Appendix A. Demonstration of Attainment of the PM_{10} NAAQS

- Candis Claiborn, January 3, 2002. PM_{10} Saturation Study in Wallula, WA. Washington State University, Pullman.

- Washington State Department of Ecology, Air Quality Program, March 2002. Analysis of 2002 Wallula Saturation Study.

- Washington State Department of Ecology, Air Quality Program, January 5, 2004. Evaluation of Two Candidate Sites for Replacement of the Wallula PM_{10} Monitoring Site.

- U. S. Environmental Protection Agency, Region 10, November 4, 2004. Letter from Mahbubul Islam, Manager, State and Tribal Programs Unit, to Mike Ragan, Ecology, re: Approval of the Burbank PM_{10} Monitoring Site as the Representative Monitor for the Wallula PM_{10} Nonattainment Area.

PM_{10} Saturation Study in Wallula, WA

Final Report to

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Objective

In response to growing concerns over particulate air pollution in Wallula, WA, and a potential re-classification by the US EPA of the airshed to "serious non-attainment" for the PM_{10} National Ambient Air Quality Standard, a short-term, "saturation" study was conducted in the summer of 2001. The objective of the study was to examine the spatial variability of PM_{10} concentrations throughout the Wallula nonattainment airshed. This report summarizes the findings from that study.

Methods

Researchers from Washington State University deployed low-volume PM_{10} samplers at 6 sites pre-selected by WDOE personnel. A seventh sampler was co-located at one site, for a precision measurement. Particulate sampling was conducted so that it was coordinated with the 1-in-3 day monitoring schedule currently being followed by the WDOE. The dates on which samples were taken are listed below in Table 1.

Table 1: Dates of Sampling for Wallula PM_{10} Saturation Study

Month	Sample Dates For Saturation Study
July, 2001	July 15, 18, 21, 24, 27, 30
August, 2001	August 2, 5, 8, 11, 14, 17, 20, 23, 26, 29
September, 2001	September 1, 4, 7, 10, 13, 16, 19

A map of the area is shown in Figure 1, along with the locations of the 6 sampling sites. A 7^{th} site across the river was initially identified, but it was agreed that this site would not be used, due to the extra time involved in servicing the site. These sites are listed below, as first identified by WDOE personnel, and then in parentheses as referred to in the remainder of this report:

1) Burbank Fire Station (Fire Station) (sampler 1602)
2) U.S. 12 and Nansum Road (Hanson Loop) (sampler 1607)
3) U.S. 12 & Dodd Road (Lundgren Orchard) (sampler 1606)
4) Wallula PM_{10} Monitor (Pulp Mill) (samplers 1608 and 1609)
5) Wallula Fire Station (Wallula) (sampler 1611)
6) Truck Inspection Station, Wallula Junction (Truck Stop) (sampler 1599)

Airmetrics low-volume samplers were used in this study. The samplers were provided to WSU by the WDOE for the duration of the study. The Airmetrics sampler operates at 5 lpm, and is battery operated. Samplers were installed on telephone poles by means of mounting brackets, at sampler height of 2 meters.

Pre-weighed Teflon filters in closed petrie dishes were supplied by WDOE. After exposure, the filters were returned to WDOE to be re-weighed. Afterward, the filters were returned to WSU for archival.

On each field visit date, charged batteries and sample inlets already loaded with the weighed filters and accompanying sample data sheets were taken to the field. Along with the 7 sampler inlets, an additional 8th inlet was also loaded with a filter, to serve as a trip blank. The sampler flow rate was checked by momentarily turning on the pump and noting the rotometer reading. The time totalizer reading was recorded, along with any other relevant information. The timer was then reprogrammed for the next sample start and stop times. Sampler batteries and inlets were changed. The previous inlet, with the sample filter, was placed in a new ziplock bag for transport back to the lab, where the filter would be removed to the proper petrie dish.

Flow rate checks were performed at the beginning and end of the study, as well as during an audit visit. The flow rates were calculated from calibration curves, and flows were reported in standard lpm. The calibration curves for each sampler are given in the appendix.

Results

Sampling was conducted on 23 days during the period of July 15 through September 19, 2001. For the first two sample dates (July 15 and 18), all samplers were operated for only 12 hours. Appendix 1 summarizes the filter weights as provided by WDOE. A summary of the concentrations from each site is given in Appendix 2.

Quality control checks included trip blanks and co-located sampling. Figure 2 shows the trip blanks. Trip blank values are missing for 7/15, 8/23, 8/27, 9/16, and 9/19. The net filter weights from the trip blanks were converted to equivalent concentrations, assuming 24 hour operation at 5 Lpm, with the exception of the trip blank for 7/18. Since the filters were exposed for only 12 hours on that date, 12-hour operation at 5 sLpm was assumed for 7/18, resulting in a much higher equivalent trip blank concentration. The average trip blank equivalent concentration was 2.5 ± 1.2 $\mu g/m^3$, and the range was 0.6 to 5.1 $\mu g/m^3$.

Figure 3 shows the concentration data for the precision pair, located at the Wallula monitoring station, across from the Boise-Cascade pulp mill (Pulp Mill site). Two data points have been removed from this plot, because of contaminated filters (these are discussed below).

Figure 4 shows all of the concentrations from all samplers, by date. There are three data points that are very high, compared to the rest of the data. All three of the high concentrations (above 200 $\mu g/m^3$) can be explained. The first two, occurring on 7/27/01 and 8/02/01, were from sampler number 1609, one of the two co-located samplers at the Pulp Mill site. The 7/27/01 filter, number 1273524, was visibly contaminated with what appeared to be droplets of oil or grease or other liquid. The 8/2/01 filter, number 1293507, also had visible contaminants – either dirt or bug parts. In general, a number of problems with insects and spiders in the samplers were noted in the data sheets for this study. Comments in the 7/24/01 data sheet for this site indicated that bugs were observed in the monitors. Spider webs in the rain cap of sampler 1608, at this site, were also noted

in the data sheets for 8/17/01 and 8/20/01. The impaction plates were cleaned and greased at the beginning of the study, and records indicate they were also done before the 8/23/01 sampling date. That particular cleaning was prompted by visual observation of spider webs in the samplers, especially at the Pulp Mill site. No comment is noted in the data sheets indicating cleaning and re-greasing before 7/27.

The third date with a very high concentration at one location is 8/17/01, sampler number 1599. This sampler was located at the Truck Stop. The data sheet for the next sampling day (8/20) indicated that there had been a burn on the hillside that had come very close to the filter, so we suspect that this was a true concentration, explained by smoke from the nearby fire. This was the second fire that occurred during this study near this sampler – the first fire occurred before the 7/30/01 filter was deployed. Comments on the 7/30 data sheet indicated that the fire evidently passed within 200 yards of the pole. The 7/30/01 sample gave a concentration similar to those from the other sites so presumably the fire either did not occur on the date that the sampler ran, or the wind carried the smoke away from the sampler on that date.

Removing the two contaminated samples from the data, and including the trip blanks, the data are replotted in Figure 5. The average, minimum and maximum concentrations of all 7 samplers are plotted by date in Figure 6. The average standard deviation among the samplers, excluding 8/17/01, is 7.2 $\mu g/m^3$ (with 8/16/01 included, the average standard deviation among the samplers is 9.9 $\mu g/m^3$). 95% of the samples were below 52 $\mu g/m^3$. Table 2, below, below summarizes the statistics for the entire data set, including the high value from 8/17/01, but not including the high values from 7/27/01 and 8/2/01 that were attributed to contamination.

Table 2: Summary of Statistics For PM_{10} Concentrations Measured During Wallula PM_{10} Saturation Study, Summery 2001

Statistics (n = 157)	Values
Average ± Standard Deviation	27.6 ± 18.8 $\mu g/m^3$
Range	6.0 – 211.7 $\mu g/m^3$
25 percentile	18.2 $\mu g/m^3$
50 percentile	24.1 $\mu g/m^3$
75 percentile	31.6 $\mu g/m^3$
95 percentile	51.9 $\mu g/m^3$

The concentrations measured at the various sites were, for the most part, fairly well correlated, with the exception of the measurements taken at the Truck Stop (sampler #1599). When the 8/17 sample from the Truck Stop (fire day) is removed from the analysis, the correlations are much better (Table 3).

Table 3: Correlation Coefficients Between the Samplers, Wallula Saturation Study

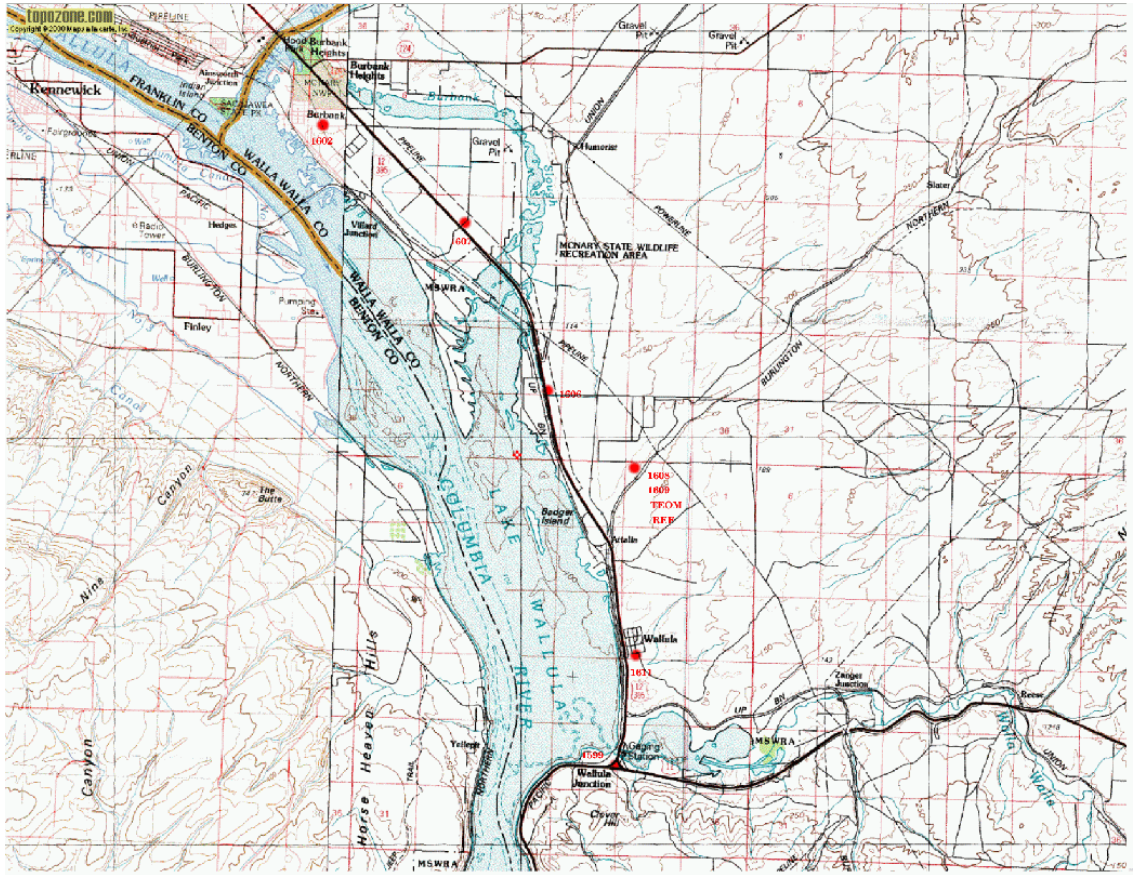
Sampler	1599 w/ 8/17	1599 w/o 8/17	1602	1606	1607	1608	1609	1611
1599	1.00	1.00						
1602	0.27	0.78	1.00					
1606	-0.07	0.45	0.50	1.00				
1607	0.14	0.50	0.77	0.66	1.00			
1608	0.14	0.42	0.51	0.54	0.61	1.00		
1609	0.17	0.45	0.76	0.69	0.71	0.61	1.00	
1611	0.11	0.42	0.72	0.66	0.87	0.42	0.71	1.00

Conclusions

During the period of July 15 to September 19, 2001, a PM_{10} saturation study was conducted in Wallula, WA. Seven low-volume PM_{10} samplers were deployed at six locations throughout the Wallula PM_{10} non-attainment area. The samplers were operated on a one-in-three day schedule to coincide with the existing WDOE PM_{10} monitoring site at Wallula. In all, 23 days of samples were collected.

When two samples are removed from further analysis based upon contamination of the filters (visually observable), the PM_{10} concentrations ranged from 6.0 $\mu g/m^3$ to over 200 $\mu g/m^3$. The high value of 211.7 $\mu g/m^3$ occurred most likely as a result of a brush fire (8/17) that came very close to the sampler. The average of all of the samples for the saturation study was 27.6 $\mu g/m^3$, and 95% of the samplers were below 52 $\mu g/m^3$. Spatially, it appears that the samples were reasonably well inter-correlated, especially when the 8/17 sample was removed from the analysis.

Figure 1. Map of the Area with the Locations of the 6 Sampling Sites



Appendix 1: Summary of Pre-Exposed and Exposed Filter Weights, and Net Weights, Wallula PM10 Saturation Study, Summer, 2001

Sample ID	Tare Weight	Gross Weight	Net Weight
1273500	144.027	144.054	0.027
1273501	143.018	143.208	0.190
1273502	143.423	143.548	0.125
1273503	138.552	138.563	0.011
1273504	143.131	143.139	0.008
1273505	141.591	141.753	0.162
1273506	143.55	143.729	0.179
1273507	140.422	140.626	0.204
1273508	142.475	142.689	0.214
1273509	141.759	141.897	0.138
1273510	143.886	143.957	0.071
1273511	142.215	142.271	0.056
1273512	140.222	140.34	0.118
1273513	142.054	142.153	0.099
1273514	141.864	141.927	0.063
1273515	141.399	141.472	0.073
1273516	142.855	142.93	0.075
1273517	145.088	145.149	0.061
1273518	142.829	142.894	0.065
1273519	142.241	142.447	0.206
1273520	142.375	142.525	0.150
1273521	141.839	142.01	0.171
1273522	144.83	145.033	0.203
1273523	140.871	141.069	0.198
1273524	139.615	142.192	2.577
1273525	143.931	144.177	0.246
1273526	143.825	143.921	0.096
1273527	138.714	138.828	0.114
1273528	137.676	137.84	0.164
1273529	150.942	151.084	0.142
1273530	149.694	149.864	0.170
1273531	140.937	140.966	0.029
1273532	138.359	138.459	0.100
1273533	139.057	139.192	0.135
1273534	142.47	142.525	0.055
1273535	145.969	146.051	0.082
1273536	140.01	140.084	0.074
1273537	146.504	146.626	0.122
1273538	144.866	144.94	0.074
1273539	143.207	143.423	0.216
1273540	145.367	145.366	-0.001
1273541	142.076	142.081	0.005
1273542	142.974	142.977	0.003

1273543	143.576	143.577	0.001
1273544	147.95	147.952	0.002
1293500	143.681	143.774	0.093
1293501	145.866	145.998	0.132
1293502	141.542	141.637	0.095
1293503	146.586	146.595	0.009
1293504	142.257	142.338	0.081
1293505	143.797	143.984	0.187
1293506	144.338	144.71	0.372
1293507	143.22	146.019	2.799
1293508	142.32	142.509	0.189
1293509	144.579	144.759	0.180
1293510	143.349	143.583	0.234
1293511	142.757	142.939	0.182
1293512	142.876	142.897	0.021
1293513	142.69	142.771	0.081
1293514	143.634	143.736	0.102
1293515	141.131	141.348	0.217
1293516	142.97	142.991	0.021
1293517	142.783	142.809	0.026
1293518	140.5	140.537	0.037
1293519	142.735	142.754	0.019
1293519	142.735	142.754	0.019
1293520	142.188	142.207	0.019
1293521	140.639	140.655	0.016
1293523	142.981	143.106	0.125
1293524	139.435	139.695	0.260
1293525	144.207	144.307	0.100
1293526	146.705	146.817	0.112
1293527	144.952	145.214	0.262
1293528	147.485	147.716	0.231
1293529	145.855	146.144	0.289
1293530	146.612	146.893	0.281
1293531	142.368	142.685	0.317
1293532	141.924	142.151	0.227
1293533	143.865	144.057	0.192
1293534	143.03	143.326	0.296
1293535	143.139	143.38	0.241
1293536	145.206	145.57	0.364
1293537	145.737	145.973	0.236
1293538	145.22	145.501	0.281
1293539	143.379	143.611	0.232
1293540	143.75	144.075	0.325
1293541	142.822	143.194	0.372
1293542	145.392	145.87	0.478
1293542	145.392	145.87	0.478
1293543	144.398	144.829	0.431
1293543	144.398	144.829	0.431
1293544	147.373	147.771	0.398
1293545	146.566	146.958	0.392
1293546	142.08	142.393	0.313

1293547	143.854	144.134	0.280
1293548	142.179	142.407	0.228
1293549	139.291	139.296	0.005
1293550	143.573	143.577	0.004
1293551	140.063	140.069	0.006
1293552	139.509	139.514	0.005
1293553	144.131	144.137	0.006
1333500	146.31	146.522	0.212
1333501	145.421	145.591	0.170
1333502	143.978	144.201	0.223
1333503	146.519	146.74	0.221
1333504	146.369	146.543	0.174
1333505	147.056	148.664	1.608
1333506	146.632	146.828	0.196
1333507	145.964	146.201	0.237
1333508	144.236	144.429	0.193
1333509	142.441	142.594	0.153
1333510	144.644	144.774	0.130
1333511	145.665	145.798	0.133
1333512	145.094	145.237	0.143
1333513	144.47	144.519	0.049
1333514	144.494	144.55	0.056
1333515	146.233	146.351	0.118
1333516	145.046	145.114	0.068
1333517	142.604	142.703	0.099
1333518	145.087	145.132	0.045
1333519	147.615	147.664	0.049
1333520	148.423	148.593	0.170
1333521	144.722	144.859	0.137
1333522	145.492	145.738	0.246
1333523	147.268	147.4	0.132
1333524	145.481	145.581	0.100
1333525	142.381	142.534	0.153
1333526	144.38	144.527	0.147
1333528	143.27	143.541	0.271
1333529	142.16	142.467	0.307
1333530	144.533	144.696	0.163
1333531	143.419	143.812	0.393
1333532	141.497	141.666	0.169
1333533	147.786	147.974	0.188
1333534	144.947	144.969	0.022
1333535	147.534	147.538	0.004
1333536	143.682	143.69	0.008
1333537	145.136	145.148	0.012
1333538	145.905	145.919	0.014
1333539	145.258	145.268	0.010
1333540	145.01	145.01	0.000
1353500	148.277	148.452	0.175
1353501	148.239	148.426	0.187
1353502	150.344	150.474	0.130
1353503	147.582	147.802	0.220

1353504	148.095	148.292	0.197
1353505	148.818	148.93	0.112
1353506	154.784	155.119	0.335
1353507	149.871	149.987	0.116
1353508	142.008	142.143	0.135
1353509	142.400	142.706	0.306
1353510	142.950	143.103	0.153
1353511	143.107	143.252	0.145
1353512	143.328	143.414	0.086
1353513	143.562	143.68	0.118
1353514	141.277	141.528	0.251
1353515	145.274	145.68	0.406
1353516	142.852	143.131	0.279
1353517	144.009	144.244	0.235
1353518	142.125	142.309	0.184
1353519	144.466	144.896	0.430
1353520	142.650	142.816	0.166
1353521	144.026	144.384	0.358
1353522	141.500	141.763	0.263
1353523	143.164	143.484	0.320
1353524	143.276	143.475	0.199
1353525	142.660	142.863	0.203
1353526	144.866	145.093	0.227
1353527	141.207	141.461	0.254
1353528	144.449	144.697	0.248
1353529	143.235	143.478	0.243
1353530	142.730	143.054	0.324
1353531	140.767	141.147	0.380
1353532	150.009	150.237	0.228
1353533	142.540	142.837	0.297
1353534	147.702	147.960	0.258
1353536	143.494	143.669	0.175
1353537	146.675	146.844	0.169
1353538	141.981	142.159	0.178
1353539	142.590	142.757	0.167
1353540	144.606	144.728	0.122
1353541	145.950	146.119	0.169
1353542	148.131	148.310	0.179
1353543	146.805	146.933	0.128
1353544	146.727	146.898	0.171
1353545	145.680	145.807	0.127
1353546	143.759	143.897	0.138
1353547	144.283	144.394	0.111
1353548	142.164	142.376	0.212
1353549	141.074	141.075	0.001
1353550	144.591	144.589	-0.002
1353551	142.315	142.314	-0.001
1353552	142.251	142.248	-0.003
1353553	143.026	143.020	-0.006
1353554	142.194	142.189	-0.005
1353535	143.755	143.925	0.170

Appendix 2: Summary of Concentrations for Each Sampler, Wallula PM10 Saturation Study, Summer 2001

	SAMPLER NUMBER 1599		SAMPLER NUMBER 1602		SAMPLER NUMBER 1606	
Date	Sample ID	ug/m3	Sample ID	ug/m3	Sample ID	ug/m3
7/15/01	1273536	19.8	1273512	31.6	1273516	20.4
7/18/01	1273511	15.0	1273514	16.9	1273535	23.9
7/21/01	1273520	20.1	1273509	19.2	1273519	27.5
7/24/01	1273504		1273506	24.1	1273522	30.4
7/27/01	1273525	29.7	1273523	26.6	1273528	22.1
7/30/01	1293510	28.3	1273527	15.3	1273501	25.8
8/2/01	1293511	23.1	1293504	10.9	1293506	50.5
8/5/01	1293526	14.7	1293513	10.9	1293515	28.7
8/8/01	1293533	25.7	1293527	35.2	1293529	38.3
8/11/01	1293540	43.6	1293534	39.8	1293536	47.7
8/14/01	1293547	36.9	1293541	49.1	1293543	60.1
8/17/01	1333505	211.7	1293548	30.6	1333501	22.3
8/20/01	1333512	18.8	1333506	26.3	1333508	29.1
8/23/01	1333519	6.5	1333513	6.6	1333515	14.6
8/26/01	1333526	20.9	1333520	23.3	1333522	29.5
8/29/01	1333533	24.8	1333527	25.2	1333529	38.4
9/1/01	1353506	32.0	1353500	24.0	1353502	17.2
9/4/01	1353513	15.5	1353507	15.6	1353509	40.5
9/7/01	1353520	21.9	1353514	34.4	1353516	36.9
9/10/01	1353527	50.2	1353521	49.0	1353523	42.3
9/13/01	1353534	25.5	1353528	33.9	1353530	54.1
9/17/01	1353541	22.3	1353535	23.3	1353537	18.8
9/19/01	1353548	27.9	1353542	24.1	1353544	22.6

	SAMPLER NUMBER 1607		SAMPLER NUMBER 1608		SAMPLER NUMBER 1609		SAMPLER NUMBER 1611	
Date	Sample ID	ug/m3	Sample ID	ug/m3	Sample ID	ug/m3	Sample ID	ug/m3
7/15/01	1273515	19.7	1273513	26.6	1273537	32.7	1273538	19.9
7/18/01	1273510	19.1	1273534	14.8	1273517	16.4	1273518	17.4
7/21/01	1273533	18.2	1273507	27.4	1273508	28.7	1273532	13.4
7/24/01	1273521	23.0	1273530	23.3	1273505	21.3	1273529	19.1
7/27/01	1273503		1273539	29.6	1273524	339.3	1273502	16.8
7/30/01	1273526	12.7	1293501	17.4	1293500	12.2	1293502	12.7
8/2/01	1293505	25.7	1293508	25.0	1293507	382.4	1293509	24.1
8/5/01	1293514	13.5	1293524	34.3	1293523	16.5	1293525	13.4
8/8/01	1293528	30.2	1293531	41.0	1293530	38.3	1293532	30.4
8/11/01	1293535	31.9	1293538	36.4	1293537	32.2	1293539	31.1
8/14/01	1293542	61.0	1293545	51.8	1293544	52.4	1293546	42.0
8/17/01	1333500	28.0	1333503	29.2	1333502	29.4	1333504	23.3
8/20/01	1333507	31.4	1333510	17.2	1333509	20.1	1333511	17.8
8/23/01	1333514	7.4	1333517	13.1	1333516	9.0	1333518	6.0
8/26/01	1333521	18.5	1333524	13.4	1333523	18.1	1333525	20.5
8/29/01	1333528	36.5	1333531	53.8	1333530	21.1	1333532	22.7
9/1/01	1353501	25.2	1353504	26.0	1353503	29.0	1353505	15.0
9/4/01	1353508	18.2	1353511	19.1	1353510	20.1	1353512	11.5
9/7/01	1353515	53.7	1353518	23.9	1353517	30.9	1353519	57.7
9/10/01	1353522	34.8	1353525	26.8	1353524	26.2	1353526	31.0
9/13/01	1353529	32.2	1353532	29.6	1353531	50.0	1353533	39.8
9/17/01	1353536	23.6	1353539	22.0	1353538	23.9	1353540	16.4
9/19/01	1353543	16.9	1353546	18.2	1353545	16.4	1353547	14.9

Appendix 3: Individual Sampler Calibration Sheets

[Available from the Washington State Department of Ecology upon request.]

ANALYSIS OF 2002 WALLULA SATURATION STUDY

Washington State Department of Ecology
Air Quality Program

March 2002

The Air Quality Program contracted with Washington State University for a saturation study during the summer of 2002 that examined relative PM_{10} concentrations within the Wallula nonattainment area. The saturation study was occasioned by the decision of the landowner that the PM_{10} reference monitor currently operating on his property would have to cease operation by October 31, 2003. The stated goal of the saturation study was to locate another site with similar of higher observed concentrations as those measured at the reference site.

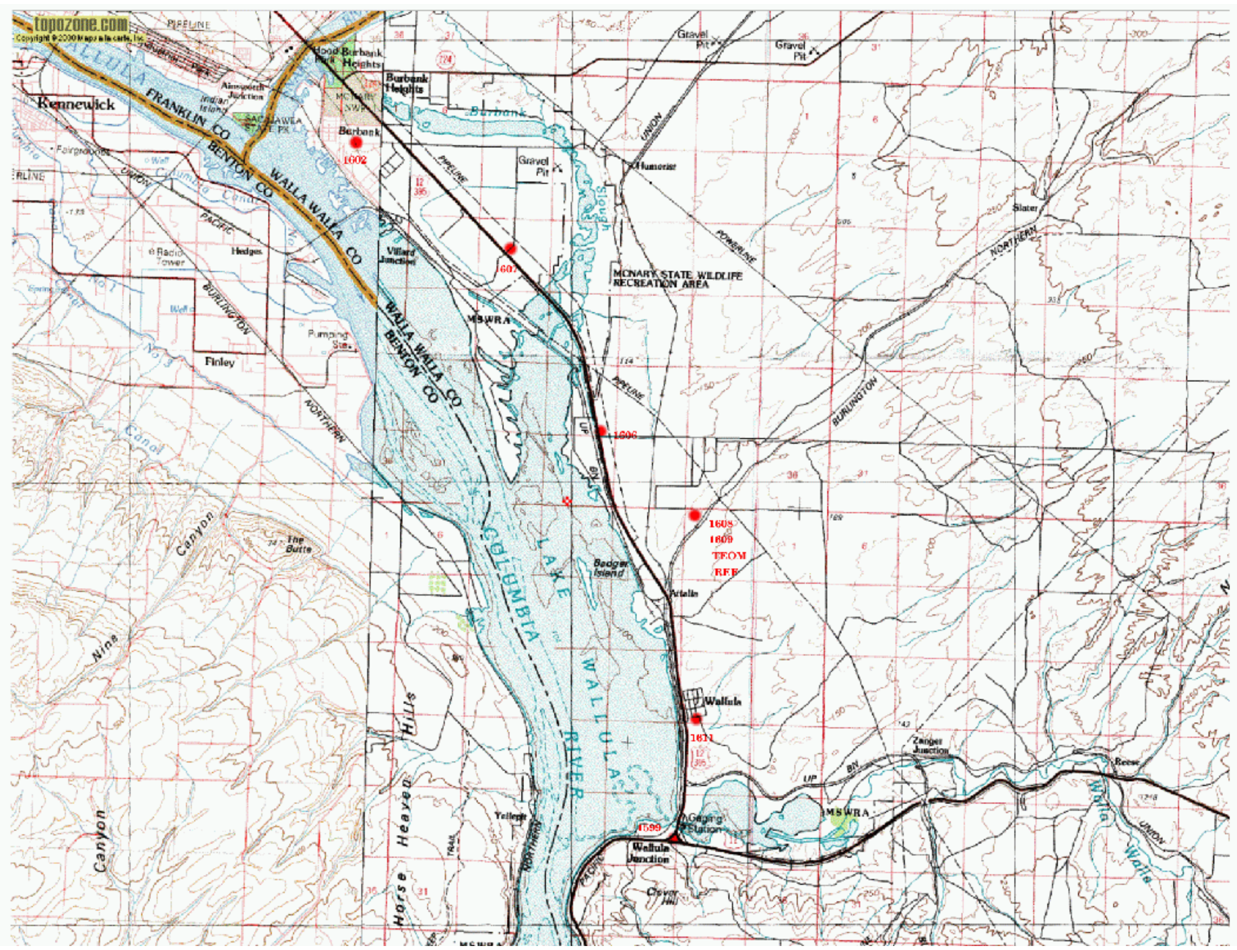
The portable samplers were strung out over a distance of roughly 20 kilometers along the east bank of the Columbia River between Burbank, WA and Wallula Junction, WA. The map on the next page shows the approximate location of each of the seven portable samplers, the TEOM, and the reference PM_{10} monitor. Throughout this analysis the sites are referenced by their site number for convenience in manipulating the data. The sites and site numbers from north to south are as follows:

Site Number	Site
1602	Burbank Fire Station
1607	Hanson Loop Road
1606	Dodd Road
1608	Co-Located #1
1609	Co-Located #2
1611	Wallula Fire Station
1599	Wallula Junction

Co-Located #1 and Co-Located #2 were located at the PM_{10} reference monitor (referred to as "ref" in this analysis). Instrumentation at the site also includes a continuous PM_{10} monitor (teom).

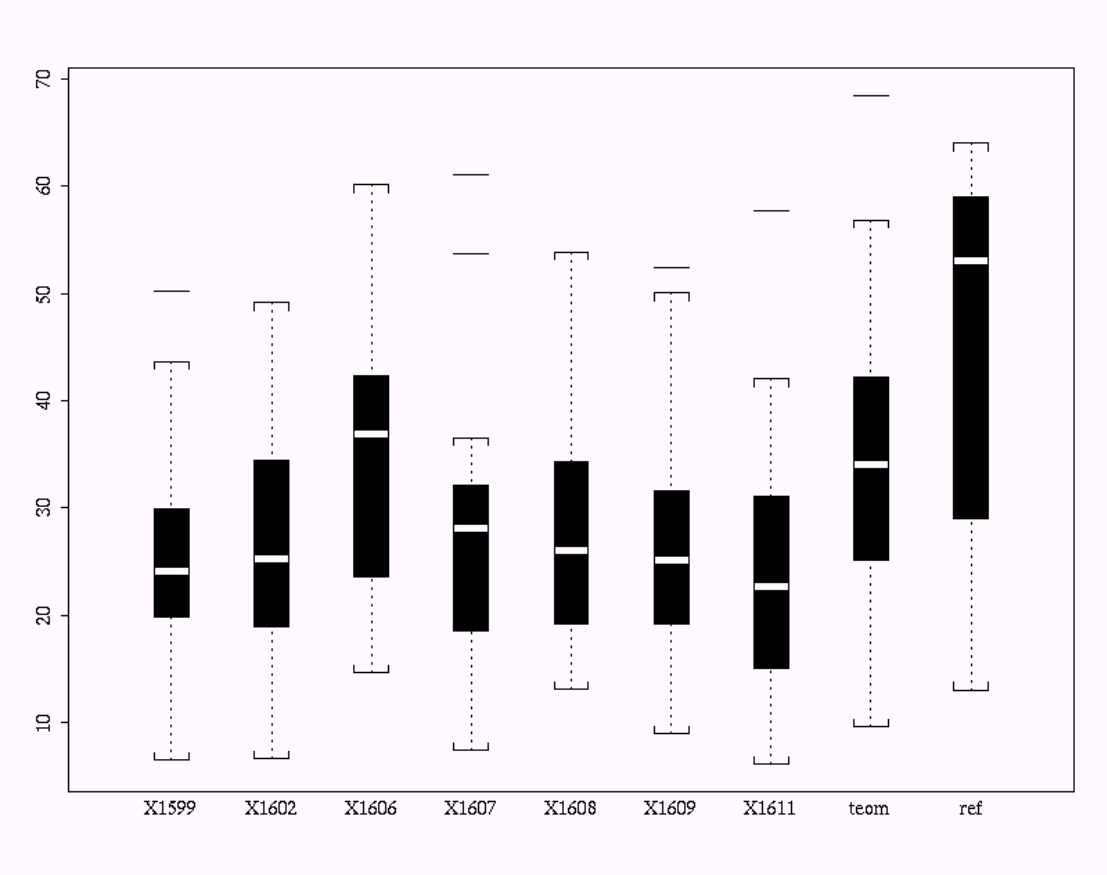
ANALYSIS

The standard tools of exploratory data analysis help to understand the inter-relationships among the six monitoring locations. The first tool is the pairs plot which shows a block of scatter plots for all inter-relationships among the variables. The pairs plot is useful in finding general functional relationships between parameters. The eye can readily see linear and other simple relationships that can be examined in more detail later.


topozone.com
Kennewick
FRANKLIN CO
BENTON CO
WALLA WALLA CO
Burbank
1602
Burbank Heights
Gravel Pit
MCNARY STATE WILDLIFE RECREATION AREA
MSWRA
Finley
1606
1608
1609
TEOM
REF
Badger Island
LAKE WALLULA
COLUMBIA RIVER
Wallula
1611
1599
Wallula Junction
Gaging Station
Zanger Junction
Horse Heaven Hills
Nine Canyon
Canyon
The Butte
Slater
Hedges
Pumping Sta
Villard Junction
Attalia
Yellepit
Reese

In the figure above note that the most visually significant correlations seem to involve sites X1607, X1608, X1609, and X1611. The prepended "X" to the site number is a characteristic of the statistical program used for the analysis. It is not readily apparent that there is any correlation between the reference site "ref" and any of the other sites including the "teom" and the co-located precision pairs X1608 and X1609. One reason for this lack of noticeable correlation with the reference site is the small number of samples as the reference site ran at a one-in-six-day rate.

The next approach is to compare the concentration distributions at the individual sites. The following figure, which shows box and whisker plots for each site, clearly shows which sites have the highest individual measurement (the teom), the highest median (the reference site), and the highest lower quartile (again, the reference site).



Two things are immediately seen: The reference site seems to be unlike any other site including the sites X1608 and X1609 and the teom, all three of which were co-located with the reference site; and site X1606 seems to be the best location for a replacement monitor. While X1606 does not meet the study goal of a site with similar or higher observed concentrations as those measured at the reference site, the site does exhibit the highest concentrations among all the sites other than the reference site.

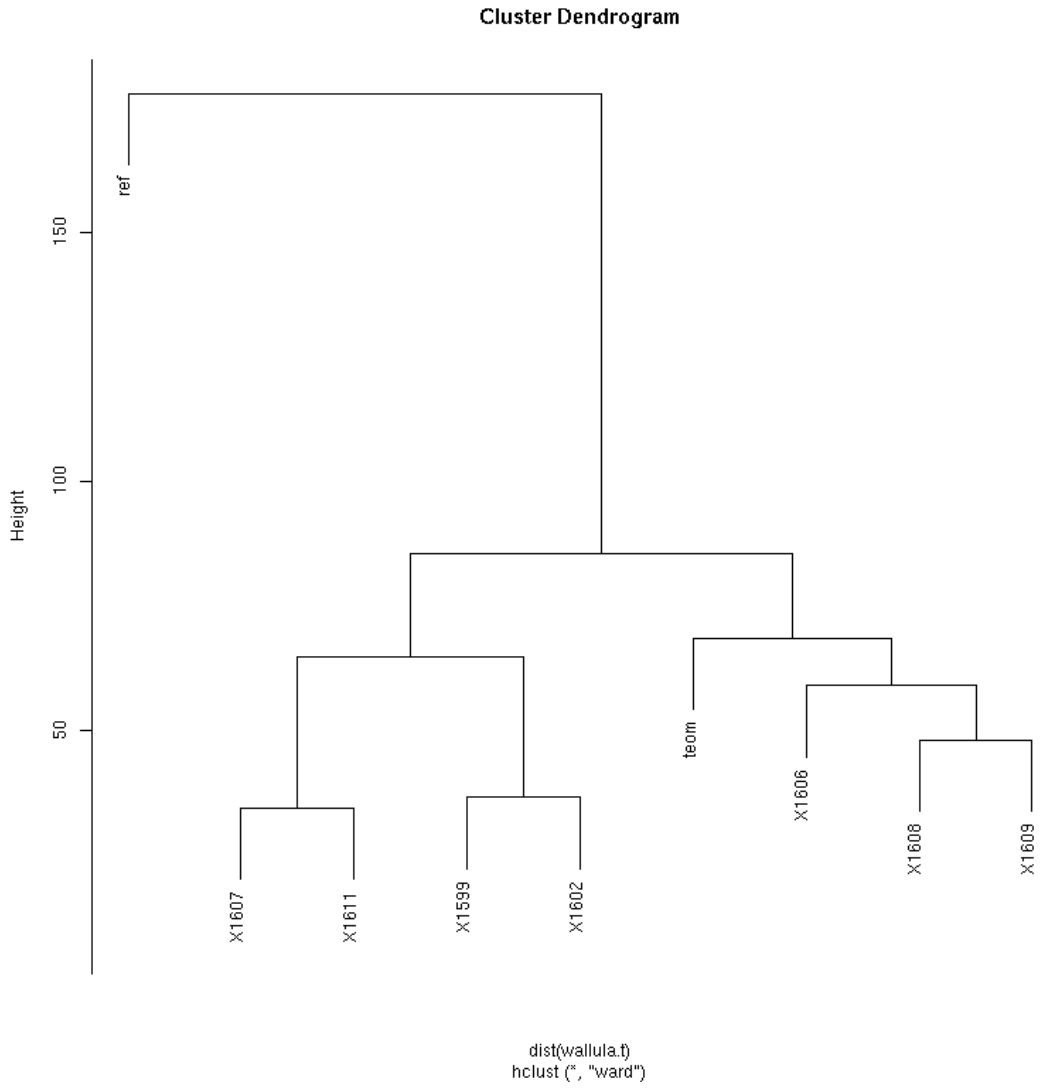
Normally, the analysis would stop at the identification of the site with the best characteristics to serve as a replacement site. Wallula however is a rural area where the ability to locate a site is constrained by practical considerations. These considerations include the ability to meet site criteria, the potential for a long-term lease and the availablity of power and telephone lines. It is prudent to determine it there is a site that can provide an alternative to site X1606.

Site X1602 provides a weak but acceptable second choice. The box and whisker plots indicate that higher observed concentrations at sites X1599, X1607 and X1611 are outliers. When these outliers are rmoved from consideration, site X1602 has the second highest set of concentrations after site X1606 and thus becomes the second best site to locate a replacement monitor.

As stated above, the goal of locating another site with similar or higher observed concentrations as those measured at the reference site was not achieved. The apparent difference between the

reference site and all other sites, including those co-located with the reference instrument, calls for additional analysis to test the suggestion that the reference site is indeed dissimilar to all the other sites.

Cluster analysis is used to group sites with similar data characteristics (see the following dendrogram) and the results are shown graphically below.



The reader may be forgiven in thinking that the reference site was not included in the analysis as the cluster analysis has put the reference site ("ref") off on its own branch. The analysis clearly shows that the two co-located portable samplers are more closely related with each other than they are with any of the other sites and then are grouped together with site X1606 and the teom. The other four sites form two groups which are paired together.

A final comparison is to do a pairwise correlation to produce numbers to support the above graphical products. In Table 1 below one sees that X1611 and X1607 are the most highly correlated with a coefficient of 0.88. The teom is correlated with the two co-located sites, X1608 and X1609 with coefficients of 0.74 and 0.79, respectively, far higher than any correlation between the reference site and any other site.

FINDINGS

The site at X1606 clearly has the best characteristics to become the replacement for the reference of the sites in this study. Because practical considerations may mean that it not possible to locate a replacement monitor near site X1606, site X1602 was identified an acceptable but less than ideal alterantive.

Reference monitor is “odd man out” and is poorly correlated with any other monitors including the two co-located samplers (X1608 & X1609) and the teom, all three of which are also located at the reference site. Additional analysis is continuing to compare the reference to the teom for a longer period of record.

Table 1. Pairwise Correlations

	X1599	X1602	X1606	X1607	X1608	X1609	X1611	teom	ref	blank
X1599	1.0000000									
X1602	0.7756383	1.00000000								
X1606	0.4521516	0.52950406	1.00000000							
X1607	0.5026919	0.76942805	0.66644132	1.0000000						
X1608	0.4150845	0.53808435	0.51578135	0.6093176	1.00000000					
X1609	0.4468872	0.75759440	0.69823406	0.7106786	0.60600642	1.0000000				
X1611	0.4225131	0.66634528	0.72815965	0.8759928	0.42224568	0.7138404	1.0000000			
teom	0.4830316	0.65317622	0.51639402	0.7405698	0.79180238	0.7828648	0.6044899	1.0000000		
ref	0.5045937	0.48310118	0.28043293	0.3915207	0.26200462	0.5133373	0.6044732	0.5573843	1.0000000	
blank	-0.1127480	-0.06043448	-0.05178535	-0.1186622	0.01536751	-0.1587392	-0.0758506	0.2255943	0.3837908	1.00000000

Evaluation of Two Candidate Sites for Replacement of the Wallula PM_{10} Monitoring Site

Air Quality Program
Washington State Department of Ecology

January 5, 2004

PURPOSE AND ISSUES

PM_{10} federal reference monitors (FRMs) were established at two locations in the Wallula PM_{10} nonattainment area (NAA) as candidate sites for replacing the NAA's long-term Wallula FRM monitoring site located on Worden Farms. It became necessary to find a replacement site after an agreement with the landowner scheduled the Wallula FRM site for termination on October 31, 2003. This evaluation examines whether one of these sites could replace the Wallula FRM for the purposes of 1) tracking the PM_{10} attainment status of the Wallula NAA in the future and 2) showing continuing attainment as required by statutory provisions for redesignation.

Wallula is not eligible for redesignation to attainment until the U. S. Environmental Protection Agency (EPA) is able to find that Wallula meets monitored attainment. The PM_{10} standard is evaluated on the basis of three calendar years of quality-assured data that meets the criteria of at least 75% of the scheduled number of samples collected each quarter. Not only was the Wallula site terminated before the end of calendar year 2003 but there was poor data recovery during the third quarter due to the operator's unilateral decision to suspend sampling during July and August due to swarming ants. It is not possible to demonstrate continuing attainment of PM_{10} standards after 2002 without the ability to combine data from one of the candidate sites with Wallula data.

BACKGROUND

After EPA reclassified the Wallula NAA from moderate to serious in 2001, the owner of Worden Farms where the Wallula FRM is located asked the Washington State Department of Ecology to remove the FRM from his property. Ecology came to an agreement with the land owner to let the monitor remain until October 31, 2003. Ecology also received permission for continuous monitoring of PM_{10} at the site with a tapered element oscillating microbalance (TEOM) until site termination.

EPA recommended that Ecology perform a saturation study to locate a replacement site. Ecology contracted with Washington State University to manage and staff the saturation study during summer 2001. Overall, the saturation study results were much less definitive than anticipated. The results suggested that Dodd Road was the best location for a replacement

monitor. The study results also suggested that Burbank may be a suitable location for a replacement monitor.

After discussing the saturation study Ecology and EPA mutually agreed on the following course of action. Ecology would establish candidate FRM replacement sites in two locations. One location would be in the vicinity of Dodd Road. The industrial sources in the nonattainment area—a pulp and paper mill and associated compost facility, a very large feedlot and a beef processing plant were all located to the south of Dodd Road. The second location would be in the unincorporated community of Burbank where most of the population of the NAA live.

The first monitoring site, Wallula Port (site no. 53-071-0003), was located on Port of Walla Walla property south of Dodd Road and along U. S. 12. At the time the property was under option for the site for the Wallula Generating Station, a 1300 MW gas turbine power plant then in the process of being permitted. While permitted, the Wallula Generating Station is currently on hold and it is not know when or if the project will go forward. The site is about a mile north-northwest of the Wallula monitoring site. The Wallula Port FRM began monitoring on November 13, 2002.

The second monitoring site, Burbank (site no. 53-071-0006), was located at Burbank public schools. In addition to the FRM, a PM_{10} TEOM and a meteorological tower were also set up at the site. The Burbank site is about seven miles west-north-northwest of the Wallula site. The Burbank FRM began monitoring on December 25, 2002.

The Wallula monitoring site was terminated at the end of October 2003 and the site dismantled in November. The map of the Wallula NAA shows the locations of all three monitoring sites.

EVALUATION

The attached spreadsheet, Wallula_comparison_rev2.xls, provides PM_{10} monitoring data from the Wallula NAA in both tabular and graphical form for the comparison period, which extended from November 2002 to October 2003.

FRM and TEOM monitoring data from all sites are found on the sheet titled “All Sites.” Graphical presentation shows that on the whole, the data plotted by date lie within a broad band. This indicates that concentrations are generally similar on any given day and that no site is an obvious outlier measuring fundamentally dissimilar air quality. On the other hand, the graph provides too much information for the eye to even begin to pick out how similar the candidate replacement sites are to the Wallula FRM.

To address the issue of similarity, data from the Wallula FRM site and each of the replacement monitoring sites were plotted on the sheets, “Wallula vs Wallula Port” and “Wallula vs Burbank.” Again, it is obvious that the sites are related but difficult to draw conclusions on how well each site is related to the long-term Wallula FRM.

To examine the issue more analytically, ratios of the PM_{10} concentration at a replacement site to the Wallula FRM concentration were calculated for each day that data are available from both

sites. If the concentrations at the replacement site and at the Wallula FRM are the same on a given date, the ratio is 1:1. If the concentration at the replacement site is higher, the ratio is greater than 1:1. If the concentration is lower, the ratio is less than 1:1.

The relationship between the ratios and the monitored concentration at Wallula was evaluated by plotting the logarithm (log_{10}) of the ratios against the Wallula FRM concentration. The log_{10} was selected for the data analysis to reduce the vertical scatter of the data and clarify patterns. The following table provides a crosswalk between the selected log_{10} axes and the ratio between the concentration at the replacement site and the concentration of the Wallula FRM.

Log_{10}	*Ratio*
0.4	2.5:1
0.2	1.6:1
0.0	1:1
-0.2	0.6:1
-0.4	0.4:1

The more closely the two monitoring sites are related, the more closely the plotted ratios should lie along the 0.0 value, which is the log_{10} of the ratio of 1:1.

The attached graph "Comparison of PM_{10} concentrations at Wallula Port and Wallula" shows lots of scatter and no obvious relationship between the two sites. In contrast, the graph "Comparison of PM_{10} Concentrations at Burbank and Wallula" shows definite clustering about the log_{10} of 0.0 above 15 $\mu g/m^3$ with all calculated ratios lying between 0.6 and 1.6. Concentrations below 15 $\mu g/m^3$ are too small to be of interest. Besides, they are greatly influenced by local conditions.

A closer examination shows that 78% of the log ratios for concentrations above 15 $\mu g/m^3$ lie within the narrower range of 0.1 to -0.1. This is equivalent to ratios between 0.8 and 1.3 (see the sheet titled "over 15 ug m-3" on attached spreadsheet).

From the clustering and the limited range of the ratios, we conclude that the Burbank replacement monitor and the Wallula FRM regularly measure the same air mass. In other words, both monitors measure similar regional PM_{10} concentrations despite being located 7 miles apart.

CONCLUSIONS AND RECOMMENDATIONS

1. The Burbank monitor should be continued to track continuing PM_{10} attainment in the Wallula NAA in the future. Evaluation of monitoring data indicates that the Burbank monitor is measuring the same air mass as the now-discontinued Wallula monitor. The Burbank monitor also provides the added benefit of measuring air quality in the part of the NAA where most of the population live.

2. The Wallula Port monitor should be discontinued. Results of the evaluation indicate monitored air quality at Wallula Port does not reflect air quality measured by the Wallula FRM. The higher scatter at all concentrations may be indicative of local conditions that are not generally representative of the NAA.

3. Burbank data should be combined with Wallula FRM data starting with the 2003 data set for evaluation of attainment. Since both monitors seem representative of PM_{10} concentrations in the Wallula NAA , this would allow EPA to find that the Wallula NAA meets the standard with no gaps in the record and thus satisfies the statutory provision for monitored attainment that is required for redesignation to attainment. Ecology will provide the opportunity for public input on combining data sets, as required by EPA, through the public hearing on the maintenance plan.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, WA 98101

Reply To
Attn Of: AWT-107

04 NOV

Mr. Mike Ragan
Washington Department of Ecology
P.O. Box 47600
Olympia, WA 98504-7600

Re: Approval of the Burbank PM_{10} Monitoring Site as the Representative Monitor for the Wallula PM_{10} Nonattainment Area

Dear Mr. Ragan:

The Department of Ecology (Ecology) discontinued operation of the Wallula -Worden Farms PM_{10} Federal Reference Monitors (FRM) site on October 31, 2003, according to an agreement with the landowner of that site. Since the Wallula area is a nonattainment area (NAA) for PM_{10}, continued monitoring of PM_{10} concentrations is required in order to determine the area's attainment status in the future. In agreement with EPA Region 10, Ecology established two alternate PM_{10} FRM sites in the Wallula area as candidate sites for replacing the existing Wallula -Worden Farms site.

The first alternate monitoring site, Wallula Port (#53-071-0003), was located on Port of Walla Walla property south of Dodd Road and along highway 12. The second monitoring site, Burbank (#53-071-0006), was located at Burbank public school. In addition to the FRM, a PM_{10} TEOM and a meteorological tower were also set up at the Burbank site. The Burbank site is about seven miles west-north-northwest of the Wallula site and is the most populated location within the Wallula NAA. PM_{10} FRM monitoring was conducted simultaneously at the Wallula - Worden Farms site and the two alternate sites on a one-in-three day schedule during the period of November 2002 through October 2003. In a report titled, "Evaluation of Two Candidate Sites for Replacement of the Wallula PM_{10} Monitoring Site", dated January 5, 2004, Ecology evaluated and compared the data collected at all three sites. The results of this evaluation showed a strong correlation between the PM_{10} concentrations measured at the Wallula -Worden Farms site and the Burbank site. This correlation between these two sites indicates that the Burbank site is exposed to the same air mass as the Wallula -Worden Farms site. The results also demonstrated that PM_{10} concentrations measured at the Wallula Port site did not correlate well with PM_{10} concentrations measured at the Wallula -Worden Farms site.

Based on the results of the investigation, Ecology recommended that the Burbank site replace the Wallula-Worden Farms site to track continuing PM_{10} attainment in the Wallula NAA. Ecology also recommended that the Wallula Port site be discontinued. We agree with these recommendations and approve the Burbank site as the permanent replacement for the Wallula - Worden Farms site to measure attainment in the Wallula PM_{10} NAA. We also acknowledge that monitoring at the Wallula Port site has been discontinued.

If you have any questions on this topic, please contact Keith Rose at (206) 553-1949.

Sincerely,

Mary K Mahaffey for

Mahbubul Islam, Manager
State and Tribal Programs Unit
Office of Air, Waste and Toxics