Proposal

Air Monitoring Recommendations to FHR

From the CAC Environmental Committee

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Community Advisory Council to Flint Hills Resources

About This Report

The purpose of this report, written by the Community Advisory Council's Environmental Committee, is to provide Flint Hills Resources with specific recommendations as what the committee believes should be implemented with regard to air monitoring. The committee consists of Otto Ped, Greg Schuck, Gary Stevens, Frank Knoll, Scott Parr, Jeff Wilkes, and Dave Erlandson. This report does that.

This report is organized into sections.

Executive Summary provides a review of the key recommendations in this report.

Background and Methodology helps the readers understand the program objectives, how information was gathered and organized and CAC's methodology for determining air monitoring recommendations

Recommendations from the STS study provide the results and recommendations from an assessment of the current air monitoring system.

Final recommendations from the committee

CONTACT INFORMATION:
Community Advisory Council to Flint Hills Resource's Pine Bend Refinery
Phone: 651-429 -8391
Web site: www.pbcac.org

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EXECUTIVE SUMMARY

The purpose of this report, written by the Community Advisory Council's Environmental Committee, is to provide Flint Hills Resources with specific recommendations as what the committee believes should be implemented with regard to air monitoring. The committee consists of Otto Ped, Greg Schuck, Gary Stevens, Frank Knoll, Scott Parr, Jeff Wilkes, and Dave Erlandson. This report does that.

The recommendations are

1. Accept the MPCA's offer to begin particulate testing for metals using the every 6th day, 24 hour sampling plan. Covered in the MPCA's monitoring plan are the key metals that pose the highest risk - chromium compounds, nickel compounds, cobalt compounds, zinc compounds, and manganese compounds. The committee is requesting information from the MPCA on how they ensure the integrity of the analyses conducted. The committee is asking that sampling and analysis be conducted at 4 sites (see item 2 below). The committee believes the quality control process should include some form of independent audits or independent sampling. The committee will make an additional recommendation with regards to verification of MPCA results after digesting information from the MPCA. The committee is recommending that FHR regularly report results (of all materials analyzed) to the committee

2. Monitoring should be done at four locations surrounding the refinery until there is evidence to reduce the number of sampling sites. The 4 recommended sites are 420 (east), 423 (northwest), Wayne (north) and 442 (southeast).

3. Analyze the HAPs and Sulfur data at 441 and 442 and see if there are any significant differences in results. Relocation of 441as a HAPs and Sulfur monitoring site depends on the findings.

4. The committee encourages FHR to continue its plans for reducing benzene emissions. The committee request annual reports on progress and air sampling results.

5. The committee would like MPCA's assistance in gathering information from knowledgeable sources on the three chemicals that FHR does not emit and yet concentration levels are high: acrolein, carbon tetrachloride and formaldehyde. The committee is interested in probable sources and health effects.

BACKGROUND

In order to better understand the recommendations and how they were generated it is important to have some background on the events that led up to them.

In the winter of 2001 the CAC began to look closely at the air monitoring system in and near Flint Hills Refinery with the goal of developing a recommendation to Flint Hills - written from the perspective of those who live near the refinery. A key step in developing our recommendation was understanding what the current air monitoring network is set up to do and what it isn't set up to do. This led us to the first phase of background work.

In order to gain a better understanding of the current air monitoring system the CAC hired STS Consultants of Maple Grove, MN to examine the current system and write report. The report, written by Dr. Jeff Stevens was titled *Flint Hills Air Monitoring Data Analysis Summary Report, March 6, 2002***.** The following excerpt from the report provides a good synopsis of the current air monitoring system.

"The Minnesota Pollution Control Agency (MPCA) currently conducts ambient air quality monitoring at four sites near the Flint Hills Rosemount petroleum refinery (facility). Table 1 summarizes which parameters are currently being monitored at each of these locations. In the past, several other monitors existed (e.g., Site 426) and other analytes, i.e., particulate matter (PM_{10}) and metals, had been monitored.

Table 1 - Monitoring Site Summary

Parameter	**Desig.**	**Site 420**	**Site 423**	**Site 441**	**Site 442**
Carbon Monoxide [1]	CO	X	X		
Nitric Oxides [1]	NO_x	X	X		
Nitrogen Dioxide [1]	NO_2	X	X		
Sulfur Dioxide [1]	SO_2	X	X	X	X
Total Reduced Sulfur [1]	TRS			X	X

Hazardous Air Pollutants [2]	HAPs	X	X	X	X
Wind Speed	WS	X	X		
Wind Direction	WD	X	X		
Temperature	Temp	X	X		

[1] Emitted from refinery in reportable quantities

[2] Only certain HAPs emitted from refinery in reportable quantities (see Table 4)

All of the parameters listed above are being measured in the field on a continuous basis, except for the hazardous air pollutants (HAPs). HAPs samples are taken as 24-hour composite samples, collected once every six days. HAPs samples are sent to the MPCA laboratory where they are analyzed for a variety of specific volatile compounds. Table 2 lists the specific chemicals currently being analyzed for in the HAP samples.

Table 2 - Analyzed HAP Species

Constituent
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon 114)
Trichlorofluoromethane (Freon 11)
Dichlorodifluoromethane (Freon 12)
1,3-Butadiene
Formaldehyde
Acetaldehyde
Propionaldehyde
Acrolein
Butyraldehyde
t-Crotonaldehyde

Acetone
Methylene Chloride
Chloroform
Carbon Tetrachloride
1,1-Dichloroethane
1,1,1-Trichloroethane
1,2-Dichloroethane
Tetrachloroethylene
1,1,2,2-Tetrachloroethane
Bromomethane
1,1,2-Trichloroethane
Trichloroethylene
1,1-Dichloroethylene
1,2-Dichloropropane
t-1,3-Dichloropropylene
1,3-Dichloropropylene
c-1,2-Dichloroethylene
1,2-Dibromoethane
Hexachlorobutadiene
Vinyl Chloride
o-Xylene
m/p-Xylene
Benzene
Toluene

Ethylbenzene
1,3,5-Trimethylbenzene
1,2,4-Trimethylbenzene
Styrene
4-Ethyltoluene
Benzaldehyde
Chlorobenzene
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene

As discussed at a February 11, 2002 project meeting, the objective of this monitoring network was not specifically to determine the ambient air impacts of this facility on the surrounding neighborhoods. Rather, the system is primarily used to provide ambient air quality data to the MPCA from this area for comparison to other sites located throughout Minnesota. Thus, it is not surprising that our evaluation such as this of this monitoring network vis-à-vis its ability to determine the health impacts of the facility on its adjacent neighborhoods indicates a less than perfect system."

And the conclusion from the report is as follows:

"Based on the analyses conducted as part of this project, it can be concluded that the current monitoring system near the Flint Hills Resources refinery is not likely adequate to determine the ambient air impacts of the facility nor its potential impacts on public health. The current monitoring network exhibits limitations in the following areas:

- The types of chemicals being monitored (specific inorganic emission compounds were identified as being relatively most hazardous; compounds which are not currently being monitored).
- The locations of the monitors may not be situated in areas where the greatest ambient air impacts by the facility are expected to occur, especially if these areas are where residents/workers exist (an air dispersion modeling analysis could be conduced to address this issue).
- Monitoring frequency and duration of sampling in the current system is not ideal for either acutely or chronically toxic chemicals, although the current system is better suited for chronic health impact analyses. Air dispersion modeling analyses or placement of directional monitors into the network, with high temporal resolution, could be used to address this limitation.

These data also indicate that the general air quality in the vicinity of these monitors is good, at least with respect to the chemicals currently being monitored. Specific source(s) for formaldehyde, acrolein and carbon tetrachloride should be investigated, however, since these compounds exhibit significant air concentration in the area."

Another way to summarize this data is by first looking at the results for the chemicals being monitored. The chemicals fall into one of two categories:

chemicals emitted from the refinery or chemicals emitted from sources other than the refinery. Then the next step is to evaluate what chemicals are being emitted from the refinery that are potentially hazardous and are not being monitored. The results are

1. Air Monitor results – Chemicals Being Monitored.

Chemicals coming from Flint Hills Resources (FHR): Except for benzene, all pollutant concentrations are well below their annual criteria.

Chemicals coming from somewhere other than FHR: Three entities are above the federal or state annual criteria. They are formaldehyde, carbon tetrachloride, and acrolein. Formaldehyde and carbon tetrachloride are carcinogens and acrolein is a lung irritant.

Monitor results are from a 24-hour average, one-out-of-every-six days. This is not ideal for comparison to chronic or acute criteria, but is acceptable for chronic criteria. 24-hour averaged data are not particularly useful for acute risk analyses.

2. What's not being monitored?

There are many more chemicals being emitted than are being monitored. Relative health impacts for all emissions were calculated by dividing the Annual Emission Rate of a Chemical by the Chemical's Toxicity Value. This identifies the top pollutants that have the highest potential health impact. These substances are chromium compounds, nickel compounds, cobalt compounds, zinc compounds, chlorine, and manganese compounds. There are more compounds on the list, but their relative health impact factor is below perchloroethylene, which is monitored, and results are well below annual criteria.

STS Recommendations

The results of the air monitoring report led to further actions

1. Investigate the requirements, both technical and economics of sampling for the key inorganic materials not being monitored today. These materials are chromium compounds, nickel compounds, cobalt compounds, zinc compounds, chlorine, and manganese compounds.
2. Investigate where the monitors should be placed for maximum efficiency
3. Investigate how sampling frequencies or procedures can be altered to obtain data for both chronic and acute levels. Today the sampling frequency can be used for chronic.
4. Recommend that FHR take action to reduce benzene emissions
5. Recommend that FHR assist with identifying likely sources for carbon tetrachloride, acrolein, and formaldehyde as these chemicals are exceeding annual chronic health criteria limits

Final Committee Recommendations

On September 5, 2002 a meeting of the environmental committee along with representatives from Flint Hills (Mike Hansel, Kevin Proops, Brian Roos, and Scott Lindemann) and from the MPCA (Rick Strassman and Dean Fundine) to discuss the issues noted above. A subsequent meeting was held on October 24, 2002 with Greg Shuck, Frank Knoll, Otto Ped, Scott Parr, Jeff Wilkes, Gary Stevens, and Dave Erlandson. The results from these two meetings are listed below.

Monitoring for Metals

With regard to the technical and economic feasibility of measuring for inorganic metals it was learned that the MPCA has just purchased a new analytical instrument (ICAP) for metal scans and the instrument will be operational by the end of the year. The instrument will scan for 80 compounds including all the inorganic metals that we wanted monitored. The machine will use a total suspended particulate (TSP) sample methodology.

One of the metals that we are most concerned with is Chromium 6 and the ICAP can't measure for Chromium 6, however it can measure for total Chrome. So the initial plan is to analyze for total Chrome and then drill down for Chromium 6 if the total Chrome results are high.

While the committee is delighted the MPCA is going to be adding sampling for metals as part of its normal testing two issues arose. First the MPCA recommended installing 4 particulate monitors and then suggested only sampling at two sites. The reason given was staffing for the extra data points may be required. Obviously the committee disagrees and will push for sampling from all four monitors. Second there is concern about a sole source for analysis of the data and recommends that an auditing procedure using a second source be implemented.

Another chemical that was determined to be a potential hazard was Chlorine. Discussion from Flint Hills' technical staff and MPCA confirmed that Chlorine doesn't remain in a pure form; rather it quickly combines with other elements. Thus the only time measuring Chlorine would make sense is if there was a release.

Air Monitor Location Summary and Recommendation

The CAC has been asked to make recommendations for the placement of air monitors near the refinery. Today air monitors exist for hazardous air pollutants (HAPs) at sites 420 (east), 423 (west), 441 (south), and 442 (southeast). Sites 420 and 423 also monitor criteria pollutants. Currently there is no monitor to the north of the refinery, but there has been at times in the past. Now, for the first time, the MPCA is starting a statewide program to monitor for particulates. The CAC is recommending that samples be taken from at least 4 new particulate monitors to be located near the refinery. The current task is to come to a consensus on where to locate 4 new particulate air monitors. A byproduct of this activity may also be the relocation of an existing HAPs monitor.

The placement of air monitors is controversial due to the varied interests of the parties involved. After hours of discussion about the placement of the new particulate air monitors the committee has not reached a consensus. This is a topic that carries strong emotions and opinions. The rationale for air monitor placement can be segmented into two lines of reasoning. I call them "Theoretical/Scientific" and Experiential/At My House

"Theoretical/Scientific" Rationale

The "Theoretical/Scientific" approach involves collecting data on refinery emissions plus meteorology information such as wind speed and direction and then creating a model of refinery emissions to determine the locations where the concentrations will likely be the highest. Then monitors are placed in these "hotspot" locations. Ideally these monitors would be providing real-time data or at a minimum activated when the wind is in the proper direction. This approach was recommended by consultants (STS) engaged to look at the existing air monitor network. Current technology and economic limitations combined with national and state sampling procedures have limited the options to real-time monitoring for criteria pollutants and 24 hour, once every 6th day sampling for HAPs and particulates.

Another "Theoretical/Scientific" method calls for placing the monitors in a ring around the perimeter of refinery or at least one in each of the four directions. The idea is to cover emissions for all wind directions. This is what the MPCA is recommending for the new particulate air monitors that will come online soon. **They have gone so far as to choose two sites 420 and 423 for the new particulate monitors; leaving the committee to recommend the remaining two sites**. Their preference is to locate the remaining two particulate monitors at sites just north and south (441) of the refinery. This line of reasoning is predicated on the idea that air emission concentrations will be highest at these monitoring sites and any location further away will experience lower emission concentrations. By covering all four sides of the refinery all of the surrounding area is covered as well.

Experiential/At My House Rationale

Many of the neighbors of FHR that have experienced refinery emissions in the past believe that the topography of the area effects the concentrations of air emissions in regions near the refinery. Their belief is that northerly and northwesterly winds carry emission in higher concentrations through the valley, which is southeast of the refinery than to the south or southwest of the refinery. This belief has led to the placing of a HAPs monitor at site 442 even though a HAPs monitor is already in place at site 441. These same neighbors have taken exception to the actual site of 441 due to the low elevation of the site.

Many of these neighbors have also suggested that air monitors placed in very close proximity to the refinery are too close to accurately reflect emission concentrations because the height of the stack increases the distance from the refinery emissions will travel before reaching the ground.

Another valid reasoning for locating air monitors is the desire of each person to know what the air quality is where they live, regardless of what the air quality is at a nearby monitor. This for many who live near the refinery is the most important factor for locating air monitors. Their desire to know the concentrations of emissions that they experience is understandable.

A potential negative to the 442 site is that it may well pick up emissions from Endres or Spectro Alloy and not be totally reflective of the emissions from FHR. Again this goes back to the purpose of air monitoring. Is it solely to determine what the refinery is emitting or is it to understand the air quality in the neighborhood?

Unfortunately these two lines of reasoning are in opposition when it comes to the location of one new particulate air monitor to the south or southeast of the refinery (provided a choice has to be made between them.) The "Theoretical/Science" reasoning dictates the monitor should be placed directly south of the refinery at 441. The experience of neighbors favors site 442. The underlying assumption here is that the number of air monitoring sensors is limited to 4 due to financial resources.

So what's the answer?

The CAC is comprised of members of the community and in particular community members that live near the refinery. Thus in this situation the influence of the community experience has to be taken seriously and **the third monitor should be placed at 442**.

The site for the fourth air monitor then is between 441 and a new site directly north of the refinery (Wayne). Using the reasoning of sighting monitors where the people live there is no preference between these two site. Neither has a high concentration of residents. Another line of reasoning is required to make the selection.

One line of reasoning is that in the summer the prevailing winds are from the south. And to accurately reflect emissions in the summer the monitors should be

downwind (north of the refinery). The only way to insure monitors are downwind is to place monitors on all four sides of the refinery. **This would dictate the fourth particulate monitor be placed to the north of the refinery**.

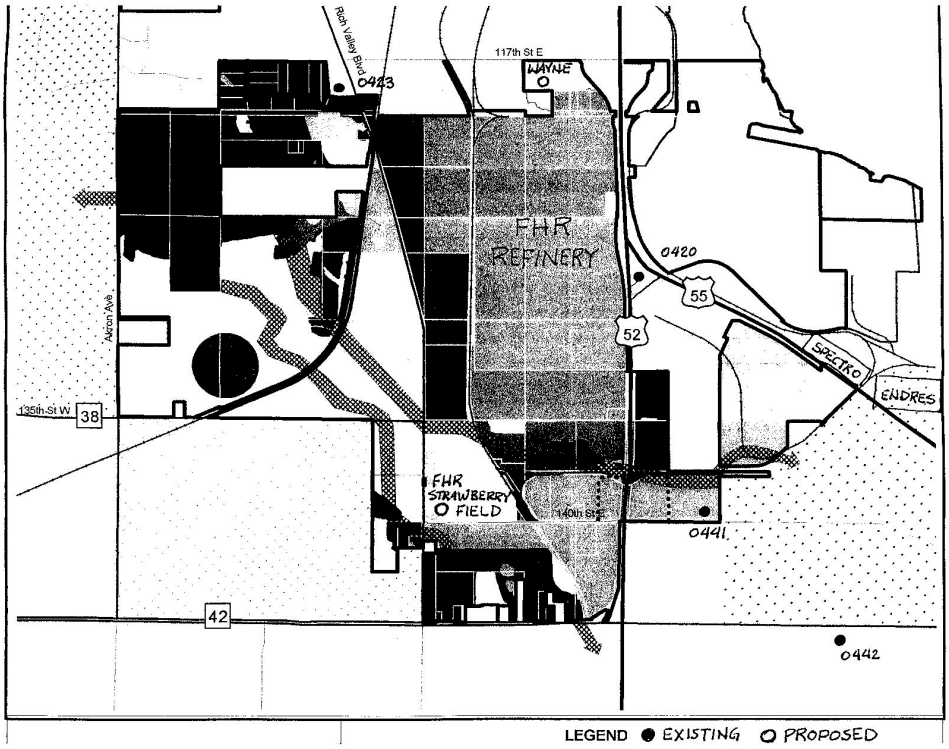
Another line of reasoning is to place the monitor at 441 and continue to collect data to determine if there are any real differences between 441 and 442. We currently have two years worth of HAPs data from 441 and 442 that needs to be analyzed. If no differences are found between the sites, one of the monitors (HAPs and particulates) should be moved to another location.

Our recommendation, assuming we are limited to 4 particulate and HAP's monitors, is to place the particulate monitors at 420, 423, 442, and to the north of the refinery.

The HAPs and Sulfur data at 441 and 442 should be analyzed to determine if there is any difference in results between the two sites. Depending on this analysis it may make sense to move the HAP's and Sulfur monitor at 441 to the northern site as well.

If the line of reasoning that monitors should be placed where people live prevails then as Rosemount continues to grow towards the east it may at a future time suggest the addition of a monitor to the southwest of the refinery will be needed.

Figure 1: Map of Air Monitoring Sites at FHR



Chronic vs. Acute – Sample Frequency

The MPCA is going to use the 24 hour, every 6th day sampling plan for metals, the same plan it uses for HAPs. The reason for this is that this is the sampling plan used by all the other sites throughout the state and in fact throughout the nation. Having the same sampling plan allows the MPCA to make comparisons to all the other sites. There are two general sets of opinions when it comes to the validity of this data for chronic health assessment. One group thinks the data is not useful and another group that believes the data is useful. Jeff Stevens indicated in his report that the sampling plan is not optimal, but correlations can be made.

The problem of acute sampling still remains. The issue we have with the current sampling plan is that is not appropriate for monitoring for acute health risks. The idea solution is to have a real-time air sampling sensor in each person's yard and

the results would be displayed on a monitor inside each person's house. A warning would sound if any chemical exceeded the acute or chronic limits.

Unfortunately the technology and economics of real-time monitoring for VOC's is not feasible. The main manufacturer of real-time gas chromatographs, Perkin Elmer has discontinued production. And real time monitoring for metals is not possible either. Other technologies such as badges were discussed. Badges are used in working environments to detect high limits of certain substances. The technology is limited in that you have to specify which chemical you want to monitor and then the badges only work for 8-24 hours at a time, they cost about $100 each and are not very sensitive in their ability to measure concentrations.

One other solution that was discussed is to have the ability to take a sample when someone suspects they detect an emission. This would require a separate sampling station or stations, quite possibly mobile stations that could be moved to a site depending on the requests from neighbors or they could be used by FHR in the event of a known release. In order to make this work a system would have to be set up to determine how many mobile stations are needed and what training requirements exist to take a good sample, determining who can take a sample, and interpreting the results as the source of the pollutant may not be easily determined. The advantage of this solution is that one would be able to determine if what they were detecting was in fact hazardous. The down side is since the analysis is done at a later time the person who is being exposed to the pollutants wouldn't know until sometime later what they were actually exposed to.

Preliminary feedback from FHR is there are a number of issues to be resolved, particularly in how this would be implemented. Given this feedback the committee recommends that it reconsider this issue and come back with a new recommendation at a later time.

Benzene Reduction Plan

In June representatives from FHR presented their plans for reducing Benzene emissions. In 1997 benzene emissions were approximately 18,000 pounds per year. In 2001 they were reduced to 10,000 pounds per year. By 2004 emissions are projected to be reduced by another 2,200 pounds per year or 20%. This is being accomplished through improved seals on tanks, leak detection and repair, improvements to the wastewater treatment plant, vapor recovery systems for loading, and by increased demand for low benzene gasoline. The committee rec-

ommends this work be continued and accelerated if possible. The committee would like to see annual reports on benzene emission levels.

Acrolein, Carbon Tetrachloride, and Formaldehyde

Although Acrolein, Carbon Tetrachloride, and Formaldehyde are not emitted by FHR is large quantities the committee would like more information as to sources, health effects, and ways to reduce concentrations. The MPCA indicated this was an important area for them and the committee will request the MPCA to make a presentation to the CAC on these three chemicals.