CITY HALL
207 Lafayette Street
P.O. Box 378
Winona, MN 55987-0378
FAX: 507/457-8212

April 12, 2013

Citizens Environmental Quality Committee
Winona, Minnesota 55987

Dear Committee Members:

The next meeting of the Citizens Environmental Quality Committee meeting will be held on Thursday, April 18, 2013 at 4:00 p.m. in the Wenonah Room of City Hall.

1. **Call to Order**

2. **Air Quality Monitoring for Silica Sand Operations**

4. **Other Business**

5. **Adjournment**

Sincerely,

Mark K. Moeller
City Planner

CITIZENS ENVIRONMENTAL QUALITY COMMITTEE	
AGENDA ITEM:	**Air Quality Monitoring for Silica Sand Operations**
PREPARED BY:	**Carlos Espinosa**
DATE:	**April 18, 2013**

Summary

During the frac sand moratorium over the past year, one of the issues studied by the was air quality. At its meeting on July 9, 2012, the Planning Commission recommended that requirements for moisture testing be added to City Code to address concerns about ambient silica dust from frac sand. The idea behind the moisture testing recommendation was that if the sand is kept wet, dust will not be produced.

The City Council adopted the moisture testing requirement in February 2013 as part of the package of ordinance amendments approved at the end of the sand moratorium.

On March 4, the City Council requested staff to further study air quality monitoring with the Planning Commission.

At its meeting on March 25, the Planning Commission referred the topic of air quality monitoring to the Citizens Environmental Quality Committee.

Overall, the subject of air quality and silica sand operations is complicated and there is a lot of information to process. Staff's intent with this agenda item is to provide the most up to date information as a starting point for discussion. Note: In this agenda item, references to PM_{10}, $PM_{2.5}$ and PM_4 refer to *size* of individual particles in the ambient (outdoor) air, and $3ug/m^3$ refers to the *amount* of particles in the ambient air.

Background

Aggregate (i.e. sand, gravel, and crushed stone) operations have the potential to produce dust when the product is mined, processed, and transported. The same is true for silica sand operations. The air quality concern pertaining to silica sand operations stems from known hazards in occupational (workplace) settings. These hazards relate to the impact on human lungs from inhaling dust at a size fraction less than PM_{10} ($1/7^{th}$ the size of a human hair). This size fraction of silica dust is typically associated with activities that break down individual sand grains – e.g. sandblasting, jack hammering, rock and well drilling, and concrete mixing. The fear is that handling of silica sand (during mining, processing, and transportation) will create silica dust at levels that are hazardous to human health in the ambient (outdoor) air. However, the silica sand process is different than occupations where health hazards have been documented because individual sand grains are *not* broken down, and the sand is processed wet – thus dramatically reducing the potential for dust.[1]

This doesn't mean that handling silica sand does not create dust. As stated previously, there is the *potential* for silica sand dust (emissions) in every step of the silica sand process (except for processing/washing). Thus, the question has been: *Are sand operations producing hazardous levels of ambient crystalline silica dust?* Until recently (See Considerations Section below), the answer has proven to be elusive – largely because of additional unanswered questions such as:

1. How should monitoring for ambient crystalline silica be conducted?
2. What is the appropriate threshold for monitoring?
3. What is the standard method and equipment for monitoring?

Answers to these questions are most appropriately answered by state agencies such as the Minnesota Department of Health (MDH) and the Minnesota Pollution Control Agency (MPCA) that have expertise and regulatory authority in the area of air quality. Currently, the two state agencies are working on responses, but they have additional questions that will probably take some time to answer. As a result, the question at the city level is: *Should the City of Winona implement regulations for air quality monitoring independent of actions at the state level?* Recommendations related to this question are what the Citizens Environmental Quality Committee is being asked to provide.

Considerations

When examining air quality monitoring, it's important to review results from monitoring that has occurred at existing silica sand operations. Perhaps the best data comes from three facilities in Wisconsin (one processing facility and two mines). At these operations, EOG Resources has hired Dr. John Richards to monitor crystalline silica in the ambient air at the PM_4 particle size level. Dr. Richards' methods for monitoring crystalline silica have been previously used to monitor for the California crystalline silica standard (3ug/m^3). Dr. Richards' methods for monitoring PM_4 are also being studied by the Minnesota Department of Health for recommendation to the MPCA. It is likely that Dr. Richards' monitoring methods will be recommended by the Minnesota Department of Health to the MPCA sometime in 2013. After that, it's the responsibility of the MPCA to determine how to implement the standard in Minnesota. As such, this Wisconsin study is particularly informative. Preliminary results from November 2012 showed that the three sites examined were not producing hazardous levels of ambient crystalline silica dust (see Attachment A). More recent results from the full fourth quarter of 2012 (see Attachment B) also show non-hazardous levels of silica dust. Monitoring at these sites is scheduled to continue through 2013, with a one-year report expected the first quarter of 2014.

[1] US EPA. Emission Factor Documentation for AP-42 Section 11.19.1 Sand and Gravel Processing. Final report. 1995. Pg. 2-11. Available at: http://www.epa.gov/ttn/chief/ap42/ch11/bgdocs/b11s19-1.pdf

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Another example comes from monitoring that was completed in January of this year. The monitoring took place adjacent to the City of Winona's Central Garage at 1104 W. 3rd Street. The monitoring was meant to provide a snapshot of background air quality in Winona. It was conducted by students from the University of Wisconsin Eau Claire under the supervision of Dr. Crispin Pierce – a professor of public health at the same university. The results show that when the samples were taken (for one hour on January 14th), the air quality at the Central Garage was below federal standards for $PM_{2.5}$ in a 24 hour period, but above federal $PM_{2.5}$ standards for an annual period (see Attachment C). As stated in the results letter from Dr. Pierce, "Our measurements should be interpreted cautiously, as they provide a "snapshot" of air quality that is affected by wind, precipitation and activities in the area. An improved assessment of air quality would entail longer-term $PM_{2.5}$ measurements of $PM_{2.5}$ concentrations."

Other monitoring is currently occurring at two Minnesota facilities in North Branch and Jordan. Both of these facilities are expected to start operating at full capacity by spring 2013. As such, it will be mid to late 2013 before more representational monitoring results are available.

In addition to results from air quality monitoring, it's also important to consider that the state is currently studying statewide standards for crystalline silica. Bills addressing silica sand are currently working their way through the state legislature. The bills differ in approach, but all include provisions for technical assistance to local governments from state agencies such as the MPCA. At the same time (as mentioned above), state agencies themselves are studying how to address air quality concerns. This is important because the resources and expertise for air quality monitoring lie with air quality consultants and the MPCA. As such, it may be prudent to wait for the state to implement appropriate air quality regulations – especially given recent monitoring results from Wisconsin.

Discussion

CEQC members have been asked to discuss air quality monitoring and work toward a set of recommendations to be made to the Planning Commission. The Planning Commission will then review the recommendations before sending them to the City Council.

Attachments:

A) Preliminary Air Quality Monitoring Results from Wisconsin, Nov. 2012
B) Fourth Quarter 2012 Air Quality Monitoring Results from Wisconsin
C) Air Quality Monitoring Results from Winona, Jan 2013

EOG Resources, Inc.
Ambient PM4 Crystalline Silica

John Richards, Ph.D., P.E.
Air Control Techniques, P.C

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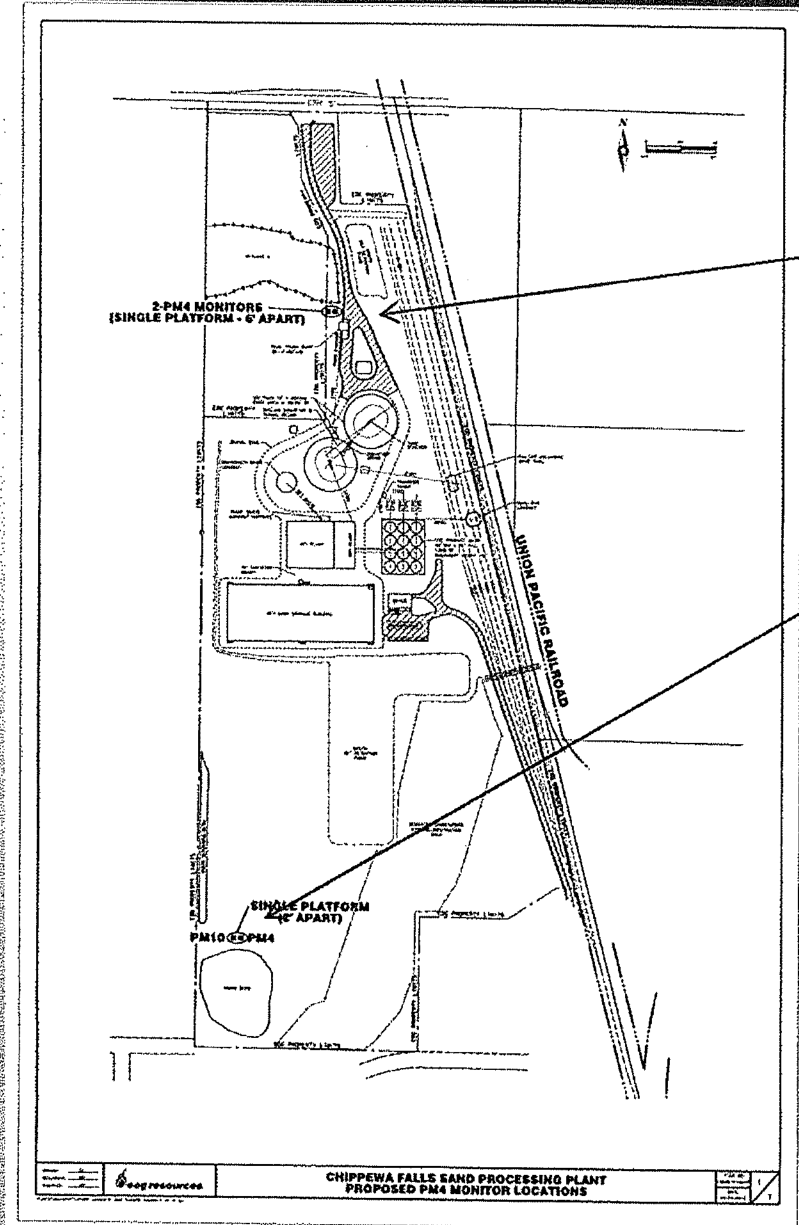
November 5, 2012

- One ambient PM4 crystalline silica sampler is located in position 1.
- Two ambient PM4 crystalline silica samplers are located in position 2.
- When winds move from position 1 to position 2 across the plant, the data from the set of samplers measure the impact of the plant being studied.
- When winds are not in the normal upwind to downwind direction, the data from samplers in both positions measure the background concentrations due to a combination of other sources.

Upwind-Downwind Sampling

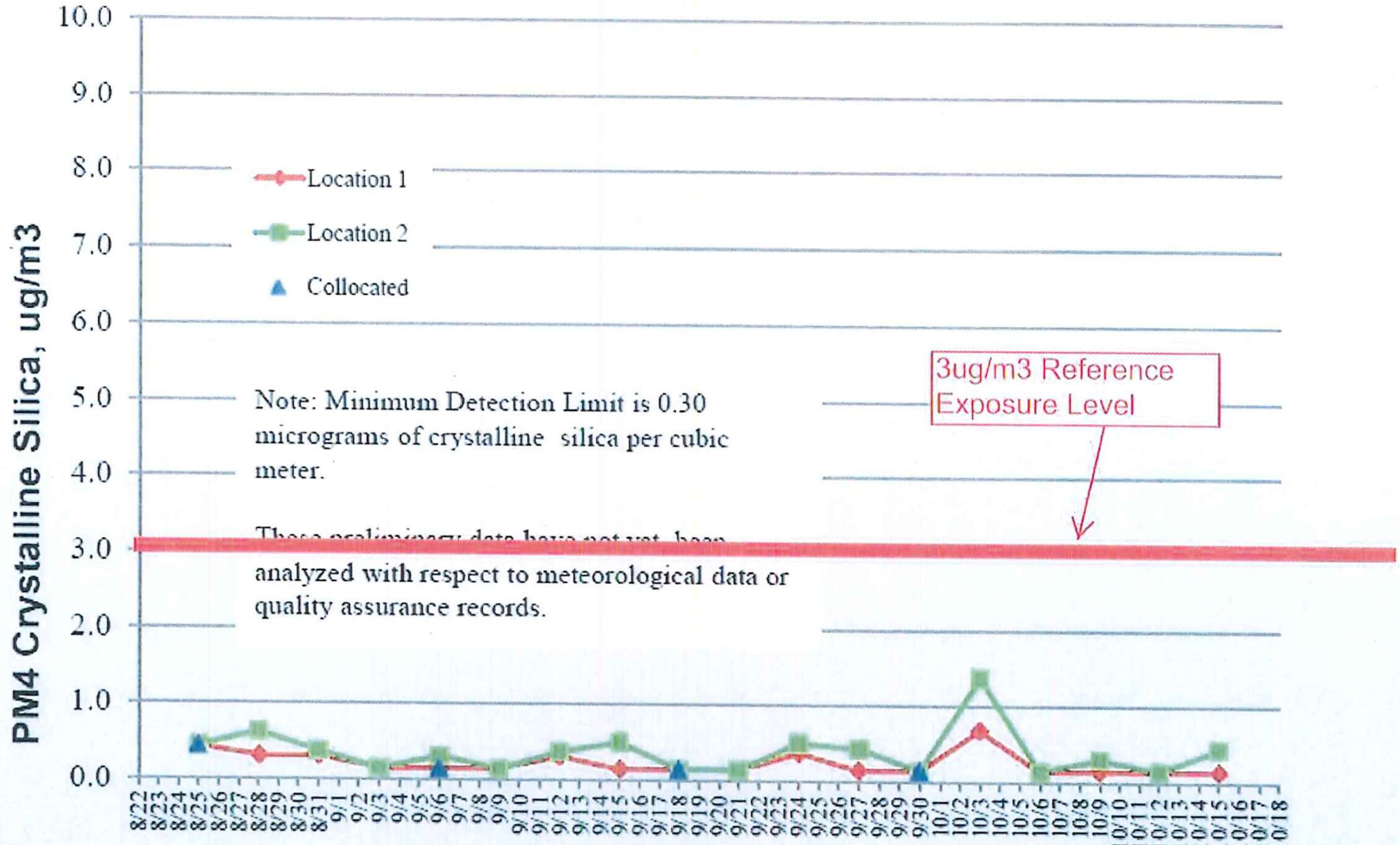


Chippewa Falls Plant

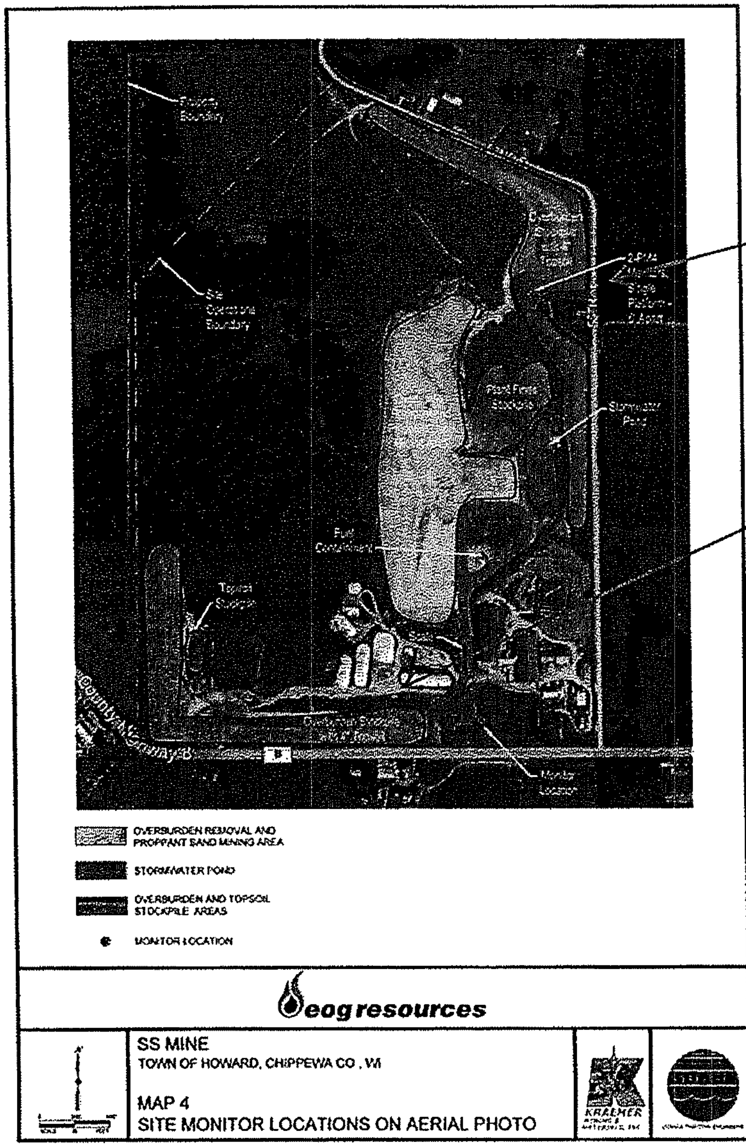
Downwind location is near the northern boundary of the facility.

Upwind location is identical to the existing PM10 sampler location at the southwest corner of the facility property.

Winds are from the south to the north approximately 25% of the year.



Chippewa Falls Preliminary Data



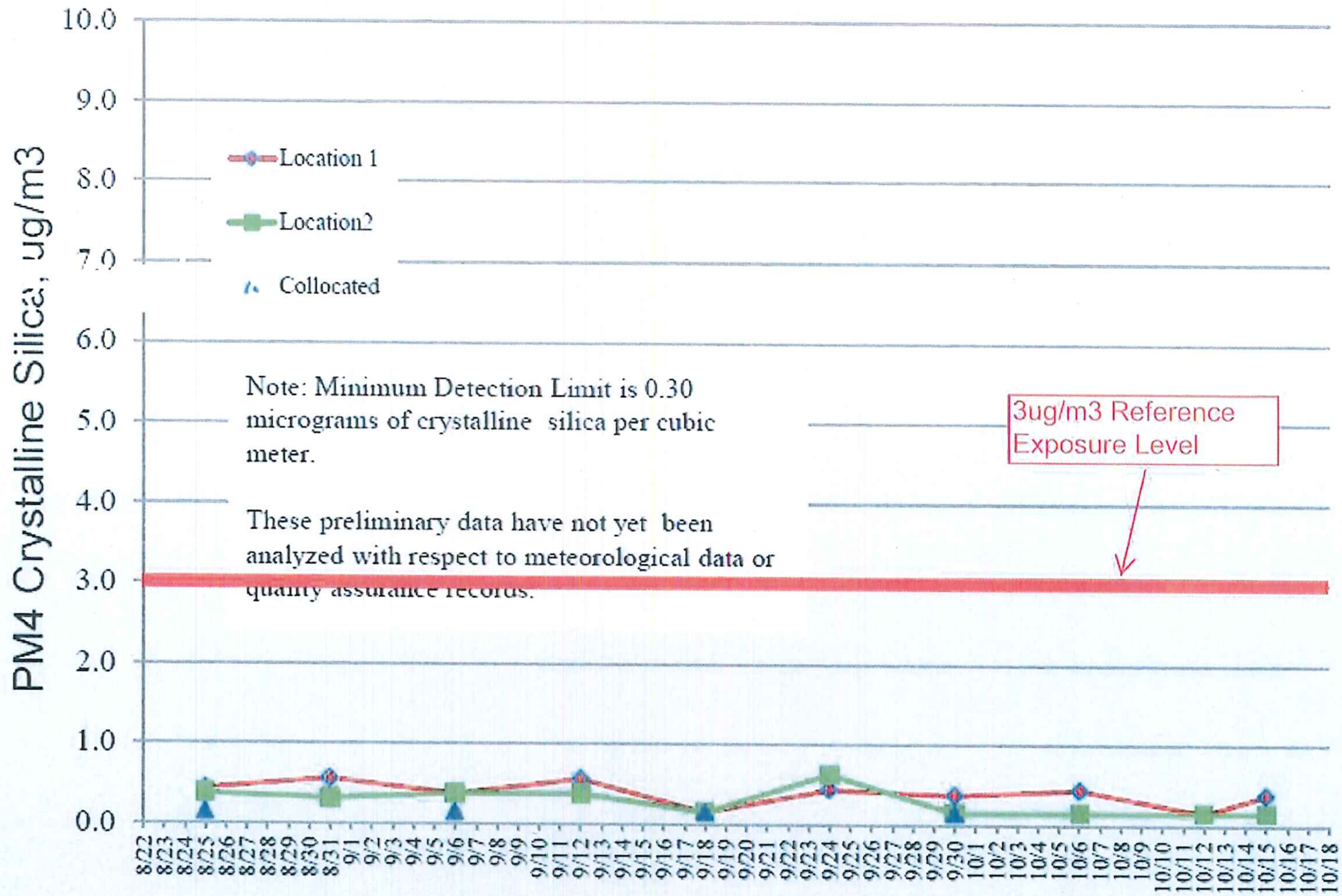
SS Mine
Town of Howard

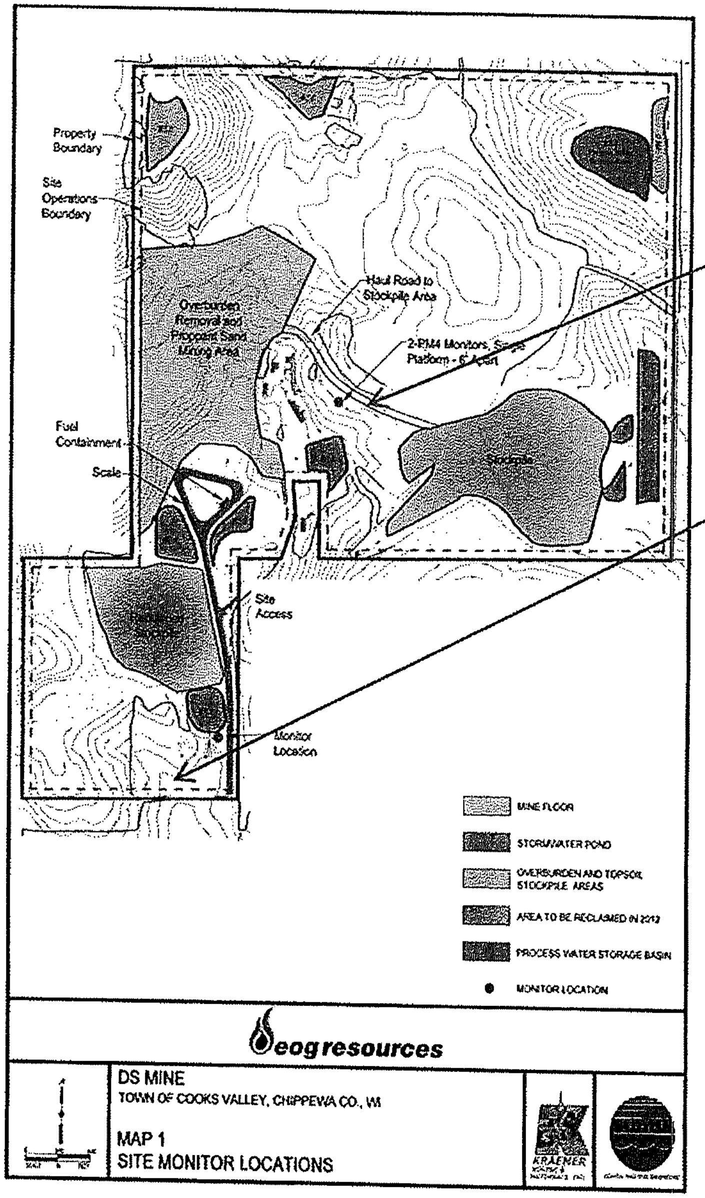
Downwind sampler location is on the northeast side of the facility property.

Upwind sampler location is in the south-center area near the plant office.

Winds are from the west, southwest, or south 50% of the time.

SS Mine Preliminary Data



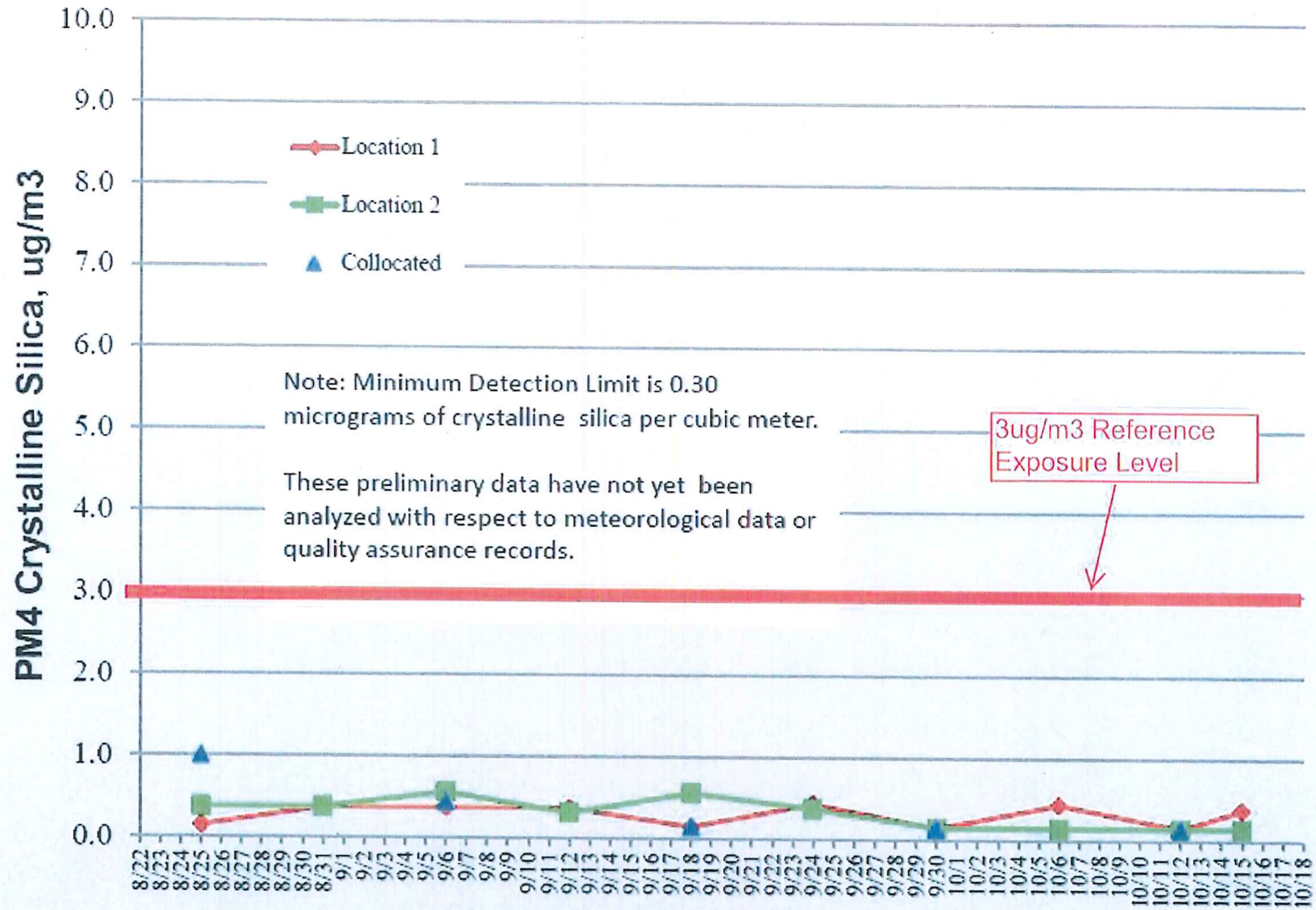


DS Mine
Cooks Valley

Downwind location is east of the active quarrying and processing areas.

Upwind location is in a grassy field on the south side of the facility property.

Winds are from the west, southwest, or south approximately 50% of the time.



DS Mine Preliminary Data

EOG Resources, Inc.
1111 Bagby
Sky Lobby 2
Houston, Texas 77002

P.O. Box 4362
Houston, Texas 77210-4362

March 25, 2013

Mr. Tom Woletz
WDNR Eau Claire Service Center
1300 W. Clairemont
P.O. Box 4001
Eau Claire, WI 54702-4001

RE: Ambient PM_4 Crystalline Silica Sampling Results - 4th Quarter, 2012

Dear Tom:

We appreciate WDNR's interest in EOG Resources, Inc. (EOG) voluntary PM_4 crystalline silica sampling program. PM_4 results from 4th Quarter, 2012 sampling at EOG's Chippewa Falls Plant and mines in Chippewa and Barron Counties are enclosed.

The laboratory analyses, weather data, field log and sampler characteristics and calibration for each location and sample run were compiled and evaluated by Dr. John Richards, Air Control Techniques (ACT). All of the measured ambient air PM4 crystalline silica concentrations are within the range of background concentrations present in agricultural, rural, and urban areas throughout the U.S.

Please contact me at 713.651.6278 or Susan Courter at 715.720.5917 if you have any questions or need additional information.

Sincerely,

Tim Wernicke

Tim Wernicke, General Manager

Enclosure

cc: Susan Courter, EOG Resources, Inc., with enclosure
Jason Treutel, WDNR Air Monitoring Specialist, with enclosure
John Richards, Air Control Techniques, without enclosure

2012 Fourth Quarter Summary
PM_4 Crystalline Silica Sampling
EOG Resources, Inc.

EOG Resources, Inc. (EOG) is submitting this summary of PM_4 crystalline silica concentrations data to the Wisconsin Department of Natural Resources (DNR). This summary presents data compiled during the fourth quarter of 2012 at the Chippewa Falls Plant, DS Mine, and S&S Mine in Chippewa County and at the DD Mine in Barron County.

1. SUMMARY

During the fourth quarter of 2012, EOG conducted ambient PM_4 crystalline silica sampling every third day at all four of the EOG facilities in Wisconsin. All of the measured ambient air PM_4 crystalline silica concentrations were within the range of background concentrations present in agricultural, rural, and urban areas throughout the U.S.

PM_4 is particulate matter that has particle sizes equal to or less than 4 micrometers as measured by the National Institute of Occupational Safety and Health (NIOSH) Method 0600. PM_4 crystalline silica is being measured to be consistent with the PM_4 crystalline health effects literature and established industrial hygiene PM_4 crystalline silica sampling and analytical procedures. To measure ambient air PM_4 crystalline silica, EOG is using EPA Reference Method $PM_{2.5}$ samplers (Thermo Fisher Partisol 2000i, U.S. EPA Designation FRPS-0498-117) satisfying the design and performance requirements of 40 CFR Part 50, Appendix L and modified for PM_4 crystalline silica sampling based on Richards and Brozell.[1] R. J. Lee Group, Inc. (R. J. Lee) is analyzing the Partisol 2000i filter samples for PM_4 crystalline silica by X-ray diffraction in accordance with the National Institute of Occupational Safety and Health (NIOSH) Method 7500. The Partisol 2000i EPA reference method samplers operated in accordance with the extensive quality assurance guidelines specified in the EPA Quality Assurance Guidance Document 2.12 dated November 1998.

The sampling and analytical procedures used in this program provide an extremely sensitive measure of ambient air PM_4 crystalline silica concentrations. The lower limit of quantification is 0.3 micrograms of PM_4 crystalline silica per cubic meter for ambient air samples of 16 cubic meters obtained over a twenty-four hour period.

The sampling programs at each EOG facility consist of measuring the ambient air PM_4 crystalline silica concentrations at two widely-separated locations inside the facility fence lines. The sampling locations satisfy the siting guidelines of the U.S. EPA as specified in 40 CFR Part 58, Appendix E. These two sampling locations are positioned along the dominant wind flow direction so that the impact of plant operations can be evaluated based on the observed change in concentration as the ambient air moves over the facility. The background PM_4 crystalline silica concentrations around these facilities are determined based on the concentrations measured at the upwind location each sampling day.

The ambient air PM_4 crystalline silica samplers (Partisol 2000i samplers) are being operated at both locations at each facility every third day in accordance with the Wisconsin Department of Natural Resources (WDNR) and U.S. EPA recommended sampling schedule. Wind speed and wind direction sensors installed at a ten-meter elevation provide the site-specific meteorological data needed to evaluate wind directions at each of the four facilities. The summarized meteorological data are provided in Appendix A to this report.

In addition to the single Partisol 2000i samplers at each location, there is a second Partisol 2000i at Location 1 for each of the four facilities. These duplicate samplers at Location 1 (sometimes termed "collocated samplers") are used strictly for quality assurance purposes.

The maximum PM_4 crystalline silica concentration value in the data set for all four facilities during the fourth quarter of 2012 was 1.38 micrograms per cubic meter ($\mu g/M^3$). The average PM_4 crystalline silica concentration taking into account all of the samplers at both locations at all four plants was 0.08 $\mu g/M^3$ above the minimum level of quantification (LOQ) concentration of 0.3 micrograms per cubic meter. All of the measured ambient air PM_4 crystalline silica concentrations during the fourth quarter of 2012 were at or below the concentrations measured in previous studies conducted by Air Control Techniques, P.C., the California EPA, and the South Coast Air Quality Management District (Los Angeles) as summarized in the paper by Richards.[2]

The entire set of ambient air PM_4 crystalline silica data compiled at the four facilities during the fourth quarter of 2012 are displayed graphically in Figure 1. Most of the measured values are below the minimum limit of quantification. All of the data are within the anticipated background range.

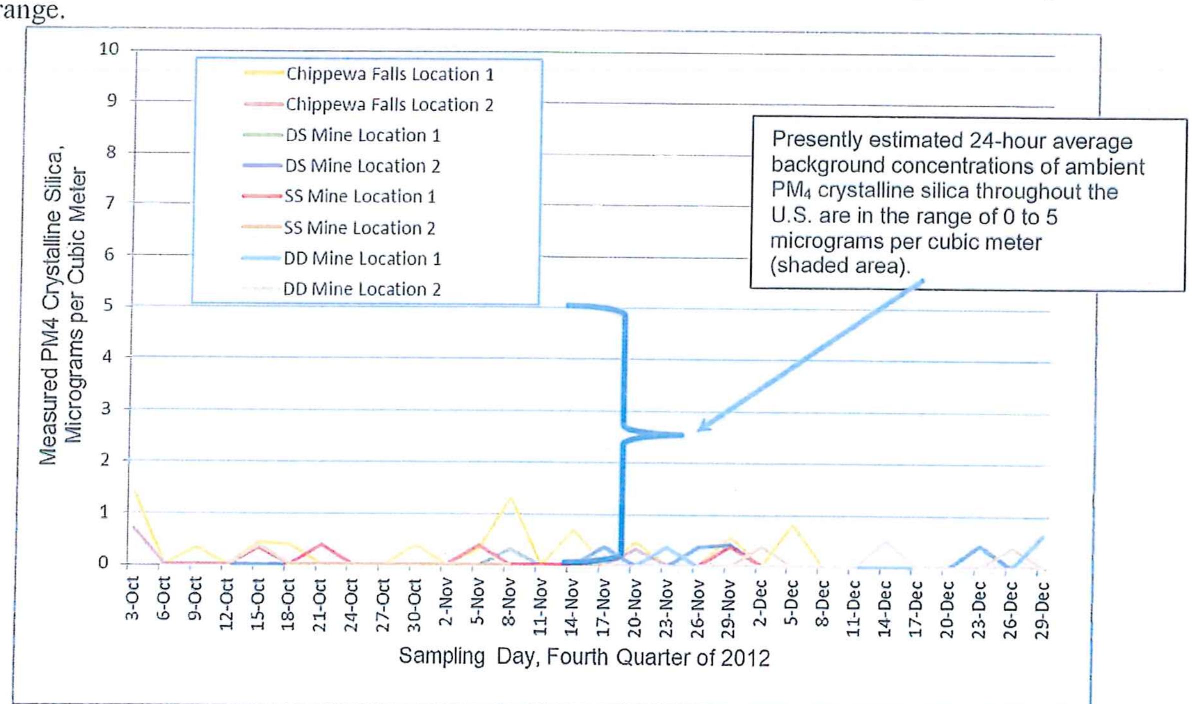


Figure 1-1. PM_4 Crystalline Silica Concentrations (Total of 201 Samples)

The differences between the PM_4 crystalline silica concentrations at the upwind and downwind sampling locations at the four facilities are summarized in Figure 1-2. These differences are small.

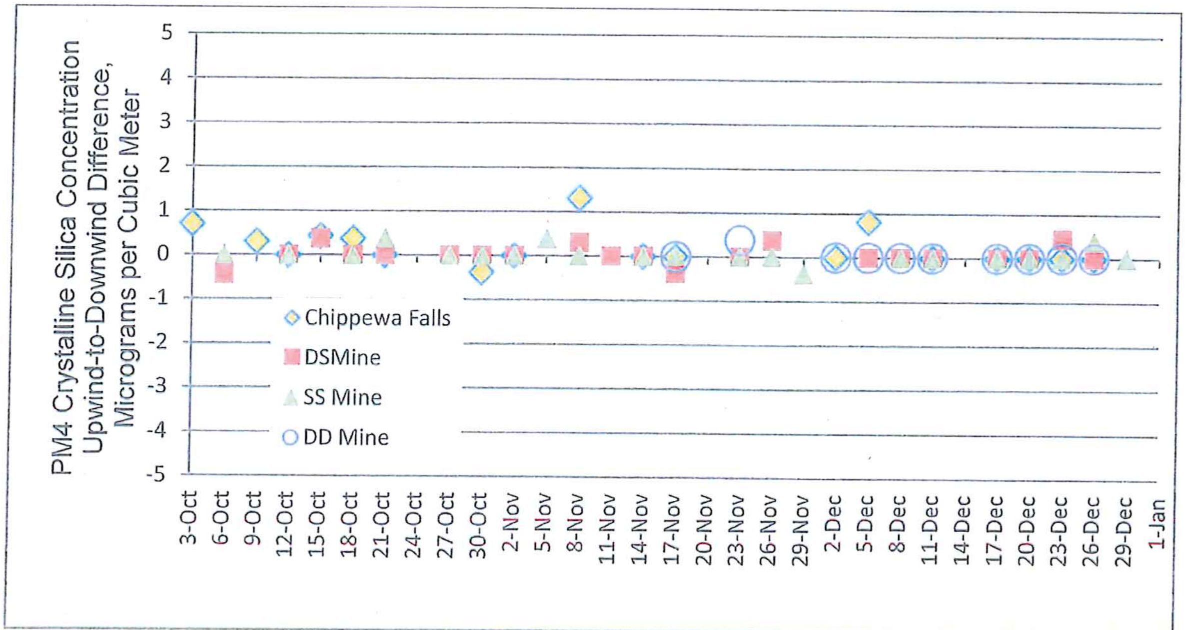


Figure 1-2. PM_4 Crystalline Silica Upwind-to-Downwind Concentration Differences
(Please note that many data points are superimposed on the zero line and that some symbols shown are actually composites of several data points for the four facilities.)

At the Chippewa Falls Plant, the differences between the upwind and downwind sampling locations averaged 0.24 micrograms of PM_4 crystalline silica per cubic meter and ranged from minus 0.38 to plus 1.31 micrograms PM_4 crystalline silica per cubic meter. At the three mines, the differences between the upwind and downwind sampling locations averaged less than 0.04 micrograms of PM_4 crystalline silica per cubic meter and ranged from minus 0.44 to plus 0.44 micrograms of PM_4 crystalline silica per cubic meter. These upwind-to-downwind ambient air PM_4 crystalline silica concentration differences are small at all four facilities.

2. AMBIENT PM_4 CRYSTALLINE SILICA CONCENTRATIONS

Tables 2-1 through 2-4 summarize the PM_4 crystalline silica concentrations measured at the Chippewa Falls Plant, the DS Mine, the S&S Mine, and the DD Mine. All of these data are 24-hour average concentrations expressed in micrograms per cubic meter ($\mu g/M^3$) at actual temperature and pressure. In the "Downwind Sampler" column of Tables 2-1 through 2-4, the sampler in the downwind position is designated each sampling day based on wind direction data measured on-site. The term "crosswind" means that the winds were approaching both sampling locations without passing over the main part of the facility. The term "mixed" means that the wind directions were too variable during the day to evaluate a dominant wind direction.

Chippewa Falls Plant—The PM_4 crystalline silica concentration data for the Chippewa Falls Plant measured during the fourth quarter of 2012 are summarized in Table 2-1.

Table 2-1. Chippewa Falls Plant Ambient PM_4 Crystalline Silica Data

Date	PM_4 Crystalline Silica, µg/M³			Downwind Sampler	Wind Speed, Avg. Mph	Wind 2-Hour Average Directions	Wind 24-Hour Average	Rain or Snow, Inches of Water
	Location 1 Sampler	Location 2 Sampler	Downwind Versus Upwind Difference					
OCT-03	1.38	0.69	0.69	Location 1	4.3	S, SSE, SSW	SSE	0
OCT-06	<LOQ	<LOQ		Crosswind	5.4	W,NNW	NNW	0
OCT-09	0.31	<LOQ	0.31	Location 1	6.3	SW, W	W	0.1
OCT-12	<LOQ	<LOQ	0	Location 1	6.5	SSW, S,SSE	SSE	0
OCT-15	0.44	<LOQ	0.44	Location 1	2.4	WSW, SW, S	S	0
OCT-18	0.38	<LOQ	0.38	Location 1	4.5	WSW, SW, S	S	0
OCT-21	<LOQ	<LOQ	0	Location 1	3.5	SE, NE, ESE, NNE	ESE	0
OCT-24	<LOQ	<LOQ		Crosswind	2.5	SSE, NNE, E, N	N	0.02
OCT-27	<LOQ	<LOQ		Crosswind	3.4	W, SW, WSW	W	0
OCT-30	0.38	<LOQ	-0.38	Location 2	8.2	N, NNW	N	0
NOV-02	<LOQ	<LOQ	0	Location 2	2.5	N,NNE, NNW	N	0
NOV-05	0.31	<LOQ		Crosswind	4.0	E, ESE	E	0
NOV-08	1.31	<LOQ	1.31	Location 1	6.7	SSW, S,SSE	S	0
NOV-11	<LOQ	<LOQ		Mixed	10.0	W, SSW	W	0.49
NOV-14	0.69	<LOQ	0.69	Location 1	4.5	S, SSE	S	0
NOV-17	<LOQ	<LOQ	0	Location 1	5.5	SSE, S, SE	SSE	0
NOV-20	0.45	0.31		Mixed	1.0	Variable	N	0
NOV-23	<LOQ	<LOQ		Crosswind	8.5	W, WNW, NNW	W	0
NOV-26	<LOQ	<LOQ		Crosswind	4.1	W, NNW, NW	NNW	0
NOV-29	0.56	0.38		Crosswind	4.3	ENE, E, SW	ENE	0
DEC-02	<LOQ	<LOQ	0	Location 1	4.3	S, SE	SE	0
DEC-05	0.81	<LOQ	0.81	Location 1	5.8	SE, SSE	SE	0
DEC-08	<LOQ	<LOQ		Mixed	2.3	E, NE, ENE	ESE	0.02
DEC-11	<LOQ	<LOQ	0	Location 1	5.7	SW, WSW, SSE	WSW	0
DEC-14	<LOQ	<LOQ		Crosswind	3.7	E,ENE, ESE	E	0
DEC-17	<LOQ	<LOQ	0	Location 2	2.5	N, WNW, W	N	0
DEC-20	<LOQ	<LOQ	0	Location 2	11.2	N, NW, WNW	N	0
DEC-23	<LOQ	<LOQ	0	Location 2	4.5	W, WNW, NNW	N	0
DEC-26	<LOQ	<LOQ	0	Location 2	3.5	N, NNW	N	0
DEC-29	<LOQ	<LOQ		Crosswind	5.8	W, WSW	W	0

Note 1. <LOQ indicate values below the minimum level of quantification.

All of the measured ambient air PM_4 crystalline silica levels at the Chippewa Falls Plant summarized in Table 2-1 were low. Forty-six of the sixty measurements were below the minimum level of quantification of 0.30 µg/M³. The maximum downwind concentration of 1.38 µg/M³ occurred on October 3 when the winds were from the South, South-Southeast, and South-Southwest. The background concentration measured at the upwind location that day was also slightly higher than typical levels.

The ambient winds passed across the two sampling locations during eighteen of the thirty sampling days in the Fourth Quarter of 2012. The average concentration increase was 0.24 µg/M³.

DS Mine—The ambient air PM$_4$ crystalline silica concentration data for the DS Mine are summarized in Table 2-2 for the fourth quarter of 2012.

Table 2-2. DS Mine Ambient PM$_4$ Crystalline Silica Data

Date	PM$_4$ Crystalline Silica, µg/M^3			Downwind Sampler	Wind Speed, Avg. Mph	Wind 2-Hour Average Directions	Wind 24-Hour Average	Rain or Snow, Inches of Water
	Location 1 Sampler	Location 2 Sampler	Downwind Versus Upwind Difference					
OCT-03	No Data	No Data					S	0
OCT-06	<LOQ	0.44	0.44	Location 2	4.3	N,NNE	NNE	0
OCT-09	No Data	No Data					SSE	0
OCT-12	<LOQ	<LOQ	0	Location 1	3.9	S	S	0
OCT-15	<LOQ	0.38	0.38	Location 2	1.4	S, SE, NNE, N	N	0
OCT-18	<LOQ	<LOQ	0	Location 1	1.5	SSE	SSE	0
OCT-21	<LOQ	<LOQ	0	Location 1	2.9	S, SE, NE	S	0
OCT-24	<LOQ	<LOQ		Mixed	2.7	S, SSE, NNE, NNW	NNW	0.02
OCT-27	<LOQ	<LOQ	0	Location 1	3.3	S,SSW, SE	SE	0
OCT-30	<LOQ	<LOQ	0	Location 2	6.8	N, NNE	N	0
NOV-02	<LOQ	<LOQ	0	Location 2	3.1	N, NNE, NNW	N	0
NOV-05	<LOQ	<LOQ		Crosswind	4.2	S, SSW, ENE, E	S	0
NOV-08	<LOQ	0.31	-0.31	Location 1	5.3	S,SSW	S	0
NOV-11	<LOQ	<LOQ	0	Location 1	5.3	S, SSE, SSW, ENE,E	S	0.49
NOV-14	<LOQ	<LOQ	0	Location 1	3.7	S, SSW	S	0
NOV-17	0.38	<LOQ	0.38	Location 1	7.3	S	S	0
NOV-20	<LOQ	<LOQ		Mixed	1.3	S,SSW, NE, NNE	SSW	0
NOV-23	<LOQ	<LOQ	0	Location 2	7.4	ENE, NE	NE	0
NOV-26	0.38	<LOQ	-0.38	Location 2	4.6	NE, N, NNE	NE	0
NOV-29	0.44	0.38		Mixed	4	NE, SW,N, NNE	NNE	0
DEC-02	<LOQ	<LOQ		Mixed	3.9	NNE, N, S	S	0
DEC-05	<LOQ	<LOQ	0	Location 1	7.6	S, SSW	S	0
DEC-08	<LOQ	<LOQ	0	Location 2	2.0	NNE, ENE	NNE	0.02
DEC-11	<LOQ	<LOQ	0	Location 1	3.5	S, SSW	SSW	0
DEC-14	<LOQ	<LOQ		Crosswind	3.8	N, E, ENE	E	0
DEC-17	<LOQ	<LOQ	0	Location 2	1.9	NE	NE	0
DEC-20	<LOQ	<LOQ	0	Location 2	8.8	N, NNE	N	0
DEC-23	0.44	<LOQ	-0.44	Location 2	3.8	N, NE, NNE	N	0
DEC-26	<LOQ	<LOQ	0	Location 2	3.2	NNW, N	N	0
DEC-29	<LOQ	<LOQ		Mixed	2.8	NE, N, S, SSW	S	0

Note 1. <LOQ indicate values below the minimum level of quantification.

The PM$_4$ crystalline silica concentrations measured at the DS Mine were very low. As indicated in Table 2-2, forty-eight of the fifty-six samples had PM$_4$ crystalline silica levels below the minimum level of quantification of 0.3 µg/M^3. Samples for October 3rd and 9th were not obtained because at this time, sampling was only conducted every sixth day. Starting on October 12th, the sampling frequency was increased to every third day.

The ambient winds passed across the two sampling locations during twenty-one of the twenty-eight sampling days in the Fourth Quarter of 2012. The PM$_4$ crystalline silica concentration change in the upwind-to-downwind direction across the DS Mine ranged from minus 0.44 to plus 0.44 µg/M^3. The average upwind-to-downwind concentration difference was approximately zero.

S&S Mine—The ambient air PM_4 crystalline silica concentrations measured at the S&S Mine are summarized in Table 2-3 for the fourth quarter of 2012.

Table 2-3. S&S Mine Ambient PM_4 Crystalline Silica Data

Date	PM_4 Crystalline Silica, µg/M^3			Downwind Sampler	Wind Speed, Avg. Mph	Wind 2-Hour Average Directions	Wind 24-Hour Average	Rain or Snow, Inches of Water
	Location 1 Sampler	Location 2 Sampler	Downwind Versus Upwind Difference					
OCT-03	No Data	No Data			2.3	S, SSE	S	0
OCT-06	<LOQ	<LOQ	0	Location 2	4.6	W, NNW, WNW	NNW	0
OCT-09	No Data	No Data			5.0	W, SW, WNW	W	0.08
OCT-12	<LOQ	<LOQ	0	Location 1	4.7	SE, SSW, SSE	SSE	0
OCT-15	0.38	0.31		Mixed	1.3	WNW, NW, SW, S	WNW	0
OCT-18	<LOQ	<LOQ	0	Location 1	2.2	SW, WSW, SSW, S	S	0.01
OCT-21	<LOQ	0.38		Crosswind	4	ESE, SSE, SE, E	ESE	0
OCT-24	<LOQ	<LOQ		Mixed	1.8	SSE, ESE, NW, E	ESE	0.1
OCT-27	<LOQ	<LOQ	0	Location 1	1.2	W, SW	W	0
OCT-30	<LOQ	<LOQ	0	Location 2	6.1	N, NNE	N	0
NOV-02	<LOQ	<LOQ	0	Location 2	1.9	WNW, N, NNE	NNW	0
NOV-05	<LOQ	0.38	0.38	Location 2	1.8	ENE, ESE, SE, SW	ENE	0
NOV-08	<LOQ	<LOQ	0	Location 1	5.8	S, SSW, SSE, SW	S	0
NOV-11	No Data	<LOQ		Mixed	10.9	W, S, SW	W	0.28
NOV-14	<LOQ[2]	<LOQ	0	Location 1	2.5	SSE, ESE,S	S	0
NOV-17	<LOQ[2]	<LOQ	0	Location 1	4.3	SE, ESE, S, SSE	SSE	0
NOV-20	<LOQ[2]	<LOQ		Mixed	1.8	SE, WNW, NW, SW	SW	0
NOV-23	<LOQ	<LOQ	0	Location 2	11.2	W, NNW, NW	NNW	0
NOV-26	<LOQ	<LOQ	0	Location 2	5.9	W, WNW, NNW	NNW	0
NOV-29	<LOQ	0.38	0.38	Location 2	2.1	NNE, ENE	NNE	0
DEC-02	0.38[3]	<LOQ		Mixed	2.4	W, NNW, ESE, SE	SE	0
DEC-05	<LOQ	<LOQ		Mixed	4.8	SE, N, NNW, SSE	SE	0
DEC-08	<LOQ	<LOQ	0	Location 1	1.5	NNE, N, ESE, E	ESE	0.01
DEC-11	<LOQ	<LOQ	0	Location 1	4.8	SW, S, SE,WSW	WSW	0
DEC-14	<LOQ	<LOQ		Crosswind	2.3	N, NNE,E	E	0
DEC-17	<LOQ	<LOQ	0	Location 2	2.3	WNW, NNW,W	WNW	0
DEC-20	<LOQ	<LOQ	0	Location 2	12.3	W, NNE, NNW	NNW	0.07
DEC-23	<LOQ	<LOQ	0	Location 2	5.9	NNW, N, NNE, NW	NNW	0
DEC-26	0.38	<LOQ	0.38	Location 2	4.8	NNW, N, WNW	NNW	0
DEC-29	<LOQ	<LOQ	0	Location 1	4.5	NW, W, WSW	WSW	0

Note 1. <LOQ indicate values below the minimum level of quantification.
Note 2. Due to a screen problem with the primary sampler, the collocated sampler was used as a substitute.
Note 3. The sampler operated from 18:00 on December 1st to 18:00 on December 2nd.

The PM_4 crystalline silica concentrations measured at the S&S Mine were very low. As indicated in Table 2-3, forty-nine of the fifty-five samples had PM_4 crystalline silica levels below the minimum level of quantification of 0.3 µg/M^3. Samples for October 3rd and 9th were not obtained because at this time, sampling was only conducted every sixth day. Starting on October 12th, the sampling frequency was increased to every third day. The Partisol 2000i at Location 1 was not available on November 11th due to a problem with the instrument display screen. The collocated sampler was used as the primary sampler for three sample days until the Thermo-Fisher service technician replaced the display screen.

The ambient winds passed across the two sampling locations during twenty of the twenty-eight sampling days in the fourth quarter of 2012. The PM_4 crystalline silica concentration change in the upwind-to-downwind direction across the DS Mine ranged from minus 0.38 to plus 0.38 µg/M^3. The average upwind-to-downwind concentration difference was 0.06 µg/M^3 quantification.

DD Mine—Sampling at the DD Mine did not start until Nov. 17, 2012 when the facility became operational. The data for the DD Mine are summarized in Table 2-4.

Table 2-4. DD Mine Ambient PM_4 Crystalline Silica Data

Date	PM_4 Crystalline Silica, µg/M^3			Downwind Sampler	Wind Speed, Avg. mph	Wind 2-Hour Average Directions	Wind 24-Hour Average	Rain or Snow, Inches of Water
	Location 1 Sampler	Location 2 Sampler	Downwind Versus Upwind Difference					
NOV-17	<LOQ	<LOQ	0	Location 2	6.7	SE,SSE	SE	0
NOV-20	<LOQ	<LOQ		Mixed	1.8	W,WNW, S, SSE	SSE	0
NOV-23	<LOQ	0.38	-0.38	Location 1	15.1	W,WNW, NW	WNW	0
NOV-26	<LOQ	<LOQ		Mixed	6.3	NW, WNW, SW, S	NW	0
NOV-29	<LOQ	<LOQ		Mixed	4.5	SSE,NNE, NE,ENE	NE	0
DEC-02	<LOQ	<LOQ	0	Location 2	4.4	W, NW, SSE, SSE	SSE	0
DEC-05	<LOQ	<LOQ	0	Location 2	6.3	NW, ESE, SE, SSE	SE	0
DEC-08	<LOQ	<LOQ	0	Location 2	2.7	ENE, SSE, E	E	0
DEC-11	<LOQ	<LOQ	0	Location 2	3.3	S, SSE, SW, WSW	SSE	0
DEC-14	0.50	<LOQ		Crosswind	4.6	NE, ENE, ESE, E	ESE	0
DEC-17	<LOQ	<LOQ	0	Location 1	3.7	NW, SW, E, SE, ENE	WNW	0
DEC-20	<LOQ	<LOQ	0	Location 1	1.3	N, NNW, NW	NNW	0.02
DEC-23	<LOQ	<LOQ	0	Location 1	6.3	NNW, N, NNE	NNW	0
DEC-26	<LOQ	<LOQ	0	Location 1	1.1	WNW, N, NNE	NNW	0
DEC-29	<LOQ	0.63		Crosswind	3.1	NNW, WSW,W, SW	WSW	0

Note 1. <LOQ indicated value below the detection limit.

The PM_4 crystalline silica concentrations measured at the DD Mine were very low. As indicated in Table 2-4, twenty-seven of the thirty samples had PM_4 crystalline silica levels below the minimum level of quantification of 0.3 µg/M^3. The ambient winds passed across the two sampling locations during ten of the fifteen sampling days in the Fourth Quarter of 2012. The upwind-to-downwind concentration differences ranged from zero to minus 0.38 µg/M^3 and averaged minus 0.04 µg/M^3.

Summary of Data from the Four EOG Facilities—A total of 201 24-hour average concentration measurements were conducted at the four facilities. The PM_4 crystalline silica concentrations at all four facilities during the fourth quarter of 2012 averaged 0.08 µg/M^3 of PM_4 crystalline silica over the minimum level of quantification.

The measured PM_4 crystalline silica concentrations are similar to previously published ambient crystalline silica data measured in California by the California EPA, the South Coast Air Quality Management District (Los Angeles), and Air Control Techniques, P.C.[2]

3. QUALITY ASSURANCE

Quality assurance procedures that exceed the stringent requirements of 40 CFR Part 50, Appendix L and EPA's quality assurance guideline manual were used in this project. The Partisol 2000i samplers used for PM_4 crystalline silica sampling at all four facilities satisfied these requirements throughout the 2012 fourth quarter study period.

3.1 Partisol 2000i Sampler Performance

The Partisol 2000i tracks the sample flow rate, the coefficient of flow variation, the ambient air and filter temperatures, and the ambient air and filter atmospheric pressures on a continuous basis during the 24-hour sampling period. All twelve of the Partisol 2000i primary and collocated (duplicate) samplers achieved the required flow rate of 11.1 liters per minute, a coefficient of flow variation below the ±4% limit, ambient and filter temperature variations less than 2°C, and ambient and filter atmospheric pressure less than 10 mm mercury. The electronic tracking data are summarized in Appendix B of this report.

3.2 Routine Sampler Performance Verification and Sampler Calibration

In this sampling project, leak checks and sample flow audits were performed every two weeks. This is more frequent than guidelines provided by the instrument manufacturer and the U.S. EPA quality assurance manual. All twelve of the Partisol 2000i samplers met all of these quality assurance objectives as indicated in the data summaries provided as Appendix C of this report.

Air Control Techniques, P.C. conducted an audit of all twelve samplers in November 2012 and three point calibrations of all of the samplers prior to the start of the fourth quarter. Kraemer Mining personnel conducted three point calibrations on three occasions when needed due to equipment maintenance. The calibration data are summarized in Appendix D of this report along with the calibration data supplied by the instrument manufacturer when the samplers were purchased. The field data sheets are reproduced in Appendix E of this report.

3.3 Collocated Sampler Precision

The collocated (duplicate) sampler at location 1 of each of the four facilities operated once every twelve calendar days. The PM_4 crystalline silica data from the collocated samplers provides a means to confirm proper operation of the samplers. The collocated sampler data summarized in Table 3-1 demonstrates good agreement between the two identical samplers at location 1 at each facility. The differences that do exist in the data set summarized in Table 3-1 are due primarily to the number of samples below the quantification limit. Measurements below the minimum level of quantification are shown as "<LOQ" in this table.

Due to the extremely low PM_4 crystalline silica concentrations, it is not possible to calculate the quarterly percent differences for each set of primary and collocated samplers as described in Equations 26 and 27 of Section 5.5.3 of 40 CFR Part 58 Appendix A, applicable to $PM_{2.5}$ with collocated Federal Reference Method (FRM) samplers. Instead, the percent differences for each set of primary and collocated samplers have been calculated based on the PM_4 particulate matter data. The results of these calculations are summarized in Table 3-2.

Table 3-1. Comparison of Location 1 Primary and Collocated Sampler Data PM_4 Crystalline Silica Concentrations, Micrograms per Cubic Meter[3]								
Date	Chippewa Falls		DS Mine		S&S Mine		DD Mine	
	Primary Sampler	Collocated Sampler	Primary Sampler	Collocated Sampler	Primary Sampler	Collocated Sampler	Primary Sampler	Collocated Sampler
Oct. 12	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	No Data[2]	No Data[2]
Oct. 24	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	No Data[2]	No Data[2]
Nov. 05	0.31	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	No Data[2]	No Data[2]
Nov 17	<LOQ	<LOQ	0.38	<LOQ	No Data[1]	No Data[1]	No Data[2]	No Data[2]
Nov. 29	0.56	0.56	0.44	0.38	<LOQ	<LOQ	<LOQ	<LOQ
Dec. 11	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ
Dec. 23	<LOQ	<LOQ	0.44	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ

Note 1: Primary sampler down for screen repair, collocated sampler operated as a substitute for the primary sampler
Note 2: Sampling network and plant not yet operational
Note 3: Concentrations of equal to or less than 0.30 $\mu g/M^3$ of PM_4 crystalline silica cannot be quantified.

Table 3-2. Quarterly Percent Differences of Primary and Collocated Sampler PM_4 Particulate Matter Concentrations at Location 1	
Facility	Percent Differences, %
Chippewa Falls	-3.44
DS Mine	-10.9
S&S Mine	4.7
DD Mine	-6.6

These data demonstrate that the PM_4 samplers used in the network at each facility are working properly. The proper performance of these instruments is further indicated by the good correlations between the primary and collocated samplers for PM_4 particulate matter data shown in Figures 3-1 through 3-4.

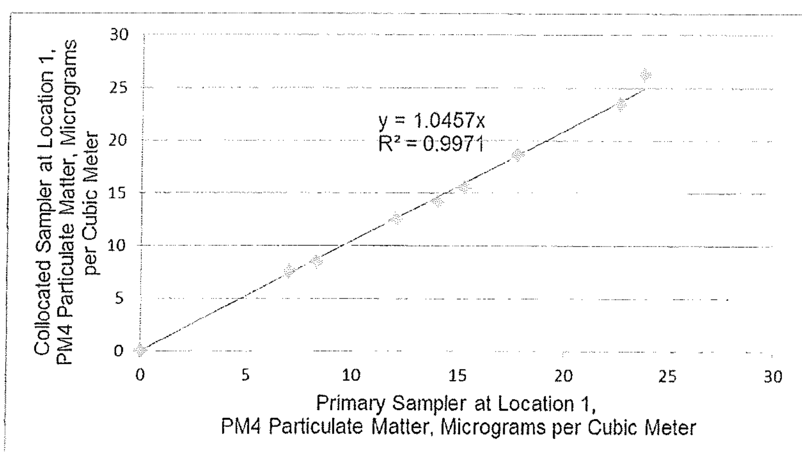


Figure 3-1. Chippewa Falls Location 1 Primary and Collocated Sampler Correlation

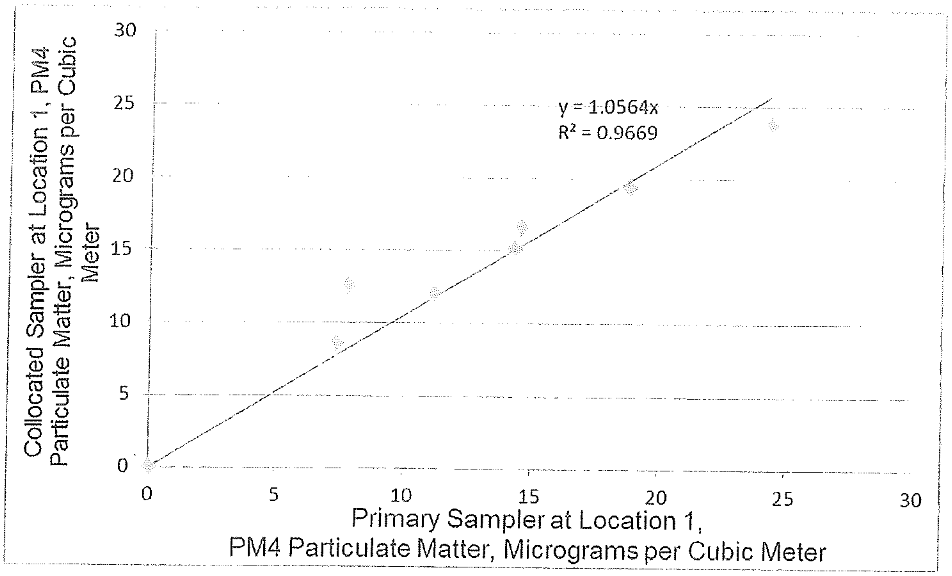


Figure 3-2. DS Mine Location 1 Primary and Collocated Sampler Correlation

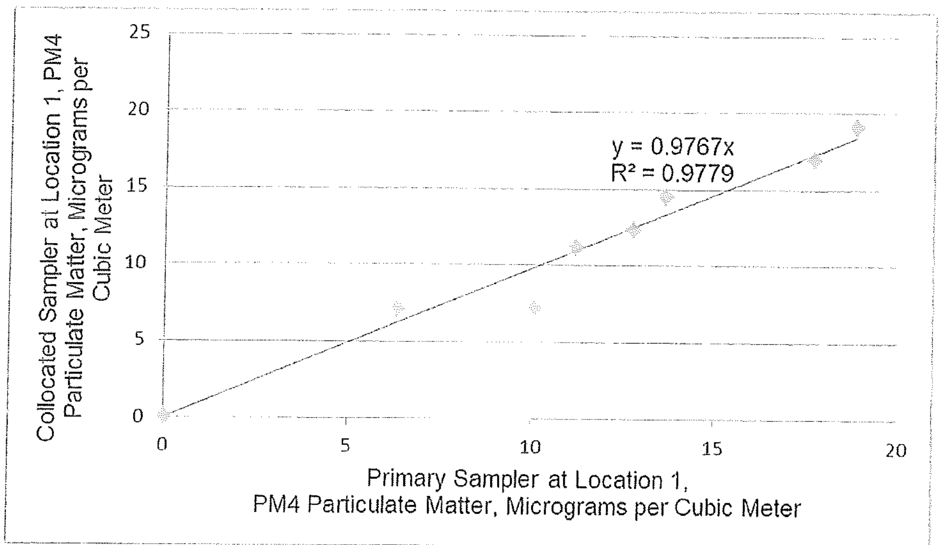


Figure 3-3. S&S Mine Location 1 Primary and Collocated Sampler Correlation

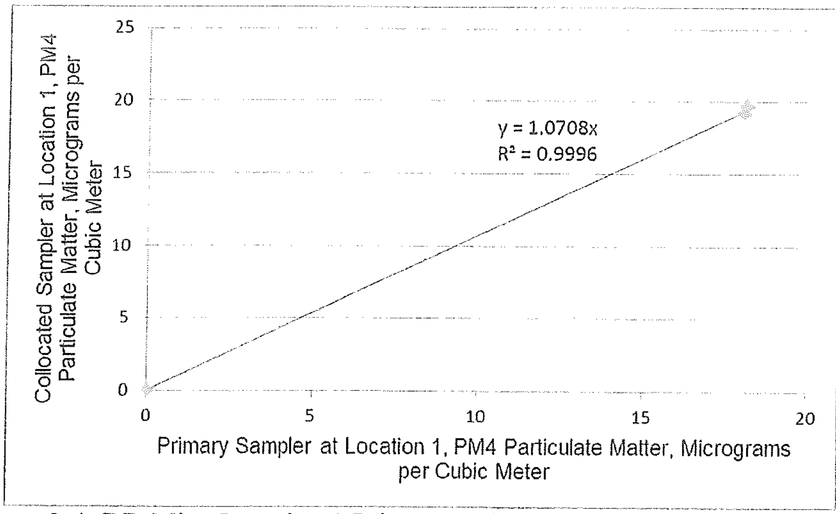


Figure 3-4. DD Mine Location 1 Primary and Collocated Sampler Correlation

3.4 Filter Blanks

The sampler operator installed and recovered a blank filter every tenth sampling period. The results of the blank filter analyses summarized in Tables 3-3 through 3-6 indicated non-quantifiable levels in all of the samples. These results demonstrate that the filters are not subject to contamination during filter loading, filter recovery, and laboratory analysis.

Table 3-3. Filter Blanks, Chippewa Falls

Date	Location 2 Primary		Location 1 Primary		Location 1 Collocated	
	Filter	mg/filter	Filter	mg/filter	Collocated	mg/filter
Sept. 20	206404	<LOQ	206405	<LOQ	206406	<LOQ
Oct. 19	206614	<LOQ	206615	<LOQ	216616	<LOQ
Nov. 21	206697	<LOQ	206699	<LOQ	206801	<LOQ
Dec. 18	206897	<LOQ	206899	<LOQ	206901	<LOQ

Table 3-4. Filter Blanks, DS Mine

Date	Location 2 Primary		Location 1 Primary		Location 1 Collocated	
	Filter	mg/filter	Filter	mg/filter	Collocated	mg/filter
Oct. 16	206605	<LOQ	206607	<LOQ	206609	<LOQ
Nov. 21	206802	<LOQ	206804	<LOQ	206806	<LOQ
Dec. 18	206885	<LOQ	206887	<LOQ	206889	<LOQ

Table 3-5. Filter Blanks, S&S Mine

Date	Location 2 Primary		Location 1 Primary		Location 1 Collocated	
	Filter	mg/filter	Filter	mg/filter	Collocated	mg/filter
Oct 16	206450	<LOQ	206602	<LOQ	206604	<LOQ
Nov. 21	206692	<LOQ	206694	<LOQ	206696	<LOQ
Dec. 18	206891	<LOQ	206893	<LOQ	206895	<LOQ

Table 3-6. Filter Blanks, DD Mine						
Date	Location 2 Primary		Location 1 Primary		Location 1 Collocated	
	Filter	mg/filter	Filter	mg/filer	Collocated	mg/filer
Dec. 18	206903	<LOQ	206905	<LOQ	206907	<LOQ

3.4 Filter Analysis Quality Assurance/Quality Control

Calibration standards were made by direct weighing of NIST 1878a, NIST 1879a, and NIOSH/ITRI tridymite reference materials onto silver membrane filters. A pure quartz sample was run to keep track of the X-ray intensity over time. These samples were used to determine if the instrument was faulty or if the X-ray intensity had degraded enough to warrant a new X-ray tube.

Once every month, R. J. Lee conducted a resolution check of the instrument. The pure quartz sample was run to show the "five finger" region. The resulting diffraction pattern was compared with the previous month to determine if anything had changed with the instrument alignment. The instrument operated properly during all sample analyses.

Microbalances were calibrated daily by R. J. Lee using ASTM Class 1 calibration weights. Filters were pre-weighed, and the weights were stored in a database. Every tenth filter was re-weighed and compared to the previous result. The balance room was monitored daily for temperature and humidity.

All filter samples were recovered by the sampler operator using standard procedures specified in the Thermo Scientific Partisol 2000i manual, Chapter 3. All of the filter cassettes recovered following sampling were transported in a sealed case to prevent contamination during transport.

The filter cassette samples were packed in an appropriate shipping box and sealed. A chain of custody record and sample log were maintained during the sampling program. The R. J. Lee Group laboratory analysis sheets and the chain-of-custody sheets are reproduced in Appendix F.

4. MAINTENANCE

The sampler operator performed routine maintenance in accordance with the schedule summarized in Table 4-1. The samplers have not operated sufficiently long to trigger the 6 month scheduled maintenance.

Table 4-1. PM_4 Sampler Maintenance Schedule		
Maintenance Activity	Frequency	Notes
Clean SCC	Once every 2 weeks	Observed dust levels in the SCC and the PM_{10} inlet have been low.
Clean PM_{10} inlet	Once every 2 weeks	
Clean cabinet inlet	Once every 4 weeks	
Clean O-rings	Once every 4 weeks	
Check the sampler clock	Once every 4 weeks	
Clean large in-line filter	Once every 6 months	
Clean screens under rain hoods	Once every 6 months	
Check battery voltage	Once every 6 months	Replace battery if necessary

During the fourth quarter, there was one operational issue with a Partisol 2000i sampler at the S&S Mine. The Thermo-Fisher factory representative visited the site and replaced the main display screen.

5. References

1. Richards, J. and T. Brozell. "Ambient PM_4 Crystalline Silica Monitoring Method Development," Preprint

2. Richards, J. "Ambient Crystalline Silica" Unpublished Paper, October 24, 2012.

Appendices

A. Meteorological Data
B. Sampler Performance Data
C. Sampler Audit Data
D. Independent Audit and Calibration Data
E. Field Data Sheets
F. Laboratory Data Sheets and Chain-of-Custody Sheets

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1 March 2013

Dear Ms. Johnson:

Thank you for the opportunity to conduct air particulate sampling in the City of Winona as part of our faculty-student research at the University of Wisconsin-Eau Claire.

On January 14, 2013 students Jeron Jacobson, Zach Kroening, and Kim Shermo used our TSI DustTrak 8520 aerosol monitor to assess air quality in two locations in Winona: 1) County Highway 6 just east of County Highway 123; and 2) The Winona City Garage yard. At each location, we collected samples of 1-2 min in duration to measure PM_{10}, also known as "coarse particulates" of diameter 10 micrometers and smaller, and $PM_{2.5}$, also known as "fine particulates" of diameter 2.5 micrometers and smaller. The $PM_{2.5}$ particle size range is most clearly associated with health effects including cardiovascular disease, lung disease and lung cancer.

Here are the results of our sampling:

Site #1 Results:

PM 2.5:

- Average minimum: 13 micrograms/m3
- Average maximum (without truck interference): 22 micrograms/m3
- Average maximum (with truck interference): 40 micrograms/m3
- **Site average (with truck interference): 19 micrograms/m3**

PM 10:

- Average minimum: 14 micrograms/m3
- Average maximum: 23 micrograms/m3
- **Site average: 17 micrograms/m3**

The wind direction was mostly westerly (3 samples were south-westerly) at an average of 1.8 m/s. The collection times were between 10:54 am-12:04 pm. Our sample durations ranged from 56 seconds to 2 minutes and 19 seconds. We collected a total of 8 samples for each particle size in locations approximately 30 feet apart.

Site #2 Results:
PM 2.5:
- Average minimum: 17 micrograms/m3
- Average maximum: 20 micrograms/m3
- **Site average: 19 micrograms/m3**

PM 10:
- Average minimum: 19 micrograms/m3
- Average maximum: 28 micrograms/m3
- **Site average: 23 micrograms/m3**

The wind direction was westerly at an average speed of 1.24 m/s. The collection times were between 2:00 pm-3:15 pm. Our sample durations ranged from 42 seconds to 2 minutes and 25 seconds. We collected a total of 8 samples for each particle size in locations approximately 30 feet apart.

Interpretation of local air particulate concentrations should be considered in the context of regional conditions measured by state agencies. On January 14, 2013, the Wisconsin Department of Natural Resources measured $PM_{2.5}$ at 38 micrograms/m3 in Eau Claire County and 29 micrograms/m3 in LaCrosse County between 11–noon (during sampling at Site #1) and at 42 micrograms/m3 and 30 micrograms/m3 between 2–3 pm (during sampling at Site #2, http://dnrmaps.wi.gov/imf/imf.jsp?site=wisards). Using the values from LaCrosse County (closer to Winona), the measured $PM_{2.5}$ concentrations in Winona were 10–11 micrograms/m3 lower than those measured by the WDNR in LaCrosse County.

The national US EPA standards for $PM_{2.5}$ concentrations are 35 micrograms/m3 over a 24-hour period and 12 micrograms/m3 over an annual period.

Our measurements should be interpreted cautiously, as they provide a "snapshot" of air quality that is affected by wind, precipitation and activities in the area. An improved assessment of air quality would entail longer-term measurements of $PM_{2.5}$ concentrations. We recommend requiring long-term $PM_{2.5}$ monitoring of sand mining, transportation and processing facilities and comparison to EPA standards to protect public health.

Sincerely,

Excellence. Our measure, our motto, our goal.

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