumption needs to be analyzed, then a separate protocol will be prepared for USEPA.

3.10 Ambient Air Quality Impact Analyses

In evaluating the impacts of the proposed project on ambient air quality, the modeled ambient impacts of the project will be added to the background concentrations presented in Section 3.8, and the sum will compared to state and federal ambient air quality standards for SO_2, NO_2, PM_{10}, $PM_{2.5}$, and CO, in accordance with the procedures described below. Impacts from all of the operating scenarios described in Section 3.7 (refined modeling of normal operations, startup/shutdown and commissioning) will be evaluated in this manner. The refined modeling for each pollutant and averaging period will also include emissions from the cooling tower.

Refined modeling of these maximum-impact scenarios will be based on four years (2000–2004, excluding 2002) of meteorological data and will identify the general locations of maximum impacts on the coarse grid of receptors, around which fine grids will be used to identify the locations of maximum impacts within 25 meters.

Because short-term federal standards are set at levels that are not to be exceeded more than once per year, compliance with these short-term standards is based on the highest

second-high modeled concentrations rather than the highest concentrations.[11] However, state standards are set at levels that are not to be exceeded, so compliance with state standards is demonstrated using the highest modeled concentrations. Therefore, in accordance with USEPA guidelines,[12] the highest second-highest modeled concentrations will be used to demonstrate compliance with the short-term federal standards and the highest modeled concentration will be used to demonstrate compliance with the federal annual and all state standards.

Modeled project impacts will also be compared with the PSD significance thresholds (if applicable) shown in Table 4 below to evaluate whether the impacts would be considered significant based on these criteria.

Table 4
Significance Levels for Air Quality Impacts in Class II Areas[a] ($\mu g/m^3$)

Pollutant	Averaging Period				
	Annual	24-hour	8-hour	3-hour	1-hour
SO_2	1.0	5	--	25	--
PM_{10}	1.0	5	--	--	--
NOx	1.0	--	--	--	--
CO	--	--	500	--	2000

a. From 40 CFR 51.165.

The impact of the proposed new equipment will be modeled using the maximum allowable emission limits as proposed in the application and the design capacities of the turbines, assuming continuous operation, in accordance with the guidance in Table 8-2 of Appendix W. If the predicted total ground-level concentration obtained by adding the maximum impact of the proposed new equipment to the monitored background concentrations is below the state or federal ambient air quality standard for each pollutant and averaging period, compliance with the applicable standard has been demonstrated and no further analysis is required for that pollutant and averaging period.

3.10.1.1 Refined Analysis for 1-hour Average NO_2

In the event that the conservative approach of adding maximum modeled project concentration to maximum monitored background concentration shows that a particular mode of project operation could cause a violation of any ambient air quality standard, a more refined analysis may be required. This would only be undertaken if project

[11] "a. For new or modified sources predicted to have a significant ambient impact and to be located in areas designated attainment or unclassifiable for the SO_2, Pb, NO_2, or CO NAAQS, the demonstration as to whether the source will cause or contribute to an air quality violation should be based on: The highest estimated annual average concentration determined from annual averages of individual years; or (2) the highest, second-highest estimated concentration for averaging times of 24-hours or less."
[12] 40 CFR Part 51, Appendix W, Sections 10.2.3.2 and 10.2.3.3.

engineering solutions, including alternative plant layouts or equipment operating restrictions (such as limitations on testing of emergency equipment) were not successful in eliminating the potential violations. If a more refined analysis of potential 1-hour NO_2 impacts is needed, then the following procedure would be used to combine background concentrations of 1-hour average NO_2 concentrations during the period 2000 through 2004 (contemporaneous with meteorological data) with modeled impact concentrations. A set (between 10 and 50) of the highest 1-hour NO_2 impacts would be examined for their year, Julian date, and hour of day occurrence. For each 1-hour impact value, the corresponding (i.e., same year, Julian date, and hour of day) background concentration of 1-hour NO_2 would be added to the modeled concentration to determine the overall impact and compared with the California 1-hour NO_2 ambient air quality standard of 338 $\mu g/m^3$.

3.11 Health Risk Assessment

A health risk assessment (HRA) will be performed according to the Office of Environmental Health Hazard Analysis "Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments" (August 2003). The HRA modeling will be prepared using CARB's Hotspots Analysis and Reporting Program (HARP) computer program (Version 1.4a, July 24, 2008). The HARP model will be used to assess cancer risk as well as non-cancer chronic and acute health hazards. Because the TACs emitted by the project include PAHs, the HRA will address not only the inhalation pathway, but also the following four pathways: dermal absorption, and soil, home-grown vegetable, and mother's milk ingestion.

The HARP model incorporates the ISCST3 model previously approved by USEPA. CARB offers a software program that allows AERMOD data to be imported into the HARP model, called HARP On-Ramp. The on-ramp will be used with most recent versions of AERMOD and HARP for the screening risk assessment.

3.12 Construction Air Quality Impact Analysis

The potential ambient impacts from air pollutant emissions during the construction of the project will be evaluated by air quality modeling that will account for the construction site location and the surrounding topography; the sources of emissions during construction, including vehicle and equipment exhaust emissions; and fugitive dust.

Types of Emission Sources − Construction of the project can be viewed as three main sequential phases: site preparation; construction of foundations; and installation and assembly of the project turbines and associated equipment. The construction impacts analysis will include a schedule for construction operation activities. Site preparation includes site excavation, excavation of footings and foundations, and backfilling operations.

Fugitive dust emissions from the construction of the project result from the following activities:

- Excavation and grading at the construction site;
- Onsite travel on paved and unpaved roads and across the unpaved construction site;
- Aggregate and soil loading and unloading operations;
- Raw material transfer to and from material stockpiles; and
- Wind erosion of areas disturbed during construction activities.

Engine exhaust will be emitted from the following sources:

- Heavy equipment used for excavation, grading, and construction of onsite structures;
- Water trucks used to control construction dust emissions;
- Diesel-fueled welding machines, gasoline-powered generators, air compressors, and water pumps;
- Gasoline-fueled pickup trucks and Diesel-fueled flatbed trucks used onsite to transport workers and materials around the construction site;
- Transport of mechanical and electrical equipment to the project site;
- Transport of rubble and debris from the site to an appropriate landfill; and
- Transport of raw materials to and from stockpiles.

Emissions from a peak activity day will be modeled. Annual average emissions over the construction period will also be calculated and modeled for comparison with annual standards.

Existing Ambient Levels – The background data discussed earlier will be used to represent existing ambient levels for the construction analysis as well as the analysis of the impacts of project operations.

Model Type − AERMOD will be used to estimate ambient impacts from construction emissions. The modeling options and meteorological data described above will be used for the modeling analysis.

The construction site will be represented as both a set of volume sources and a separate set of area sources in the modeling analysis. Emissions will be divided into three categories: exhaust emissions, mechanically generated fugitive dust emissions, and wind-blown fugitive dust emissions. Exhaust emissions and mechanically generated fugitive dust emissions (e.g., dust from wheels of a scraper) will be modeled as volume sources with a height of 6 meters. Wind-blown fugitive dust emissions, sources at or near the ground that are at ambient temperature and have negligible vertical velocity, will be modeled as area sources with a release height of 0.5 meters.

For the construction modeling analysis, the receptor grid will begin at the property boundary and will extend approximately one kilometer in all directions. Receptor

spacing will be 60 meters, except for one tier of receptors along the project boundary composed of four segments with 25-meter spacing that extends out 100 meters.

3.13 Cumulative Air Quality Impact Analysis

To address CEC requirements, a cumulative air quality modeling impacts analysis will be performed of the project's typical operating mode in combination with other stationary source emissions sources within a six-mile radius that have received construction permits since January 1, 2008, or are in the permitting process. For each criteria pollutant, facilities having an emission increase of less than five tons per year are generally considered to be *de minimis*, and these facilities may be excluded from the cumulative impacts analysis after consultation with the CEC staff. The District will be requested to provide information on any sources that might be appropriate for a cumulative air quality impact analysis, as defined above.

Upon receipt of sufficient information from the District to allow air dispersion modeling of the non-project sources to be included in the cumulative air quality impact analysis, AERMOD will be used in a procedure similar to that described earlier in this protocol.

3.14 Visibility Analysis

Although visibility is not normally impacted by natural gas-fueled power plants, potential visibility impacts will be analyzed, if required. The two aspects of visibility impact that may be analyzed are potential plume blight and generation of regional haze, both of which were originally intended to be conducted with respect to Class I areas where visibility is an important air quality related value.

Potential plume blight, the ability to see a discrete plume against either a sky or terrain background, would be analyzed in the approximate distance range of 10 km out to 50 km by using the model VISCREEN. The VISCREEN model was designed to be used as a conservative screening tool to determine if an emission source might create a plume visible to an observer positioned at the source side of a specified Class I area, both when looking into, and when looking outside, the Class I area. Because the closest Class I area to the project is 98 km away, use of VISCREEN would not be appropriate at the Class I areas surrounding the proposed project.

VISCREEN would also be inappropriate to use close to the source (e.g., less than 10 km) because the model was designed to evaluate the potential creation of plume blight in relatively clean air at substantial distances from the emission source. If the model was used at such a close distance as 10 km, it would mean that an observer, looking at the proposed power plant with the plume heading straight towards the observation point, must "see" the plume just as the observer can see the power plant stack itself at such close distances.

If modeling of the plume position, plume blight, or regional haze is needed over a wider range of distances, including close to the source (i.e., less than 10 km) and distances beyond 50 km, then CALPUFF would be the appropriate model. CALPUFF is a multi-layer, multi-species non-steady-state puff dispersion modeling system that simulates the effects of time- and space-varying meteorological conditions on pollutant transport, transformation, and removal. The CALPUFF modeling system is one of the two USEPA preferred/recommended air dispersion models (USEPA, 2007) (AERMOD is the other). CALPUFF can be used on scales from tens of meters from a source to hundreds of kilometers. CALPUFF is the only preferred model available for evaluating the effects of chemical transformation on directly emitted pollutants. Such transformations, especially those that produce nitrate, sulfate, and organic particulates from NOx, SOx, and VOC emissions, respectively, are important to the evaluation of potential visibility impacts.

The use of CALPUFF in its complete version requires assembly of a complex wind field data file from multiple meteorological monitoring stations into a special format (i.e., MM5). If CALPUFF modeling is required for federal purposes, a separate protocol will be prepared for that analysis.

4. REPORTING

The results of the criteria pollutant and TAC modeling will be integrated into the application documents, and will include the following information:

- Project Description – This section of the CEC Application for Certification (AFC) will include a site map and site plan along with descriptions of the emitting equipment and air pollution control systems.

- Model Options and Input – The Air Quality section of the AFC will present model options, screening and refined source parameters, criteria pollutant and TAC emission rates, meteorological data, and receptor grids used for the modeling analyses.

- Air Dispersion Modeling – The Air Quality section and appendices will include the following information:

  - Plot plan showing emission points, nearby buildings (including dimensions), cross-section lines, property lines, fence lines, roads, and UTM coordinates;
  - A table showing building heights used in the modeling analysis;
  - Summaries of maximum modeled impacts for each air quality scenario showing meteorological conditions and receptor location and elevation; and
  - Model input and output files, including BPIP-PRIME and meteorological files, in electronic format on a compact disc, together with a description (README file) of all filenames.

- HRA – The HRA will be contained in the Public Health section and appendix of the AFC, and will include the following:

  - Descriptions of the methodology and inputs to the construction and operation AERMOD runs;
  - Tables of TAC emission rates, sensitive receptor locations, and health impacts; and
  - Model input and output files in electronic format on a compact disc, together with a description (README file) of all filenames.

5. REFERENCES

Briggs, G.A. (1972). *Discussion on Chimney Plumes in Neutral and Stable Surroundings*. Atmos. Environ. 6:507-510.

Bunyak, John (1993). *Permit Application Guidance for New Air Pollution Sources*. Natural Resources Report NPS/NRAQD/NRR-93/09, U.S. Dept. of the Interior, National Park Service.

Cole, Henry S. and John E. Summerhays (1979). *A review of techniques available for estimating short-term NO2 concentrations*, Journal of the Air Pollution Control Association, Volume 29, Number 8, pages 812-817, August 1979.

Nappo, C. J. et al. (1982). *The Workshop on the Representativeness of Meteorological Observations*, June 1981, Boulder, Co. Bull. Amer. Meteor. Soc., Vol. 63, No. 7, pp. 761-764. American Meteorological Society, Boston, MA.

National Park Service (2007). Personal communication from Dee Morse, Air Resources Division, to Sierra Research, November 9, 2007.

Office of Environmental Health Hazard Analysis (2003). *Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments*, August 2003.

U.S. Forest Service Air Quality Program, National Park Service Air Resource Division, U.S. Fish and Wildlife Service - Air Quality Branch (2000). *Federal Land Managers' Air Quality Related Values Workgroup (FLAG) Phase I Report.* December 2000.

USEPA (1985). *Guideline for Determination of Good Engineering Practice Stack Height* (Technical Support Document for the Stack Height Regulations) - Revised. EPA-450/4-80-023R.

USEPA (1987a). *Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD)*, Office of Air Quality Planning and Standards, Research Triangle Park, NC, EPA-450/4-87-007, May 1987.

USEPA (1987b). *On-Site Meteorological Program Guidance for Regulatory Modeling Applications*.

USEPA (1990). *New Source Review Workshop Manual − Draft*. Office of Air Quality Planning and Standards, Research Triangle Park, NC.

USEPA (1992a). *Procedures for Substituting Values for Missing NWS Meteorological Data for Use in Regulatory Air Quality Models*. Dennis Atkinson and Russell F. Lee, Office of Air Quality Planning and Standards, Research Triangle Park, NC. July 7, 1992.

USEPA (1992b). *Screening Procedures for Estimating the Air Quality Impact of Stationary Sources*, Revised, Report 454/R-92-019.

USEPA (1995). *Supplement C to the Guideline on Air Quality Models (revised).* Office of Air Quality Planning and Standards, Research Triangle Park, NC.

USEPA (1998). *Interagency Workgroup on Air Quality Modeling (IWAQM) Phase 2 Summary Report and Recommendations for Modeling Long-Range Transport Impacts*. Air Quality Modeling Group (MD-14), Research Triangle Park. National Park Service - Air Resource Division, Denver, Colorado. USDA Forest Service - Air Quality Program, Fort Collins, Colorado. U.S. Fish and Wildlife Service Air Quality Branch, Denver, Colorado.

USEPA (2000). *Meteorological Monitoring Guidance for Regulatory Modeling Applications*. Publication No. EPA-454/R-99-005. Office of Air Quality Planning & Standards, Research Triangle Park, NC. (PB 2001-103606) (Available at *www.epa.gov/scram001/*)

USEPA (2005). 40 CFR Part 51, Appendix W. *Guideline on Air Quality Models*. Last update November 9, 2005.

USEPA (2007). Technology Transfer Network, Support Center for Regulatory Atmospheric Modeling, Air Quality Models, Dispersion Modeling, Preferred/Recommended Models, http://www.epa.gov/scram001/dispersion_prefrec.htm#calpuff, accessed May 19, 2007.

Appendix A

Information on CTSCREEN Model

The CTDMPLUS and CTSCREEN Models

Complex terrain impacts may need to be modeled with more accuracy than that provided by AERMOD. The use of more refined modeling techniques is specifically addressed in USEPA's Appendix W[13] modeling guidance, as follows:

> *Since AERMOD treats dispersion in complex terrain, we have merged sections 4 and 5 of appendix W, as proposed in the April 2000 NPR [Notice of Proposed Rulemaking]. And while AERMOD produces acceptable regulatory design concentrations in complex terrain, it does not replace CTDMPLUS for detailed or receptor-oriented complex terrain analysis, as we have made clear in Guideline section 4.2.2. CTDMPLUS remains available for use in complex terrain. [p. 68225]*
>
> *4.2.2 Refined Analytical Techniques*
> *d. If the modeling application involves a well defined hill or ridge and a detailed dispersion analysis of the spatial pattern of plume impacts is of interest, CTDMPLUS, listed in Appendix A, is available. CTDMPLUS provides greater resolution of concentrations about the contour of the hill feature than does AERMOD through a different plume-terrain interaction algorithm. [p. 68233]*

CTSCREEN is the same basic model as CTDMPLUS, except that meteorological data are handled internally in a simplified manner. As discussed in the CTSCREEN users guide,[14]

> *Since [CTDMPLUS] accounts for the three-dimensional nature of plume and terrain interaction, it requires detailed terrain and meteorological data that are representative of the modeling domain. Although the terrain data may be readily obtained from topographic maps and digitized for use in the CTDMPLUS, the required meteorological data may not be as readily available.*
>
> *Since the meteorological input requirements of the CTDMPLUS can limit its application, the EPA's Complex-Terrain-Modeling, Technology-Transfer Workgroup developed a methodology to use the advanced techniques of CTDMPLUS in situations where on-site meteorological measurements are limited or unavailable. This approach uses CTDMPLUS in a "screening" mode--actual*

[13] 40 CFR 51 Subpart W, as amended November 9, 2005 at 70 FR 68218, "Revision to the Guideline on Air Quality Models: Adoption of a Preferred General Purpose (Flat and Complex Terrain) Dispersion Model and Other Revisions."
[14] USEPA, EPA-600/8-90-087, "User's Guide to CTDMPLUS: Volume 2. The Screening Mode (CTSCREEN)," October 1990.

source and terrain characteristics are modeled with an extensive array of predetermined meteorological conditions.

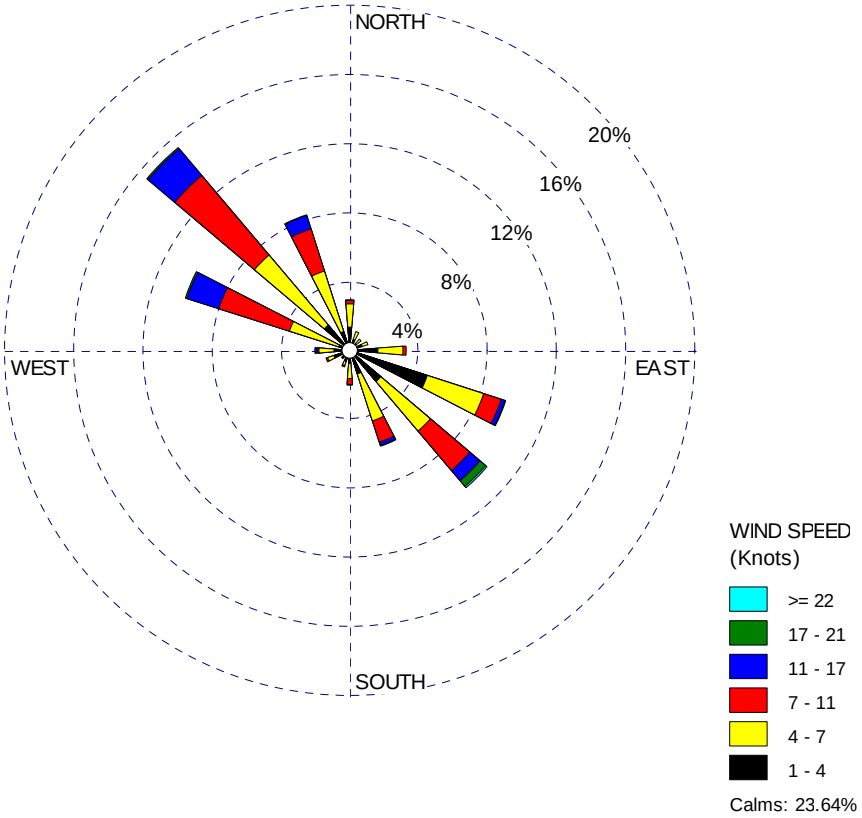
This CTDMPLUS screening mode (CTSCREEN) serves several purposes in regulatory applications. When meteorological data are unavailable, CTSCREEN can be used to obtain conservative (safely above those of refined models), yet realistic, impact estimates for particular sources.

Therefore, the use of the CTSCREEN version of CTDMPLUS is consistent with USEPA guidance.

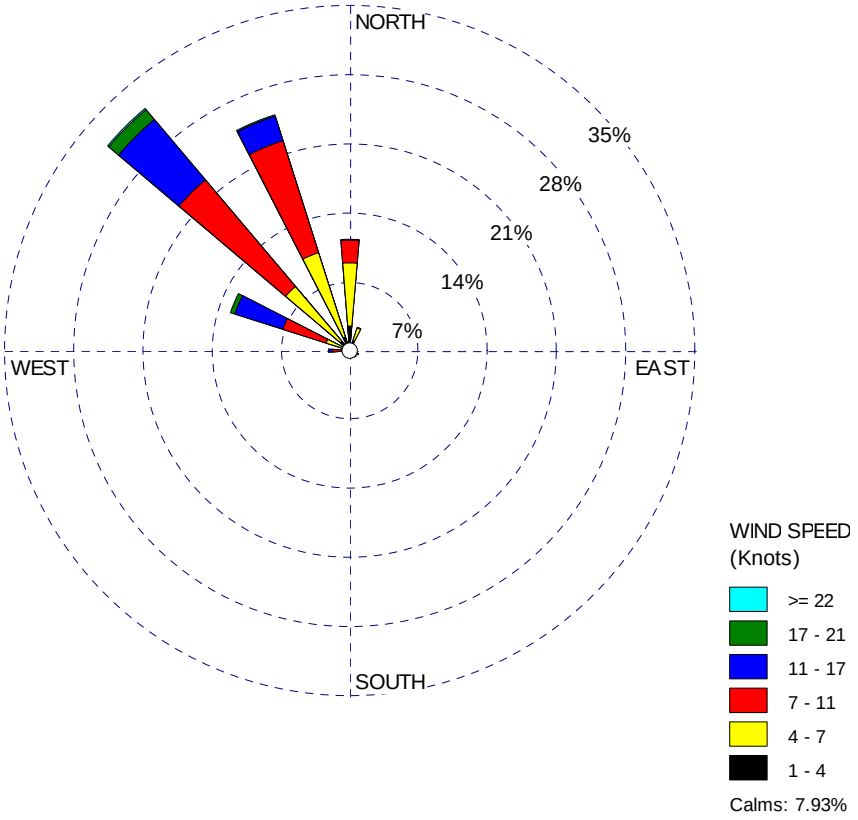
Appendix B

Quarterly and Annual Wind Roses for Modesto

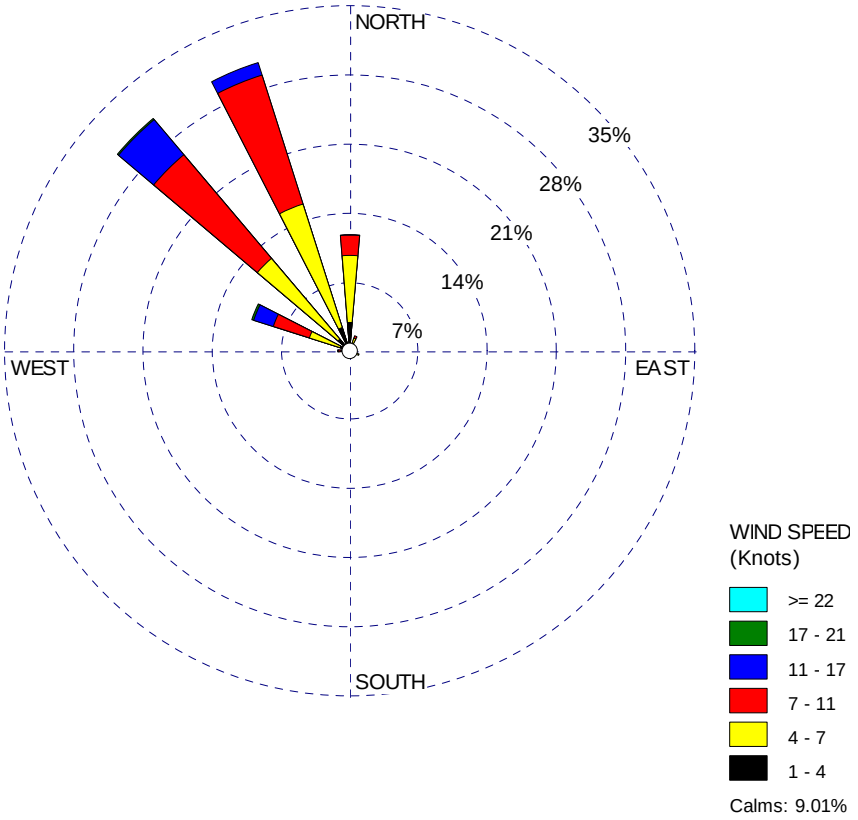
First Quarter 2004, Modesto, CA



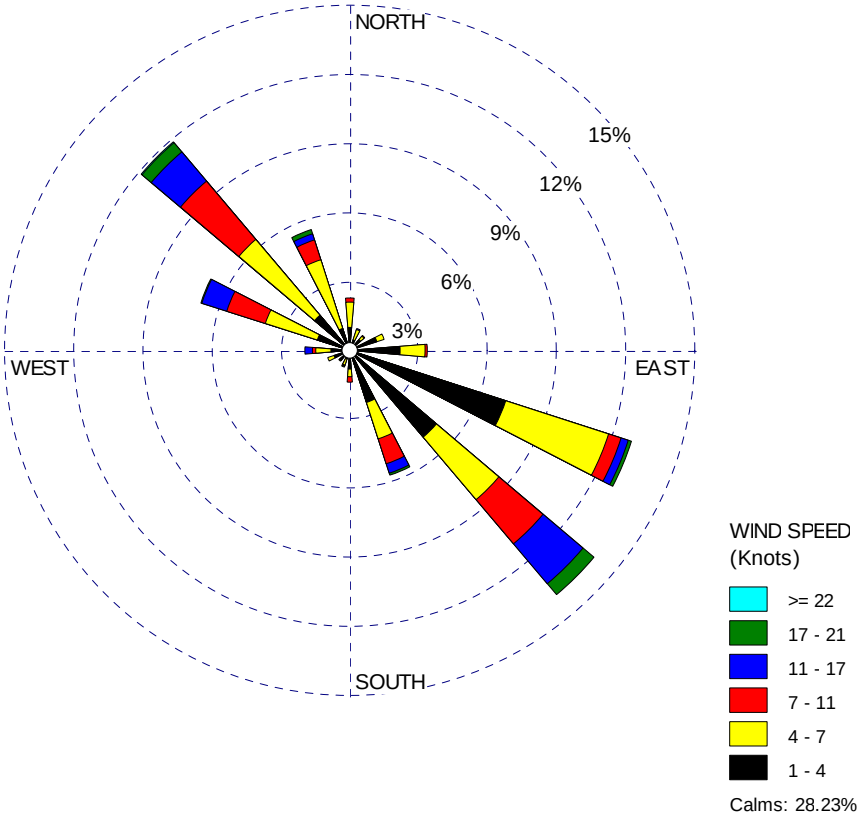
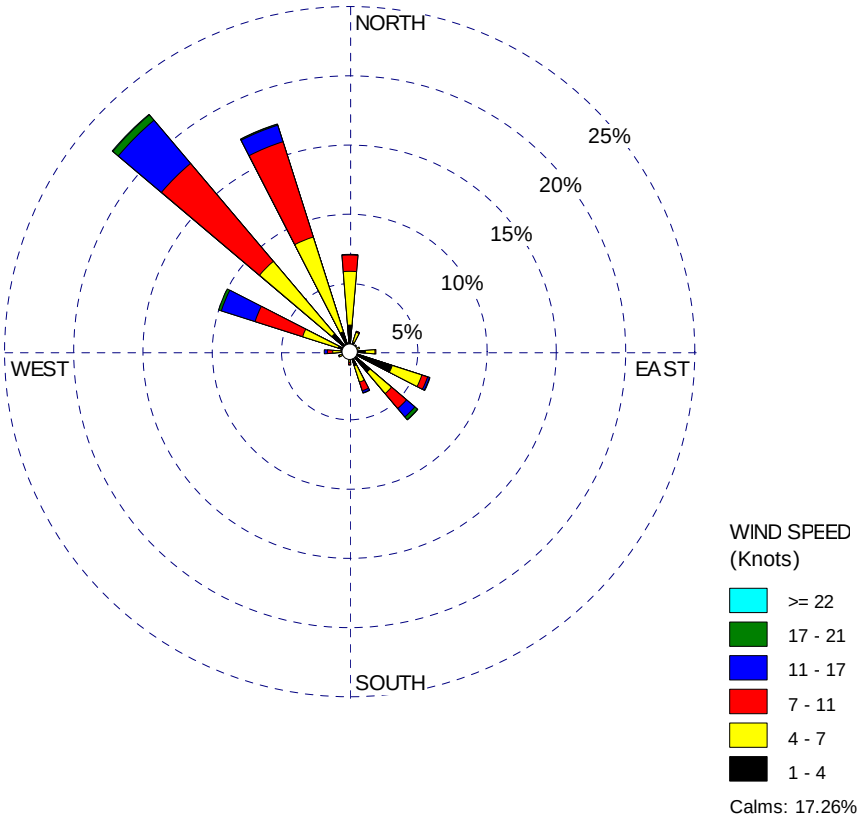
Second Quarter 2004, Modesto, CA



Third Quarter 2004, Modesto, CA



Fourth Quarter 2004, Modesto, CA



Annual 2004, Modesto, CA