Health Consultation

for the Ashland Oil Refinery Site

St. Paul Park, Minnesota

MND006162820

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The Minnesota Department of Health
in Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

FORWARD

This document summarizes potential public health concerns at a Site in Minnesota. It is based on a formal Site evaluation prepared by the Minnesota Department of Health (MDH). A number of steps are necessary to do such an evaluation:

! **Evaluating exposure:** MDH scientists begin by reviewing available information about environmental conditions at the Site. The first task is to find out how much contamination is present, where it's found on the Site, and how people might be exposed to it. Usually, MDH does not collect its own environmental sampling data. We rely on information provided by the Minnesota Pollution Control Agency (MPCA), U.S. Environmental Protection Agency (EPA), and other government agencies, businesses, and the general public.

! **Evaluating health effects:** If there is evidence that people are being exposed—or could be exposed—to hazardous substances, MDH scientists will take steps to determine whether that exposure could be harmful to human health. The report focuses on public health—the health impact on the community as a whole—and is based on existing scientific information.

! **Developing recommendations:** In the evaluation report, MDH outlines its conclusions regarding any potential health threat posed by a Site, and offers recommendations for reducing or eliminating human exposure to contaminants. The role of MDH in dealing with hazardous waste Sites is primarily advisory. For that reason, the evaluation report will typically recommend actions to be taken by other agencies—including EPA and MPCA. However, if there is an immediate health threat, MDH will issue a public health advisory warning people of the danger, and will work to resolve the problem.

! **Soliciting community input:** The evaluation process is interactive. MDH starts by soliciting and evaluating information from various government agencies, the organizations responsible for cleaning up the Site, and the community surrounding the Site. Any conclusions about the Site are shared with the groups and organizations that provided the information. Once an evaluation report has been prepared, MDH seeks feedback from the public. ***If you have questions or comments about this report, we encourage you to contact us***.

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Introduction

A Citizen's Advisory Panel (CAP) was formed in February, 1994 to address issues related to the Ashland Oil Refinery Site (Site). The intention behind formation of the CAP was to act as a communication link between the communities around the Site and Ashland. The CAP requested that the Minnesota Department of Health (MDH) evaluate any known or potential human health hazards posed by chemical contamination at the Site. This consultation has been prepared by the Site Assessment and Consultation (SAC) Unit of MDH in response to that request.

Site-specific information and environmental data used by MDH to prepare this consultation were obtained from many sources, including: meetings with the Minnesota Pollution Control Agency (MPCA), representatives of Ashland, the CAP, and Washington county; documents prepared by the staff at those agencies and private environmental consulting firms; and a brief Site visit. An alphabetical list of specific information sources used in developing this Consultation is at the end of this report along with a list of contact individuals in various agencies.

Site Background and History

The Site is about 10 miles southeast of the Twin Cities along the Mississippi River in Section 1, Township 27N Range 22W in Washington county, MN (Appendix 1, Figure 1). The mailing address for the refinery is: 100 W. Third Ave, PO Drawer 9, St. Paul Park, MN 55071; phone: 612-459-9771. The active refinery is located eight miles east of the confluence of the Mississippi and Minnesota Rivers and is built on a terrace cut out of the bedrock. There are steep bluffs nearby to the east, parallel to the Mississippi River. The cities of Newport and St. Paul Park are adjacent to the refinery to the north and south, respectively. The refinery is on the border between the two cities. The 1992 population of Newport was 3,756 and St. Paul Park was 5,116. The zoning for the area is industrial or commercial/residential adjacent the refinery and single family residential to the north (in Newport) and southeast (in St. Paul Park). With the exception of several residents to the south who have private drinking water wells, the entire area is served by municipal water from one of the municipalities.

The refinery itself occupies about 100 acres, consisting of one third "process" areas and two thirds "storage" areas (Appendix 1, Figure 2). The process areas are on the northern portion of the refinery and are where crude oil is converted into usable petroleum products. It includes the main refiner, the cracker unit, sulfur recovery unit, and the initial oil/water separator. The barge docks, wastewater treatment facility and ponds are located along the River (western portion of the refinery). Most of the stacks that are visible are heater stacks. The two tallest stacks are for the sulfur recovery unit (the one with the red and white stripes) and the recracker unit. The "loading" area is north of the process area and consists of eight large, top-filling truck stalls. Storage areas consist of over 100 tanks, with a total storage capacity of around 170 million gallons, containing various products produced or used in the process area:

Product	**Total Volume (million gallons)**
Gasoline	45
Crude Oil	40
Asphalt	34
“Distillate”	29
“FCC charge” (cracker unit)	7.4
Fuel Oil	5.2
Ethanol	2.7
“light ends” (propane, butane, etc.)	1.8
Slop oil	1.3

An additional area of the Site being addressed as part of the overall cleanup effort is the “Park Penta” location. This is a property near the refinery in St. Paul Park where complaints allege that frequent spills of pentachlorophenol (PCP) and improper disposal of refinery wastes occurred. Soil and groundwater are contaminated with oil and PCP. Although this area is not part of normal refinery operations, Ashland is addressing the contamination as part of their Superfund efforts.

The SAC Unit of MDH initially became involved with current activities in late 1993 in response to concerns raised by homeowners located directly above a free product plume and along the River. The possibility of fumes entering the basements of these homes (on Factory Rd.) was considered. In cooperation with MPCA, data was gathered and local conditions evaluated. While no underground fumes were detected, unusually high ambient air levels were found. This has led to an expanded review of the facility as a whole.

Operational History

The Ashland refinery was originally built in the late 1930's by the Northwestern Refinery company. It was operated by them until 1970, when it was purchased by the Ashland Petroleum company. It produces gasoline, fuel oils, kerosene, asphalt, propane and butane products. These materials are collectively referred to as “product”.

The refinery operates 24 hours per day and processes about 70,000 barrels (2,940,000 gallons) of crude oil every day. Although this is a large volume of material, it is relatively small compared to the largest refineries, which can process tens of millions of gallons of crude oil per day. The refinery employs about 250 people from Ashland and about 100 contractors performing various

tasks throughout the facility. There are 26 miles of piping throughout the refinery to transport materials from location to location and over 20,000 valves. The entire refinery is contained within a fence and security guards are located at the entrance gates.

Virtually all of the crude oil for the Ashland refinery is delivered by a pipeline and comes from North Dakota or Canadian sources. Ashland is mainly targeted to process "sweet" crude oil (which contains less than 1% sulfur). "Sour" crude oil contains higher levels of sulfur (hence the pungent "sour" odor) and requires additional scrubbing and sulfur removal steps to process. In addition to sulfur content, crude oil can be described by the relative amounts of "heavy ends" such as asphalt, coal tars, and other unsaturated linear and branched-chain hydrocarbons and "light ends" such as benzene, propane, and butane. Ashland tends to process crude oils with a higher percentage of light ends. For comparison, the nearby Koch refinery (located west of the River in Inver Grove Heights, Dakota County) typically deals with more heavy ends and sour crude than the Ashland refinery.

The crude oil arrives at the refinery by pipeline from Ashland's Cottage Grove tank farm, where it is stored. The refining of crude oil into other usable products begins with several treatment steps to remove unwanted materials. An initial step prior to refining the crude oil results in removal of salts and benzene. Removal of benzene in wash water is not desirable because it is an essential part of the final refining product (for efficiency, Ashland needs to keep it in the crude, not the water) and, as a potent carcinogen, it greatly increases the toxicity of the wastewater. This wash water is then sent to the wastewater treatment facility. Sulfur is removed by amine washing and eventual conversion/treatment in a sulfur recovery unit.

The general flow of wastewater in the refinery follows several steps: 1) use for some purpose in the refinery (wash water, rinsing/cleaning equipment, storm events, etc.); 2) flow into a drain or other collection area; 3) initial recovery of oil by separation at an American Petroleum Institute (API) separator unit; 4) piping to a holding tank where the next treatment is dissolved gas floatation (which involves blowing tiny air bubbles through the liquid); 5) piping to an additional treatment of biocontactor/slime disks; and 6) release to an outside lagoon. Although there is no air emission control over the lagoon, these treatment steps help minimize volatilization and odors by removing most of the wastes before being discharged into the lagoons. The API separator operates by dividing wastes into three streams: a) slop oil (which includes the "light ends"), which is allowed to float to the surface and continuously skimmed off; b) "heavy ends" (composed of oil-covered grit and dense oil sludge), which settle to the bottom and are manually removed periodically; and c) water (between the light and heavy ends) which is sent to the treatment facility.

Once impurities are removed from the crude, it is distilled (or "refined") to separate and remove the various fractions by differences in boiling point. Gasoline, for example, boils in the range between 70 and 200 ^{o}C. Liquid gasoline is a complex mixture of at least 150 hydrocarbons with about 60 - 70% alkanes (or paraffins, which are straight chain C_4 to C_{12} compounds), 25-30% aromatics (principally benzene, toluene, ethylbenzene, and xylene), and 6-9% alkenes (or olefins,

which are unsaturated linear and branched-chain hydrocarbons). The benzene in gasoline typically ranges from 0.41 to 1.74 percent by volume. This is especially important since benzene tends to be one of the most toxic components of gasoline.

In addition to being sold as product, extreme light ends such as methane, propane and butane can be used to fire heaters throughout the refinery. Since the lighter ends are typically in higher demand than heavier components, a "cracking" process is used after initial distillation on the heavy ends (e.g. asphalt) to break them into lighter fractions. This is an anaerobic process since the presence of oxygen will promote the formation of coke and tars, which gum up the process chemistry and machinery. Sixty percent of the product produced is shipped out of the refinery via the loading area (this corresponds to 100 to 400 trucks per day, depending on market demands) and 40% is shipped to other customers by pipeline.

Although Occupational Safety and Health Administration (OSHA) regulations are the main source for health and safety limits within the refinery, Ashland also has specific company policies and procedures that are suited specifically to the petroleum industry. The applicable parts of this refinery-wide standard operating procedure are given to employees as part of their initial orientation. They are expected to be familiar with proper personal protection for areas within their job responsibilities. The allowable levels established and enforced by OSHA are designed to be protective of a healthy, adult employee for a variety of work situations (e.g. 10 minute exposures, 8 hour exposures). Most of these standards are for materials in air, since that is the most common occupational exposure route. They are not designed to be applied to potentially sensitive residents (e.g. children) receiving exposures 24 hours per day.

The first level of responsibility for implementing health and safety within the refinery is the front-line supervisor. The supervisor is the first contact for an affected employee, and will immediately review conditions in his/her area to ensure they are within specifications. The supervisor can consult with the plant industrial hygienist on specific issues as needed. Every employee at the plant receives a yearly physical. The extent of the exam is dependant on job responsibilities (those with higher hazards or chemical exposures receive more intense reviews). Problems are reported to Ashland by the examining physician, which then reviews the information on a case by case basis to determine if there are problems within the plant. If unsafe conditions or procedures are found, appropriate remedies are implemented.

Process equipment in the refinery is monitored on a regular basis for operation. This information is especially useful in developing new processes or upgrading current facilities. Potential problems can be identified early and rectified in the planning stage.

Regulatory History

There are many governmental entities that interact with the refinery, including OSHA, Washington County, the Metropolitan Council Wastewater Control (sewers and wastewater), the local Cities, and several state agencies. The MPCA (the State environmental agency), in

cooperation with the federal Environmental Protection Agency (EPA), has primary responsibility for overseeing environmental operations at the refinery. Within the MPCA, four divisions deal with various aspects of the facility:

< **Groundwater and Solid Waste Division:** responsible for activities in the federal and state Superfund programs. This includes direct contamination of soils and groundwater at the refinery and at the "Park Penta" Site.

< **Water Quality Division:** responsible for monitoring water quality of discharges from the refinery, including the treatment facility and discharges to the Mississippi River and local sewer system. This is done using a series of permits.

< **Air Quality Division:** responsible for regulating releases to air and ensuring that they are within limits specified in a series of permits.

< **Hazardous Waste Division:** responsible for tracking and cleaning up spills from tanks, pipes, and other storage locations in the refinery. They also monitor the management of hazardous waste as specified in the Resource Conservation and Recovery Act (RCRA).

These four divisions work together to address potential problems as they arise at the refinery. The Hazardous Waste division retains overall responsibility for overseeing the management of "hazardous waste" (as defined by RCRA) at the refinery, but several other divisions within MPCA have been delegated areas of responsibility. For example, the Water Quality division oversees the permit for the operation of the wastewater treatment facility (NPDES permit MN0000256 dated 7/13/90) and the Site Response Unit addresses 13 of the 25 RCRA "solid waste management units" under Superfund. Air emissions (e.g. from tanks, pipes, valves, stacks) are handled as part of the Air Quality permits and are not addressed in the Hazardous Waste permits. This division of labor allows technical staff to become experts in their particular aspect of the law and refinery operation, but can also lead to some communication and coordination problems between Divisions.

MDH works with each division as needed to provide information on public health issues and to give feedback on proposed cleanup plans. Although responsibility is divided between divisions, there have recently been efforts to combine approaches and view the refinery from a broader perspective. Towards this end, MPCA has signed a "Multimedia" Stipulation Agreement that addresses concerns in both the Hazardous Waste and Water Quality divisions in one document.

The Site is listed on the Minnesota Permanent List of Priorities (State Superfund list) but not on the National Priorities List (federal Superfund list). In order to gather information for the Superfund decision-making process, a comprehensive study of the soil and groundwater at the Site was proposed in a Remedial Investigation/Feasibility Study (RI/FS) Work Plan in 1989. The primary response action objectives in the RI for the Superfund aspect of the cleanup include:

- limit or eliminate leaching of contaminants to soil and access of people to contaminated soil

- prevent, limit, or control exposures to contaminated groundwater

- remediate groundwater sufficient to protect the Mississippi River

- recover free product and prevent product from entering underground utilities or the Mississippi River

A groundwater extraction system began operating in 1989, when MPCA requested company actions to mitigate releases of petroleum products to the Mississippi River. This system involved installing a French Drain capture system to limit releases to the River. The French Drain system is a series of trenches, or "drains", which are dug down to groundwater in a line along the Mississippi River. These trenches are then refilled with a porous material which acts to intercept groundwater before it reaches the waterway. Although it is very detailed, the RI addresses only issues related to soil and groundwater contamination. Other areas of contamination (such as air quality and waste/process water quality) are addressed under different regulatory authority.

Air quality issues are addressed through a series of separate State permits. Individual permits are written to cover specific areas within the refinery, which may include releases to the air from process areas, tanks, stacks, pipes, and valves. The comprehensive regulation of air quality for a facility as large as a refinery is extremely complex and therefore generalizations are hard to draw. However, general conditions which are common to most air permits, include:

- providing assurance that all statutory requirements are met, including the state rules (MN rules pts. 7005.0010 - 7005.0080), the State Ambient Air Quality standards, and the federal National Primary and Secondary Ambient Air Quality Standards (40 CFR Part 50).

- maintaining records for at least 3 years;

- notifying the MPCA 24 hours before the planned shutdown of any air quality control equipment; MPCA must be notified immediately of any breakdown of air quality control equipment of 1 hour duration or greater.

- MPCA will not "permit the operation of an attended facility which may cause an immediate public health hazard". Therefore, regardless of permit conditions, if an immediate threat is posed, action must be taken to correct the situation.

In addition to tracking an overall release allowance for the Site, the air permit sets emission limitations for specific areas of the Site. When each of these specific areas are summed, they should not exceed the total allowed release for a particular substance. This total release

limitation is typically based on the need to meet EPA Air Quality standards in ambient air around the Site.

The Water Quality Division of MPCA regularly inspects the refinery. In 1992 and 1993 they found that it was in "marginal"compliance due to past effluent violations. In October, 1993, a "Notice of Violation" was issued to Ashland for effluent violations during that year. In response, Ashland upgraded its wastewater treatment system, removing two of the four open-air lagoons and replacing them with enclosed systems. The contaminated material in the lagoons was stabilized by mixing it with cement and fly ash, thereby immobilizing the contaminants so they do not reach the River or groundwater. The new wastewater facility began operation in January, 1994. Although there have been occasional problems with effluent meeting the water quality toxicity criteria, the new facility has generally met all other permit requirements. Ashland and MPCA are working together to determine the source of the effluent toxicity and minimize future violations.

The proper operation and maintenance of the many storage tanks and process lines are also a concern for both MPCA and Ashland. Although significant volumes of product are routinely handled without incident, there are occasional problems. For example, in 1994 there were four significant product spills, including the discovery of a major leak in a storage tank and a spill into the Mississippi River. In August, 1995 the MPCA (Hazardous Waste Division, Tanks and Emergency Response Section) and Ashland reached an agreement resolving the refinery's alleged past failure to comply with state rules regarding its aboveground storage tank system. Under the terms of this agreement, Ashland committed to undertaking a multi-year, multi-million dollar project to upgrade its tank farm system. The two main goals of the project are to prevent future spills and to better prepare an appropriate response in case there are spills in the future.

The Washington County Department of Health, Environment and Land Management also interacts with Ashland via several ongoing activities. These include conducting RCRA inspections, handling odor and health complaints from nearby residents, tracking emergency response activities, and participating in training. The RCRA inspections are carried out both with and without MPCA participation. Odor complaints are periodic and generally are associated with respiratory problems. The offending odors are distinctive and are associated with the refinery. Emergencies are typically monitored via reports from the State Duty Officer. Training opportunities include flammable liquid and hazardous material fire procedures. The County also reviews MPCA permits and provides comments, as appropriate.

Site Visit

On January 17, 1996 Daniel Symonik of MDH met with Robert Gross of Ashland to conduct a brief Site visit. Due to inclement weather (freezing rain, high winds, blizzard warning for late evening), we did not enter the working portion of the refinery, but rather had an extensive discussion in a nearby office. In addition to collecting information on the history and operation of the plant, the following were noted:

- There are bluffs to the east, the Mississippi River to the west, and a major highway (MN 61) and railway running parallel to the River through the valley. Although there had been quite a bit of cold weather, the River remained mostly ice-free. Due to the wind blowing from the refinery, directly out over the River, the severity of odors in the adjacent residential areas could not be determined on this day. On subsequent trips to the area, however, it was noted that there is a distinct gasoline/motor oil odor downwind from the refinery.

- Homes along the River to the north of the refinery tend to be large, multi-story structures on heavily wooded lots with several buildings (e.g. garages, storage sheds, barbeque pits) on the properties. The large trees throughout the area give the neighborhood a very "established" feeling. Second Avenue runs parallel to the River, but dead ends before it gets to the refinery. Factory Road is just east of 2nd Ave and does run right to the edge of the refinery. The closest homes to the refinery to the north are located on Factory Rd; 125 Factory Rd is not occupied; 127 Factory Rd has been used by adult Ashland employees (no kids allowed) on a temporary basis. Both these homes are now owned by Ashland. The closest homes to the south are two blocks away along 1st and 3rd Streets. The stacks at the refinery can clearly be seen from the Elementary School at 5th Ave and 7th St. Each of the homes directly on the River appears to have access to the waterway.

- The sign over the main entrance indicated that it had been 28 days since the last "stop work" accident, indicating that injury and accidents do periodically occur. Even though it was a nasty winter day, there still appeared to be a great deal of activity throughout the refinery complex, with carts, trucks, and employees moving from place to place. Everyone appeared to be very busy.

- All of the stalls in the loading dock area were filled at the time of the visit with trucks from various gasoline retailers and distributors. There was a strong gasoline odor downwind of this dock. This loading dock zone was the area targeted for air sampling several months ago, and was determined to be a significant source of the benzene identified in the area.

Review of Site Contamination

Contaminants may be present on the Site as the result of several activities. The handling of large volumes of materials as part of the refining process has inevitably led to spills, resulting in widespread contamination. These spills could also potentially be a source of releases to the surrounding air and thereby contribute to an odor problem. Leaks from underground storage tanks and other storage areas on the Site have resulted in soil and groundwater contamination. Releases to the air also may occur during routine refining processes (e.g. from leaky valves, pressure changes, or from heater stacks), during transfer of product from bulk storage to working containers, as a result of spills, or as part of the waste and wastewater treatment system.

Wastes that are produced periodically (during regular cleaning and maintenance) include tank bottom sludge, API separator sludge, and cooling tower sludge. Wastes that are generated continuously include used process water, a low ambient air level of fugitive emisssions (e.g. volatilized product), and other materials involved in production process. The majority of liquid product releases to the environment have occurred from pipelines in the tank farm areas (Figure 2). Other release points include the barge dock area, pipeline operator error, and overfilling of tanks or other receptacles (e.g. rail cars, trucks). When a release occurs, Ashland's typical response is to attempt to recover as much of the spilled material as is possible to return it into the process line and then clean any remaining residual product. Ashland is required to report all spills to MPCA.

A list of the materials found in an investigation of groundwater and soil at the refinery is given in Appendix 1. This list does not give an indication of the levels of contamination or potential toxicity of materials at the Site. Just because a compound is listed does not necessarily mean it is present in large quantities. For example, most of the heavy metals listed, with the exception of lead, are likely to be found at background levels that occur naturally in any part of Minnesota (e.g. they are not likely a result of operations at the Site). On the other hand, common constituents of gasoline (e.g. butane, pentane, benzene, toluene, ethyl benzene, xylene) may be present in very large amounts (millions of gallons) in controlled containers (tanks, pipelines). The list in Appendix 1 is presented to give an indication of the wide range of materials that may be present at the Site.

In comparing contaminant concentrations, it is crucial to use consistent units (otherwise you are comparing apples and oranges). The following table presents the most common units that are used for various media along with a brief explanation of what they mean:

Media	**Unit**	**Explanation**
Groundwater	mg/L	milligram of pollutant per liter of water
Groundwater	ppm	part pollutant per million parts of water
Groundwater		1 mg/L = 1 ppm = 1000 ppb
Groundwater	Fg/L	microgram of pollutant per liter of water
Groundwater	ppb	part pollutant per billion parts of water
Groundwater		1Fg/L = 1 ppb
Soil	mg/kg	milligram of pollutant per kilogram of soil
Soil	ppm	parts per million 1 ppm = 1000 ppb = mg/kg
Soil	Fg/kg	microgram of pollutant per kilogram of soil
Soil	ppb	parts per billion 1Fg/kg = 1 ppb

Air	mg/m^3	milligram of pollutant per cubic meter of air
Air	ppm	part of pollutant per million parts of air
Air		mg/m^3 does NOT equal ppm; 1 ppm = 1000 ppb
Air	Fg/m^3	microgram of pollutant per cubic meter of air
Air	ppb	part of pollutant per billion parts of air
Air		Fg/m^3 does NOT equal ppb; 1 mg/m^3 = 1000 Fg/m^3

A "u" is often used instead of the Greek letter "F" when describing micrograms (ug = Fg).

Groundwater

There are three major bedrock aquifers present in the vicinity of the refinery: a) the Mt. Simon/Hinkley, which is the deepest, starting between 450 feet and 800 feet below ground; b) the Ironton/Galesville, which is between 220 feet and 580 feet below ground; and c) the Prairie du Chien/Jordan, which is the most heavily used aquifer in the area, between 50 and 300 feet below ground (e.g. the nearest to the ground surface). The depths and thicknesses of the aquifers vary because they were formed at different times and have been altered by geologic forces over time. The surface of the saturated zone (the "water table") is typically between 20 and 50 feet below the ground and approaches the surface nearer the River. The Mississippi River is the main discharge point for groundwater in the upper aquifer in the area. Although the Prairie du Chien/Jordan is usually referred to as a single aquifer in geology textbooks, they actually are relatively distinct units and will be addressed individually in this report.

The Prairie du Chien consists of fractured limestone and is the shallow zone of the main drinking water aquifer, while the Jordan is made of sandstone and is the lower zone. The Jordan aquifer is the preferred source for high volume wells such as those supplying the municipal systems and the refinery. For example, St. Paul Park municipal well #1 (which is located very near the east tank farm) is only open to the Jordan aquifer. Although head differences of up to 10 feet have been observed between the Prairie du Chien and Jordan aquifers, it is not clear what effect this has on the flow of groundwater between the two zones. While differences in transmisivity and stratigraphy act to limit communication between the Prairie du Chien and Jordan layers, under certain conditions flow from one to the other can occur.

Free product is defined as gasoline or other petroleum products that have been released, traveled through the soil and bedrock, and come to rest (float) on the top of the water table. This free product has been found on the groundwater directly under the refinery (Figure 3, Appendix 1). The water table in the bedrock immediately east of the backwater areas is controlled by the cyclical level of the River. The collection drain in that area (for collecting free product off the groundwater and preventing it from reaching the River) takes this into account and is designed to

work during normal River-flow conditions. However, if highly irregular flow conditions exist (e.g. the Spring flood of 1993), the drain may not be effective.

Contaminants identified by the RI in the upper zone of the ground water which exceed health-based standards include benzene, toluene, ethylbenzene, and xylene (which are common constituents of gasoline are sometimes referred to collectively as "BTEX") ranging between 0.1 mg/L to 50 mg/L, other volatile organics (ethyl ether, methylene chloride), and Polynuclear Aromatic Hydrocarbons (PAHs)(cresol and naphthalene). Chlorinated solvents (trichloroethylene (TCE), and 1,2 dichloroethane) found in the Prairie du Chien aquifer at levels above health-based standards are believed to be from nearby sources not associated with the Park Penta operations. The pentachlorophenol found at a level above its health-based standard is related to the Park Penta location. If water exceeds health-based recommendations and is used domestically (drinking, cooking, washing), then there is a potential for adverse health effects.

There are 10 production wells that are used to meet the water needs of the refinery. They are all located within the refinery area. Due their high rate of withdrawal of groundwater, the production wells likely capture a significant portion of the water directly under the facility. However, to date, there has not been a detailed analysis of the amount of groundwater removal as a percentage of total flow in the area.

Data from 1989-90 indicated that well P9 (which is open to the Jordan and St. Lawrence formations) contained 330 Fg/L benzene, 17 Fg/L xylene, 50 Fg/L trichloroethylene, and no semi-volatile compounds (below detection limit). Since the production wells collectively remove up to 3 million gallons per day, there is significant drawdown in the immediate vicinity of the refinery. In addition to limiting horizontal movement, this drawdown is apparently transporting the contamination vertically from the upper (Prairie du Chien) aquifer down into the lower (Jordan) aquifer. Therefore, these large production wells raise the possibility of inter-aquifer movement of contamination.

Surface Water

There have been both large periodic spills into the River (from accidents and breakages) and seeps along the shore. Large spill events are addressed on a case by case basis as outlined in a Spill Response plan which has been developed specifically for this facility. The French Drain system was installed to address general groundwater concerns and to stop oil seeps along the shoreline of the River. It will soon be expanded from four to five drains to help insure that it adequately performs this duty. Spills and breaks are a function of human error or normal wear in equipment, and therefore are impossible to eliminate completely. However, they may be reduced by training, equipment maintenance and replacement, and a company culture that encourages vigilance.

A product sheen has been reported on the River in the area of the waste water treatment plant and in Wiley's Marina (just downstream of the refinery). The likely source of this release is the free

product plume which underlies the more than half of the refinery and is two to five feet deep (estimated two to four million gallons). Because the water table is sloped toward the River, and therefore the groundwater is generally flowing toward the River in the Prairie du Chien aquifer, the free product plume is also moving towards the River. The free product has seeped, and continues to occasionally seep, out of the side of the River bank and into the River (though this has been greatly reduced by the French Drain system).

In addition to the free product on the water table, soil borings have shown that there are layers of sand occurring below the water table that are saturated with petroleum product. Since flow conditions are in the direction of the River, this product is also likely seeping into the River.

A main sewer line for the area runs on an easement through refinery property. Historically, there has been a problem with vapors being released from the free product under the refinery seeping into the sewer. The sewer line has been retro-fitted, thereby greatly reducing leakage, and vapors from this location no longer appear to be a concern.

Soil

Soils in the vicinity of the Site are generally less than five feet in thickness, indicating that released product and contaminated soils are likely in contact with the underlying bedrock. The spill response plans developed for the refinery in recent years indicate that contaminated soil is excavated after a spill and then disposed of according to regulation. Contaminated soils are placed into one of three categories: a) “heavily contaminated”, with an organic vapor reading greater than 500 ppm and a total petroleum hydrocarbon (TPH) value greater than 5000 ppm; b) “lightly to moderately contaminated”, with an organic vapor reading under 500 ppm and a TPH value less than 5000 ppm; and c) “clean”, with no noticeable odor or discoloration. Specific contaminants found in the soil can be found in Appendix 1.

Product reaches the bedrock and pools (floats) on the water table in a free product plume under the refinery. This plume varies in thickness, but can reach eight feet. In addition to contaminating the bedrock, this free product also releases contaminants into the shallow groundwater. The free product is removed via extraction wells specially designed for this purpose. The bedrock is not typically excavated as part of a spill response. The French Drain system acts along with the extraction wells to reduce releases of free product into the surrounding area (mostly the Mississippi River, since that is where shallow groundwater flows).

Air

EPA estimated that about 360 million gallons of gasoline were emitted to the atmosphere nationally as vapors in 1982, of which about 40% occurred at retail service stations (EPA, 1984). The 1987 estimate for liquid gasoline consumption for Minnesota was about 5.5 million gallons per day (MPCA, 1992). Based on federal 1982/83 values, it is estimated that 0.3% of each gallon produced is eventually emitted to the atmosphere. Therefore, about 16,500 gallons of gasoline

are evaporated into the air in Minnesota every day, making gasoline a very common air pollutant.

Releases to the air in and around the facility are controlled by one of two regulatory programs. Exposures within the plant must meet the standards established by OSHA for workplace safety. These values are intended to be protective of an adult worker exposed to those conditions for an 8-hour workday. They are not intended to be applicable to a residential area. In contrast, the air around the plant (and being released into the surrounding community) is regulated by an Air Quality permit. This permit, as currently designed, regulates only the "criteria pollutants" as a group and does not address health effects of any other specific materials which may be released at the Site. These "criteria pollutants" are nitrous oxides (NO_x), sulfur oxides (SO_x), carbon monoxide (CO), ozone, particulates (PM_{10}), and lead. The terms SO_X and SO_2 (sulfur dioxide) are often used interchangeably. Any other releases of materials from the refinery (volatile organic compounds (VOCs), for example) are only considered if they create or affect one of the previously listed 6 "criteria pollutants". The new permit that is currently being developed will allow an additional 189 air toxics to be addressed in addition to the 6 criteria pollutants.

Ambient air quality for an area is monitored to evaluate whether criteria pollutants are less than health-based standards (e.g. if they are not below the standard, they do not “attain” compliance with regulation). If criteria pollutants regularly do not attain compliance with established standards in a given region, the area is designated a “non-attainment” zone. The area of the refinery is a non-attainment zone for CO. This means that even if emissions from the refinery were reduced to zero, the CO levels would still be present at some level in the ambient air.

Yearly emission levels are established for each portion of the refinery that has the potential to release pollutants. For example, for the new wastewater treatment facility, emissions that are allowed for “non-attainment compounds” are 100 tons/yr for CO. Emission levels for “attainment compounds” (those pollutants which are consistently below standards) for the wastewater treatment facility are 15 tons/yr for PM_{10}; 40 tons/yr for NO_x; 25 tons/yr for total suspended particulate; 40 tons/yr for SO_2; and 40 tons/yr for VOCs.

The current air permit specifies both total allowable releases for the entire refinery and for a given individual unit within the refinery. The following table summarizes the total permitted releases for the entire refinery for key materials for 1994. The permitted releases are given in tons per year and pounds per hour (these values are equal, just expressed in different units; e.g. 245 pounds/hr = 1070 tons/yr). These values are the sum of all the individual sources (such as the wastewater treatment facility mentioned above) and represent the total amount that is released from the Site.

Pollutant	**Permitted Amount**	**Permitted Amount**	**Actual Amount Released**
	pounds/hour	tons/year	tons/year
PM_{10}	245	1070	888
SO_x	1120	4900	3430
CO	14370	62960	55570
NO_x	397	1740	1210
VOCs	779	3410	2220
Total HAPs	317	1390	169

The term HAP stands for hazardous air pollutants and represents the total sum of all materials that have been determined by EPA to be "toxic" including 189 compounds under current law.

One of the main environmental concerns (and sources of odor complaints from the surrounding area) is the release of sulfur. The main sources of sulfur releases to the air related to the refinery are: a) the sulfur recovery unit, which is permitted to release about 15 pounds per hour (lb/hr) SO_2; b) the cracker unit, which is permitted to release about 514 lb/hr SO_2; and c) the multitude of heat sources located throughout the refinery, which are collectively permitted to release 480 lb/hr S. Typical operating release rates for the sulfur recovery unit and heat sources are 15 lb/hr and 400 lb/hr, respectively. A sulfur-containing compound which is particularly odorous is the mercaptan that is added to the propane. The odor masking agent "Alamask" is occasionally used when unusually large releases occur to help reduce the "refinery" odor. This is only done infrequently and is not considered part of standard operating procedures.

An air monitoring network was established in the fall of 1990 to collect data on ambient air quality in the industrial areas of Washington and Dakota counties. This is known as the "Pine Bend Monitoring Network". In 1993 two sampling locations near the Ashland refinery were added to the monitoring network. The two locations are labeled "MPCA 0436" (southwest of the refinery at 649 Fifth St., St. Paul Park), and "MPCA 0438" (north of the refinery on the corner of 4th Ave and Second St., Newport) (Figure 4). Data from these two locations are very useful in estimating ambient air levels around the Ashland refinery. The most recent summary report (First quarter, 1996) includes data on 42 different compounds. A representative listing of materials identified in the air near the Site by the Pine Bend monitoring network is presented in Appendix 2. Data from two quarterly reports (April, May and June, 1994; and October, November, December, 1995) are included. Sites "0436" and "0438" generally reflect emissions from the Ashland refinery. This data shows that there are many compounds present in the air at part per billion (ppb) concentrations

Appendix 2 also contains data from a temporary monitoring station set up just east and north of the loading dock area to investigate possible benzene releases and a table of general benzene levels at locations in the Twin Cities metro area.

DISCUSSION

Toxicity Assessment

This section will present information regarding the potential health effects that may result from exposure to various compounds which have been found at the Site. It is important to recall that in order to have a public health concern, two things must be present: a) a sufficient amount of a toxic material (e.g. concentrations above health based standards or guidelines); and b) a complete exposure pathway. The exposure pathways for the area are discussed in the "Exposure Assessment" section. A summary of criterion values used in characterizing potential toxicity for various compounds is found in Appendix 3. Information in both the Toxicity Assessment and Exposure Assessment sections must be considered together to characterize potential health concerns.

The known effects of these chemicals typically occur at very high exposure levels or after exposure for a long period of time. These high concentrations have not been found in the vicinity of the Site. Nevertheless, criterion and regulatory values are set well below levels at which effects have been observed, and some excedence of these regulatory values have occurred.

The information below is presented to give an indication of the types of problems which could occur in the case of a major release or if an individual is especially sensitive to some material which is commonly used at the Site. A person's individual sensitivity to a given material is best determined with the assistance of their own personal physician or some other individual who is knowledgeable regarding the details of their personal health history. The possible effects of long term exposure to low levels of contaminants close to criterion or regulatory values are less clear and are discussed further under "Feasibility of Conducting Health Studies".

Summary of Toxic Effects - Individual Components

The vast majority of the compounds which are present at this Site are organic solvents which are commonly used in industrial situations for a variety of purposes and also are common elements found in gasoline. These include acetone, benzene, carbon tetrachloride, chlorobenzene, isopropylbenzene (cumene), 1,2 - dichloroethane, ethylbenzene, ethyl ether, formaldehyde, methyl isobutyl ketone, tetrahydrofuran, toluene, and xylene. Inhalation of these compounds can lead to irritation of mucous membranes (eye, nose and throat), and at higher concentrations dizziness, nausea, and loss of consciousness. Excessive dermal exposure can lead to skin irritation. Isopropylbenzene and ethylbenzene can also have narcotic effects at high exposures.

Compounds which are suspected to (or have been shown to) cause cancer include benzene,

formaldehyde, carbon tetrachloride, 1,2 dichloroethane, dibenzo(a,h)anthracene, bis(2-ethylehexyl) phthalate, and o-,m-, and p-cresols.

The compounds dibenz(a,h)anthracene, 1-methyl naphthalene, naphthalene, and phenanthrene are "polycyclic aromatic hydrocarbons (PAHs)". These are chemicals formed during the incomplete burning of coal, oil, gas, wood, garbage, or other organic substances such as tobacco and charbroiled meat. They also occur naturally in substances such as crude oil, coal, coal tar pitch, creosote, and roofing tar and can be found at various levels throughout the environment in air, soil, and water. Studies in animals have shown that PAHs can have harmful effects on skin, body fluids, and the immune system (the body's system for fighting disease) after both short- and long-term exposure.

The PAH naphthalene is the main active ingredient in moth balls (it is what gives them their distinctive odor) and is naturally found in petroleum and coal. Exposure to large amounts of naphthalene may damage or destroy some red blood cells. This could result in too few red blood cells (until they are replaced by the body), which is called hemolytic anemia. Some of the symptoms that may occur with hemolytic anemia are fatigue, lack of appetite, restlessness, and a pale appearance to the skin. Doses which cause these effects, however, are usually very high (e.g. from swallowing a mothball).

Cresols are naturally-occurring materials that are present in many foods, urine, smoke, crude oil and coal tar. Cresols have a medicinal smell when dissolved in water, and can give it a medicinal taste. Cresols in air quickly change and break down into smaller chemicals, some of which, along with the original cresol, can irritate the eyes. Exposure to high levels can cause kidney problems and anemia (see above for effects of anemia). Most of the cresols that enter the body are quickly changed to other substances and leave in the urine within a day.

The two phthalate compounds (bis(2-ethylehexyl) phthalate and di-n-butyl phthalate) are man-made compounds that are commonly added to plastics to make them flexible. In addition to plastics, they are present in paints, flexible tubing, plastic bags, printing inks, pesticides, nail polish, and many other materials. Since they are used in so many different products, they are common laboratory contaminants (that is, they are leached from tubes, gloves, brushes, and other plastic things in the lab rather than being in the samples from the refinery). This laboratory contamination often undermines the credibility of the data and, therefore, reported concentrations in samples must be viewed with caution. Only low (and therefore suspect) levels of phthalates have been found around the refinery. However, very high doses (e.g. those well above levels normally found in air, food, or water) can cause kidney and reproductive problems.

Phenol is a naturally-occurring material that is present in many foods, medicines, smoke, crude oil and coal tar. It has a sickeningly sweet and irritating smell and can easily enter the body through skin contact, breathing, or eating. Although it can have a positive effect when used for medicinal reasons, very high levels can cause diarrhea, mouth sores, skin irritation, lung irritation, and kidney, heart and liver damage. However, most phenol that enters the body is

removed in the urine within 24 hours. Therefore, repeated heavy exposures are necessary to have these more serious effects.

The criteria pollutants of concern in air are SO_2, CO, and PM_{10}. Sulfur dioxide is highly water soluble, and therefore is absorbed in the moist passages of the upper respiratory system. Exposure to as little as 1 ppm of SO_2 can lead to constriction of the airways in the respiratory tract. This can especially be a problem for individuals with asthma. Although the 24-hour standard for SO_2 is 0.14 ppm, studies have shown that there is not a clear response threshold and that effects may occur in some individuals at various levels. However, no effects have ever been observed below a level of 0.25 ppm Carbon monoxide, being relatively insoluble, is carried deep into the lungs where it interferes with the blood's ability to transport oxygen. Exposure to CO at a level of 50 ppm can lead to headaches and a reduction in mental acuity (e.g. hand-eye coordination, detection of infrequent events, visual sensitivity). Extremely high levels of CO can lead to vomiting and death. PM_{10} is particulate matter less than 10 microns in diameter (hence the subscript "10" in PM_{10}; 10 microns equal 0.0004 inches) that can be inhaled into the lungs where it can cause bronchitis, reduced lung function, and an increase in the rate of asthma attacks. The current 24-hour standard for PM_{10} is 150 Fg/m^3.

Summary of Toxic Effects - Product as a Mixture

Many of the toxicological effects associated with exposure to gasoline can be attributed to specific components of the mixture (e.g. benzene, organic lead compounds). These effects were discussed above. The discussion below will include information from studies conducted using whole gasoline. It should be noted that the composition of liquid and vaporized gasoline is significantly different, with the vapor phase being enriched in alkanes and depleted in aromatics. Therefore the mixture of things an individual is exposed to through the vapor route (e.g. breathing vapors at a service station) is slightly different than exposure to liquid gasoline (e.g. spills on the skin while filling tank). Although most of these studies addressed exposures at service stations, they can provide perspective to residents near the refinery regarding the types of effects that may occur as a result of exposure to large amounts of gasoline.

Short term

Gasoline has been shown to be irritating at the point of exposure (e.g. eyes and lungs for inhalation). Because the nervous system is a key target for gasoline toxicity, a range of neurological effects which increase in severity with increasing dose are seen following acute exposure to high levels. Health effects resulting from large doses (e.g. sniffing) include eye irritation, neurological and psychological effects (such as dizziness, excitement, intoxication, nausea, anesthesia, and muscular weakness), and mild liver, pulmonary, or kidney damage. (Poklis and Burkett, 1977; Page and Mehlman, 1989; ATSDR, 1995).

Although there are several benefits to adding octane-boosting compounds to gasoline, there is some concern that this "reformulated" gasoline may have been responsible for widespread health

effects (Rudo, 1995). Information was collected as part of a survey looking for symptoms such as headaches and other flu-like effects. The interpretation of the study is currently being debated in the epidemiological journals.

Long term

Inhalation of air contaminated with petrol vapor (100 ppm) has been shown to produce reduced surfactant levels in the lungs of rats. Although levels of pulmonary surfactant were extremely sensitive to petrol inhalation, significant variation preceded the onset of morphological damage (Le Mesurier, et al, 1979). The main function of the surfactant is to decrease surface tension and to stabilize surface forces between large and small alveoli during the inflation/deflation cycle in the lung. Therefore the long term inhalation of vapors could have significant secondary effects by reducing lung function capability.

There has been some debate regarding the carcinogenicity of whole gasoline. While some effects can be attributed to the individual components (e.g. leukemia associated with exposure to benzene), other studies using gasoline have relied on an observed increase in mouse liver tumors as an indication of carcinogenicity. A recent study using unleaded gasoline (Standeven, et al, 1994) found that the use of male mice is not applicable to human risk assessment because the protein most likely to be promoting the tumor growth in the mice is not present in humans. However, they also conclude that the relevance of the increase in female mice liver tumors is not as clear. They postulate that the primary effect may be the inhibition of estrogen hormone activity and that the tumors in liver are a secondary effect (caused by the estrogen disruption). Their data appear to "reveal novel individual and interactive effects of gasoline and estrogen in female mouse liver."

It also has been suggested that n-butane, isobutane, n-pentane, and isopentane (the main paraffins in gasoline), at concentrations which exceed worst case conditions, produce no kidney damage in male rats (Halder, et al, 1986). Differences in the studies could be due to the fact that some used vaporized whole gasoline as opposed to true gasoline vapors (which have a different composition), confounding factors are not accounted for, different target organs are evaluated (liver versus kidney), and animal models used by some studies are not applicable to human health.

Exposure Pathways

When a substance is released from a large area, such as a refinery, it enters the environment. This release does not always lead to exposure. Exposure to a substance occurs only when an individual comes in contact with it. Exposure routes include breathing, eating or drinking materials containing the contaminant(s) or by skin contact.

If exposure to contaminants does occur, many factors will determine whether harmful health effects will occur and what the type and severity of those health effects will be. These factors

include the dose (how much), the duration (how long) the route or pathway of exposure (breathing, eating, drinking, or skin contact), the combined effect of other chemicals which may be present, and individual characteristics such as age, sex, nutritional status, family traits, lifestyle, and overall state of health. Therefore, even if an exposure pathway is complete, it does not automatically indicate that health problems will occur. In order to assess the liklihood of health problems, both the type of material (toxicity) and the amount and location of the release (exposure) must be considered.

This section is separated into individual discussions of exposure which may result from releases to various environmental media, such as ambient air, soil, groundwater, and the sewer system. Information is summarized at the end by a listing of the possible complete exposure pathways. These pathways constitute the linking of information on toxicity and exposure, and represent areas that are (or may become) a public health concern.

Releases to the Groundwater

A review conducted by MPCA of a pumping test done in the area indicates that there is a hydraulic connection between the upper Prairie du Chien aquifer (which contains free product from the refinery) and the lower Jordan aquifer (which is the drinking water supply). However, there also is a confining layer between the two aquifers which greatly reduces flow between them. Based on this, the Jordan aquifer is described as a "leaky confined aquifer". Therefore, although there is a connection between the two aquifers, it is relatively difficult for water to flow between them. This confining layer provides a degree of protection for the Jordan aquifer by restricting flow of contaminated water downward. In addition to vertical flow, the general horizontal flow of groundwater is towards the Mississippi River (e.g. away from nearby residential areas).

The St. Paul Park municipal well #1 is located within 1/4 mile of the east tank farm, which has a free product plume (Figure 3). This well is developed in the Jordan aquifer, is sampled for contaminants two times per month, is the oldest well in the municipal system, and is only used periodically when needed during the peak demand of summer. The monitoring well (W265) located near the municipal well is also sampled quarterly and should act as a "sentinel well" (e.g. show contamination *before* it reaches the municipal well). St. Paul Park is aware of the conditions around the well and appears to be hesitant to expand the pumping volume in the future. The City currently has ample water storage capacity (1.3 million gallons) to allow for additional users in the future. Any additional water that may be needed in the future would likely be drawn from other municipal wells or from a new well (rather than expanding use of well #1). Decisions regarding water use are ultimately made by the City Council. The combination of regular monitoring (which shows no contamination) and periodic use (which reduces the volume of water pumped), indicates that St. Paul Park municipal well #1 is not a current complete exposure pathway. If the pumping rates were to be increased or the contamination plume expand, however, it may become complete (and therefore be a health concern) in the future. For this reason, regular monitoring of water quality and Site conditions are necessary during periods

when the well is operational.

There also is free product floating on groundwater in other areas below the refinery. These areas are indicated on Figure 3 in Appendix 1. However, since most of the homes in the area are connected to the municipal water supply, this contaminated water is not known to be used by the public as a drinking water supply. Due to the general flow direction (e.g. west, towards the River) and the interception of the French Drain system, it is not likely that contamination would be present in groundwater other than in the immediate vicinity of the Site. Therefore, due to a lack of current users, groundwater in the upper aquifers is not a current complete exposure pathway. If a high volume well (e.g. manufacturing supply well) were constructed nearby, or a residential well placed near the current plume, this pathway may become complete (and therefore be a health concern) in the future.

Releases to Surface Water

The old water treatment system at the refinery consisted of three API separators, four aerated lagoons and a slop oil recovery system. The new system at the refinery was designed to comply with the most recent RCRA regulations and involved closing two of the four aerated lagoons. New equipment installed included an API separator pump pit, new slop oil recovery equipment, equalization tanks, a dissolved gas floatation unit, and submerged biological contractors. The new system has a capacity of 3200 gallons per minute, but typically operates at around 1600 gallons per minute. With the installation of the new treatment system and the retro-fitting of the sewer line under the refinery, it is not likely that there will be significant releases in the future to the sewer system.

While the French Drains are a practical, efficient, and cost effective method for capturing a portion of the free product and reducing its seepage into the River, they do not completely eliminate seepage. Because the French Drains do not currently extend uninterrupted the length of the impacted area, a small amount of free product may get through the gaps and around the ends. In addition, the drains do not work 100% effectively. The existing drains also are not designed to capture petroleum product in sand lenses below the water table, so they may also let this petroleum product pass through. Therefore, because product continues to be periodically released to the River and individuals use the River recreationally, this constitutes a complete exposure pathway. The limited nature of the exposure (and the fact that Ashland is taking further steps to mitigate releases of free product), however, greatly diminishes the likelihood of the occurrence of significant health problems. This release may also have environmental consequences for the aquatic River environment.

Releases to the Soil

Exposure to contaminated soil or dusts at the refinery is likely only for workers who are digging or drilling since they would have the greatest amount of direct contact. Due to the fence around the facility and 24-hour security measures, incidents of trespassing from nearby residents or

transients are not likely to occur. In addition, since spills are generally limited to Ashland property, the likelihood of contaminated soil in an area that is accessible to the public is very low. Therefore, the chances of a member of the public being exposed to contaminated soil is very low and this is not likely to be a significant exposure pathway.

Releases to Ambient Air

General Exposure Considerations

It is has been shown that the average cancer risk resulting from air exposure in the seven county metropolitan Twin Cities area is 2.26 additional cancer cases per year per million residents. Diesel and gasoline particulates are the two highest individual pollutants contributing to this excess cancer incidence, accounting for 27% and 15%, respectively (MPCA, 1992). The most significant source was motor vehicles, which contributed 61% of the total risk. Total air emissions Statewide from service stations which contribute to this risk estimate include 49000 lb/yr benzene, 7500 lb/yr ethylene dichloride, and 750 lb/yr ethylene dibromide. The latter two materials are added to gasoline to help reduce knocking (e.g. to enhance the octane rating). While the cancer risk was quantified (and is slightly above the commonly used "acceptable level" of 1 per million), it is relatively small compared to the background incidence rate for cancer (which is in the range of 4 in 10 to 5 in 10; that is, nearly half the people in Minnesota will get cancer at some point in their lives) and is well below the level that could be documented in an epidemiological study.

Quantitative Acceptable Ambient Air Standards for gasoline as a mixture have been developed by eight States, with values ranging between Nevada's 21.4 mg/m^3 for 8 hours down to Connecticut's 1.8 Fg/m^3 for 8 hours (a difference of almost 10000)(ATSDR, 1995). Minnesota has not, to date, developed an air quality standard (e.g. MDH Health Risk Value or MPCA Air Concentration Limit) for gasoline as a mixture. Its various components are regulated individually. The federal Occupational Safety and Health Administration regulations include an 8-hr Time-weighted average (TWA) of 900 mg/m^3 and a 15 minute TWA of 1500 mg/m^3 for gasoline. The federal regulations represent conditions under which it is believed healthy workers may be exposed five days per week without adverse health effects (ATSDR, 1995).

These exposure values may be compared to those reported by Page and Mehlman (1989) during automobile tank filling in Appendix 2. While the mean values do not exceed the 8-hr federal occupational standards, they all exceed each of the State standards. Therefore employees at high volume service stations could conceivably receive a regular eight hour exposure that exceeded recommendations made by the States. In addition, the upper range for the reported values exceeds the 15 minute federal standard in three cases (service plaza attendant, single car in winter, and self service customer). The range also indicates, however, that there is a great deal of variability in the results. Considering the number of factors that could alter results (e.g. wind speed and direction, temperature, air turbulence from buildings and pumps, type of delivery system), this is not surprising. Although the values do not demonstrate an obvious occupational

hazard, neither does it eliminate gasoline vapors as a potentially significant exposure pathway. Under worst case conditions, a sensitive individual may be at significantly increased risk.

One major uncertainty in modeling exposures (and therefore public health risk) in urban air is the ambient level of formaldehyde. In addition to being emitted directly, it is also a secondary breakdown product from the emissions of many hydrocarbons such as gasoline. In the Twin Cities study (MPCA, 1992), it was concluded that without an accounting of this secondary production, the formaldehyde carcinogen risk, and therefore the aggregate risk, was underestimated. Until representative ambient air monitoring data is available, the magnitude of the error can not be estimated.

An additional uncertainty is the development of a reliable method for sampling the extreme light ends of gasoline ($<C_6$). Historically, these have been considered to have a low toxicity and therefore the development of trace methods was not rigorously pursued. However, in light of recent toxicity studies, more attention is being paid to exposures to low levels of light ends. Sampling is made difficult by the volatile nature of the compounds (leading to rapid breakdown) and dependance of optimum sampling parameters on temperature and relative humidity.

Therefore, based on variable meteorological, analytical, and practical conditions, there is an inherently large degree of uncertainty in estimating public health concerns from the air exposure pathway. This means that precise estimates of actual risk from ambient air exposures are very difficult to obtain.

Site-specific Exposure Considerations

Based upon past on-Site data from MPCA and anecdotal evidence in complaints filed by nearby residents and companies, it appears that there has been a historical problem with releases of material from the Site to the surrounding air. There were numerous complaint records included in the MPCA correspondence files, with no particular pattern regarding timing of occurrence during a given month or time of day. There were several for virtually every month. A typical example would be complaint #6124 log #203 filed on September 28, 1995 which mentioned burning eyes, odors, and rotten egg smells throughout the 27th and 28th. Similar complaints were logged from other nearby residents on September 18th , 23rd, and 24th. Sulfur odor was listed for August 19. On June 9, complaint #5657 log #203 indicated that a fire at the refinery had spread black smoke across the neighborhood, causing bad headaches and burning eyes. On May 4, 1995 there were several complaints of “bad odors” from the community. There were several references stating “it was a bad refinery day”, indicating that the offending smells were sufficiently frequent that neighbors recognized the odors readily.

Data from the Pine Bend air monitoring network (in Appendix 2) gives an estimate of materials in ambient air around the Site. When comparing values, it is important to use consistent units, since a milligram of pollutant per cubic meter of air ($mg/m^{3)}$ does not equal a part per million (ppm) of pollutant. For example, 1 mg/m^3 benzene is equal to 0.3 ppm benzene. A review of the

data shows that there are numerous compounds present in ambient air in ppb concentrations.

None of the observed data exceed worker air standards. In addition, with the exception of 1 day for total reduced sulfur, no acute air standards are exceeded. Compounds which do occasionally exceed the chronic (long-term, lifetime) standards include benzene, formaldehyde, and reduced sulfur. The standard for hydrogen sulfide is used as a surrogate for the total reduced sulfur values. Maximum benzene levels identified from the Pine Bend data are generally between 1 and 3 ppb, with an average level being between 0.5 and 1 ppb. The monitoring station which collected data directly downwind from the old loading dock (not part of the Pine Bend network) had a high daily maximum benzene reading of 36 ppb. Elevated benzene readings were strongly correlated with a wind direction from the loading dock towards the sampler. Maximum formaldehyde levels are generally between 2 and 3 ppb, with an average level being around 1 ppb. Maximum total reduced sulfur levels are generally between 5 and 10 ppb, with one exception. On the morning of 1/27/96, the total reduced sulfur maximum was 69 ppb during one hour. This level was greatly reduced (e.g. <5 ppb) by late afternoon the same day, however.

The observed benzene and formaldehyde levels are higher than the proposed chronic exposure standards of 0.3 ppb and 0.7 ppb, respectively. This standard reflects the amount of a chemical in ambient air to which most people can be exposed for a lifetime without significantly increasing their cancer risk. Values exceeding this standard do not automatically indicate a health threat. Rather, they indicate that additional, site specific conditions need to be taken into account. Factors at this Site that would tend to reduce the possibility of a health concern include the fact that the levels at the Pine Bend monitoring stations (which are assumed to be generally representative of conditions in the residential areas) are within an order of magnitude of the standard (e.g. not extremely high), a lifetime of exposure (70 years) is assumed (few individuals live in the same residence for 70 years), cold weather will tend to keep people inside for greater periods of time (and therefore not inhaling outdoor air) and the loading dock (which is a significant benzene emitter, as indicated by benzene levels above 30 ppb from the adjacent temporary monitoring station) is currently being upgraded to reduce emissions. Factors that will tend to increase the potential for health concerns include the presence of homes very close to the Site (greater distance correlates to greater dilution and lower exposure), 24-hour emissions (since the plant runs 24 hours per day), and possible additive/synergistic effects with other compounds or sources in the air. On balance, the overall carcinogenic risk may be slightly above the "acceptable level" of 1 additional case per 100,000 exposures. However, health studies are not sufficiently sensitive to detect this level of influence.

This "acceptable level" reflects the negligible lifetime cancer risk from a single source, including sensitive individuals, and therefore is conservative (e.g. very protective). As discussed previously, in the MPCA Urban Soup study, background levels of benzene in the metro area are around 1 ppb (e.g. above the target standard of 0.3 ppb). This ambient level comes from many different sources. Therefore Ashland is only one source, and the incremental benzene addition from the refinery to ambient conditions should be considered (rather than making Ashland entirely responsible for general ambient conditions). In some cases, however, specific areas of

the refinery may be targeted. For example, the loading dock area was clearly a significant benzene source, with levels over 100 times higher than the chronic standard.

On one occasion, the acute standard for hydrogen sulfide (70 ppb) was exceeded by the total reduced sulfur values. This is a conservative conclusion, however, because the total reduced sulfur value may also include mercaptans (or other reduced sulfur compounds) that have lower toxicity. The acute standard reflects the amount of a chemical in ambient air to which almost all people (including sensitive individuals) can be exposed for an hour without significant health risk. More typical *maximum* 1-hour values for total reduced sulfur (5 - 10 ppb) are very close to the subchronic standard for hydrogen sulfide (7 ppb). The subchronic standard reflects the amount of a chemical in ambient air to which almost all people can be exposed for 90 days without significant health risk. Day-to-day reduced sulfur values are generally < 5 ppb. Most of the factors listed in the paragraph above that increase/decrease the potential for health concerns also apply to the sulfur emissions. While it is usually below the subchronic standard, the ambient level of sulfur is relatively close to the standard. It therefore warrants close monitoring by both Ashland and MPCA to ensure that levels do not rise to a point where they may pose a health concern. Any reductions in sulfur emissions that can be realized will assist in reducing the potential for adverse health effects in the area.

Air quality within the plant is monitored using periodic analytical checks. This includes both personal pumps and badges and monitors set up in targeted rooms/areas to determine average levels. Noise levels are also periodically monitored to ensure they are within specified limits. Each area of the refinery has a specific safety requirement for workers, such as a particular type of glove, respirator, or outer protective clothing. Compliance with these standard procedures is monitored by the supervisors. Special care is given for fire and explosion hazards, since these can be disastrous.

It should be noted that the Site is located in an area which is designated as a non-attainment for carbon monoxide. This means that the concentration of these contaminants in the air in the area consistently exceeds the recommended standards for these pollutants (but that no one particular source is entirely to blame). Therefore, an assessment of potential health effects must include the cumulative effects of all sources in the area, including those being released from the Site. Federal and State rules are currently being developed to deal with air toxics and hazardous pollutants. The draft State air standards for compounds identified at the Site are listed under "Minn. HRV" in the table in Appendix 3.

Should activities occur at this Site that expose large amounts of subsurface material, or result in a large spill or release of volatile material, there may be significant releases of noxious fumes and odors into the Site and surrounding community. Due to the toxic and/or odorous nature of the materials located on the Site, a major release has the potential of impacting the health and well-being of the surrounding community.

Regarding day-to-day conditions, it is well beyond the scope of this document to accurately

assess the possible effect of releases to the air (either historical or ongoing low-level releases) on the health of the surrounding community. The types of health complaints which have been registered by the community (e.g. irritated eyes, nose and throat, asthma, and headaches) are similar to those typically encountered with exposure to solvents, other volatile organic compounds, PM_{10}, or sulfur compounds. However, there is no method to definitively demonstrate if the adverse health effects which have been noted in the community were the result of emissions from the refinery (see "Feasibility of Health Studies" section for further explanation of the limitations of a health study). Nevertheless, MDH, through application of protective criteria for toxics in ambient air, water, and soil, seeks to protect the public by limiting exposures to orders of magnitude *less* than levels that would result in health effects that could be perceived in an epidemiological study.

Summary of Pathways of Concern

Based upon the information listed above, the potential pathways of exposure to Site-related contaminants are:

- Inhalation of airborne contaminants by on-Site workers, frequent Site visitors, and downwind residents in the case of a major spill or other significant airborne release of Site materials to the surrounding area (e.g. fire, tank rupture). Releases which occur as part of daily operation of the plant are also a source of odors and potentially toxic chemicals in the surrounding community, although the significance of these releases to the health of the area is difficult to evaluate.

- Incidental ingestion of contaminated soils or dusts or sludges present in the on-Site area by workers, frequent Site visitors, and trespassers.

- Direct skin contact with contaminated soils or other solvents/products on-Site by workers.

- Ingestion of or other direct contact with contaminated groundwater by future residents of the immediate area of the refinery who are not supplied with municipal water. This is restricted to wells placed directly in, or in the immediate vicinity of, the current contamination plumes.

- Periodic releases to the Mississippi River from seeps, spills and other uncontrolled incidents in addition to wastewater treatment plant outfall may result in dermal exposure to, and incidental ingestion of, contaminants by recreational users of the River. There also may be environmental consequences of these releases.

If the land use in the area changes significantly (e.g. refinery closes and land redeveloped, residences are built close to the refinery in currently open areas), then the exposure pathways will need to be reevaluated in light of the new information. The future development and land use in the area and any technology or system upgrades at the refinery should be tracked to insure that

the new uses do not expose individuals to health threats, especially through air releases.

Because this Site is located in a highly developed area, there may be multiple low-level exposures from various adjacent sources. This is common in urban areas where automobiles and industrial activity all contribute to generally diminished air quality. Therefore any quantitative assessment of exposure pathways should take into account these potentially confounding factors. Any new technologies, clean-up activities, or other changes in daily operating procedures at the refinery also may result in new or different exposure pathways.

Health Concerns of Area Residents and the Feasibility of Health Studies

Community Concerns

Ashland distributes a quarterly publication called the "Ashland Community Advisory Press". It summarizes the activities of the Community Action Panel (CAP), which was formed to be a liaison between the company, the agencies, and the community and gives updates on activities at the refinery. Recent articles have addressed issues related to air emissions, storage tanks, and groundwater contamination. It also includes columns from CAP members and the refinery superintendent discussing areas of concern and policy approaches. Residents near the refinery are encouraged to contact their local representative with questions and concerns that are important to the community. Informing decision-makers of concerns and problems allows them to better understand and address situations they may not otherwise be aware of.

The CAP includes five representatives each from Newport, St. Paul Park, and Cottage Grove. The first meeting was on February 8, 1994 and they have met regularly since. When asked about their general attitude towards the CAP, some members indicated it was a useful group, to a point. They felt that the CAP was hindered by some procedural problems and differences in opinion between members. These concerns were outlined in a memo from some CAP members to other interested parties in September, 1995. Not all CAP members agreed with these recommendations, however. Rather than engaging in discussions on health concerns of a few members, the memo alleged that the CAP meetings were filled with an emphasis on company public relations. Due to the structure and membership of the CAP, however, there may be a reluctance to express negative concerns. The members appear to agree that establishing the CAP was a significant step forward and were glad that the refinery was making the effort to communicate with them. This improved communication, and the increased awareness it fosters, can assist in protecting public health by informing residents of potential exposure pathways, thereby allowing them to take actions to avoid coming in contact with contamination.

As indicated in the "Air" section above, residents are very concerned about air quality issues. When asked to describe the "refinery smell", residents have indicated that it is a distinctive odor that is a combination of rotten eggs (from the reduced sulfur) and gasoline. The wastewater treatment area also has a characteristic smell that is more an oily water odor. Residents also felt that the frequency of bad odors is about biweekly, but can be very streaky. Depending on

weather conditions (and likely on what is being processed at the refinery), several months can pass without a report of strong odors. Periods of temperature inversion and hot summer weather (when windows are open and people are outside more) appeared to residents to be the most likely times for odor complaints.

A discussion with several members of the CAP representing the surrounding communities resulted in a list of five health-related issues that they felt were important and needed open discussion: 1) volume of truck traffic; 2) noise; 3) possible long-term health effects from inhalation of VOC's, especially benzene; 4) odor; and 5) the groundwater plume. The issues are not presented in any order of priority. When asked about the truck traffic, they indicated that although there are many, many trucks always coming and going, there has only been one major accident in the last several years. A young boy was killed 5 or 6 years ago, but there have been no major accidents since then. However, it can be very irritating to be behind a slow moving truck, inhaling the diesel fumes and occasionally small spills/overfills. The noise levels from the refinery has improved in response to citizen complaints several years ago, but it still remains a noisy place. Odors also have improved over the last couple of years, but still are occasionally very bad. These issues are the basis for ongoing discussions in the CAP.

Feasibility of Health Studies

A variety of health complaints have been registered by area residents in relation to the operation of the Ashland Oil refinery. These complaints include irritated eyes, nose, and throat; asthma; and headaches. Some residents also believe that there is a high prevalence of cancer in the area. Based on these complaints and perceptions, some residents have asked for a community health study. After some introductory background information, the possibility of further studies to address complaints will be discussed under three main headings: i) those related to irritation of eyes, nose and throat from odors from the refinery; ii) those related to a perceived increase in occurrence of asthma in the area; and iii) those related to concerns over increased risk of cancer.

The MDH receives frequent requests for such studies when there is a perceived or known exposure potential and/or a perceived excess of disease. In our experience, public requests for community health studies in relation to environmental concerns often stem from misunderstandings about the level of risks arising from environmental exposures, the normal prevalence and variability of health problems in the population, the limitations of epidemiologic studies; and the distinction between exposures and risks that are of regulatory and/or aesthetic concern and those that may have a observable impact on actual community disease rates. Requests for health studies may also arise when there is continuing public frustration, anger, and concern over resolution of an environmental issue and a health study is viewed as a means of dramatically documenting to public and industry officials the impact of some environmental exposure. Unfortunately, the conduct of health studies under inappropriate conditions can be counterproductive to the community's concerns. Delays may occur in resolving environmental issues while all parties await results of the study. Although well-conducted community health studies can provide valuable information for a variety of public health purposes, such studies

often have very limited utility in resolving public concerns over environmental issues. The general utility of community health studies in this context is described below.

In general, community health studies can be performed for two distinct purposes. One is to obtain baseline information on the prevalence of health conditions within the community. The purpose of such a study is purely descriptive and does not seek to determine causes. The information can be used in many different ways, such as characterizing disease prevalence in terms of age, sex, race, etc. This information, in turn, can be used for following trends, planning intervention or health education programs, and many other uses. Depending on the health conditions that are of interest, a community health survey may consist of questionnaires, interviews, or even medical examinations, that are administered to the community or a representative sample of the community. These types of studies are unable to determine the effect of a single source (in this case, the Ashland Oil refinery), but rather assess the health of the community as a result of exposure to all sources in the area.

A second purpose of a community health study is to determine whether the health of the community has been adversely impacted by exposure to environmental pollutants from a specific site or source. This type of question cannot be answered by simply ascertaining the prevalence of certain health problems in the exposed community and comparing it to the prevalence in a similar, but non-exposed community, since undoubtedly the two communities will differ in many ways in addition to their exposure status. Some of these factors, such as age and ethnicity, can be measured, but others, (e.g. concentrations of indoor pollutants and diet) are very difficult to accurately determine. In addition, the recall and reporting of many health conditions or symptoms can depend on a person's knowledge and level of concern about their environment. In addition, as improved technology has been added to the refinery, environmental exposures to chemicals from the site have apparently declined over time as releases have been lowered. Historical exposures would have been different than current exposures. Thus, exposure potential to individuals would have varied by both place and time. A rigorously conducted study attempts to minimize these problems and requires substantial time and money to accomplish these goals. Even after the best scientific efforts, significant uncertainty often remains regarding the conclusions of such a study.

The usefulness and feasibility of a community health study in addressing an environmental issue depends on many factors. These factors include, but are not limited to, the following: (1) whether there is a large enough population to draw meaningful conclusions; (2) whether there is an adequate measure of exposure to the agents in question; (3) whether the exposure is likely to occur at concentrations capable of causing an increased frequency of health problems; (4) the types of health problems that are of concern; and (5) whether other causes of such health problems can be taken into account. Without adequate consideration of such factors, the conduct of a health study can be an effort that at best will shed little or no light on the issue, and at worst can provide a very misleading picture (i.e., falsely indicate that there is a problem when none exists or falsely indicate there is no problem when one does exist). In general, community health studies are rarely able to provide scientifically valid conclusions concerning low level

environmental exposures of the type currently occurring at the Ashland facility.

Concerns Over Irritation of Eyes/Nose/Throat

Smell can often be a good indicator of the presence of a volatile material in the area and therefore a potentially complete exposure pathway of concern. In addition, highly sensitive individuals may experience health problems at levels below standards which are typically used at a site of this nature. Several of the solvents and reduced-sulfur-containing compounds identified at this site, however, can be problematic in that they might be noticed by smell at concentrations below levels that are threatening to public health. It needs to be emphasized that just because the odor of a material is noticeable, it is not necessarily a threat to public health.

Therefore, while there have been numerous complaints such as burning eyes, headaches, and itchy throats (which may result from periodic, short-term exposures associated with strong odors), it remains very difficult to prove a conclusive link between odors and long-term health problems. A complete exposure pathway (such as an odor in the neighborhood) does not, by itself, indicate a long-term public health concern. The concentration of a compound must also be considered in determining the presence of a public health threat.

Some of the confounding factors which make an irritant/odor test difficult to conduct and interpret include:

< In a relatively small population such as this, it would be very difficult to ascertain whether the prevalence of these symptoms was elevated or not, let alone attempt to attribute them to a specific cause. These symptoms also are difficult to define or document, and the recall and reporting of such symptoms can be influenced by an individual's level of environmental concern.

< Most of the reported symptoms are relatively common conditions in any population and these conditions have many potential causes (both known and unknown). It would be very difficult to identify the many potential determinants of these conditions.

There has been some effort in the past by state agencies to regulate odorous emissions. The MPCA currently has a statute which was designed to attempt to address odors in communities near significant emissions (MN Rules ch. 7011). However, this statute has proved to be nearly impossible to implement and is currently being reviewed (see Current Issues section). Although a draft replacement rule has been prepared, there is significant concern that, due to the local nature of odor emissions, a state-wide rule may not be the most effective means for reaching the desired goal of reduced noxious emissions. If promulgated, however, this odor rule could provide a way for the community to get involved in regulating air quality around the Site.

Concerns Over Asthma/Bronchitis

Bronchial asthma is a disease of the lower airways that is characterized by an obstruction in the normal flow of air into and out of the lungs. This can lead to wheezing, shortness of breath, and a reduced ability to perform physical tasks. Although asthma can be made worse by high levels of certain pollutants (such as SO_2, PM_{10} and ozone), most scientists believe that asthma is not caused by air pollution. For this reason, even if there is a higher prevalence of asthma in this neighborhood, it is extremely unlikely to be the result of emissions from the Ashland refinery. In addition, although there are periodic, short-term problems, the refinery is generally in compliance with the permitted emission rates in the air permits. For example, in the 4th quarter of 1995, the highest 1-hour reading for SO_2 at the monitoring station in St. Paul Park was 106 ppb (the primary standard for SO_2 for 1-hour exposures is 500 ppb; this is different than the acute standard for hydrogen sulfide (7 ppb) which was mentioned previously). A worsening of asthma symptoms has not typically been seen at levels of several hundred ppb SO_2.

The incidence of asthma is increasing all over the United States and in many other countries, for reasons which are not yet clear. This general increase may be responsible for the perception that there is more asthma than there should be in the area.

MDH did perform a study of asthma prevalence in the Pine Bend area, where there was concern over emissions from the Koch Refinery. At the time the study was performed, there was no information available about ambient levels of SO_2 or any other pollutants in that community. That study showed that there was more asthma in the areas closer to the refinery than in areas further away. However, subsequent extensive air monitoring showed that the air quality in these areas did not differ. From this experience, the MDH learned that performing a health study in the absence of information on air quality was not useful, since the cause of the increase in asthma could not be identified but did not appear to be due to emissions.

Concerns Over Possible Cancer

All of the factors discussed above which complicate efforts to conduct health studies in an area such as Ashland also apply to attempts to quantify cancer risks. Even if an excess of cancers were found in this area, it would be difficult to scientifically demonstrate any relationship to ambient environmental exposures. The major determinants of cancer in a population include age and a variety of lifestyle factors such as smoking, diet, alcohol, and reproductive/sexual history. Furthermore, cancer is not one disease, but many different diseases that have many different causes. The MDH estimates, based on current cancer rates and life expectancy, that between 4 and 5 Minnesotans out of 10 will be diagnosed with a cancer at some point during their lifetimes. Therefore the background occurrence rate for cancer in the State (and in the nation) is very high, which makes identification of local increases difficult. For example, intensive studies of so-called "cancer clusters" (documented excess of a specific type of cancer such as leukemia) in a community have almost never revealed a common environmental cause.

Based on these factors, a health study of residents near the Ashland Oil refinery does not appear warranted or feasible. It would have little or no possibility of documenting a relationship

between community health and pollutants from the refinery. Therefore MDH does not anticipate conducting a community health study in this area in the near future. While a health study is not sufficiently sensitive to detect the influence of exposure at the 1 in 100,000 risk range, reductions in emissions by the refinery will lead to a lower exposure in the community, and therefore a lower risk of public health threats. For this reason, it is important that operations are continually reviewed to ensure that the minimum level of emission is achieved.

In addition, MDH will continue to play an active role at this Site by assisting the MPCA and other regulatory agencies in reviewing site plans from a health perspective, answering individual public inquiries regarding health questions, providing toxicological information to decision makers as requested, and continuing to attend public meetings on significant milestones. This will help promote an awareness of public health issues for all parties involved with the Site.

Current Issues

Starting in October, 1993, and continuing on a regular basis since, meetings have been held to promote a dialog between the technical people at MPCA, Ashland (and their environmental consultant, Barr Engineering), the cities of Newport and St. Paul Park, and the State Representatives. Initially, this was coordinated by the State representatives of that area (Senator Leonard Price and Representative Patrick Beard). Senator Price and recently-elected Representative Sharon Marko have continued the effort. The meetings have been held both at the Capitol and in the local communities. This provides an opportunity for all parties involved to hear what other entities are doing, voice concerns, and help set priorities for future directions. It is anticipated that these meetings will continue into the foreseeable future.

Recent projects which have been completed to improve refinery operations and reduce ambient emissions were listed in the most recent *Community Advisory Press* (Spring, 1996) and include:

< The Clean Fuels project is an effort to develop a low sulfur diesel gasoline in response to 1993 EPA standards. This production line became operational in August, 1993.

< The valve maintenance program, which was started in 1987 to help reduce losses (both liquid and vapor) from valves that control product flow. This ongoing effort was expanded to be refinery-wide in 1993 and is anticipated to yield significant reductions in ambient volatile and sulfur emissions.

Environmental projects which will be implemented in the near future include:

< Extension of the French Drain system to provide better assurance that the free product plume is captured. This includes possible installation of a deep trench designed to capture free product located in sand lenses below the normal water table. In addition, three groundwater pumpout wells have been installed in the northern portion of the system to further assist in controlling the plume.

< Recalibration of the SO_2 air dispersion model to compensate for overestimates in the EPA model which was originally used to determine permitted emission rates for sulfur. The model is designed to help set refinery emission limits so that Ashland can demonstrate modeled compliance with the Minnesota 1-hour SO_2 standard.

< Continue to conduct air monitoring near the loading dock in response to initial air data showing elevated levels of benzene at homes nearby (on Factory Rd.). These homes have since been purchased by Ashland and are no longer permanently occupied. However, more residents are located a short distance away. This monitoring will assist in attempts to estimate exposure concentrations to residents in the nearby area and to validate effectiveness of vapor control procedures at the new loading dock.

< Upgrading of the loading dock to allow for better control of transient vapors using a bottom loading, closed system. A permit application was sent to the MPCA in October, 1995 and the permit was issued in May, 1996. The new PTE (Potential to Emit) air quality standards for the upgraded loading dock are: 160.5 tons per year VOCs and 0 tons/year for PM_{10}, SO_2, NO_X, CO and Pb. This is over 1000 tons/year less than current VOC emission from the loading dock.

< Other projects which are planned for the near future include upgrading the asphalt loading rack, installing a foul water surge tank, and revamping the FCC regenerator (to convert CO to CO_2). In addition, the effort to raise all lines above the ground and upgrade bulk storage tanks to have double bottoms and overflow protection will continue.

As part of a settlement agreement with MPCA, Ashland provided $30,000 to the CAP to be used however they saw fit to address community concerns. The CAP decided to conduct an inventory of local wildlife requirements and develop nearby lands owned by Ashland to provide quality habitat and nature trails. The money would be spent on providing materials and input on potential habitats, and extensive volunteer labor would be required to implement the plan (which is a positive, since it promotes community involvement and buy-in). Having met the public health concerns by requesting this Consultation, air permit concerns by contacting MPCA for assistance in community relations and risk communication, and assuring that Ashland will continue to produce the newsletter to the community, the CAP resolved to recommend to MPCA that the funds be used for the wildlife habitat restoration/preservation activities. These activities will be coordinated by Ashland, but will include efforts by many stakeholders throughout the community. Ashland committed to supporting the approach over the long-term.

On July 3, 1996, Judge Giles (an Administrative law judge) recommended that the MPCA repeal its existing odor rule and not promulgate a new rule. The new rule which was being considered would maintain a State role in addressing odor issues and attempt to bring a measure of state-wide consistency to odor regulation, and provide a consistent procedure for local governments to use to document and refer odor problems to the MPCA. The current MPCA staff plan is to

pursue repeal of the existing odor rule at the August 27, 1996 MPCA Board meeting. If the new rule is not promulgated and the old rule repealed, MPCA would no longer be in position to enforce odor cases, which would then be referred to the local units of government. MPCA would still have authority to require performance testing in cases where odor complaints indicate a possible public health concern or excessive emissions of a regulated pollutant.

MPCA is also taking steps to help reduce the emission of toxic sulfur compounds from large feedlots. These efforts may also assist in providing valuable information and procedures for the Ashland refinery since both are relatively large emitters of sulfur compounds which can have very strong odors.

Negotiations are currently ongoing to resolve final issues related to the “Part 70" air permit for the entire facility. MPCA met with the CAP on 4/9/96 to discuss general issues addressed by the permit. It is anticipated that as portions of the draft permit are agreed upon, they will be circulated through the CAP for review and comment before being finalized. In this manner, the CAP can be kept aware of the most current conditions. While MPCA does not have any specific plans for coordinating with the surrounding communities, they are committed to keeping the public involved throughout the drafting and decision making process.

The Koch refinery in Dakota County is also undergoing negotiations to reissue their comprehensive Part 70 air permit. An innovative approach utilizing “Plant wide Applicability Limits” is currently being proposed. Although the current schedule is to have the permit issued by September, 1996, there may be delays caused by issues related to the review of a risk assessment. Information on, or comments about, this permit may be obtained from MPCA.

Conclusions

1. The Site is about 10 miles southeast of the Twin Cities along the Mississippi, adjacent to the cities of Newport and St. Paul Park. The refinery itself occupies about 100 acres, consisting of one third “process” areas and two thirds “storage” areas. The process areas are on the northern portion of the refinery and are where crude oil is converted into usable petroleum products. Storage areas consist of well over 100 tanks, containing the various products produced in the process area.

2. The MPCA, in cooperation with the federal Environmental Protection Agency (EPA), has primary responsibility for overseeing environmental operations at the refinery. The environmental regulation effort includes both cooperative and independent activities by each of MPCA’s four divisions.

3. The handling of large volumes of materials as part of the refining process has led to spills, resulting in widespread contamination. Leaks from underground storage tanks and other storage areas on the Site have resulted in soil and groundwater contamination. Releases to the air may occur during routine refining processes (e.g. from leaky valves, pressure

changes, or from heater stacks), during transfer of product from bulk storage to working containers, as a result of spills, or as part of the waste and wastewater treatment system.

4. The vast majority of the compounds which are present at this Site are petroleum-based organic solvents commonly used in industrial situations for a variety of purposes and also are common elements found in gasoline. Many of these materials are present in low ppb concentrations in ambient urban air and can come from a variety of sources.

5. Contaminants identified in the upper zone of the ground water which exceed health-based standards include benzene, toluene, ethyl benzene, xylene, ethyl ether, methylene chloride, cresol, naphthalene, trichloroethylene, 1,2 dichloroethane, and pentachlorophenol. If water exceeds health-based recommendations and is used domestically (drinking, cooking, washing), then there is a potential for adverse health effects. There are no known current complete exposure pathways for the groundwater.

6. Due to a number of technical and meteorological factors, there is an inherently large degree of uncertainty in estimating public health concerns from the air exposure pathway. Although current data do not indicate the presence of an acute health threat from the Site, the possibility of adverse long-term health threats was less clear. The compounds identified in the air which are most likely to be contributing the greatest risk are benzene, formaldehyde, and reduced sulfur compounds.

7. The potential pathways of exposure to Site-related contaminants include: a) inhalation of airborne contaminants by on-Site workers and downwind residents, b) incidental ingestion of contaminated soils or dusts or sludges by both workers and trespassers, c) direct skin contact with contaminated soils or other solvents/products on-Site by workers, d) ingestion of or other direct contact with contaminated groundwater by future residents of the immediate area, and e) periodic releases to the Mississippi River. Of these, exposure through the air pathway is most likely to be a significant public health concern.

8. A community health study in the neighborhood near the Ashland Oil refinery would have little or no possibility of documenting a relationship between community health and pollutants from the refinery. Therefore MDH does not anticipate conducting a community health study in this area in the near future. Nevertheless, MDH, through application of protective criteria for toxics in ambient air, water, and soil, seeks to protect the public by limiting exposures to orders of magnitude *less* than levels that would result in health effects that could be perceived in an epidemiological study. In addition, MDH will continue to participate in various Site activities.

9. There are numerous ongoing environmental projects designed to increase efficiency of the refinery and reduce emissions. By reducing emissions and continuing with air monitoring to document the emissions reductions, the refinery will reduce the possibility of adverse public health effects.

Recommendations

1. It is important to continue the communication network that has been established as part of the CAP. Ashland must remember that open and trusted lines of communication are essential in helping residents near their large petroleum operation be aware of all of the remedial/prevention efforts and improvements that are ongoing. With good information and communication, all parties involved can negotiate in good faith towards common solutions. In addition, the periodic meetings held by Senator Price involving all parties associated with the refinery (commercial, regulatory, public) are helpful in establishing and keeping specific goals and objectives for the refinery. These meetings also should be continued.

2. The targeted air monitoring for downwind volatile organic compounds from both the loading dock and the refinery in general should be continued until a reasonable estimate can be made regarding the outer edge of the elevated levels. This will assist in better characterizing the potential carcinogenic risk by better defining the benzene and formaldehyde exposure values. While it is recognized that the new loading facility should have significantly lower emissions, it still is important to attempt to characterize ambient conditions in the nearby communities. In addition, all parties should maintain their current efforts to be responsive to odor complaints.

3. St. Paul Park municipal well #1 should continue to be monitored to help ensure that the free product plume located directly above it is not drawn into drinking water system. This monitoring should include a periodic chemical analysis of the water, management of the pumping rate to prevent significant drawdown, and some method of ensuring that future city water managers are aware of Site conditions and the limitations of the use of the well. In addition, efforts to control the off-site movement of the free product and groundwater contamination plume should continue.

4. Although Ashland already has several programs in place to promote quality and efficiency in the workplace, they should continue to encourage frequent, comprehensive reviews of operations to find ways to limit releases (especially to ambient air). This may include such things as valve maintenance, an upgrade of technology, new methods of handling internal airflow within the facility, and early detection and prevention of leaks and spills. This will assist in providing a safe workplace and in lowering ambient exposures to surrounding communities.

5. Due to the large volume of potentially toxic materials which are located on the Site, it is crucial that all Site safety regulations be reviewed, updated as necessary, and strictly followed. Although the materials may be handled safely in a controlled situation, any action which is not consistent with an overall Site safety plan could potentially release toxic materials into the surrounding community and impair public health.

Information Sources

The following is a list of the materials which were utilized by MDH in the development of this health consultation:

1. Agency for Toxic Substances and Disease Registry. *Toxicological Profile for Phenol,*US Public Health Service, December, 1989.
2. Agency for Toxic Substances and Disease Registry. *Toxicological Profile for Cresols: o-Cresol, p-cresol, m-cresol,*US Public Health Service, ATSDR/TP-91/11, July, 1992.
3. Agency for Toxic Substances and Disease Registry. *Toxicological Profile for Naphthalene; Draft Update,*US Public Health Service, October, 1993.
4. Agency for Toxic Substances and Disease Registry. *Toxicological Profile for Automotive Gasoline; Update,*US Public Health Service, June, 1995.
5. Agency for Toxic Substances and Disease Registry. *Toxicological Profile for Polycyclic Aromatic Hydrocarbons (PAHs); Update,*US Public Health Service, August, 1995.
6. Amdur, O.A., J. Doull, and C.D. Klassen. 1991. *Casarett and Doull's Toxicology, The Basic Science of Poisons, 4th Ed.* Pergammon Press, New York, 1033 pp.
7. American Conference of Governmental Industrial Hygienists, *1990-1991 Threshold Limit Values for Chemical Substances and Physical Agents,* ISBN: 0-0936712-86-4
8. Ashland Petroleum Company, *Ashland Community Advisory Press,* Summer, 1995.
9. Ashland Petroleum Company, *Ashland Community Advisory Press,* Spring, 1996.
10. Barr Engineering, Company, *Remedial Investigation Study Plan, Ashland Petroleum company, St. Paul Park Refinery,* May, 1989.
11. Barr Engineering Company, *Remedial Investigation Report, Ashland Petroleum Company, St. Paul Park Refinery,* February, 1991.
12. Barr Engineering Company, *Revised Baseline Human Health Risk Assessment, Ashland Petroleum Company, St. Paul Park Refinery,* October, 1991.
13. Halder, C.A., G.S. VanGorp, N.S. Hatoum, and T.M. Warne. 1986. Gasoline vapor exposures. Part II. Evaluation of the nephrotoxicity of the major C_4/C_5 hydrocarbon components. *Am. Ind. Hyg. Assoc. J.* 47:173-175.
14. Le Mesurier, S.M., B.W. Stewart, P.J. O'Connell, and A.W.J. Lykke. 1979. Pulmonary responses to atmospheric pollutant. II. Effects of petrol vapor inhalation on secretion of pulmonary surfactant. *Pathology*. 11:81-87.
15. McDermott, H.J. and G.A. Vos. 1979. Service station attendants' exposure to benzene and gasoline vapors. *Am. Ind. Hyg. Assoc. J.* 40:315-321.
16. Minnesota Department of Health, *Proposed Insert for Interplastic Report, Division of Disease Prevention and Control,* November 4, 1993.
17. Minnesota Department of Health. Memo from Daniel Symonik to Ashland Site file. *Ashland Refinery Site visit.* January 23, 1996.
18. Minnesota Department of Health. Memo from Daniel Symonik to Ashland Site file. *St. Paul Park Municipal Well #1.* February 8, 1996.

19. Minnesota Department of Health. Memo from Daniel Symonik to Ashland Site file. *Citizen Concerns at Ashland.* February 13, 1996.
20. Minnesota Department of Health. Memo from Daniel Symonik to Ashland Site file. *Spills to Bedrock.* February 16, 1996.
21. Minnesota Department of Health. Memo from Daniel Symonik to Ashland Site file. *Visit with Ashland Industrial Hygienist.* March 18, 1996.
22. Minnesota Department of Health. Memo from Daniel Symonik to Ashland Site file. *Meeting with Washington County Environmental Agency.* April 8, 1996.
23. Minnesota Department of Health. Memo from Daniel Symonik to Ashland Site file. *PCA Odor Control statute.* May 24, 1996.
24. Minnesota Geological Survey. 1990. *Geologic Atlas, Washington County, Minnesota.* County Atlas Series, Atlas C-5.
25. Minnesota Pollution Control Agency. 1992. *Estimation and Evaluation of Cancer Risks from Air Pollution in the Minneapolis/St. Paul Metropolitan Area.* March, 1992.
26. Minnesota Pollution Control Agency, *Air Emission Permit for the Installation and Operation of Two Diesel Additive Tanks and Associated Piping, Valves, and Pumps*" (permit #203-93-I/O-4), 1993.
27. Minnesota Pollution Control Agency, *Hazardous Waste Treatment Facility Permit for Ashland Petroleum Company*, September 30, 1993.
28. Minnesota Pollution Control Agency, *Pine Bend Monitoring Network, Data Summary Report; Second Quarter, 1994*, August 15, 1994.
29. Minnesota Pollution Control Agency, *Permit Application Form GI-07, Facility Emissions Summary*, November 14, 1994.
30. Minnesota Pollution Control Agency, letter from Lisa Thorvig (MPCA) to Thomas Gale (Ashland), December 8, 1994
31. Minnesota Pollution Control Agency, *Permanent List of Priorities*, June, 1995
32. Minnesota Pollution Control Agency, letter from David Beil (MPCA) to Robert Gross (Ashland), October 10, 1995
33. Minnesota Pollution Control Agency, Memo from James Lundy to Frank Wallner, *St. Paul Park Municipal Well #1 Pumping Test*, November 8, 1995.
34. Minnesota Pollution Control Agency, personal communication, *Amrill Okonkwo, MPCA*, December 18, 1995.
35. Minnesota Pollution Control Agency, *Pine Bend Monitoring Network, Data Summary Report; Second Quarter, 1994*, August 15, 1994.
36. Minnesota Pollution Control Agency, *Pine Bend Monitoring Network, Data Summary Report; Fourth Quarter, 1995*, February 16, 1996.
37. Minnesota Pollution Control Agency, *Pine Bend Monitoring Network, Data Summary Report; First Quarter, 1996*, May 10, 1996.
38. Minnesota Pollution Control Agency, "*Public Notice on Proposed Air Emission Facility Permit*" (Permit #16300003-041), March 20, 1996.
39. National Institute for Occupational Safety and Health, *NIOSH Pocket Guide to Chemical Hazards*, US Department of Health and Human Services, June, 1990.

40. Page, N.P. and M. Mehlman. 1989. Health effects of gasoline refueling vapors and measured exposures at service stations. *Toxicol. Ind. Health.* 5(5):869-890.
41. Poklis, A and C. Burkett. 1977. Gasoline sniffing: a review. *Clinical Tox.* 11:35-41.
42. Rudo, K. 1995. Review of the Wisconsin DHSS report on health concerns attributed to reformulated gasoline use in southeastern Wisconsin. *Toxicol. Ind. Health* 11:463-466.
43. Seinfeld, J.H. 1986. *Atmospheric Chemistry and Physics of Air Pollution.* John Wiley and Sons, New York. 738 pp.
44. Standeven, A.M., D.C. Wolf, and T.L. Goldworthy. 1994. Investigation of antiestrogenicity as a mechanism of female mouse liver tumor induction by unleaded gasoline. At: http://www.ciit.org/ACT94/ACTIVITIES.MAR94.
45. US Environmental Protection Agency. 1984. Regulatory strategies for the gasoline marketing industry. 49FR31706. *Federal Register.* August 8, 1984.
46. Vershueren, K. 1983. *Handbook of Environmental Data on Organic Chemicals, Second Ed.*, Van Nostrand Reinhold, New York. 1310 pp.

Report Prepared by:

Daniel M. Symonik
Section of Environmental Health Hazard Management
Minnesota Department of Health

CERTIFICATION

This Ashland Oil Refinery Site Health Consultation was prepared by the Minnesota Department of Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was begun.

_____

Richard R. Kauffman, M.S.
Technical Project Officer
Superfund Site Assessment Branch (SSAB)
Division of Health Assessment and Consultation (DHAC)
ATSDR

The Division of Health Assessment and Consultation, ATSDR, has reviewed this health consultation, and concurs with its findings.

_____

Richard E. Gillig, M.C.P.
Chief, SPS, SSAB, DHAC, ATSDR

Ashland Refinery, Inc.
Information and Agency Contact List
August, 1996

		Phone:
Ashland Refinery, Inc.:		
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	Bob Everett, Adminstrative Superintendent	458-6458
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	Kathy Svanda, EHHM Section Manager	215-0878
	Rita Messing, SAC Unit Supervisor	215-0924
	Daniel Symonik, Health Assessor	215-0920
Minnesota Pollution Control Agency:		
	Frank Wallner, Superfund project manager	296-7443
	Emmy Reppe, Public Information Office	296-6706
	Don Kriens, Water Quality	296-7734
	Steve LaRoque, RCRA Inspections	297-8495
	Rick Strassman, Air Quality - monitoring	296-7754
	Amrill Okonkwo, Air Quality - permits	296-7009
	Steve Lee, Tanks and Spills	297-8610
Washington County:		
	Nate Arthur, RCRA Inspections	430-6689
	Cheryl Erler, RCRA Program	430-6684
City Government:		
	Newport City Hall	459-5677
	St. Paul Park City Hall	459-9785
State Government:		
	Senator Leonard Price	297-8060
	Representative Sharon Marko	296-3135
	Duty Officer (odor complaints, emergency calls)	649-5451

Appendix 1

General Site Maps

and

Groundwater and Soil Contaminants
as reproduced from (Barr, Oct. 1991)

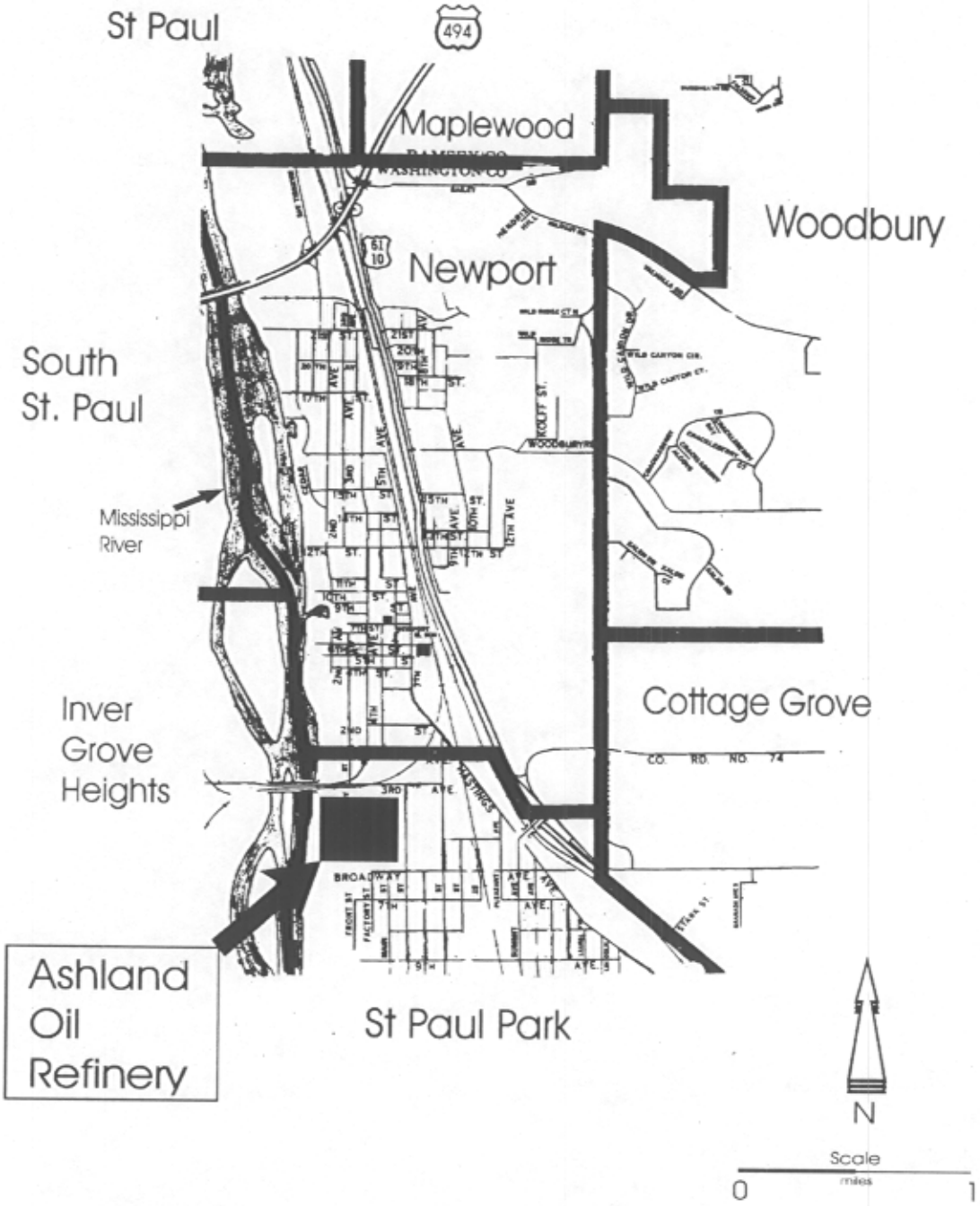


Figure 1: General Site Area (Based on Hudson, 1990)

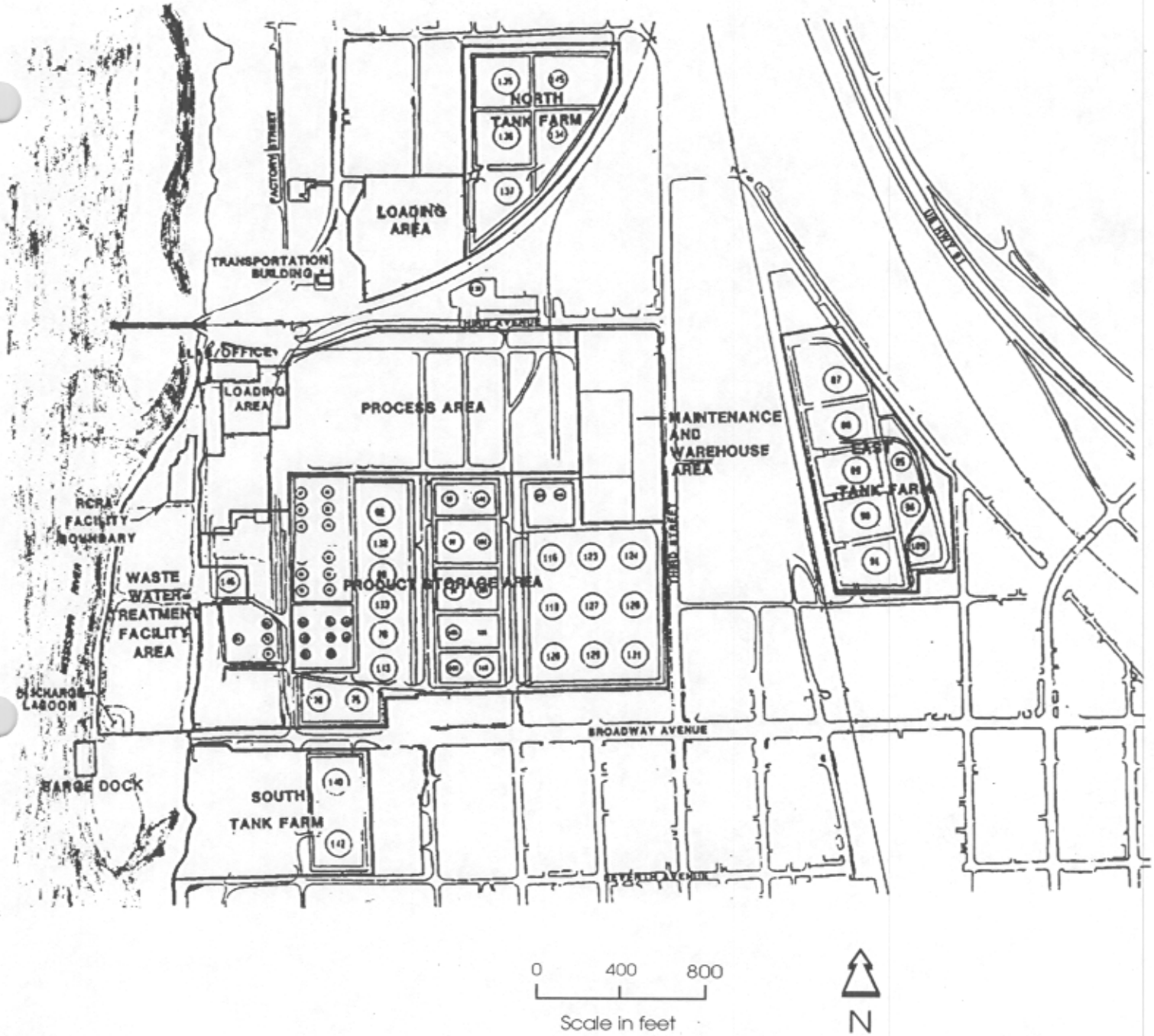


Figure 2: General Locations of Areas Within the Site (Based on Barr, 1991)

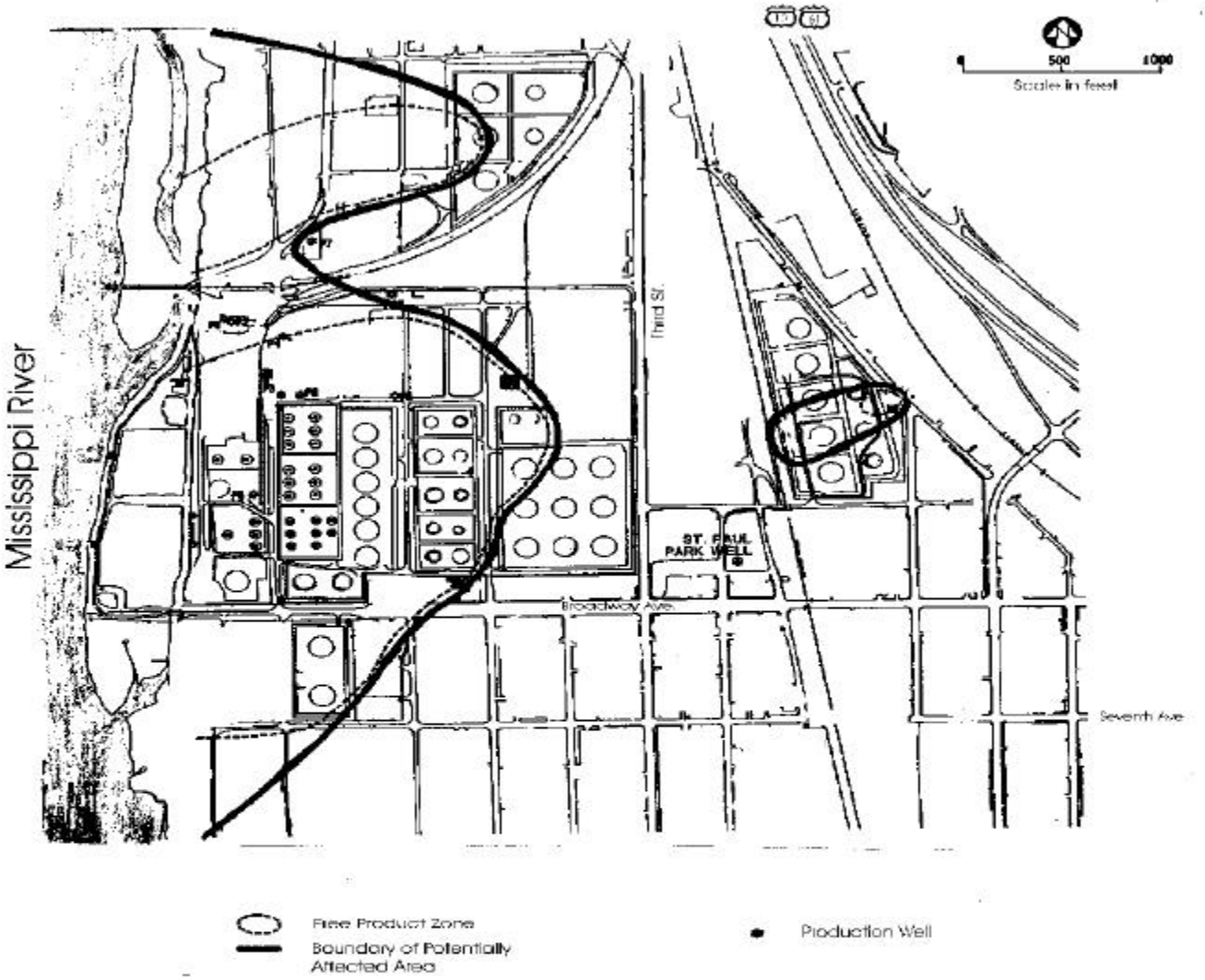


Figure 3: Off-Site Areas Potentially Affected by Contaminated Groundwater (Based on Barr, 1991)

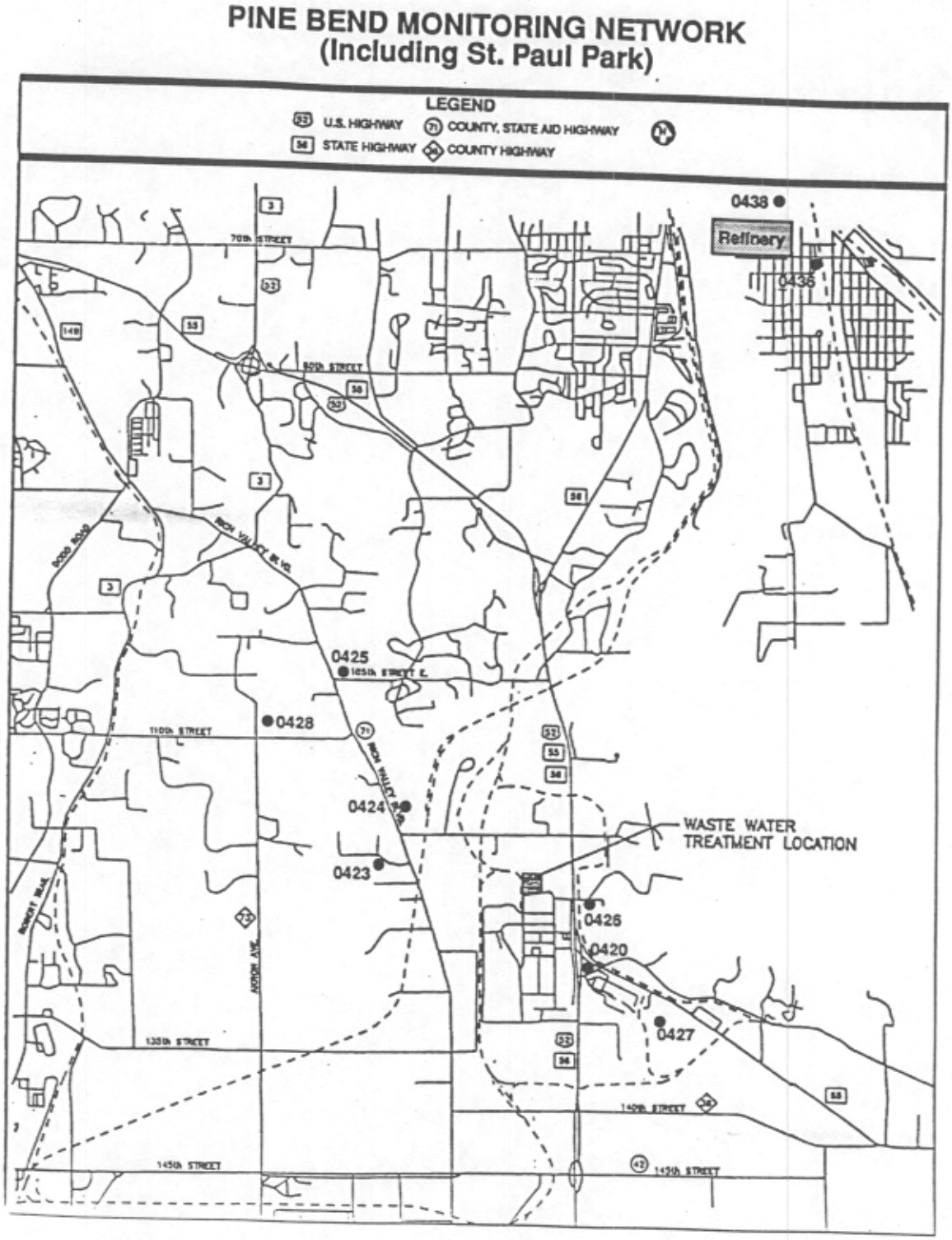


Figure 4: Monitoring locations for Pine Bend air quality data. The two Ashland locations are in the upper right corner. (Adapted from MPCA, 1996)

TABLE 41 (Continued)

SUBSTANCES DETECTED IN SOIL AND GROUNDWATER SAMPLES

	Media		
	Monitoring Wells	Production Wells	Soil
METALS			
Arsenic	X		X
Barium	X	X	X
Beryllium		X	X
Cadmium			X
Chromium (Total)			X
Cobalt	X		X
Cyanide	X		
Lead	X		X
Nickel	X		X
Selenium	X		
Vanadium			X

TABLE 41

SUBSTANCES DETECTED IN SOIL AND GROUNDWATER SAMPLES

	Media		
	Monitoring Wells	Production Wells	Soil
VOLATILES			
Acetone	X	X	X
Benzene	X	X	X
Carbon Tetrachloride	X		
Chlorobenzene	X		
Chloroform		X	
Chloromethane		X	
cis-1,2-Dichloroethylene		X	
Cumene	X		
1,1-Dichloroethane		X	
1,2-Dichloroethane	X	X	
Ethylbenzene	X	X	X
Ethyl Ether	X	X	
Methyl Ethyl Ketone			X
Methylene Chloride	X		
Methyl Isobutyl Ketone	X		
Tetrachloroethylene		X	
Tetrahydrofuran	X		
Toluene	X		X
trans-1,2-Dichloroethylene		X	
Trichloroethylene[a]	X	X	
1,1,1-Trichloroethane			X
Xylene (Total)	X	X	X

[a]Non-refinery source

23\82\111\SEC6TAB.TAB\TMK

TABLE 41 (Continued)

SUBSTANCES DETECTED IN SOIL AND GROUNDWATER SAMPLES

	Media		
	Monitoring Wells	Production Wells	Soil
SEMIVOLATILES			
Anthracene			X
Benzenethiol			X
Benzo(a)anthracene			X
Benzo(b)fluoranthene			X
Benzo(a)pyrene			X
bis(2-ethylhexyl)phthalate	X	X	X
Chrysene			X
o-Cresol	X		X
m & p-Cresol	X		X
Dibenzo(a,h)anthracene	X		
2,4-Dimethylphenol	X		X
Di-n-butyl phthalate	X		
Fluoranthene			X
1-Methyl Naphthalene	X		X
Naphthalene	X		X
Pentachlorophenol[a]	X		
Phenanthrene	X		X
Phenol	X		X
Pyrene			X
Quinoline			X

[a]Non-refinery source

23\82\111\SEC6TAB.TAB\TMK

Appendix 2

Contaminants Identified in Ambient Air

Data from MPCA, August, 1994

Samples collected as part of the Pine Bend Monitoring Network
during April, May, and June, 1994

The Site number MPCA 0436 corresponds to the sampling location in St. Paul Park, just to the south of the refinery. The "maximum 1 hour average" reported for SO_2 is the highest average concentration observed for a one hour period. The value reported for PM_{10} is the maximum 24 hour average and corresponds to the highest concentration observed when levels were averaged over an entire day (as opposed to one hour). The VOC data reported is highest and average concentration observed for the entire sampling period (3 months). The compounds are coded according to numbers along the column headings (for example, column "43502" is data for formaldehyde; "45201" is for benzene"). The numbers within the table are in concentration units of ppb.

Only data from location 0436 (located to the south of the refinery) is given. No information from sampling location MPCA 0438 (in Newport) is reported for this time period.

No current regulatory air quality standards are exceeded for the time period. However, draft State criteria for benzene, formaldehyde and total reduced sulfur are occasionally exceeded.

CHART D
Minnesota Pollution Control Agency
Pine Bend Monitoring Network
Total Reduced Sulfur (TRSUL)
Maximum 1 Hour Average
MPCA 0436 2Q 1994

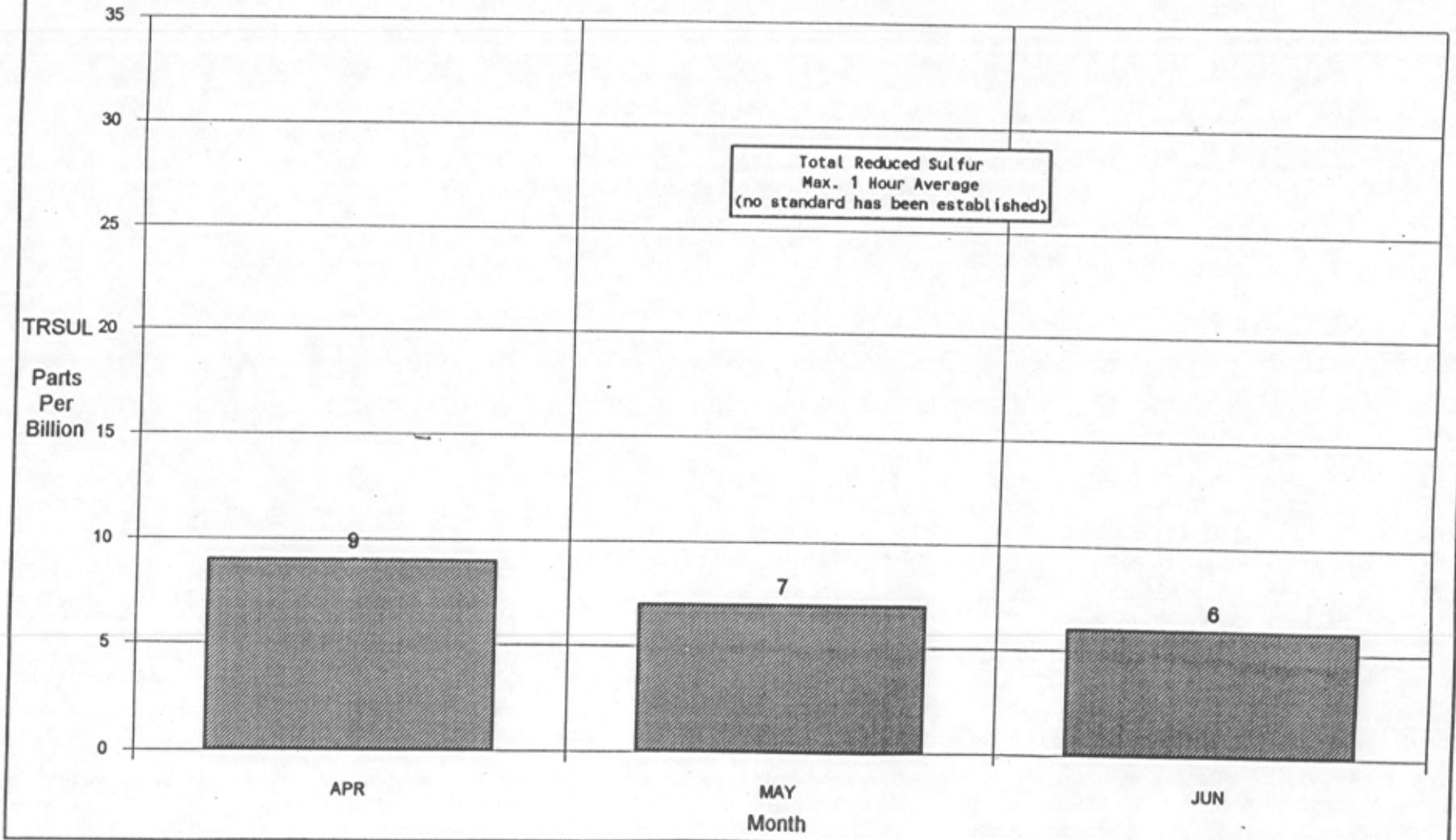


CHART C
Minnesota Pollution Control Agency
Pine Bend Monitoring Network
Sulfur Dioxide (SO2)
Maximum 1 Hour Average
2Q 1994

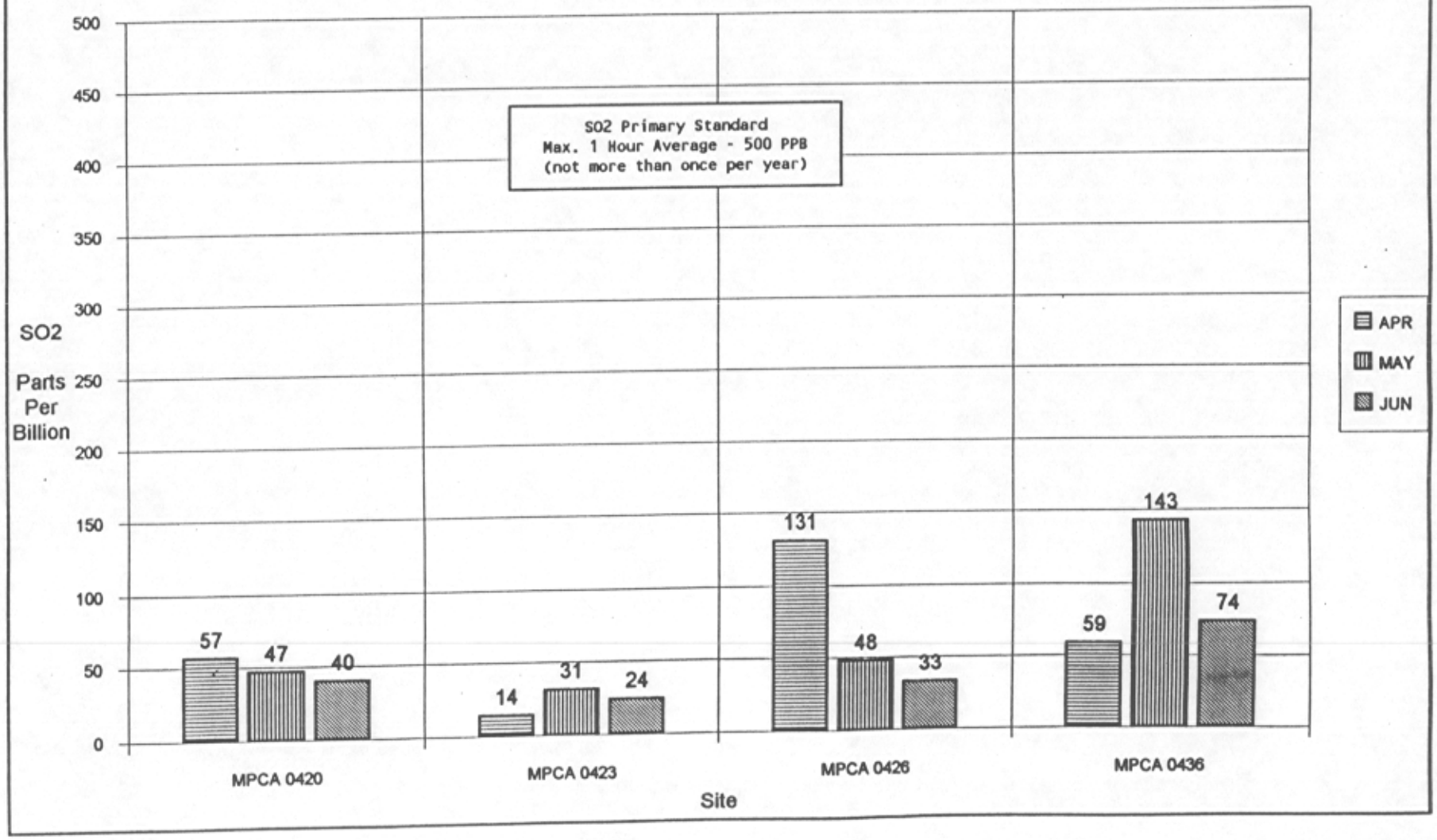
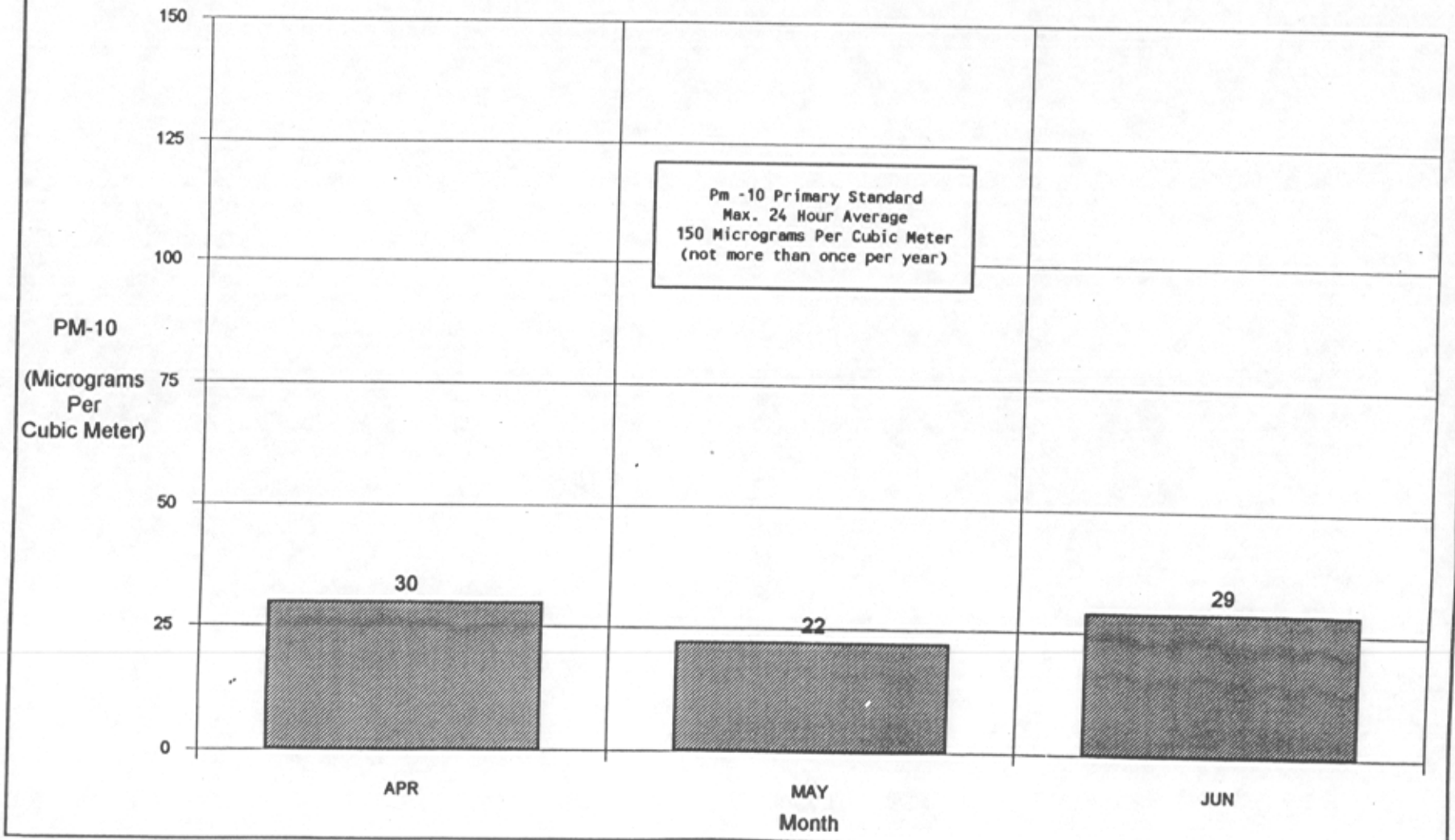


CHART B
Minnesota Pollution Control Agency
Pine Bend Monitoring Network
Particulate Matter (PM-10)
Maximum 24 Hour Average
MPCA 0436 2Q 1994



Minnesota P[illegible]tion Control Agency

DATA SUMMARY REPORT

PINE BEND MONITORING NETWORK

Volatile Organic Compounds (VOC's) and Formaldehyde

Compound	Measurement Units	Collection Method	Analysis Method
VOC's	Parts Per Billion	SS-Canister Pressurized	Gas Chromatography/Mass Spectrometer(GS/MS)
Formaldehyde	Parts Per Billion	Cartridge-DNPH-SEP-PAK	High Performance Liquid Chromatography(HPLC)

MPCA Site 0436 Year: 1994 Quarter: 2 Report Date: 08/04/94

DATE	SITE	TAG	43502	43802	43803	43804	43813	43814	43815	43817	43826	43827	43843	43860	45201	45202	45203	45204	45205	45801	45806
04/02/94	MPCA 0436	P04024	0.61	0.07	0.02	0.10	0.01	0.18	0.03	0.04	0.00	0.00	0.00	0.00	3.66	3.68	0.54	0.70	1.89	0.00	0.01
04/08/94	MPCA 0436	P04084	0.46	0.09	0.02	0.11	0.00	0.19	0.03	0.03	0.00	0.00	0.00	0.00	0.37	0.51	0.11	0.11	0.31	0.01	0.00
04/14/94	MPCA 0436	P04144	0.60	0.24	0.02	0.11	0.00	0.28	0.02	0.12	0.00	0.00	0.00	0.00	1.04	2.34	0.49	0.55	1.42	0.00	0.04
04/20/94	MPCA 0436	P04204	1.53	0.20	0.01	0.11	0.00	0.64	0.04	0.11	0.00	0.00	0.00	0.00	1.68	3.33	0.65	0.66	1.83	0.01	0.05
04/26/94	MPCA 0436	P04264	0.26	0.07	0.02	0.11	0.00	0.47	0.00	0.02	0.00	0.00	0.00	0.00	0.45	0.90	0.10	0.11	0.35	0.00	0.00
05/02/94	MPCA 0436	P05024	0.55	0.14	0.02	0.11	0.00	0.19	0.02	0.04	0.00	0.00	0.00	0.00	0.94	3.05	0.40	0.46	1.31	0.01	0.00
05/08/94	MPCA 0436	P05084	0.53	0.08	0.02	0.10	0.00	0.56	0.03	0.04	0.00	0.00	0.00	0.00	0.80	1.37	0.25	0.30	0.80	0.03	0.02
05/14/94	MPCA 0436	P05144	1.07	0.11	0.02	0.11	0.00	0.18	0.03	0.06	0.00	0.00	0.00	0.00	0.61	1.34	0.24	0.26	0.69	0.02	0.05
05/20/94	MPCA 0436	P05204	0.80	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7
05/26/94	MPCA 0436	P05264	0.39	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7
06/01/94	MPCA 0436	P06014	0.61	0.13	0.02	0.12	0.00	0.32	0.02	0.06	0.00	0.00	0.00	0.00	0.84	2.27	0.47	0.54	1.53	0.01	0.05
06/07/94	MPCA 0436	P06074	0.47	0.10	0.02	0.13	0.00	0.16	0.03	0.04	0.00	0.01	0.00	0.00	0.64	1.50	0.31	0.34	0.93	0.01	0.04
06/13/94	MPCA 0436	P06134	0.98	0.12	0.00	0.14	0.00	0.19	0.03	0.05	0.00	0.01	0.00	0.00	0.70	1.49	0.27	0.29	0.81	0.01	0.04
06/19/94	MPCA 0436	P06194	0.89	0.11	0.03	0.13	0.00	0.15	0.02	0.04	0.00	0.01	0.00	0.02	0.32	0.73	0.11	0.16	0.32	0.06	0.10
06/25/94	MPCA 0436	P06254	0.92	0.24	0.03	0.11	0.00	0.22	0.00	0.14	0.00	0.00	0.00	0.02	1.34	2.26	0.46	0.52	1.39	0.03	0.06
	NUMBER		15	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
	AVERAGE		0.71	0.13	0.02	0.11	0.00	0.29	0.02	0.06	0.00	0.00	0.00	0.00	1.03	1.91	0.34	0.38	1.05	0.02	0.04
	MAXIMUM		1.53	0.24	0.03	0.14	0.01	0.64	0.04	0.14	0.00	0.01	0.00	0.02	3.66	3.68	0.65	0.70	1.89	0.06	0.10

PARAMETER CODES

43502 Formaldehyde
43802 Dichloromethane
43803 Chloroform
43804 Carbon Tetrachloride
43813 1,1 Dichloroethane
43814 1,1,1 Trichloroethane
43815 1,2 Dichloroethane
43817 Tetrachloroethylene
43826 Vinylidene Chloride
43827 1,2 Dichloroethylene
43843 Ethylene Dibromide
43860 Vinyl Chloride
45201 Benzene
45202 Toluene
45203 Ethylbenzene
45204 O-xylene
45205 M-xylene
45801 Chlorobenzene
45806 M-Dichlorobenzene

Data from MPCA, February, 1996

Samples collected as part of the Pine Bend Monitoring Network
during October, November, and December, 1995

Data from station MPCA 0436 (St. Paul Park) and MPCA 0438 (Newport) are included for this time period. Charts are configured exactly the same as those presented in the 1994 report previous. Once again, no current regulatory air quality standards are exceeded for the time period. However, draft State criteria for benzene, formaldehyde and total reduced sulfur are occasionally exceeded.

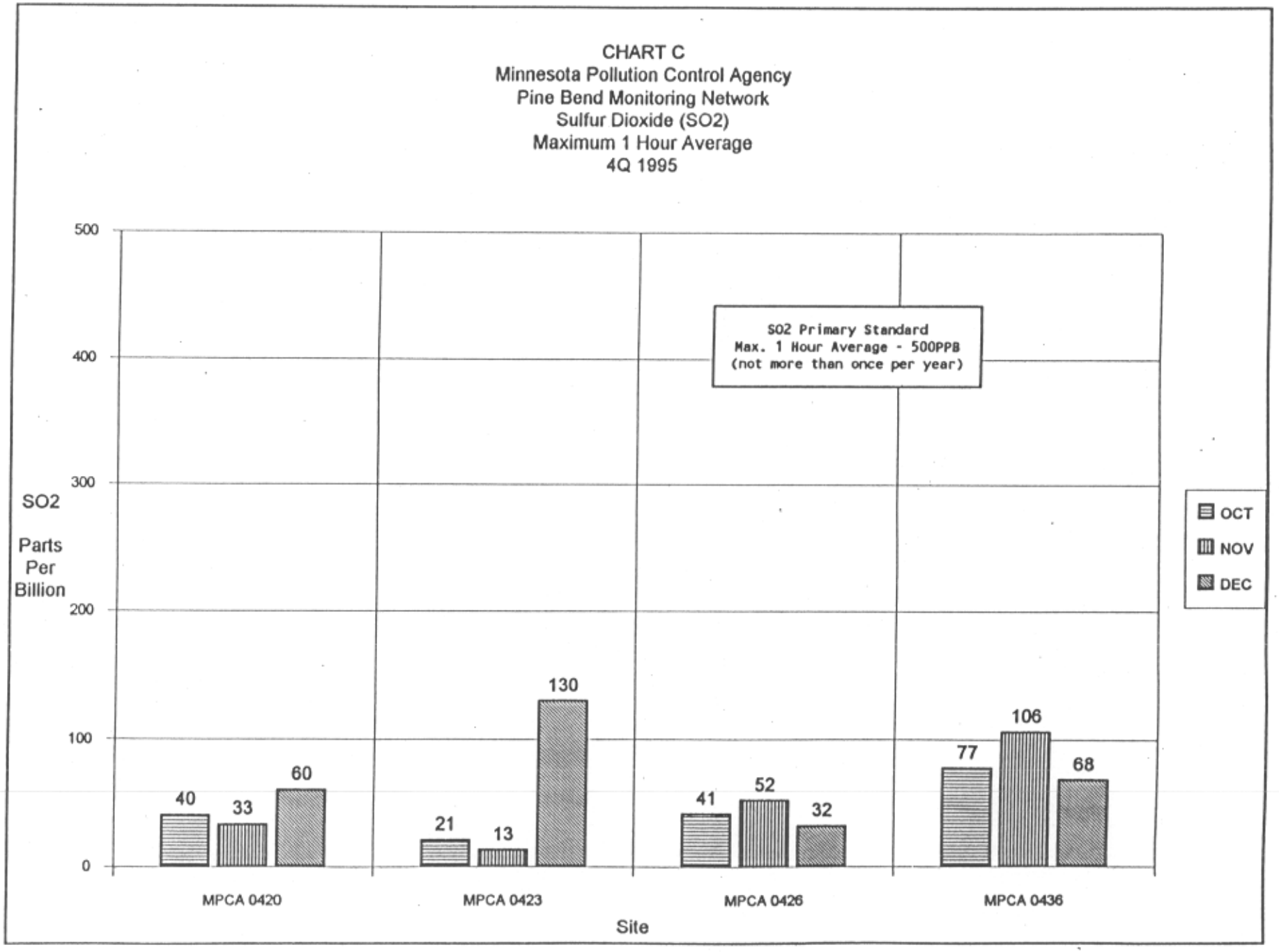
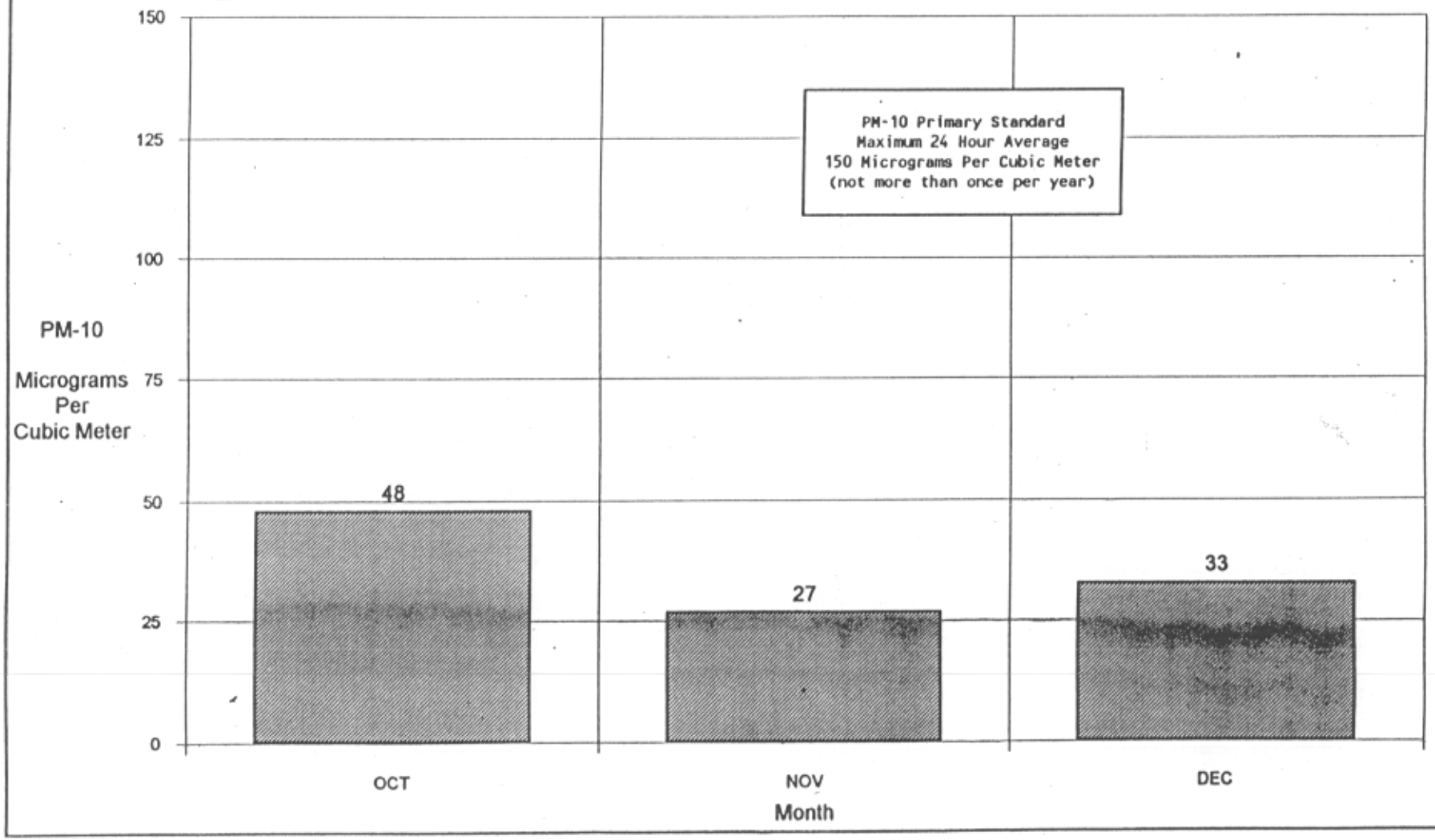


CHART C
Minnesota Pollution Control Agency
Pine Bend Monitoring Network
Sulfur Dioxide (SO2)
Maximum 1 Hour Average
4Q 1995
SO2 Primary Standard
Max. 1 Hour Average - 500PPB
(not more than once per year)
SO2
Parts
Per
Billion
500
400
300
200
100
0
40
33
60
21
13
130
41
52
32
77
106
68
MPCA 0420
MPCA 0423
MPCA 0426
MPCA 0436
Site
OCT
NOV
DEC

CHART B
Minnesota Pollution Control Agency
Pine Bend Monitoring Network
Particulate Matter (PM-10)
Maximum 24 Hour Average
MPCA 0436 4Q 1995



MINNESOTA POLL. .ON CONTROL AGENCY
PINE BEND MONITORING NETWORK

DATA SUMMARY REPORT

Volatile Organic Compounds (VOC's)
Part 1

Compound	Measurement Units	Collection Method	Analysis Method
VOC's	Parts Per Billion	SS-Canister Pressurized	Gas Chromatography/Mass Spectrometer(GS/MS)

MPCA Site 0436 **Year: 1995** **Quarter: 4** **Report Date: 02/13/96**

SITE	DATE	TAG	43802	43803	43804	43813	43814	43815	43817	43826	43827	43843	43860	45109	45201	45202	45203	45204	45801	45806
MPCA 0436	10/06/95	P10065	0.02	0.03	0.08	0.03	0.10	0.00	0.05	0.00	0.00	0.00	0.10	0.20	0.54	0.83	0.22	0.04	0.00	0.00
MPCA 0436	10/12/95	P10125	0.30	0.02	0.07	0.00	0.09	0.02	0.00	0.00	0.00	0.00	0.00	0.15	0.21	0.62	0.17	0.02	0.00	0.00
MPCA 0436	10/18/95	P10185	0.03	0.02	0.06	0.00	0.11	0.00	0.01	0.00	0.00	0.00	0.00	0.61	0.43	1.40	0.55	0.19	0.00	0.00
MPCA 0436	10/24/95	P10245	0.04	0.02	0.06	0.00	0.14	0.00	0.07	0.00	0.00	0.00	0.00	0.66	1.17	1.63	0.59	0.20	0.00	0.00
MPCA 0436	10/30/95	P10305	0.05	0.02	0.08	0.00	0.14	0.00	0.05	0.00	0.00	0.00	0.00	0.60	0.66	1.31	0.54	0.17	0.00	0.00
MPCA 0436	11/05/95	P11055	0.16	0.00	0.06	0.00	0.06	0.00	0.02	0.00	0.00	0.00	0.00	0.19	0.21	0.23	0.08	0.10	0.04	0.00
MPCA 0436	11/11/95	P11115	0.06	0.04	0.08	0.02	0.07	0.02	0.05	0.02	0.00	0.01	0.00	0.36	1.80	0.89	0.10	0.12	0.01	0.00
MPCA 0436	11/17/95	P11175	0.10	0.03	0.08	0.00	0.06	0.01	0.04	0.00	0.00	0.00	0.00	0.42	0.48	0.95	0.12	0.13	0.01	0.00
MPCA 0436	11/23/95	P11235	0.04	0.02	0.06	0.00	0.03	0.01	0.02	0.01	0.00	0.00	0.00	0.17	0.45	0.54	0.03	0.02	0.00	0.00
MPCA 0436	11/29/95	P11295	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7
MPCA 0436	12/05/95	P12055	0.03	0.03	0.05	0.01	0.04	0.01	0.01	0.00	0.00	0.00	0.00	0.54	0.69	1.01	0.13	0.19	0.00	0.00
MPCA 0436	12/11/95	P12115	0.03	0.01	0.05	0.00	0.04	0.01	0.00	0.01	0.00	0.00	0.00	0.21	0.47	0.56	0.06	0.08	0.00	0.00
MPCA 0436	12/17/95	P12175	0.05	0.02	0.05	0.00	0.03	0.00	0.01	0.01	0.00	0.00	0.00	0.27	0.41	0.73	0.08	0.09	0.00	0.00
MPCA 0436	12/23/95	P12235	0.03	0.00	0.04	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.14	0.23	0.32	0.04	0.05	0.00	0.00
MPCA 0436	12/29/95	P12295	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7
	NUMBER		13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00
	AVERAGE		0.07	0.02	0.06	0.00	0.07	0.01	0.03	0.00	0.00	0.00	0.01	0.35	0.59	0.85	0.21	0.11	0.00	0.00
	MAXIMUM		0.30	0.04	0.08	0.03	0.14	0.02	0.07	0.02	0.00	0.01	0.10	0.66	1.80	1.63	0.59	0.20	0.04	0.00

PARAMETER CODES

43802 Dichloromethane
43803 Chloroform
43804 Carbon Tetrachloride
43813 1,1 Dichloroethane
43814 1,1,1 Trichloroethane
43815 1,2 Dichloroethane
43817 Tetrachloroethylene
43826 Vinylidene Chloride
43827 1,2 Dichloroethylene
43843 Ethylene Dibromide
43860 Vinyl Chloride
45109 m/p - Xylene
45201 Benzene
45202 Toluene
45203 Ethylbenzene
45204 o-xylene
45801 Chlorobenzene
45806 m-Dichlorobenzene

MINNESOTA POLL .ON CONTROL AGENCY
PINE BEND MONITORING NETWORK

DATA SUMMARY REPORT

Volatile Organic Compounds (VOC's)
Part 2

Compound	Measurement Units	Collection Method	Analysis Method
VOC's	Parts Per Billion	SS-Canister Pressurized	Gas Chromatography/Mass Spectrometer(GS/MS)

MPCA Site 0436 **Year: 1995** **Quarter: 4** **Report Date: 02/13/96**

SITE	DATE	TAG	16822	43207	43811	43818	43819	43820	43823	43824	43829	43830	43831	43844	45207	45208	45220	45805	45807
MPCA 0436	10/06/95	P10065	0.05	0.02	0.22	0.00	0.03	0.00		0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MPCA 0436	10/12/95	P10125	0.05	0.02	0.23	0.00	0.03	0.00		0.10	0.00	0.00	0.00	0.00	0.01	0.10	0.00	0.00	0.00
MPCA 0436	10/18/95	P10185	0.05	0.02	0.21	0.00	0.00	0.00		0.09	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.00
MPCA 0436	10/24/95	P10245	0.05	0.02	0.20	0.00	0.00	0.00		0.02	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00
MPCA 0436	10/30/95	P10305	0.05	0.02	0.25	0.00	0.04	0.00		0.09	0.00	0.00	0.00	0.00	0.00	0.11	0.65	0.00	0.00
MPCA 0436	11/05/95	P11055	0.03	0.00	0.32	0.06	0.07	0.00	0.53	0.00	0.00	0.00	0.00	0.00	0.06	0.04	0.04	0.04	0.00
MPCA 0436	11/11/95	P11115	0.02	0.00	0.23	0.00	0.05	0.00	0.55	0.00	0.00	0.00	0.00	0.00	0.11	0.10	0.01	0.00	0.04
MPCA 0436	11/17/95	P11175	0.02	0.00	0.21	0.00	0.07	0.01	0.45	0.00	0.00	0.00	0.00	0.00	0.05	0.14	0.06	0.01	0.04
MPCA 0436	11/23/95	P11235	0.01	0.00	0.18	0.00	0.01	0.00	0.39	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.03
MPCA 0436	11/29/95	P11295	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7
MPCA 0436	12/05/95	P12055	0.01	0.03	0.16	0.01	0.05	0.00	0.38	0.01	0.01	0.00	0.00	0.00	0.08	0.16	0.01	0.00	0.00
MPCA 0436	12/11/95	P12115	0.01	0.03	0.15	0.00	0.00	0.00	0.35	0.01	0.00	0.00	0.00	0.00	0.05	0.04	0.02	0.00	0.00
MPCA 0436	12/17/95	P12175	0.01	0.02	0.14	0.00	0.00	0.00	0.30	0.01	0.00	0.00	0.00	0.00	0.06	0.07	0.02	0.00	0.00
MPCA 0436	12/23/95	P12235	0.01	0.02	0.12	0.00	0.00	0.00	0.23	0.01	0.00	0.00	0.00	0.00	0.03	0.05	0.01	0.00	0.01
MPCA 0436	12/29/95	P12295	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7
	NUMBER		13.00	13.00	13.00	13.00	13.00	13.00	8.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00
	AVERAGE		0.03	0.02	0.20	0.01	0.03	0.00	0.40	0.03	0.00	0.00	0.00	0.00	0.03	0.08	0.06	0.00	0.01
	MAXIMUM		0.05	0.03	0.32	0.06	0.07	0.01	0.55	0.10	0.01	0.00	0.00	0.00	0.11	0.16	0.65	0.04	0.04

PARAMETER CODES

16822 1,2 Dichloro 1,1,2,2 tetrafluoroethane
43207 Freon 113
43811 Trichlorofluoromethane
43818 1,1,2,2 tetrachloroethane
43819 Bromomethane
43820 1,1,2 trichloroethane
43823 Dichlorodifluoromethane
43824 Trichloroethene
43829 1,2 dichloropropane
43830 Trans-1,3 dichloropropene
43831 Cis-1,3 dichloropropene
43844 Hexachloro-1,3 butadiene
45207 1,3,5 trimethylbenzene
45208 1,2,4 trimethylbenzene
45220 Styrene
45805 o-dichlorobenzene
45807 p-dichlorobenzene

MINNESOTA POL. ION CONTROL AGENCY
PINE BEND MONITORING NETWORK

DATA SUMMARY REPORT

Volatile Organic Compounds (VOC's)
Part 1

Compound	Measurement Units	Collection Method	Analysis Method
VOC's	Parts Per Billion	SS-Canister Pressurized	Gas Chromatography/Mass Spectrometer(GS/MS)

MPCA Site 0438 **Year: 1995** **Quarter: 4** **Report Date: 02/13/96**

SITE	DATE	TAG	43802	43803	43804	43813	43814	43815	43817	43826	43827	43843	43860	45109	45201	45202	45203	45204	45801	45806
MPCA 0438	10/06/95	A10065	0.01	0.02	0.08	0.00	0.09	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.12	0.10	0.05	0.00	0.00	0.00
MPCA 0438	10/12/95	A10125	0.09	0.02	0.08	0.03	0.12	0.00	0.01	0.00	0.00	0.00	0.10	1.12	2.88	2.33	0.98	0.36	0.00	0.00
MPCA 0438	10/18/95	A10185	0.06	0.00	0.07	0.03	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.72	0.73	1.62	0.64	0.21	0.00	0.00
MPCA 0438	10/24/95	A10245	0.05	0.01	0.06	0.00	0.10	0.00	0.02	0.00	0.00	0.00	0.00	0.33	0.35	0.75	0.32	0.09	0.00	0.00
MPCA 0438	10/30/95	A10305	0.05	0.02	0.08	0.00	0.45	0.00	0.00	0.00	0.00	0.00	0.00	0.59	0.73	1.29	0.53	0.17	0.00	0.00
MPCA 0438	11/05/95	A11055	0.19	0.07	0.07	0.02	0.07	0.00	0.01	0.00	0.00	0.00	0.00	1.14	2.69	2.01	0.30	0.40	0.05	0.00
MPCA 0438	11/11/95	A11115	0.05	0.02	0.08	0.00	0.06	0.02	0.03	0.00	0.00	0.01	0.00	0.28	0.36	0.49	0.07	0.09	0.02	0.00
MPCA 0438	11/17/95	A11175	0.10	0.03	0.08	0.00	0.06	0.01	0.04	0.00	0.01	0.01	0.00	0.35	0.39	0.64	0.10	0.12	0.02	0.00
MPCA 0438	11/23/95	A11235	0.04	0.02	0.06	0.00	0.04	0.01	0.02	0.02	0.00	0.00	0.00	0.11	0.20	0.25	0.03	0.04	0.01	0.00
MPCA 0438	11/29/95	A11295	0.07	0.03	0.06	0.01	0.05	0.02	0.03	0.00	0.01	0.01	0.00	0.54	0.60	1.41	0.13	0.15	0.00	0.03
MPCA 0438	12/05/95	A12055	0.03	0.02	0.05	0.00	0.04	0.00	0.00	0.01	0.00	0.00	0.00	0.18	0.25	0.38	0.04	0.07	0.00	0.00
MPCA 0438	12/11/95	A12115	0.03	0.01	0.05	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.24	0.42	0.05	0.07	0.00	0.00
MPCA 0438	12/17/95	A12175	0.10	0.03	0.05	0.00	0.03	0.00	0.01	0.01	0.00	0.00	0.00	0.35	0.51	0.81	0.10	0.11	0.01	0.00
MPCA 0438	12/23/95	A12235	0.03	0.01	0.04	0.00	0.03	0.00	0.01	0.00	0.00	0.00	0.00	0.13	0.19	0.31	0.04	0.05	0.01	0.00
MPCA 0438	12/29/95	A12295	0.03	0.02	0.03	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.37	1.51	0.82	0.09	0.12	0.01	0.00
	NUMBER		15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
	AVERAGE		0.06	0.02	0.06	0.01	0.09	0.00	0.01	0.00	0.00	0.00	0.01	0.43	0.78	0.91	0.23	0.14	0.01	0.00
	MAXIMUM		0.19	0.07	0.08	0.03	0.45	0.02	0.04	0.02	0.01	0.01	0.10	1.14	2.88	2.33	0.98	0.40	0.05	0.03

PARAMETER CODES

43802 Dichloromethane
43803 Chloroform
43804 Carbon Tetrachloride
43813 1,1 Dichloroethane
43814 1,1,1 Trichloroethane
43815 1,2 Dichloroethane
43817 Tetrachloroethylene
43826 Vinylidene Chloride
43827 1,2 Dichloroethylene
43843 Ethylene Dibromide
43860 Vinyl Chloride
45109 m/p - Xylene
45201 Benzene
45202 Toluene
45203 Ethylbenzene
45204 o-xylene
45801 Chlorobenzene
45806 m-Dichlorobenzene

MINNESOTA POL ION CONTROL AGENCY
PINE BEND MONITORING NETWORK

DATA SUMMARY REPORT

Carbonyl Compounds

Compound	Measurement Units	Collection Method	Analysis Method
Carbonyl Compounds	Parts Per Billion	Cartridge-DNPH-SEP-PAK	High Performance Liquid Chromatography(HPLC)

MPCA Site 0436 **Year: 1995** **Quarter: 4** **Report Date: 02/07/96**

SITE	DATE	TAG	43502	43503	43504	43510	43516	43551	45501
MPCA 0436	10/06/95	P100695	0.56	0.51	0.05	0.10	0.01	0.90	0.01
MPCA 0436	10/12/95	P101295	2.74	1.17	0.18	0.46	0.02	3.26	0.03
MPCA 0436	10/18/95	P101895	1.28	0.83	0.10	0.18	0.01	1.08	0.01
MPCA 0436	10/24/95	P102495	1.26	0.80	0.10	0.15	0.01	1.03	0.03
MPCA 0436	10/30/95	P103095	1.27	0.86	0.09	0.24	0.01	0.89	0.03
MPCA 0436	11/05/95	P110595	0.77	0.66	0.08	0.14	0.00	1.05	0.01
MPCA 0436	11/11/95	P111195	1.12	0.66	0.10	0.12	0.01	0.79	0.02
MPCA 0436	11/17/95	P111795	1.57	1.18	0.15	0.23	0.02	1.09	0.05
MPCA 0436	11/23/95	P112395	0.84	0.55	0.10	0.11	0.00	0.73	0.01
MPCA 0436	11/29/95	P112995	1.30	0.92	0.14	0.23	0.01	1.31	0.03
MPCA 0436	12/05/95	P120595	0.92	0.46	0.06	0.11	0.00	0.82	0.01
MPCA 0436	12/11/95	P121195	0.95	0.50	0.10	0.10	0.00	0.71	0.01
MPCA 0436	12/17/95	P121795	2.07	1.43	0.22	0.31	0.01	1.54	0.04
MPCA 0436	12/23/95	P122395	0.94	0.66	0.10	0.13	0.00	0.62	0.02
MPCA 0436	12/29/95	P122995	0.81	0.62	0.09	0.14	0.00	0.71	0.02
	NUMBER		15.00	15.00	15.00	15.00	15.00	15.00	15.00
	AVERAGE		1.23	0.79	0.11	0.18	0.01	1.10	0.02
	MAXIMUM		2.74	1.43	0.22	0.46	0.02	3.26	0.05

PARAMETER CODES

43502 Formaldehyde
43503 Acetaldehyde
43504 Propionaldehyde
43510 Butyraldehyde
43516 Crotonaldehyde
43551 Acetone
45501 Benzaldehyde

MINNESOTA POL. ION CONTROL AGENCY
PINE BEND MONITORING NETWORK

DATA SUMMARY REPORT

Carbonyl Compounds

Compound	Measurement Units	Collection Method	Analysis Method
Carbonyl Compounds	Parts Per Billion	Cartridge-DNPH-SEP-PAK	High Performance Liquid Chromatography(HPLC)

MPCA Site 0438 **Year: 1995** **Quarter: 4** **Report Date: 02/07/96**

SITE	DATE	TAG	43502	43503	43504	43510	43516	43551	45501
MPCA 0438	10/06/95	A100695	N7	N7	N7	N7	N7	N7	N7
MPCA 0438	10/12/95	A101295	3.11	2.77	0.40	0.58	0.03	3.31	0.04
MPCA 0438	10/18/95	A101895	1.38	0.91	0.11	0.18	0.00	0.93	0.02
MPCA 0438	10/24/95	A102495	0.82	0.53	0.06	0.10	0.00	0.54	0.01
MPCA 0438	10/30/95	A103095	1.14	0.84	0.09	0.16	0.00	0.71	0.01
MPCA 0438	11/05/95	A110595	0.91	0.76	0.10	0.12	0.00	0.86	0.01
MPCA 0438	11/11/95	A111195	0.76	0.48	0.07	0.09	0.00	0.61	0.00
MPCA 0438	11/17/95	A111795	1.05	0.83	0.12	0.17	0.01	0.70	0.03
MPCA 0438	11/23/95	A112395	0.82	0.55	0.08	0.09	0.00	0.57	0.01
MPCA 0438	11/29/95	A112995	1.09	0.92	0.13	0.23	0.00	1.16	0.02
MPCA 0438	12/05/95	A120595	0.40	0.43	0.05	0.09	0.00	0.57	0.00
MPCA 0438	12/11/95	A121195	0.78	0.52	0.08	0.10	0.00	0.64	0.01
MPCA 0438	12/17/95	A121795	1.81	1.39	0.19	0.26	0.01	1.10	0.03
MPCA 0438	12/23/95	A122395	0.94	0.67	0.10	0.11	0.00	0.42	0.02
MPCA 0438	12/29/95	A122995	0.72	0.54	0.07	NA	NA	0.67	NA
	NUMBER		14.00	14.00	14.00	13.00	13.00	14.00	13.00
	AVERAGE		1.12	0.87	0.12	0.17	0.00	0.91	0.02
	MAXIMUM		3.11	2.77	0.40	0.58	0.03	3.31	0.04

PARAMETER CODES

43502 Formaldehyde
43503 Acetaldehyde
43504 Propionaldehyde
43510 Butyraldehyde
43516 Crotonaldehyde
43551 Acetone
45501 Benzaldehyde

Data from MPCA

Samples collected from a temporary station established near the loading dock during Summer, 1994

This data was collected as part of a targeted effort to determine if there were transient emissions from the loading dock area. The station was placed midway between the loading dock and the nearest home located along Factory Rd. This is very near the small brick lift station building. Results were reported for every 6th day. VOC levels are significantly higher (e.g. 6/13, 7/7) when the wind was blowing from the loading dock towards the sampler (and the homes).

These higher values indicate that the loading dock, as it is currently operated, may be a significant source of benzene for the southern portion of Newport.

VOLATILE ORGANIC COMPOUND DATA NEAR ASHLAND REFINERY

SAMPLING DATE	WIND DIRECTION PINE BEND SITE 426	NEWPORT SITE CONC., PARTS PER BILLION					ST. PAUL PARK CONC., PARTS PER BILLION				
		BENZENE	TOLUENE	ETHYL-BENZENE	O-XYLENE	M-XYLENE	BENZENE	TOLUENE	ETHYL-BENZENE	O-XYLENE	M-XYLENE
5/26/94	N-NE 75%; NE-E 4%; E-SE 8%; NW-N 13%	2.34	3.39	0.54	0.58	1.56					
6/1/94	N-NE 46%; NE-E 33%; W-NW 13%; NW-N 8%	1.67	3.12	0.55	0.62	1.69	0.84	2.27	0.47	0.54	1.53
6/7/94	N-NE 17%; NE-E 79%; E-SE 4%	2.31	3.51	0.56	0.63	1.80	0.64	1.50	0.31	0.34	0.93
6/13/94	N-NE 4%; NE-E 33%; E-SE 42%; NW-N 21%	32.35	31.29	4.46	4.51	12.97	0.70	1.49	0.27	0.29	0.81
6/19/94	NE-E 8%; E-SE 58%; SE-S 33%	28.19	28.83	4.27	4.46	12.82	0.32	0.73	0.11	0.16	0.32
6/25/94	N-NE 4%; NE-E 13%; E-SE 4%; S-SW 21%; SW-W 21%; W-NW 25%; NW-N 13%	8.84	11.20	1.98	2.12	5.50	1.34	2.26	0.46	0.52	1.39
7/1/94	N-NE 25%; SW-W 4%; W-NW 63%; NW-N 8%	0.49	0.92	0.19	0.23	0.59					
7/7/94	NE-E 17%; E-SE 63%;SE-S 17%; W-NW 4%	36.00	32.76	4.92	5.14	14.34	0.52	1.50	0.20	0.21	0.65
7/13/94	N-NE 8%; NE-E 58%; E-SE 29%; SE-S 4%	22.49	24.41	3.65	3.67	10.10	0.60	1.27	0.25	0.24	0.76
7/19/94	NE-E 4%; E-SE 21%; SE-S 42%; S-SW 13%; SW-W 13%; NW-N 8%	31.30	33.12	4.69	4.75	13.74	0.77	2.14	0.31	0.32	0.91
7/25/94	W-NW 54%; NW-N 46%;	0.86	1.71	0.38	0.43	1.18	2.21	3.16	0.68	0.77	2.10
7/31/94	N-NE 4%; SE-S 4%; S-SW 38%; SW-W 13%; W-NW 25%; NW-N 17%	1.65	2.47	0.42	0.60	1.61	0.67	1.08	0.15	0.17	0.46
8/6/94	SE-S 38%; S-SW 50%; SW-W 13%	9.03	10.44	1.62	1.77	4.89					
8/12/94	NE-E 8%; E-SE 17%; SE-S 42%; S-SW 17%; SW-W 17%	19.00	22.83	3.51	4.11	10.99	0.58	1.16	0.23	0.24	0.72
8/18/94	N-NE 38%; NE-E 21%; SE-S 21%; SW-W 4%; W-NW 4%; NW-N 13%	4.34	7.27	1.23	1.49	4.16	1.29	2.63	0.54	0.56	1.53
8/24/94	SW-W 46%; W-NW 54%	2.32	4.31	0.76	1.10	2.86	0.94	2.05	0.39	0.45	1.27
8/30/94	N-NE 25%; NE-E 8%; E-SE 33%; NW-N 33%	12.69	15.69	2.41	2.52	6.57	0.58	1.77	0.21	0.25	0.69

Data from MPCA

Information gathered from a variety of sources for Summer, 1994

This information was compiled by the Air Quality division of MPCA to provide some perspective on the benzene values that were being observed in the vicinity of the Ashland refinery during the summer of 1994. The locations are scattered throughout the metro Twin Cities area.

BENZENE LEVELS AT METRO AREA SITES

Date/Site	Hwy 55&52	Cemetary	Wicker	Newport	St. Paul Park	Mpls. Library	Holman Field
5/26/94	0.24	0.23	0.43	2.34	7.00	0.68	0.48
6/1/94	1.27	0.53	0.58	1.67	0.84	0.70	0.67
6/7/94	0.30	0.25	0.40	2.31	0.64	0.72	0.44
6/13/94	0.38	0.48	0.71	32.35	0.70	0.91	0.52
6/19/94	0.28	0.22	0.47	26.19	0.32	0.71	0.68
62594	0.66	1.25	0.73	8.84	1.34	1.34	1.55
7/1/94	0.78	1.30	0.62	0.49	7.00	0.84	0.48
7/7/94	0.27	0.24	0.59	36.00	0.52	1.00	0.48
7/13/94	0.27	0.18	0.72	22.49	0.60	0.99	0.51
7/19/94	0.51	0.57	0.78	31.30	0.77	1.36	0.75
7/25/94	1.53	2.20	0.82	0.86	2.21	1.30	0.78
7/31/94	0.49	0.47	0.46	1.65	0.67	0.59	0.34
8/6/94	0.10	0.09	0.40	9.03	7.00	0.52	0.39
8/12/94	0.37	0.64	0.63	19.00	0.58	1.68	0.58
8/18/94	1.03	1.10	0.98	4.34	1.29	1.80	0.98
8/24/94	6.29	4.87	0.50	2.32	0.94	1.24	0.86
8/30/94	0.38	0.23	0.59	12.69	0.58	0.63	0.43

Information from Page and Mehlman, 1989.

This is a summary table from the article published in *Toxicology and Industrial Health*

TABLE 5
Summary of Reported Exposures to Gasoline Vapors (Total Hydrocarbons) During Automobile Tank Filling

Exposure Situation	Exposure (mg/m^3) Mean (Range)	Reference
Self Service Customer	102 (31-508)	Kearney & Dunham (1986) (29)
Full Service Attendant	85 (35-265)	
Service Plaza Attendant	128 (35-4170)	Halder et al. (1986) (47)
Self Service Attendant	106	
Single Car Filling	59 (47-88)	Bond et al. (1985) (45)
Single Car (Winter)	148 (2-1750)	Tironi et al. (1986) (3)
Single Car (Summer)	47 (3-680)	
Self Sercice Customer	140 (9-2500)	Clayton Env. Cons (1983) (43)
Service Attendant (filling)	112 (33-273)	McDermott & Vos (1979) (42)
Full Service Attendant	56 (50-64)	McDermott & Vos (1979) (42)

Source: Williams et al. (1987) (46)

Appendix 3

Regulatory and Health Based Criterion Values

for

Contaminants Found At the Site

Materials which have been located on the Site and a sampling of their associated regulatory values or health based criteria for various media are presented in the following table. The values are presented for informational purposes. It should not be implied that all of these materials are present at levels of health concern at the Ashland facility. The text of this consultation should be consulted for a listing of exposure pathways of public health concern.

	Water	*Water*	*Soil*	*Air*	*Air*	*Air*
Compound	**US EPA MCL (μg/L)**	**Minn. HRL (μg/L)**	**ATSDR Soil (ppm)**	**Worker Air (mg/m3)**	**Minn. HRV (mg/m3)**	**Odor Threshold (mg/m3)**
Acetone	-	700	5000	593	20 (A)	50
Benzene*	5	10	-	0.3	0.001 ©	5
Carbon Tetrachloride*	5	3	40	12	-	500
Chlorobenzene	-	100	-	345	-	4
Chloroform*	100	60	500	10	0.5 (A)	500
c-1,2 Dichloroethene	70	70	-	-	-	-
Cumene	-	300	2000	246	-	0.1
1,1 - Dichloroethane	-	70	-	400	-	200
1,2 - Dichloroethane*	5	4	-	40	-	300
Ethyl benzene	700	700	5000	434	10 (A)	2
Ethyl Ether	-	1000	10000	400	-	30
Methyl Ethyl Ketone	-	4000	-	590	30 (A)	-
Methyl Isobutyl Ketone	-	300	-	205	-	5
Methylene Chloride*	5	50	3000	105	7 (A)	100
Tetrachloroethylene*	5	7	500	170	7 (A)	250
Tetrahydrofuran	-	-	-	590	-	8
Toluene	1000	1000	10000	377	0.4 ©	10
t-1,2 Dichloroethene	100	100	1000	-	-	-
Trichloroethylene*	5	30	-	270	2 (A)	400
1,1,1 Trichloroethane	200	600	-	-	10 (A)	1000
Xylene	10000	10000	-	434	1 (A)	8

	Water	*Water*	*Soil*	*Air*	*Air*	*Air*
Compound	**US EPA MCL (μg/L)**	**Minn. HRL (μg/L)**	**ATSDR Soil (ppm)**	**Worker Air (mg/m3)**	**Minn. HRV (mg/m3)**	**Odor Threshold (mg/m3)**
Anthracene	-	-	2000	-	-	-
Benzo(a)anthracene	0.1	-	-	-	-	-
Benzo(b)fluoranthene	0.2	-	-	-	-	-
Benzo(a)pyrene*	0.2	-	-	-	-	-
bis(2-ethylhexyl) phthalate*	400	20	1000	-	-	-
Chrysene	0.2	-	-	-	-	-
m & o - Cresol*	-	30	-	10	-	0.001
p - Cresol*	-	3	-	10	-	0.001
dibenzo(a,h)anthracene*	0.3	-	-	-	-	-
2,4 Dimethylphenol	-	100	-	-	-	0.001
Di-n-butyl phthalate	-	700	5000	-	-	-
Fluoranthene	-	300	2000	-	-	-
Naphthalene	-	300	-	52	0.001 ©	0.5
Pentachlorophenol*	1	3	2000	0.5	-	-
Formaldehyde	-	1000	10000	1.2	0.06 (A) 0.0008 ©	0.1
Hydrogen sulfide	-	-	200	14	0.07 (A) 0.01 (S)	0.005
Phenol	-	4000	30000	19	-	3
Pyrene	200	200	2000	-	-	-

- = no data available. Those listed with (*) are carcinogenic

EPA MCL=**M**aximum **C**ontaminant **L**evel for drinking water as established by the US Environmental Protection Agency. This is the maximum permissible level of a contaminant in water which is delivered to a user of a public water system.

Minn. HRL = **H**ealth **R**isk **L**imit for drinking water as established by MDH. This value

estimates the long-term exposure level that is unlikely to result in deleterious effects to humans and applies to private water supplies (e.g. residential wells).

ATSDR Soil = Soil comparison values developed by ATSDR. Not a regulatory standard. Values chosen were for the "Reference Dose Media Evaluation Guide" for children not exhibiting pica behavior. Actual clean-up values chosen for the Site may differ from those listed.

Worker Air = Workplace air standards as presented by either ACGIH (TLVs) or NIOSH (TWAs). Where two values were listed, the more conservative (lower) of the two is presented. Values are not equivalent to residential exposure.

Minn. HRV = **H**ealth **R**isk **V**alue as proposed by MDH. A HRV is the amount of a chemical in ambient air to which most people can be exposed without significantly increasing their health risks. (A) indicates an acute value, which is applicable to a 1 hour exposure; (S) indicates a subchronic exposure value, which is applicable to a 90 day exposure; © indicates a chronic value, which is applicable to a lifetime exposure. **These values are currently in draft format and may be subject to change.**

Odor Threshold = rough estimate of lowest concentration in air noticeable by smell as presented in Verschueren (1983).

CHART C
Minnesota Pollution Control Agency
Pine Bend Monitoring Network
Sulfur Dioxide (SO2)
Maximum 1 Hour Average
4Q 1995

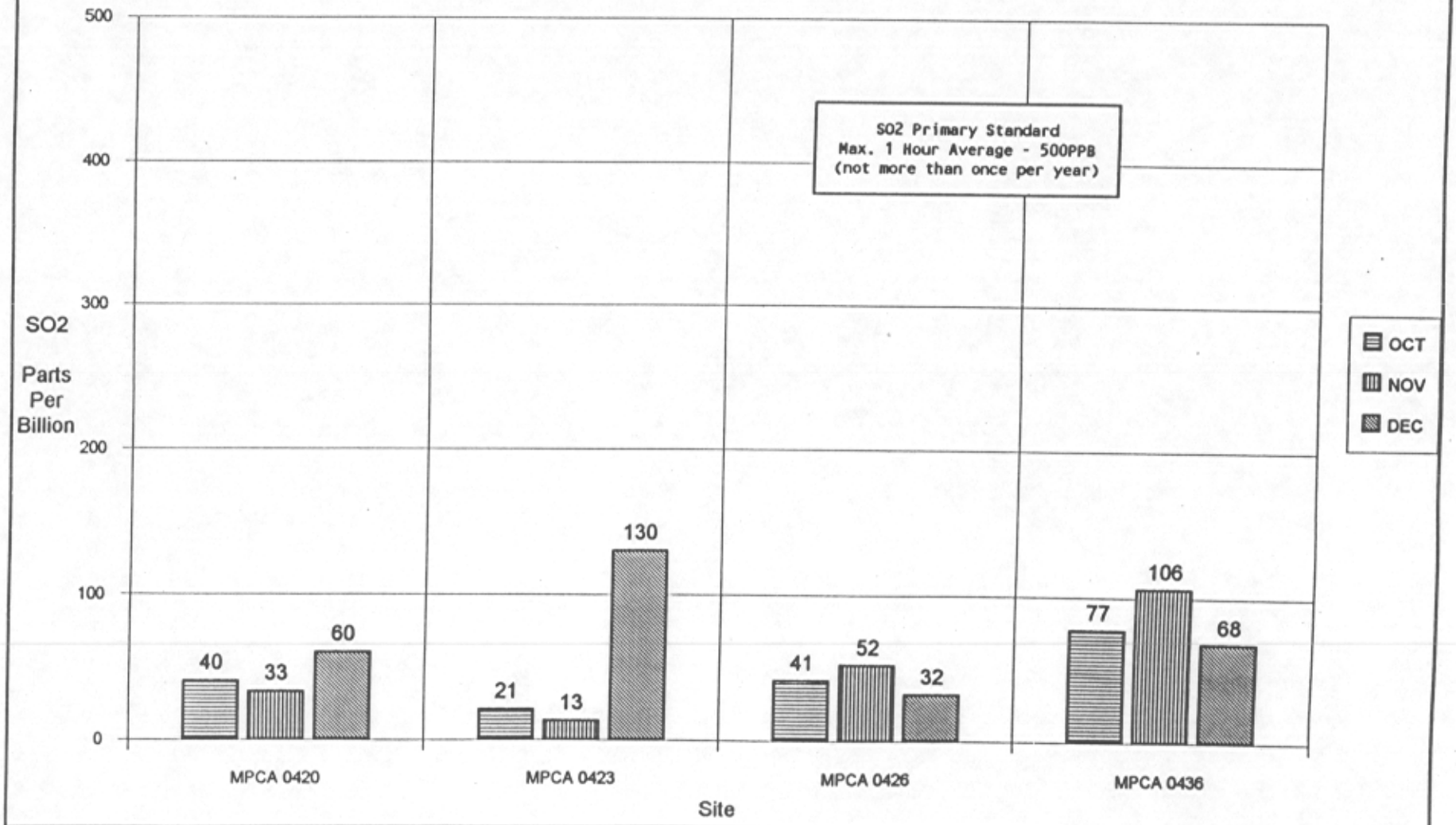
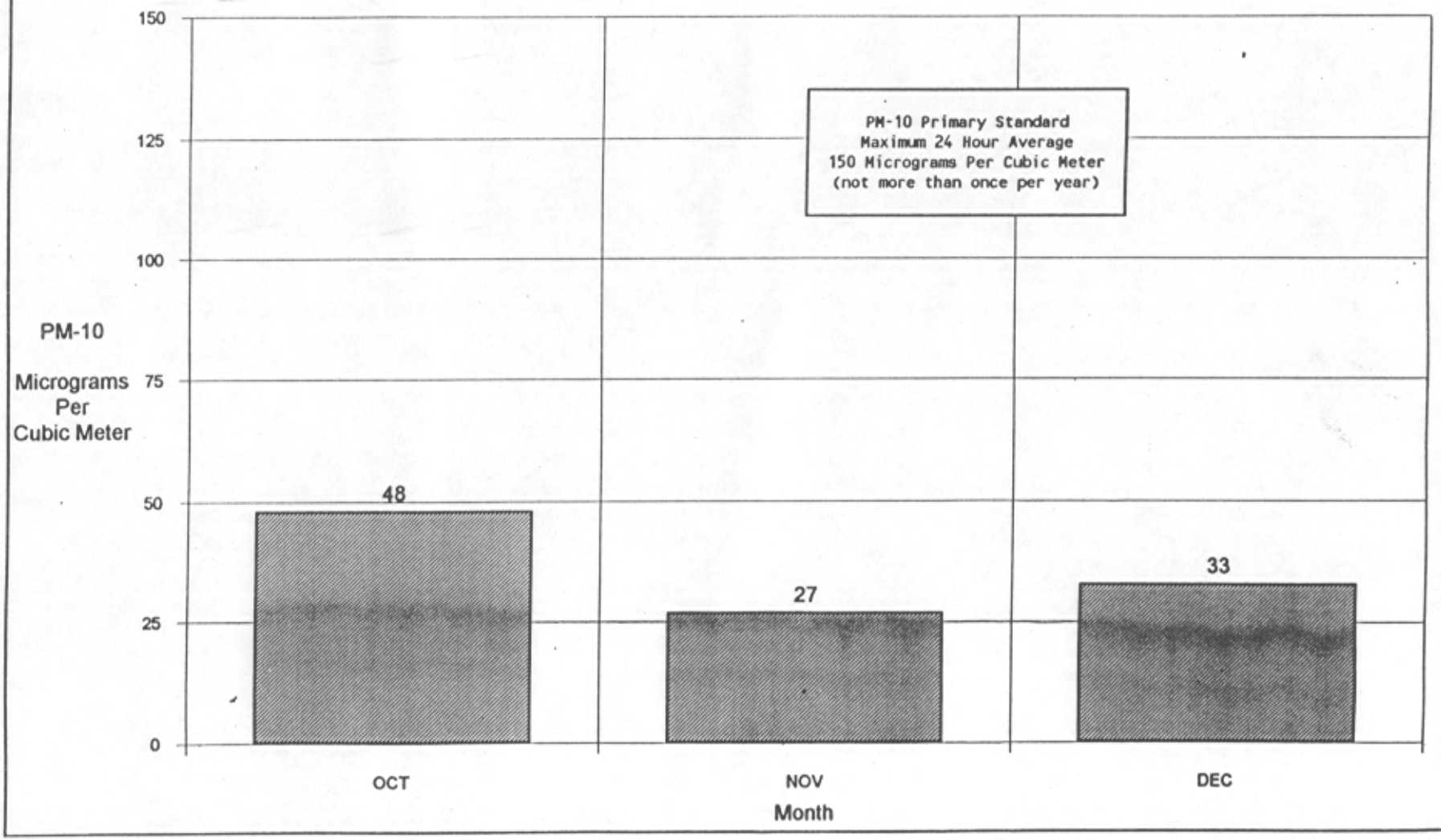


CHART B
Minnesota Pollution Control Agency
Pine Bend Monitoring Network
Particulate Matter (PM-10)
Maximum 24 Hour Average
MPCA 0436 4Q 1995



MINNESOTA POLLUTION CONTROL AGENCY
PINE BEND MONITORING NETWORK

DATA SUMMARY REPORT

Volatile Organic Compounds (VOC's)
Part 1

Compound	Measurement Units	Collection Method	Analysis Method
VOC's	Parts Per Billion	SS-Canister Pressurized	Gas Chromatography/Mass Spectrometer(GS/MS)

MPCA Site 0436 **Year: 1995** **Quarter: 4** **Report Date: 02/13/96**

SITE	DATE	TAG	43802	43803	43804	43813	43814	43815	43817	43826	43827	43843	43860	45109	45201	45202	45203	45204	45801	45806
MPCA 0436	10/06/95	P10065	0.02	0.03	0.08	0.03	0.10	0.00	0.05	0.00	0.00	0.00	0.10	0.20	0.54	0.83	0.22	0.04	0.00	0.00
MPCA 0436	10/12/95	P10125	0.30	0.02	0.07	0.00	0.09	0.02	0.00	0.00	0.00	0.00	0.00	0.15	0.21	0.62	0.17	0.02	0.00	0.00
MPCA 0436	10/18/95	P10185	0.03	0.02	0.06	0.00	0.11	0.00	0.01	0.00	0.00	0.00	0.00	0.61	0.43	1.40	0.55	0.19	0.00	0.00
MPCA 0436	10/24/95	P10245	0.04	0.02	0.06	0.00	0.14	0.00	0.07	0.00	0.00	0.00	0.00	0.66	1.17	1.63	0.59	0.20	0.00	0.00
MPCA 0436	10/30/95	P10305	0.05	0.02	0.08	0.00	0.14	0.00	0.05	0.00	0.00	0.00	0.00	0.60	0.66	1.31	0.54	0.17	0.00	0.00
MPCA 0436	11/05/95	P11055	0.16	0.00	0.06	0.00	0.06	0.00	0.02	0.00	0.00	0.00	0.00	0.19	0.21	0.23	0.08	0.10	0.04	0.00
MPCA 0436	11/11/95	P11115	0.06	0.04	0.08	0.02	0.07	0.02	0.05	0.02	0.00	0.01	0.00	0.36	1.80	0.89	0.10	0.12	0.01	0.00
MPCA 0436	11/17/95	P11175	0.10	0.03	0.08	0.00	0.06	0.01	0.04	0.00	0.00	0.00	0.00	0.42	0.48	0.95	0.12	0.13	0.01	0.00
MPCA 0436	11/23/95	P11235	0.04	0.02	0.06	0.00	0.03	0.01	0.02	0.01	0.00	0.00	0.00	0.17	0.45	0.54	0.03	0.02	0.00	0.00
MPCA 0436	11/29/95	P11295	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7
MPCA 0436	12/05/95	P12055	0.03	0.03	0.05	0.01	0.04	0.01	0.01	0.00	0.00	0.00	0.00	0.54	0.69	1.01	0.13	0.19	0.00	0.00
MPCA 0436	12/11/95	P12115	0.03	0.01	0.05	0.00	0.04	0.01	0.00	0.01	0.00	0.00	0.00	0.21	0.47	0.56	0.06	0.08	0.00	0.00
MPCA 0436	12/17/95	P12175	0.05	0.02	0.05	0.00	0.03	0.00	0.01	0.01	0.00	0.00	0.00	0.27	0.41	0.73	0.08	0.09	0.00	0.00
MPCA 0436	12/23/95	P12235	0.03	0.00	0.04	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.14	0.23	0.32	0.04	0.05	0.00	0.00
MPCA 0436	12/29/95	P12295	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7
	NUMBER		13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00
	AVERAGE		0.07	0.02	0.06	0.00	0.07	0.01	0.03	0.00	0.00	0.00	0.01	0.35	0.59	0.85	0.21	0.11	0.00	0.00
	MAXIMUM		0.30	0.04	0.08	0.03	0.14	0.02	0.07	0.02	0.00	0.01	0.10	0.66	1.80	1.63	0.59	0.20	0.04	0.00

PARAMETER CODES

43802 Dichloromethane
43803 Chloroform
43804 Carbon Tetrachloride
43813 1,1 Dichloroethane
43814 1,1,1 Trichloroethane
43815 1,2 Dichloroethane
43817 Tetrachloroethylene
43826 Vinylidene Chloride
43827 1,2 Dichloroethylene
43843 Ethylene Dibromide
43860 Vinyl Chloride
45109 m/p - Xylene
45201 Benzene
45202 Toluene
45203 Ethylbenzene
45204 o-xylene
45801 Chlorobenzene
45806 m-Dichlorobenzene

MINNESOTA POLL ON CONTROL AGENCY
PINE BEND MONITORING NETWORK

DATA SUMMARY REPORT

Volatile Organic Compounds (VOC's)
Part 2

Compound	Measurement Units	Collection Method	Analysis Method
VOC's	Parts Per Billion	SS-Canister Pressurized	Gas Chromatography/Mass Spectrometer(GS/MS)

MPCA Site 0436 **Year: 1995** **Quarter: 4** **Report Date: 02/13/96**

SITE	DATE	TAG	16822	43207	43811	43818	43819	43820	43823	43824	43829	43830	43831	43844	45207	45208	45220	45805	45807
MPCA 0436	10/06/95	P10065	0.05	0.02	0.22	0.00	0.03	0.00		0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MPCA 0436	10/12/95	P10125	0.05	0.02	0.23	0.00	0.03	0.00		0.10	0.00	0.00	0.00	0.00	0.01	0.10	0.00	0.00	0.00
MPCA 0436	10/18/95	P10185	0.05	0.02	0.21	0.00	0.00	0.00		0.09	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.00
MPCA 0436	10/24/95	P10245	0.05	0.02	0.20	0.00	0.00	0.00		0.02	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00
MPCA 0436	10/30/95	P10305	0.05	0.02	0.25	0.00	0.04	0.00		0.09	0.00	0.00	0.00	0.00	0.00	0.11	0.65	0.00	0.00
MPCA 0436	11/05/95	P11055	0.03	0.00	0.32	0.06	0.07	0.00	0.53	0.00	0.00	0.00	0.00	0.00	0.06	0.04	0.04	0.04	0.00
MPCA 0436	11/11/95	P11115	0.02	0.00	0.23	0.00	0.05	0.00	0.55	0.00	0.00	0.00	0.00	0.00	0.11	0.10	0.01	0.00	0.04
MPCA 0436	11/17/95	P11175	0.02	0.00	0.21	0.00	0.07	0.01	0.45	0.00	0.00	0.00	0.00	0.00	0.05	0.14	0.06	0.01	0.04
MPCA 0436	11/23/95	P11235	0.01	0.00	0.18	0.00	0.01	0.00	0.39	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.03
MPCA 0436	11/29/95	P11295	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7
MPCA 0436	12/05/95	P12055	0.01	0.03	0.16	0.01	0.05	0.00	0.38	0.01	0.01	0.00	0.00	0.00	0.08	0.16	0.01	0.00	0.00
MPCA 0436	12/11/95	P12115	0.01	0.03	0.15	0.00	0.00	0.00	0.35	0.01	0.00	0.00	0.00	0.00	0.05	0.04	0.02	0.00	0.00
MPCA 0436	12/17/95	P12175	0.01	0.02	0.14	0.00	0.00	0.00	0.30	0.01	0.00	0.00	0.00	0.00	0.06	0.07	0.02	0.00	0.00
MPCA 0436	12/23/95	P12235	0.01	0.02	0.12	0.00	0.00	0.00	0.23	0.01	0.00	0.00	0.00	0.00	0.03	0.05	0.01	0.00	0.01
MPCA 0436	12/29/95	P12295	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7	N7
	NUMBER		13.00	13.00	13.00	13.00	13.00	13.00	8.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00
	AVERAGE		0.03	0.02	0.20	0.01	0.03	0.00	0.40	0.03	0.00	0.00	0.00	0.00	0.03	0.08	0.06	0.00	0.01
	MAXIMUM		0.05	0.03	0.32	0.06	0.07	0.01	0.55	0.10	0.01	0.00	0.00	0.00	0.11	0.16	0.65	0.04	0.04

PARAMETER CODES

16822 1,2 Dichloro 1,1,2,2 tetrafluoroethane
43207 Freon 113
43811 Trichlorofluoromethane
43818 1,1,2,2 tetrachloroethane
43819 Bromomethane
43820 1,1,2 trichloroethane
43823 Dichlorodifluoromethane
43824 Trichloroethene
43829 1,2 dichloropropane
43830 Trans-1,3 dichloropropene
43831 Cis-1,3 dichloropropene
43844 Hexachloro-1,3 butadiene
45207 1,3,5 trimethylbenzene
45208 1,2,4 trimethylbenzene
45220 Styrene
45805 o-dichlorobenzene
45807 p-dichlorobenzene

Appendix 2

Contaminants Identified in Ambient Air

Data from MPCA, August, 1994

Samples collected as part of the Pine Bend Monitoring Network during April, May, and June, 1994

The Site number MPCA 0436 corresponds to the sampling location in St. Paul Park, just to the south of the refinery. The "maximum 1 hour average" reported for SO_2 is the highest average concentration observed for a one hour period. The value reported for PM_{10} is the maximum 24 hour average and corresponds to the highest concentration observed when levels were averaged over an entire day (as opposed to one hour). The VOC data reported is highest and average concentration observed for the entire sampling period (3 months). The compounds are coded according to numbers along the column headings (for example, column "43502" is data for formaldehyde; "45201" is for benzene"). The numbers within the table are in concentration units of ppb.

Only data from location 0436 (located to the south of the refinery) is given. No information from sampling location MPCA 0438 (in Newport) is reported for this time period.

No current regulatory air quality standards are exceeded for the time period. However, draft State criteria for benzene, formaldehyde and total reduced sulfur are occasionally exceeded.

Data from MPCA, February, 1996

Samples collected as part of the Pine Bend Monitoring Network during October, November, and December, 1995

Data from station MPCA 0436 (St. Paul Park) and MPCA 0438 (Newport) are included for this time period. Charts are configured exactly the same as those presented in the 1994 report previous. Once again, no current regulatory air quality standards are exceeded for the time period. However, draft State criteria for benzene, formaldehyde and total reduced sulfur are occasionally exceeded.

Data from MPCA

Samples collected from a temporary station established near the loading dock during Summer, 1994

This data was collected as part of a targeted effort to determine if there were transient emissions from the loading dock area. The station was placed midway between the loading dock and the nearest home located along Factory Rd. This is very near the small brick lift station building. Results were reported for every 6th day. VOC levels are significantly higher (e.g. 6/13, 7/7) when the wind was blowing from the loading dock towards the sampler (and the homes).

These higher values indicate that the loading dock, as it is currently operated, may be a significant source of benzene for the southern portion of Newport.

Data from MPCA

Information gathered from a variety of sources for Summer, 1994

This information was compiled by the Air Quality division of MPCA to provide some perspective on the benzene values that were being observed in the vicinity of the Ashland refinery during the summer of 1994. The locations are scattered throughout the metro Twin Cities area.

Information from Page and Mehlman, 1989.

This is a summary table from the article published in *Toxicology and Industrial Health*

Appendix 3

Regulatory and Health Based Criterion Values

for

Contaminants Found At the Site

Materials which have been located on the Site and a sampling of their associated regulatory values or health based criteria for various media are presented in the following table. The values are presented for informational purposes. It should not be implied that all of these materials are present at levels of health concern at the Ashland facility. The text of this consultation should be consulted for a listing of exposure pathways of public health concern.

	Water	*Water*	*Soil*	*Air*	*Air*	*Air*
Compound	**US EPA MCL (Fg/L)**	**Minn. HRL (Fg/L)**	**ATSDR Soil (ppm)**	**Worker Air (mg/m3)**	**Minn. HRV (mg/m3)**	**Odor Threshold (mg/m3)**
Acetone	-	700	5000	593	20 (A)	50
Benzene*	5	10	-	0.3	0.001 ©	5
Carbon Tetrachloride*	5	3	40	12	-	500
Chlorobenzene	-	100	-	345	-	4
Chloroform*	100	60	500	10	0.5 (A)	500
c-1,2 Dichloroethene	70	70	-	-	-	-
Cumene	-	300	2000	246	-	0.1
1,1 - Dichloroethane	-	70	-	400	-	200
1,2 - Dichloroethane*	5	4	-	40	-	300
Ethyl benzene	700	700	5000	434	10 (A)	2
Ethyl Ether	-	1000	10000	400	-	30
Methyl Ethyl Ketone	-	4000	-	590	30 (A)	-
Methyl Isobutyl Ketone	-	300	-	205	-	5
Methylene Chloride*	5	50	3000	105	7 (A)	100
Tetrachloroethylene*	5	7	500	170	7 (A)	250
Tetrahydrofuran	-	-	-	590	-	8
Toluene	1000	1000	10000	377	0.4 ©	10
t-1,2 Dichloroethene	100	100	1000	-	-	-
Trichloroethylene*	5	30	-	270	2 (A)	400
1,1,1 Trichloroethane	200	600	-	-	10 (A)	1000
Xylene	10000	10000	-	434	1 (A)	8

	Water	*Water*	*Soil*	*Air*	*Air*	*Air*
Compound	**US EPA MCL (Fg/L)**	**Minn. HRL (Fg/L)**	**ATSDR Soil (ppm)**	**Worker Air (mg/m3)**	**Minn. HRV (mg/m3)**	**Odor Threshold (mg/m3)**
Anthracene	-	-	2000	-	-	-
Benzo(a)anthracene	0.1	-	-	-	-	-
Benzo(b)fluoranthene	0.2	-	-	-	-	-
Benzo(a)pyrene*	0.2	-	-	-	-	-
bis(2-ethylhexyl) phthalate*	400	20	1000	-	-	-
Chrysene	0.2	-	-	-	-	-
m & o - Cresol*	-	30	-	10	-	0.001
p - Cresol*	-	3	-	10	-	0.001
dibenzo(a,h)anthracene*	0.3	-	-	-	-	-
2,4 Dimethylphenol	-	100	-	-	-	0.001
Di-n-butyl phthalate	-	700	5000	-	-	-
Fluoranthene	-	300	2000	-	-	-
Naphthalene	-	300	-	52	0.001 ©	0.5
Pentachlorophenol*	1	3	2000	0.5	-	-
Formaldehyde	-	1000	10000	1.2	0.06 (A) 0.0008 ©	0.1
Hydrogen sulfide	-	-	200	14	0.07 (A) 0.01 (S)	0.005
Phenol	-	4000	30000	19	-	3
Pyrene	200	200	2000	-	-	-

- = no data available. Those listed with (*) are carcinogenic

EPA MCL=**M**aximum **C**ontaminant **L**evel for drinking water as established by the US Environmental Protection Agency. This is the maximum permissible level of a contaminant in water which is delivered to a user of a public water system.

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Minn. HRV = **H**ealth **R**isk **V**alue as proposed by MDH. A HRV is the amount of a chemical in ambient air to which most people can be exposed without significantly increasing their health risks. (A) indicates an acute value, which is applicable to a 1 hour exposure; (S) indicates a subchronic exposure value, which is applicable to a 90 day exposure; © indicates a chronic value, which is applicable to a lifetime exposure. **These values are currently in draft format and may be subject to change.**

Odor Threshold = rough estimate of lowest concentration in air noticeable by smell as presented in Verschueren (1983).