Health Consultation

Summary of Air Quality Issues and Identification of Information Needed to Address Community Health Concerns - Port Townsend Paper Corporation
Jefferson County, Washington

December 2008

Prepared by

The Washington State Department of Health
Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

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Foreword

The Washington State Department of Health (DOH) has prepared this health consultation in cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR). ATSDR is part of the U.S. Department of Health and Human Services and is the principal federal public health agency responsible for health issues related to hazardous waste. This health consultation was prepared in accordance with methodologies and guidelines developed by ATSDR.

The purpose of this health consultation is to identify and prevent harmful human health effects resulting from exposure to hazardous substances in the environment. Health consultations focus on specific health issues so that DOH can respond to requests from concerned residents or agencies for health information on hazardous substances. DOH evaluates sampling data collected from a hazardous waste site, determines whether exposures have occurred or could occur, reports any potential harmful effects, and recommends actions to protect public health. The findings in this report are relevant to conditions at the site during the time of this health consultation, and should not necessarily be relied upon if site conditions or land use changes in the future.

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For more information about ATSDR, contact the ATSDR Information Center at 1-888-422-8737 or visit the agency's Web site: www.atsdr.cdc.gov/.

Glossary

Air emissions inventory	An air emissions inventory is a listing of the amount of air pollution emitted by various sources. Every year, Ecology and the local air quality agencies inventory large businesses. Every three years, Ecology inventories many additional sources such as motor vehicles, woodstoves, outdoor burning, agricultural sources, and natural sources.
Acute	Occurring over a short time [compare with **chronic**].
Agency for Toxic Substances and Disease Registry (ATSDR)	The principal federal public health agency involved with hazardous waste issues, responsible for preventing or reducing the harmful effects of exposure to hazardous substances on human health and quality of life. ATSDR is part of the U.S. Department of Health and Human Services.
Carcinogen	Any substance that causes cancer.
Chronic	Occurring over a long time (more than 1 year) [compare with **acute**].
Comparison value	Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.
Contaminant	A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.
Dose **(for chemicals that are not radioactive)**	The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An "exposure dose" is how much of a substance is encountered in the environment. An "absorbed dose" is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.
Emissions inventory	An emissions inventory provides a detailed description of the quantity of pollutants along with their emissions characteristics (how and where contaminants are being emitted.
Exposure	Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [**acute exposure**], of intermediate duration, or long-term [**chronic exposure**].

Hazardous air pollutants (HAPs)	HAPs are those pollutants that are known or suspected to cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental effects. Examples of toxic air pollutants include benzene, which is found in gasoline; perchlorethlyene, which is emitted from some dry cleaning facilities; and methylene chloride, which is used as a solvent and paint stripper by a number of industries. EPA has identified 188 chemicals as HAPs (http://www.epa.gov/ttn/atw/188polls.html).
Inhalation	The act of breathing. A hazardous substance can enter the body this way [see **route of exposure**].
Media	Soil, water, air, plants, animals, or any other part of the environment that can contain contaminants.
Organic	Compounds composed of carbon, including materials such as solvents, oils, and pesticides that are not easily dissolved in water.
Pollutants	Air pollution describes a collection of airborne pollutants that contribute to our air quality. The term "pollutants" recognizes that these substances are undesirable because of their impact on human health, the environment and the economy.
Parts per billion (ppb)/Parts per million (ppm)	Units commonly used to express low concentrations of contaminants. For example, 1 ounce of trichloroethylene (TCE) in 1 million ounces of water is 1 ppm. 1 ounce of TCE in 1 billion ounces of water is 1 ppb. If one drop of TCE is mixed in a competition size swimming pool, the water will contain about 1 ppb of TCE.
Route of exposure	The way people come into contact with a hazardous substance. Three routes of exposure are breathing [inhalation], eating or drinking [ingestion], or contact with the skin [dermal contact].
Toxics Release Inventory (TRI)	Toxics Release Inventory (TRI) - TRI is the common name for Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA). Each year, facilities that meet certain thresholds must report their releases and other waste management activities for listed toxic chemicals. That is, facilities must report the quantities of toxic chemicals recycled, collected and combusted for energy recovery, treated for destruction, or disposed of. A separate report must be filed for each chemical that exceeds the reporting threshold. EPA compiles the reported information into a publicly available database known as the Toxics Release Inventory.

Purpose

The Washington State Department of Health (DOH) prepared this health consultation at the request of citizens of Port Townsend and Jefferson County. Local residents expressed concern over the potential health impacts of both past and current air emissions from the Port Townsend Paper Corporation (PTP) mill. The purpose of this health consultation is to summarize health concerns regarding air pollution generated from the PTP mill and respond to the requests made by some members of the community for an investigation of the following issues:

- Epidemiological analysis of the incidence of cancer cases and detailed geographic tracking of cancer cases in Jefferson County.
- Tracking of hospital visits for asthma, respiratory issues, and/or cardiac problems with comparison to wind direction and speed at the time of visit to the emergency room to see if there is a correlation to mill plume or other sources of air pollution.
- Tracking of self-reported health impacts from the mill.

DOH reviewed available information and attempted to find answers for these questions, unfortunately, they are complex and not easy to address. In order to measure the relationship between the given exposure and the observed health effect an epidemiological health study would need to be conducted. DOH found no record of specific health evaluation studies done in the Port Townsend area by either Jefferson County Public Health or the Washington State Department of Health Office of Epidemiology. Such a study would require a sufficiently large population exposed in sufficient concentrations to the contaminants being investigated. It would also need distinctions between exposed and unexposed populations of sufficient size to be able to attribute health effects to these air pollutants.

In addition, it would have to consider that several health endpoints (health conditions) could also be associated with other causes (e.g., diesel emissions, wood stoves, fireplaces, outdoor burning, etc). For example, the symptoms and community health concerns, including headache, sleep disturbance, nausea, vomiting, and worsening of respiratory symptoms and asthma could be associated with many other exposures and conditions.

In order to conduct a health study, it would also be necessary to clearly identify the contaminants of concern, measure the exposure, and demonstrate a complete exposure pathway. All the information necessary to conduct a health study, as described above, is not available to assess the possible health effects associated with air emissions from PTP mill.

Instead, DOH focused on available information and studies on health effects of mill emissions released by kraft paper and pulp mills in general. DOH also conducted a health statistics review and evaluated available epidemiological data in order to assess whether Port Townsend residents experience a higher rate of certain health conditions than those reported for Washington State residents overall. Please refer to Appendix C which includes detailed information about what a health statistics review is, why it is conducted, and its strengths and limitations.

In addition, this health consultation included a discussion of data gaps that need to be filled in

order to assess the health impacts of mill related pollutants on the community.

DOH prepares health consultations under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR).

Background and Statement of Issues

Site Description and History

Port Townsend is situated at the extreme northeastern end of the Olympic Peninsula in Jefferson County, Washington. The elevation is 131 feet. The 2000 census indicated a population of 8,334. The Port Townsend Paper (PTP) mill is just south of Port Townsend. It is an active facility located along the southeast shore of Port Townsend Bay on the northeastern corner of the Olympic Peninsula in Port Townsend, Jefferson County, Washington (Figures 1 and 2). The Port Townsend site began operation in 1927, employs approximately 325 full-time employees, and manufactures unbleached kraft pulp paper and lineboard for sale both domestically and internationally.[1] The process produces approximately 941 tons of pulp per day. This corresponds approximately to 2/3 of unbleached kraft pulp and 1/3rd of recycled pulp from corrugated cardboard.

Kraft is the German word for "strength," which is an important characteristic for paper making. The kraft chemical pulping process includes a recycling process where most of the chemicals used to produce pulp and paper are captured, recovered, and reused again and again. At the same time, byproducts from the pulping process are used as a fuel source to generate steam and electricity. The site contains both a pulp mill and a paper mill. The product of the pulp milling process is pulp fiber and water slurry which, through the use of mechanical and chemical treatment at the paper mill, is turned into various paper products such as boxes, paper bags, paper towels, and paper sheets.

Industry description and practices

The main steps in pulp and paper manufacturing are raw material preparation, such as wood debarking and chip making[a]; pulp manufacturing; pulp bleaching; paper manufacturing; and fiber recycling. The following general description of the kraft industry does not necessarily depict actual practices at the PTP mill. For example, PTP mill does not do wood debarking and chip making on-site. PTP mill uses a chemical pulp process without bleaching to make printing papers for applications in which low brightness is acceptable. The pulp mill uses wood chips and sawdust as raw material and adds them separately to digesters. The digesters chemically break down the lignin holding the cellulose fibers together in the wood. The chip digesters use steam and a sodium hydroxide and sodium sulfide solution (liquor) to break down the wood fibers into a brown wood pulp. The pulp is washed, screened, and the liquor is removed and recycled.

Air permit

[a] PTP mill does not do wood debarking and chip making. The mill is an unbleached mill and does not make printing papers.[2]

PTP mill is required to have a Title V Air Operating Permit because it emits or has the potential to emit, one hundred tons per year or more of one or more air pollutants (WAC 173-401-300(1)).[3] Under the Title V permit sulfur dioxide and hydrogen sulfide are monitored periodically. SO_2 and H_2S are monitored from the appropriate emissions sources, including continuous total reduced sulfur (TRS) monitoring for the recovery boiler and lime kiln stacks. However, a complete set of toxic air emissions[b] are not routinely monitored. According to PTP mill, they only monitor the required HAPs. The mill is regulated under the National Emission Standards for Hazardous Air Pollutants (NESHAP) rules which is in compliance with the Maximum Achievable Control Technology (MACT) standards I and II.[2] However, one limitation of the MACT approach is that it relies mostly on engineering judgment about the amount of emissions reduction that can be achieved, and not on analyses of where action is needed to protect the public's health. According to Ecology and PTP mill, chlorine, chloroform, and chlorine dioxide are not currently being released at the mill.[4,5] Consequently, chlorine, chloroform, and chlorine dioxide are not monitored.

Local air monitoring

In Port Townsend, monitoring for air pollution occurs at Blue Heron Middle School, 3339 San Juan Avenue in Jefferson County. This monitor only collects information on particulate matter (PM2.5).[6] Additionally, it may not be sited in a place that is relevant (i.e., does not consistently capture emissions from PTP mill). Indeed, this monitoring station was sited to represent air quality conditions representing the overall air shed. It was never intended to capture emissions directly from the mill but many other sources such as woodstoves, motor vehicle emissions, and other combustion sources in Port Townsend.

According to the EPA, air quality samples are generally collected for several reasons: (1) to judge compliance [of an air shed] with and/or progress made towards meeting ambient air quality standards, (2) to activate emergency control procedures that prevent or alleviate air pollution episodes, (3) to observe pollution trends throughout the region, including non-urban areas, and (4) to provide a data base for research evaluation of effects: urban, land-use, and transportation planning; development and evaluation of abatement strategies; and development and validation of diffusion models.[7]

Potential air pollution sources at PTP mill

There are many potential emission sources at the pulp mill including combustion units, chemical manufacturing operations, and effluent treatment processes. According to EPA's Toxics Release Inventory (TRI), industries in the Port Townsend industrial area release toxic substances into the air. Estimates of the annual air emissions of many chemicals can be found at http://www.epa.gov/triexplorer/. TRI data provide DOH staff with a general overview of the potential chemicals in an area. However, the TRI regulations only require facilities in certain

[b] Air toxics can be defined as having three characteristics: a) they have the potential to cause serious adverse health effects in the general population or to organisms in the environment as a result of airborne exposures; b) they are released from anthropogenic sources; and c) they include 189 hazardous air pollutants listed in Section 112.b.1 of the Clean Air Act of 1990.

industries to disclose releases for specific hazardous chemicals. The regulations do not require that all facilities report and do not address all chemicals. In addition, information in the TRI database does not represent measured concentrations; rather, it represents industry-reported estimates of emissions. The accuracy of these estimates of emissions is not known. Furthermore, while TRI data typically capture large stationary sources of emission releases, smaller stationary sources are not captured. These smaller stationary sources could include offices and residences, gasoline stations, and dry cleaners. Additionally, TRI data do not capture mobile sources, like automobiles, trucks, buses, and motorcycles. These mobile sources may be a significant source of outdoor air pollution, including such chemicals as acetaldehyde, propionaldehyde, and formaldehyde. TRI data shows self-reported estimates of pollutants emitted from PTP in the past. Tables 1 and 2 show TRI emissions (tons per year) from 2002, 2005 and 2006. Additional limitations of the data collected in the TRI inventory include the following.[8]

- TRI requires the reporting of chemical releases only when a facility manufactures, processes, or otherwise uses an amount greater than the TRI reporting threshold [e.g., more than 0.1 grams/year of dioxin and dioxin-like compounds, more than 100 pounds/year of polycyclic aromatic hydrocarbons (PAHs)].

- Per TRI guidance, release reports may be based on estimates, not measurements. As a result, facilities may overstate releases because they can be penalized for under-reporting releases.[8]

- Certain chemicals (PAHs, dioxin and dioxin-like compounds, metal compounds) are reported as a class, not as individual chemical compounds. Because the individual compounds in the class have widely varying toxic effects, the potential toxicity of chemical releases can be inaccurately estimated.

- Year-to-year comparisons are nearly impossible given that the TRI rules and definitions for reporting change year-to-year.

Table 1. Annual Air Emissions and Toxics Release Inventory for 2002-2006 from PTP Corporation, Port Townsend, Washington.[9,10]

Stack source	Description of fuel or material processed	Pollutant	Units (Tons per year)		
			2002*	2005	2006
Recovery Furnace	Pulp -unbleached kraft	Formaldehyde	1	1	1
		PM	71	150	144
		PM_{10}	53	113	107
		$PM_{2.5}$	48	101	97
		SO_2	298	196	195
		NO_x	185	193	185
		CO	1124	1166	1122
		VOC (reported as THC)	35	36	35
Smelt Tank	Pulp – unbleached kraft	Phenol	0.1	0.1	0.1
		PM	40	43	29
		PM_{10}	30	34	21
		$PM_{2.5}$	27	30	19
		SO_2	3	3	3
		NO_x	5	5	5
		CO	0	0	0
		Ammonia (NH_3)	23	26	2
Lime Kiln	Pulp – unbleached kraft	PM	38	20	26
		PM_{10}	38	19	26
		$PM_{2.5}$	37	19	25
		SO_2	1	2	1
		NO_x	62	64	62
		CO	10	11	10
		VOC (reported as THC)	1	1	1
		NH_3	13	14	13
#10 Power Boiler	Wood/Bark & Reprocessed Fuel Oil	Lead	0.01	0.03	0.03
		Manganese	0.7	0.03	0.03
		Mercury	0.0001	0.0002	0.0002
		Hydrochloric acid aerosol (HCl)	7	60	57
		PM	116	110	102
		PM_{10}	113	107	99
		$PM_{2.5}$	113	107	99
		SO_2	167	140	14
		NO_x	250	273	239
		CO	531	592	515
		VOC	12	17	15
Package Boiler	Specification Reprocessed Fuel Oil	PM	18	25	33
		PM_{10}	15	21	28
		$PM_{2.5}$	10	14	18
		SO_2	76	69	74
		NO_x	48	46	60
		CO	8	8	10
		VOC (reported as VOC)	0	0	1
Kraft pulping	Washer vents, pulp & paper dryers	Methanol	31	29	29
		VOC (reported as THC)	14	15	14
Pulp & paper, wood products, fugitive emissions	Material handling & storage (excluding mobile sources)	PM	4	13	6
		PM_{10}	1	5	2
		$PM_{2.5}$	0	1	1

VOC = volatile organic compounds; PM = particulate matter; $PM_{2.5}$ = particle matter size equal or less than 2.5 micrometers (μm); PM_{10} = particle matter size equal or less than 10μm; SO_2 = sulfur dioxide; NO_x = nitric oxide; CO = carbon monoxide; THC = Total hydrocarbon.
* Emission year 2002 represents emissions and stack data: This data set gives emissions of criteria pollutants and some air toxics by emission point (emission unit) basis - and includes stack data; criteria pollutants are from Washington Department of Ecology (WDOE) data, broken down by stack. The portion of the air toxic data presented here is from the Toxic Release Inventory (TRI). The TRI pollutants are reported in accordance with the federal law, on a plant wide basis. The TRI pollutants were assigned to emission points based on engineering judgments.[11]

Table 2. Summary of PTP TRI and annual air emissions, TRI 2002/2005.

Pollutant	**Annual emissions, Tons/year**	
	2002	**2005**
Acetaldehyde	32	44
Ammonia	36	41
Benzo(g,h,i)perylene	0.001	NA
Cresol (mixed isomers)	NA	9
Dioxin & dioxin-like compounds*	0.4 g	0.4 g
Formaldehyde	5	8
Hydrochloric acid aerosols	137	11
Lead compounds	0.04	0.04
Manganese compounds	0.7	0.05
Mercury compounds	0.0005	0.0005
Methanol	57	56
Naphthalene	NA	7
Phenol	3	3
Polycyclic aromatic compounds	0.03	0.03
Propionaldehyde	NA	11
PM_{10}	268	333
$PM_{2.5}$	240	282
SO_2	545	410
NO_x	550	582
VOC	63	72
CO	1,680	1,788
Total reduced sulfur (TRS)	18	15

Source: Port Townsend Paper Emissions Inventory & Toxic Release Inventory, year 2002 & 2005.[12]
NA – Pollutant was not reported because mass emissions were zero or below federal reporting thresholds.
VOC = volatile organic compounds; PM = particulate matter; $PM_{2.5}$ = particle matter size equal or less than 2.5 micrometers (μm); PM_{10} = particle matter size equal or less than 10μm; SO_2 = sulfur dioxide; NO_x = nitric oxide; CO = carbon monoxide.
* Dioxin & dioxin-like compounds are in grams (g) per year.

Based on annual air emissions reported in 2005 (Table 2), total chemical releases at PTP mill were about 3,657 tons per year. PTP mill's emissions consist of 51% carbon monoxide (CO), 17% nitrogen dioxide (NO_2), 12% sulfur dioxide (SO_2), 10% particulate matter PM_{10}, 8% $PM_{2.5}$, and 2% volatile organic carbons (VOCs).

Use of Reprocessed Fuel Oil (RFO)

The package boiler is run on reprocessed fuel oil (RFO). In 2006, the total pulp mill burned an estimated 13.2 million gallons of RFO (the package boiler itself used 3.8 million gallons).[13,14] Used oil is any oil that has been refined from crude oil, or any synthetic oil, that has been used and as a result of such use is contaminated by physical or chemical impurities (WAC 173-303-040 and 40 CFR 279.10).[15] According to Ecology, reprocessing removes heavy metals and some other contaminants from used oil. Most oil used in Washington is reprocessed to remove the toxic components of the oil so it can be used as a fuel.[16] RFO is less expensive than alternate fuels such as #2 fuel oil or diesel, and it has properties most similar to #4 fuel oil. It is used in all of the power boilers, recovery furnace, and lime kiln. Burning RFO emits less sulfur into the atmosphere than burning #6 fuel oil, but RFO creates significantly more ash. WAC 173-303-515 rule describes standards for management of used oil. Used oil exceeding any specification level described in this rule is subject to this section when burned for energy recovery.[17] RFO combustion generates an ash content of 0.54% weight compared to 0.05 – 0.10 for #6 fuel oil.

Notices of violation at PTP mill

Notices of violation have occurred periodically since 1999 at PTP mill. Most of the violations were for opacity (measurement of PM emissions) exceedances, but included TRS and nitrogen oxides (NOx) exceedances. For instance, in 1999 most exceedances were related to opacity, while in 2000, most exceedances were related to opacity, TRS and NOx. In 2001 and 2002, most exceedances were attributed to opacity, NOx, TRS and PM. Violation of opacity limits have decreased since 2004 until 2007. No data exist to evaluate opacity violations before 2004 and 2008. Violations of NOx standards were more frequent in 2005 and decreased in 2006 and 2007.[18] By emitting pollutants in excess of what is normally allowed there are some potential for release of more particulate matter and/or chemicals which can be harmful to humans.

Community health concerns

DOH has received numerous health complaints since May 2007, from the Port Townsend AirWatchers and local citizens. DOH received community complaints by regular mail, electronic mail and summaries from the Port Townsend Paper Corporation. DOH received a list of 285 complaints recorded by the mill from 1/19/2004 to 7/10/2007, ten written letters and ten electronic mail messages. Overall, the community complaints include smells of rotten egg and/or "pungent acid" odors that irritate eyes, throat, and nose and causes headaches. Some residents have reported that these odors trigger asthma-like reactions and vomiting. The following summarizes community health complaints made by citizens of Port Townsend to the mill related to air emissions from March 2004 to July 2007:[19]

- Chronic throat and lung irritation
- Persistent "respiratory and cardiac" problems in a previously healthy 43-year old female
- Strong smells "pungent acid"
- High noise level
- Headaches and/or nausea and/or eye irritation and/or respiratory irritation
- Development of "chronic respiratory problems" that disappear when people leave town

- Development of "extreme chemical sensitivity" and severely heightened seasonal allergies

Some members of the community complain that smoke emissions from the mill are higher in the middle of the night, and on weekends. Residents perceive higher odor levels at night.[c] People living in close proximity to the pulp mill (i.e., people living within 3 to 5 mile radius from the mill) often complain (e.g., some people complain that they are breathing "toxic fumes" at least once per week and some people expressed they can smell rotten egg odors within an approximately three to five mile radius from the mill) of breathing discomfort, with some people expressing concern about possible adverse health effects following exposure. Residents reported experiencing headaches, coughing, nausea, allergies, mucous irritation in eyes and respiratory tract concurrent with odors. Odors are typically a rotten egg and pungent acid smell that may be associated with hydrogen sulfide (H_2S) and sulfur dioxide (SO_2) respectively (these chemicals are described in detail below). DOH has been informed of at least one family that has left the area because of the impact mill emissions had on their health.[21]

Port Townsend employee non-health concerns

DOH also received a list of 101 signatures from employees of Port Townsend Paper Corporation that feel do not suffer any health concerns from any emissions released from this mill. They believe the mill meets or exceeds all local, state, and federal laws concerning emissions.[22]

Air pollution and health effects

Air pollution is associated with a variety of health effects including respiratory tract irritation, asthma, heart and lung diseases, decreased immunity, and increased risk of cancer. The very young and very old are particularly sensitive to air pollution. Most healthy people recover from the effects of air pollution when air quality improves. However, people with existing lung and heart diseases (such as asthma or chronic obstructive pulmonary disease) are at risk of dying from either short-term or long-term exposure to air pollution.

The air we breathe contains a mixture of gases and particles, and breathing this mixture affects us 24 hours a day, indoors and outside. Humans are exposed to air pollution outdoors and indoors, including during transit in vehicles. Indoor air pollution comprises a mixture of contaminants penetrating from outdoors and those generated indoors. Because most of the health effects attributable to air pollutants can also be attributable to a wide variety of other risk factors, the impact of air pollution on human health is further complicated by human exposure to a mixture of substances at various concentrations present in the air. The mixture is different inside and outside, and may affect people in different ways.

[c] Ecology has determined that the mill does not release more reduced sulfur gases during the night. Reduced sulfur gas emissions remains steady, day and night. The natural behavior of air in relation to day and night warming and cooling of water can explain why more odorous gases are released from water bodies at night. Winds tend to be calmer at night, and there is little or no mixing of the air. As the surface of the water cools at night, mixing occurs as the cooler water sinks, and more dissolved gases are released. In the daytime there is good mixing of air as the land heats up, and this leads to ventilation that disperses and dilutes gases. Because of topography, odorous, heavier than air gases can also be trapped so that their concentrations increase under an inversion layer and the smell will be more intense.[20]

There are many different factors that contribute to air pollution. Depending on the length of time you are exposed, your health status, your genetics, and the concentration of pollutants, air pollution can have a negative effect on your respiratory system (lungs and airways) and on your cardiovascular system (heart function and blood circulation) by:

- Making it harder to breathe
- Irritating the respiratory system
- Affecting Chronic Obstructive Pulmonary Diseases such as chronic bronchitis emphysema and in some cases asthma
- Causing heart attack, heart failure and other manifestations of heart disease because of narrowing (constriction) of blood vessels, altering heart rate and rhythm and affecting blood clotting

The relationship between current concentrations of ambient air pollution and adverse health effects is controversial. Very little is known on the concentration or physical/chemical properties of pollutants in places where people live and work, such as in community air, homes, schools, workplaces, restaurants, or vehicles. Adverse health effects associated with air pollution, especially particulate matter increase as air pollution worsens. PM is associated with decreased respiratory function, aggravation of existing respiratory and cardiovascular conditions, altered defense mechanisms and even premature death.[23,24,25,26,27,28,29,30,31,32,33] Studies have shown that even modest increases in air pollution can cause small but measurable increases in emergency room visits, hospitals admissions and death. Some health effects, such as an increase in asthma attacks, have been observed in conjunction with episodes of high pollution concentration lasting one or two days. Such effects are considered acute, because they are associated with short-term exposures to a pollutant. In fact, it has been shown that even small increases in air pollution levels for a short period of time can exacerbate illness among sensitive or at-risk people.[34,35,36]

Information about health risks of people living near kraft pulp mills and/or evidence of disease is limited and inconclusive.[37,38,39,40,41,42,43] There are many substances emitted from kraft mills that can have an effect on the respiratory tract, and little is known about the health effects of living in close proximity to pulp and paper mills and low-level exposure to malodorous sulfur compounds. A review of the scientific literature indicated there is a possible association between a paper mill's location and wheezing symptoms among adolescents. The results of a study conducted in North Carolina suggests that the community-based exposure to pulp and paper mill emissions may have a greater impact on smokers and individuals exposed to cigarette smoke in the home than on non-smokers without such household exposure.[44] In 1995, DOH conducted a health study (Phase I) in Port Angeles to determine the amount of respiratory disease among elementary school children in response to community health concerns regarding air pollution. This study reported levels of cough and bronchitis among school children in Port Angeles as high as those in other areas of the U.S. with relatively high levels of air pollution. The reported levels of other respiratory conditions (wheeze, asthma, etc.) in Port Angeles were not high compared to those in other areas of the U.S.[45] A second phase (Phase II) of the study in Port Angeles was conducted in order to determine whether children who reported asthma, wheeze, or

chronic cough in the Phase I study had more respiratory symptoms on days with relatively high levels of ambient air pollution compared to days with relatively low levels of air pollution. The results of this study showed that respiratory symptoms in children increased as levels of air pollution (i.e., SO_2) increased. However, there were several limitations of this study which made the results uncertain including changes in symptom reporting over time and difficulties in accurately characterizing individual exposures using air pollution data collected from monitoring stations.[46]

An air pollution study conducted in 1996, assessed exposure to very low levels of ambient-air malodorous sulfur compounds and their effects on eye irritation, respiratory-tract symptoms, and central nervous system symptoms in adults. This study concluded that residents living in close proximity to a pulp mill had a higher risk of developing respiratory infections, headache and cough.[42] An exposure investigation study conducted in 2007 at a kraft pulp and paper mill in Plymouth, North Carolina concluded that SO_2 levels found in Plymouth can cause respiratory irritation and, thus pose a health hazard. Elevated levels of other sulfur compounds, including carbonyl sulfide may contribute to respiratory irritation.[47]

No data currently exist for the Port Townsend area that specifically can be used to assess the direct relationship between health effects in the community and PTP mill air emissions. Even if there were reports from the community about these types of health effects such as headache, nausea, or respiratory irritation, asthma, and cancer, it would be difficult to establish the extent the mill's emissions contribute to these effects. There may be other air contaminant exposures (e.g., motor vehicle exhaust including diesel emissions,[d] chemicals released by wood stoves[e], fireplaces, outdoor burning, and wildfires)[f], and reasons why people experience these symptoms. Thus, the relationship of health effects to PTP emissions remains undetermined.

Possible health effects associated with odors

Odors in the air can be caused by various things and can affect people in different ways. According to some experts, it is possible for unpleasant odors from environmental sources to be associated with health symptoms that are dependent on many individual and environmental factors.[49,50] Bad odors do not necessarily mean people are inhaling bad things or that they would have negative health impacts. When faced with strong smells, some people may experience physical symptoms, which may include headaches, nausea or dizziness.[51] People may also feel that underlying medical conditions such as asthma or other respiratory problems may become aggravated by an exposure to strong odors.

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[d] Chemicals in vehicle emissions can irritate the eyes, nose and throat; cause wheezing, coughing and breathing difficulties; worsen existing heart and lung problems; increase the risk of heart attacks; and lead to premature death.

[e] Health effects of wood-smoke exposure include an increased risk of lower respiratory tract illness such as coughing, wheezing, shortness of breath, and chest tightness. For people with asthma, wood smoke is associated with an exacerbation (or flaring up) of asthma. Other health effects include a decrease in lung function or decreased breathing ability resulting in increased emergency room visits.

[f] Wood stoves, fireplaces, on-road diesel, and on-road gasoline have been identified as sources of air pollution in Port Townsend area.[48]

Additional data will need to be collected in order to determine the relationship of mill emissions and odors, and the potential impact to human health. Currently, odor and data in the Port Townsend area are not sufficient to determine health impacts, if any.

Discussion

Community members in Port Townsend and surrounding neighborhoods have raised health concerns regarding potential exposures to chemical compounds emitted into the air from the PTP mill. The residents have contacted state and local agencies. The discussion that follows will address sources of pollution, key pollutants, possible exposures, health data relevant to air pollution concerns, and data gaps.

Sources of pollution at PTP mill

TRI data indicate that emissions from the mill occur from these predominant sources (Tables 1 and 2).

- Recovery furnace
- Smelt Tank
- Lime Kiln
- Hog Fuel and package boiler
- Treatment system
- Water treatment ponds

The TRI data for the PTP mill includes plant-wide emissions to air, land and water. However, the list of chemicals in TRI is not comprehensive and does not report emissions of many air toxics below certain threshold quantities, nor does it attribute emissions to specific sources at the mill.

Key pollutants at PTP mill

Air pollution is not completely characterized in most kraft pulp mills. In fact, air pollution from any source (e.g., automobiles, agriculture, volcanoes, industry) is never completely characterized. PTP Corporation only monitors emissions specified in their Air Operating Permit.[3] Toxics emissions are not monitored. The TRI emissions inventory only includes a partial list of chemicals emitted from the mill. Key pollutants from the mill that could possibly cause odors or health effects are nitrogen dioxide, sulfur containing chemicals (i.e., sulfur dioxide, and total reduced sulfur compounds), and particulate matter. As mentioned above, local residents typically report rotten egg and pungent acid smells that may be associated with H_2S and SO_2 respectively. Some people believe that the odors signal something harmful to their health, and that the odors reduce their quality of life and sense of well-being.

Without knowing more about the specific emissions from PTP mill and the resulting ambient air concentrations, it is difficult to identify which chemical substances might contribute to adverse health effects. The presence of odors in the air does not necessarily suggest that adverse health effects will occur among exposed populations. To estimate, identify and quantify the public health impact at any given level of exposure of a specific pollutant is a challenging task and typically requires the use of large sample sizes and sophisticated statistical methods. The

following discussion summarizes health related information for each of the primary air pollutant categories associated with kraft paper mill production methods.

Nitrogen Dioxide (NO_2)

NO_2 is a gas produced as a by-product of nitrogen oxide incineration at sufficiently high temperatures. NO_2 is a product of the combustion of fuels in boilers. NO_2 contributes to two major pollution problems: smog and acid rain. NO_2 combines with volatile organic compounds and sunlight in the lower atmosphere to form ozone, a key component of smog. In moist air, nitrogen oxides can also form nitric acid, which is precipitated as a component of acid rain. NO_2 is harmful to the lungs, irritates bronchial and respiratory systems, and increases symptoms in asthmatic patients.

Sulfur containing chemicals

Sulfur Dioxide (SO_2)

SO_2 is a colorless gas or liquid that has a pungent odor. SO_2 is emitted when sulfur containing fuel (i.e., burning of fossil fuels (coal, oil) is combusted for uses during kraft pulp production). SO_2 increases symptoms in asthmatic patients and irritates the respiratory system.

Total reduced sulfur (TRS)

Total reduced sulfur compounds cause the distinct odor typically associated with kraft pulp mills. These mills can release a range of odorous sulfur compounds that include hydrogen sulfide (H_2S), methyl mercaptan (CH_3SH), dimethyl sulfide (CH_3SCH_3), and dimethyl disulfide (CH_3SSCH_3).

The sulfur in these malodorous substances can be measured or monitored in ambient air as a group. When measured in this manner they are referred as "total reduced sulfur" (TRS) compounds, also known as "non-condensable" gases. According to the Environmental Protection Agency (EPA) Sector Notebook for the pulp and paper industry, "humans can detect some TRS compounds in the air as a 'rotten egg' odor at as little as one part per billion"[52] Mercaptan has a skunky odor (it is about ten times less toxic than H_2S) while H_2S smells like rotten eggs at low concentrations. The combined odor of the TRS gases may not be distinctly the odor of rotten eggs or skunk, but a different complex odor. Residents from Port Townsend report that this odor irritates the eyes and the respiratory tract, can awaken people from sleep, and causes a sensation of "not being able to breathe."

Generally H_2S, methyl mercaptan, dimethyl sulfide and dimethyl disulfide account for 95% of TRS in air, with other sulfur compounds generally present in small amounts. Environmental exposures to malodorous emissions are usually to a mixture of sulfur-containing gases. The exact concentration of hydrogen sulfide in these types of mixtures cannot be determined. In estimating exposure, there is also uncertainty about the dose and duration of exposure. Based on limited information presented in toxicological studies, rodents appear to be less sensitive to hydrogen sulfide than humans. Since the respiratory tract is the major target organ of hydrogen sulfide

toxicity, humans with asthma, the elderly and young children with compromised respiratory function represent sensitive subpopulations.[53,54]

Hydrogen sulfide

Hydrogen sulfide can be found in sewage treatment facilities, fish aquaculture and in areas where livestock or manure is handled.[54] Hydrogen sulfide is also present in emissions from industrial paper plants that use the kraft process (i.e., it is a by-product of kraft pulp and paper manufacturing). Of all reduced sulfur gases, hydrogen sulfide is the most toxic, followed by methyl mercaptan (about one-tenth as toxic) and the methyl sulfides (much less toxic).

Effects resulting from short-term, relatively high exposures are well documented and are of great concern for occupational safety and health. Hydrogen sulfide is a respiratory tract irritant and exposures greater than 20 ppm can cause irritation of the mucous membranes. Respiratory irritation may decrease the ability of people to fight off infection. Generally pulmonary function tests changes are not seen in healthy people exposed to 5-10 ppm. However, asthmatics have shown changes in pulmonary function following exposure to 2 ppm for 30 minutes.[55] Eye irritation is another sensitive effect. A normal healthy adult male exposed to concentrations in the range of 30 ppm and higher could exhibit olfactory sense paralysis—so he could no longer smell the gas.[56,54] At very high exposures—greater than 500 ppm during brief periods, or greater than 50 ppm during several hours—the exposed person could lose consciousness and stop breathing. H_2S in ambient air could, at times, pose a health risk to area residents, especially for persons with pre-existing respiratory conditions. In some people, levels found in the air (i.e., at low levels, perhaps at less than 1,000 ppb) could lead to headaches, eye irritation, nausea, and can sometimes make asthma symptoms worse or more frequent. In general, symptoms are unlikely to occur if the odor is not present. (See Appendix A, Table 1 for a detailed description of effects of hydrogen sulfide at increasing concentrations).

The emissions that most people are likely to notice (reduced sulfur gases) are not known to be causes of cancer, and other known emissions such as the aldehydes, are not known to be associated with the top five common cancers in Jefferson County (i.e., prostate, bladder, breast (female), lung, and melanoma of the skin).[57]

Asthma is not a condition that results from hydrogen sulfide exposure.[58,54] Asthma can be a relatively non-specific indicator for exposure to irritant gases, of which TRS are one class. Acute exposures to such gases could be tracked if monitoring in the community were done over a period of time sufficient to encompass a fair number of odor episodes, and if tracking of asthma-related indicators (emergency room (ER) visits, hospitalizations, physician visits or medication use) was conducted over the same time period. However, the reported effects are not necessarily related to TRS gases or the mill, but may result from exposure to other sources of pollution.

Particulate Matter (PM)

Epidemiological studies indicate that small particles or PM air pollution is associated with increases in mortality, especially in people older than 65 years old who have existing cardiopulmonary diseases and in infants.[59,25,32,31,27,28,60,61,30] It is also associated with health problems including aggravation of asthma, especially in children, and other chronic lung diseases, impacts on lung function, and increased susceptibility to infectious illnesses.[62,63,64,65,66,67,68,69,24,70,71,72,73,74,75] Most studies on PM conclude that there is little information about the relative effects of PM constituents with less than 2.5 μm in diameter (i.e., it is not clear what constituents of particles contribute to their toxicity). Despite the wealth of data supporting associations between health outcomes and PM exposures, there are many gaps in our knowledge. One concern is whether the particle concentration measured at an outdoor monitoring site is, in fact, related to the exposure of people in the community. Another concern is also the lack of knowledge on the synergistic interaction of various pollutants or the effects of multiple exposures.

Particulate matter air pollution includes several types of particles with different chemical compositions. Particulate matter with a diameter of less than 10 micrometers (μm), PM_{10} has been the criteria pollutant of greatest current interest with respect to lung cancer because particles of size 10μm or less can be inhaled into the lung and generally originates from combustion processes and may carry carcinogenic substances, such as polycyclic aromatic hydrocarbons, on their surfaces. Smaller sized particulate matter with less than 2.5μm in diameter ($PM_{2.5}$) has the potential to penetrate deeply into the lung's small airways and alveoli. $PM_{2.5}$ comes from combustion sources, while larger particles between $PM_{2.5}$ and equal or greater than 10 μm and up to 30-40 μm in diameter include wind-blown dust as well as bacteria, pollen, and mold spores. Particles emitted from a combustion source generally consist of a central carbon core upon which other pollutants can be attached, such a polycyclic aromatic hydrocarbons (PAHs) or metals, depending on the source.

Other potential contaminants released at pulp mills

PTP Corporation has never been a bleaching mill, so it never used chlorine as a bleaching agent. There is no historical reason to associate dioxin with the mill's liquid effluent. Chlorinated organic compounds such as dioxin, however, may form as a by-product of combustion if chlorine is present in hogged fuel,[20] and/or halogenated materials are present in the combustion of reprocessed fuel oil. According to the mill under the PTP Title V permit it is prohibited to burn salty hogged fuel. However, it is likely that dioxins can be released if the analysis of RFO indicates the presence of halogenated materials in it. Any used oil exceeding any specification level when burned for energy recovery has the potential to release dioxins into the environment. The total halogens permitted in Washington are 4,000 ppm maximum.[17]

In addition to pollutants identified in the TRI, PTP mill may also emit numerous other compounds in smaller quantities (e.g., dioxins, mixtures of dioxin-like compounds (DLCs) (the TRI and emissions inventory data for 2002 and 2005 revealed the presence of dioxins in very small quantities (0.4 g per year)), chlorinated forms of dibenzofurans and certain polychlorinated biphenyls (PCBs), VOCs (volatile organic compounds), and metals). Emissions from fuel oil

combustion depend on the grade and composition of the fuel, the type and size of the boiler, the firing and loading practices used, and the level of equipment maintenance. Because the combustion characteristics of distillate and residual oils are different, their combustion can produce significantly different emissions.[76] An emissions inventory is not available at this time to assess potential human health risks related to air emissions from the mill. The mill process releases these chemicals through:

- Air emissions, i.e., from burning of lignin/black liquor to generate energy
- Water emissions through effluent disposal
- Sludge - incinerated or landfilled
- Contaminants in products

Dioxins and DLCs are released into the environment from several sources, including combustion, metal processing, and chemical manufacturing and processing. They are ubiquitous in the environment. The most toxic of these compounds is TCDD (2,3,7,8-tetrachlorodibenzo-p-dioxin), often simply called dioxin. PCBs, dioxins and furans have been found in fly ash from the burning of sludge from bleached kraft pulp mills[77] raising concerns that some quantities may be emitted to the atmosphere. Because of its exceptional potency TCDD is the most studied dioxin or furan, therefore, the IARC (International Agency for Research on Cancer) has classified TCDD as a known human carcinogen (Group 1) and NTP (National Toxicology Program) as a known human carcinogen.[78,79] Other polychlorinated dibenzo-*p*-dioxins and dibenzofurans have not been studied sufficiently for IARC to determine their carcinogenicity. Information about environmental levels and health effects is available http://www.atsdr.cdc.gov/toxprofiles. The U.S. EPA provides updated exposure and health assessments online at http://www.epa.gov/ncea/pdfs/dioxin.

Review of Jefferson County health data

DOH reviewed the literature and compiled available data. DOH used age-adjusted hospitalization, cancer incidence and death rates for Jefferson County and compared these to the Washington State total. The use of age-adjusted rates[g] is necessary due to differences in population demographics between Jefferson County and Washington State overall. Also, the population of Jefferson County is relatively small and so rates vary from year to year relative to Washington State rates. Differences in rates may be assessed by comparing 95% confidence intervals (CIs)[h].[80]

[g] Age-adjustment is a method of developing rates that eliminate the impact of different age structures in two populations. Age-adjustment also allows us to compare rates in the same population over a period of time during which the population may have aged. Age-adjusted rates are computed by multiplying the rate for a specific age group in a given population by the proportion of people in the same age group in a standard population and then adding across age groups.

[h] In statistics a confidence interval (CI) is an interval estimate of a population parameter. Instead of estimating the parameter by a single value, an interval of likely estimates is given. How likely the estimates are, is determined by the confidence coefficient. The more likely it is for the interval to contain the parameter, the wider the interval will be. Specifically, when two confidence intervals do not overlap, this implies statistical significance. When one confidence interval is contained entirely within the other, or when one confidence interval includes the other estimate rate, this implies that the two rates are not significantly different. We use the statistical test when the confidence intervals overlap, but neither confidence interval includes the other rate.

Limited information exists on health data relevant to air pollution concerns for residents of Jefferson County. In general, air pollution can increase the risk of developing asthma attacks through several different mechanisms including: 1) a direct irritant effect on sensitive airways; 2) a toxic effect on the respiratory epithelium; 3) generating bronchial hyper reactivity, both allergen-specific and nonspecific; or 4) modifying the immune response by increasing susceptibility to an immunological trigger.[81] Exposure to other allergens, airborne pollen, irritant gases, cold air, physical and emotional stress, and exercise have been shown also to initiate asthma attacks.[82,83,84]

Health statistics reviews (HSRs)

DOH used HSR to determine whether higher rates of a specific disease occurred at Jefferson County. To achieve this objective, DOH compared disease occurrence in the community of concern, in this case Jefferson County and compared these to Washington State rates. For example, hospitalization rates in Jefferson County were compared to those in Washington State. To obtain these data, DOH compared age-adjusted rates in Jefferson County to age-adjusted rates for Washington State. Appendix C describes in more detail the advantages and limitations of HSR.

Based on published reports and the health concerns raised by residents, disease conditions that might be associated with mill air emissions in general are respiratory diseases (i.e., diseases of the lung such as, asthma[i], and chronic obstructive pulmonary disease (COPD))[j], ischemic heart diseases[k] and some forms of cancers.

Asthma

One of the diseases that might be associated with air pollution is asthma. The telephone-based Behavioral Risk Factor Surveillance System (BRFSS)[l] reported that Jefferson County in 2003-2005, the age-adjusted county level prevalence for current asthma was 8.8%, 95% confidence

[i] Asthma is a chronic inflammatory disorder of the airways characterized by variable airflow obstruction and airway hyper-responsiveness. Prominent clinical manifestations include wheezing and shortness of breath.

[j] Chronic obstructive pulmonary disease (COPD) is a term referring to two lung diseases, chronic bronchitis and emphysema, that are characterized by obstruction to airflow that interferes with normal breathing. Both of these conditions frequently co-exist, hence physicians prefer the term COPD. It does not include other obstructive diseases such as asthma. COPD is most often caused by smoking, but also cause by exposure to second-hand smoke and in some instances by exposure to other toxic substances.

[k] Ischemic heart disease: A condition in which there is an inadequate blood supply to the heart due to blockage of the blood vessels to the area.

[l] The purpose of the BRFSS is to provide indicators of health risk behavior, preventive practices, attitudes, health care use and access, and prevalence of selected diseases in Washington. BRFSS is the largest telephone survey of health in the world sponsored by the Centers for Disease Control and Prevention (CDC), BRFSS utilizes random-digit-dialing to survey adults ages 18 and over, and is used to track health risks among the American people.

interval (CI) (6.5 – 12%). The overall asthma prevalence rate in Washington for 2003 to 2005 was 9.1% (8.8 – 9.3%).[85,86] The Jefferson County rate is similar to the Washington State rate.

The rates of hospitalization for asthma have been declining in Washington and Jefferson County over the past decade.[87] In the period 1997-1999, the state asthma age-adjusted hospitalization rate was 91.3 per 100,000.[87] The Jefferson County rate was similar to the Washington State rate (Table 3).[85]

Table 3. Age-adjusted asthma hospitalization rates per 100,000 for all ages combined from 2003 to 2005 in Washington.[85]

PLACE	RATE	LB	UB
State Total	**80.6**	**79.3**	**81.9**
Adams	109.3	83.5	141.3
Asotin	38.4	24.2	58.4
Benton	85.0	76.7	94.0
Chelan	78.3	66.8	91.3
Clallam	118.6	103.4	135.6
Clark	46.3	42.3	50.5
Cowlitz	109.7	98.0	122.5
Douglas	74.4	58.9	93.2
Ferry	61.8	29.6	117.2
Franklin	88.5	74.5	104.8
Grant	88.2	76.8	100.9
Grays Harbor	92.2	79.6	106.4
Island	31.8	24.8	40.2
Jefferson	**85.2**	**63.3**	**113.4**
King	83.7	81.2	86.3
Kitsap	79.9	73.3	86.9
Kittitas	41.9	29.6	58.0
Klickitat	90.7	67.5	120.1
Lewis	85.8	73.9	99.3
Lincoln	99.0	66.9	144.0
Mason	69.0	55.9	84.4
Okanogan	51.6	39.2	67.0
Pacific	76.0	54.7	104.4
Pend Oreille	98.0	65.7	143.0
Pierce	91.3	87.4	95.5
Skagit	54.2	46.6	62.7
Skamania	87.6	51.2	141.9
Snohomish	60.3	56.8	63.9
Spokane	104.9	99.4	110.7
Stevens	120.4	99.8	144.5
Thurston	80.7	73.8	88.1
Wahkiakum	166.7	91.7	287.3
Walla Walla	75.2	62.2	90.3
Whatcom	98.4	89.8	107.6
Whitman	51.5	38.0	68.5
Yakima	108.0	100.3	116.2

Counties with fewer than 10 hospitalizations not reported.
Asthma Hospital Rates per 100,000, 2003-2005 combined, by age, by county
11-27-2007, VistaPHw 7.2.0.0, Calculator Version 6.0.2.1 Web. LB = lower bound, and UB = upper bound
LB and UB correspond to 95% confidence intervals.

From 2000 through 2005, while the age-adjusted asthma hospitalization rates in Jefferson County appear to be higher than for the state overall, in fact, the rates are not different than the Washington State rates (Table 4). Due to the small numbers of cases in Jefferson County, asthma rates vary between years and have wide confidence intervals. Asthma is a complex illness that varies in extent and severity among individuals. Some studies on short-term exposure to gaseous pollution on asthma hospitalization in children showed that carbon monoxide, sulfur dioxide, coarse particulate matter ($PM_{10-2.5}$) and nitrogen dioxide were positively associated with asthma admissions in both sexes.[88,89,75]

Table 4. Age-adjusted hospitalization rates per 100,000 for asthma, Jefferson County vs. Washington State, 2000-2005.

State Total				Jefferson County			Jefferson different than WA*
Year	Rate	LB	UB	Rate	LB	UB	
2000	91.7	89.3	94.3	126.0	82.6	187.8	No
2001	88.7	86.3	91.2	104.3	62.8	165.7	No
2002	93.4	91.0	95.9	92.0	53.7	150.1	No
2003	81.4	79.1	83.7	88.7	52.8	143.9	No
2004	75.9	73.7	78.1	92.8	56.3	148.4	No
2005	84.1	81.8	86.4	70.6	37.1	124.8	No
2000-2005	84.6	83.6	85.7	89.6	71.7	111.2	No

Data Sources:
Hospitalization Discharge Data: Washington State Department of Health, Office of Hospital and Patient Data Systems. 1990-2005 Population Estimates: Population Estimates for Public Health Assessment, Washington State Department of Health. Vista Partnership, and Krupski Consulting. November 2006.
LB = lower bound, and UB = upper bound, LB and UB correspond to 95% confidence intervals.
International classification of disease (ICD) ICD -9 codes: 493
**Jefferson County rates are not significantly[m] different than Washington state rates.*

Table 5. Childhood (0-14 years old) hospitalization rates per 100,000 for asthma, Jefferson County vs. Washington State, 2000-2005.

State Total				Jefferson County			Jefferson different than WA*
Year	Rate	LB	UB	Rate	LB	UB	
2000-2005	157.0	154.2	159.9	152.6	105.8	213.3	No

LB = lower bound, and UB = upper bound, LB and UB correspond to 95% confidence intervals.
** The significance for individual years in Jefferson County can't be tested because the number of hospitalizations is too small to perform a statistical test.*

[m] Significantly different means that the number of asthma cases in a place or time is greater than would be expected due to normal fluctuations alone. Researchers use statistics to help them decide if a disease rate is really unusual. For asthma concerns, researchers commonly agree that an excess of asthma cases is "statistically significant" when it is so different from average that you would expect it only 5 out of 100 times by chance alone. "Statistical significance" only means that the number of cases that has occurred is unusual. It does not explain why the number of cases is elevated. Furthermore, it does not rule out chance as a cause.

Table 6. Adult (15-99 years old) hospitalization rates per 100,000 for asthma, Jefferson County vs. Washington State, 2000-2005.

State Total				Jefferson County			Jefferson different than WA*
Year	Rate	LB	UB	Rate	LB	UB	
2000	64.5	62.2	66.9	91.4	55.1	142.5	No
2001	67.5	65.1	69.8	76.1	43.6	123.4	No
2002	70.2	67.8	72.6	75.7	43.4	122.8	No
2003	67.6	65.3	69.9	79.6	46.4	127.3	No
2004	58.9	56.8	61.1	101.7	63.8	153.9	No
2005	64.3	62.1	66.6	58.4	31.1	99.5	No
2000-2005	65.4	64.5	66.4	80.3	65.6	97.4	No

Data sources:
Hospitalization Discharge Data: Washington State Department of Health, Office of Hospital and Patient Data Systems. 1990-2005 Population estimates: Population Estimates for Public Health Assessment, Washington State Department of Health. Vista Partnership and Krupski Consulting. November 2006.
LB = lower bound, and UB = upper bound, LB and UB correspond to 95% confidence intervals.
ICD-9 codes: 493
** The statistical test did not show significant differences between Jefferson County and the state, even though there is little overlap the statistical test did not reveal a statistical significance. When one CI is contained entirely within other, or when one confidence interval includes the other estimate rate, this implies that the two rates are not significantly different.*

The observed childhood (0-14 years old) asthma hospitalization rate is not significantly different for Jefferson County compared to Washington State (Table 5). A statistical test cannot be performed for individual years because the number of hospitalizations is too small. The observed adult (15- 99 years old) hospitalization rates for asthma were not significantly different for Jefferson County compared to Washington state rates (Table 6).

Other health conditions that might be associated with air pollution in Port Townsend are ischemic heart diseases and chronic lower respiratory diseases. Tables 7 and 8 present hospitalization rates for these conditions, comparing Jefferson County with the overall Washington State hospitalization rates.

The observed hospitalization rate for Jefferson County compared to Washington State for ischemic heart disease was higher in 2000, 2001 and 2002, but not different than the Washington State rate in 2003, 2004, and 2005 (Table 7). The combined hospitalization rate (2000-2005) for ischemic heart disease was higher in Jefferson County compared to Washington State total.

The observed hospitalization rates for chronic lower respiratory disease was higher only in 2003 in Jefferson County compared to Washington State total (Table 8). The combined hospitalization rates (2000-2005) were not significantly different in Jefferson County compared to Washington State total. Due to the small numbers of cases in Jefferson County, rates vary between years and have wide confidence intervals, which indicate that rates are quite variable.

Table 7. Age-adjusted hospitalization rates per 100,000 for ischemic heart disease, Jefferson County vs. Washington State, 2000-2005.

State Total				Jefferson County			Jefferson different than WA
Year	Rate	LB	UB	Rate	LB	UB	
2000	488.4	482.6	494.3	631.3	553.5	722.7	Yes, higher
2001	463.2	457.6	468.9	618.8	543.5	707.5	Yes, higher
2002	441.4	435.9	446.8	592.8	515.8	683.7	Yes, higher
2003	418.6	413.4	423.9	377.7	319.2	450.3	No
2004	407.7	402.6	412.9	446.8	383.3	524.1	No
2005	383.6	378.7	388.5	343.2	288.3	412.0	No
2000-2005	432.3	430.1	434.4	499.7	471.3	530.2	Yes, higher

Age adjusted to 2000 US population.
Data Sources for the Ischemic Heart Disease and Respiratory disease figures:
Hospitalization Discharge Data: Washington State Department of Health, Office of Hospital and Patient Data Systems.
1990-2005 Population Estimates: Population Estimates for Public Health Assessment, Washington State Department of Health, Vista Partnership, and Krupski Consulting. November 2006.
LB = lower bound, UP = upper bound, LB and UB correspond to 95% confidence intervals.
ICD-9 codes: 410-414, 429.2

Table 8. Age-adjusted hospitalization rates per 100,000 for chronic lower respiratory disease, Jefferson County vs. Washington State, 2000-2005.

State Total				Jefferson County			Jefferson different than WA
Year	Rate	LB	UB	Rate	LB	UB	
2000	760.6	753.3	767.9	794.3	689.1	915.1	No
2001	756.0	748.8	763.2	729.5	628.8	845.7	No
2002	762.9	755.7	770.1	728.6	631.3	841.1	No
2003	754.8	747.7	761.9	904.8	795.3	1029.6	Yes, higher
2004	684.9	678.2	691.6	780.4	681.0	895.0	No
2005	798.9	791.8	806.1	769.6	668.5	886.2	No
2000-2005	752.9	750.0	755.8	783.7	741.1	828.7	No*

Age adjusted to 2000 US population.
Data Sources for the Ischemic Heart Disease and Respiratory disease figures:
Hospitalization Discharge Data: Washington State Department of Health, Office of Hospital and Patient Data Systems.
1990-2005 Population Estimates: Population Estimates for Public Health Assessment, Washington State Department of Health, Vista Partnership, and Krupski Consulting. November 2006.
LB = lower bound, UP = upper bound, LB and UB correspond to 95% confidence intervals.
ICD-9 codes: 460-519
The statistical test did not show significant differences between Jefferson County and the state. When one CI is contained entirely within other, or when one confidence interval includes the other estimate rate, this implies that the two rates are not significantly different.

Death and hospitalization rates have similar trends. The age-adjusted annual death rates in Jefferson County show that death rates for chronic lower respiratory disease and major

cardiovascular diseases are not significantly different compared to Washington State rates (Tables 9 and 10).

Table 9. Age-adjusted chronic lower respiratory disease death rate per 100,000 in Jefferson County vs. Washington State, 2000-2005.

State Total				Jefferson County			Jefferson different than WA*
YEAR	RATE	LB	UB	RATE	LB	UB	
2000	49.3	47.4	51.2	43.5	25.7	77.5	No
2001	48.2	46.3	50.0	32.5	17.7	64.2	No
2002	48.6	46.7	50.4	33.6	18.3	65.8	No
2003	46.4	44.6	48.2	25.6	12.8	56.4	No
2004	43.6	41.9	45.4	51.1	31.2	87.3	No
2005	45.1	43.4	46.9	42.7	25.6	76.0	No
2000-2005	46.8	46.1	47.5	38.3	31.0	47.9	No

Source: Center for Health Statistics Death Data.[90]
Rate per 100,000 age-adjusted to U.S. 2000 population. Does not include deaths where age is unknown.
LB and UB correspond to 95% confidence intervals.
ICD-10 codes: J40-J47; ICD-9 codes: 490-494, 496
Comparability ratio: 1.0411, standard error (SE): 0.00095
** There were no significant differences for Jefferson County compared to Washington State rates.*
For each individual year and for 2000 – 2005 combined years, the confidence interval for Jefferson County either completely contained the state confidence interval or at least contained the point estimate for the state. This implies that there were no significant differences between Jefferson County and the state.

Table 10. Age-adjusted cardiovascular death rate per 100,000 in Jefferson County vs. Washington State, 2000-2005.

State Total				Jefferson County			Jefferson different than WA*
Year	Rate	LB	UB	Rate	LB	UB	
2000	299.1	294.5	303.8	245.1	198.5	305.4	No
2001	290.3	285.9	294.9	314.6	260.9	382.0	No
2002	281.6	277.3	286.0	253.0	206.3	313.3	No
2003	272.6	268.4	276.9	261.5	214.0	322.8	No
2004	251.3	247.2	255.3	201.4	160.7	256.0	No
2005	244.9	241.0	248.9	237.4	193.6	294.8	No
2000-2005	272.5	270.7	274.2	252.1	232.5	273.8	No

Source: Center for Health Statistics Death Data.[90]
Rate per 100,000 age-adjusted to U.S. 2000 population. Does not include deaths where age is unknown.
LB = lower bound, UP = upper bound, LB and UB correspond to 95% confidence intervals.
ICD-10 codes: I00-I78, ICD-9 codes: 390-434, 436-448
Comparability ratio: 0.9963, SE: 0.00021
For each individual year and for 2000 – 2005 combined years, the confidence interval for Jefferson County either completely contained the state confidence interval or at least contained the point estimate for the state. This implies that there were no significant differences between Jefferson County and the state.

Cancer incidence data

Heart and lung illnesses and diseases are common in Washington, and there are many factors that can increase the chances of contracting them such as smoking and genetic predisposition. The role of air pollution as the underlying cause remains unclear but it is the subject of considerable research. However, it is clear that air pollution, infections and allergies can exacerbate these conditions. An early diagnosis can lead to appropriate treatment and ensure a normal or close to normal quality of life. In many cases however, there is no cure and those affected may die prematurely.

The Washington State Cancer Registry (WSCR) has collected information on all Washington residents diagnosed with cancer since 1992.[91] Information includes the type of cancer, age and ZIP code of the person's residence at diagnosis. Data sharing agreements with Oregon and Idaho assure that we obtain information on Washington residents who have cancer even if they are not diagnosed and treated in Washington.

Lung and bronchus cancer[n] rates for Jefferson County and Washington State are presented below (Table 11). The age adjusted incident rates for lung and bronchial cancer are not significantly different in Jefferson County compared to the state overall. Rates vary considerably between years due to the small number of cases. The overall observed pattern of lung and bronchial cancer does not indicate Jefferson County has a significantly elevated occurrence of lung and bronchial cancer over the years compared to Washington.

[n] **Lung Cancer -** is the most common cause of death due to cancer in women and men. Cigarette smoke contains various carcinogens and is responsible for most cases of this often fatal disease. The symptoms of lung cancer begin silently and then progress to chronic cough, wheezing and chest pain. Air pollution has been linked somewhat weakly to lung cancer.

Table 11. Age-adjusted incident rates per 100,000 for lung and bronchial cancer, Jefferson County vs. Washington Sate, 2000-2005.

	State Total			Jefferson County			Jefferson different than WA*
Year	Rate	LB	UB	Rate	LB	UB	
2000	71.3	69.1	73.6	55.7	34.6	92.7	No
2001	72.0	69.8	74.3	71.4	48.1	110.0	No
2002	68.9	66.8	71.1	70.9	46.9	110.6	No
2003	69.8	67.6	72.0	87.9	62.4	128.4	No
2004	67.3	65.3	69.5	54.6	34.9	90.4	No
2005	67.0	65.0	69.1	74.0	50.4	112.8	No
2000-2005	69.3	68.4	70.2	69.0	59.1	81.1	No

RATE = Cancer cases per 100,000, age-adjusted to year 2000 US population.
Data Sources for the cancer rates: Cancer Registry: Washington State Cancer Registry, Washington State Department of Health, November 2006.
1990-2005 Population Estimates: Population Estimates for Public Health Assessment, Washington State Department of Health, Vista Partnership, and Krupski Consulting. November 2006.
LB = lower bound, UB = upper bound, LB and UB correspond to 95% confidence intervals.
ICD-O: C34.0-34.9, excluding histologies 9140, 9590-9989, SiteCode Codes: 14
For each individual year and for 2000 – 2005 combined years, the Jefferson County confidence interval completely contains the state confidence interval, implying that the rates are not significantly different.

Child health considerations

ATSDR and DOH recognize infants and children are susceptible to environmental hazards from multiple sources and in a variety of settings that can occur at levels much lower than those causing other types of toxicity. Infants and children are also more vulnerable to exposures than adults. The following factors contribute to this vulnerability at this site:

- Children can be at increased risk because they are more sensitive to air pollution.
- Not only do children have less developed respiratory systems, but because of their relative size, children also breathe more rapidly and inhale more air per kilogram of body weight compared to adults.
- Children also tend to be more exposed to ambient air pollution because they spend more time outdoors being physically active.
- Fetal and child exposure to many chemicals can cause permanent damage during critical growth stages.

These unique vulnerabilities of infants and children demand special attention in communities with contamination of their water, food, soil or air.

Conclusions

Port Townsend residents have long reported odor and health illnesses from the mill's air emissions. The following is a summary of DOH findings.

A review of available health statistics in Jefferson County revealed that:

- Age-adjusted asthma hospitalization rates are not significantly different in Jefferson County compared to Washington State overall between 2000 and 2005.

- Childhood (0-14 years old) asthma hospitalization rates are not significantly different in Jefferson County compared to Washington State overall between 2000 and 2005.

- Adult (15-99 years old) asthma hospitalization rates are not significantly different in Jefferson County compared to Washington State overall.[o]

- Age-adjusted hospitalization rates for ischemic heart disease are higher in 2000, 2001 and 2002 in Jefferson County compared to Washington State overall. The hospitalization rate was higher for the combined period 2000 to 2005 in Jefferson County compared to Washington State overall.

- The age-adjusted hospitalization rates for chronic lower respiratory disease in Jefferson County were only significantly higher in 2003 compared to Washington State overall.

- Age-adjusted death rates for chronic lower respiratory and major cardiovascular diseases for individual and combined years are not significantly different for Jefferson County compared to Washington State overall.

- Age-adjusted incidence rates for lung and bronchial cancer are not significantly different in Jefferson County compared to Washington State overall.

At this time, it is not possible to directly associate any of the observed disease conditions at Port Townsend to chemical substances that may be emitted to the air from the mill. Even in the presence of certain chemicals, not all individuals would be expected to develop a disease, and for those who did, pinpointing the sole cause to emissions from the mill would be very challenging. This is because several other factors can contribute to respiratory diseases, ischemic heart diseases, and cancer. In order to identify specific cause(s), information on all possible exposure factors, and a follow-up of healthy individuals for a long period of time would be required.

Since levels of all air pollutants in the community of Port Townsend are unknown, exposure cannot be fully assessed. DOH cannot conclude whether air emissions from PTP mill could harm

[o] *The statistical test did not show significant differences between Jefferson County and the state, even though there is little overlap the statistical test did not reveal a statistical significance. When one CI is contained entirely within other, or when one confidence interval includes the other estimate rate, this implies that the two rates are not significantly different.*

people's health because the information on the six criteria air pollutants and air toxics is not available to fully assess the health risks in the community. DOH cannot currently evaluate the degree of past, current, or future exposure to PTP site-related contaminants. (Appendix B lists a more detailed description about general steps for evaluating exposure pathways that can be applied at PTP mill). In communities where hazardous chemicals exist, DOH's goal is to ensure that the community has the best information possible to safeguard its health. In order to reach a conclusion, DOH needs air monitoring data for levels of chemicals emitted by the mill which could impact neighborhoods surrounding the plant.

Data gaps

DOH has identified the following data gaps:

- Emissions inventory data – e.g., information about all the possible chemicals being released from the mill to outdoor air.
- Dispersion modeling (See Appendix B, for more detail to better understand the exposed populations).
- Meteorological data
  In order to help determine if the odors experienced by individuals are coming from PTP or if there are certain meteorological conditions under which odors seem to be more prevalent, DOH needs meteorological data. Data must be collected during these events. Useful information would include temperature, wind speed, wind direction, relative humidity, and barometric pressure etc.
- Limitations of looking at county-wide data when the exposed population may only be a small subset of the population.

Recommendations

1. In addition to the criteria pollutants and precursors[p] (e.g., carbon monoxide, particulate matter, nitrogen oxides, sulfur dioxide, and lead) and the non-condensable gases coming from the pulping process (e.g., TRS compounds), DOH has identified the following chemicals of concern (COCs) as the most significant hazardous air pollutants (HAPs) emitted from the pulping process and combustion sources:
   - Metals (e.g., cadmium, beryllium, arsenic, chromium (total), manganese compounds and all forms of mercury)
   - Various organic compounds (e.g., methanol, propionaldehyde, acetaldehyde, and formaldehyde)
   - Hydrochloric acid (HCl)

[p] A precursor of a criteria pollutant is a compound that reacts in the air to produce that pollutant (e.g., the precursors of ozone are VOCs, and nitrogen oxides).

However, there may be other COCs released by the mill which can cause health impacts. In order to begin assessing exposure to air pollutants, DOH recommends Ecology, as the regulatory enforcement authority, require an expanded emissions inventory[q].

The information obtained from the emissions inventory should be used with appropriate emission factors (e.g., EPA's AP-42 emission factors[r], and/or emission factors listed in the EPA's National Emission Inventories (NEI) clearinghouse for inventories and emission factors, web page (http://www.epa.gov/ttn/chief/), and/or emission factors listed in the Environmental Resource Handbook for Pulp and Paper Mills from the National Council for Air and Stream Improvement (NCASI), web page (http://www.ncasi.org)) from the PTP mill to determine what, how and where they are being emitted. If PTP mill is unable to estimate emission rates based on existing data, Ecology should require the mill to do source test of stacks, ponds, and identify other emission sources. In conjunction with recommendations 2 - 4, this information will be used to estimate community exposures at various locations downwind of the PTP mill.

2. Obtain meteorological data near the source:
    - Useful information includes temperature, wind speed, wind direction, relative humidity, and barometric pressures etc.
    - These data in conjunction with emissions data will be useful to model air emissions

3. Ecology should ensure that air dispersion modeling or risk modeling is conducted in order to estimate levels of contaminants in ambient air at locations in the community. This will help us to determine the community's short- and long-term exposures to contaminants from the mill.

4. Continue to track odor complaints from community members specifically identifying the date, time, and nature of the complaint. Useful information would include:
    - Address where the odor was detected
    - Time when odor was first detected
    - Duration of odor
    - Description of the odor, perhaps taken from a list of possible descriptors
    - Intensity of the odor, rated on a 1-2-3 scale rather than a 0-to-5 scale, without fractions
    - Any additional information the citizen wishes to share

[q] An emissions inventory provides a detailed description of the quantity of pollutants along with their emissions characteristics (how and where they are being emitted).

[r] An EPA42 is an emission factor is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant. These factors are usually expressed as the weight of pollutant divided by a unit weight, volume, distance, or duration of the activity emitting the pollutant (e. g., kilograms of particulate emitted per megagram of coal burned). Such factors facilitate estimation of emissions from various sources of air pollution. In most cases, these factors are simply averages of all available data of acceptable quality, and are generally assumed to be representative of long-term averages for all facilities in the source category (i.e., a population average).

Communicate the results of this health consultation and health messages to the community through fact sheets and public health meetings.

Why DOH is making these recommendations?

Additional data is necessary in order for DOH to provide a response to the community of Port Townsend and to fully assess the health significance of air pollutants in the vicinity of PTP mill. The data gaps are related to air emissions (both criteria and air toxics chemicals). Many of these chemicals (i.e., criteria and air toxics) may be associated with community respiratory complaints and/or some cancers in the community. An approach to investigating the health significance of ambient concentrations of chemicals in the air would involve two phases:

Phase I

1. Better characterization of both criteria pollutants and air toxics is necessary to determine levels of contaminants in the surrounding air near PTP mill. Criteria pollutants may be particles (PM_{10}, $PM_{2.5}$, lead or gases (CO, NO_2, SO_2, O_3). Air toxics may be particles (various metals), gases (VOCs), or a combination (semivolatiles, including PAHs, PCBs, etc).

2. Modeling of air toxics concentrations should be conducted as a screening process to identify both pollutants for subsequent further assessment and areas of concern or hotspots in Port Townsend.

3. Air modeling can help us determine:
   - Which air pollutants are key contributors to acute and/or chronic health risks in the Port Townsend area.
   - Whether or not the PTP mill is the only significant source of pollution and if there are other key contributors to acute and/or chronic health risk in the Port Townsend area.
   - To what degree and/or extent the community of Port Townsend is affected by air emissions from the mill (i.e., once ambient concentrations of these pollutants is determined, the second step would involve defining the number of people exposed at different concentrations).

Phase II

Once modeling has been completed, DOH will be available to conduct a human health risk and toxicological assessment of PTP mill's emissions. Risk assessment examines the likelihood of adverse health effects to the general public as a result of acute (short-term) and chronic (long-term) exposures to mill emissions. The assessment will evaluate non-cancer and cancer hazards of chemicals in the air through the inhalation (breathing in) pathway. (See Appendix D which describes the risk assessment process in more detail.)

Public Health Action Plan

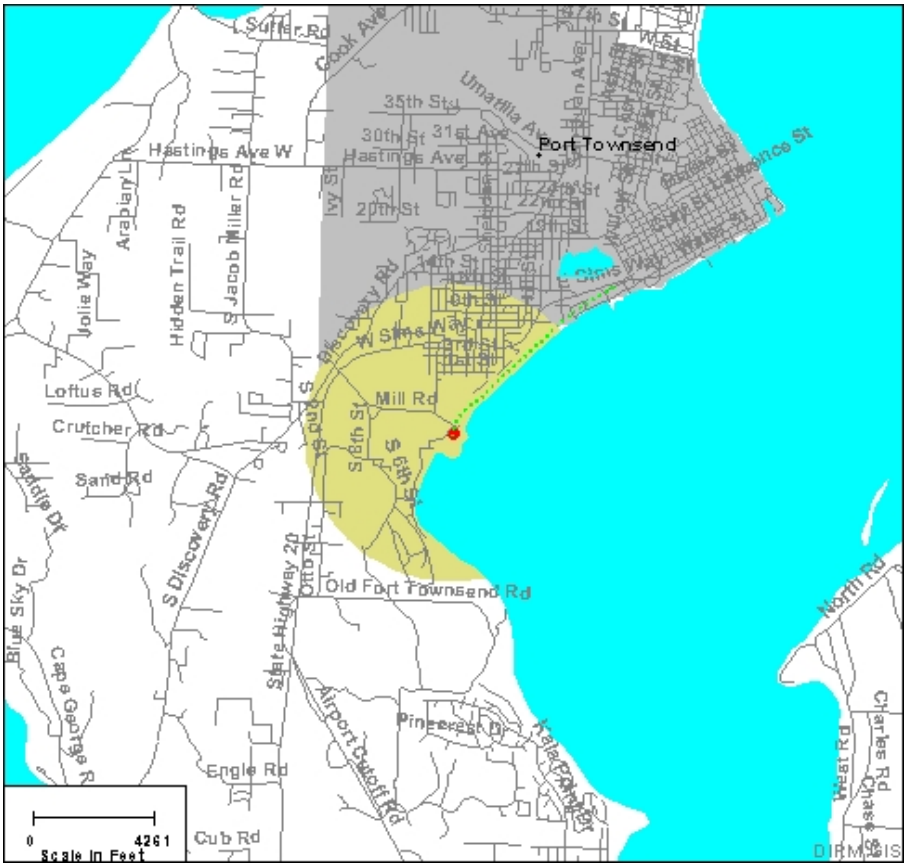
DOH understands that the uncertainty surrounding air quality issues and their health is stressful to community members. In order to assure that community concerns are addressed DOH provided this document to the community for review and comment. Comments received are listed in Appendix E, with responses. DOH will work closely with PTP mill and Ecology to assure air emissions data is collected and conduct air modeling in the community in order to gather the information needed to assess community exposures to emissions from PTP mill. Once this information is at hand, one could look at "hot spots' and determine the best locations to establish air monitoring, if possible.

The adverse health effects caused by industrial air pollution have been the subject of international health research for many decades. The association between air pollution and human illness has been well established. People who are most sensitive to air pollution are those with heart and lung disease (including asthma), stroke, diabetes, infants and children, and older adults, (those 65 and older), or people with a current respiratory infection. While we are gathering the information we need, if you are among those sensitive to air pollution or are concerned about your health, limit outdoor activity during poor air quality days. If this is not possible, reduce the amount and intensity of activity or exercise and take frequent breaks.

Establishing a cause and effect relationship between specific industrial pollution sources and patterns of illness in a community requires expensive, large scale studies that are oftentimes inconclusive. Human disease is the result of many risk factors – behavioral, genetic, and environmental – with effects cumulative over an individual's entire life span. If the goal is improvement of air quality, the highest priority should be given to accurately characterizing the type and range of contaminants released by mill emissions, determining whether they exceed legally permitted levels, and measuring the concentrations of pollutants that community members are being exposed to. This information can be used to guide individual health recommendations and, if indicated, prompt regulatory action or changes in industrial practice (i.e. reduced emissions during adverse weather conditions).

DOH will be available to comment on work plans that are generated in the future at this site. DOH will also explore the need to conduct further studies. Residents can get general information on air quality from the Olympic Regional Clean Air Agency at 2940 B Limited Lane NW Olympia, Washington 98502, 360-586-1044 or 1-800-422-5623. Email: info@orcaa.org or http://www.orcaa.org/

Figure 1. Port Townsend Paper Mill, Jefferson County, Washington



Jefferson County

Demographic Statistics Within One Mile of the Site*

Total Population	1229
White	1127
Black	7
American Indian, Eskimo, Aleut	26
Asian or Pacific Islander	18
Other Race	19
Hispanic Origin	44
Children Aged 6 and Younger	105
Adults Aged 65 and Older	251
Females Aged 15 – 44	228
Total Aged over 18	956
Total Aged under 18	273
Total Housing Units	653

* Calculated using the area proportion technique.
Source: 2000 U.S. CENSUS

Figure 2. Demographic Statistics within One Mile of the Site* - Port Townsend Paper Corporation, Jefferson County

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Appendix A

Table 1. Literature review on the effects of hydrogen sulfide at increasing concentrations

H_2S concentration	Reported effects
0.02 – 0.05 ppb	This is the concentration of H_2S measured in undeveloped area[92].
0.5 ppb	The odor of 0.5 ppb H_2S can be detected by 2% of the population.[93,94]
0.7 ppb	This is the Chronic Reference Concentration (RfC) for H_2S For the United States Environmental Protection Agency (USEPA). It is an estimate (with uncertainty Spanning perhaps and order of magnitude) of a daily inhalation exposure of the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.
H_2S concentration	**Reported effects**
2 ppb	The odor of 2 ppb H_2S can be detected by 14% of the population, and 2% of the population is annoyed by the odor.[93,94]
4 ppb	The odor of 4 ppb H_2S can be detected by 30% of the population and 5% of the population is annoyed by the odor.[93,94]
5 ppb	The World Health Organization (WHO) recommends that H_2S concentrations not exceed 5 ppb (7 µg /m^3) for ½-hour.[42,39]
7 to 27 ppb annual average with peaks up to 500 ppb	Exposure to ambient air containing H_2S at these levels resulted in elevated self-reported health symptoms (especially those related to the central nervous system) for 9 of 12 symptom categories.[95]
8 ppb	The odor of 8 ppb H_2S can be detected by 50% of the population, and 11% of the population is annoyed by the odor[93,94]
10 ppb	The odor of 10 ppb H_2S can be detected by 56% of the population and 17% of population is annoyed by the odor.[93,94]
10 ppb average (100 ppb peak)	Exposure to air containing 10 ppb H_2S on average resulted in neurophysiological abnormalities in reaction time, color discrimination, and mood in humans.[96,97,98]
10 ppb daily average	At an average daily exposure to this level of H_2S, there were increased reports of eye and nasal symptoms and cough for the previous year.[39]

30 ppb	This is the intermediate inhalation minimum risk level (MRL) for ATSDR.[54]
30 ppb (CAAQS)	The odor of 30 ppb H_2S can be detected by 83% of the population, and 40% of the population is annoyed by the odor. In addition, 30 ppb or 42 µg /m3 H_2S averaged over 1 hour and not to be equaled or exceeded is the California Ambient Air Quality Standard (CAAQS).[94]
H_2S concentration	**Reported effects**
40 ppb	This concentration constitutes the mean annoyance threshold, i.e., odor annoyance for 50% of the population (annoyance occurs by 5 times the detection threshold; 5 times 8 ppb = 40 ppb).[94]
70 ppb	This is the acute inhalation minimum risk level (MRL) for the Agency for Toxic Substances and Disease Registry (ATSDR). This MRL is an estimate of the daily exposure that is likely to be without appreciable risk of adverse non-cancer health effects for acute (1-14 days) exposure.[92,54]
≥ 30 ppb	TRS or H_2S levels may be associated with exacerbations of asthma or other respiratory diseases among the residents of Dakota City and South Sioux City when they are exposed to high ambient level (30-min rolling average ≥ 30 ppb).[99,100]
≥ 90 ppb	Air data for 1999 indicated that Dakota city residents, in Nebraska were repeatedly exposed, both indoors and outdoors, to moderate levels of H_2S. Individual and population exposures to air contaminants depend upon many factors including time spent outdoors and indoors, permeability of housing structures, and mobility within a community.[101]
≥ 90 ppb	Repeated and long-term exposure to moderate-to-low-level H_2S was not associated with poorer performance on neurobehavioral tests.[97]
2 ppm	Headache and increased airway resistance were found in an asthmatic subset.[55]
2.5 to 5 ppm	Coughing and throat irritation (after 15 minutes) were found for this level of H_2S.[94,102]

Appendix B

General steps for evaluating exposures that can be applied at PTP mill

To evaluate whether the public will be exposed to concentrations of chemicals that could cause adverse health effects, chemical concentrations in the emissions are compared to health comparison values (CVs). When exposure to contaminated media occurs, the exposure pathway is regarded as "complete." To determine whether completed pathways pose a potential health hazard, DOH compares contaminant concentrations to health-based comparison values. Comparison values are calculated from scientific literature available on exposure and health effects. These values, which are derived for each of the different media, reflect the estimated contaminant concentration for a given chemical that is *not* likely to cause adverse health effects, given a standard daily ingestion rate and standard body weight. If contaminant concentrations are greater than comparison values, DOH further analyzes exposure variables (for example, duration and frequency) and the toxicology of the contaminant.

The following questions need to be answered in order to determine exposure pathways for residents of Port Townsend exposed to air pollutants and to conduct a prospective health risk assessment for air emissions from the facility:

- What is in the emissions? And/or what chemicals and at what concentrations are they in the air when odor events are reported?
- Where are people exposed?
- How much are people exposed?
- How much is in the air and what is the personal exposure pattern?
- What is the direction of the wind?

What is in the emissions?

An adequate emissions inventory, dispersion analysis and meteorological data can help identify “hot spots” and determine the best locations to establish air monitoring, if possible.

1) What chemicals, at what concentrations, are detected in the air during odor events? Are the concentrations above background, or control, levels?

2) Are chemicals detectable in the air during odor events? Is there a temporal (time) trend to the detection of these chemicals?

3) What airborne particulates, and at what concentrations, are in the air?

4) Is it plausible that the Port Townsend citizen’s complaints of health effects are associated with detected chemicals and concentrations?

5) When an odor event occurs, do meteorological data indicate that the PTP mill is upwind of the odor detection?

Where are people exposed?

Modeling is used to predict the average concentration of a pollutant at different distances and directions from the source in the air for a specific time. Air dispersion models are mathematical equations that predict (simulate or model) the movement of chemicals in the air; this movement is called dispersion since the chemicals disperse after they are released into the air. The mathematical equations are entered into a computer program for ease of use. Data needed for these air dispersion models include weather data, the amount of pollutants released to the air over time, site topography, and site geometry. Predicted concentrations are generally calculated for one hour or 24 hours and are called the predicted one hour average or the 24 hour average ground level concentrations. The modeled hourly results can be used to calculate 24-hour or annual averages or maximums. Dispersion modeling works by matching patterns of emissions from a specific source with the variability of winds (meteorology data) that occur over a year in the general area.

Overall air models can:[103]

- Be used to estimate a substance's concentration over different time frames, such as a given day or an entire year.
- Be used to estimate the level of multiple substances in the air as a result of emissions from a single source or multiple sources.
- Estimate a substance's concentration at a wide range of locations.
- Be used to estimate levels of air pollution in residential areas.
- Offer insights into where contaminants deposit in greatest quantities.
- Identify areas where air sampling should take place.

Models usually require inputs that describe the source of contamination and local weather conditions. Model outputs are estimates of air pollution levels and the amount of air contaminants that might land on the ground. Though many models are quite advanced, none are perfect. Therefore, outputs from models should be viewed as estimates of actual conditions.

Certain meteorological patterns may exacerbate conditions that result in health complaints. Air current monitoring is extremely complex in coastal Washington, especially along the Straits of Juan de Fuca, where the interaction of sea, mountains, water currents, and atmospheric changes complicate most software modeling efforts. Therefore, certain meteorological conditions which odors seem to be more prevalent need to be considered.

How much are people exposed?

The extent people are exposed to background pollutants and mill emissions is determined by two major factors; how much is in the air and the behavior of the person.

How much is in the air?

Concentrations of pollutants in the air from point industrial sources are not constant; the concentration varies according to the direction and strength of the wind, time of day, how far away the location is from the emission source etc. Sometimes the pollutant concentration may be

high for a short time but not present at other times and will be between these extremes for varying periods. Most of the time the concentration will not be zero, but nonetheless will be very low.

Personal exposure pattern

Most people spent 90 – 95% of the time indoors. Whether or not a person is affected by a pollutant in air from an industrial source requires them to be present at the location at the same time the high concentration occurs. Although people may move around, they can still receive different levels of exposure while they are indoors or outdoors. Although the chances of being present during an episode may be low if the receptor is a residence, the chances are high if the modeled receptor is a workplace.

Appendix C

What is a Health Statistics Review?

A HSR uses existing health data from data sources like health registries database to determine whether health outcomes in a particular community are occurring at higher, lower, or about the same level compared to statewide or national levels after taking into account the age, race, and sex of individuals in the community. A HSR does not tell us why elevations or deficits in health outcomes exist and can not prove whether there is a cause and effect relationship between exposure to chemicals and health outcomes. While a health statistics review can take risk factors commonly found on health records into account, a health statistics review may not be able to take into account certain individual risk factors for health outcomes such as medical history, genetics and occupational exposures which may explain the elevations or deficits. Rather a HSR can generate hypotheses and may indicate whether a more rigorous study should be considered.

Why was a HSR conducted?

A HSR was conducted because of concerns about possible exposures to chemicals emitted from PTP mill. It is unknown what is in the emissions, and/or what chemicals and at what concentrations are in the air when odor events are reported. Because of possible health concerns, the Washington State Department of Health conducted this health statistics review. HSR are conducted to respond to community concerns; provide specific information on the health status of a community; and examine outcomes associated with exposures to chemicals. State health departments may provide annual summaries on the rates of asthma, cancer, diabetes and other diseases to provide communities with the health status in a particular area. In developing HSR, DOH only uses previously collected data, such as cancer, hospitalization rates, and other registry data as well as birth certificates, death records and other vital statistics. Data in registries are reported by physicians and hospitals to health agencies.

Strengths and limitations of HSRs

DOH acknowledges that each data source contains strengths and limitations. For example, only physical birth defects seen at delivery are reported by physicians. Malformations or internal health conditions are not captured on birth certificates. To conduct an HSR analysis, DOH examines the ratio between the observed number of cases in the area of concern and the expected number of cases based on county or state data. Particularly for cancer, the analysis accounts for age and gender. None of DOH analyses accounted for differences in race.

HSR results provide data on the number of persons in an area who have or died from a specific disease. The findings also determine whether more cases are present in the area than would be expected in comparison to the county or state. HSRs have both strengths and limitations. One the one hand, HSRs respond to community concerns about disease occurrence in the area; specify particular geographic locations and disease outcomes to examine; and use established methods to conduct analyses. On the other hand, HSRs rely on available data; cannot determine the cause of disease; do not identify other risk factors that may be associated with the disease; provide no

information on length of residence or occupational exposures; and generate unstable estimates due to a small number of cases.

Other limitations of HSRs?

As mentioned before, HSRs can not establish a cause and effect relationship between an exposure and a health outcome for a variety of reasons. While this review was conducted for Jefferson County with unknown documented exposures, current exposure and historical data was not available. Therefore, we can not be sure that all residents who were diagnosed with a respiratory illness or cancer lived in the area for a substantial duration and were exposed to mill emissions prior to the occurrence of their health outcome. Likewise, HSR does not capture long-time residents who were potentially exposed to chemicals and moved away prior to a respiratory illness or cancer diagnosis. Also, the small population size of Jefferson County limited the ability to detect meaningful elevations or deficits in disease rates, hospitalization rates, and certain types of respiratory problem or cancer.

Will DOH conduct additional HSRs?

DOH will not conduct additional HSRs until complex exposure (i.e., exposure pathways to air emissions) and risk characterization (i.e., how individuals or populations are affected, or what is the extra risk to health, cancer versus non-cancer health effects) is resolved.

Appendix D

Risk Assessment

In order to evaluate the potential for non-cancer adverse health effects that may result from exposure to air pollutants, a dose (how much of something a person takes into the body) is estimated for each pollutant. These doses are calculated for situations (scenarios) in which residents might breathe in air pollutants. The estimated dose for each contaminant under each scenario is then compared to a reference exposure level (REL). RELs are doses below which non-cancer adverse health effects are not expected to occur (so called "safe" doses). They are derived from toxic effect levels obtained from human population and laboratory animal studies. Due to uncertainty in these data, the toxic effect level is divided by "safety factors" giving a lower and more protective REL. If a dose exceeds the REL, this indicates only the potential (possibility) for adverse health effects. The magnitude of this potential can be inferred from the degree to which this value is exceeded (the higher the number is above the REL the greater the possibility there might be a health risk). If the estimated exposure dose is only slightly above the REL, then that dose will fall well below the toxic effect level (i.e., the level of exposure where health effects were observed in animal or epidemiological studies). The higher the estimated dose is above the REL, the closer it will be to the actual toxic effect level. This comparison is typically known as a hazard quotient.[s] For the purposes of this report, the term hazard index (HI) is used in place of hazard quotient.

$$\text{HI (inhalation)} = \frac{\text{Estimated average daily exposure concentration } (\mu g/m^3)}{\text{REL } (\mu g/m^3)}$$

Theoretical cancer risk is estimated by calculating a dose similar to that described above and multiplying it by a cancer potency factor, also known as the cancer slope factor. Each chemical has a different cancer potency factor which is based on the best studies available of either cancer in people or animals. Laboratory animal studies involve doses much higher than what would be encountered in the environment. Use of animal data requires extrapolation of the cancer potency obtained from these high dose animal studies down to real-world human exposures. This process involves much uncertainty.

Current regulatory practice assumes there is no "safe dose" of a carcinogen and that a very small dose of a carcinogen will give a very small cancer risk. Cancer risk estimates are, therefore, not yes/no answers but measures of chance (probability). Such measures, however uncertain, are useful in determining the degree or amount of a cancer threat assuming that any level of a carcinogenic contaminant carries some risk, and are a helpful tool for prioritizing pollutants to target for emissions reduction. Some people are more likely to develop cancer than others depending on a number of factors including: their age, genetic make up, sex, or the amount of chemical exposures they have received in a lifetime.

[s] In this Health Risk Assessment report, the term health hazard index (HHI) will be used in place of hazard quotient. Typically, the term hazard index is used to define the sum of hazard quotients.

The following equations in Table 2a show how cancer risk and hazard indices are calculated for inhalation pathway. Table 2b defines each parameter.

Table 2a. Equations to calculate cancer risk and non-cancer hazard indices.

Exposure Route/ Pathway	Cancer Risk	Chronic non-cancer hazard index	Acute hazard index
Inhalation	$\frac{Cair \times IR \times EF \times ED \times CF \times CPF}{AT}$	$\frac{Cair \times IR \times EF \times ED \times CF}{AT \times REL}$	$\frac{Cair}{Acute\ REL}$
Soil ingestion	$\frac{Cs \times BAF \times SIR \times EF \times ED \times CF \times CPF}{AT}$	$\frac{Cs \times BAF \times SIR \times EF \times ED \times CF}{AT \times REL}$	NA
Dermal Absorption	$\frac{Cs \times SA \times SL \times EF \times ABS \times CF \times ED \times CPF}{BW \times AT}$	$\frac{Cs \times SA \times SL \times EF \times ABS \times CF \times ED}{BW \times AT \times REL}$	NA

Table 2b. Exposure parameters defined

Exposure Route / Pathway	Parameter	Value	Units	Source / comments
Inhalation	Cair = Concentration in Air	Modeled concentration: average concentration for chronic and one-hour maximum concentrations for acute exposures	micrograms per cubic meter ($\mu g/m^3$)	Based on assumed emission rates.
	IR = Inhalation Rate	393	Liters per kilogram body weight per day	95th percentile inhalation rate
	EF = Exposure Frequency	350	days/year	
	ED = Exposure duration	70	years	
	CF = Conversion Factor	0.000001	ug/mg Liters/m^3	Converts ug to mg Converts liters to m^3
	AT = Averaging Time	25,550	days	70 years
	REL = Reference Exposure Level	Contaminant-specific	ug/m^3	Available for chronic and acute non-cancer hazards
	CPF = Cancer Potency Factor	Contaminant - Specific	$(mg/kg/day)^{-1}$	

Many of the assumptions used in the risk assessment portion of the project are designed to be especially protective of the public. For example, many of the exposure parameters (i.e., inhalation rate and dermal soil loading) are intended to be high-end estimates. Cancer potency factors used to estimate a chemical's cancer risk are generally based on the theoretical upper bound (the 95% upper confidence limit) probability of extra cancer cases occurring in an exposed population, assuming a lifetime exposure. These assumptions, because they are intended to be conservative and not underestimate exposure and risk, are likely to result in overestimation of the actual risk. Additionally, OEHHA has defined cancer potency factors for many contaminants that U.S. EPA has not. The uncertainty with many of these factors may tend to over-estimate risk as opposed to underestimate. HARP risk assessment guidance points out that the risks estimated using this methodology are meant to err on the side of public health protection, so they are on the cautious side in order to protect as many people as possible. An individual's true risk is likely to be lower than the estimates provided using this methodology. The results are not intended to predict disease rates in the community, but to prioritize concerns for potential public health actions (or figure out which chemicals or exposures we should be most concerned about). The following statement from the HARP guidance document summarizes the issue:

> "Risk estimates generated by a health risk analysis should not be interpreted as the expected rates of disease in the exposed population but rather as estimates of potential risk, based on current knowledge and a number of assumptions. Additionally, the uncertainty factors integrated within the estimates of non-cancer reference exposure levels (RELs) are meant to err on the side of public health protection in order to avoid underestimation of risk. Risk assessment is best used as a ruler to compare one source with another and to prioritize concerns. Consistent approaches to risk assessment are necessary to fulfill this function."

Appendix E

Community Health Concerns, questions and answers on the health consultation report

April 2008

This section addresses questions received from members of the community and the PTP mill, and answers regarding the draft Port Townsend health consultation. This initial report was released for public comment on March 2008. The Public was invited to review and comment on the health consultation report titled "Summary of air quality issues and identification of information needed to address community health concerns - Port Townsend Paper Corporation." Comments were submitted to the Department of Health from March 10th to April 10th, 2008. All pages referenced in this appendix are comments from the public.

1) Question: The report does not review the cancers for which Jefferson County has high rates because it states that these cancers are not linked to the toxins emitted from the mill. However, my quick online search suggests that bladder and prostate cancer may be linked to exposure of burning fuel oil and that endometrial cancer may be linked to exposure to paper and lumber industry emissions. Is this information incorrect?

   Answer: Bladder cancer is associated with numerous occupational exposures. For example, increased risk of bladder cancer has been reported in many occupational settings: dyestuff workers and dye users, rubber workers, leather workers, painters, drivers of trucks and other motor vehicles, aluminum workers, metal workers, printers, chemical workers, hairdressers, dry cleaners, carpenters, construction workers, miners, gas workers, coke plant workers, auto mechanics, petroleum workers, railroad workers, textile workers, tailors, engineers, butchers, clerical workers, cooks and kitchen workers, food processing workers, electricians, medical workers, pharmacists, glass processors, photographic workers, welders, stationary fireman or furnace operators, paper and pulp workers, roofers, gardeners, bootblacks, and asbestos workers, etc.[104]

   There is epidemiological evidence of the relationship between polycyclic aromatic hydrocarbons (PAH) and cancer. Cancer has been associated with some occupational exposures such as, aluminum production, coal gasification, coke production, iron and steel foundries, tar distillation, shale oil extraction, wood impregnation, roofing, road paving, carbon black production, carbon electrode production, chimney sweeping, and calcium carbide production. In addition, workers exposed to diesel engine exhaust in the transport industry and in related occupations are exposed to PAHs and nitro-PAHs. Heavy exposure to PAHs entails a substantial risk of lung, skin, and bladder cancer, which is not likely to be due to other carcinogenic exposures present in the same industries. The lung seems to be the major target organ of PAH carcinogenicity and increased risk is present in most of the industries and occupations listed above.[105]

There are not air emissions data on chemicals from the PTP mill to associate with any types of cancer. There are no epidemiological studies conducted in Jefferson County to link prostate and bladder cancer with mill emissions. In 2003, a health of Jefferson County study was conducted. This study compiled data from a health database about the people of Jefferson County. The goal of this study was to provide vital statistics, health measures and economic indicators that can be used to better understand the complex pattern of preventable disease and disability within the community of Jefferson County.[106] As mentioned in the report the amount of air toxic species in the vicinity of the PTP mill has not been well characterized. Thus it is necessary to quantify the amount of chemicals released in pulp and paper mill processing.

2) Question: A number of the toxins released by the mill are suspected neurological, reproductive, and developmental toxins, yet the report makes no attempt to investigate neurological diseases in the community (such as Parkinson's) or reproductive or developmental problems in the community. Why is this?

Answer: As mentioned in the report, air toxics are not well characterized at the PTP mill. Therefore, it is unknown what, how, and where chemicals are being emitted. We have not yet identified an exposed population in Port Townsend and pinpointing the cause of disease with environmental exposure (i.e., unknown chemicals released by the mill) is difficult and challenging. The report does not address suspected neurological diseases in Port Townsend based on assumptions or epidemiological studies. Until PTP mill identifies what is in the air emissions and air modeling is conducted it is impossible to predict levels of chemicals in the air. Thus, exposure pathways and, risk characterization need to be resolved first to establish the link between chemical exposure and patterns of disease in a community.

The EPA does recognize that the degree of adverse health effects from kraft pulp mills can range from mild to severe. The extent and degree to which health effects may be experienced is dependent upon:

- ambient air concentrations observed in the area
- duration of exposures
- characteristics of exposed individuals (e.g., genetics, age, pre-existing health conditions, and lifestyle) which vary significantly with the population

Some of these factors are also influenced by

- Source-specific characteristics (e.g., emission rates and local meteorological conditions)
- Pollutant-specific characteristics

3) Question: I notice that the report was marked "Draft". Does this mean it is not complete? Is it still possible to make changes?

Answer: Yes, it is a draft for review and public comment, and it is still subject to change.

4) Question: On page 5, you wrote that SO2 is not monitored frequently because the volume is thought to be low. On page 8, the amount of SO2 for 2005 is listed as 410 tons, more than a ton per day. Is this considered to be a low amount?

   Answer: PTP mill released in 2005, 410 tons of SO_2 per year. DOH considers this amount to be significant. According to the mill, under the Title V permit, sulfur dioxide and hydrogen sulfide are monitored periodically. SO_2 and H_2S are monitored from the appropriate emissions sources, including continuous total reduced sulfur (TRS) monitoring for the recovery boiler and lime kiln stacks.

5) Question: On page 7, you list "residual oil" in an unnamed boiler. Is it true that residual oil is being used? Residual oil is more like a number 6 than a number 4. It is a big difference and raises questions about the permit.

   Answer: Yes, PTP mill uses residual oil; that's called reprocessed fuel oil (RFO) and it is mentioned in the report. Number 5 and 6 are considered residual oils. Number 4 is either distillate oil or a mixture of distillate and residual oils. Because residual oils are produced from the residue remaining after the lighter fractions (gasoline, kerosene, and distillate oils) have been removed from the crude oil, they contain significant quantities of ash, nitrogen, and sulfur.

   It is unknown what chemicals exactly are released from burning RFO. PTP mill has not provided a list of chemicals released from burning RFO. As a result, there is no analytical data and/or evidence to determine whether chlorine is released from this process. This is one of the amendments to the permit; PTP Corporation must sample and test the recycled fuel oil it purchases from Conoco Phillips prior to burning it.

6) Question: Regarding the reprocessed fuel oil that is used in the boilers, I have questions about whether it is sufficiently monitored. Since each batch is different, how frequently are batches tested? The Mill uses about 14 million gallons of "RFO" a year so this is a significant piece of the air pollution. The Department of Ecology tells me that: "heavy metals, volatile organics, semi-volatile organics, and halogens have been found in used oils. Metals include barium, cadmium, chromium, nickel, lead, antimony, selenium and zinc. Volatiles include, but not limited to acetone, benzenes, n-butlybenzens, ethylbenzine, isopropylbenzene, naphthalene, perc, toluene, xylene. Semi-volatiles include but not limited to anthracene, benzo (a) anthracene, 2-methylnaphthalene, naphthalene, and pyrene. The halogens that have been found include fluoride and chloride."

   Answer: PTP mill has not provided a list of chemicals released from burning RFO. As a result, there is no analytical data and/or evidence to determine what chemicals are released from this process. The mill has not provided information whether or not RFO is sufficiently monitored. As mentioned above, this is one of the amendments to the permit; PTP Corporation must sample and test the recycled fuel oil it purchases from Conoco Phillips prior to burning it.

7) Question: On page 16, you mention that dioxin can be present if there is chlorine in the hogged fuel. I believe that the hogged fuel is not being tested, so how do you know that it does not contain chlorine? If it is shipped by open barge, does it not pick up chloride?

Answer: According to the mill, chlorine is not present because the mill is not and has not been a bleached kraft mill nor does it burn salt-laden hog, so there is no a mechanism for introducing chlorine into the mill's processes or emissions.

8) Question: On page 16, you write about the combustion of fuel oil. Should not the fuel oil, whether residual or reprocessed be tested frequently in light of where it comes from?

Answer: Used oil is any oil that has been refined from crude oil, or any synthetic oil, that has been used and as a result of such use is contaminated by physical or chemical impurities (WAC 173-303-040 and 40 CFR 279.10).[15] According to Ecology, reprocessing removes heavy metals and some other contaminants from used oil. Most oil used in Washington is reprocessed into fuel oil, and reprocessing removes the toxic components of the oil so it can be used as a fuel.[16] WAC 173-303-515 describes standards for management of used oil. Used oil exceeding any specification level described in this rule is subject to this section when burned for energy recovery.[17]

Table 1. Used oil exceeding any specification level is subject to this section when burned for recovered energy.

Constituent/property	**Allowable level**
Arsenic	5 ppm maximum
Cadmium	2 ppm maximum
Chromium	10 ppm maximum
Lead	100 ppm maximum
Flash point	100°F minimum
Total halogens	4,000 ppm maximum

Source: WAC 173-303-515, Standards for the management of used oil.[17]

9) Question: On page 24, there is a table on cancer statistics. I understand from Lillian Bensley, acting State Epidemiologist, that prostate and bladder cancer are significantly higher than expected in Jefferson County. I wonder why this was not reported in your section on cancer. I believe that bladder cancer has been associated with occupational exposures. Regarding prostate cancer, we have only a small number of urologists in the county and they do not appear to overly diagnose prostate cancer.

Answer: The answer to this question was addressed above in question No. 1. DOH does not address occupational exposures and health effects in workers.[t] This evaluation deals with the identification of chemicals from a possible source and identification of

[t] This is one of the missions of the Occupational Safety and Health Administration (OSHA) which deals with preventing injuries and protecting the health of America's workers by ensuring safe and healthful workplaces. The Washington Industrial Safety and Health Act (WISHA) also deals with occupational safety and health programs, designed to assure a safe and healthful working conditions for all workers in the State of Washington.

information needed to address community health concerns. The findings in the report are targeted toward non-occupational exposure settings and potential health effects in the community. A summary of cancer statistics was provided to some members of the community in a separate document.

10) Question: On page 26, you mention data gaps and recommend an emissions inventory. I think we also have a data gap about days when there are odors in the community. Trained volunteers could help to fill that data gap with daily reporting. Would the DOH consider working with Ecology and the Mill to facilitate such a daily reporting? It could lead to a practical way of giving feedback to the Mill daily to enable the Mill to check for system problems. It is obvious to everyone (even the new CEO mentioned it to the newspaper) that the equipment is antiquated and frequently breaks down. This could be one source of air releases that cause symptoms. It could also give the validated daily odor data to check against symptoms reported by those affected.

    Answer: This is one of the recommendations listed in the report. DOH understands the mill is responsible for tracking odor complaints. Tracking odor complaints from members of the community is one of the requirements that Ecology has listed in the agreed order. Ecology is requiring the mill to facilitate daily reporting as part of the information needed to identify odor complaints from the community. In addition, the mill has agreed to install a meteorological (met) station in order to track wind and speed direction. This met station data will be available to the general public in the near future.

11) Question: On Page 27, you mentioned DOH working with the Mill and Ecology. Will DOH also work with the community on this? Or only with the Mill and Ecology?

    Answer: DOH is committed to working diligently and reviewing work plans and/or activities proposed by the paper mill and Ecology. DOH will continue to communicate with the community and let you know about the progress of these activities.

12) Question: On page 28 you recommend staying in on bad air days. I want to point out that the odors can arise quickly and catch people unawares. They also penetrate into the houses even with windows closed. The odors also permeate the elementary school, nursing home and hospital district. There is no escape if you live here.

    Answer: DOH recognizes that odors and smoke can easily penetrate through tiny cracks and holes in walls, windows and doors, and in turn, pollute our indoor air. This is especially true when odors are frequent on calm days with no wind, or when temperature inversion has reached a valley community. (A **temperature inversion** occurs when warmer upper air acts like a lid to hold surface air and odors or smoke near the ground. This occurs most commonly in the fall and winter, but is also common overnight and early in the morning during clear and calm conditions at any time of the year). Because hazardous chemicals are not diluted on calm days, they can build up and remain in the air we breathe for long periods, increasing the risk for health effects and reducing the visibility.

In general, levels of pollutants that come from outside sources tend to be lower indoors than outdoors. Older homes often allow more air pollutants to travel indoor because they are leakier or less air-tight. The amount of air pollution that comes inside from outdoors depends on a number of factors including, the construction of the home (such as weatherization, and type of building material used), wind speed and direction, and the amount of rainfall. People frequently have a higher level of activity when they are outdoors. As people's activity increases, they breathe more deeply and frequently and take in more air pollution. People in general will be less active indoors and therefore breathe less air pollution.

There are also a number of sources of indoor air pollutants that can cause poor air quality indoors. Indoor sources of air pollutants or allergens include: mold, wood stoves, especially uncertified ones, faulty heating systems, emissions from furniture, paint, or carpets, dust mites or cockroaches, tobacco smoke, and cleaning products. Northwest Clean Air Agency has produced a video called "Attack Asthma at Home: A Practical Approach to Asthma Trigger Source Control and Prevention" the video is targeted to people with asthma but has helpful information on improving air quality indoors. The link to this video is as follows: http://www.nwcleanair.org/aqPrograms/indoorAir.htm. Washington State Department of Health Indoor Air Quality Air Program can also be contacted for additional information on improving indoor air quality at 1-888-586-9427 or via the web at: http://www.doh.wa.gov/ehp/ts/IAQ/default.HTM
Homes can be made more air tight and energy efficient by improving weatherization. Contact the agency that provides heat for you home to find out about the availability of weatherization programs in your area.

Since DOH has no air emission data to assess potential health risks from chemicals emitted from the paper mill, it is difficult to determine what chemicals produce odors that are potentially harmful and can cause health problems. While the paper mill is gathering the information we need (i.e., air emissions data is collected and air modeling is conducted), DOH recommends that people stay indoors during bad odor events, as a prudent health practice. DOH understands that communities living in close proximity to pulp mills can be annoyed by odorous emissions. Odors can alert people that something may be harmful, but generally, you can smell many chemicals before they are at levels that are harmful to your health. For example, we are able to smell hydrogen sulfide, which smells like rotten eggs at very low levels; levels much lower than those at which this chemical can cause toxic health effects.

Health effects from exposure to chemical odors can be an immediate (acute) health threat, a long-term (chronic) threat, or may pose no health threat at all. Getting sick from chemical odors will depend on what you are exposed to, how much you were exposed (dose), how long you were exposed (duration), how often you were exposed (frequency), and your individual sensitivity to the odor.

13) Question: I recently became aware of suggestions from Dr. Locke, Jefferson County Health Officer. He suggested performing ambient air sampling. He pointed out the difficulty of models of air dispersion in this area, which could complicate computerized

models of how much of the chemicals are in the air in residential areas. I can cite a personal example of the complications. I reported a bad case of mill odor in my house one night when the wind was slight. It turns out that my house was upwind from the Mill at the time of the event. Also from my house I can see the flagpoles of two neighbors that are two blocks apart. It is not uncommon for the two flags to be blowing in opposite directions. So my question is: Why do you not recommend ambient air sampling (as suggested by Dr. Locke) of specific chemicals in the areas of Port Townsend that appear to be most affected by the mill odors?

Answer: The following is a summary of the advantages and disadvantages of ambient air monitoring versus air emissions inventories. Knowing the usefulness and limitations will help us understand both monitoring and inventories.

Ambient air monitoring program

Advantages of air sampling

- Air sampling has the advantage of producing data considered "real" results
  - "Real" in the sense that the mix of chemicals identified actually existed in the air at the location and time the sample was taken

Disadvantages of air sampling

- Difficult to target all chemicals because substances can originate from many and/or varied sources (results would not necessarily implicate the mill)
- This mix of chemicals may be the result of many different sources
- Only provides estimates of concentrations at the point at which samples are taken
  - Sampling results are based on *conditions* at the time of the sampling event
- Meteorological conditions and the amount of rates at which chemicals were released
  - Conditions could be an extremely low or high condition and not representative of average conditions
- Air sampling is expensive
  - Not very accurate – tends to underestimate concentrations
  - Takes a long time to obtain representative results

Ambient air emissions program

- Air emissions
  - Emissions is the term to describe the gases and particles which are put into the air or emitted by various sources
  - The amounts and types of emissions change every year. In general, these changes are caused by changes in the nation's economy, industrial activity, technology improvements, traffic, etc. Air pollution regulations and emissions control also have an effect.
- Sources
  - Point sources – includes things like factories and electric power plants
  - Mobile sources – includes cars, trucks, air planes and anything that moves and puts pollution into the air

- Air emissions inventories
  - Are quantities of pollutants measured over time
  - Emissions inventories can be *compared* with air pollutant levels in an area to determine if increased emissions decrease air quality

- Modeling
  - Emissions data is gathered – used to create models, which can help predict air quality

Overall structure of an air quality model

- Provides estimates of ambient air concentrations and/or deposition rates for one or more chemicals emitted from one or more sources
- Air quality modeling consists of three major components
  - An emissions (release) model
  - A meteorological model
  - Air quality model that predicts the movements of chemicals in the air

For more information about Assessing Air Quality Modeling:
http://www.epa.gov/ttn/fera/data/risk/vol_1/chapter_09.pdf

14) Question: I am very puzzled by DOH's recommendation that people stay inside on days with bad air quality. The air quality issues in Port Townsend are obviously very different from typical air pollution issues associated with big cities. The emissions from the Port Townsend Paper Mill not only contain particulates, but also contain some very heavy toxic gases that can easily seep into houses. In fact, a large portion, if not vast majority of the citizen reports indicate that people were impacted by emissions from the Paper Mill while inside their houses. The advice to stay in one's home is clearly inadequate. Even previously healthy people have reported severe impacts to their health from emissions inside their homes, much less people with preexisting respiratory problems. I understand that it would be politically difficult to advise susceptible people to leave town temporarily or permanently, but I think it is highly inappropriate of the DOH to suggest that the problem can be resolved by locking oneself in your house, when there is clear evidence that homes are not air tight enough to protect people from the dense, highly toxic gases.

    Answer: Please see response above in # 12.

15) Question: I am also puzzled as to why DOH focused on lung cancer and not any one of the several cancers that are highly elevated in Port Townsend, especially when the report indicates that lung cancer isn't even associated with air pollution. Several of the cancers that are at elevated rates in Port Townsend have been linked to exposure to chemicals from pulp mills in other studies. The Health Consultation is incomplete without a discussion of the carcinogens emitted from the pulp mill, including methanol, that itself is

not a carcinogen but is reported by the EPA to turn into formaldehyde in the body (formaldehyde is a known carcinogen). A discussion of the cancers elevated in Jefferson County, etc should also be included. You forwarded me a copy of a cancer report, but I don't understand why not all of the chemicals were discussed and why none of this information was included in the study. I understand that the health department doesn't consider Port Townsend to have a high enough population to look at cancer data, however the fact that PT has one of the highest cancer rates year after year after year is significant.

Answer: As mentioned in the report, there aren't air emissions chemical data from PTP mill to associate with any types of cancer, nor has exposure modeling[u] been conducted. Epidemiological studies have not been conducted in Jefferson County to link other forms of cancer with mill emissions. Well-conducted epidemiological studies that show a positive association between exposure to a chemical and adverse health effects often provide evidence about human health effects associated with chronic exposures. Such data, however, are not available. Even in the presence of good epidemiological data, interpretations are very difficult because the number of exposed individuals may be small, the incidence of effects may be low, doses are not well-characterized, and there may be complicating factors such as simultaneous exposure to multiple chemicals and heterogeneity among the exposed group in terms of age, sex, diet, and other factors.

As mentioned earlier, the amount of air toxins in the vicinity of PTP mill is not well-characterized and DOH has not yet identified a population that is exposed to these chemicals in the vicinity of the mill. In the report, DOH summarized the "key pollutants" (i.e., both criteria and hazardous air pollutants) based on TRI data and estimation of emissions inventories provided by the mill.

Without identifying species of chemicals and concentrations released from the pulp and paper mill processing and who's exposed, it is nearly impossible to assess the health significance of "air toxins" in ambient air. A quantitative risk assessment of potential effects from all of the "air toxins" emitted from the pulp and paper combustion sources has not been conducted.

The purpose of this document is to identify data gaps and make recommendations to Ecology and the mill to collect additional data. The mill has not yet identified the "toxic chemicals" released into the ambient air and DOH has not identified who is exposed to these chemicals of concern. Air emissions data and air modeling results can help us understand the overall exposure to specific contaminants from the mill.

A Health Statistics Review (HSR) was conducted because of concerns about possible exposures to chemicals emitted from PTP mill. It is unknown what is in the emissions, and/or what chemicals and concentrations are in the air when odor events are reported. Because of possible health concerns, DOH conducted this HSR which are done to

[u] Exposure modeling uses the ambient air concentration estimates along with information about the population of interest and information on how the pollutant concentration can vary in different microenvironments to derive estimates of exposure concentration over the period of exposure.

respond to community concerns; provide specific information on the health status of a community; and examine possible outcomes associated with exposures to chemicals. State health departments may provide annual summaries on the rates of asthma, cancer, diabetes, and other diseases to provide communities with the health status in a particular area. In developing an HSR, DOH only uses previously collected data, such as cancer, hospitalization rates, and other registry data as well as birth certificates, death records and other vital statistics. Data in registries are reported by physicians and hospitals to health agencies. Please refer to Appendix C which includes detailed information about what a health statistics review is, why it is conducted, and its strengths and limitations.

In general, the American Cancer Society estimates that exposure to chemicals in the work place and exposure to pollutants in non-work settings is about four and two percent, respectively (ACS – Cancer Facts and Figures, 2007). On the other hand, the U.S. Centers for Disease Control (CDC) *Third National Report on Human Exposure to Environmental Chemicals* found no exposure to environmental chemicals that constituted a health risk. The CDC report included data gathered from the biomonitoring of 148 environmental chemicals including metals, pesticides, and tobacco smoke. According to the CDC, this report was the largest study ever done on human exposure to environmental chemicals.[107] The CDC's *National Report on Human Exposure to Environmental Chemicals* was based on extensive biomonitoring which did not discover exposure levels that constitute a health risk.

While the CDC did not report state-specific data, it can be assumed that these findings indicate that Washingtonians are generally not subjected to exposure levels which constitute a health risk. Quantifying the cancer risk posed by environmental carcinogens is challenging due to the difficulty in measuring exposure. Human exposure to any given environmental carcinogen is highly variable and depends on a number of factors including the concentration of the carcinogen in the environment, individual behaviors (e.g., location of residence, frequency of contact with soil or air), and how the carcinogen is taken into the body. Furthermore, each person's exposure to environmental carcinogens can vary greatly over a lifetime. For these reasons, it is not possible to provide a reliable estimate of the cancer burden associated with any particular environmental carcinogen in Washington State.

16) Question: I do not understand why the DOH focused on looking at evidence for high rates of the types of disease caused by typical big city pollution instead of looking for evidence of impacts that might be expected from exposure to the highly toxic chemicals that the mill emits, which are very different. As admitted by many, the emissions data from the mill is only approximate and incomplete, but DOH didn't even discuss all of the major chemicals that are known to be emitted by the mill. All parties have admitted that emissions may accumulate in pockets due to topography, weather patterns, etc…so at times small groups of citizens may be exposed to very high levels of some of these chemicals. All the major chemicals need to be discussed. There is not enough data to be definitive, but DOH should fully discuss the available data and possible risks so citizens can make an informed decision as to whether they are willing to risk damage to their health.

Answer: Please see response above.

17) Question: DOH mentions that citizen reports would need to be verified. Why? Why would hundreds of citizens make up reports? Ecology claims that citizen reports are reliable enough to be used as a monitoring method. No citizens that I know of intend to open up their own paper mill and compete with the mill. What other motivation would they have for lying about being impacted? Most of the citizen reports are consistent with other reports or occurred at a time of less than ideal conditions at the mill. Also, I don't believe there is much of a mention that Ecology neglected to record the information from the citizen reports made directly to them. PTPC's records of citizen complaints are only a fraction of the number of reports made. I myself recall at least a dozen reports to Ecology, based on impacts from 20-40 episodes, and until the injury that caused severe permanent damage to me, my daughter and severe but temporary damage to my son and 2 neighbors, and others, Ecology made no note of any of my reports. Other citizens also have noted that Ecology has no record of their calls to Ecology. I think that DOH should include a note that a large portion of citizen reports were not recorded adequately thus not considered in the health consultation.

18) Question: How would citizen reports be verified? Most reports are of nausea, headaches in the middle of the night when resident's houses filled with pulp mill emissions. Would citizens have to pay their doctors to sleep in their houses with them for a week or two until a bad "mil night" occurs? How does one prove that you have a headache or that your eyes are irritated or that you are nauseous? How does a doctor definitively state whether a patient's condition was caused by the mill if the patient's observations of correlation of symptoms to mill odors are considered unreliable. Doctors in Port Townsend don't have the type of equipment needed to check for blood gases or whatever to find the accumulations of toxic gases in the body.

Answer: To summarize questions # 17 and 18, the relationship between current concentrations of ambient air pollution and adverse health effects is controversial. Very little is known about the concentration or physical/chemical properties of pollutants in places where people live and work, such as in community air, homes, schools, workplaces, restaurants, or vehicles.

Current understanding of the complex relationships between environmental exposures and health effects is limited. In general, few community health studies have been carried out by some kraft pulp mills, and there is not conclusive evidence that the emissions of pulp mills pose serious health risk to residents in surrounding communities. [37,38,39,40,41,42,43] Little is known about the synergistic interaction of various pollutants or the effects of multiple exposures. Even with good data, the cause-and-effect relationships between environmental exposures and health consequences are uncertain.

Why is DOH making these recommendations?

Additional data is necessary in order for DOH to provide a response to the community of

Port Townsend and to fully assess the health significance of air pollutants in the vicinity of PTP mill. The data gaps are related to air emissions (both criteria and air toxics chemicals). Many of these chemicals (i.e., criteria and air toxics) may be associated with community respiratory complaints and/or some cancers in the community. An approach to investigating the health significance of ambient concentrations of chemicals in the air would involve two phases:

Phase I

a) Better characterization of both criteria pollutants and air toxics is necessary to determine levels of contaminants in the surrounding air near PTP mill.

- Criteria pollutants may be particles (PM_{10}, $PM_{2.5}$, lead or gases (CO, NO_2, SO_2, O_3).
  - Human health effects are well defined by epidemiological studies
  - National ambient air quality standards (NAAQS) standards based on these health studies
  - Monitoring aimed at measuring attainment of NAAQS

- Air toxics[v] may be particles (various metals), gases (volatile organic compounds (VOCs)), or a combination (semivolatiles, including polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), POM (polycyclic organic matter) etc).
  - Health effects not as well documented: human health risks are generally derived from animal studies
  - There are no air quality standards for air toxics
  - Monitoring data is aimed at estimating human health risks, either alone or in concert with modeling efforts

b) Modeling of air toxics concentrations should be conducted in order to identify
  - Pollutants for subsequent further assessment
  - Areas of concern or hotspots in Port Townsend.

c) Air modeling can help us determine
  - Which air pollutants are key contributors to acute and/or chronic health risks in the Port Townsend area
  - Whether or not the PTP mill is the only significant source of pollution and if there are other key contributors to acute and/or chronic health risk in the Port Townsend area
  - To what degree and/or extent the community of Port Townsend is affected by air emissions from the mill (i.e., once ambient concentrations of these pollutants is determined, the second step would involve defining the number of people exposed at different concentrations)

[v] Air toxics can be defined as having three characteristics: a) they have the potential to cause serious adverse health effects in the general population or to organisms in the environment as a result of airborne exposures; b) they are released from anthropogenic sources; and c) they include 189 hazardous air pollutants listed in Section 112.b.1 of the Clean Air Act of 1990.

Phase II

Once modeling has been completed, DOH will be available to conduct a human health risk and toxicological assessment of PTP mill's emissions. Risk assessment examines the likelihood of adverse health effects to the general public as a result of acute (short term)[w] and chronic (long term)[x] exposures to mill emissions. The assessment will evaluate non-cancer and cancer hazards of chemicals in the air through the inhalation (breathing in) pathway. (Appendix D describes the risk assessment process in more detail).

- Gathering all this information is the first part of a process that will ultimately help us assess the health significance of air pollutants in the community
- It's important for us to clearly identify why we need to conduct an "air toxics" risk assessment and what we want to include in that assessment
- Once this information is available, one could look at "hot spots" and determine the best locations to establish air monitoring.

However, it takes time to obtain representative or comprehensive data on emissions of various organic and trace metal "air toxics". A yearly value may not provide the level of information required to evaluate the risk assessment questions, and more detailed information may be necessary. For example, do the emissions fluctuate seasonally? Are the releases continuous around-the-clock, seven days-a-week, or more intermittent with a different schedule?

19) Question: DOH did not discuss the possibility of dioxins being produced from the burning of contaminated waste oil. Ample evidence exists in PTPC's monthly monitoring reports that ideal burning temperatures are often not met when burning this type of fuel and that the fuel is contaminated with chlorine. If the temperature is not ideal, dioxins can form during the burning of this kind of fuel. PTPC's records indicate that they burn about 14 million gallons a year of this contaminated fuel. I do not understand why DOH declined to discuss this concern. My understanding is that EPA has mentioned the possibility of dioxins from this type of fuel oil.

    Answer: Based on the air emissions data, dioxins and dioxin-like compounds are emitted in very small quantities (0.4 g per year). Dioxins could be released if the analysis of RFO indicates the presence of halogenated materials. Any used oil exceeding specification levels when burned for energy recovery has the potential to release dioxins into the environment. PTP mill has not provided a list of chemicals so it's unknown what chemicals exactly are released from burning RFO. As a result, there are no analytical data

[w] Infrequent exposure to relatively high concentrations of air toxics over short periods of time (**acute exposures**) that may result in the expression of either near term **acute health effects** (which can range from mild effects, such as reversible eye irritation, to extreme effects, such as loss of consciousness or sudden death), or long term effects (chronic effects).

[x] Repeated or extended exposure to relatively low concentrations of air toxics over long periods of time (**chronic exposures**) that may result in **chronic health effects** (e.g., diseases like cancer or recurring respiratory ailments).

and/or evidence to determine what chemicals are released from this process. This is one of the amendments to the permit; PTP Corporation must sample and test the recycled fuel oil it purchases from Conoco Phillips prior to burning it. Dioxin and dioxin-like compounds are discussed in the report in general terms because dioxin has been identified as a potential contaminant released at pulp mills.

20) Question: DOH suggests an air pollution modeling study. Such a study is needed, but real sampling of the air quality must happen as soon as possible, not in a few years after an air pollution modeling study is done. The high cancer rates and huge volume of citizen reports seem significant enough for a more active approach. I specifically feel that immediate sampling of air above the ponds needs to be completed as there does not appear to be any data about what chemicals are being emitted and what the concentrations are. PTPC claims that emissions are insignificant, and does not report emissions in the annual emissions inventory, despite much evidence that the odor from the ponds is quite significant.

Answer: Please refer to the answer to #13, above. Air dispersion modeling is a tool used to estimate the level of a pollutant (e.g., one or more chemicals emitted from one or more sources) downwind from an air pollution source.

Ecology is currently working on an agreed order with PTP mill that will require that they develop a plan to determine the emissions of methanol, acetaldehyde, propionaldehyde, and total reduced sulfur from the wastewater treatment ponds.

21) Question: I agree with the comments by the local health department…air sampling must happen. The citizens are being impacted frequently, some severely. Postponing sampling for a few years until another study is done is not ok. I also believe that a full health survey of the citizens is needed. Public data on health conditions in the area are too limited for adequate study.

Answer: DOH's recommendations and the rationale for collecting additional sampling data are clear in the health consultation report. Ambient air emissions program versus air monitoring program advantages and limitations were explained above. As mentioned previously, it takes time to obtain representative or comprehensive emissions data of various organic and trace metal "air toxins". Developing an emissions inventory requires 1) planning; 2) gathering information; 3) estimating emissions; 4) compiling data into a database; 5) data augmentation (i.e., the need to collect additional information, most notably emission data, vent parameters, and location coordinates); 6) quality control/quality assurance; 7) documentation; and 8) access to data. For detailed information about this please see:
http://www.epa.gov/ttn/fera/data/risk/vol_1/chapter_07.pdf

Depending on the community goals and questions needing an answer and how those answers will be used to address a community's health, a community health survey is an option. A health survey may help to investigate a wide variety of health outcomes, not all of which may be related to the exposure. A health survey looks at many different factors

that affect health (for example, social and economic status), as well as different health conditions. However, this type of survey cannot be used to show an association between exposure to contaminants and development of a specific disease.

For more information about a Health Study and/ or a health survey: http://www.communityhealthstudies.com/content/welcome.html

22) Question: In the Health Consultation regarding Port Townsend Paper Corporation, you mentioned that the company used approximately 14 million gallons of reprocessed fuel oil in 2006. Do you know if the amount of RFO has been similar in recent years, from 2005 onwards? I know that they are using waste wood and so are they continuing to use as much RFO?

Answer: DOH has no information on this because the mill has not provided the amount of RFO used during previous years.

May 8, 2008

Re: WA Dept of Health Draft Health Consultation

Dear Mr. Diaz:

Thank you for the work of yourself and others at the WA Dept of Health in conducting a Health Consultation for Port Townsend. The document validates our concerns, the principal of which is that "data gaps ... need to be filled in order to assess the health impacts of mill related pollutants on the community." (p.4)

We have some questions and concerns.

23. Question: Hospitalization rates. Hospitalization rates alone are insufficient to characterize the health impacts on the community. At a minimum, general practice physicians, specialists and alternative practitioners would need to be consulted. However, for many symptoms that people experience, although debilitating and potentially with long-term effects, people do not necessarily seek medical treatment, or they go in the course of other visits or longer-range care. Yet the effect on their health can be profound and long-lasting. Asthma or migraines are but two examples: people report that the if the symptoms come on, they check the ambient air and if mill emissions are present, they often simply take their customary treatment (over-the-counter, prescription, special nutrients or herbs) and go to bed until the symptoms abate.

Thus, without doing a community survey as well as confidential surveys of other medical practitioners, a true picture of the health impacts cannot be discerned.

Answer: **Is a health study appropriate for Port Townsend?**

Linking health problems to an exposure to environmental **contaminants** in the environment might seem straightforward at first. Often, community members suggest that a health survey be conducted in their community. A health survey is the number of people with illnesses (or health outcomes) in their community. A health survey provides information about the health status of the community. However, in order to suggest a link between **exposure** and illness, one needs to carry out a scientific health study. A scientific health study requires carefully measuring exposure and illness. A disease may be caused by many different factors. It may be difficult to determine if the disease was caused by exposure to contaminants, and not due to other factors. No community is free of disease; there is always some level of disease in a community. It can be hard to show there are an unusually high number of people with a particular disease.

Because these types of health studies present many challenges, they are rarely conducted in small communities. However, a health study is only one of many options that can address concerns about exposure and health in a community exposed to contaminants. Some goals can often be obtained more effectively through other activities.

Epidemiologists ask various questions when evaluating whether to conduct a health study in a community. Answering both the basic and advanced questions successfully provides the "building blocks" to conducting a good study. If there are strong answers to these questions, a health study may be appropriate from a scientific point of view. Other practical considerations, such as funding and stakeholder support, will then need to be considered. **It is important to note that health studies are not commonly carried out.** There are many conditions that need to be met before deciding to invest the large amount of time and resources needed to conduct a health study.

In an environmental epidemiology study, **there must be one or more contaminants in the environment.** Usually, these types of studies involve looking at a contaminant that was introduced into the environment by humans.

Some questions asked at this stage:

a) Is there contamination?

- Do we have strong evidence of contamination?
- Do we have enough information to know where the environmental contamination is located?
- Are there sampling data that shows the contaminants in the air, water, or soil?

b) Did people come in contact with the contamination? Evidence is needed to show that people had some contact with the contaminant by touching, breathing or ingesting it.

For example, it is possible that contamination existed in the community's surrounding air. However, there is no evidence of people being exposed to chemicals by breathing the air while

living near the Port Townsend paper mill and working at the facility. DOH understands that communities living in close proximity to pulp mills can be annoyed by odorous emissions. Odors can alert people that something may be harmful, but generally, you can smell many chemicals before they are at levels harmful to health. For example, humans are able to smell hydrogen sulfide, which smells like rotten eggs, at very low levels; levels much lower than those at which this chemical causes toxic health effects.

Another scenario is that contamination exists in the community's **groundwater**. However, there is evidence that no one drank the water, touched the water, or breathed water vapor. Instead all water supplied to residents in the community came from **surface water** collected in the mountains far away from the community.

By looking at these various issues, we can determine if, in fact, people came into contact with contamination. When that occurs, we have what is known as "completed exposure pathway."

Some questions asked at this stage:

- How large of a geographical area did the contamination spread?
- Do we know if people breathed, ingested, or otherwise had some contact with the contaminant?

c) Could the contaminant cause the health outcome?

Different chemicals may cause very different health outcomes. In an environmental study, **it must be scientifically reasonable to think the exposure to contaminants could cause the health problems a community is concerned about.**

If exposure to a particular exposure is consistent with what we know about how a particular disease develops, then the connection between the exposure and the disease is said to be biologically plausible. To determine biological plausibility, scientists explore past research findings looking for evidence of a biological mechanism connecting the exposure to the disease. If there was contamination, and people were actually exposed to it, then we must also ask if the association between the exposure and the health outcome is biologically plausible.

Some questions asked at this stage:

- Is there scientific information showing a link between the chemical and the health outcome?
- Can we suspect there might be a link, based on what we know about how the chemical behaves in the body?

d) How much were people exposed to?

Based on what we know, **is the amount of exposure high enough to possibly cause the health outcome?**

A chemical may cause a specific health problem in people when people are exposed to a certain amount of it; yet, at low levels it may not cause that problem at all. For example, health effects from exposure to chemical odors can be an immediate (acute) health threat, a long-term (chronic) threat, or may pose no health threat at all. Getting sick from chemical odors will depend on what you are exposed to, how much you were exposed (dose), how long you were exposed (duration), how often you were exposed (frequency), and your individual sensitivity to the odor.

Some questions asked at this stage:

- According to existing toxicology studies, what levels of contaminant exposure result in a health outcome?
- Does the available data suggest the contaminant is present at levels high enough to raise a concern about a specific health outcome?

e) Is the timing right?

Are we looking for the health outcome at the right time based on when exposure occurred?

The period of time between exposure and the appearance of a related health outcome is known as the "latency period."

Some health outcomes take a long time to develop. If we look too soon after the exposure, we won't find anything, even if the contaminant could in fact cause the health outcome in the future. On the other hand, some health outcomes may only be seen while exposure is ongoing. If exposure has ceased, there would be no reason to conduct a study.

Some questions asked at this stage:

- Do we know how long it takes for a specific health outcome to appear after a person has been exposed to a specific contaminant?
- Has enough time passed from the time of exposure for the health outcome to develop?

Let's now apply all these basic questions to Port Townsend mill (PTP mill) emissions.

Basic Question a:
Is there contamination?
Yes, PTP mill emits more than 100 tons per year or more of one or more air pollutants.

- **Do we have strong evidence of contamination?**

We know PTP mill emits more than 100 tons per year or more of one or more air pollutants. But there are a lot of unknowns and data are needed to estimate levels of contamination in the community.

- **Do we have enough information to know where the environmental contamination is located?**

PTP mill is not the only source of pollution; there are other sources of emissions that contribute to chemical pollution in the area. According to the Olympic Regional Clean Air Agency (ORCAA), Port Townsend's other sources of emissions include commercial sources, wood stoves, fireplaces, outdoor burning, wildfires, and motor vehicle diesel emissions.

- **Is there sampling data that shows the contaminants in the air, water, or soil?**

There are not enough data that are able to quantify exactly what is coming out of the emissions (i.e., recovery furnace, smelt tank, lime kiln, hog fuel and package boiler, treatment system and water treatment ponds).

Basic Question b:
Did people come into contact with the contamination?
It is unknown whether people have been exposed to chemicals by breathing the air while living near PTP mill (i.e., within 3 to 5 miles) and working at the mill. Former mill workers have expressed no health concern working at the mill.

Basic Question c:
Could the contaminant cause the health outcome?
It is unknown what chemicals are causing respiratory or any other type of illnesses in the community.

Basic Question d:
How much were people exposed to?
It is unknown what chemicals are in the emissions, how much, how often, and where people are exposed. We have not identified yet an exposed population.

Basic Question e:
Is the timing right?

The period of time between exposure and the appearance of a related health outcome is unknown.

For more information about a Health Study:

http://www.communityhealthstudies.com/content/welcome.html

24. Question: Which Cancers? The report discusses cancers, citing the "top 5 cancers", or most frequently found cancers for Jefferson County. However, this misses the point, as these particular cancers are variously elevated throughout most of Washington. Much more telling are rates of given cancers relative to the same cancers in other WA Counties. By this measure, we find that Jefferson County not only leads all Washington Counties in total cancers, but exceeds up to double the rates for approximately 14 cancers, and this pattern has held for at least a ten-year period. This is significant.

25. Question: Irrelevant case example used. Lung cancer is used as an example but it's not one of the comparatively elevated cancers. More telling is to look at, for instance, oral cavity/pharynx, bladder or brain (almost 2x state average incidence); liver, melanoma of the skin, pancreas, prostate or stomach (1.3 to 1.6x state average incidence). This must be considered in a valid final report.

Answer: To summarize questions 24 and 25 DOH provided a thorough review of cancer rates and statistics in Jefferson County to some members of the community. A copy is available for your information. In summary:

- There is not supporting evidence to correlate the significance of any form of cancer in Jefferson County linked to air emissions from the PTP mill in absence of environmental and epidemiological data. Cancer is the product of many factors (e.g., lifestyle, genetics, and exposure to cancer causing agents) and many types of carcinogens.

- It is unknown which chemicals are the cancer and non-cancer drivers at PTP mill to fully assess adverse health effects. DOH provided a list of "suspected" chemicals based on TRI and air emissions data. A human exposure model (HEM) has not been conducted at PTP mill.

- The Human Exposure Model (HEM) is used primarily for performing risk assessments for major point sources (usually producers or large users of specified chemicals) of air toxics. The HEM only addresses the inhalation pathway of exposure, and is designed to predict risks associated with emitted chemicals in the ambient air (i.e., in the vicinity of an emitting facility but beyond the facility's property boundary). The HEM provides ambient air concentrations, as surrogates for lifetime exposure, for use with unit risk estimates and inhalation reference concentrations to produce estimates of cancer risk and noncancer hazard, respectively, for the air toxics modeled.

    - For more information about HEM: EPA's Risk Assessment and modeling http://www.epa.gov/ttn/fera/human_hem.html

- The report does not address high incidence of cancers and/or suspected neurological diseases in Port Townsend based on assumptions or epidemiological studies. Until PTP mill identifies what is in the air emissions and air modeling is conducted it is impossible to predict levels of chemicals in the air and estimate cancer and non-cancer adverse

health effects.

26. Question: Children's health is discussed in the abstract, but not related to the issue. No recommendations are made for collecting children's health data. This should be done.

Answer: As mentioned in the report, ATSDR and DOH recognize children's vulnerability to environmental hazards. Any data that is collected to assess human health risks will be relevant to predict potential adverse health effects in children as well as adults.

27. Question: Mill workers' health is not discussed. We feel that given our concerns, mill workers should be afforded a study to identify, remedy and prevent any undue health effects that may arise from their honest efforts to provide for their families.

Answer: DOH does not address occupational exposures and health effects in workers. This evaluation deals with the identification of chemicals from a possible source, and identification of information needed to address community health concerns. DOH received a list of 101 signatures from employees of Port Townsend Paper Corporation stating they do not suffer any health concerns from any emissions released from this mill. They believe the mill meets or exceeds all local, state, and federal laws concerning emissions.[22]

28. Question: Other sources? Citizens are clearly reporting health impacts which they often can directly correlate with presence of mill emissions. However, if studies by the agency fail to discern a correlation with mill emissions, nonetheless, the health impacts remain very real and well known among the populace. The WA Department of Health is charged with (and paid through taxpayer dollars to) protect the health of the populace. Therefore, regardless of ultimate source, we petition the Dept of Health to find out what is causing the health impacts and help us correct it.

Answer: In summary;

- DOH was unable to fully assess adverse health effects because it is unknown which chemicals are the cancer and non-cancer drivers at PTP mill.

- DOH has not yet identified who's exposed to environmental pollutants, what pollutants they are exposed to, how they are exposed, the toxicity of the chemicals they may be exposed to, and the likelihood that harm could occur because of the exposure. DOH's role is to answer these questions. Once data and risk modeling is conducted, DOH will be able to conduct a human health risk and toxicological assessment of PTP mill's emissions. Risk assessment examines the likelihood of adverse health effects to the general public as a result of acute (short term)[y] and chronic (long term)[z] exposures to

[y] Infrequent exposure to relatively high concentrations of air toxics over short periods of time (**acute exposures**) that may result in the expression of either near term **acute health effects** (which can range from mild effects, such as reversible eye irritation, to extreme effects, such as loss of consciousness or sudden death), or long term effects (chronic effects).

mill emissions. The assessment will evaluate non-cancer and cancer hazards of chemicals in the air through the inhalation (breathing in) pathway.

- DOH is working closely with the mill and Ecology to ensure air emissions and meteorological data are collected. Once we gather this information, we will ensure that air modeling is conducted to determine what is being emitted and how and where contaminants move in the air.

- DOH is available to review air dispersion modeling results.

- DOH will use air modeling data results to conduct health risk analyses for each of the emission source areas. Then we will compute cancer and chronic non-cancer health effects.

Some specifics in the report:

29. Question: Page 10, pp2: "Most healthy people recover from the effects of air pollution when air quality improves." Generally we'd agree. However, long-term air pollution can have long-term effects on health. Nonetheless, this is a good reason for cleaning up the air. Your following sentence addresses those with more delicate or compromised systems.

30. Question: Page 10, footnote 3: "Ecology has determined that the mill does not release more reduced sulfur gases during the night." People report increased emissions on weekends as well. Regardless, without actual on-site working monitors, the statement cannot be supported. However, even if a nighttime concentration of mill pollutants is due to regular nighttime atmospheric conditions, the effect is the same: frequently, higher emission concentrations at night.

Answer: The mill and Ecology have determined the mill does not release more chemicals during the night. The mill operates 24 hours a day and seven days per week. The mill odor is noticed by the community primarily at night and in the early morning due to weather patterns, not changes in mill operations.[108]

31. Question: Page 10, pp3: "The mixture is different inside and outside, and may affect people in different ways." Granted, but often mill emissions collect inside buildings and may be more concentrated indoors until the outside emissions disperse and the building can be aired out. People regularly report this problem.

Answer: The answer to this statement was discussed earlier in question # 12.

32. Question: Page 11. Port Angeles study and other citations. Although apparently the study did not come to a solid conclusion, it begins to corroborate other research and our point: that exposure to air pollution damages health.

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[z] Repeated or extended exposure to relatively low concentrations of air toxics over long periods of time (**chronic exposures**) that may result in **chronic health effects** (e.g., diseases like cancer or recurring respiratory ailments).

Answer: Information about health risks of people living near kraft pulp mills and/or evidence of disease is limited and inconclusive.[37,38,39,40,41,42,43] Thus there is a need to conduct conclusive environmental and epidemiological studies so the results can provide useful information whether or not emissions of a modern pulp mill poses any serious health risk to residents of surrounding communities.

33. Question: Page 12: other exposures. Other pollutants undoubtedly contribute to overall body burden. Even there, it merits paying heed to PTPC's contribution to these other pollution sources. For instance, approximately 78% of PTPC's fuel is wood-burning, perhaps on the order of 300-600 cords of wood per day; PTPC burns approximately 14 million gallons of reprocessed fuel oil annually, a type of fuel that produces more particulates than some other types of fuel oil. In addition, a constant stream of diesel trucks carries fuel and supplies to the mill.

Answer: According to the TRI and annual air emissions inventory, PTP mill releases approximately 3,657 tons of chemicals per year. Other commercial sources in Port Townsend area that contribute to air pollution include Port Townsend Furniture Clinic, Townsend Bay Marine and Lakeside Industries – Cape George. As mentioned in the report, the Olympic Regional Clean Air Agency (ORCAA) study identified chemical emissions also from wood stoves, fireplaces, diesel emissions, outdoor burning and wildfires.[48]

34. Question: Page 12-13: "Toxics emissions are not monitored."..."Without knowing more about the specific emissions from PTP mill and the resulting ambient air concentrations, it is difficult to identify which chemical substances might contribute to adverse health effects." Exactly!

Answer: This statement is correct. A complete set of toxic air emissions are not routinely monitored. According to PTP mill, they only monitor the required HAPs. The mill is regulated under the National Emission Standards for Hazardous Air Pollutants (NESHAP) rules which is in compliance with the Maximum Achievable Control Technology (MACT) standards I and II.[2]

35. Question: Page 16: Dioxins and dioxin-like compounds: That is one of our concerns, especially in light of the use of reprocessed fuel oil.

Answer: Even though the TRI and air emissions data showed dioxins and dioxin-like compounds in very small quantities (0.4 g per year), there is a potential for dioxins to be released by burning reprocessed fuel oil. DOH considers this paragraph important and has included it to provide potentially relevant information to the community.

The document will be revised to state: PTP Corporation has never been a bleaching mill, so it never used chlorine as a bleaching agent. There is no historical reason to associate dioxin with the mill's liquid effluent. Chlorinated organic compounds such as dioxin, however, may form as a by-product of combustion if chlorine is present in hogged fuel,[20] and/or halogenated materials are present in the combustion of reprocessed fuel oil.

According to the mill, under the PTP Title V permit it is prohibited to burn salty hogged fuel. However, it is possible dioxins could be released if the analysis of RFO indicates the presence of

halogenated materials. Used oil exceeding any specification level when burned for energy recovery has the potential to release dioxins into the environment. The total halogens permitted in Washington are 4,000 ppm maximum.

36. Question: Health data review: already commented upon in major comments, above.
Data gaps: We especially feel that Direct Monitoring, both at the source and in the community are crucial to getting to the bottom of the puzzle

Answer: If air emission levels identify chemicals of concern in the surrounding ambient air then further monitoring is necessary. In other words, if "hot spots" are co-located in the vicinity of the mill there is a need to conduct air monitoring in the community.

37. Question: Recommendations: "DOH recommends Ecology, as the regulatory enforcement authority, require an expanded inventory." Yes, thank you! However, we STRONGLY feel that any characterization of the mill emissions must be proven against actual direct monitoring in the community. A wise monitoring plan is essential to accurately characterizing any relationship between reported health effects and pollution that is present at the time.

Answer: Ecology has consulted with EPA so they can provide an update in the residual risk assessment for the pulp and paper industry. Preliminary results show a list of chemicals for cancer and non-cancer risk drivers similar to those identified in the health consultation. In the agreed order with PTPC, Ecology is requiring the mill to determine emission unit specific basis on 17 chemicals and polycyclic organic matter (POM) 71002. POM 71002 includes a lists 16-PAH (polycyclic aromatic hydrocarbons).

Port Townsend Paper Corporation comments on April 2008 health consultation

38. Question: Purpose (p.4)

"The purpose of this health consultation is to summarize health concerns regarding air pollution generated from the PTP mill and respond to the community's requests for an investigation of the following issues: …" In general, throughout the document, DOH refers to the petitioners as "the community."

While the petitioners represent a portion of the community, they do not represent the community as a whole. Using the term "the community" paints with too broad a brush. In our estimation, nearly 150 petition signatures were received asking for regulation of the mill, whereas in another petition, a similar amount of signatures were received from people reporting their health had not been affected by the mill.

The three bullet points are identified as the issues for which the petitioners had requested an investigation. When compared to the petition on file with DOH, these bullet items do not accurately reflect the petitioners' request.

Answer: DOH considers the petitioners as members of the community of Port Townsend. They might not represent the community as a whole but they still belong or are part of the community at large. However, the point is valid and we will revise the document to say "some members of the community"

DOH believes our characterization of the petitioner's request accurately reflects their petition on file.

Background and Statement of Issues

39. Question: Industry description and practices (p. 5)

This section is confusing. PTPC does not have "…wood debarking and chip making…" on-site. The mill is an unbleached mill and does not make printing papers. This serves only to confuse a reader unfamiliar with distinctions between a generic description of the industry and an actual description of this mill.

Answer: The report has been modified as follows: The following general description of the kraft industry does not necessarily depict actual practices at the PTP mill. For example, PTP mill does not do wood debarking and chip making on-site.

40. Question: Air permit (p.5)

The report states: **"Sulfur dioxide and hydrogen sulfide are monitored periodically, but because the volumes are thought to be low, they are not monitored frequently."** PTPC's Title V permit clearly states the requirements for the ongoing monitoring SO2 & H2S from the appropriate emission sources, including continuous TRS monitoring for the recovery boiler and lime kiln stacks. Furthermore, the mill is required to track and report via the annual emission inventory the amounts of these chemicals emitted from the mill site.

Answer: The report has been modified as follows: Under the Title V permit, sulfur dioxide (SO_2) and hydrogen sulfide (H_2S) are monitored periodically. SO_2 and H_2S are monitored from the appropriate emission sources, including continuous total reduced sulfur (TRS) monitoring for the recovery boiler and lime kiln stacks.

41. Question: "Toxics emissions are not monitored." It is unclear how the author or DOH is defining the generic term "toxics emissions". The mill is required to track all emissions deemed appropriate by EPA & Ecology through over a 35-year period of rule-making to Port Townsend Paper Corporation ensure that the mill is sufficiently protective of the airshed under the Clean Air Act, including hazardous air pollutants.

Since 1970, the Clean Air Act has provided the primary framework for protecting people and the environment from the harmful effects of air pollution. A key component of the Clean Air Act is a requirement that the U.S. Environmental Protection Agency (EPA) significantly reduce daily, so-called "routine" emissions of the most potent air pollutants: those that are known or suspected to cause serious health problems such as cancer or birth defects. The Clean Air Act refers to these pollutants as "hazardous air pollutants," but they are also commonly known as toxic air pollutants or, simply, air toxics.

Prior to 1990, the Clean Air Act required EPA to set standards for each toxic air pollutant individually, based on its particular health risks. This approach proved difficult and minimally effective in reducing emissions. As a result, when amending the Clean Air Act in 1990, Congress directed EPA to use a "technology-based" and performance-based approach to significantly reduce emissions of air toxics from major sources of air pollution, followed by a risk-based approach to address any remaining, or residual, risks.

Under the "technology-based" approach, EPA develops standards for controlling the "routine" emissions of air toxics from each major type of facility within an industry group (or "source category"). These standards - known as "maximum achievable control technology (MACT) standards" - are based on emissions levels that are already being achieved by the better-controlled and lower-emitting sources in an industry. This approach assures citizens nationwide that each major source of toxic air pollution will be required to employ effective measures to limit its emissions. Also, this approach provides a level economic playing field by ensuring that facilities that employ cleaner processes and good emission controls are not disadvantaged relative to competitors with poorer controls.

In setting MACT standards, EPA does not generally prescribe a specific control technology. Instead, whenever feasible, the Agency sets a performance level based on technology or other practices already used by the industry. Facilities are free to achieve these performance levels in whatever way is most cost-effective for them. The MACT standards issued by EPA over the past 10 years have proven extremely successful. *

* Taken from EPA-425/K-00-002, Taking Toxics Out of the Air, Introduction, pp.1-2, USEPA Office of Air Quality Planning and Standards, Research Triangle Park, NC, August 2000, p 2.

It should be noted that all discussion of "toxic" air emissions in the health consult, including its conclusions, fails to reflect the fact that EPA has spent more than a decade evaluating emissions from pulp mills for the MACT program, and based on that work identified specific pollutants that are representative of hazardous air emissions, and required that they be controlled.

The mill is regulated under NESHAP rules and is in compliance with MACT I and II. It monitors the required hazardous air pollutants. In addition, the company reports hazardous and toxic pollutant emissions estimating them using federally approved factors.

Answer: The report has been modified as follows: Toxic air emissions, or hazardous air pollutants, or air toxics can be defined as having three characteristics: a) they have the potential to cause serious adverse health effects in the general population or to organisms in the environment as a result of airborne exposures; b) they are released from anthropogenic sources; and c) they include 189 hazardous air pollutants listed in Section 112.b.1 of the Clean Air Act of 1990.

A complete set of toxic air emissions are not routinely monitored. According to PTP mill, they monitor the required HAPs. The mill is regulated under the National Emission Standards for Hazardous Air Pollutants (NESHAP) rules which is in compliance with the Maximum Achievable Control Technology (MACT) standards I and II.[2] However, one limitation of the MACT approach is that it relies mostly on engineering judgment about the amount of emissions reduction that can be achieved, and not on analyses of where action is needed to protect the public's health.

42. Question: "According to Ecology and PTP mill, chlorine, chloroform, and chlorine dioxide are not currently being released at the mill. Consequently, chlorine, chloroform, and chlorine dioxide are not monitored."

The reason that these chemicals are not monitored is that the mill is not and has not been a bleached kraft mill nor does it burn salt-laden hog. Absent a process that uses chlorine bleach or the burning of hog fuel that contains salt, there is no mechanism for introducing chlorine into the mill's processes or emissions, and as a result, no potential for emissions of chlorine compounds, including dioxin. Some comments have suggested that RFO fuel could be a source of chlorine, through solvents mixed with used oil, since RFO is made from used oil. EPA regulations require testing of used oil for the presence of chlorinated solvents, and the specifications for RFO include the EPA limitations on chlorinated solvents. As a result, there is no factual basis for

concerns regarding RFO as a chlorine source. It is inappropriate and confusing to insert these sentences into a discussion of the Port Townsend Title V Air permit.

Answer: It's unknown what chemicals exactly are released from burning RFO. PTP mill has not provided a list of chemicals released from burning RFO. As a result, there is no analytical data and/or evidence to determine what chemicals are released from this process. This is one of the amendments to the permit that PTP Corporation must sample and test the recycled fuel oil it purchases from Conoco Phillips prior to burning it.

43. Question: Local air monitoring (p.6)

The paragraph on local air monitoring is misleading. According to the EPA, local air monitors are placed for several reasons: (1) to judge compliance [of an airshed] with and/or progress made towards meeting ambient air quality standards, (2) to activate emergency control procedures that prevent or alleviate air pollution episodes, (3) to observe pollution trends throughout the region, including non-urban areas, and (4) to provide a data base for research evaluation of effects: urban, land-use, and transportation planning; development and evaluation of abatement strategies; and development and validation of diffusion models.*

* US EPA Air Quality and Standards, The Ambient Air Monitoring Program, http://www.epa.gov/air/oaqps/qa/monprog.html, last update May 6, 2008.

Additionally, fine particulate matter ($PM_{2.5}$) is a pollutant often associated with woodstoves, motor vehicles, and other combustion sources, and thus is a logical pollutant to monitor in our area. It is also a pollutant that may not be localized – i.e., it may travel across state and national boundaries.

Answer: The report has been modified as follows: In Port Townsend, monitoring for air pollution occurs at Blue Heron Middle School, 3339 San Juan Avenue in Jefferson County. This monitor only collects information on particulate matter (PM2.5).[6] Additionally, it may not be sited in a place that is relevant (i.e., does not consistently capture emissions from PTP mill). Indeed, this monitoring station was sited to represent air quality conditions representing the overall air shed. It was never intended to capture emissions directly from the mill but many other sources such as woodstoves, motor vehicle emissions, and other combustion sources in Port Townsend.

According to the EPA, air quality samples are generally collected for several reasons: (1) to judge compliance [of an air shed] with and/or progress made towards meeting ambient air quality standards, (2) to activate emergency control procedures that prevent or alleviate air pollution episodes, (3) to observe pollution trends throughout the region, including non-urban areas, and (4) to provide a data base for research evaluation of effects: urban, land-use, and transportation planning; development and evaluation of abatement strategies; and development and validation of diffusion models.[7]

44. Question: Potential air pollution sources at the PTP mill (p.6)

"Some limitations of the data collected in the TRI inventory include the following:"

This limitation should be added to the listed bullets.

- Year-to-year comparisons are nearly impossible given that the TRI rules and definitions for reporting change year-to-year.

You may want to refer the reader to your glossary for a description of the TRI.

Answer: Comment has been noted in the report. This bullet will be inserted in the report.

45. Question: Table 1 (p.7)

Table 1 lists "Hog Fuel" and then "Boiler" as separate items, even though they represent the same unit. This results in listing 2002 data separately from 2005 & 2006. This leaves the appearance of not having the data available when it really is just further down the page. Also the smelt tank data for 2005 & 2006 is missing from Table 1. The package boiler data are also notably absent. These data were reported in the emissions inventories for those years.

It states in the footnotes of this table that the emission points were based on engineering judgments. There should be a reference to who did this work.

The footnotes also refer to nitrogen dioxide (NO_2). The mill reports nitrogen oxides (NO_X) which include both NO_2 and NO.

Answer: Comment has been noted.

46. Question: Table 2 (p.8)

The Annual Air Emissions and TRI data for the PTPC mill should come directly from the PTPC reports and not be derived from ORCCA estimated emissions inventories.

Attached are revised Tables 1 & 2, corrected to reflect the emissions points and emissions reported by PTPC.

Answer: Comment has been noted.

47. Question: Use of Reprocessed Fuel Oil (RFO) (p.9)

In 2006, Port Townsend Paper combusted 13.2 million gallons of RFO, not 14 million.

"RFO is essentially used oil blended with other fuels to achieve the desired specifications."
This statement is incorrect. Ecology notes that "most used oil in the state is reprocessed into fuel oil. Reprocessing removes the toxic components of the oil so it can be used as a fuel."
* The used oil goes through processing (e.g., filtering, etc.) not just blending.

*Solid Waste & Financial Assistance Program, A Guide to The Used Oil Problem- - - What can you do? Washington State Department of Ecology, Publication #90-BR-10 Revised 3/94, http://www.ecy.wa.gov/pubs/90br10.pdf

Answer: Comment has been noted.

48. Question: "…but RFO creates significantly more ash." This phrase is misleading. It may be true that a sample of the RFO could contain more ash than a given sample of #6 fuel oil. What isn't stated in this section is that RFO is a product that is subject to stringent WA state regulations (WAC 173-303-515). Additionally, the mill's use of RFO was a result of a NSPS/PSD review by Ecology & EPA and that the amount of particulate emitted from the emissions units is limited by permit regulations regardless of the fuel burned, and the mill has installed pollution control devices to limit particulate emissions.

Answer: Comment has been noted.

49. Question: "Ash is a source of PTP particulate emissions that come from PTP.11"

This statement is misleading. The way the paragraph is written implies that burning RFO results in ash and infers that not burning RFO would eliminate ash. There is a component of ash in the particulate catch regardless of which fuel is burned. The amount of particulate emitted is limited by the established standard for each emission unit (as listed in the Title V permit).

Answer: This sentence has been deleted to clarify any confusion.

50. Question: Notice of violation at PTP mill (p.9)

Including notices of violation seem irrelevant to the health consult. If left in the final report, at least the term "Notice of Violation" should be defined and the relevance explained.

Answer: DOH believes emitting pollutants in excess of what is normally allowed increases the potential for release of more particulate matter and/or chemicals which could be harmful to humans. This comment has been noted in the report.

51. Question: Community health concerns (p.9)

This would have been the appropriate place to also duly report that the DOH has received a petition from mill workers and several letters from the community reporting no ill effects.

Answer: Comment has been noted in the report as follows:

52. Question: Port Townsend employee non-health concerns

DOH also received a list of 101 signatures from employees of Port Townsend Paper Corporation that feel do not suffer any health concerns from any emissions released from this mill. They believe the mill meets or exceeds all local, state, and federal laws concerning emissions.

"People living in close proximity to the pulp mill often complain…"
Can the terms "close proximity" and "often" be quantified?

Answer: Some people from the community expressed they are breathing "toxic fumes" at least once per week. Some people expressed they can smell rotten egg odors within an approximately three to five mile radius from the mill.

53. Question: "Over ten residents also reported that they have left their homes…."

DOH has included no viable reference for this statement. If this anecdotal information can not be substantiated, DOH should strike it from the study.

Answer: DOH has revised the document to state: DOH has been informed of at least one family that has left the area because of the impact of mill emissions on their health.

54. Question: Air pollution and health effects (p.10)

There are several reports referenced throughout this section. Enclosed is a list of references that provide scientific data to support why Jefferson County's health statistics are found to be "…not significantly different from WA state overall."

Answer: In general, environmental health data at most pulp mills are not available. Without good quality data and a complete characterization of chemical releases emanating from the mill it is impossible and/or uncertain to determine that mill emissions are very unlikely to cause direct health effects, either alone or as a mixture. Many toxic substances and their interactions have not been tested and verified. Little is known about the synergistic interaction of various pollutants or the effects of multiple exposures. Most studies referenced here are old studies and thus most of them do not reflect worst-case exposure scenarios. These studies focus on low-level air pollution from malodorous sulfur compounds released by a pulp mill and associated respiratory illnesses. In addition, they do not describe the toxic effects of many chemicals released by mills – that is, criteria and hazardous air pollutants. Even with good data, the cause-and-effect relationships between environmental exposures and health consequences are uncertain.

55. Question: A study done in Port Angeles "…showed that respiratory symptoms in children increased as levels of air pollution (i.e., SO2) increased." The reference to this study is confusing and misleading. This study was published in 1996 and was conducted on a bleach sulfite mill. The PTP mill is an unbleached kraft mill that by virtue of its chemical process emits lower SO_2. It has also undergone both NSPS/PSD review and MACT pollution control upgrades since that study was conducted. In addition, today's DOH report indicates that "Childhood (0-14 years old) asthma hospitalization rates are not significantly different in Jefferson County compared to Washington State overall between 2000 and 2005."

Answer: According to the annual air emissions inventory and TRI for the year 2002 and 2005, the mill emitted nearly 545 and 410 tons of SO_2 a year respectively. DOH considers this to be a significant amount since SO_2 is a very stable atmospheric compound and is likely to be toxic.

A recent exposure investigation study conducted in 2007 at a kraft pulp and paper mill in Plymouth, North Carolina concluded that SO_2 levels found in Plymouth can cause respiratory irritation and, thus pose a health hazard. Elevated levels of other sulfur compounds, including carbonyl sulfide may contribute to respiratory irritation.[47] The Port Angeles study was mentioned here mainly to describe the significance of SO_2 and its potential to cause disease.

56. Question: "Thus, the relationship of health effects to PTP emissions remains undetermined." The same can be said about the more dominant emission sources cited in the sentence that precedes this statement. There are a number of good quality studies that have been conducted in the US and other parts of the world that looked at the health of residents of communities near pulp and paper mills. None of these studies have provided any solid evidence that residence in a pulp mill community is associated with increased risk of cancer or other illnesses.*

*National Council for Air and Stream Improvement, Inc. (NCASI), 2001, A Review of Kraft Pulp Mill Community Health Studies, Technical Bulletin No. 835, Research Triangle Park, NC

Answer: Information about the health risks of people living near PTP mill and/or evidence of disease has not been conducted. The health outcome data review presented here is inconclusive and has many limitations. Health statistics reviews (HSRs) cannot establish a cause-and-effect relationship between an exposure and a health outcome for a variety of reasons. To establish a cause-and-effect relationship between exposure and illness, scientists consider many studies over a period of time and more evidence in addition to studies. While this review was conducted for Jefferson County with unknown documented exposures, current exposure and historical data was not available. Therefore, we can not be sure that all residents who were diagnosed with a respiratory disease or cancer lived in the area for a substantial duration and were exposed to mill emissions prior to the occurrence of their health outcome. Likewise, HSRs do not capture long-time residents who were potentially exposed to chemicals and moved away prior to a respiratory illness or cancer diagnosis. Also, the small population size of Jefferson County limited the ability to detect meaningful elevations or deficits in disease rates, hospitalization rates, and certain types of cancer.

Discussion

57. Question: Key pollutants at PTP mill (p.12)

"Air pollution is not completely characterized." This statement appears to be general and it is hoped that was the intent. Air pollution from any source (e.g., automobiles, agriculture, volcanoes) is never completely characterized.

Answer: This comment has been noted in the report as: Air pollution is not completely characterized in most kraft pulp mills. In fact, Air pollution from any source (e.g., automobiles, agriculture, volcanoes, industry) is never completely characterized.

58. Question: "PTP Corporation only monitors emissions specified in their Air Operating Permit." The mill is required to monitor emissions as specified by law. A permit is intended to be a summary of applicable law, but as regulations change or limits become tighter through

rulemaking, the new laws apply regardless of whether they are reflected in the permit, which is updated only every five years.

"Toxics emissions are not monitored." As commented on previously, it is unclear how the author or DOH is defining the generic term "toxics emissions". The mill is required to track all emissions deemed appropriate by EPA & Ecology. These requirements have been developed over a 35-year period of rule-making to ensure that the mill is sufficiently protective of the airshed under the Clean Air Act, including hazardous air emissions.

Answer: Toxic air emissions are defined above.

Under the Federal Clean Air Act, EPA establishes health-based standards called National Ambient Air Quality Standards (NAAQS) for criteria air pollutants. Unlike criteria air pollutants, there are no national standards or guidelines to define ***allowable concentrations*** in the air of contaminants for air toxics. Identifying the significance of ambient concentrations of HAPs and human health would involve four steps:

1) Identify ***pollutants of concern*** based on their toxicity and the magnitude of releases or potential releases
2) Determine ***ambient concentrations*** of these pollutants and the number of people exposed at different concentrations
3) D***efine standards or guidelines*** for allowable concentrations of these pollutants consistent with public health protection
4) C***ompare ambient concentrations to these health-based standards*** or guidelines and identify populations at risk

By following these steps, regulatory agencies would be able to take action to reduce risks deemed to be unacceptably high.

59. Question: Hydrogen Sulfide (p.15)

The last sentence in the TRS section presupposes that the mill emissions will have statistically significant health effects. A less biased statement would be, "However, the reported effects are not necessarily related to TRS gases or the mill, but may result from exposure to other sources of pollutants or chemicals, or may be associated with other personal factors (e.g., household chemicals or cigarette smoke)."

Answer: Comment has been noted. The document will be revised to state: "However, the reported effects are not necessarily related to TRS gases or the mill, but may result from exposure to other sources of pollution."

60. Question: Other potential contaminants released at pulp mills (p.16)

To end this section with a paragraph on dioxins implies that DOH has reason to believe that this is a problem at this site.

"Chlorinated organic compounds such as dioxin, however, may form as a byproduct of combustion if chlorine is present in hogged fuel.14
This statement from the PTP Title V permit support document should be paired with the statement that follows it in the support document: "But the permit prohibits PTPC from burning such salty hogged fuel."

This mill is not a bleached kraft mill and is consequently NOT **"…burning sludge from bleached kraft pulp mills…."** PTPC is an unbleached kraft mill and does not receive sludge from bleached kraft mills. The air emissions for DLCs for 2006 & 2007 were each approximately 0.4 grams per year.

This paragraph is immaterial and should be dropped.

Answer: DOH has clarified our statements regarding this issue in the report. Even though the TRI and air emissions data showed dioxins and dioxin-like compounds in very small quantities (0.4 g per year), there is a potential for dioxins to be released by burning reprocessed fuel oil. DOH considers this paragraph important and has included it to provide potentially relevant information to the community.

The document will be revised to state: "PTP Corporation has never been a bleaching mill, so it never used chlorine as a bleaching agent. There is no historical reason to associate dioxin with the mill's liquid effluent. Chlorinated organic compounds such as dioxin, however, may form as a by-product of combustion if chlorine is present in hogged fuel, [20] and/or halogenated materials are present in the combustion of reprocessed fuel oil. According to the mill under the PTP Title V permit it is prohibited to burn salty hogged fuel. However, it is likely that dioxins can be released if the analysis of RFO indicates the presence of halogenated materials in it. Any used oil exceeding any specification level when burned for energy recovery has the potential to release dioxins into the environment. The total halogens permitted in Washington are 4,000 ppm maximum."

61. Question: Review of Jefferson County health data (p.17)

Cigarette smoke is noticeably missing from your list of exposures.
"Based on published reports and the health concerns raised by residents, disease conditions that might be associated…" Anecdotal reports or concerns are unreliable sources of data.

Answer: Since evidence of disease and air emissions from PTP mill is not available, DOH relies on the best available information that exists. These reports are not anecdotal neither are they unreliable sources of data. ***A great deal of research*** shows there are positive correlations between criteria, hazardous air pollutants and respiratory chronic disease in people living near or downwind from a source of toxic emission. [23 ,24 ,25 ,26 ,27 ,28 ,29 ,30 ,31 ,32 ,33 59 ,25 ,32 ,31 ,27 ,28 ,60 ,61 ,30 ,62 ,63 ,64 ,65 ,66 ,67 ,68 ,69 ,24 ,70 ,71 ,72 ,73 ,74 ,75] The human health effects of criteria pollutants are well-defined by epidemiological studies, The National Ambient Air Quality Standards (NAAQS) are based on health studies. Thus, criteria pollutants are often monitored in the environment. In contrast, the health effects of air toxics are not as well documented (i.e., human health risks are generally derived from animal studies). There are no air quality standards for air toxics, and most

monitoring data is aimed at estimating human health risks, either alone or in concert with modeling efforts.

It is not uncommon for communities to express concerns about the possible impact of hazardous air pollution on their health, especially when these emissions are visible or odorous. Cigarette smoke is not considered in this review because it is not what we were petitioned to address.

62. Question: Conclusions (p.25)

The third bullet of the conclusion is confusing. Your last statement on that subject in the review section was stated more clearly: "The overall observed pattern of the two conditions does not indicate Jefferson County as having an unexpected occurrence of ischemic heart disease and respiratory disease over the years."

Answer: This statement "The overall observed pattern of the two conditions does not indicate Jefferson County as having an unexpected occurrence of ischemic heart disease and respiratory disease over the years." has been deleted in the review section. The statistics show some significance of disease during these years. DOH believes this statement is correct.

63. Question: "DOH cannot conclude whether air emissions from PTP mill could harm people's health because the information we need to make a firm conclusion is not available."

PTPC is submitting a list of references that would help you assess the available science on the lack of health impacts from pulp mill emissions.

Firm conclusions are rare. However, these studies are available, and do address concern regarding potential health impacts.

The ORCAA 2005 Regional Risk Assessment estimates the greatest contributors of pollution in Jefferson County to be wood stoves and automobile exhaust.
This Health Consult concludes that Jefferson County health statistics are not significantly different than Washington State overall.

Answer: Current understanding of the complex relationships between environmental exposures and health effects is limited. Experimental research on the respiratory effects of air toxics is largely limited to animal models or *in vitro* studies. Most of the research on air pollution has been conducted in large urban areas where air monitors routinely collect data on levels of ozone, particulate matter, and the other criteria pollutants. In most communities, air monitoring data for hazardous air pollutants is nonexistent or insufficient to evaluate health risks.[109] Most of the references listed here are old and do not address the health effects of hazardous air pollutants (HAPs) or toxic air emissions, which have the potential to cause serious adverse health effects (i.e., carcinogenic, reproductive, or neurological effects).

It is factual to state the information necessary to fully assess the health significance of criteria and hazardous air pollutants at Port Townsend are not currently available.

64. Question: Recommendations (p.26)

"There may be other COCs released by the mill which can cause health impacts."

The "chemicals of concern" are currently regulated under the ongoing federal Maximum Achievable Control Technology (MACT) process under the National Emission Standards for Hazardous Air Pollutants (NESHAP). We currently report chemicals we emit in excess of the federal reporting threshold in the annual Toxics Release Inventory. Any work going forward needs to be framed in the context of existing rules and regulations laid out by the existing regulatory authority of EPA and Ecology.

Answer: As pointed out in the report there are limitations with TRI data. TRI information on releases of chemicals to the environment does not represent ***measured concentrations*** nor a ***direct measure of exposure***. TRI data represents industry-reported estimates of emissions and the accuracy of these emission estimates is not known. TRI regulations only require facilities in certain industries to disclose releases for specific hazardous chemicals. The regulations do not require that all facilities report and address all chemicals.

As mentioned above, the health significance of ambient concentrations of hazardous air pollutants and their impact on the community has not been investigated. It's unknown what is in the emissions and/or what chemicals, and the air concentrations when odor events are reported.

In addition to the criteria pollutants and precursors, air toxic data are needed to characterize exposure levels and to help us understand temporal and spatial trends. This will also provide us with air quality measurement data to evaluate an air model.

National Council for Air and Stream Improvement, Inc. (NCASI) comments on April 2008 health consultation

NCASI
Comments on the April 2008 Health Consultation

65. Question: The discussion of dioxin and DLCs on page 16 is irrelevant and unnecessarily alarming. The Port Townsend mill (PTP) is not, nor has it ever been, a bleaching mill. It does not burn sludge from bleached kraft mills nor does it burn chlorine-containing hog fuel (i.e. by-products of logs floated/stored in salt water). There is no reason to believe dioxin or DLCs are emissions of concern from the PTP mill and the inclusion of a paragraph outlining their health effects in the DOH report is unwarranted.

Answer: Some members of the community expressed concern about dioxins being released from the burning of reprocessed fuel oil (RFO). This information has been provided to the community to explain that dioxins are not being released here in great quantities, but there could be a potential for release from the burning of RFO. DOH also stated that PTP mill is not a bleaching mill and does not burn bleaching material.

A more complete response to this concern was addressed earlier on page 58 (community comments, question # 19) and page 79 (PTP mil comments).

66. Question: The Health Consultation includes considerable verbiage on the subject of the reported health effects of air pollution in general. I do not believe this is necessary, but if DOH wished to retain this information, it needs to be clearly separated from any specific discussions of the PTP mill and surrounding areas. As currently written, readers might easily misinterpret general descriptions of adverse health effects as being descriptions of current conditions in Port Townsend.

Answer: The health consultation does address health effects in general terms. The purpose of this general review is to inform the public about the potential health effects of air pollution and not necessarily to implicate PTP mill emissions. The conclusions and recommendations clearly state that there are not enough data to associate any of the observed disease conditions in Port Townsend to chemical substances possibly emitted by the mill to the air.

67. Question: Some of the descriptions of adverse health effects, both in chemical-specific information or generic comments on air pollution, contain no information on dose-response. And, even in cases where some dose-response data are given, no attempt is made to put that information in context by providing any data on actual or estimated exposures around the PTP mill. The report should be clear about differences between exposure levels associated with specific adverse effects and the ambient concentrations measured or likely to exist in and around the PTP mill.

Answer: Most studies on air toxics are inconclusive and lack information about human exposure pathways and human dose response. Most studies on air toxics have been conducted in non-human mammals such as rats, mice, rabbits, guinea pigs, hamsters, dogs, or monkeys and there are no national standards or guidelines to define allowable contaminant concentrations in the air other than the six criteria pollutants. For the six criteria pollutants, the EPA has adopted ambient air quality standards that have already established health benchmarks that reflect the toxicity of the pollutants. These health benchmarks have not been defined for hazardous air pollutants. Developing a health benchmark requires information about the toxicity of the compound, particularly the health outcomes the compound is thought to cause, and exposure levels associated with these effects. We have no information or data available on air toxics and DOH has not identified an exposed population to estimate exposure pathways and human dose response of chemicals around the mill.

68. Question: The Health Consultation is inadequately referenced. Some of the references that were cited did not appear to have been critically evaluated to ensure good quality and accurate data interpretation. Some relevant high quality publications from well-regarded journals were not cited, while other publications of questionable quality from less well-regarded journals were referenced.

Answer: Some feedback and suggestions were provided in the final draft by ATSDR on updating the literature review. The references have been updated by using the best available and most current information, and the specifics on some references were discussed in detail.

Certification

The Washington State Department of Health prepared this Evaluation of Air Exposure at Port Townsend in Washington, Washington Public Health consultation under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It was completed in accordance with approved methodologies and procedures existing at the time the health consultation were initiated. Editorial review was completed by the Cooperative Agreement partner.

Technical Project Officer, CAPEB, DHAC

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

Team Lead, CAPEB, DHAC, ATSDR

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